

EFFECT OF PLANT GROWTH REGULATORS ON DORMANCY AND GROWTH OF GLADIOLUS

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B. Sc. (Hort.)

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IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE OF
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CERTIFICATE

Mr. N. SEENIVASAN has satisfactorily prosecuted the course of research and that the thesis entitled "EFFECT OF PLANT GROWTH REGULATORS ON DORMANCY AND GROWTH OF GLADIOLUS" submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the thesis or part thereof has not been previously submitted by him for a degree of any University.

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CERTIFICATE

This is to certify that the thesis entitled "EFFECT OF PLANT GROWTH REGULATORS ON DORMANCY AND GROWTH OF GLADIOLUS" submitted in partial fulfilment of the requirements for the degree of "MASTER OF SCIENCE IN HORTICULTURE" of the Acharya N.G. Ranga Agricultural University, Hyderabad, is a record of the bonafide research work carried out by Mr. N. SEENIVASAN under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee.

No part of the thesis has been submitted for any other degree or diploma. The published part has been fully acknowledged. All assistance and help received during the course of the investigation have been duly acknowledged by the author of the thesis.

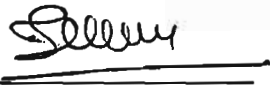

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LIST OF SYMBOLS AND ABBREVIATIONS

%	:	per cent
°C	:	Degree centigrade
$\mu\text{l l}^{-1}$:	micro litre per litre
@	:	at the rate of
ABA	:	Absciscic acid
BA	:	Benzyl adenine
CD	:	Critical difference
CEPA	:	2-chloro-ethyl phosphonic acid
cm	:	centimetre
cm^{-2}	:	centimetre square
cv.	:	cultivar
DAP	:	Days after planting
DAS	:	Days after sprouting
<i>et al.</i>	:	and others
Fig.	:	Figure
FYM	:	Farm yard manure
g	:	gram
GA	:	Gibberellic acid
gm m^{-2}	:	grams per metre square
ha^{-1}	:	per hectare
hrs	:	hours
i.e.	:	which is to say, in other words
K	:	Potassium
m^{-2}	:	metre square
mg l^{-1}	:	milli grams per litre
ml kg^{-1}	:	milli litre per kilogram
ml l^{-1}	:	milli litre per litre
ml	:	milli litre
N	:	Nitrogen
NS	:	Non significant
P	:	Phosphorus
Plant^{-1}	:	per plant
ppm	:	parts per million
S.Em	:	Standard error mean
viz.,	:	namely

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DECLARATION

I, N. SEENIVASAN hereby declared that the thesis entitled "EFFECT OF PLANT GROWTH REGULATORS ON DORMANCY AND GROWTH OF GLADIOLUS" submitted to Acharya N.G.Ranga Agricultural University for the degree of "MASTER OF SCIENCE IN HORTICULTURE" is the result of original research work done by me. It is further declared that the thesis or any part thereof has not been published earlier in any manner.

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ABSTRACT

A field experiment was conducted on red sandy loam soils at College of Agriculture, Rajendranagar, Hyderabad, during winter season October 2000 to February 2001 to study the "Effect of plant growth regulators on dormancy and growth of gladiolus". The experiment was laid out in split plot design consisting 28 treatment combinations with seven main treatments (250, 500 and 1000 ppm of ethrel, 100, 250, 500 ppm of BA and the control) and subtreatments of four cvs (Moon Majic, Sevilla, Rose Supreme and Peter Pears) used for the study.

Preplanting cormel treatment with BA 100 ppm resulted in an early sprouting of cormels, better vegetative growth, corm size and corm weight. Whereas ethrel 1000 ppm treatment resulted in maximum number of cormels and cormel weight. Among varieties early sprouting, number of leaves per plant, leaf area, corm size and corm weight were superior in cv. 'Moon Majic'. Rose Supreme was superior with respect to plant height, cormel number and cormel weight. However, number of leaves was found to be not influenced with preplanting growth regulator treatment.

INTRODUCTION

...

... these characters have ...

... which 145 are native to South Africa and one to tropical Africa (Lindenberg, 1975)

... are the products of ...

... *C. ...* *C. ...* *C. ...* *C. ...*



CHAPTER I

INTRODUCTION

Gladiolus (*Gladiolus hybridus* Hort.) is glamorous bulbous flower crop for beauty and perfection. It is said to be queen of bulbous flowers grown in many parts of the world.

The word 'Gladiolus' was coined from the Latin word 'gladius' meaning a 'sword' on account of shape of its leaves. In Europe it is commonly called as 'Corn flag' due to its infestation on weed in corn fields. It was introduced into cultivation towards the end of 16th century (Innes, 1985), while in India it is comparatively a recent introduction.

Among the several flowering bulbous plant species in ornamental horticulture, gladiolus is very popular. There **are many excellent** cultivars of gladiolus with magnificent inflorescence, inexhaustive range of colours, different shades, number of florets, size, keeping quality and adaptability to different seasons. These characters have made it attractive for use as cut flower, for vase, bouquet herbaceous borders, beddings, rockeries, pot cultivation and window boxes.

Gladiolus belonging to the family Iridaceae is represented by 250 species of which 103 are native to South Africa and next to tropical Africa (Anonymous, 1976). The common garden gladioli do not represent a single species, but are the products of continuous hybridization of few species, that have proved horticulturally useful. It is likely that *G. carneus*, *G. cardinalis*, *G. oppositiflorius*, *G. primulinus*, *G. purpureoratus* and *G. saundersii* have contributed much to the development of common garden gladioli

which are included under *G. hybridus*, Hort. from these species many excellent modern varieties have been developed.

Gladiolus is propagated sexually by seed and asexually by corms and cormels. The corms are bulb like globose or ovoid having series of nodes wholly covered with tunic or husks. Cormels are out growths (stolons) present between mother and daughter corms. Since corms are used for commercial propagation apart from cut flowers they have got a great export potential.

The cultivation of gladiolus on commercial basis is concentrated in the Netherlands, Spain, United Kingdom and United States of America. In India, gladiolus grows well in the plains of Northern India, however, the corms are produced commercially in Kallimpong, Sikkim and Srinagar. In Southern parts of India, people are not very much aware of this bewitching flower, and hence, it has not become much popular in their region. However, it is grown in Bangalore, Hyderabad and Ooty regions for commercial purpose. Major cities like Delhi, Madras, Bombay, Calcutta, Pune, Bangalore, Hyderabad and Coimbatore etc., have good demand for gladiolus cut flowers. Apart from cut flowers, the corms themselves have a great export potential. Hence, these can also be produced and exported.

In gladiolus cultivation, for obtaining the flower grade corms, cormels take 2 to 3 years. However, flowering grade corms are obtained by planting smaller sized cormels (0.5 cm) in one season (Paswan, 1977). In commercial gladiolus cultivation, corms are of greater economic importance. Demand for corm production is increasing every year. It could be met by thrift cultivation of gladiolus cormels. Cormels are the easy and

cheapest source for production of corms, which are required for cut flower production. Hence, cormels play an important role in increasing gladiolus cultivation.

One of the major hindrances in commercial cultivation of gladiolus is that, it cannot be grown year round for regular supply of flowers and corms to the markets. As cormels and corms have to pass through a dormant/rest period which varies from few weeks to several months depending upon the cultivars, size and grade of the cormels, corms and the environmental conditions.

Freshly harvested cormels, when planted soon after harvest, do not sprout for 4-6 months even under the favourable conditions (Bautista and Cadiz, 1964). Various techniques for reducing dormancy of gladiolus corms and cormels have been deployed by several workers but with only limited success. Besides, the conventional methods of reducing dormancy by cold storage, some chemical treatments specially the plant growth regulators have been tried by a few workers. Presowing ethylene treatment of gladiolus increased sprouting rates and yield of corms (Suh and Kwack, 1990; Muthoo and Maurya, 1995; Pai and Chowdhury, 1998). Treatment of gladiolus corms with BA resulted in early sprouting and plant development which lead to improved corm yield (Paswan, 1985; Roychoudhury *et al.*, 1985; Murali, 1988).

In India, the harvesting time of gladiolus corms and cormels in the hills coincides with the planting time in the plains and vice versa. The nurserymen are selling dormant corms and cormels, therefore, storing of corms and cormels becomes a necessity for few months before planting. Development of suitable technique to reduce dormancy of corms and cormels will be of great benefit to the farmers. Among several improved

agrotechniques used for commercial cultivation of ornamental plants, the plant growth regulators play an important role. Plant growth regulators have come as a boon for the commercial cultivation of many bulbous flowering crops. Extensive use of growth regulators for modifying their developmental processes, mainly in breaking dormancy, improving the vegetative growth thus increasing the corm and cormel yield.

Realising the importance of corm production in commercial gladiolus cultivation and ever increasing role of plant growth regulators, the present investigations were taken up with the following objectives in view.

1. To study the effect of plant growth regulators on release of dormancy in gladiolus cormels.
2. To study the effect of plant growth regulators on vegetative growth and development.
3. To study the effect of plant growth regulators on corm and cormel production in different varieties of gladiolus.

REVIEW OF LITERATURE

On the one hand, are organic compounds, other than plant substances which lead to reduce dormancy and other inhibit, stimulate or alter growth. The ester and other plant growth regulator, are used in floriculture for rapid propagation, plant height control, breaking dormancy, regulation of flowering, increasing yield of flowers, etc. The use of plant growth regulator of sprouts and flower quality and prolonging the life of blooms by using them after harvest. Considerable emphasis has been

REVIEW OF LITERATURE

2.1 DORMANCY OF GLADIOLUS

Freshly harvested corms are dormant for a period of 1-2 months. Dormancy is the period with time (Harrison, 1961; Ginzburg, 1971). The length of dormant period, depends on both environmental and cultural conditions. Research work has been done on dormancy and techniques for breaking it, its control and control dormancy of corms has been described on the condition of the corms after the leaves

CHAPTER II

REVIEW OF LITERATURE

Growth regulators are organic compounds, other than plant nutrients which when used in minute quantities can either inhibit, stimulate or alter growth. The major areas where plant growth regulators are used in floriculture are plant propagation, plant height control, breaking or prolonging dormancy, regulation of flowering, increasing yield of flowers and bulbs, improvement of spike and flower quality and prolonging the life of cut blooms besides some other minor uses. Considerable emphasis has been placed on pre-sowing treatments in gladiolus to overcome dormancy and for invigorating plant growth and development.

The work done so far on the various aspects like dormancy, sprouting, vegetative growth and corm and corm yield are reviewed under the following headings.

2.1 DORMANCY OF GLADIOLUS

Freshly harvested corms and cormels of gladiolus are in a state of deepest, condition that appears with time (Hartsema, 1961; Ginzburg, 1973). The length of dormant period depends on both environmental and internal conditions. Profound work has been done on dormancy and techniques for breaking it, in corms and cormels. Dormancy of corms has been described on the condition of the corms after the leaves have died and before extension growth is resumed. Dormancy of bulbs and corms has been classified into three different groups. Of which, gladiolus comes under "Lily type", which has 'true physiological dormancy' (Kamerbeek *et al.*, 1972). Duration of

dormancy varies in different cultivars and in the same cultivar when grown under different conditions. Thus, methods of reducing the dormancy also vary with duration of rest (Paswan, 1985).

Chromatographic studies were conducted in corm extracts in gladiolus to note the changes in endogenous growth substances and it appears that dormant corms contain a marked amount of inhibiting substances but no auxins, while the corms whose dormancy has been broken show a reduced amount of inhibiting substances together with the appearance of auxins. This fluctuation of auxins and inhibitors are considered to be related to the degree of dormancy. Auxins content in the corm of normally growing plants, which disappeared after harvest, but appeared again in the corms after storing at room temperature for two months. The inhibitors content in corm of growing plants was low, but increased at harvest time reaching a maximum. It gradually decreased, after passage of storage period. Then the activities of GA like substances and auxin like substances were resumed. Ethylene production was more whereas growth inhibitors like ABA like substances activity was decreased.

Three zones of inhibitors were recognised in chromatograms. Inhibitor-I seems to be fatty acid compound (mainly Linolenic acid) and III-a phenolic compound (mainly ferulic acid), while II was identified as ABA. These substances together, cause dormancy in gladiolus corms and cormels (Tsukamoto *et al.*, 1973 and Tsukamoto *et al.*, 1974).

2.1.1 Dormancy of gladiolus cormels

The level of dormancy in gladiolus cormels was higher than that of corms of the same plants (Apte, 1962). There were 3 to 6 tunic layers in cormels of gladiolus. This

number varies from variety to variety which plays major role in level of dormancy (Jung-Wooyoon *et al.*, 2000). The outer scales in a large and small gladiolus cormels contained growth stimulants and inhibitors of phenolic nature. In the scales of large cormels the stimulants were more active, whereas in small cormels the inhibitors were more active (Sarkisyan *et al.*, 1975).

2.2 EFFECT OF ETHYLENE ON SPROUTING

Ethylene is a gaseous hydrocarbon commercially available as an ethrel or ethephon. It has wide range of physiological and morphological effects on plants. Ethylene has also been reported to play an important role in dormancy of many plant organs (Pratt and Goeschel, 1969). Two-chloro ethane phosphoric acid or a mixture of the acid and its clusters and anhydride have been made available (ANCHEM PRODUCTS, USA) and designated as 'Ethrel'. These preparations which are available in a liquid state release ethylene directly to plant where the pH of the solution is raised as a result of contact with plant tissue (Cooke and Randall, 1968).

2.2.1 Gladiolus

Promotion and inhibition of sprouting in dormant and non-dormant cormels, respectively by ethrel treatment in gladiolus were observed (Ginzburg, 1973 and Ginzburg, 1974). In summer gladiolus corms of several varieties notably in case of 'Picardy', the treatment with 0.3 per cent solution of ethylene chlorohydrin shortened the rest period and stimulated early sprouting and flowering (Evenari *et al.*, 1950). Shortening of rest period in three cultivars of gladiolus was also noticed, when corms were treated with ethylene chlorohydrin (Nakasone, 1954). Sprouting occurred in

gladiolus corms treated with ethylene chlorohydrin vapour after 75 days of planting, while untreated showed no sprouting (EL-Gamassy, 1957 and EL-Gamassy, 1960). According to Bautista and Cadiz (1964) dipping of gladiolus corms in ethyl alcohol resulted in early sprouting, which is also a ethylene releasing compound. Halevy *et al.* (1970) found the influence of ethrel on breaking dormancy in gladiolus corm and on sprouting which was enhanced by 30 min dipping at various concentrations. Ethrel at 1000 ppm enhanced sprouting when corms were stored at high temperature. Magie (1971) reported that gladiolus corm production was increased by 50 per cent and cormel production by 90 per cent when fusarium inoculated dormancy cormels were soaked in ethephon 1000 ppm along with fungicides.

Mukhamed (1985) observed that corm treatment with ethephon shortened dormancy period and advanced flowering in artificial light. Ethephon applied at 0.05 per cent for zomin was most effective treatment for breaking dormancy in gladiolus corms.

According to Bylov *et al.* (1988), several substances tested as corm treatments viz., the ethephon based preparations, Hydrel, Flodimex and Composan were the best in shortening the dormancy period of gladiolus corms. Suh (1989) observed that cormels of gladiolus cultivar "Red beauty" treated with ethephon at 200 ppm increased sprouting but not the corm weight. Suh and Kwack (1990) reported that ethephon treatment to gladiolus cormels resulted in increased sprouting rates and yield of corms. Muthoo and Maurya (1995) reported that ethrel at 8000 fg l^{-1} positively affected both corms obtained from summer and autumn crops with respect to sprouting percentage and days taken for 50 per cent sprouting. Pal and Chowdhury (1998) reported that ethrel at 100 ppm for 24 hrs significantly reduced number of days for sprouting compared with controls.

2.3 OTHER BULBOUS CROPS

2.3.1 *Freesia*

According to Kukuczanka (1969) treatment of *Freesia hybrids* and *Freesia refracta* corms with ethylene chlorohydrin most effectively stimulated corm sprouting. Hayashi (1974 and 1977) also reported that the ethylene treatment induced sprouting and broke dormancy of *Freesia* corms.

Gilbertson *et al.* (1981) reported that soaking of freshly harvested *Freesia hybrida* 'Baily' 'Moya' corms in solutions of ethephon increased the sprouting rate and decreased the number of days to sprout. Exposure of *Freesia* corms to an atmosphere containing 1 ml l⁻¹. Ethylene strongly promoted sprouting of the corms when the treatment was applied at room temperature (Masuda and Asahira, 1979, 1980 and 1981).

Exposure of *Freesia* corms to either smoke or ethylene enhanced early sprouting besides breaking dormancy. Ethylene exposure at 10 µl l⁻¹ for an hour was sufficient to promote sprouting (Imanishi, 1979; Uyemura and Imanishi, 1980, 1983 and 1984).

2.3.2 *Iris*

Iris bulbs treated with ethylene gas at 21°C stimulated early sprouting and flowering (Uhring, 1973). Ethylene treatment induced sprouting and broken dormancy of *Iris* bulbs (Hayashi, 1977). Freshly harvested bulbs of Dutch *Iris* exposed to ethylene (10 fl l⁻¹ for 1-8 days) promoted sprouting and these also markedly increased the number of bulblets per plant (Yue and Imanishi, 1989).

2.3.3 *Lily*

Dormancy of lily bulbs could be broken by treatment with ethrel (Wang, 1969). Soaking of bulbs of *Hippeastrum hybridum* in ethrel at 1000 ppm increased the sprouting rates significantly.

2.3.4 Narcissus

Exposure of freshly lifted *Narcissus tazetta* bulbs to ethylene at $10 \mu \text{l}^{-1}$ showed an earlier sprouting and faster development (Imanishi, 1983).

2.3.5 Tuberose

Devendra and Nagda (1999) reported that treatment of bulbs of freshly harvested *Polyanthus tuberosa* cv. Single with ethrel 2000 ppm enhanced bulb sprouting, increased the number of days required for sprouting from 20.83 in the control to 12.03. Nagaraja *et al.* (1999) reported that the soaking of bulbs in ethrel at 500, 1000 and 1500 ppm concentrations for 24 hrs resulted in earlier plant emergence, a higher percentage of sprouting as compared to control. Preethi *et al.* (1997) also reported that ethrel 400 ppm promoted early sprouting in Tuberose *Polyanthus tuberosa* cv. Single.

2.3.6 Potato

Ethylene treatment of potato tubers breaks dormancy and causes the appearance of relatively large amount of glutathione. Glutathione has been shown to cause the disappearance of the growth inhibitors associated with dormancy (Guthrie, 1940). The dormancy of freshly harvested potatoes can be broken by dipping tubers in three per cent solution of ethylene chlorohydrin (Grewal, 1974). By placing freshly harvested dormancy potato tubers in ethyl-alcohol or ethylene chlorohydrin extract 2 ml kg^{-1} tubers advanced sprouting (Swaminathan *et al.*, 1976). Ayub *et al.* (1999) reported that dormancy breaking and yield were significantly higher with 2-4 chloroethyl phosphonic acid (Ethephon) than GA or carbon disulfide and control.

2.4 EFFECT OF CYTOKININ ON SPROUTING

Cytokinins have been known to break the seed dormancy in *Lactuca sativa* (Miller, 1956) and other plant organs including the resting buds of hydrocharis, *Lemna minor* and *Vitis vinifera* (Kurz and Kummerow, 1957; Deysson, 1959; Weaver, 1963). Cytokinins notably kinetin and benzyl adenine are well known to be frequently effective in overcoming dormancy of tree buds, tubers and other resting organs (Vegis, 1964).

2.4.1 Gladiolus

Ginzburg (1973) reported that Benzyl Adenine (BA) treatment promoted cormel germination (sprouting) in gladiolus. He observed 50 per cent germination at 10 days and 90 per cent after 15 days. Soaking corms in 20 ppm BA solution for 24 hours resulted in early sprouting of corms (Tsukamoto, 1974).

Early sprouting can be attributed to the ABA counteraction by the BA. Abscisic acid (ABA), among the growth inhibitors reported to be present in the cormels of gladiolus (Ginzburg, 1973 and Konoshima *et al.*, 1973).

Treatment of gladiolus corms with BA resulted in early sprouting and improved plant development leading to increased height of plant, weight of corms and number of cormels (Jayaselan, 1981). Paswan (1985) observed that the soaking of gladiolus corms of three cultivars in BA took less mean days for sprouting as compared to other chemical treatments. Roychoudhury *et al.* (1985) reported significant enhancement in sprouting of gladiolus corms by kinetin treatment over control. Murali (1988) found corm dip application of BA in early emergence in gladiolus due to corm dip application in BA.

Muthoo and Maurya (1995) reported that treatment of gladiolus cv. Oscar corms obtained from summer and autumn crops with BA 400 fg l^{-1} for 6 hrs. promoted early sprouting in both seasons with more pronounced effect on autumn corms.

2.5 OTHER CROPS

2.5.1 *Freesia*

BA treatment of dormant corms of *Freesia* enhanced the sprouting rate (Nakamura *et al.*, 1974). Soaking of dormant *Freesia* corms in 1000 ppm BA solution for 18 hours, showed 100 per cent sprouting (Masuda and Asahira, 1978). Pre-sowing soaking of *Freesia* in benzyl adenine solution had earlier emergence (11.55 days) as compared to control (119.8 days) (Gilbertson *et al.*, 1981). Uyemura and Imanishi (1987) reported that the dipping of dormant *Freesia* corms in BA solution had broken dormancy and enhanced sprouting.

2.5.2 *Lily*

Presowing soaking of *Lilium speciosum* cultivar 'Uchida' bulbs in BA at 5°C for 60 days stimulated early sprouting (Okhawa, 1979).

2.5.3 *Achimenes*

Apical and basal halves of *Achimenes* rhizomes were soaked in different concentration of benzyl adenine. At higher concentrations (50 and 100 mg l^{-1}) dormancy was broken and the sprouting was enhanced in both apical and basal rhizomes (Vlahos, 1985).

2.5.4 *Begonia*

Esashi *et al.* (1971) found that BA was effective in breaking the dormancy of *Begonia evansiana* aerial tubers.

2.5.5 Citrus

Zhu *et al.* (1989) reported that two successive applications of BA solution (100 or 200 ppm) at pH 6.8, 4 days apart accelerated axillary bud sprouting. BA was more effective when applied during naturally quiescent periods than during growth flushes.

2.5.6 Potato

Hemberg (1970) reported that cytokinins not only broke the dormancy of potato tuber but also reduced in the contents of acid inhibitors found in the potato peelings.

2.6 EFFECT OF ETHREL ON VEGETATIVE GROWTH

2.6.1 Gladiolus

Bhattacharjee (1984) reported that there was considerable reduction in the vegetative growth in gladiolus cv. 'Friendship' when the corms were treated with ethrel before planting. Roychoudhury (1989) found a marked inhibition of plant growth by ethrel treatment in gladiolus cv. Psittacinus.

Ethrel at 100 ppm for 24 hrs significantly increased leaf area as compared to control and also induced the early appearance of flower spike (Pal and Chowdhury, 1998).

2.7 OTHER BULBOUS CROPS

2.7.1 Tuberose

Mukhopadhyay and Bankar (1983) studied the effects of ethrel sprayed at 40 days after planting on tuberose cv. 'single' and they witnessed considerable increase in plant height, spike length, arachis length with increasing ethrel concentrations. Nagaraja *et al.*

(1999) reported that ethrel at all concentrations (100, 500, 1000 and 1500) increased plant height in tuberose as compared to control.

Devendra *et al.* (1999) reported that ethephon 1000 ppm significantly increased plant height in tuberose

2.7.2 *Triteleia laxa*

Han *et al.* (1989) reported that on exposure of recently harvested dormant corms of brodiaea (*Triteleia laxa*) cv. Queen Fabiola to ethylene (7 days at 20 ppm) produced leaves, which were wider and longer than that of control.

2.7.3 Potato

Zrust *et al.* (1993) reported that an application of 0.1 per cent CEPA (ethephon [ethylene]) increased stolon numbers and the number of branches 3 to 10 nos. per hill as compared to control.

2.8 EFFECT OF CYTOKININ ON VEGETATIVE GROWTH

2.8.1 Gladiolus

Jayaselan (1981) reported that benzyl adenine increased the height of plant, number of leaves and leaf area when compared to control. Similar results were obtained by Murali (1988) in gladiolus. Jung-Wooyoon *et al.* (2000) reported that tunic removal and BA 10 mg L⁻¹ treatment significantly improved the vegetative growth like plant height, leaf area as compared to control where tunics were not removed and no BA treatment was given.

2.9 EFFECT OF ETHYLENE ON CORM AND CORMEL YIELD CHARACTERS

Gladiolus has two kinds of tuberous organs. The corms consist of the inflated lower stem nodes and the cormel, which is a stolon tuber. Numerous cormels are formed on an extensively branched stolon system developing at the basal nodes of the new corm.

2.9.1 Gladiolus

Halvey *et al.* (1970) reported that ethrel at 1000 ppm increased corm splitting, reduced the corm size when corms were stored at high temperatures before planting. Gladiolus corm production was increased by 50 per cent when fusarium inoculated dormant cormels were soaked in ethephon 100 ppm along with fungicides (Magie, 1971). Ethrel treatment at 1000 ppm significantly increased the number of corms (Jayaselan, 1981).

Paswan (1985) observed decreased corm weight and increased number of cormels when corms were treated with ethrel before planting. Suh (1989) reported that ethephon at 200 ppm reduced the corm weight.

2.10 OTHER BULBOUS CROPS

2.10.1 Freesia

Corms of *Freesia hybrida* and *Freesia refracta* treated with ethylene chlorohydrin most effectively increased the number of corms (Masuda and Asahira, 1981) Gilbertson *et al.* (1981) reported the soaking of *Freesia hybrida* cultivars 'Bailey' and 'Moya' corms in solution of ethephon increased the number of corms plant⁻¹.

2.10.2 Hyacinth

Kapachina and Ivanova (1983) reported production of more number of daughter bulbs from hyacinth plants sprayed with ethrel at 200 mg l⁻¹ as compared to other treatments.

2.10.3 Tuberose

Preeti *et al.* (1997) reported that pre-planting treatment of bulbs of polyantha tuberosa cv. Single with ethrel at 400 ppm increased the number of bulbs plant⁻¹ as compared to control.

Nagaraja *et al.* (1999) reported that bulbs soaked for 24 hr in solution of ethrel at 1000 ppm increased the bulb number plant⁻¹.

2.10.4 Narcissus

EL-Sallami (1997) reported that as application of ethrel 300 ppm both through bulb soaking and foliar spray methods was effective in increasing bulb production (number and weight).

2.10.5 Tritelleia laxa

According to Han *et al.* (1989 and 1990) exposure of freshly harvested dormant corm of *Triteleia laxa* cv. Queen Fabiola to ethylene increased the leaf surface area which contributed for the increased corm and cormel fresh weight.

2.10.6 Potato

The role of cytokinins in the regulation of tuber formation has been studied in potatoes. Cytokinins induced tuber formation is stolen tips of potatoes grown in sterile conditions (Palmer and Smith, 1969). Ethrel in aqueous solution (100, 200, 400 and 600 ppm) was sprayed on potato cv. Kufri Jyothi and it was observed that number of tubers per plant increased from 9.3 to 11.8 with increasing ethrel rates (Perumal, 1984).

2.11 EFFECT OF CYTOKININ ON CORM AND CORMEL YIELD

2.11.1 Gladiolus

Ginzburg and Ziv (1973) reported that kinetin treatment *in vitro* resulted in increased cormel formation from 8 to 10 n tips and the cormels formed in *in vitro* system did not differ in their structure from those grown *in vivo*. They also reported that kinetin was the only growth substance that could induce cormel formation by the stolons.

Jayaselan (1981) reported that treatment of gladiolus corm with benzyl adenine significantly increased weight of corms and number of cormels.

Increase in corm yield was reported in gladiolus due to presowing soaking of corms with kinetin (EL-Rahaman *et al.*, 1985). Roychoudhury *et al.* (1985) reported that maximum weight of corm was attained by kinetin treatment. Murali (1988) found corm dip application of BA resulted in significant increase in number of daughter corms and yield of cormels, besides there was decrease in weight and size of daughter corms.

2.12 OTHER BULBOUS CROPS

2.12.1 Tuberose

Nagaraja *et al.* (1999) reported that the soaking of bulbs for 24 h in solutions of BA at all concentrations (100, 500, 1000 and 1500 ppm) reduced bulb number.

2.13 COMPARATIVE STUDY

Ginzburg (1973) studied the hormonal regulation of cormel dormancy in *Gladiolus grandiflorus*. Benzyl adenine treatment was better in breaking dormancy in gladiolus cormels than the ethrel treatment.

Cormels of gladiolus cultivars 'Scarlet' treated with benzyl adenine at 50 ppm and 500 ppm were found effective in breaking dormancy than ethrel at 250 ppm which showed higher promotive trend in days taken for 50 per cent sprouting (Pandey and Gaur, 1980).

Pandey and Gaur (1982) observed that an externally applied cytokinins, especially benzyl adenine (BA), broke the dormancy of gladiolus cormels and induced physiological changes in gladiolus cormels during dormancy. An appreciable increase was observed in the activity of alpha-amylase in the benzyl adenine treated cormels at two weeks after the treatment confirmed the reports on the action of cytokinins in influencing the activities of a number of specific enzymes. The induction of a-amylase activity in seed embryo was achieved in wheat by their treatment with cytokinins (Boothby and Wright, 1962). The activity of this a-amylase enzyme was also reported to be stimulated by cytokinins in excised hypocotyls of *Phaseolus vulgaris* (Clum, 1967) and growing plants of *Stellaria media* (Haggman and Haapala, 1971). It has been suggested that the increase in enzyme activity may not be a direct effect of the cytokinin but rather an indirect one (Cherry, 1977).

An increase in a-amylase activity and consequent rise in starch break down level of sugars and respiratory activity, observed prior to sprouting, could explain the benzyl adenine-induced promotion of growth and release of dormant buds. The increased a-amylase activity observed is treated once. The inhibition of a-amylase activity is due to endogenous abscisic acid. It was counteracted by exogenous application of benzyl adenine. Abscisic acid, reportedly a major growth inhibitor involved in the dormancy of

gladiolus cormels, is also known to inhibit the activity of enzymes in many species (Pandey and Gaur, 1982).

Jayaselan (1981) found an enhancement in early germination and increased corm weight by soaking the gladiolus corms in benzyl adenine as compared to ethrel. However, ethrel treatments also resulted in early germination, but reduced the corm weight significantly.

Paswan (1985) also found that the benzyl adenine treatments were effective in enhancing early sprouting as compared to the ethrel treatments.

In soaking treatments of gladiolus corms kinetin treatment resulted in maximum weight of corm, whereas ethrel treatment resulted in increased cormel production (Roychoudhury *et al.*, 1985).

Kapachina and Ivanova (1983) reported that as compared to BA, ethrel produced greatest number of bulbs with 2000 mg l⁻¹ in Hyacinth cvs. Aune, Marie and Carnegie. Nagaraja *et al.* (1999) reported that ethrel at 1000 ppm increased bulb number, whereas all other ethrel (100, 500 and 1500 ppm) and all BA treatments reduced bulb number per plant.

CHAPTER III

MATERIALS AND METHODS

3.1 EXPERIMENTAL SITE

Experiments on dormancy and growth of gladiolus were conducted at College Farm, Department of Agriculture, Acharya N. R. Ganguli Agricultural University, Rajendranagar, Hyderabad during winter season (October-February) 2000-2001 in red sandy soil.

The experimental farm is located at an altitude of 542.6 m above mean sea level

MATERIALS & METHODS

3.2 METEOROLOGICAL DATA

The meteorological data such as relative humidity, average minimum and maximum temperature and sunshine hours were obtained from the records of meteorological observatory, Agricultural Research Institute, Rajendranagar, Hyderabad and are presented in Appendix-I, and depicted in fig.1. The total rainfall received during the experimental period was 2.8 mm.

The weekly mean temperature ranged from 27.5°C to 31.9°C while the mean minimum temperature ranged from 8.1°C to 17.5°C. The relative humidity ranged from 55.4 per cent at 7.16 hours and was 13.0 to 48.0 per cent at 14.16 hours. The mean sunshine hours ranged from 5.2 to 10.0.

CHAPTER III

MATERIALS AND METHODS

3.1 EXPERIMENTAL SITE

A field experiment entitled as “Effect of plant growth regulators on dormancy and growth of gladiolus” was conducted at College Farm, College of Agriculture, Acharya N. G. Ranga Agricultural University, Rajendranagar, Hyderabad during winter season (October-February) 2000-2001 on red sandy soil.

The experimental farm is located at an altitude of 542.6 m above mean sea level with a geographical bearing of 17°19' North latitude and 78°23' east longitude.

3.2 METEOROLOGICAL DATA

The meteorological data viz., rainfall, number of rainy days, relative humidity, average minimum and maximum temperature and sunshine hours were obtained from the records of meteorological observatory, Agricultural Research Institute, Rajendranagar, Hyderabad and are presented in Appendix-I and depicted in fig.1. The total rainfall received during the experimental period was 2.8 mm.

The weakly mean temperature ranged from 27.6°C to 31.9°. While the mean minimum temperature ranged from 8.1°C to 17.5°C. The relative humidity ranged from 75.0 to 89.0 per cent at 7.16 hours and was 18.0 to 48.0 per cent at 14.16 hours. The mean sunshine hours per day was 5.2 to 10.0.

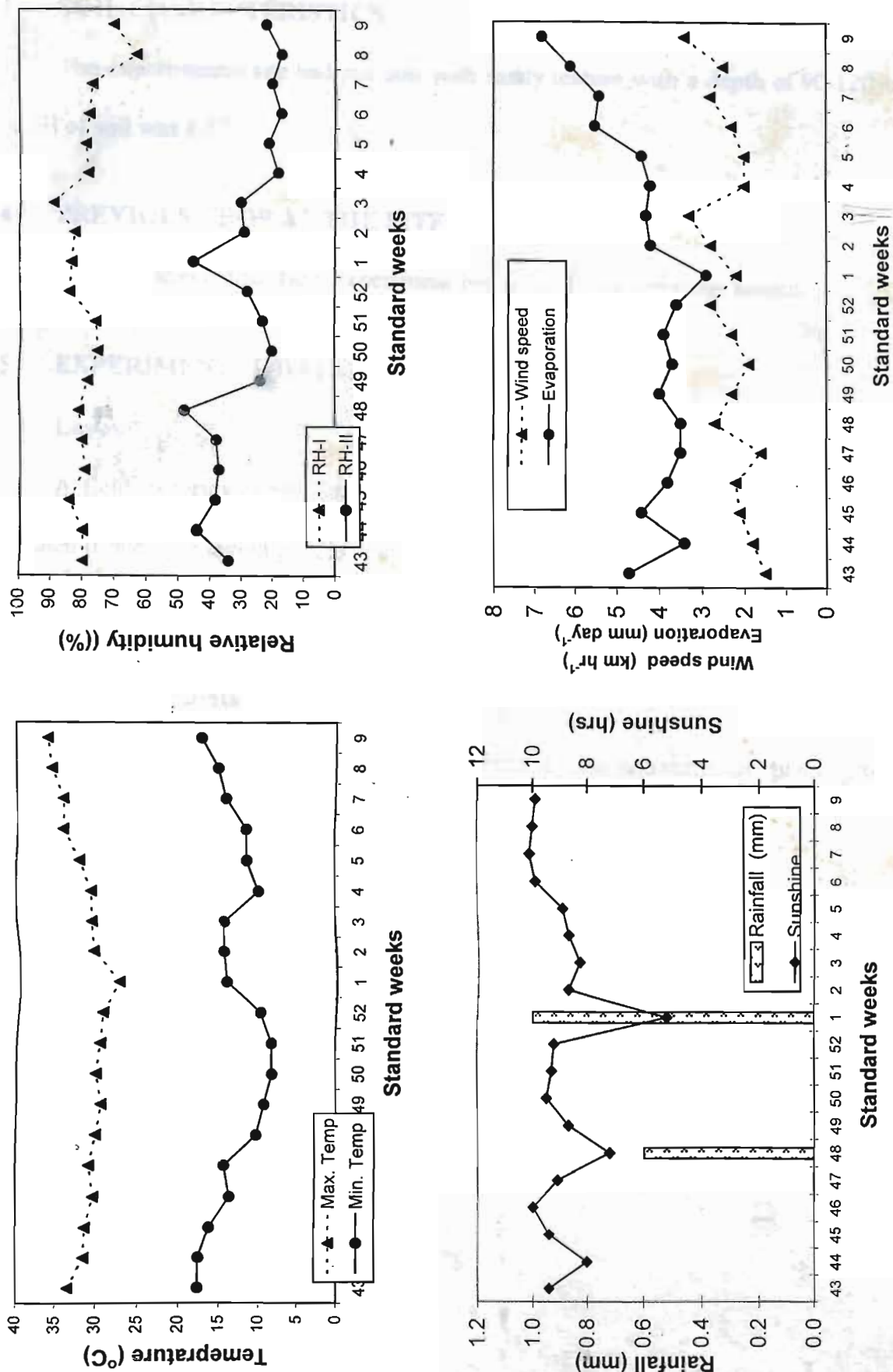


Fig. 1 : Weekly meteorological data during crop growth period

3.3 SOIL CHARACTERISTICS

The experimental site had red soil with sandy texture with a depth of 90-120 cm.

The pH of soil was 6.57.

3.4 PREVIOUS CROP AT THE SITE

The plot selected for field experiment had onion in the previous season.

3.5 EXPERIMENTAL DETAILS

3.5.1 Layout

A field experiment was laid out with Factorial Randomized Block Design and replicated thrice. The layout plan is shown in fig.2.

3.5.2 Treatments

Growth regulators (Factor A)

The treatment consisted of seven different concentration of plant growth regulators viz.,

Ethrel (2-chloro-ethyl phosphonic acid, CEPA).

- i. 250 ppm (T_1)
- ii. 500 ppm (T_2)
- iii. 1000 ppm (T_3)

N⁶- Benzy! Adenine (BA)

- iv. 100 ppm (T_4)
- v. 250 ppm (T_5)
- vi. 500 ppm (T_6)

Control

- vii. Distilled water (T_7)

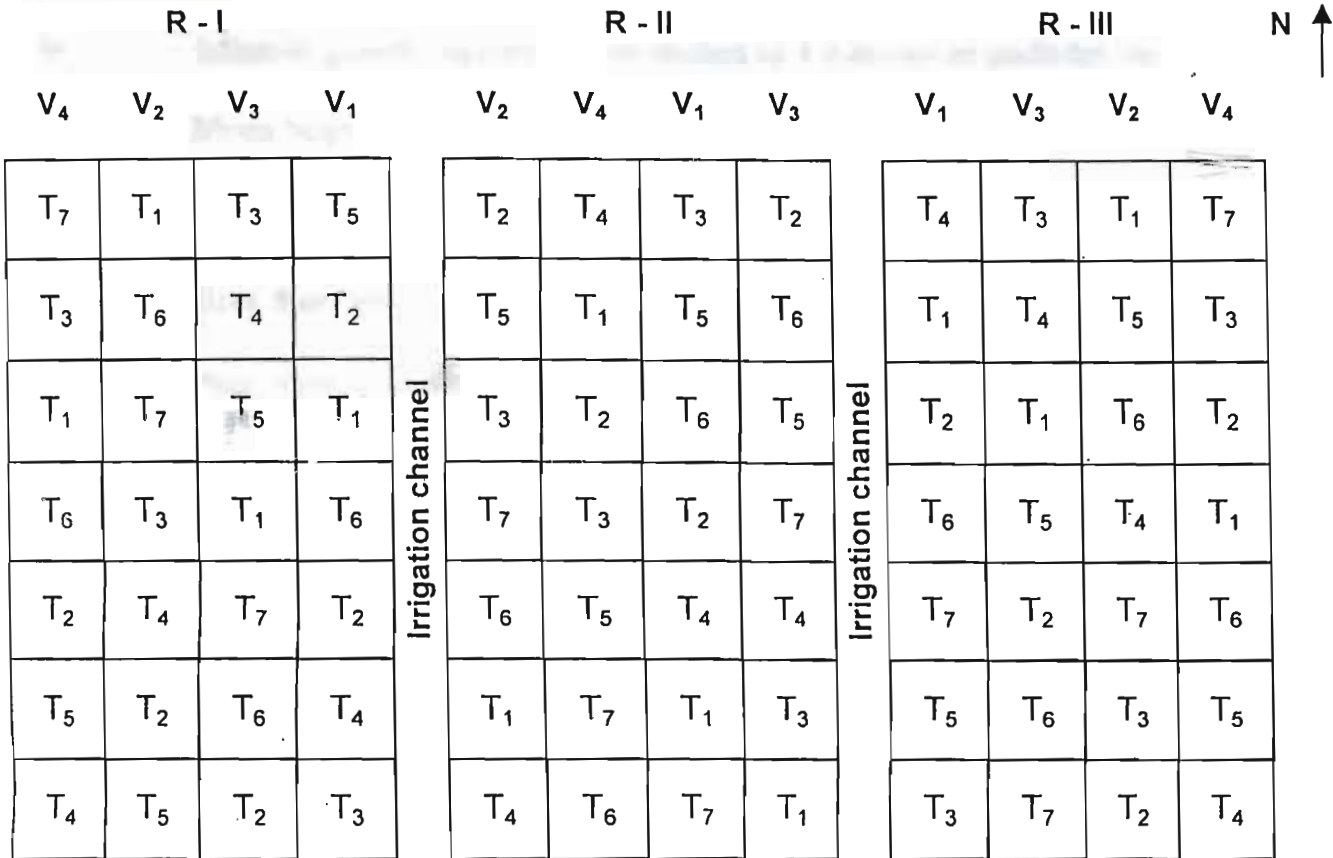


Fig. 2 : Layout plan of the experiment field

T₁ : Ethrel 250 ppm

T₂ : Ethrel 500 ppm

T₃ : Ethrel 1000 ppm

T₄ : BA 100 ppm

T₅ : BA 250 ppm

T₆ : BA 500 ppm

T₇ : Control

V₁ : Moon Majic

V₂ : Sevilla

V₃ : Rose Supreme

V₄ : Peter Pears

GROWTH REGULATORS PREPARATION

Varieties (Sub plot)

Effect of growth regulators were studied on 4 cultivars of gladiolus viz.,

- i. Moon Majic V_1
- ii. Sevilla V_2
- iii. Rose Supreme V_3
- iv. Peter Pears V_4

28 treatment combinations can be presented as follows :

T_1V_1	T_2V_1	T_3V_1	T_4V_1	T_5V_1	T_6V_1	T_7V_1
T_1V_2	T_2V_2	T_3V_2	T_4V_2	T_5V_2	T_6V_2	T_7V_2
T_1V_3	T_2V_3	T_3V_3	T_4V_3	T_5V_3	T_6V_3	T_7V_3
T_1V_4	T_2V_4	T_3V_4	T_4V_4	T_5V_4	T_6V_4	T_7V_4

3.6 DETAILS OF EXPERIMENT

Crop	: Gladiolus
Season	: Winter 2000-2001
Spacing	: 20 cm x 30 cm
Method of planting	: Ridge and furrow
Gross plot size	: 1 m x 3 m
Net plot size	: 0.8 m x 2.7 m
Date of planting	: 27 th October, 2000

3.7 GROWTH REGULATORS PREPARATION

3.7.1 Ethrel solution

Solution of ethrel 250, 500 and 1000 ppm are prepared in a volumetric flask by dissolving 0.25, 0.50 and 1 ml in distilled water and made upto 1000 ml.

3.7.2 Benzyl adenine

Solution of BA 100, 250, 500 ppm were prepared in a volumetric flask by dissolving 250, 500, 750 mg of BA in little quantity of dilute HCl. Then made up the volume to 1000 ml with distilled water.

3.8 CULTIVATION DETAILS

3.8.1 Preparatory cultivation

The experimental field was prepared by ploughing twice with tractor drawn plough followed by harrowing twice and levelling was done with wooden plank after the removal of stubbler and weed trash from the field. A spacing of 1 m between two replication and 0.5 m between two plots were provided for laying out the bund.

3.8.2 Planting

Freshly lifted uniform sized cormels of gladiolus were procured locally and selected for uniformity in size (1.50 ± 0.25 cm). Each of the cormels weighed 285 mg on an average. The cormels were descaled and soaked for 30 minutes in different concentration solution of ethrel and BA. Soaking in distilled water acted as control. Both the treated and control cormels (50 cormels per treatment) were sown on ridges on the same day in separate plots in a split plot design at a depth of 2 cm on 27th October, 2000.

3.8.3 Manures and fertilizers

At the time of planting full dose of N, P and K each (i.e., 30 gm m⁻²) was applied between the rows at a depth of 3 to 6 cm. Farm yard manure was applied at the rate of 5 kg plot⁻¹.

3.8.4 Irrigation

The first irrigation was given immediately after planting while subsequent irrigations were given as and when required depending upon soil moisture and weather conditions.

3.8.5 Intercultivation

Earthing up of beds and irrigation channels was carried out whenever required. The experimental area was kept weed free throughout the cropping period. Weeding was done manually at 15 and 30 days after planting (DAP).

3.8.6 Plant protection

Necessary plant protection measures were adopted to control the pest and diseases during the crop growth period.

3.8.7 Harvesting

Harvesting was done when the leaves turned yellow and started drying and the lifting of corms was done carefully. The individual plant was lifted and bagged separately.

3.9 SAMPLING PROCEDURE

One row on either side of the plot was left as border row. The second row from the border on either side of the plot in each treatment was used for destructive sampling

and the remaining central rows were considered as net plot. Five plants were selected from the each individual plot from the second row on either side of plot for recording leaf area at 30, 60 and 90 DAS. Five plants at random from the remaining central rows were labelled and used for recording different growth and yield attributes, which are as follows.

3.10 SPROUTING PARAMETERS

The number of sprouted cormels was noted daily. Emergence of sprouts above the ground was taken as criterion for sprouting.

3.10.1 Days for 50 per cent sprouting

The number of days taken for 50 per cent cormels to sprout was recorded.

3.10.2 Days for 100 per cent sprouting

The number of days taken for 100 per cent cormels to sprout was recorded.

3.11 GROWTH PARAMETERS

3.11 Height of the plant

Plant height was measured from the base of plant at ground level to the tip of the plant at 30, 60 and 90 days after sprouting.

3.11.2 Number of leaves per plant

Number of leaves per plant was counted at 30, 60 and 90 days after sprouting.

3.11.3 Leaf area per plant

Leaf area was recorded directly by using leaf area meter. Leaf area per plant was calculated using the formula, leaf area x number of leaves and expressed in cm^2 .

3.11.4 Leaf area index (LAI)

Leaf area index was worked out using the following formula

$$\text{Leaf area index} = \frac{\text{Leaf area}}{\text{Area around (spacing) each plant}} \quad (\text{Sestak } et \text{ al., 1971})$$

3.12 YIELD PARAMETERS

3.12.1 Corm size

Diameter of corm in cm was measured with the help of Vernier callipers after harvest.

3.12.2 Corm weight

Weight of corm in g was recorded at harvest after removing adhering soil particles.

3.12.3 Number of cormels per plant

Number of cormels per plant was counted after the harvest

3.12.4 Weight of cormels per plant

Weight of all the cormels per plant in g was recorded after the harvest after cleaning the cormels.

3.13 STATISTICAL ANALYSIS AND INTERPRETATION OF THE DATA

The statistical analysis of the data was done by following the Fiesher's analysis of variance techniques as given by Panse and Sukhatme (1967). The level of significance used in 'F' and 't' test was $P = 0.05$.

CHAPTER IV

RESULTS

The experimental findings of the "Effect of plant growth regulators on dormancy and growth of gladiolus" in four varieties of gladiolus are presented in this chapter.

SPROUTING PARAMETERS

The number of days for 50 per cent sprouting

and the number of days for 50 per cent sprouting as influenced by growth regulator treatments and varieties are presented in the table 1 and fig. 1.

Significant differences were found with growth regulator treatments, varieties and

RESULTS

and treated controls as compared to control. Minimum number of days (20.17) was required for 50 per cent

sprouting in the control treatment (T₀) (62.56) and 1000 ppm, respectively) significantly varied from each other and required lesser number of days for 50 per cent sprouting (40.78 and 50.21 days, respectively) as compared to control (T₀) (62.56)

Among the varieties, minimum number of days to 50 per cent sprouting (37.51) was observed in the variety 'Miss Major' that was significantly lower than the rest of the varieties. This was followed by 41.65 days in the cv. 'Peter Pan'. The cv. 'Rose Supreme' took maximum number of days for 50 per cent sprouting (49.13).

CHAPTER IV

RESULTS

The experimental findings of the “Effect of plant growth regulators on dormancy and growth of gladiolus” in four varieties of gladiolus are presented in this chapter.

4.1 SPROUTING PARAMETERS

4.1.1 Number of days for 50 per cent sprouting

The data on number of days for 50 per cent sprouting as influenced by growth regulator treatments and varieties are presented in the table 1 and fig. 3.

Significant differences were found with growth regulator treatments, varieties and their interactions on sprouting of cormels.

The number of days for 50 per cent sprouting was significantly reduced in growth regulator treated cormels as compared to control. Minimum number of days (29.37) was required for 50 per cent sprouting in the cormels treated with BA 100 ppm (T_4). All the three ethrel treatments, T_1 , T_2 and T_3 (250, 500 and 1000 ppm, respectively) significantly varied from each other and required lesser number of days for 50 per cent sprouting (43.89, 45.78 and 50.21 days, respectively) as compared to control (T_7) (62.56).

Among the varieties, minimum number of days to 50 per cent sprouting (37.51) was observed in cv. Moon Majic that was significantly lower than the rest of the varieties. This was followed by 41.55 days in the cv. Peter Pears. The cv. Rose Supreme took maximum number of days for 50 per cent sprouting (49.13).

Table 1 : Effect of plant growth regulators and varieties on number of days for 50 % sprouting in cormels of different varieties of gladiolus

Treatments	Moon Majic	Sevilla	Rose Supreme	Peter Pears	Mean
Ethrel 250 ppm	38.50	45.33	49.93	41.80	43.89
Ethrel 500 ppm	41.33	47.50	51.50	42.80	45.78
Ethrel 1000 ppm	45.93	50.50	56.07	48.33	50.21
BA 100 ppm	24.87	30.13	35.00	27.50	29.38
BA 250 ppm	29.07	34.91	40.82	32.67	34.37
BA 500 ppm	30.20	36.73	41.67	33.84	35.61
Control	52.70	64.73	68.91	63.91	62.56
Mean	37.51	44.26	49.13	41.55	
S.Em ±		T = 0.102	V = 0.476	T x V = 1.260	
CD (P=0.05)		T = 0.314	V = 1.361	T x V = NS	

The interaction between growth regulators and varieties significantly influenced the number of days for 50 per cent sprouting. Among benzyl adenine treatment combination, least number of days for 50 per cent sprouting (24.87) was observed in treatment combination of cv. Moon Majic with BA 100 ppm which was at par with cv. Moon Majic + BA 250 ppm. Maximum number of days for 50 per cent sprouting (68.91) was recorded in the treatment combination of cv. Rose Supreme and control.

In general, all benzyl adenine treatments significantly reduced number of days for 50 per cent sprouting than ethrel treatments.

4.1.2 Number of days for 100 per cent sprouting

The data pertaining to the number of days for 100 per cent sprouting as influenced by growth regulators and varieties are presented in table 2 and fig. 4.

Significant differences were observed among treatments, varieties and their interactions.

The number of days for 100 per cent sprouting was significantly reduced in growth regulator treated cormels as compared to control. Minimum number of days (38.11) was required for 100 per cent sprouting in the cormels treated with BA 100 ppm (T₄). All the growth regulator treatments took significantly less number of days for 100 per cent sprouting as compared to control (70.41 days).

Among the varieties minimum number of days for 100 per cent sprouting (44.39) was observed in cv. Moon Magic which was significantly lower than the rest of the

Table 2 : Effect of plant growth regulators and varieties on number of days for 100 % sprouting in cormels of different varieties of gladiolus

Treatments	Moon Majic	Sevilla	Rose Supreme	Peter Pears	Mean
Ethrel 250 ppm	46.77	53.72	61.40	50.53	53.11
Ethrel 500 ppm	47.80	54.47	62.07	50.92	53.82
Ethrel 1000 ppm	48.93	58.67	68.18	56.95	58.18
BA 100 ppm	33.53	37.40	46.33	35.50	38.19
BA 250 ppm	36.00	42.33	50.77	40.92	42.51
BA 500 ppm	36.67	43.92	50.87	41.50	43.24
Control	61.03	72.80	78.47	69.33	70.41
Mean	44.39	51.90	59.73	49.38	
S.Em \pm		T = 0.309	V = 0.396	T x V = 1.048	
CD (P=0.05)		T = 0.952	V = 1.133	T x V = 1.078	

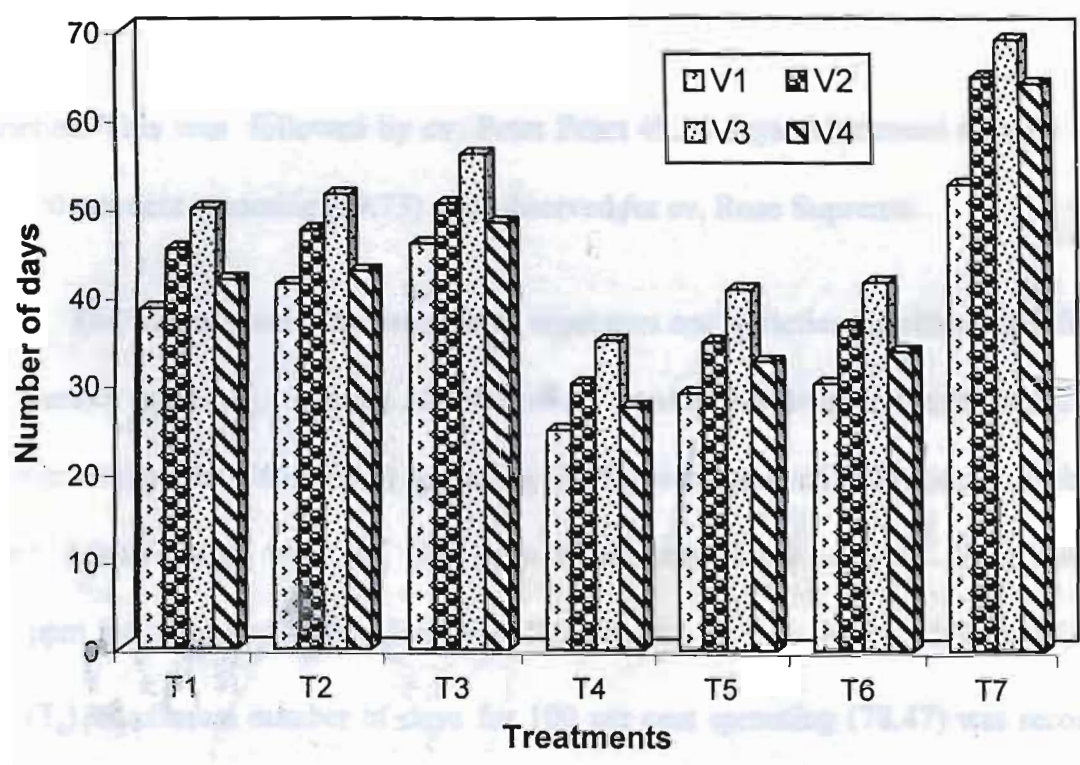


Fig. 3 : Effect of plant growth regulators and varieties on number of days for 50 % sprouting in cornels of different varieties of gladiolus

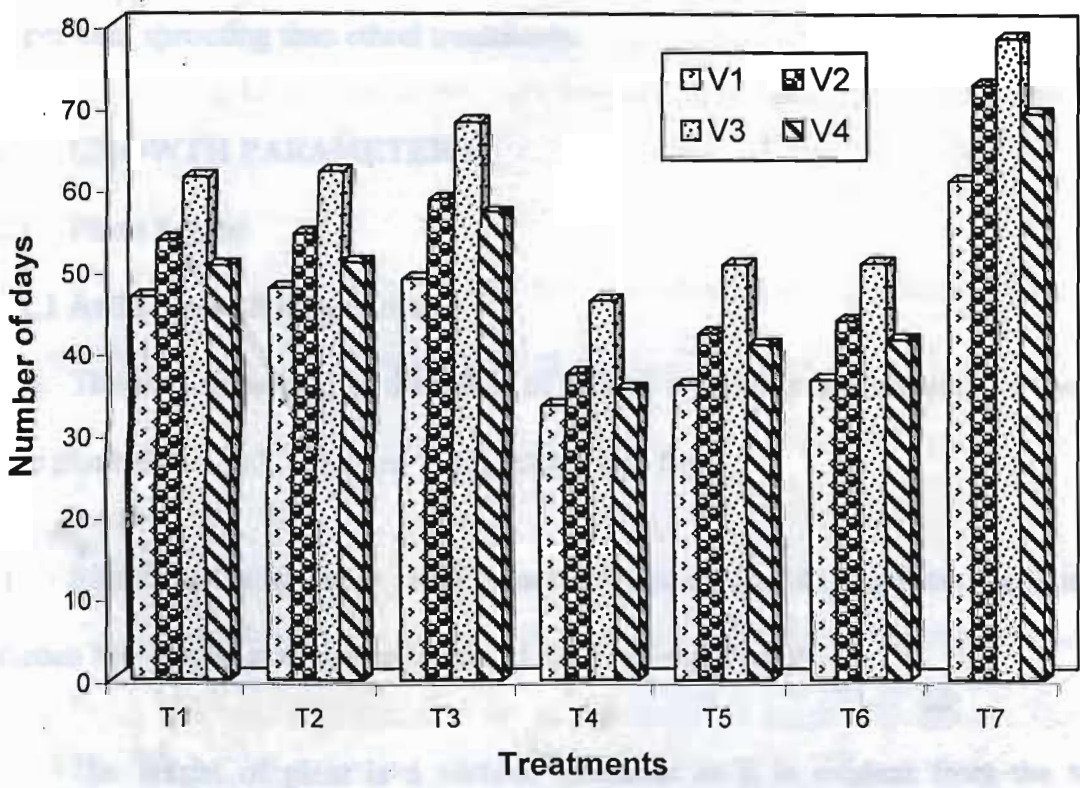


Fig. 4 : Effect of plant growth regulators and varieties on number of days for 100 % sprouting in cornels of different varieties of gladiolus

varieties. This was followed by cv. Peter Pears 49.38 days. Maximum number of days for 100 per cent sprouting (59.73) was observed for cv. Rose Supreme.

The interactions between growth regulators and varieties significantly influenced the number of days for 100 per cent sprouting. Among BA treatment combinations, least number of days for 100 per cent sprouting (33.53) was observed in treatment combination of cv. Moon Magic with BA 100 ppm which was at par with cv. Peter Pears and 100 ppm BA (T_2), cv. Moon Majic and 250 ppm BA (T_3), cv. Moon Majic and 500 ppm BA (T_6). Maximum number of days for 100 per cent sprouting (78.47) was recorded in the treatment combination of cv. Rose Supreme without growth regulator treatment (T_1).

In general, all BA treatments significantly reduced number of days for 100 per cent sprouting than ethrel treatments.

4.2 GROWTH PARAMETERS

4.2.1 Plant height

4.2.1.1 At 30 days after sprouting

The data pertaining to the effect of growth regulators and varieties on the height of the plant at 30 DAS are given in the table 3 and fig. 5.

Significant differences were observed among growth regulator treatment and varieties but their interactions were found to be not-significant.

The height of plant is a varietal character as it is evident from the table 3, which showed significant difference among varieties. Cv. Rose Supreme recorded the

maximum height (15.78 cm) which was significantly higher than rest of the varieties and least height (10.86) was recorded in cv. Sevilla.

Growth regulator treatments also showed a significant influence on the height of the plant at 30 DAS. Among the growth regulator treatments, highest plant height was recorded in BA 100 ppm (13.22 cm) and least in control (21.30 cm).

The interaction between varieties and different growth regulator treatments was found not-significant.

4.2.1.2 At 60 days after sprouting

Data showing the effect of growth regulators and varieties on plant height at 60 DAS are presented in the table 3.

Growth regulator treatments, varieties and their interactions were found to be significantly different.

Height of the plant was found to be significantly varying among the varieties at 60 DAS. The maximum plant height (35.02 cm) was recorded in cv. Rose Supreme that was significantly higher than rest of the varieties. Least plant height (23.10 cm) was recorded in cv. Peter Pears.

The growth regulator treatments significantly influenced the plant height at 60 DAS. BA 250 ppm (T_5) recorded the maximum plant height (29.11 cm). The lowest plant height (24.34 cm) was recorded in control (T_7) compared to other treatments.

The interaction between growth regulators and varieties significantly influenced the height of the plant at 60 DAS. Maximum plant height was recorded in cv. Rose Supreme with 250 ppm BA (36.65 cm) and minimum in cv. Sevilla (19.86 cm) without any growth regulator treatment.

4.2.1.3 At 90 days after sprouting

The data pertaining to the effect of growth regulators and varieties on plant height at 90 DAS are presented in the table 3.

Significant differences were recorded among different varieties, growth regulator and their interactions.

Growth regulator treatments significantly influenced the plant height at 90 DAS. BA 250 ppm (T_5) recorded the maximum plant height (40.26 cm). The lowest plant height (36.58 cm) was recorded in control (T_1) without any growth regulator treatment compared to other treatments.

The plant height significantly varied among the varieties at 90 DAS. The maximum plant height was recorded in cv. Rose Supreme (47.71 cm) which was significantly higher than rest of the varieties. Least plant height was recorded in cv. Peter Pears (32.43 cm).

The interactions between growth regulators and varieties significantly influenced the height of the plant at 90 DAS. Maximum plant height (49.25 cm) was recorded in cv. Rose Supreme with 100 ppm BA (T_4) and minimum plant height (30.41 cm) was recorded in cv. Sevilla without any growth regulator treatment (T_1).

Table 3 : Effect of plant growth regulators and varieties on plant height (cm) of different varieties of gladiolus

Treatments	Moon Majic	Sevilla	Rose Supreme	Peter Pears	Mean
30 DAS					
Ethrel 250 ppm	12.75	10.22	15.53	10.90	12.35
Ethrel 500 ppm	12.67	10.58	15.42	10.58	12.31
Ethrel 1000 ppm	13.10	10.47	15.25	11.60	12.61
BA 100 ppm	13.50	11.55	16.25	11.59	13.22
BA 250 ppm	13.17	10.99	16.20	11.25	12.90
BA 500 ppm	12.84	11.65	16.25	11.90	13.16
Control	12.50	10.55	15.58	10.58	12.30
Mean	12.93	10.86	15.78	11.20	
S.Em \pm		T = 0.118	V = 0.364	T x V = 0.339	
CD (P=0.05)		T = 0.364	V = 1.082	T x V = NS	
60 DAS					
Ethrel 250 ppm	24.64	23.69	33.67	21.66	25.92
Ethrel 500 ppm	24.01	24.80	34.95	22.90	26.67
Ethrel 1000 ppm	25.87	25.30	34.90	23.24	27.33
BA 100 ppm	26.00	26.62	35.61	24.22	28.11
BA 250 ppm	28.11	26.85	36.65	24.82	29.11
BA 500 ppm	26.00	25.95	35.85	24.29	28.02
Control	23.44	19.86	33.51	20.56	24.34
Mean	25.44	24.72	35.02	23.10	
S.Em \pm		T = 0.147	V = 0.153	T x V = 0.406	
CD (P=0.05)		T = 0.454	V = 0.438	T x V = 1.160	
90 DAS					
Ethrel 250 ppm	34.78	35.57	46.54	31.12	37.00
Ethrel 500 ppm	36.10	37.21	47.70	31.40	38.10
Ethrel 1000 ppm	36.78	36.67	47.58	32.10	38.28
BA 100 ppm	36.81	38.72	48.75	33.61	39.47
BA 250 ppm	37.97	38.91	49.25	34.92	40.26
BA 500 ppm	36.81	38.40	47.85	33.42	39.12
Control	34.21	35.40	46.29	30.41	36.58
Mean	36.21	37.27	47.71	32.43	
S.Em \pm		T = 0.080	V = 0.132	T x V = 0.349	
CD (P=0.05)		T = 0.246	V = 0.376	T x V = 0.996	

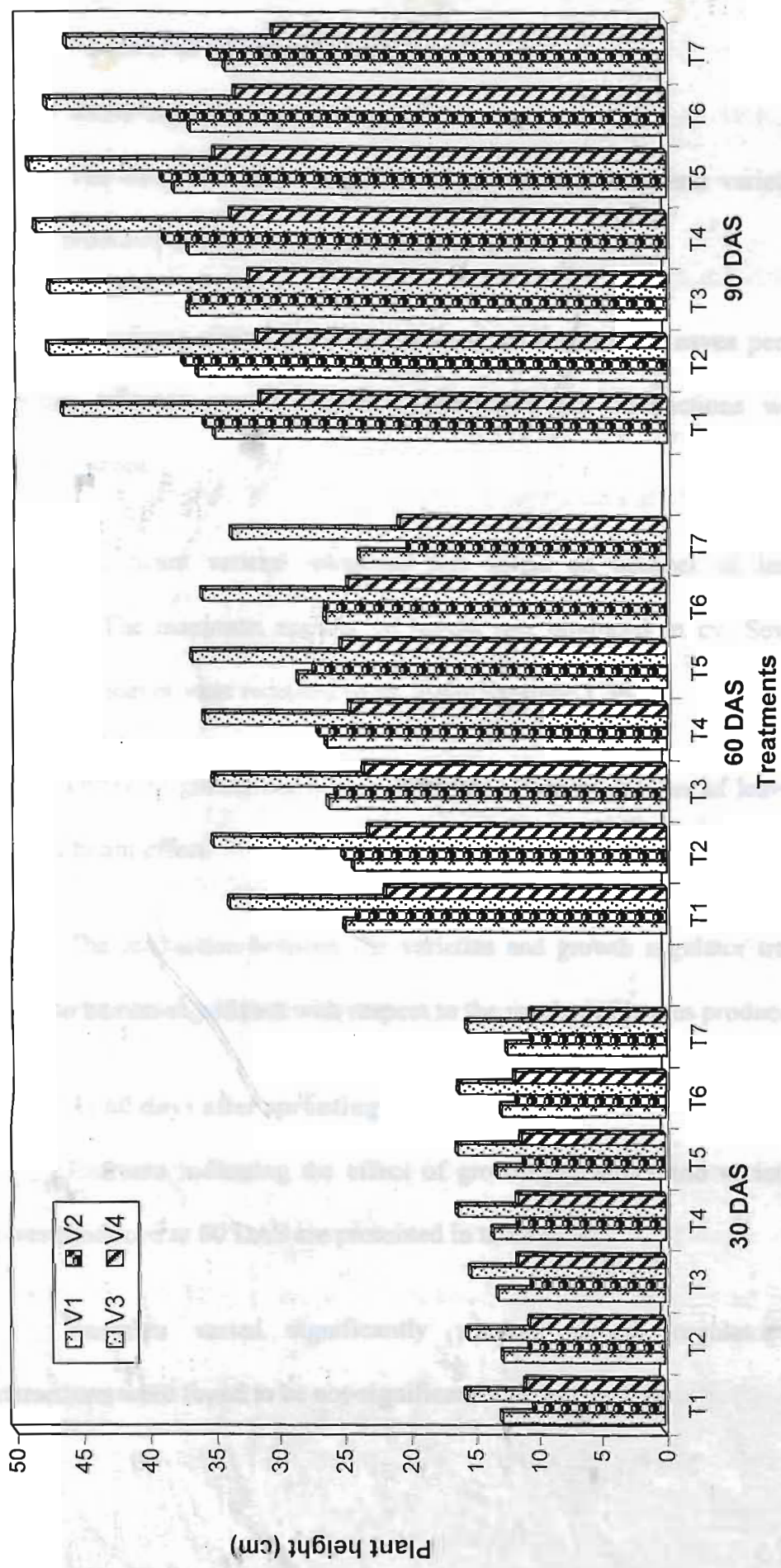


Fig. 5 : Effect of plant growth regulators and varieties on plant height (cm)

4.2.2 Number of leaves per plant

4.2.2.1 At 30 days after sprouting

The data indicating the effect of growth regulators and varieties on number of leaves produced at 30 DAS are presented in table 4 .

Significant difference was observed for number of leaves per plant among the varieties whereas growth regulator treatments and interactions were found to be not-significant.

Significant varietal influence was found on number of leaves produced at 30 DAS. The maximum number of leaves was produced in cv. Sevilla 1.8 and least number of leaves were recorded in cv. Rose Supreme 1.56.

Different growth regulator treatments effect on number of leaves at 30 DAS has no significant effect.

The interaction between the varieties and growth regulator treatments was also found to be non-significant with respect to the number of leaves produced at 30 DAS.

4.2.2.2 At 60 days after sprouting

The data indicating the effect of growth regulators and varieties on number of leaves produced at 60 DAS are presented in table 4.

Varieties varied significantly whereas growth regulator treatments and interactions were found to be not-significant.

Significant varietal influence was found on number of leaves produced at 60 DAS. The maximum number of leaves was produced in cv. Rose Supreme and the least number of leaves was recorded in cv. Moon Majic.

The growth regulator treatments did not significantly influence the number of leaves produced at 60 DAS.

The interactions of varieties and growth regulator treatments were also found to be not-significant with respect to number of leaves produced at 60 DAS.

4.2.2.3 At 90 days after sprouting

The data pertaining to the effect of growth regulators and varieties on the number of leaves produced at 90 DAS are presented in table 4.

Significant difference were found among the varieties whereas, growth regulator treatments and interactions were found to be non-significant. Non-significant differences were noticed among the various concentrations of two growth regulators tried with respect to the number of leaves produced per plant at 90 DAS.

Varieties differed significantly with respect to the number of leaves produced at 90 DAS. Cv. Rose Supreme produced maximum number of leaves (6.50) at 90 DAS, which was at par with cv. Moon Majic 6.37. There were significantly superior over other two varieties. cv. Sevilla produced least number of leaves (5.56) at 90 DAS.

Among the various concentrations of two growth regulators tried, non-significant differences were noticed with respect to the number of leaves produced at 90 DAS.

Table 4 : Effect of plant growth regulators and varieties on number of leaves per plant

Treatments	Moon Majic	Sevilla	Rose Supreme	Peter Pears	Mean
30 DAS					
Ethrel 250 ppm	1.67	1.87	1.60	1.60	1.69
Ethrel 500 ppm	1.60	1.73	1.53	1.67	1.63
Ethrel 1000 ppm	1.60	1.80	1.60	1.80	1.70
BA 100 ppm	1.60	1.80	1.60	1.53	1.63
BA 250 ppm	1.53	1.80	1.60	1.67	1.65
BA 500 ppm	1.60	1.80	1.50	1.60	1.63
Control	1.47	1.77	1.47	1.60	1.58
Mean	1.58	1.80	1.56	1.64	
S.Em \pm	T = 0.036		V = 0.047	T x V = 0.123	
CD (P=0.05)	T = NS		V = 0.133	T x V = NS	
60 DAS					
Ethrel 250 ppm	3.60	3.87	3.80	3.93	3.80
Ethrel 500 ppm	3.67	3.73	3.87	3.87	3.79
Ethrel 1000 ppm	3.60	3.80	3.87	3.93	3.80
BA 100 ppm	3.53	3.80	3.93	3.87	3.78
BA 250 ppm	3.67	3.80	3.87	3.94	3.82
BA 500 ppm	3.60	3.80	3.93	3.80	3.78
Control	3.60	3.87	3.80	3.80	3.77
Mean	3.61	3.81	3.87	3.88	
S.Em \pm	T = 0.053		V = 0.098	T x V = 0.260	
CD (P=0.05)	T = NS		V = NS	T x V = NS	
90 DAS					
Ethrel 250 ppm	6.35	5.57	6.50	5.81	6.06
Ethrel 500 ppm	6.42	5.59	6.54	5.72	6.07
Ethrel 1000 ppm	6.34	5.54	6.5	5.73	6.03
BA 100 ppm	6.28	5.53	6.48	5.76	6.01
BA 250 ppm	6.43	5.61	6.49	5.77	6.08
BA 500 ppm	6.34	5.56	6.58	5.80	6.07
Control	6.40	5.53	6.42	5.83	6.05
Mean	6.37	5.56	6.50	5.77	
S.Em \pm	T = 0.047		V = 0.084	T x V = 0.223	
CD (P=0.05)	T = NS		V = 0.241	T x V = NS	

The interaction among varieties and growth regulator treatments were found to be not-significant with respect to number of leaves produced at 90 DAS.

4.2.3 Leaf area per plant

4.2.3.1 At 30 days after sprouting

The data pertaining to the leaf area as influenced by the growth regulators and varieties at 30 DAS are presented in table 5 and fig. 6.

Varieties, growth regulator treatments and their combinations varied significantly.

Varietal influence was found to be significant on leaf area and 30 DAS. cv. Moon Majic recorded maximum leaf area (15.90 cm²) which was significantly superior over rest of the varieties. This was followed by cv. Peter Pears that recorded a leaf area of 14.35 cm². Minimum leaf area (11.57 cm²) was recorded in cv. Rose Supreme (11.57).

Growth regulator treatments were found to be significant with respect to leaf area recorded 30 DAS. Maximum leaf area (14.41 cm²) was recorded with BA 100 ppm followed by BA 250 ppm (14.33).

Growth regulator treatments and varietal interaction were also found to be significant. cv. Moon Majic treated with BA 100 ppm (T₄) recorded maximum leaf area followed by BA 250 ppm. Minimum leaf area (10.34 cm²) was recorded with ethrel 1000 ppm (T₃) in cv. Rose Supreme.

4.2.3.2 At 60 days after sprouting

The data pertaining to the effect of growth regulators and varieties on leaf area at 60 DAS are given in the table 5.

Significant differences were found among varieties, growth regulator treatments and their interactions.

Leaf area significantly varied with growth regulator treatments at 60 DAS. Maximum leaf area (103.57 cm²) was found in BA 100 ppm (T₄) treated cormels whereas minimum leaf area (94.0 cm²) was recorded in untreated cormels (T₇).

Leaf area significantly varied among the varieties at 60 DAS. Maximum leaf area (120.40 cm²) was recorded in cv. Moon Majic that was significantly superior over other varieties. cv. Rose Supreme recorded minimum leaf area (78.20 cm²).

The interaction between varieties and growth regulator treatments were also found to be significant with respect to leaf area at 60 DAS. Maximum leaf area (126.00 cm²) was recorded in cv. Moon Majic with BA 100 ppm (T₄) cormel treatment. Minimum leaf area (72.14) control (T₇) in cv. Rose Supreme.

4.2.3.3 At 90 days after sprouting

The data indicating the effect of growth regulators and varieties on leaf area at 90 DAS are given in the table 5.

Significant differences were found among growth regulators, varieties and their interactions.

It is evident from the table 5 that growth regulators had a significant effect on leaf area at 90 DAS. BA at 100 ppm (T₄) recorded maximum leaf area (283.64 cm²). Minimum leaf area (254.73 cm²) was recorded in control.

Table 5 : Effect of plant growth regulators and varieties on leaf area per plant

Treatments	Moon Majic	Sevilla	Rose Supreme	Peter Pears	Mean
30 DAS					
Ethrel 250 ppm	15.56	11.97	11.14	13.75	13.11
Ethrel 500 ppm	15.26	12.01	11.10	13.85	13.06
Ethrel 1000 ppm	15.76	11.95	10.34	13.67	12.93
BA 100 ppm	16.58	13.52	11.61	15.95	14.42
BA 250 ppm	16.37	13.11	12.95	14.71	14.29
BA 500 ppm	16.49	13.27	12.74	14.83	14.33
Control	15.27	11.93	11.14	13.68	13.01
Mean	15.90	12.54	11.57	14.35	
S.Em \pm	T = 0.2361		V = 0.2163	T x V = 0.4948	
CD (P=0.05)	T = 0.6993		V = 0.6489	T x V = 1.485	
60 DAS					
Ethrel 250 ppm	116.75	93.85	76.00	99.24	96.46
Ethrel 500 ppm	119.23	94.75	77.19	102.42	98.40
Ethrel 1000 ppm	119.25	95.14	77.23	106.10	99.43
BA 100 ppm	126.00	100.92	81.95	105.41	103.57
BA 250 ppm	123.29	102.90	82.15	103.45	102.95
BA 500 ppm	122.52	101.81	80.75	102.68	101.94
Control	115.75	89.77	72.14	98.34	94.00
Mean	120.40	97.02	78.20	102.52	
S.Em \pm	T = 0.9394		V = 0.9261	T x V = 0.6789	
CD (P=0.05)	T = 2.8183		V = 2.7783	T x V = 2.0367	
90 DAS					
Ethrel 250 ppm	291.51	269.85	206.90	259.95	257.05
Ethrel 500 ppm	298.50	283.95	209.75	257.95	262.54
Ethrel 1000 ppm	299.72	280.52	210.25	270.39	265.22
BA 100 ppm	307.77	292.95	252.08	281.75	283.64
BA 250 ppm	284.50	291.50	222.05	281.72	269.94
BA 500 ppm	301.85	292.50	225.87	261.72	270.49
Control	291.94	269.75	201.50	255.74	254.73
Mean	296.54	283.00	218.34	267.03	
S.Em \pm	T = 6.7276		V = 5.3191	T x V = 13.6494	
CD (P=0.05)	T = 20.1829		V = 15.957	T x V = 40.9482	

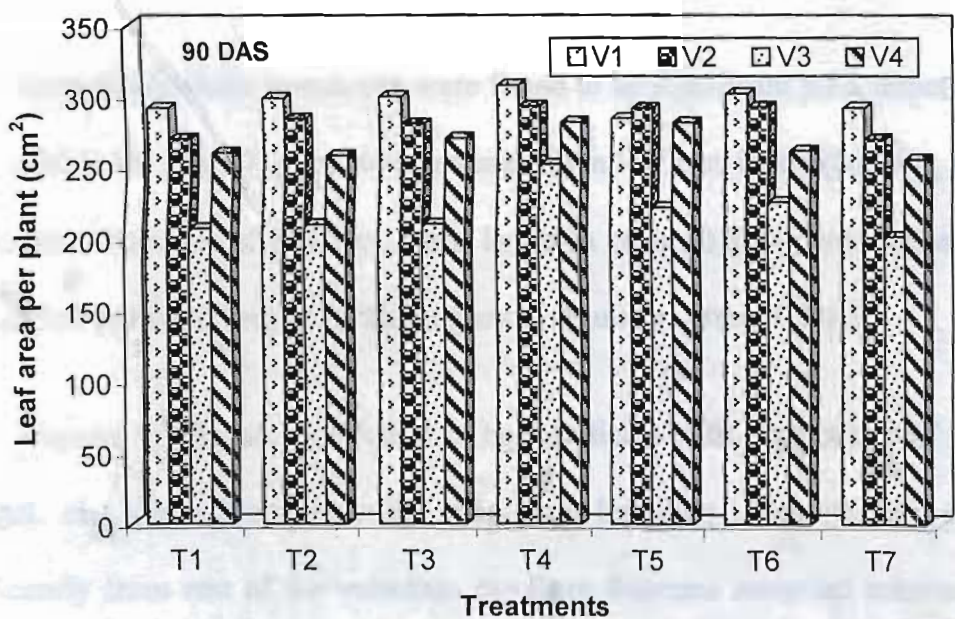
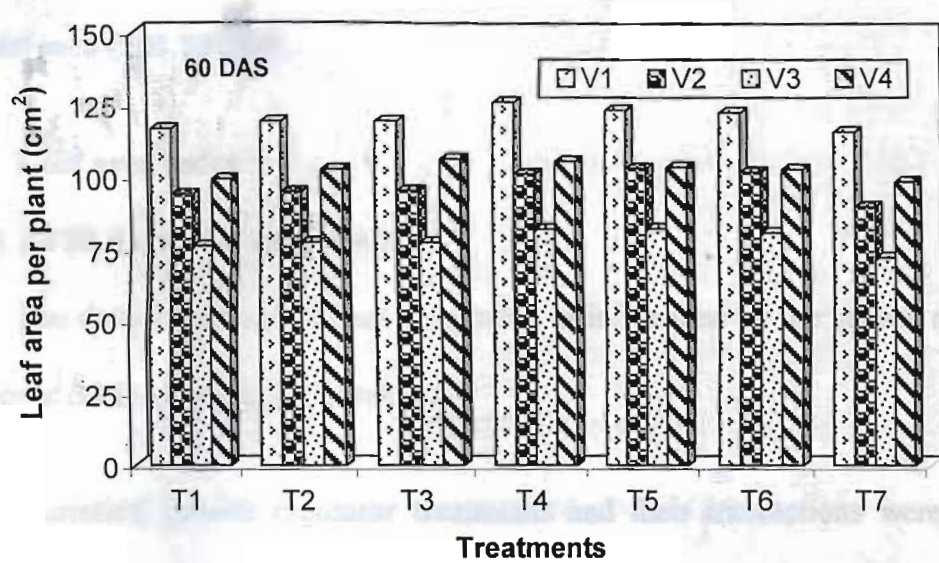
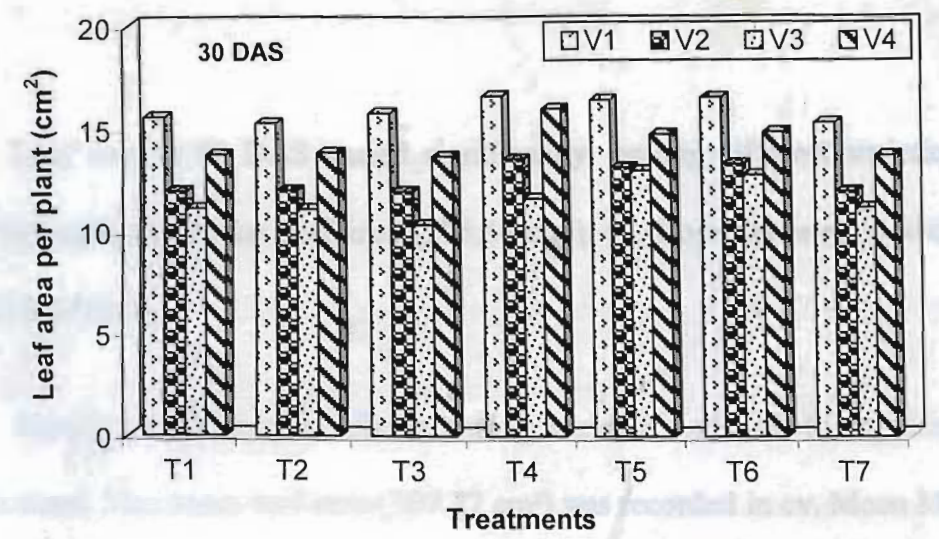


Fig. 6 : Effect of plant growth regulators and varieties on leaf area per plant (cm²)

Leaf area at 90 DAS varied significantly among different varieties. cv. Moon Majic recorded maximum leaf area (296.54 cm²). cv. Rose Supreme recorded least leaf area (218.34 cm²).

Significant interaction effects among varieties and growth regulator treatments were noticed. Maximum leaf area (307.77 cm²) was recorded in cv. Moon Majic with BA 100 ppm control (T₁) without any growth regulator treatment in Rose Supreme recorded least leaf area (201.50 cm²).

4.2.4 Leaf area index

4.2.4.1 At 30 days after sprouting

The data indicating the leaf area index as influenced by the growth regulators and varieties at 30 DAS are given in table 6.

Varieties, growth regulator treatments and their interactions were found to be significant.

Growth regulator treatments were found to be significant with respect to leaf area index at 30 DAS. BA 500 ppm recorded maximum leaf area index (0.0240), which varied significantly from rest of varieties. Least leaf area index (0.0210) was noticed with ethrel 250 and 500 ppm and control (without growth regulator) after 30 DAS.

Varietal influence was found to be significant with respect to leaf area index at 30 DAS. cv. Moon Majic recorded maximum leaf area index (0.026), which varied significantly from rest of the varieties. cv. Rose Supreme recorded minimum leaf area index (0.019).

The interaction between growth regulator treatments and different growth regulator treatments was found significant. Cv. Moon Magic with BA (500 ppm) recorded maximum leaf area index. Least leaf area index (0.017) was observed in Rose Supreme with control (no growth regulator treatment).

4.2.4.2 At 60 days after sprouting

The data pertaining to the effect of growth regulators and varieties on leaf area index at 60 DAS are given in the table 6.

Significant differences were found among varieties, growth regulator treatments and their interaction.

The different growth regulator treatments were found to be significantly influenced the leaf area index at 60 DAS. Maximum leaf area index (0.172) was found with BA 100 ppm (T₄) preplanting cornel treatments, whereas minimum leaf area index (0.155) was recorded in control (T₇).

Leaf area index varied significantly at 60 DAS, among varieties. Cv. Moon Majic recorded the maximum leaf area index (0.200), which was significantly superior over the rest of the varieties. Cv. Rose Supreme recorded minimum leaf area index (0.129).

The interaction between growth regulator treatments and varieties varied significantly with respect to leaf area index. BA (100 ppm) on cv. Moon Magic recorded maximum leaf area index (0.210) whereas cv. Rose Supreme recorded minimum leaf area index (0.119).

4.2.4.3 At 90 days after sprouting

The data indicating the effect of growth regulators and varieties on leaf area index at 90 DAS are given in the table 6.

Significant differences were found among growth regulator treatments, varieties and their interaction.

Leaf area index varied significantly at 90 DAS with growth regulator treatment. BA (100 ppm) (T_4) recorded maximum leaf area index (0.461) and minimum leaf area index (0.424) was recorded with control (T_7) (no growth regulator treatments). Among the different varieties, significant influence on leaf area index was observed. Cv. Moon Majic recorded maximum leaf area index (0.491). Cv. Rose Supreme recorded least leaf area index (0.376).

Significant interaction effects were observed within varieties and growth regulator treatments. Among the ethrel treatments cv. Moon Magic with 1000 ppm (T_3) recorded maximum leaf area index, and cv. Rose Supreme with ethrel 250 ppm recorded least leaf area index (0.344). Among the BA treatments cv. Moon Magic with BA 100 ppm (T_4) recorded maximum leaf area index (0.512), whereas BA (500 ppm) T_6 and cv. Rose Supreme combination recorded least leaf area index (0.364).

Minimum leaf area index (0.355) was recorded with no growth regulator treatment (T_7) and cv. Rose Supreme combination.

Table 6 : Effect of plant growth regulators and varieties on leaf area index

Treatments	Moon Majic	Sevilla	Rose Supreme	Peter Pears	Mean
30 DAS					
Ethrel 250 ppm	0.025	0.020	0.018	0.022	0.021
Ethrel 500 ppm	0.025	0.020	0.018	0.022	0.021
Ethrel 1000 ppm	0.026	0.019	0.019	0.022	0.022
BA 100 ppm	0.026	0.021	0.021	0.024	0.023
BA 250 ppm	0.026	0.022	0.021	0.024	0.023
BA 500 ppm	0.028	0.022	0.019	0.027	0.024
Control	0.025	0.019	0.017	0.022	0.021
Mean	0.026	0.020	0.019	0.023	
S.Em \pm	T = 0.00034		V = 0.00034	T x V = 0.00034	
CD (P=0.05)	T = 0.001		V = 0.001	T x V = 0.001	
60 DAS					
Ethrel 250 ppm	0.194	0.156	0.128	0.176	0.164
Ethrel 500 ppm	0.198	0.157	0.126	0.164	0.161
Ethrel 1000 ppm	0.198	0.158	0.128	0.186	0.168
BA 100 ppm	0.210	0.167	0.136	0.175	0.172
BA 250 ppm	0.205	0.171	0.136	0.171	0.171
BA 500 ppm	0.204	0.169	0.134	0.170	0.169
Control	0.192	0.149	0.119	0.163	0.156
Mean	0.200	0.161	0.130	0.172	
S.Em \pm	T = 0.00068		V = 0.00067	T x V = 0.337	
CD (P=0.05)	T = 0.002		V = 0.002	T x V = 1.006	
90 DAS					
Ethrel 250 ppm	0.472	0.449	0.344	0.432	0.424
Ethrel 500 ppm	0.497	0.472	0.349	0.429	0.437
Ethrel 1000 ppm	0.499	0.467	0.490	0.450	0.477
BA 100 ppm	0.512	0.487	0.376	0.469	0.461
BA 250 ppm	0.473	0.481	0.371	0.468	0.448
BA 500 ppm	0.501	0.487	0.364	0.435	0.447
Control	0.486	0.449	0.335	0.425	0.424
Mean	0.491	0.470	0.376	0.444	
S.Em \pm	T = 0.0013		V = 0.0013	T x V = 0.368	
CD (P=0.05)	T = 0.004		V = 0.004	T x V = 1.100	

4.3 YIELD PARAMETERS

4.3.1 Corm size (cm)

The data on the corm size as influenced by growth regulators and varieties are presented in table 7 and fig. 7.

Significant differences were found among the varieties, growth regulator treatments and their interaction with respect to the size of the corms produced.

It is evident from the table 7 that there was significant varietal influence on the average corm size. cv. Moon Majic produced the largest corm size (4.15 cm) which was significantly superior over rest of the varieties. Least corm size (3.17 cm) was produced by cv. Rose Supreme.

Growth regulator treatments significantly influenced corm size. All the three ethrel treatments (250, 500 and 1000 ppm, respectively) significantly reduced the corm size (3.47, 3.38 and 3.33 cm, respectively) as compared to control T_1 (3.87 cm). Ethrel treatments were found to be at par with each other with respect to the corm size produced. Among benzyl adenine treatments 100 ppm (T_4) recorded maximum corm size (4.01 cm) which is significantly superior over all the growth regulator treatments and BA 500 ppm (T_6) produced minimum corm size (3.56).

The interaction of growth regulator treatments and varieties was also found to be significant. Among the ethrel treatment combination cv. Moon Majic with ethrel 250 ppm produced largest corm size (3.85 cm). Cv. Rose Supreme with ethrel 1000 ppm produced least corm size 2.95 cm. Among the BA treatment combination. BA with 100 ppm produced largest corm size (4.82 cm). Cv. Rose Supreme with BA 500 ppm produced least corm size (3.25 cm).



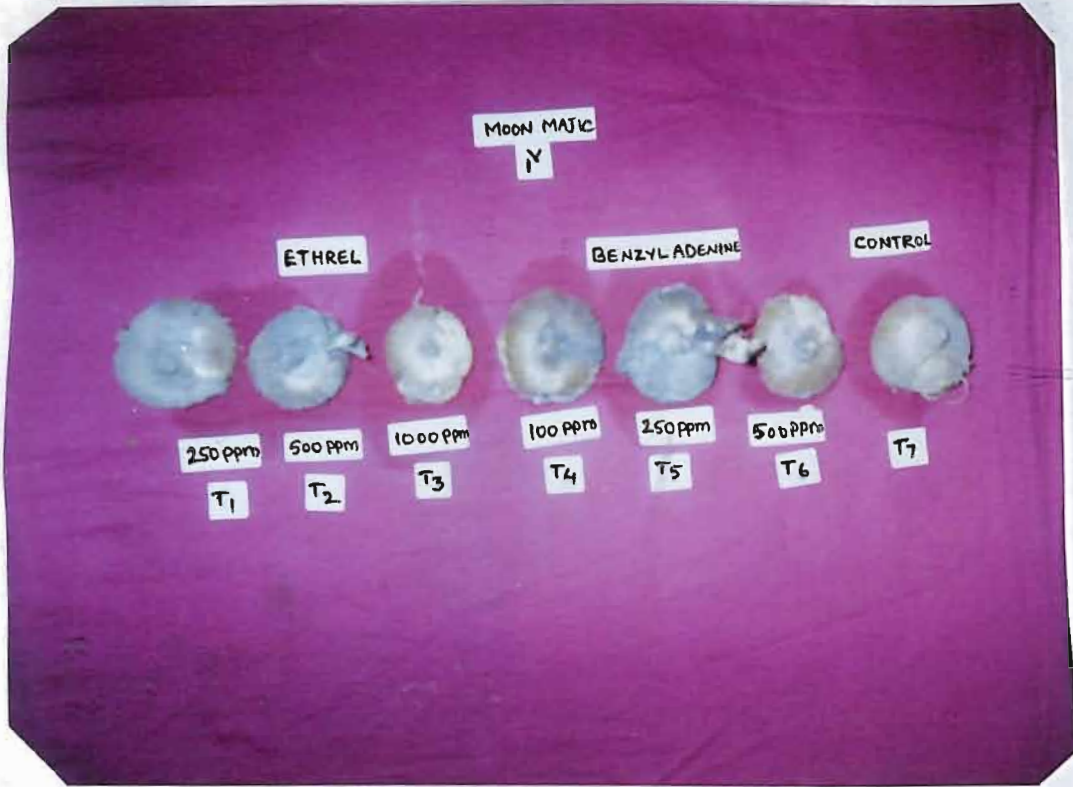


Plate 1: Effect of plant growth regulators on corm size in variety Moon Magic (V₁)

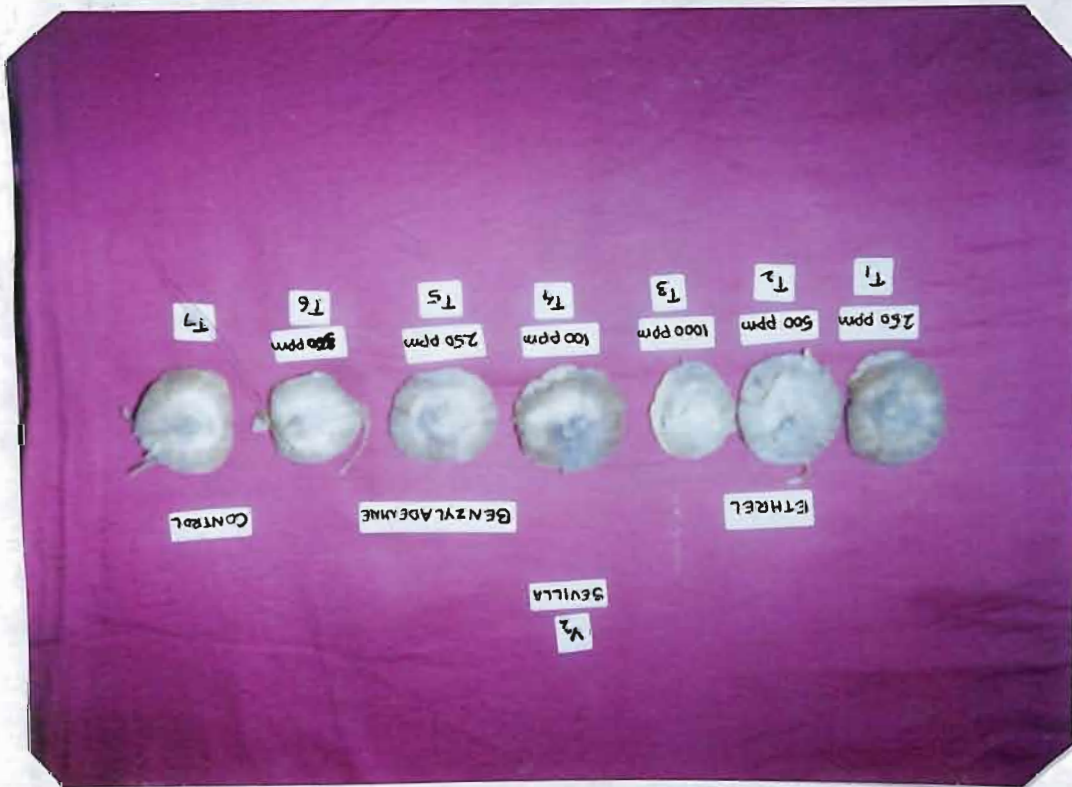


Plate 2: Effect of plant growth regulators on corm size in variety Sevilla (V₂)



Plate 3: Effect of plant growth regulators on corm size in variety Rose Supreme (V₃)



Plate 4: Effect of plant growth regulators on corm size in variety Peter Pears (V₄)

Table 7 : Effect of plant growth regulators and varieties on corm size

Treatments	Moon Majic	Sevilla	Rose Supreme	Peter Pears	Mean
Ethrel 250 ppm	3.85	3.46	3.04	3.53	3.47
Ethrel 500 ppm	3.75	3.33	2.98	3.45	3.38
Ethrel 1000 ppm	3.65	3.30	2.95	3.40	3.33
BA 100 ppm	4.82	3.83	3.45	3.95	4.01
BA 250 ppm	4.29	3.45	3.33	3.81	3.72
BA 500 ppm	4.01	3.34	3.25	3.65	3.56
Control	4.71	3.61	3.20	3.95	3.87
Mean	4.15	3.47	3.17	3.68	
S.Em ±		T = 0.078	V = 0.100	T x V = 1.263	
CD (P=0.05)		T = 0.239	V = 0.285	T x V = NS	

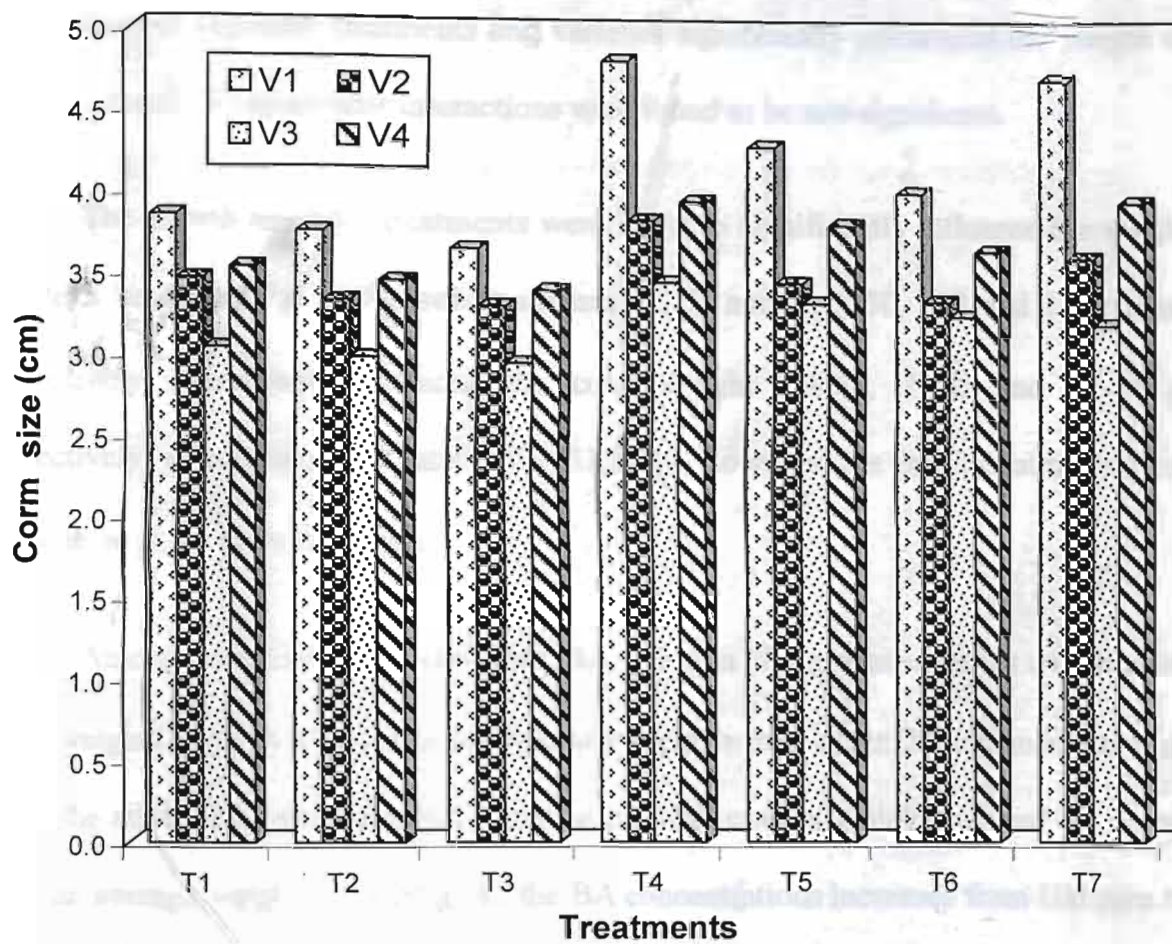


Fig. 7 : Effect of plant growth regulators and varieties on corm size

4.3.2 Corm weight (g)

Table 8 and fig. 8 shows the data pertaining to the corm weight as influenced by varieties and growth regulator treatments.

Growth regulator treatments and varieties significantly influenced the weight of corm produced. Whereas their interactions were found to be not-significant.

The growth regulator treatments were found to significantly influence the weight of corms produced. All the ethrel treatments T_1 , T_2 and T_3 (250, 500 and 1000 ppm, respectively) significantly reduced the corm weight (28.68, 27.65 and 27.45 g, respectively) as compared to control (T_0) (33.29 g). However, the ethrel treatments were found to be at par with each other.

Among benzyl adenine treatments, BA 100 ppm (T_4) produced corms with highest corm weight (34.75 g) which was significantly superior over other BA treatments as well as all the ethrel concentrations. But it was at par with control which produced the corms with an average weight of 33.29 g. As the BA concentrations increased from 100 ppm to 500 ppm the corm weight was reduced from 34.75 g to 29.07 g. However, BA 250 ppm (T_5) was found to be at par with BA 500 ppm (T_6).

Among the various treatment combinations with regard to the average corm weight produced were found to be not-significant. However, corm weight varied among the various treatment combinations. cv. Moon Majic cormels treated with BA 100 ppm produced the corm with highest weight 36.50 g, which was found to be at par with cv. Peter Pears cormels treated with BA 100 ppm (36.00 g). Lowest corm weight (26.47 gm) was recorded by cv. Sevilla cormels treated with ethrel 1000 ppm (T_3).

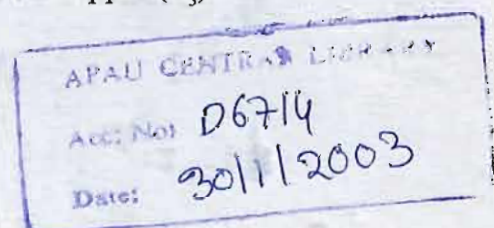


Table 8 : Effect of plant growth regulators and varieties on corm weight

Treatments	Moon Majic	Sevilla	Rose Supreme	Peter Pears	Mean
Ethrel 250 ppm	30.15	28.50	27.50	28.59	28.69
Ethrel 500 ppm	29.85	26.80	26.47	27.50	27.66
Ethrel 1000 ppm	29.80	26.01	25.90	28.10	27.45
BA 100 ppm	36.50	33.99	32.50	36.00	34.75
BA 250 ppm	32.50	30.75	28.67	31.52	30.86
BA 500 ppm	30.29	28.50	27.45	30.04	29.07
Control	35.50	32.40	31.22	34.05	33.29
Mean	32.08	29.56	28.53	30.83	
S.Em ±		T = 0.225	V = 0.347	T x V = 0.917	
CD (P=0.05)		T = 0.694	V = 0.991	T x V = NS	

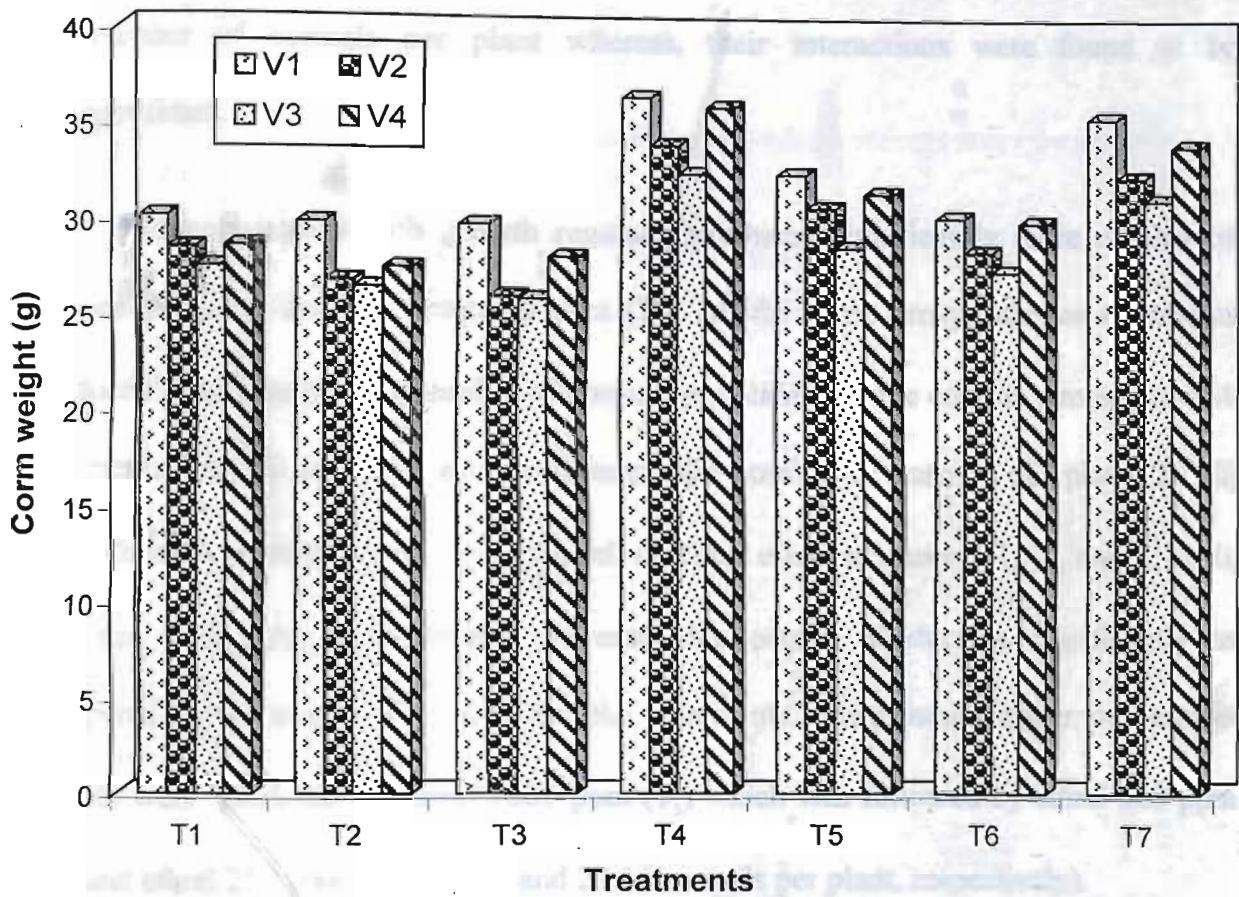


Fig. 8 : Effect of plant growth regulators and varieties on corm weight (g)

4.3.3 Number of cormels per plant

The data pertaining to the effect of growth regulators and varieties on the number of cormels per plant are presented in the table 9 and fig. 9.

Growth regulator treatments and varieties were found to significantly influence the number of cormels per plant whereas, their interactions were found to be not-significant.

Cormels treated with growth regulator produced significantly more number of cormels per plant than the untreated ones (T_7). All the three benzyl adenine treatments produced significantly more number of cormels per plant than the control. Among the BA treatments BA 500 ppm (T_6) produced maximum number of cormels per plant (22.50) than other BA concentrations. However, all the three ethrel treatments T_1 , T_2 and T_3 (250, 500 and 1000 ppm, respectively) increased the cormel production significantly as compared to the control (T_7) and the BA treatments. Maximum number of cormels (26.36) were produced in ethrel 1000 ppm (T_3) which was followed by ethrel 500 ppm (T_2) and ethrel 250 ppm (T_1) (23.71 and 22.16 cormels per plant, respectively).

In general, ethrel treated cormels produced 9.25 more than control, whereas BA treated cormels produced 6.07 cormels per plant more than the control.

The interactions between growth regulator treatments and varieties were found to be not-significant with respect to number of cormels per plant produced. However, variations were found in cormel production among various treatment combinations.

Table 9 : Effect of plant growth regulators and varieties on number of cormels per plant

Treatments	Moon Majic	Sevilla	Rose Supreme	Peter Pears	Mean
Ethrel 250 ppm	16.25	21.72	30.10	20.56	22.16
Ethrel 500 ppm	16.79	23.56	32.37	22.13	23.71
Ethrel 1000 ppm	17.56	27.37	35.68	24.83	26.36
BA 100 ppm	13.51	18.90	26.77	17.37	19.14
BA 250 ppm	15.17	20.97	28.56	19.10	20.95
BA 500 ppm	16.59	22.68	30.37	20.34	22.50
Control	9.56	13.72	22.51	13.37	14.79
Mean	15.06	21.27	29.48	19.67	
S.Em \pm		T = 0.191	V = 0.356	T x V = 0.943	
CD (P=0.05)		T = 0.589	V = 1.018	T x V = NS	

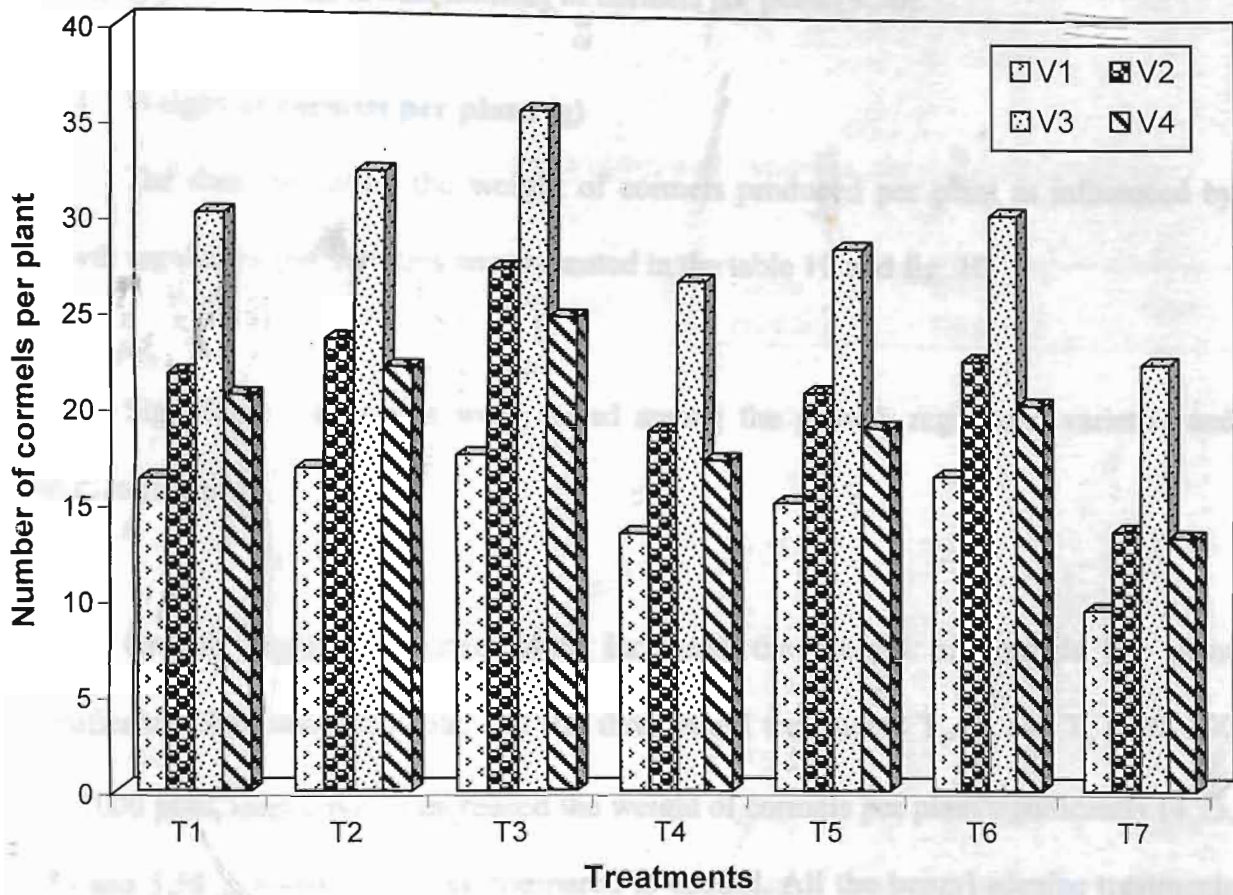


Fig. 9 : Effect of plant growth regulators and varieties on number of cormels per plant

Maximum number of cormels per plant (35.68) were produced by the cv. Rose Supreme treated with ethrel 1000 ppm (T_3). cv. Moon Majic without any chemical treatment produced the lowest number of cormels per plant (9.56).

4.3.4 Weight of cormels per plant (g)

The data indicating the weight of cormels produced per plant as influenced by growth regulators and varieties are presented in the table 10 and fig. 10.

Significant differences were found among the growth regulators, varieties and their interactions.

Growth regulator treated plots increased the weight of cormels per plant significantly than untreated lots. All the three ethrel treatments T_1 , T_2 and T_3 (250, 500 and 1000 ppm, respectively) increased the weight of cormels per plant significantly (4.75, 4.89 and 5.55 g, respectively) as compared to control. All the benzyl adenine treatments T_4 , T_5 and T_6 (100, 250 and 500 ppm) reduced the cormels weight significantly (2.77, 2.53 and 2.28 g, respectively) than control.

In general, the weight of cormels per plant was significantly increased with ethrel treatments, whereas benzyl adenine treatments decreased weight of cormels per plant significantly than control.

Table 10 : Effect of plant growth regulators and varieties on weight of cormels per plant

Treatments	Moon Majic	Sevilla	Rose Supreme	Peter Pears	Mean
Ethrel 250 ppm	2.41	5.43	7.95	3.21	4.75
Ethrel 500 ppm	2.63	5.46	8.07	3.39	4.89
Ethrel 1000 ppm	3.03	7.10	8.15	3.91	5.55
BA 100 ppm	1.83	2.99	4.21	2.05	2.77
BA 250 ppm	1.64	2.91	3.85	1.73	2.53
BA 500 ppm	1.35	2.54	3.67	1.57	2.28
Control	2.03	3.55	4.85	2.51	3.24
Mean	2.13	4.28	5.82	2.62	
S.Em ±		T = 0.095	V = 0.149	T x V = 0.395	
CD (P=0.05)		T = 0.293	V = 0.427	T x V = 1.129	

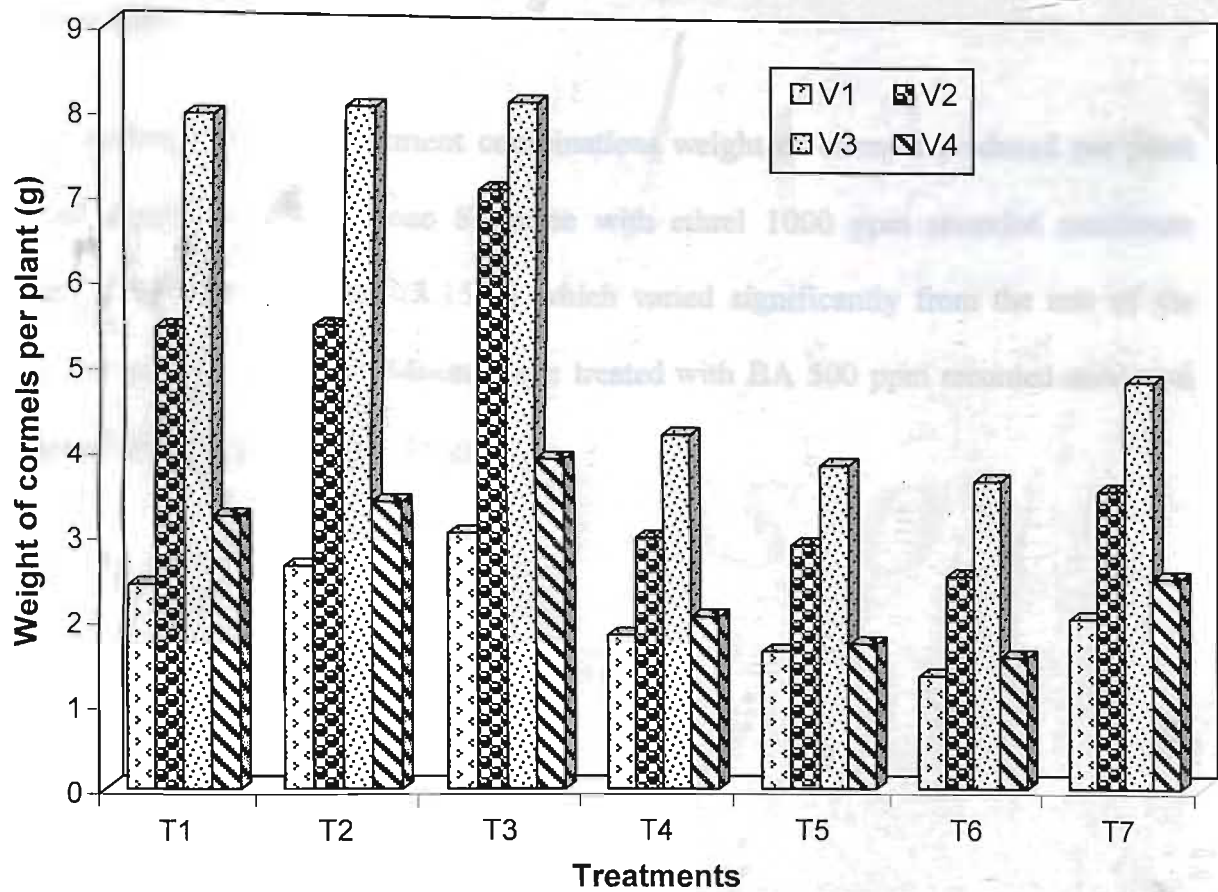


Fig. 10 : Effect of plant growth regulators and varieties on weight of cormels per plant (g)

Varietal influence was significant on the weight of cormels per plant produced. Varieties differed significantly with respect to the weight of cormels produced per plant. Among varieties, cv. Rose Supreme produced cormels of maximum average weight (5.82 g), than rest of varieties. Minimum weight of cormels per plant (2.62 g) was recorded in cv. Peter Pears.

Among different treatment combinations weight of cormels produced per plant differed significantly. cv. Rose Supreme with ethrel 1000 ppm recorded maximum weight of cormels per plant (8.15 g) which varied significantly from the rest of the treatment combinations. Cv. Moon Majic treated with BA 500 ppm recorded minimum weight of cormels per plant (1.35 g).

DISCUSSION

DISCUSSION

The major hindrance in commercial cultivation of gladiolus is that it does not have a regular supply of flowering stems in the market. The stems and corms have to pass through a dormancy period which varies from 10 to 12 weeks depending on the environmental conditions. Epiphyse inhibits the growth of the stems and corms and the control of dormancy in gladiolus (Tschermak and Tschermak, 1961). The inhibitors present in the corms of growing plants pass to the stems and corms during their growth and gradually decrease after passage of time and thus the activities of GA and auxin like substances are reduced. Stem corm production increases and growth inhibitors like ABA activity decreases (Kumar, 1959 and 1960). Results obtained from the present study are discussed in the following paragraphs.

SPROUTING PARAMETERS

A close period of the present investigation showed that the sprouting parameters significantly increase when the corms are treated with GA. The results are discussed in the following paragraphs.

CHAPTER V

DISCUSSION

The effect of plant growth regulators on breaking the cormel dormancy and growth of gladiolus was investigated under field conditions during winter season, 1999-2000. The results obtained from the experiments which were presented in the results chapter are discussed hereunder :

One of the major hindrances in commercial cultivation of gladiolus is that, it cannot be grown year round for regular supply of flowers and corms to the markets. As cormels and corms have to pass through a dormant/rest period which varies from few weeks to several months depending upon the cultivar, size and grade of the cormels, corm and the environmental conditions. Balance between the growth promoters and inhibitors play an important role in the control of dormancy in gladiolus (Tsukamoto and Asahira, 1956). The inhibitors content in the corms of growing plants will be low, but it increases at harvesting time reaching a maximum. It gradually decreases after passage of storage period and then the activities of GA and auxin like substances are resumed, while ethylene production increases and growth inhibitors like ABA activity decreases (Tsukamoto, 1959 and 1960). Results obtained from the present study are discussed in this chapter under three subheads. 1) sprouting parameters 2) growth parameters and 3) yield parameters.

5.1 SPROUTING PARAMETERS

A close perusal of the data set out in table 1 showed that the cv. Moon Majic took significantly minimum number of days for 50 and 100 per cent sprouting. Whereas the

cv. Rose Supreme took maximum number of days for 50 and 100 per cent sprouting. This indicated that number of days for sprouting is a varietal character. These findings are in conformity with the findings of Ginzburg (1973) and Suh and Kwack (1990) who had concluded that the varieties differ with respect to the number of days taken for sprouting.

The present investigation revealed that a significant influence of plant growth regulators especially benzyl adenine at various concentrations on number of days taken for 50 and 100 per cent sprouting in gladiolus cormels of all the varieties was noticed. From the results obtained we could observe that preplanting cormel treatment with BA reduced the number of days taken for 50 per cent and 100 per cent sprouting when compared to the control. Among the BA concentrations, BA 100 ppm was found to be best in reducing the number of days taken for 50 per cent and 100 per cent sprouting.

All the ethrel concentrations reduced number of days for 50 and 100 per cent sprouting as compared to control. Among the ethrel treatments, ethrel at lower concentration 250 ppm was found to be better in advancing 50 and 100 per cent sprouting as compared to control.

Ethrel is an ethylene releasing compound. With the preplanting treatment of cormels by ethrel there will be an increase in ethylene production, which might have enhanced the release of dormancy followed by bud elongation. Thus ethrel could break the dormancy and enhance early sprouting (Vacha and Harvey, 1927).

The early sprouting can be attributed to the counteraction of ABA a major growth inhibitor reported to be present in the cormels of gladiolus by BA. BA an analogue of kinetin is the only growth regulator capable of effectively reducing dormancy in gladiolus cormels. There will be an increase in ethylene production as a result of benzyl adenine treatment, this increase will be preceding step to dormancy breaking followed by bud elongation. Thus, it is evident that BA could be enhancing sprouting through increased endogenous ethylene production (Ginzburg, 1973 and Konoshima *et al.*, 1973).

The above results are in conformity with those reported by several workers that growth regulators play major role in release of dormancy and inducing early sprouting in gladiolus corms and cormels. Favourable effect of ethylene treatments on early sprouting and induced dormancy release had been reported in different gladiolus varieties Deboneir (Jayaselan, 1981), New Moon (Mukhamed, 1985), Red beauty (Suh, 1989) and Novalux, Spic and Span (Suh and Kwack, 1990).

Similarly effect of BA on early sprouting and dormancy release had been reported in different varieties of gladiolus viz., Texas, Friendship, Spic and Span, Silver Horn and Grog (Ginzburg, 1973), Scarlet (Pandey and Gaur, 1980) and Tropic Sea (Pal and Chowdhury, 1998).

5.2 GROWTH PARAMETERS

The data presented in the tables 3 to 6 revealed that growth parameters like plant height, number of leaves, leaf area and leaf area index significantly differed among the varieties. Cv. Rose Supreme was found to be significantly superior in growth characters like plant height and cv. Moon Majic recorded maximum leaf area and leaf area index

than rest of the varieties, whereas cv. Peter Pears recorded the lowest values for plant height and cv. Rose Supreme recorded lowest values for leaf area and leaf area index. The above observations clearly indicates that the varietal characteristics which are genetically controlled.

The plant height increased significantly at 30, 60 and 90 days after sprouting in growth regulator treated cormels.

Pre planting cormel treatment of gladiolus cormels with ethrel at higher concentration (1000 ppm) significantly increased the plant height. The above results are on same lines as those reported by Mukhopadhyay and Bankar (1981), Jayaselan (1981) and Devendra and Nagda (1999) while they were experimenting with ethrel on gladiolus and other bulbous crops.

Among the growth regulator treatments BA at different concentrations significantly increased plant height as compared to control. Jayaselan (1981), EL-Rahman *et al.* (1985), Murali (1988) and, Pal and Chowdhury (1998) who also reported a significant improvement in plant height as result of soaking of gladiolus corms in BA.

The data presented in table 4 revealed that preplanting cormel treatment with BA and ethrel did not significantly influence the number of leaves produced, indicating that number of leaves is a varietal characters. But preplanting cormel treatment with BA at all three concentrations and ethrel at lower concentration (250 ppm) significantly increased the leaf area and leaf area index at 30, 60 and 90 days after sprouting. Murali (1988) and,

Pal and Chowdhury (1998) also found that gladiolus corms treated with BA and ethrel treatment increased leaf area but it did not influence the number of leaves produced. Similar results were also reported by Hammond (1979) and Han *et al.* (1989) in potato and *Triteleia laxa*, respectively. In the present study there was significant increase in leaf area and leaf area index due to BA and ethrel treatment which could be attributed to the increased leaf size mainly in terms of increased leaf length and leaf breadth.

5.3 YIELD PARAMETERS

As far as yield of gladiolus corm and cormels is concerned, it is a highly complex character, which are determined by various corm and cormel yield attributes like, size of corm, corm weight, number of cormels per plant and weight of cormels per plant. The present investigation has revealed the effects of plant growth regulators in determining the yield attributes by preplanting treatments of freshly harvested dormant cormels. Also significant varietal influence was observed which is evident from the tables 7 to 10 that there was a significant varietal influence on yield parameters like size of corm, weight of corm, number of cormels per plant and weight of cormels per plant.

Results from the present investigation showed that corm and cormel yield per plant varied significantly with ethrel treatment as compared to control. Increase in number of cormels and weight of cormels per plant varied significantly with ethrel treatments as against untreated cormels. With ethrel treatments there was an increase in the average number of cormels per plant and average weight of cormels per plant with a reduction in corm size and corm weight. Corm size and average corm weight per plant varied significantly with BA preplanting cormel treatments as compared to control.

However, the average number of cormels increased significantly whereas there was a significant reduction in cormel weight per plant.

The results obtained from the present investigation revealed that yield parameters differed significantly among the varieties. Maximum corm size and weight were observed in cv. Moon Majic that was significantly superior over other varieties. Cv. Rose Supreme produced minimum corm size and corm weight. The reason for increase or decrease of corm size and corm weight may be attributed to leaf area. As the leaf area increases, photosynthetic surface increases thus leading to increased photosynthesis and more storage of food, which in turn increased availability of photosynthates for storing in corms.

As far as preplanting cormel treatment with growth regulators are concerned, ethrel at all the three concentrations significantly reduced the average corm size and average corm weight, with increase in concentrations as against BA and also control. The above results corroborated with those reported by Halevy *et al.* (1970) who also reported reduction in corm size and corm weight with ethrel treatment. Preplanting cormel treatment with BA at higher concentrations (BA 250 ppm and 500 ppm) significantly decreased corm size and corm weight. On the other hand, BA at lower concentration (BA 50 ppm) increased corm size and corm weight.

These results of present investigation are similar with the findings of Murali (1988) and Nagaraja *et al.* (1999) in gladiolus and tuberose, respectively with BA application. This decrease in size and weight of corm with increase in concentration may be due to initiation of more lateral buds by ethrel treatment, which resulted in

increased number of cormels per plant. Among the ethrel and BA concentrations the extent of reduction in size and weight of corm was more pronounced with ethrel treatment.

The results of present investigation clearly revealed a significant effect of varieties on cormel yield per plant indicating that the cormel yield per plant is a varietal character. Cv. Rose Supreme produced maximum number of cormels per plant while cv. Moon Majic produced minimum number of cormels and weight of cormels per plant. This may be attributed to size of cormels produced. The above results are in conformity with the findings of Paswan (1985) who reported that number of cormels per plant varied in different cultivars of gladiolus.

Among the growth regulator treatments, cormel dipping in ethrel at all the three concentrations significantly increased cormel yield per plant in respect of its number and weight. These results are in confirmation with those obtained by Halevy *et al.* (1970) who reported a promotive effect of ethrel on lateral bud sprouting by breaking apical dominance, which might have increased the number of cormels in gladiolus.

Results of present investigation clearly revealed that ethrel treatments increased the cormel weight per plant which may be due to the increase in the weight of tissue of cormels produced from ethylene treated cormels. These results are in agreement with the results of Magie (1971), Mukhopadhyay and Banker (1981) and Roychowdhary *et al.* (1985). The increase in cormel yield gains support from the earlier hypothesis that ethylene causes elongation and swelling of tissues, because of which there is increase in weight of tissues (Kaldewey and Vardar, 1971).

CHAPTER VI

SUMMARY

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SUMMARY

Since a field experiment was conducted on the study of effect of plant growth regulators on dormancy and growth of gladiolus...

Department of Agriculture, Rajasthan during winter season (October 2000 to February 2001)

The experiment was laid out in split plot design with 1 applied as 1st factor and growth regulator effect and BA at 2 different concentrations as 2nd factor. The growth regulator treatment was applied at 2 different concentrations...

CHAPTER VI

SUMMARY

In commercial gladiolus cultivation, cormels are of great economic importance as demand for cormel production is increasing every year. One of the major hindrances in commercial cultivation of gladiolus is that, it cannot be grown year round for regular supplies of flowers and corms to the market. Freshly harvested cormels have to pass through a dormant/rest period, which varies, from few weeks to several months depending upon the cultivars, size and grade of the cormels and environmental condition. Therefore, storing of cormels becomes a necessity for few months before planting. So development of suitable technique for overcoming the dormancy period of corms and cormels will be of great benefit to the farmers. Among several improved techniques used in commercial cultivation, growth regulators play an important role.

Hence, a field experiment was conducted on red sandy loam soil to “Study the effect of plant growth regulators on dormancy and growth of gladiolus” at College Farm, College of Agriculture, Rajendranagar during winter season (October 2000 to February 2001).

The experiment was laid out in split plot design with 3 replications. Two different growth regulators ethrel and BA at 3 different concentrations each plus a control without any growth regulator treatment were used on 4 different varieties of gladiolus (Moon Majic, Sevilla, Rose Supreme and Peter Pears) totalling 28 treatment

combinations. The ethrel concentrations were 250, 500 and 1000 ppm and BA @ 100, 250, 500 ppm was used for this study.

Data is collected for recording different growth and yield attributes such as sprouting parameters, growth parameters and yield parameters.

Since BA is known for breaking dormancy BA 100 ppm treatment showed early sprouting of cormels (38.11 days) over control (70.41 days). Vegetative growth was also found superior with BA treatments. BA at 250 ppm resulted an increase in plant height. However, ethrel treatments exhibited suppressive effect on vegetative growth and recorded more number of days to 100 per cent sprouting as against BA treatments.

Among the yield parameters like corm size, corm weight, cormel number per plant and cormel weight per plant, corm size and average corm weight characteristics were superior (4.01 cm) with BA 100 ppm, when compared with ethrel (more size 3.497 cm) @ 250 ppm and control (3.87 cm), where as with respect to cormel yield, ethrel 1000 ppm produced maximum number of cormels per plant (26.36) and maximum average cormel weight per plant (5.55 g).

Among the varieties Moon Majic was found superior with respect to number of days for sprouting (44.39 days), number of leaves per plant (6.37), leaf area per plant (296.54 cm), corm size (4.71 cm), corm weight (35.50 gm), whereas cv. Rose Supreme was found to be superior with respect to height of the plant, number of cormels and average weight of cormels.

Practical utilities

Practical utilities of the present investigations are listed hereunder.

1. Moon Majic took minimum number of days for 50 and 100 per cent sprouting which could be recommended as early sprouting variety.
2. Since preplanting treatment with BA at 100 ppm recorded significantly earlier sprouting in all the varieties, it can be recommended for using as preplanting corm and cormel treatment to induce early sprouting.
3. Since BA 100 ppm recorded maximum average size and weight of corms, it can be recommended to produce larger sized corms.
4. With respect to multiplication of planting material (cormels) ethrel 1000 ppm was found superior. Hence, it can be recommended for production of more cormel yield per plant.

III

*LITERATURE
CITED*

LITERATURE CITED

- Anonymous 1976 Hortus third A concise dictionary of plants cultivated in the United States and Canada. Macmillan Publishing Company Inc. New York pp. 511-512.
- Apte S S 1962 Dormancy and sprouting of gladiolus *Meded Landbhogesch.* Wageningen 62(5) : 1-47.
- Ayub R A, Furiatti R S, Pereira A B, Reghin M Y, Banzatto D A and Oliviera A V-de 1999 Effect of gibberellic acid, carbon disulfide and 2-4 chloroethyl phosphonic acid on dormancy and yield of potato tubers. *Scientia Agricola* 56(4) : 1015-1018.
- Bautista O D K and Cadiz T G 1964 Breaking the dormancy of gladiolus. *Philippines Agriculture* 48 : 288-306.
- *Bhattacharjee S K 1984 Influence of growth regulating chemicals in gladiolus. *Gartenbauwissenschaft* 49 : 103-106.
- Boonby D and Wright S T C 1962 Effects of kinetin and other plant growth regulators on starch degradation. *Nature London* 196 : 389-390.
- *Bylov V N, Raikov N I, Mukhamed D S and Ganyushkin E V 1988 The effect of physiologically active substances (PAS) on shortening the dormant period of gladioli. *Referativyi Zhurnal* 4.55.832.
- Cherry J H 1977 Hormone action in the molecular biology of plant cells ed. H. Smith, Oxford, Blackwell, Scientific Botany Monograph No. 14 : 329-364.
- Clum H H 1967 Formation of amylase in discs of bean hypocotyl. *Plant Physiology* 50 : 748-751.
- Cooke A Z and Randall D J 1968 2-Haloethanephosphonic acids as ethylene releasing agents for the induction of flowering in pineapples. *Nature London* 218 : 974.
- Devendra-Taki and Nagda C L 1999 Effect of growth regulators on growth and flower yield of tuberose cv. Single. *Scientific Horticulture* 6 : 147-150.
- *Deysson M G 1959 Action de la kinetine et de la thiokenetine sur la croissance de la lentille d'eau (*Lemma minor* L.). *Compt. Rend.* 248 : 841-843.

EL-Gamassy A M 1957 Effectiveness of chemical treatment in breaking the rest and sprouting of gladiolus corm. Annals of Agricultural Science Cairo 2(1) : 230-240.

GAMASSY HAKIM

EL-Hakim S, EL-Gamassy A M and Shedeed M R 1960 The rest period and respiration rate of winter and summer grown gladiolus corms. Ann. Agric. Sci. Cairo 5(2) : 171-180.

EL-Rahman A, Awad E and EL-Hamied A A 1985 Anatomical study on gladiolus stem apex as affected by kinetin, gibberellin, ethephon concentrations and r irradiation doses. Acta Horticulturae 167 : 177-185.

EL-Sallami I H 1997 Effect of bulb soaking on growth, flowering, bulb production and certain chemical contents in narcissus plant. Assiut Journal of Agricultural Sciences 28(1) : 37-57.

Esashi V, Cho S, Okagami N and Nagao M 1971 Effect of benzyladenine on dormancy of *Begonia evansiana* aerial tubers. Proceedings of International Seminar on Physiology of Differentiation in Plants pp. 675-679.

Evenari M, Konis E and Zirkin D 1950 The breaking of the rest period of gladiolus corms. Palestenian Journal of Botany 5 : 32-45.

Gilbertson T L, Ferris and Wilkins H F 1981 Response of *Freesia hybrida* corms to exogenous growth regulator applications. HortScience 16 : 568-570.

Ginzburg C 1973 Hormonal regulation of cormel dormancy in *Gladiolus grandiflorus*. Journal of Experimental Botany 24 : 558-566.

Ginzburg C 1974 Studies on the role of ethylene in gladiolus cormel germination. Plant Science Letter 2 : 133-138.

Ginzburg G and Ziv M 1973 Hormonal regulation of cormel formation in gladiolus stolons growth *in vitro*. Annals of Botany 37 : 219-224.

Grewal J S 1974 Manurial and agronomic problems of potatoes in India. Journal of the Indian Potato Association 1 : 29.

Guthrie 1940 Rest period requirement for potato tubers. Proceedings of American Society for Horticultural Science 41 : 189-194.

- Haggman J and Haapala H 1971 Effect of 6-benzyl aminopurine on the starch metabolism of *Stellaria media*. *Physiologia Plantarum* 24 : 548-551.
- Halevy A H, Shillo R and Simchon S 1970 Effect of 2-chloroethane phosphonic acid ethrel) on health, dormancy, flower and corm yield of gladioli. *Journal of Horticultural Science* 45 : 427-434.
- Hammond H D 1979 Growth regulation interactions on morphogenesis in *Solanum* species. *Biology and Taxonomy Solanaceae*, London pp. 359-369.
- Han S S, Halevy A H, Sachs R M and Reid M S 1989 Effect of ethylene on growth and flowering of *Triteleia lava*. *Acta Horticulturae*. 261 : 209-214.
- Han S S, Halevy A H, Sachs R M and Reid M S 1990 Enhancement of growth and flowering of *Triteleia laxa* by ethylene. *Journal of American Society for Horticulture Science* 115 : 428-486.
- *Han S S, Halevy A H, Suachs R M and Reid M S 1989 Effect of ethylene on growth and flowering of brodiaea (*Triteleia laxa*). *Flower and Nursery Report for Commercial Growers (spring)* pp. 5-6.
- Hartsema A M 1961 Influence of temperature on flower formation of bulbous and tuberous plants. W. Ruhland, ed. Springer-verlag, Berlin. *Encyclopedia of Plant Physiology* 16 : 123-167.
- Hayashi K 1974 Studies on the smoke and vapour treatment to some bulbous and cormous plant for flower forcing. III. Effects of smoke and vapour on breaking dormancy of freesia corms. *Bulletin of China. Horticultural Experimental Station* 2 : 27-40.
- Hayashi K 1977 Studies on the smoke and vapour treatment to some flowers and ornamental plants. VI. Gaseous components in smoke and its effect on breaking dormancy of Dutch iris and freesia corms. *Spring Meet. Japanese Society for Horticulture Science* pp. 364-365.
- Hemberg T 1970 The action of some cytokinins on the rest period and the contents of acid growth-inhibiting substances in potato. *Physiologia Plantarum* 23 : 850-855.
- *Imanishi H 1979 Chemical regulation of growth and flowering in potted bulbous and tuberous plants. *Nogyo Oyobi Engie* 54 : 1449-1453.

- Imanishi H 1983 Effects of exposure of bulbs to smoke and ethylene on flowering of *Narcissus tazetta* cultivar 'Grand Soeild'. *Scientia Horticulturae* 21 : 173-180.
- *Innes C 1985 The world of Iridacea, a comprehensive record, Holly Gate International Ltd., England.
- Jayaselan J 1981 Effect of presowing treatments of corms of *Gladiolus* on their sprouting, cormel development, growth and flowering. M.Sc. (Hort.) thesis, University of Agricultural Science, Bangalore.
- Jung-Wooyoon, Kim-Jung A and Park-Insook G 2000 Effect of tunic and plant growth regulators on dormancy breaking and growth of gladiolus cormel. *Journal of the Korean Society for Horticultural Science* 41(5) : 535-539.
- *Kaldeway H and Vardar Y 1971 Hormonal regulation in plant growth and development. *Proceedings of the Advanced Study Institute, Izmir* pp. 125-136.
- Kamerbeek G A Beijersbergen J C M and Schenk P K 1972 Dormancy in bulbs and corms. *Proceedings of 18th International Horticultural Congress* 5 : 233-239.
- *Kapachina V and Ivanova I 1983 Effect of some growth regulators on hyacinth propagation (*Hyacinthus orientalis* L.). *Fiziologiya na Rasteniyatu* 9 : 80-88.
- Konoshima H, Susumu Y and Tsukamoto Y 1973 Inhibitors concerned in the dormancy of the gladiolus corms. *Journal of the Japanese Society for Horticulture Science* 42 : 35-39.
- Kukuczanka K 1969 The effect of chemical and physical factors on increasing the efficiency of vegetative propagation of freesia corms. Part I. Stimulation of axillary buds. Part II. The effect of ethylene chlorhydrin. *Acta Agrobotany.* 62 : 303-342.
- *Kurz L and Kummerow J 1957 Brechung der Ruheperiode Von *Hydrocharis* durch keneti. *Naturwiss* 44 : 121.
- Magie R O 1971 Effects of ethephon and benzimidazoles on corm and cormel production by gladiolus cormels. *HortScience* 6 : 351-352.
- Masuda M and Asahira T 1978 Changes in endogenous cytokinin-like substances and growth inhibitors in freesia corms during high temperature treatment for breaking dormancy. *Scientia Horticulturae* 8 : 371-382.

- Masuda M and Asahira T 1979 Studies on the dormancy of freesia corms. V. Effect of ethylene on breaking dormancy and changes in endogenous ethylene evolution (Hort Abstr) Spring Meet. Japanese Society for Horticulture Science pp. 314-315.
- Masuda M and Asahira T 1980 Effect of ethylene on breaking dormancy of freesia corms. *Scientia Horticulturae* 13 : 85-92.
- Masuda M and Asahira T 1981 Effects of various gaseous compounds and respiratory inhibitors on breaking dormancy of freesia corms. *Scientia Horticulturae* 15 : 373-381.
- Miller C O 1956 Similarity of some kinetin and red light effects. *Plant Physiology* 31 : 318-319.
- *Mukhamed D S 1985 Shortening the dormant period in gladioli corm. *Byulleten Glavnogo Botaniches Kogo Sada* 137 : 62-64.
- Mukhopadhyay A and Bankar G J 1981 A note on effects of soaking gladiolus corms with ethrel. *The Lal-baugh Journal of the Mysore Horticultural Society* 26(2) : 10-13.
- Murali T P 1988 Pre harvest and post harvest physiology of gladiolus (*Gladiolus hortensis* L.). Ph.D. Thesis, University of Agricultural Science, Bangalore.
- Muthoo A K and Mauyra A N 1995 Effect of soaking gladiolus corms with benzyl adenine and ethrel on sprouting and growth. *Advances in Plant Sciences* 6(1) : 70-73.
- Nagaraja G S, Gowda J V N and Farooqui A A 1999 Effect of growth regulators on growth and flowering of tube rose cv. Single. *Karnataka Journal of Agricultural Sciences* 12(1-4) : 236-238.
- *Nakamura S S, Yashida and Akeyama K 1974 Studies on the dormancy of bulbs and corms II. Effect of calcium cyanamide and benzyl adenine on the corms and cormels of freesia and gladiolus. *Bull. Fac. Agr. Yamaguchi Univ.* 25 : 857-867.
- Ohkawa K 1979 Effects of gibberellins and benzyl adenine on dormancy and flowering of *Lilium speciosum*. *Scientia Horticulturae* 10 : 255-240.
- Pal R and Chowdhury T 1998 Effect of growth regulators and duration of soaking on sprouting, growth, flowering and corm yield of gladiolus cv. *Tropicsea. Horticultural Journal* 11(2) : 69-77.

- Palmer C E and Smith O E 1969 Effects of abscisic acid on elongation and kinetin induced tuberization of isolated stolons of *Solanum tuberosum*. *Plant Cell Physiology* 10 : 657-664.
- Pandey R N and Gaur B K 1980 Breaking the dormancy of gladiolus cormels by 6-benzyl adenine and ethrel (2-chloroethane phosphonic acid). *Indian Journal of Horticulture* 37 : 178-181.
- Pandey R N and Gaur B K 1982 Benzyl adenine-induced physiological changes in gladioli cormels during dormancy. *Indian Journal of Horticulture* 39 : 118-124.
- Panse V C and Sukhatme P V 1967 *Statistical Methods for Agricultural Workers*, ICAR, New Delhi.
- Paswan L 1977 Studies on the effect of time of planting of various size of cormel of gladiolus cv. Snow princes. M.Sc. (Ag.) Thesis, Punjab Agric., Univ. Ludhiana.
- Paswan L 1985 Studies on dormancy of gladiolus. Ph.D. Thesis, IARI, New Delhi.
- Perumal N K 1984 Effect of ethrel on growth, yield and sprouting behaviour of potato. *Madras Agricultural Journal* 71(2) : 115-117.
- Pratt H K and Goeschel J D 1969 Physiological roles of ethylene in plants. *Annual Review of Plant Physiology*. 20 : 541-584.
- Preeti Hatibarua, Gogoi S and Mazumder A 1997 Effect of preplant chemical treatment of bulbs on growth and flowering of tuberose (*Poliantha tuberosa*) cv. Single. *Annals of Biology, Ludhiana* 13(1) : 145-149.
- Roychoudhury N 1989 Effect of plant spacing and growth regulators on growth and flower yield of gladiolus grown under polythene tunnel. *Acta Horticulturae* 246 : 259-263.
- Roychoudhury N, Biswas J, Dhua R S and Mitra S K 1985 Effects of chemicals on germination, growth, flowering and corm yield of gladiolus. *Indian Agriculture* 20 : 215-217.
- *Sarkisyan E D, Azatyan S A and Arunozhyan E S 1975 Studies on growth stimulants in gladioli cormels. *Biologicheskii Zhurnal Armenii* 28(7) : 72-76.

- *Sestak Z, Catasky J and Jarris P G 1971 Plant photosynthetic production : Manual of Method. Ed. W. Unk, N. V. Publ. The Hague pp. 343-381.
- Suh J K 1989 Corm formation in gladiolus as influenced by dormancy breaking methods and cormels planting and corm harvesting dates (Hort. Abstracts). Journal of Korean Society for HortScience 7(1) : 158-159.
- Suh J K and Kwack B H 1990 The corm formation of gladiolus influenced by dormancy breaking methods, cormel planting and corm harvesting dates. Journal of Korean Society HortScience 31 : 294-299.
- Swaminathan K, Chauhan H B, Saini S S and Sikka L C 1976 Breaking dormancy in potatoes by vapour treatment with ethyl alcohol. Current Science 45 : 500-501.
- Tsukamoto Y 1974 Changes in endogenous regulators and dormancy in bulbous plants. Proceedings of 19th International Horticulture Congress pp. 293-306.
- Tsukamoto Y 1974 Breaking dormancy of gladiolus corms and inhibitors inducing dormancy. Acta Horticulturae 43(II) : 393-404.
- Tsukamoto Y and Asahira T 1956 Dormancy of gladiolus corms. II. On temperature treatment and the inhibiting substances. Journal of Horticultural Association, Japan 25 : 133-140.
- Tsukamoto Y 1959 Dormancy of gladiolus corms. V. Fluctuation of auxin and inhibitors contents in gladiolus corms. Journal of Horticultural Association, Japan 26 : 59-64.
- Tsukamoto Y 1960 Dormancy of gladiolus corms. VI. Effects of temperature treatments on breaking dormancy of gladiolus corms stored in a storage room and of there grown under different day length. Plant Cell Physiology 1 : 221-230.
- Tsukamoto Y, Ando T and Yazawa S 1973 Inhibitors inducing dormancy in bulbous plants. Plant Growth Substances pp. 133-141.
- Uhring H 1973 Morphological studies of flower bud initiation and development in bulbous iris stored at various temperatures. Journal of the American Society for Horticultural Science 98 : 54-61.
- Uyemura S and Imahishi H 1984 Effects of duration of exposure to ethylene on dormancy release in freesia corms. Scientia Horticulturae 22 : 383-390.

- Uyemura S and Imanishi H 1980 Effects of exposure of corms to smoke and ethylene on removing corm dormancy in freesia (Hort. Abstr.). Autumn Meet. Japanese Society for Horticultural Science pp. 332-333.
- Uyemura S and Imanishi H 1983 Effects of gaseous compounds in smoke on dormancy release in freesia corms. *Scientia Horticulturae* 20 : 91-99.
- Uyemura S and Imanishi H 1987 Changes in abscisic acid levels during dormancy release in freesia corms. *Plant Growth Regulation* 5(2) : 97-130.
- Vacha G A and Harvey R B 1927 The use of ethylene, propylene and similar compounds in breaking the rest period of tubers, bulbs, cuttings and seeds. *Plant Physiology Lancaster* 2 : 187-193.
- Vegis A 1964 Dormancy in higher plants. *Annual Review of Plant Physiology* 15 : 185-224.
- Vlahos J C 1985 Effects of GA and BA on sprouting of *Achemene longiflora* rhizomes. *Acta Horticulturae* 167 : 221-223.
- *Wang S Y 1969 Physiology of dormancy in *Lilium longiflorum* 'Ace' Thunb. Diss Abstr. B30 : 1428-1929.
- Weaver R J 1963 Use of kinetin in breaking rest in buds of *Vitis vinifera*. *Nature Lond* 198 : 207-208.
- Yue D, Imanishi H 1989 Effect of ethylene exposure on dormancy and flowering for early forcing of Dutch iris cv. Blue Magic. *Journal of Japanese Society for Horticultural Science* 57(4) : 662-667.
- Zhu X R, Matsumoto K and Shiraishi M 1989 Acceleration effect of 6 benzylaminopurine spray on the sprouting of axillary buds in satsuma (citrus unshiu Marc) trees. *Journal of Japanese Society for Horticultural Science* 57(4) : 578-574.
- *Zrust J, Mica B and Juzl M 1993 Effect of ethephon on the initiation and production of potato stolons and tubers. *Rostlinna-Vyroba* 39(11) : 1047-1056.

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Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025																																	
0	22-01	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

APPENDIX



APPENDIX - I
WEEKLY METEOROLOGICAL DATA OF A.R.I., RAJENDRANAGAR (2000-2001)

Week No.	Period	Temperature (°C)		R.H (%)		Rain fall (mm)	Rainy days	Sun shine (Hrs)	Wind speed (km/hr)	Evapo-ration (mm)
		Max.	Min.	I	II					
43	22-28 Oct	33.4	17.6	80	34	0.0	0.0	9.4	1.5	4.7
44	29-04 Nov	31.4	17.5	80	44	0.0	0.0	8.0	1.8	3.4
45	05-11	31.3	16.2	84	38	0.0	0.0	9.4	2.1	4.4
46	12-18	30.4	13.7	79	37	0.0	0.0	10.0	2.2	3.8
47	19-25	31.0	14.4	80	38	0.0	0.0	9.1	1.6	3.5
48	26-02 Dec	30.2	10.3	81	48	0.6	0.0	7.2	2.7	3.5
49	03-09	29.5	9.2	78	24	0.0	0.0	8.7	2.3	4.0
50	10-16	30.0	8.1	75	20	0.0	0.0	9.5	1.9	3.7
51	17-23	29.5	8.2	76	23	0.0	0.0	9.3	2.3	3.9
52	24-31	29.4	9.8	84	28	0.0	0.0	9.2	2.8	3.6
1	01-07 Jan	27.6	14.2	83	45	1.0	0.0	5.2	2.2	2.9
2	08-14	30.6	14.4	82	29	0.0	0.0	8.7	2.8	4.2
3	15-21	30.5	14.1	89	30	0.0	0.0	8.3	3.3	4.3
4	22-28	30.4	9.7	78	18	0.0	0.0	8.7	2.0	4.2
5	29-04 Feb	31.9	11.2	79	21	0.0	0.0	8.9	2.0	4.4
6	05-11	34.2	11.4	78	17	0.0	0.0	9.9	2.3	5.5
7	12-18	34.2	14.1	77	20	0.0	0.0	10.1	2.8	5.4
8	19-25	35.5	15.1	63	17	0.0	0.0	10.0	2.5	6.1
9	26-04 Mar	35.9	17.1	70	22	0.0	0.0	9.9	3.4	6.8

