EFFECT OF GROWTH REGULATORS ON ROOTING OF CUTTINGS AND LAYERS IN JASMINE

(*Jasminum auriculatum* Vahl.)

By

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THESIS

submitted in partial fulfilment of
the requirement for the degree

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DECLARATION

I hereby declare that the thesis entitled "Effect of growth regulators on rooting of cuttings and layers in jasmine (*Jasminum auriculatum* Vahl.)" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

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Introduction

INTRODUCTION

Jasmine, which has its home in India, spells a breath of gaiety and grandeur. The sweet scented flowers of jasmine are mainly used for personal decorations and religious offerings and of late, their values as essential oil yielding plants have been well recognised in India. There exist distinct possibilities for large scale production of planting materials of various species of jasmine in Kerala.

Jasmine is mainly propagated vegetatively through cuttage and layers. Though certain species are some what difficult to root by stem cuttings, mist propagation helps significantly for the regeneration. Horticulturists and nurserymen have resorted to the application of growth regulators for enhancing the rooting of cuttings and layers. However, the type of growth regulators, the method of their application and the most ideal concentration have to be decided by detailed experimentation under a particular agroclimatic situation. Similarly, the best season for layering also has to be standardised by systematic research trials. Such detailed investigations in jasmine were not seen to be done in Kerala. Standardisation of a suitable and easy method of vegetative propagation was therefore, considered necessary and hence the present series of studies were taken up with the following objectives:

i) To find out an easy and effective method of vegetative propagation through cuttings and layering

ii) To find out the effect of growth regulators on rooting of cuttings and layers

iii) To standardise the best season for layering under Vellanikkara condition.

Review of Literature

REVIEW OF LITERATURE

2.1 Propagation through cuttings

Cuttings can be made from almost all parts of the plant including stem, modified stem, root and even leaves. Among these, propagation through stem cuttings is one of the most important methods in ornamental shrubs as well as broad and narrow leaved deciduous and evergreen species.

2.1.1 Season of collection of cuttings

It is possible to make cuttings at any time of the year. But season of collection of cuttings has been reported to be one of the key factors determining rooting of cuttings in many plants. Purkayastha and Kumar (1970) studied the effect of season on rooting behaviour of Albizzia lucida. They took cuttings of Albizzia lucida throughout the year at monthly intervals and planted after treating with different growth regulators viz. IBA, 2, 4-D and 2, 4, 5-T and observed that cuttings treated with 10 ppm IBA rooted successfully in January and March.

Cuttings of Jasmine planted during July recorded maximum rooting compared to January, April and October when the rooting percentage was very poor (Bryzgalova, 1974).

Hardwood cuttings of *Ficus nitida* rooted best during March in the first year of study while in the next year rooting was maximum during February (Mohammed *et al*., 1975).

Yadav *et al*. (1977) also observed the effect of season on rooting percentage, number of roots produced by cuttings and root length in bougainvillea cv. 'Mahara'. The cuttings were collected and planted at monthly intervals from February to September and they obtained maximum (90 per cent) and minimum (42.5 per cent) rooting when the cuttings were planted on 15th August and 15th September respectively. Cuttings planted during July also recorded a very high percentage of rooting. However, in bougainvillea cv. 'Thimma', Singh and Motial (1979) obtained maximum rooting (65 per cent) during February under intermittent mist condition. Singh (1982) while studying the rooting behaviour of the varieties 'Mary Palmer' and 'Thimma' obtained maximum rooting during July.

Cuttings of *Ixora banduca* recorded highest rooting during October and poorest in January regardless of the treatments with indole butyric acid, indole acetic acid and naphthalene acetic acid (Singh, 1980).

Istas and Meneve (1982) studied the rooting percentage and shoot growth of cuttings of *Betula jacquemontia*, *Nothofagus antarica*, *Prunus avium* and

Prunus pandora. The cuttings of all the above species were planted at the end of May, in mid June and at the end of July and observed that the cuttings of all the species except *N. antartica* recorded highest rooting percentage when planted at the end of July where as *N. antartica* rooted best when planted at the end of May or mid June.

In *Callistemon lanceolatus* highest rooting (95 per cent) of softwood cuttings was observed during July while the semihard wood cuttings rooted best (85 per cent) during September. In both the types of cuttings, rooting was poor (60 per cent) during February (Singh and Motial, 1982).

2.1.2 Physiological stage of cuttings

2.1.2.1 Types of cuttings

Propagation through hardwood and softwood cuttings has been tried with varying degrees of success in several species of ornamental plants. In several plants cuttings are taken either from vegetative or flowering shoots, although rooting potential varied between these two types.

Bajpai and Parmar (1958) working on *Jasminum sambac* reported that hardwood cuttings gave the highest rooting percentage when treated with 400 ppm IBA.

In many species of ornamental plants, it has been reported that semihardwood cuttings give better rooting than other types of cuttings. Shanmugavelu (1960) observed 90 per cent rooting in Hibiscus rosasinensis when semihard wood cuttings were treated with 6000 ppm of IBA or NAA.

However, in Mussaenda philippica, Umali (1970) observed the superiority of hard wood cuttings in rooting compared to other types of cuttings. He observed that all the softwood and semihard wood cuttings died in about 35 days after treatment with NAA whereas hardwood cuttings treated with NAA 600 ppm recorded highest (80 per cent) rooting.

Superiority of semihard wood cuttings with respect to rooting was also observed by Bose et al. (1975) in various species of ornamentals like hibiscus, gardenia, bougainvillea, jasmine and ixora. All the above species registered better rooting (85 to 100 per cent) with semi-hard wood cuttings.

In bougainvillea, Singh and Rathore (1977) studied the rooting behaviour of hardwood (25 cm long) semihard wood (15 cm long) and softwood (15 cm long) cuttings after treating with IBA 1000 ppm. Though the softwood cuttings rooted well, the survival rate was the lowest (48 per cent) when compared to 83 per cent rooting and 54 per cent survival in hard wood cuttings. However, the superiority of softwood cuttings was reported in bougainvillea by Singh and Motial (1979) and in *Allamanda cathartica* by Singh (1980).

In *Jasminum auriculatum*, a better rooting (70 per cent) with semihard wood cuttings was reported by Jayapal *et al*. (1980) under mist condition.

2.1.3 Position of the cuttings

Variations in root production by cuttings taken from different portions of the shoots were observed by many workers. In many cases, highest rooting was observed in cuttings taken from the basal portions of the shoots. Seetharama and Mohanram (1972) reported that the basal cuttings of bougainvillea were superior and recorded 20 per cent more rooting than median and tip cuttings. Keel and Schelstraete (1981) however, recorded a better rooting with tip cuttings in two species of bougainvillea viz. *B. glabra* and *B. spectabilis*.

The superiority of apical or tip cuttings has been reported in many other ornamental species also. In a detailed study conducted by Bose *et al*. (1975) basal, mid-shoot and tip cuttings, each of 15 cm long of gardenia, hibiscus, jasmine, nyctanthes and mussaenda spp. were treated with IBA 3000 ppm and planted in sand under mist for rooting. All the above species except mussaenda recorded highest rooting with mid-shoot cuttings while tip cuttings were found to be most promising for rooting (75 per cent) in mussaenda. Jayapal *et al*. (1980) propagated three commercial species of jasmine by 5 node apical and semi hard wood cuttings. Among these, *Jasminum grandiflorum* and *Jasminum sambac* recorded a rooting percentage of 98 and 94 per cent respectively when propagated through apical cuttings where as *Jasminum auriculatum* rooted best (70 per cent) with semi hard wood cuttings. In common alder (*Alnus glutinosa*), apical cuttings rooted slightly better than basal cuttings (Kralik and Sebanek, 1983). However, with growth regulator treatments, the basal cuttings showed better response.

2.1.4 Effect of growth regulators on rooting of cuttings

2.1.4.1 Type of growth regulators

Considerable amount of work has been done to study the effect of growth regulators on rooting of cuttings in woody perennials including jasmine and other ornamental shrubs. The response of cuttings to growth regulators varied with the species, varieties and age of the cuttings. Audus (1959) stated that for rooting of cuttings, the most suitable and widely used growth regulators are IAA, IBA and NAA. Besides these, auxins like 2, 4 - dichlorophenoxy acetic acid (2, 4-D) and various chemical preparations like 'rooton', 'Hormodin' and 'seradix' are also used to a lesser extent.

El-Hakim, as early as 1954 studied the efficiency of IAA on rooting of *Jasminum sambac* and obtained better rooting when cuttings were treated with 25 ppm IAA for 24 hours. Bajpai and Parmar (1958) working on *Jasminum sambac* reported that the hard wood cuttings registered the highest rooting with 400 ppm of IAA.

The effect of IBA, NAA and intermittent mist on rooting of cuttings of *Jasminum auriculatum*, *Jasminum grandiflorum* and several cultivars of hibiscus and ixora was studied by Bose *et al.* (1972) and observed that all the above species which failed to root under ordinary conditions, rooted well under intermittent mist and treatment with IBA and NAA further increased the rooting percentage, number of roots and final survival. Bose and Mondal (1972) reported that a moderate rooting percentage could be obtained in difficult to root species of trees, shrubs and climbers under mist conditions. They also stated that further improvement in rooting could be obtained by treating with IBA and to a lesser extent with NAA each at 3000 or 6000 ppm. *Jasminum pubescens* var.

rubescens which failed to root even under mist, gave 100 per cent rooting with IBA 3000 ppm. In *Jasminum sambac*, Bryzgalova (1974) obtained an improved rooting of cuttings by treating with heteroauxin. Bose *et al.* (1975) found that leafy cuttings from the semi woody middle portions of *Jasminum auriculatum* showed better rooting (85 per cent) when treated with IBA 3000 ppm compared to other types of wood. In *Jasminum sambac* cv. 'Gundumalli' as significantly high percentage of rooting was obtained by treating with IAA 200 ppm followed by Alar 500 ppm and IBA 2000 ppm (Muthuswamy and Pappiah, 1976). Singh (1976) treated the basal end of cuttings of *Jasminum sambac* cv. 'Motia' with IBA at 1000 to 4000 ppm for 10 seconds and obtained highest percentage of rooting with 4000 ppm IBA. This was reconfirmed by another study by the same author in the year 1980 where the rooting was 97 per cent for 4000 ppm IBA. In *Jasminum sambac* cv. 'Madanban' maximum rooting (97.5 to 100 per cent) was obtained when cuttings were treated with IBA 4000 ppm in quick dip method (Singh and Motial, 1981).

Mukhopadhyay and Bose (1966) treated the cuttings taken from one year old shoots of four varieties of bougainvillea viz. 'Partha', 'Scarlet Queen', 'Mary Palmer' and 'H.C. Buck' with IBA, NAA and Seradix B_3 each at a concentration of 10 and 100 ppm and observed that the auxin treatment in general resulted in better rooting in all varieties and that IBA at all concentrations were significantly superior to NAA and Seradix B_3. Responses of the varieties were also different. The beneficial effect of IBA on rooting of cuttings in bougainvillea was also stressed by Kale and Bhujpal (1972) in the variety 'Mary Palmer' where a concentration of 1500 ppm IBA produced maximum number and length of roots. In hard wood cuttings of bougainvillea, Singh and Rathore (1977) obtained the highest rooting (83 per cent) and survival (54 per cent) by treating with 1000 ppm IBA. The bougainvillea variety 'Thimma' recorded the maximum rooting (65 per cent) when cuttings were treated with IBA at a concentration of 3000 ppm (Singh and Motial, 1979). Studies conducted at Vellanikkara in the bougainvillea cv. 'Mahara', using different growth regulators like IAA, IBA, NAA each at concentrations of 1000, 2000, 4000 and 6000 ppm and 2, 4-D at 20, 40, 60 and 80 ppm, revealed that treating the hard wood cuttings with IBA 6000 ppm produced 100 per cent rooting (Philip and Gopalakrishnan, 1981). Singh (1982) observed that in bougainvillea treating the basal end of cuttings with a combination of 100 ppm IBA and sodium hydroxide having a pH of 10.5 promoted rooting in two commercial varieties viz. 'Thimma', and 'Mary Palmer'. The rooting response of bougainvillea varieties 'Scarlet Glory', 'Jayalakshmy', 'Cherry Blossom', 'Mahara', 'Spring Festival' and 'Maharaja of Mysore' was studied under Vellanikkara condition by treating the cuttings with IBA and NAA each at concentrations of 100, 300, 750 and 1000 ppm. The results revealed that treating the basal ends of the cuttings with IBA 500 ppm solution for a period of 6 hours recorded maximum rooting both in rainy and summer seasons (Aishabi, 1985).

In Hibiscus rosasinensis, semi hard wood cuttings gave 90 per cent rooting by treating with 6000 ppm IBA or NAA (Shanmugavelu, 1960). Dipping the basal end of cuttings was found superior to soaking and dust treatments. The beneficial effect of dipping the stem cuttings of Hibiscus rosasinensis in IBA solution was also observed by Kachecheba (1975) when he got an increased number and dry weight of roots. The rooting behaviour of 10 hibiscus types was studied by Verghese (1984) under Vellanikkara conditions. The semi hard wood cuttings were treated with IAA, IBA and NAA each at concentrations of 25, 50, 75, 100, 1000, 3000, 5000, 7000 and 10,000 ppm and was observed that maximum rooting percentage, number and length of roots were obtained with NAA 3000 ppm followed by IBA 5000 ppm and IAA 10,000 ppm.

Purkayastha and Kumar (1970) studied the effect of different growth regulators viz. IBA, 2, 4-D and 2, 4, 5-T on rooting of cuttings of Albizzia lucida and observed that cuttings rooted successfully when treated with 10 ppm IBA.

Umali (1970) working on *Mussaenda philippica* reported that hard wood cuttings produced 80 per cent rooting with 600 ppm NAA. But Kumar and Vijayakumar (1984) found that in mussaenda, semi hard wood cuttings were most promising for rooting (93 per cent) especially with IBA 4000 ppm.

In *Ixora banduca*, treatment with IBA at a concentration of 2000 ppm for 15 seconds gave maximum rooting upto 97 per cent (Singh, 1977, 1980 and 1981).

Singh (1980) reported that the nature and the concentration of growth regulator to be applied varied with the maturity of wood from which cuttings were taken. He treated soft wood, semi hard wood and hard wood cuttings of *Allamanda cathartica* with IBA at 1000 to 4000 ppm for 15 seconds. In soft wood cuttings, the maximum rooting (92.5 per cent) was obtained with 2000 ppm IBA whereas semi hard wood and hard wood cuttings recorded highest rooting of 87.5 per cent with 3000 ppm IBA.

In both easy and difficult to root species of Ficus, Kumar (1982) obtained the highest rooting percentage, root number and the final survival when the cuttings were treated with 4000 ppm IBA.

2.1.4.2 Method of application of growth regulators

Williams (1943) experimented with the cuttings of certain broad leaved evergreens using commercial hormone preparations such as 'hormodin' and 'rooton' by soaking and dusting method to promote rooting of cuttings. The results of the studies indicated that the cuttings treated with solution produced higher percentage of rooting while those treated with dust produced maximum number of roots.

Audus (1959) while studying the effect of growth regulators on rooting of cuttings stated that the growth regulators could be applied in various forms such as powder, concentrated dip, dilute solution dip (soaking) or as paste and the effectiveness of these treatments often varied with plant species.

Shanmugavelu (1960) working on hibiscus reported that dipping the cuttings for 5 seconds in concentrated solutions of IBA or NAA at 6000 ppm was found to be superior to soaking and dust treatment. The beneficial effect of dipping the stem cuttings of *Hibiscus rosasinensis* in IBA solution for 5 seconds was also observed by Kachecheba (1975) where he obtained an increased number and dry weight of roots.

2.1.5 Effect of rooting media

Cuttings of many plant species root easily in a wide variety of rooting media. Long (1932) observed that rooting percentage and type of root system produced by the cuttings of difficult to root plants were highly influenced by the rooting medium. The generally recommended media for rooting of cuttings are sand, peat moss and water (Smith, 1944).

De Boer (1947) while studying the effect of rooting media on propagation of Acer by cuttings observed that a compost of two parts of peat moss and one part of sand was better than the traditional mixture containing a high proportion of sand. An open rooting medium consisting of three parts of sand and one part of rice husk was found to be most satisfactory for the propagation of Derris elliptica (Nieuwstraten, 1949).

Vermiculite and sphagnum moss also have been found to be successful media for rooting of cuttings in many ornamental plant species (Chadwick, 1949 and Creech et al., 1955). Nakasone and Bowers (1956) recorded vermiculite as the most suitable medium for rooting of cuttings of carnations, hibiscus, jasmine, passion fruit and guava under mist condition.

The hard wood and soft wood cuttings of Ilex verticillata rooted best when planted in peat and this was found to be superior to a mixture of peat and sand (Boylan and Davidson, 1975).

In *Acacia floxifolia*, Elliard and Ollerenshaw (1984) obtained 91 per cent rooting when planted in a medium of 2:1:1 sand, sphagnum peat and perlite.

2.1.6 Carbohydrate and nitrogen in relation to sprouting and rooting

There are considerable evidences in literature that the nutrition of stock plant influences to a great extent, their root and shoot development. Pearse (1943) reported that in cuttings reduced nitrogen in the stock plants increased the root formation. Hawn and Cornell (1951) while studying the rooting potential of geranium cuttings observed that low and medium levels of nitrogen resulted in higher percentage of rooting. Studies by Howard and Sykes (1966) on the rooting of hop (*Humulus lupulus*) illustrated the need for ample carbohydrate for root formation. In easy to root red variety of hibiscus approximately three times more starch was accumulated than in the difficult to root white variety (Stoltz and Hess, 1966). They also found no apparent correlation between amino acid content and the increased rooting response of red variety cuttings.

Stoltz (1968) determined all the possible factors of easy and difficult to root cultivars of chrysanthemum and reported that a higher storage level of carbohydrate was present in the stem of easily rooted type than in the difficult to root types.

Exogenous application of auxins such as IAA, IBA and NAA increased the rooting response of *Justicia gendarussa* especially when cuttings were taken from the stock plant grown in the presence of low amount of nitrogen (Basu and Ghosh, 1974). They noticed that the supply of low nitrogen to the stock plant was associated with a better root promoting effect and that high C/N ratio increased the rooting cofactor activity in tissues of stem cuttings. Rooting cofactor activity was inversely related with nitrogen supply and was the highest under low nitrogen levels.

Carbohydrate translocated from leaves undoubtedly contribute to root formation in cuttings. Kraus and Kraybill as quoted by Hartmann and Kester (1975) reported that tomato cuttings with a relatively high content of carbohydrate and low nitrogen produced many roots but only feeble shoots, while those shoots with green stem having high nitrogen and ample carbohydrate produced fewer number of roots but stronger shoots.

Studies on easy to root (*Ficus elastica* var. *decora*) and difficult to root (*Ficus elastica* var.

variegata) types of Ficus, revealed that there was a highest total reducing and non-reducing sugars, phenolic compounds and C/N ratio and lower nitrogen contents in the easy to root types, compared to difficult to root ones (Kumar, 1982).

2.1.7 Environmental factors

Environmental conditions like moisture, temperature and light have considerable influence on rooting of many species of plants. Nakasone and Bowers (1956) obtained a better rooting in hibiscus, carnation, jasmine, passion fruit and guava under intermittent mist. Kunisaki and Sagawa (1971) studied the effect of intermittent mist on rooting of Anthurium cuttings. They found that the rooting percentage and average root length were much higher under mist.

The deleterious effect of extra light on rooting of cuttings in *Hibiscus rosasinensis* and *Hibiscus schizopetalous* was demonstrated by Kachecheba (1976). Johnson and Hamilton (1977) also confirmed this result in their studies with *H. rosasinensis* cuttings.

Singh (1976) working on *Jasminum sambac* reported that the semihard wood cuttings of cv. 'Motia' rooted best (97.36 per cent) under intermittent mist conditions, particularly when treated with 4000 ppm IBA.

In *Jasminum auriculatum*, a better rooting (70 per cent) with semi hard wood cuttings was also reported by Jayapal *et al*. (1980) under mist condition.

In bogainvillea, Singh and Rathore (1977) obtained maximum rooting (91 per cent) when the cuttings were planted inside partially shaded polyethylene tents. Singh and Motial (1979) obtained the highest rooting (65 per cent) of soft wood cuttings of bogainvillea under intermittent mist condition especially when treated with 3000 ppm IBA.

The advantage of partial shade on rooting in ixora was reported by Singh (1980) under North Indian condition. Singh (1981) also reported maximum rooting in cuttings of *Ixora banduca* under intermittent mist.

Eccher (1982) propagated cuttings of different species of Ficus viz. *F. benjamina*, *F. furcata* and *F. triangularis* under intermittent mist inside a green house on heated benches maintained at 26, 28, 30 and 34°C and noted that these species recorded 100 per cent rooting respectively at 30 to 32°, 28 to 30° and 34°C.

The beneficial effect of low light intensity on the successful rooting of cuttings in *Cyclamen indicum* was reported by Lee and Kohl (1985).

2.2 Propagation through layering

The principal advantage of layering is the development of roots on a stem while it is still attached to the parent plant. Many clones which will not root easily by cuttings can be successfully propagated by layering. Application of root inducing substances in layering was found to be beneficial in various species of ornamentals although the method of application was different (Ching et al., 1956). They stated that application of the rooting substance to girdled cuts as a powder in lanolin or as a solution in 50 per cent alcohol produced successful layers in various species of ornamentals. Root formation during layering is influenced to a great extent by season and type of growth regulators. Excessively high temperatures in the upper layers of soil during the spring and summer months may reduce the moisture content and cause soil compaction, not only inhibiting rooting but injuring the shoots as well.

In hollylock (*Althea rosea*), IBA and NAA each at a concentration of 400 ppm were found better in inducing roots in air layers, compared to very higher concentrations of 2000 and 3000 ppm (Lingaraj, 1960). Raman et al. (1969) reported that among the different growth substances tried in air layering of crossandra, 'rooton' was found to be the best for producing maximum number and length of roots.

In view of preparing a package of practice for *Jasminum grandiflorum*, considerable work was done at Agricultural College and Research Institute, T.N.A.U., Coimbatore in the year 1970 and they observed that layering as well as planting of layers during the period from June to December resulted considerable success compared to other seasons.

A higher concentration of IBA (5000 ppm) was reported to be the best in rooting of air layers in *Michelia champaka* (Venkata Rajappa *et al*., 1978). In *Michelia champaka*, the beneficial effect of IBA at 5000 ppm in air layering was also stressed by Channaveerappa and Gowda (1984).

A lower concentration of IBA or NAA was reported to be the best in rooting of air layers in *Gardenia jasminoides* (Mithra *et al*., 1980). They ringed uniform vigorous terminal shoots of 1 cm in diameter and treated with IBA or NAA each at 50 to 150 ppm in lanolin paste and obtained 100 per cent rooting whereas rooting was only 55 per cent in control even after 25th day of layering. A combination of IBA and IAA was recorded to be the best treatment in the propagation of ornamental trees like *Peltophorum dubium* and *Bauhinia alba* through air laying (Misra and Majumdar, 1983). Among the different combinations tried, they found that a combination of IBA and IAA, each at 4000 ppm gave 100 per cent rooting.

In *Cassia javanica*, Tewari and Pathak (1984) observed that the air layers rooted well in July to August when treated with seradix-B in lanolin paste.

Materials and Methods

MATERIALS AND METHODS

The present series of studies were carried out in the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara during the period from August 1985 to October 1986 with an objective to standardise the vegetative propagation techniques in jasmine.

The study mainly consisted of the following two aspects:

(i) Propagation through cuttings and

(ii) Propagation through layering

3.1 Propagation through cuttings

The two cultivated species of jasmine viz. *Jasminum auriculatum* and *Jasminum grandiflorum*, maintained in the All India Coordinated Floriculture Improvement Project, Vellanikkara were made use of for the study. The cuttings were taken and planted during January 1986.

3.1.1 Preparation of nursery

Polythene bags of 20 x 15 cm size were used for planting the cuttings. The bags were filled with potting mixture consisting of FYM, sand and soil in 2:1:1 ratio and the bags were arranged in rows.

3.1.2 Preparation of cuttings

Semihard wood healthy cuttings of 15 cm long and 1.5 to 2 cm in diameter were collected from the mother plant. Cuttings were prepared by giving a flat cut in the top and a slanting cut of 1 to 2 cm just below a node in the basal portion. The leaf blades were removed carefully, keeping the petioles intact and the cuttings were made into bundles of fifty each for treating with various growth regulators.

3.1.3 Effect of growth regulators on rooting of cuttings

Two growth regulators viz. IBA and NAA each at concentrations of 2000, 3000 and 4000 ppm were used for the study during January 1986. Three hundred cuttings were treated under each of the following seven treatments. The experiment was laid out in CRD. The treatment details are furnished below:

T_0	-	Control
T_1	-	IBA 2000 ppm
T_2	-	IBA 3000 ppm
T_3	-	IBA 4000 ppm
T_4	-	NAA 2000 ppm
T_5	-	NAA 3000 ppm
T_6	-	NAA 4000 ppm

Total number of treatments = 7

One hundred and fifty cuttings from each of the above treatment were kept under mist and open condition.

3.1.4 Preparation of growth regulators

A stock solution of 4000 ppm each of NAA and IBA were prepared separately by dissolving 4 gm of the respective growth regulator in minimum quantity of alcohol and subsequently diluted with glass distilled water and made up the volume to one litre. All the treatment solutions of the required concentrations were prepared from the stock solutions by adding glass distilled water. The precipitation noticed in the prepared growth regulator solution was over come by the addition of 2 to 3 drops of N/10 sodium hydroxide as suggested by Miller (1963).

3.1.5 Treatment of cuttings with growth regulator solution

The cuttings were treated in quick dip method. The basal 4 to 5 cm of the cuttings were soaked in respective treatment solution for 5 seconds. The cuttings were then taken out and planted immediately in the centre of polythene bags filled with potting mixture. The cuttings were watered daily during the course of the experiment.

3.1.6 Effect of mist on rooting of cuttings

To study the effect of mist on rooting, the treated cuttings were planted in polythene bags kept in mist chamber (Plate I). Misting was done at one hour interval for three minutes, from 8 a.m. to 6 p.m. every day during the course of study.

3.1.7 Observations

Random samples consisting of 30 cuttings planted under open and mist conditions were uprooted from each treatment at fortnightly intervals. The following observations were made:

3.1.7.1 Percentage of rooting

The number of cuttings rooted were recorded under each treatment and percentage of rooting was worked out.

3.1.7.2 Number of leaves

The number of leaves produced by each cutting was counted and the mean number was then computed.

3.1.7.3 Number of primary branches

The number of primary branches produced by each cutting was recorded and the mean number of primary branches was then worked out.

Plate I

3.1.7.4 Length of primary branches

The length of primary branches was recorded in centimetres and the mean length was computed.

3.1.7.5 Number of roots

The mean number of roots produced by cuttings was recorded at fortnightly intervals.

3.1.7.6 Length of roots

The length of roots produced by cuttings was measured in centimetres at fortnightly intervals and the mean length was then worked out.

3.1.7.7 Fresh weight of roots

The roots were separated from the cuttings carefully and washed in tap water and finally in distilled water to remove the dirt and soil particles adhered on the root surface. Then mean fresh weight of the roots was found out using a chemical balance.

3.1.7.8 Dry matter content

The dry weight of the roots was recorded after drying them in a cross flow air oven at 70° $\pm$ 20° till constant weights were obtained.

3.1.8 Chemical analysis

3.1.8.1 Preparation of samples

Representative samples of five to six cuttings were taken from the whole lot uprooted at fortnightly intervals. Cuttings were first washed in tap water and then in distilled water and finally dried thoroughly in a hot air oven, at 70°C till constant weights were obtained. The dried material was powdered in a wiley grinding mill. Samples were analysed for total carbon and nitrogen as per the standard procedures given below.

3.1.8.2 Estimation of organic carbon

The total carbon content of the mother plant and that of the cuttings at fortnightly intervals was estimated as per the methods suggested by Jackson (1958).

3.1.8.3 Estimation of total nitrogen

Total N content of the cuttings as well as that of the mother plant was estimated by Kjeldahl digestion and distillation method (Jackson, 1958).

3.2 Propagation through layering

For layering studies, uniform plants of *Jasminum auriculatum* maintained in the All India Coordinated Floriculture Improvement Project, Vellanikkara were made use of. Layering was carried out at monthly intervals for a period of one year from August 1985.

3.2.1 Effect of growth regulators on rooting of layers

Two growth regulators viz. IBA and NAA each at concentrations of 100 and 250 ppm were tried for the study. Forty five layers were done under each of the following treatment at monthly intervals. The experiment was laid out in CRD. The details of the treatments are furnished below:

T_0	-	Control
T_1	-	IBA 100 ppm
T_2	-	IBA 100 ppm
T_3	-	NAA 100 ppm
T_4	-	NAA 250 ppm

Total number of treatments = 5

3.2.2 Preparation of growth regulator in lanolin paste

For each treatment, the required quantity of growth regulator was weighed separately and dissolved in 2 ml of alcohol. This was made into a paste with lanolin by using a mortar and pestle.

3.2.3 Layering operation

The method of layering adopted was simple layering. Horizontally spreading uniform branches were selected and a slanting cut of 2 cm long retaining the flap was made on the lower side of the stem. The growth regulator at proper concentrations mixed with lanolin paste was applied as a thin coating on the cut surface before doing layering. The branches were then bent to soil surface and the layered portion was covered with fine soil to ensure easy rooting. The layers were watered daily during summer months.

3.2.4 Observations

Random samples of 15 layers were cut at monthly interval from each treatment for the following observations:

3.2.4.1 Percentage of rooting

The number of layers rooted was recorded under each treatment and percentage of rooting was worked out.

3.2.4.2 Number of roots

The mean number of roots produced by layers was recorded at monthly intervals.

3.2.4.3 Length of roots

The length of roots produced by layers was measured in centimetre at monthly intervals and mean length was then worked out.

3.2.4.4 Fresh weight of roots

The roots were separated from the layers carefully and they were washed in tap water and finally in distilled water to remove dirt and soil particles adhered on the root surface. The mean fresh weight of the roots was found out in a chemical balance.

3.2.4.5 Dry matter content

The dry weight of the roots was recorded after drying them in a cross flow air oven at 70° $\pm$ 20°C till constant weights were obtained.

3.3 Statistical analysis

The data relating to the different aspects of propagation through cuttings and layering was statistically analysed as per the techniques described by Panse and Sukhatme (1978).

The differences among treatments with regard to percentage of rooting was tested for significance by using chi-square test. When the number of treatments was more than two, chi-square was calculated as

$$= \frac{1}{n_1 \; n_2} \sum \frac{(an_2 - a^1 n_1)^2}{a + a^1}$$

Where	=	Chi-square
a	=	the number of success under each treatment
a^1	=	the number of failure under each treatment
n_1	=	the number of success for all the treatments taken together
n_2	=	the number of failures for all the treatments taken together

When there were only two treatments, Chi-square was calculated as

$$= \frac{(|ad - bc| - n/2)^2 \, n}{(a+b)\;(c+d)\;(a+c)\;(b+d)}$$

Where a and c are the number of success under each treatment, b and d are the number of failure under each treatment and $n = a + b + c + d$

The differences among treatments with respect to quantitative characters such as number of leaves, number of primary branches, length of primary branches, number of roots, fresh weight of root and dry matter content were tested for significance using analysis of variance.

Correlation coefficient among various growth parameters with percentage of rooting was computed from the following equation:

$$r = \frac{\sum xy - \frac{\sum x \cdot \sum y}{n}}{\sqrt{\left(\sum x^2 - \frac{(\sum x)^2}{n}\right)\left(\sum y^2 - \frac{(\sum y)^2}{n}\right)}}$$

Correlation coefficient (r) was calculated for the organic carbon content, nitrogen content and C/N ratio with percentage of rootings and tested for significance.

Results

RESULTS

The results of the present series of studies on standardisation of propagation techniques in jasmine are presented in the following pages.

4.1 Propagation through cuttings

4.1.1 Effect of growth regulators and mist

The results of the experiment conducted to find out the effect of growth regulators and mist on rooting of cuttings and other characters are summarised below.

4.1.1.1 Rooting of cuttings

The two commercial species of jasmine viz. *Jasminum auriculatum* and *Jasminum grandiflorum* maintained in All India Coordinated Floriculture Improvement Project, Vellanikkara were made use of for the study during January 1986. The analysis of the data indicated that in *Jasminum auriculatum* there was no significant difference between the treatments with regard to rooting while in the case of *Jasminum grandiflorum*, the growth regulator treatments differed significantly particularly under mist condition (Tables 1 and 2). It is evident from the table that under mist, the cuttings of *Jasminum auriculatum* produced maximum rooting on 75th day when treated with

Table 1. Effect of growth regulators and mist on percentage rooting of cuttings in *Jasminum auriculatum*

Treatments	Number of cuttings sampled/ fortnight	Number of cuttings rooted					Percentage rooting				
		15DAP	30DAP	45DAP	60DAP	75DAP	15DAP	30DAP	45DAP	60DAP	75DAP
IBA 2000 ppm											
mist	30	0	1	1	2	1	0	3.33	3.33	6.67	3.33
open	30	0	1	0	0	1	0	3.33	0	0	3.33
IBA 3000 ppm											
mist	30	1	1	1	1	2	3.33	3.33	3.33	3.33	6.67
open	30	1	0	1	1	2	3.33	0	3.33	3.33	6.67
IBA 4000 ppm											
mist	30	1	4	2	1	4	3.33	13.33	6.67	3.33	13.33
open	30	0	0	0	1	0	0	0	0	3.33	0
NAA 2000 ppm											
mist	30	0	1	2	3	3	0	3.33	6.67	10.00	10.00
open	30	0	0	0	1	3	0	0	0	3.33	10.00
NAA 3000 ppm											
mist	30	0	0	0	0	4	0	0	0	0	13.33
open	30	0	0	0	0	1	0	0	0	0	3.33
NAA 4000 ppm											
mist	30	0	3	0	0	1	0	0	0	0	3.33
open	30	0	0	0	0	0	0	0	0	0	0
Control											
mist	30	0	0	1	2	2	0	0	3.33	6.67	6.67
open	30	0	0	0	0	3	0	0	0	0	10.00
				Chi-square values:			11.08	26.61*	13.25	14.07	12.71

DAP = Days after planting
* Significant at 5 per cent level of probability

Table 2. Effect of growth regulators and mist on percentage rooting of cuttings in *Jasminum grandiflorum*

Treatments	Number of cuttings sampled/ fortnight	Number of cuttings rooted					Percentage rooting				
		15DAP	30DAP	45DAP	60DAP	75DAP	15DAP	30DAP	45DAP	60DAP	75DAP
IBA 2000 ppm											
mist	30	5	6	6	2	15	16.67	20.00	20.00	6.67	50.00
open	30	0	0	0	0	1	0	0	0	0	3.33
IBA 3000 ppm											
mist	30	2	10	10	10	12	6.67	33.33	33.33	33.33	40.00
open	30	4	0	0	0	0	13.33	0	0	0	0
IBA 4000 ppm											
mist	30	0	3	5	4	6	0	10.00	16.67	13.33	20.00
open	30	3	3	3	0	0	10.00	10.00	10.00	0	0
NAA 2000 ppm											
mist	30	5	5	8	2	6	16.67	16.67	26.67	6.67	20.00
open	30	6	0	0	0	0	20.00	0	0	0	0
NAA 3000 ppm											
mist	30	10	4	2	2	2	33.33	13.33	6.67	6.67	6.67
open	30	4	0	0	0	0	13.33	0	0	0	0
NAA 4000 ppm											
mist	30	8	5	3	1	1	26.67	16.67	10.00	3.33	3.33
open	30	9	0	0	0	0	30.00	0	0	0	0
Control											
mist	30	0	10	5	6	5	0	33.33	16.67	20.00	16.67
open	30	0	1	0	0	2	0	3.33	0	0	6.67
				Chi-square values:			43.85**	54.74**	54.07**	62.58**	94.53**

DAP = Days after planting
** Significant at 1 per cent level of probability

IBA 4000 ppm and NAA 3000 ppm whereas in control rooting was only 6.67 per cent even under mist condition. However, under open condition, there was no rooting for IBA 4000 ppm and NAA 3000 ppm. It is also evident from the table that on the 15th day of planting the cuttings IBA 3000 ppm and 4000 ppm produced at least 3.33 per cent rooting while there was no rooting at all for any other treatment.

In the case of Jasminum grandiflorum under mist, maximum rooting of 50 per cent was recorded when cuttings were treated with IBA 2000 ppm followed by 40 per cent rooting in IBA 3000 ppm after 75 days of planting the cuttings. Under mist, the growth regulator treatments were found to produce rooting even on the 15th day while under control, there was no rooting at all (Plates II to VII).

The pooled analysis of the data on the effect of growth regulators on rooting of cuttings in Jasminum auriculatum indicated that all the treatments were on par with regard to rooting while in Jasminum grandiflorum there was significant difference between the treatments (Tables 3 and 4). On 15th day of planting the cuttings, NAA 4000 ppm produced maximum rooting (28.33 per cent) followed by NAA 3000 ppm (23.33 per cent) compared to control where there was

Table 3. Effect of growth regulators on percentage rooting of cuttings in *Jasminum auriculatum*

Treatments	Number of cuttings sampled/ fortnight	Number of cuttings rooted					Percentage rooting				
		15DAP	30DAP	45DAP	60DAP	75DAP	15DAP	30DAP	45DAP	60DAP	75DAP
IBA 2000 ppm	60	0	2	1	2	2	0	3.33	1.67	3.33	3.33
IBA 3000 ppm	60	2	1	2	2	4	3.33	1.67	3.33	3.33	6.67
IBA 4000 ppm	60	1	4	2	2	4	1.67	6.67	3.33	3.33	6.67
NAA 2000 ppm	60	0	1	2	4	6	0	1.67	3.33	6.67	10.00
NAA 3000 ppm	60	0	0	0	0	5	0	0	0	0	8.33
NAA 4000 ppm	60	0	3	0	0	1	0	5.00	0	0	3.33
Control	60	0	0	1	2	5	0	0	3.33	6.67	8.33
				Chi-square values:			8.73^{NS}	7.64^{NS}	4.33^{NS}	6.86^{NS}	5.22^{NS}

DAP = Days after planting
NS = Non significant

Table 4. Effect of growth regulators on percentage rooting of cuttings in *Jasminum grandiflorum*

Treatments	Number of cuttings sampled/ fortnight	Number of cuttings rooted					Percentage rooting				
		15DAP	30DAP	45DAP	60DAP	75DAP	15DAP	30DAP	45DAP	60DAP	75DAP
IBA 2000 ppm	60	5	6	6	2	16	8.33	10.00	10.00	3.33	26.67
IBA 3000 ppm	60	6	10	10	10	12	10.00	16.67	16.67	16.67	20.00
IBA 4000 ppm	60	3	6	8	4	6	5.00	10.00	13.33	6.67	10.00
NAA 2000 ppm	60	11	5	8	2	6	18.33	8.33	13.33	3.33	10.00
NAA 3000 ppm	60	14	4	2	2	2	23.33	6.67	3.33	3.33	3.33
NAA 4000 ppm	60	17	5	3	1	1	28.33	8.33	5.00	1.67	1.67
Control	60	0	11	5	6	7	0	18.33	8.33	10.00	11.67
		Chi-square values:					32.88**	7.26 NS	9.26 NS	16.86**	26.83**

DAP = Days after planting
** Significant at 1 per cent level of probability
NS = Non significant

Plate II. Effect of growth regulators on rooting of cuttings in *J. grandiflorum* (45th day of planting under mist condition)

T_0 Control

T_1 IBA 2000 ppm

T_2 NAA 2000 ppm

T_3 IBA 3000 ppm

T_4 NAA 3000 ppm

T_5 IBA 4000 ppm

T_6 NAA 4000 ppm

Plate III. Effect of growth regulators on rooting of cuttings in *J. grandiflorum* (45th day of planting under open condition)

T_0 Control

T_1 IBA 2000 ppm

T_2 NAA 2000 ppm

T_3 IBA 3000 ppm

T_4 NAA 3000 ppm

T_5 IBA 4000 ppm

T_6 NAA 4000 ppm

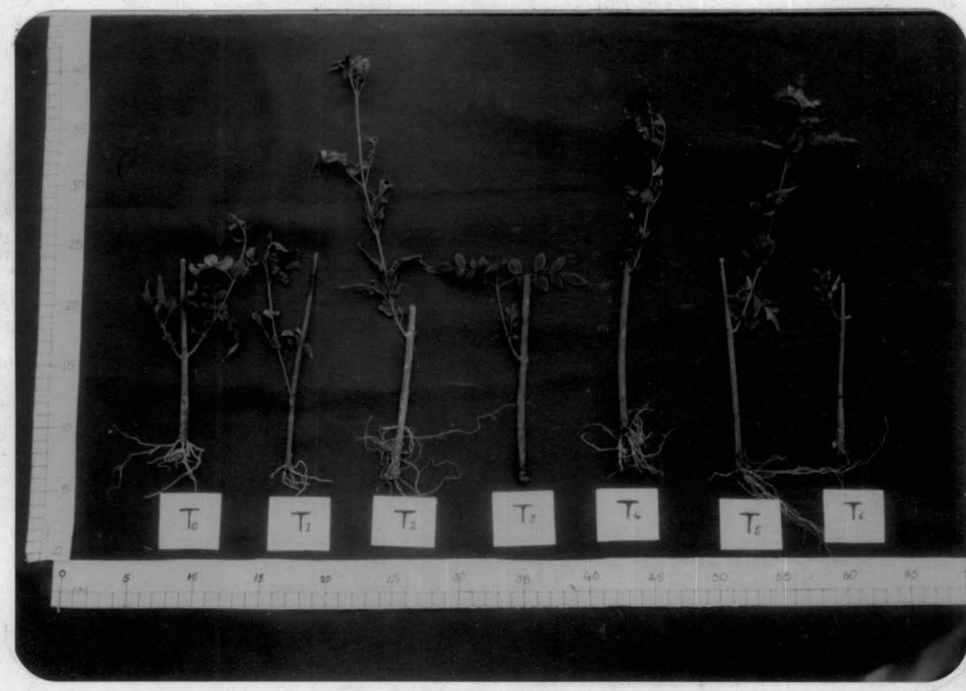


Plate II

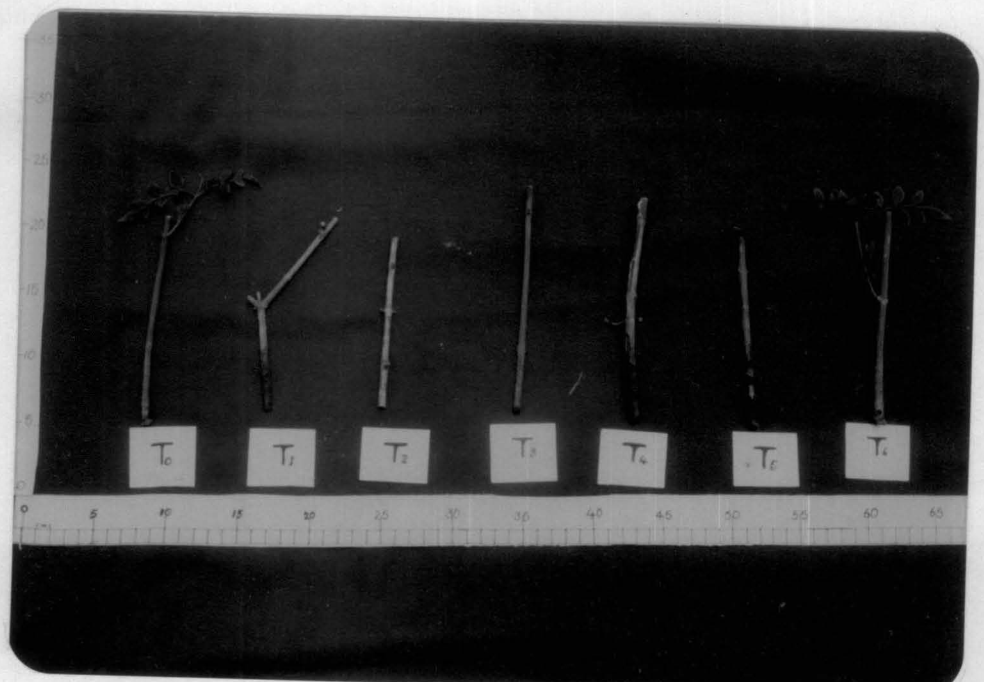


Plate III

Plate IV. Effect of growth regulators on rooting of cuttings in *J. grandiflorum* (60th day of planting under mist condition)

T_o Control

T_1 IBA 2000 ppm

T_2 NAA 2000 ppm

T_3 IBA 3000 ppm

T_4 NAA 3000 ppm

T_5 IBA 4000 ppm

T_6 NAA 4000 ppm

Plate V. Effect of growth regulators on rooting of cutting in *J. grandiflorum* (60th day of planting under open condition)

T_o Control

T_1 IBA 2000 ppm

T_2 NAA 2000 ppm

T_3 IBA 3000 ppm

T_4 NAA 3000 ppm

T_5 IBA 4000 ppm

T_6 NAA 4000 ppm

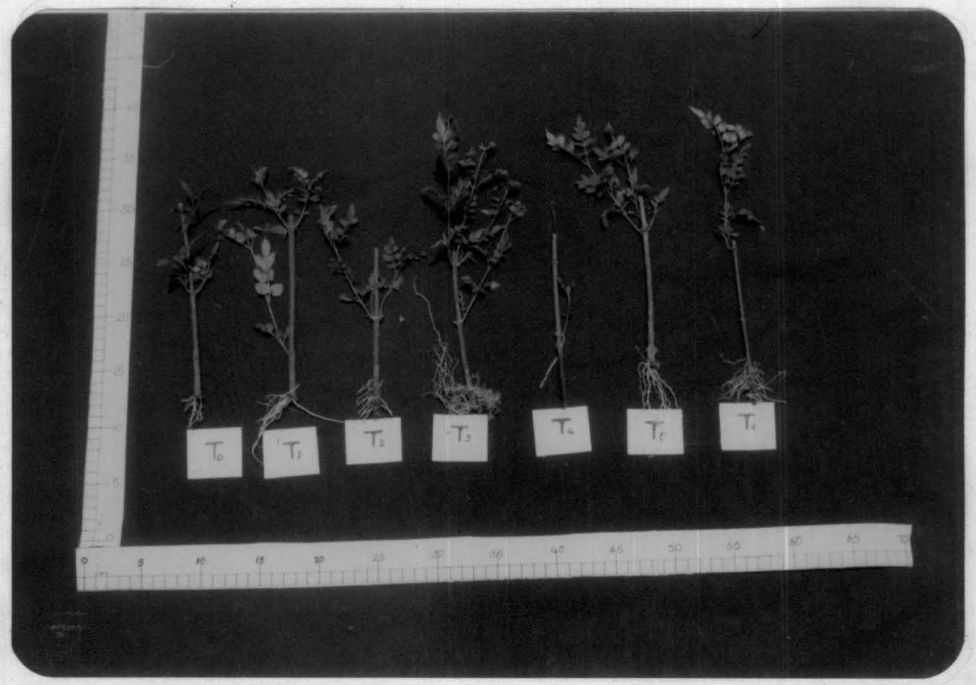


Plate IV

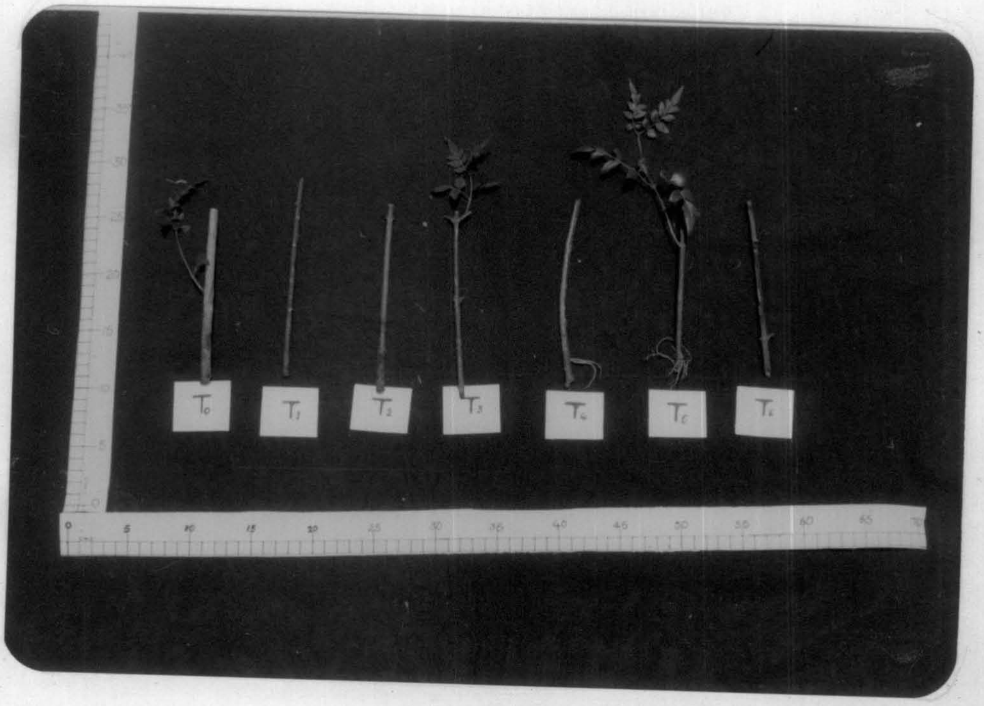


Plate V

Plate VI. Effect of growth regulators on rooting of cuttings in *J. grandiflorum* (75th day of planting under mist condition)

T_0 Control

T_1 IBA 2000 ppm

T_2 NAA 2000 ppm

T_3 IBA 3000 ppm

T_4 NAA 3000 ppm

T_5 IBA 4000 ppm

T_6 NAA 4000 ppm

Plate VII. Effect of growth regulators on rooting of cuttings in *J. grandiflorum* (75th day of planting under open condition)

T_0 Control

T_1 IBA 2000 ppm

T_2 NAA 2000 ppm

T_3 IBA 3000 ppm

T_4 NAA 3000 ppm

T_5 IBA 4000 ppm

T_6 NAA 4000 ppm

Plate VI

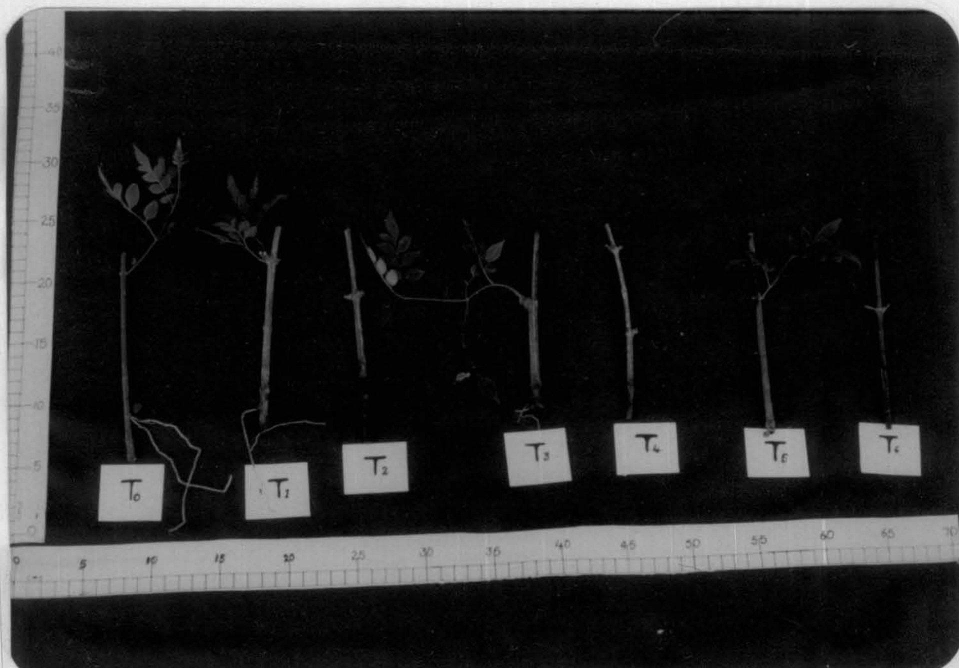


Plate VII

no rooting at all. But on the 75th day IBA 2000 ppm was found to be most superior to all other treatments.

The pooled data presented in Tables 5 and 6 clearly indicated the beneficial effect of mist on rooting of cuttings both in *Jasminum auriculatum* and *Jasminum grandiflorum*. In *Jasminum auriculatum*, even though there was no statistical difference between the treatments, cuttings under mist condition seemed to record most rooting compared to open condition throughout the period under study, while in *Jasminum grandiflorum*, mist significantly increased the rooting compared to open condition.

4.1.1.2 Number of leaves

The effect of different growth regulators and mist on the number of leaves produced by the cuttings are presented in Tables 7 to 9 and Figures 1 to 4. The statistical analysis of the data revealed that there was significant difference between different treatments. In *Jasminum auriculatum* the control treatment ranked first with regard to the mean number of leaves produced by cuttings both under open and mist condition, while in *Jasminum grandiflorum* under mist condition, the mean number of leaves produced by cuttings was maximum for the treatment with IBA 3000 ppm (11.65) while under open condition, the mean number of

Table 5. Effect of mist on percentage rooting of cuttings in *Jasminum auriculatum*

Treatments	Days after planting	Number of cuttings sampled	Number of cuttings rooted	Percentage rooting	χ^2 value
Mist	15	210	2	0.95	1.32^{NS}
Open	15	210	1	0.48	
Mist	30	210	10	4.76	5.97^{*}
Open	30	210	1	0.48	
Mist	45	210	7	3.33	3.19^{NS}
Open	45	210	1	0.48	
Mist	60	210	9	4.29	2.14^{NS}
Open	60	210	3	1.43	
Mist	75	210	17	8.10	1.42^{NS}
Open	75	210	10	4.76	

* = Significant at 5 per cent level of probability

NS = Non significant

Table 6. Effect of mist on percentage rooting of cuttings in *Jasminum grandiflorum*

Treatments	Days after planting	Number of cuttings sampled	Number of cuttings rooted	Percentage rooting	χ^2 Value
Mist	15	210	30	14.29	2.76^{NS}
Open	15	210	26	12.38	
Mist	30	210	43	20.48	34.59^{**}
Open	30	210	4	1.90	
Mist	45	210	39	18.57	32.41^{**}
Open	45	210	3	1.43	
Mist	60	210	27	12.86	26.76^{**}
Open	60	210	0	0	
Mist	75	210	47	22.38	41.98^{**}
Open	75	210	3	1.43	

** = Significant at 1 per cent level of probability

NS = Non significant

leaves was maximum (4.35) with IBA 2000 ppm. The observations recorded on 60th and 75th days also revealed the superiority of IBA at 3000 ppm in producing maximum number of leaves.

The pooled analysis of the data on the effect of growth regulators on the number of leaves produced by cuttings clearly indicated the significant difference between the treatments. In *Jasminum auriculatum*, the mean number of leaves produced by cuttings was maximum in control (6.95) followed by NAA 3000 ppm (5.71) and IBA 4000 ppm (5.61).

In *Jasminum grandiflorum*, on 60th day of planting, IBA 3000 ppm recorded maximum number of leaves. The mean number of leaves (10.25) was also significantly higher in this treatment compared to all other treatments.

In both the species mist had profound influence on the number of leaves produced by cuttings (Table 9). Cuttings of *Jasminum auriculatum* recorded a mean number of 5.96 and 5.01 leaves respectively under mist and open condition while in *Jasminum grandiflorum* the mean number under these two conditions was 9.81 and 4.00 respectively.

Table 7. Effect of growth regulators and mist on number of leaves/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
IBA 2000 ppm												
mist	5.00	8.18	6.13	5.29	6.40	6.20	5.57	9.00	8.78	9.25	16.13	9.75
open	7.00	5.38	4.00	5.20	5.17	5.35	4.75	5.00	4.00	0	8.00	4.35
IBA 3000 ppm												
mist	4.41	3.53	5.25	5.64	4.82	4.73	8.08	8.16	10.10	13.31	18.61	11.65
open	3.75	5.16	4.75	5.70	5.00	4.87	5.13	3.21	3.20	0	5.00	3.31
IBA 4000 ppm												
mist	4.57	5.65	4.94	3.86	4.17	4.64	6.71	7.89	10.13	12.14	17.13	10.80
open	3.00	5.50	4.50	4.80	0	3.56	2.60	3.78	3.60	4.00	4.00	3.60
NAA 2000 ppm												
mist	4.00	5.14	4.85	6.23	4.93	5.03	5.00	11.00	7.30	10.00	11.18	8.90
open	3.00	3.33	5.50	4.60	6.50	4.59	2.00	0	0	0	0	0.40
NAA 3000 ppm												
mist	9.00	5.61	0	5.57	8.82	5.80	4.00	0	5.00	10.00	21.00	8.00
open	0	4.30	0	0	8.67	2.59	3.00	0	0	0	0	0.60
NAA 4000 ppm												
mist	4.25	5.71	0	0	4.00	2.79	2.00	5.50	4.33	0	14.00	5.17
open	0	7.00	8.00	0	6.00	4.20	6.00	0	0	0	0	1.20
Control												
mist	6.50	7.95	6.94	8.35	9.55	7.86	8.16	8.26	8.94	7.52	10.33	8.64
open	8.00	4.54	4.88	5.50	4.56	5.50	5.00	4.75	2.77	4.00	4.60	4.22
CD	1.02	1.22	0.98	1.15	1.26		1.04	1.31	1.42	1.49	2.40	
SEm±	0.11	0.13	0.10	0.12	0.13		0.11	0.14	0.15	0.15	0.25	

DAP = Days after planting
CD = Critical difference
SEm = Standard error of mean

Table 8. Effect of growth regulators on number of leaves/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
IBA 2000 ppm	5.17	6.67	5.42	5.25	5.53	5.61	5.27	8.50	8.30	9.25	15.63	9.39
IBA 3000 ppm	4.25	3.92	5.00	5.67	4.89	4.75	6.90	6.00	7.80	13.31	17.25	10.25
IBA 4000 ppm	4.29	5.64	4.89	4.11	4.16	4.62	5.00	5.83	7.62	9.70	12.75	8.18
NAA 2000 ppm	3.80	4.60	5.00	5.78	5.40	4.92	4.00	11.00	7.30	10.00	11.18	8.50
NAA 3000 ppm	9.00	5.19	0	5.57	8.79	5.71	3.40	0	5.00	10.00	21.00	7.88
NAA 4000 ppm	4.25	5.89	8.00	0	4.67	4.56	4.00	5.50	4.33	0	14.00	5.57
Control	7.14	6.61	6.28	7.28	7.45	6.95	7.00	7.35	6.35	7.03	8.48	7.24
CD	NS	1.01	0.78	0.92	1.03		0.83	1.10	1.19	1.27	2.06	
SEm±	0.11	0.14	0.11	0.13	0.14		0.11	0.15	0.16	0.17	0.28	

DAP = Days after planting

CD = Critical difference

SEm = Standard error of mean

FIGURE. 1. EFFECT OF GROWTH REGULATORS ON NUMBER OF LEAVES/CUTTING IN *J. auriculatum*.

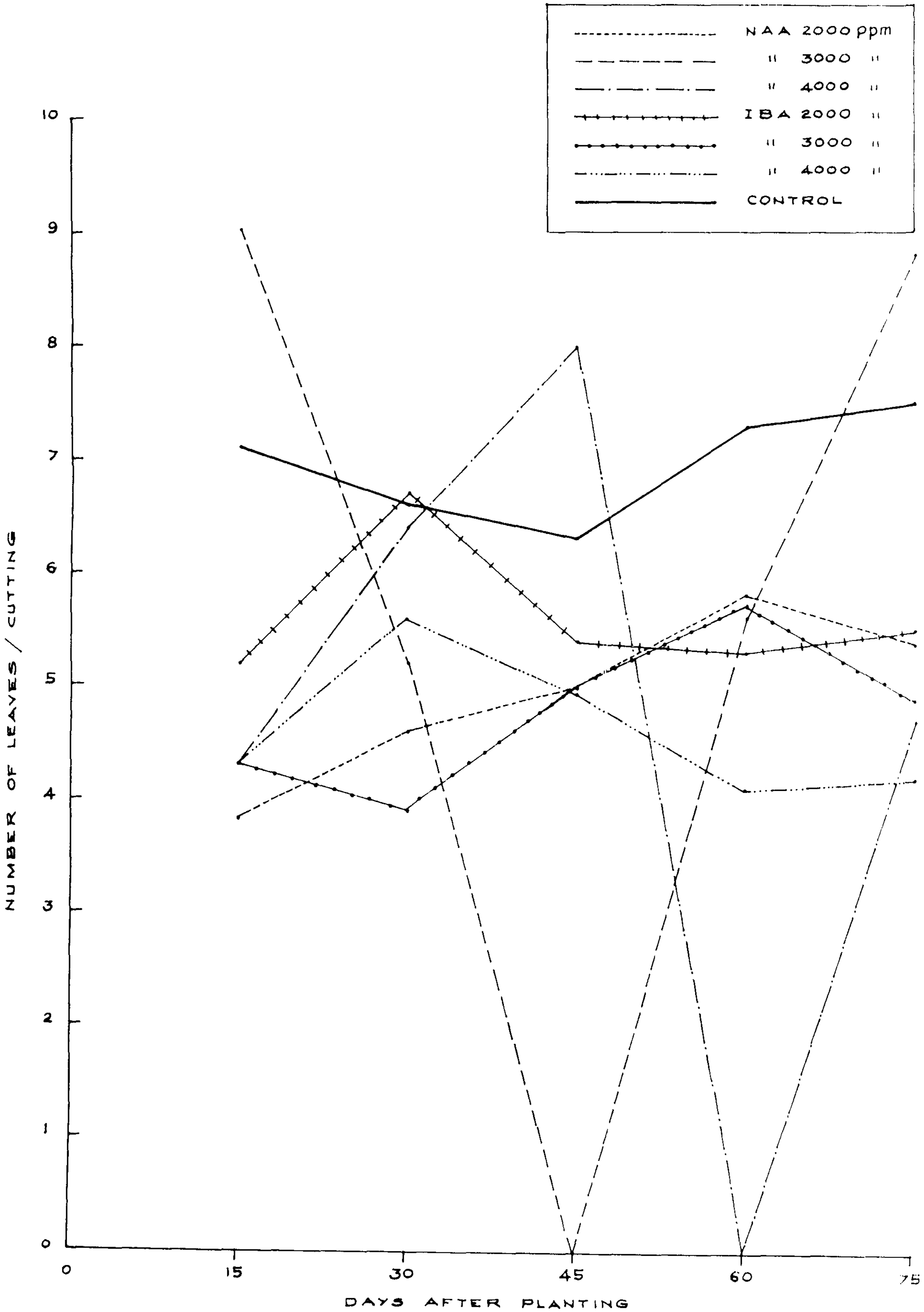


FIGURE. 2. EFFECT OF GROWTH REGULATORS ON NUMBER OF LEAVES/CUTTING IN *J. grandiflorum*.

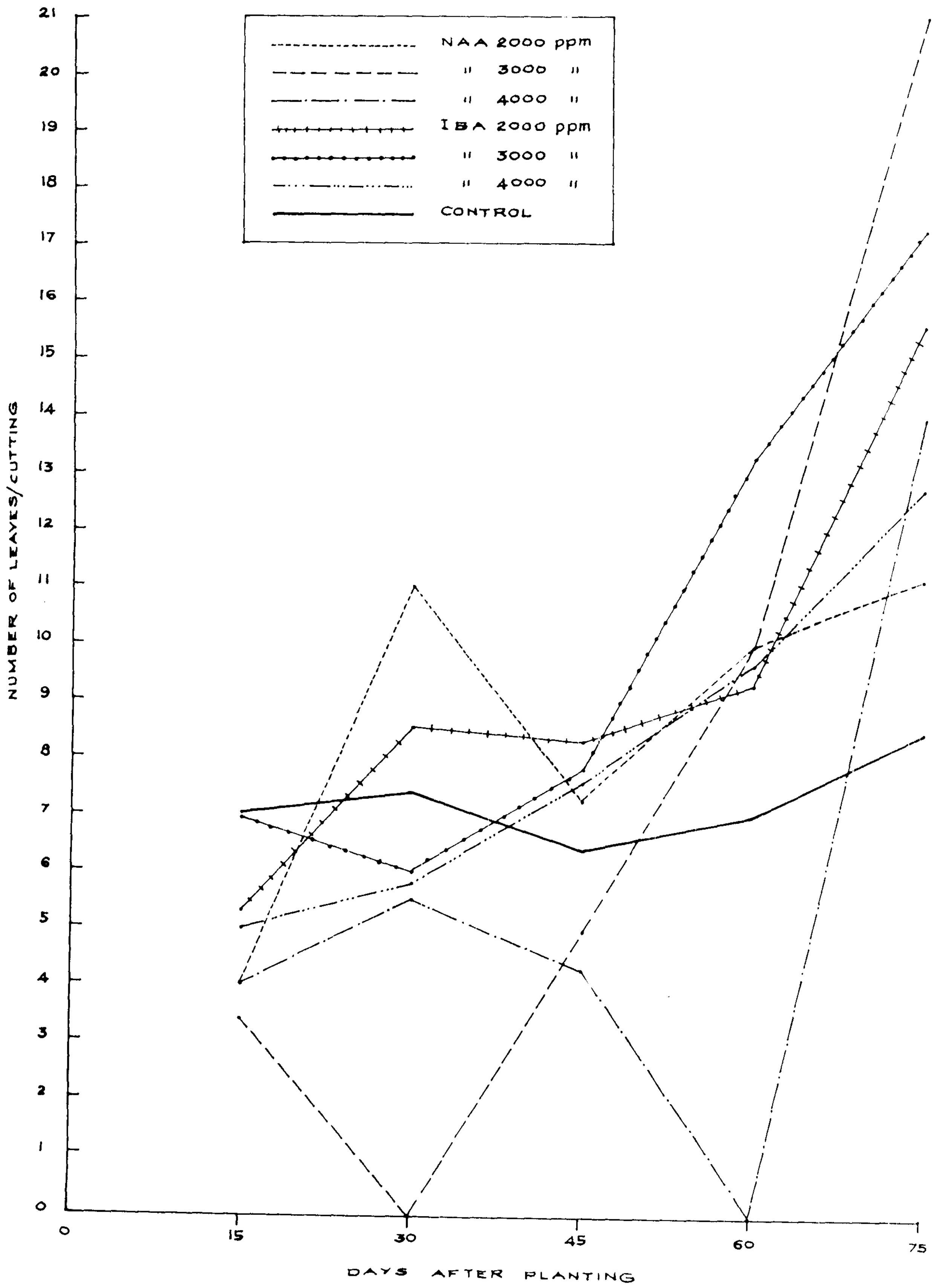


Table 9. Effect of mist on number of leaves/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
Mist	5.41	5.93	5.63	6.11	6.74	5.96	7.16	8.54	8.84	10.05	14.42	9.81
Open	4.69	4.83	4.87	5.30	5.36	5.01	4.39	3.81	3.10	4.00	4.70	4.00
CD	0.41	0.53	0.41	0.48	0.57		0.41	0.59	0.63	0.68	1.05	
SEm±	0.10	0.13	0.10	0.12	0.14		0.10	0.15	0.16	0.17	0.27	

DAP = Days after planting

CD = Critical difference

SEm = Standard error of mean

FIGURE. 3. EFFECT OF MIST ON NUMBER OF LEAVES/CUTTING IN *J. auriculatum*

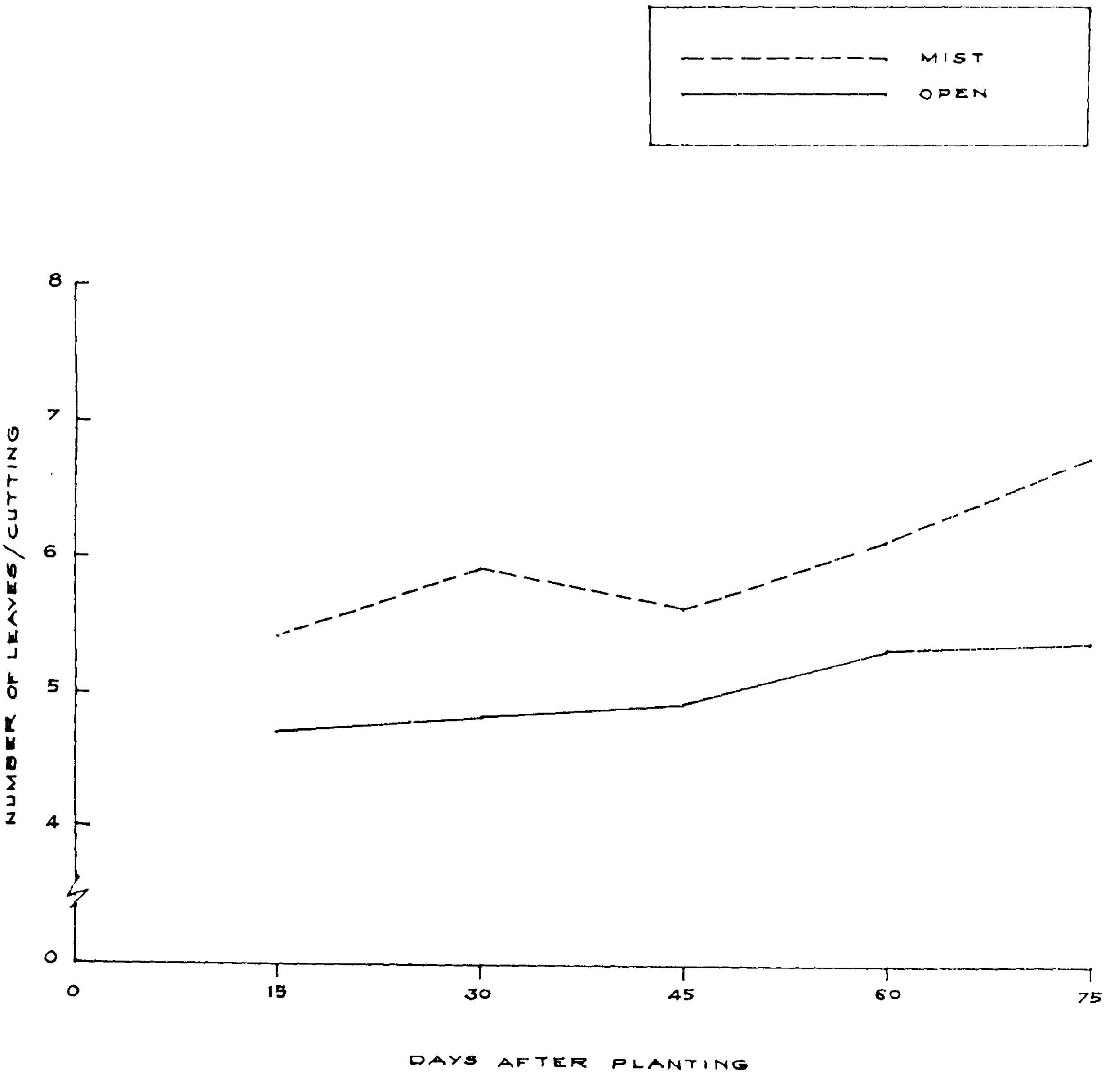
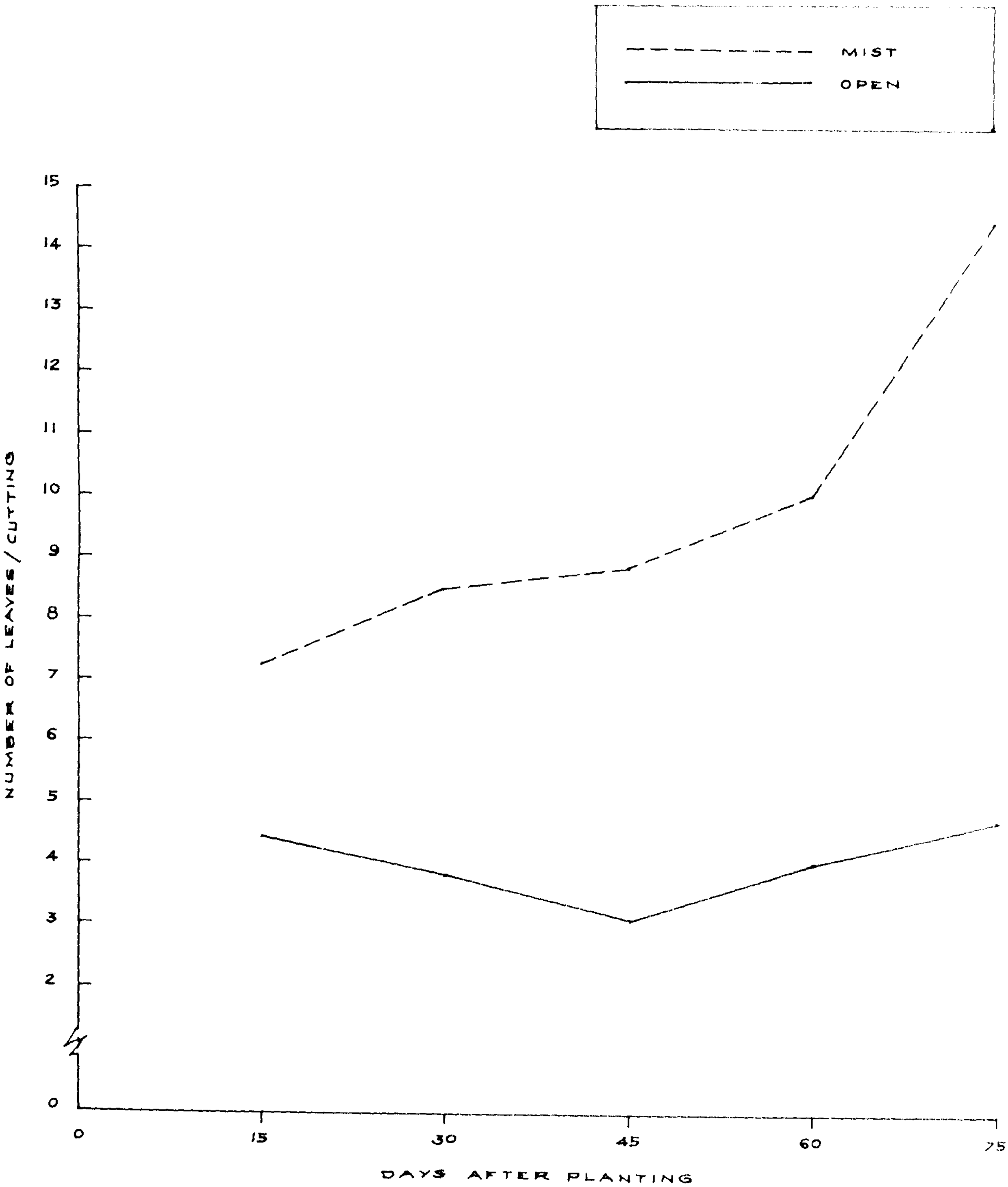


FIGURE 4. EFFECT OF MIST ON NUMBER OF LEAVES/CUTTING IN *J. grandiflorum*



4.1.1.3 Number of primary branches

The data presented in Table 10 indicated the effect of growth regulators and mist on the number of primary branches produced by cuttings. The statistical analysis of the data clearly revealed the significant difference between the treatments. In *Jasminum auriculatum*, under mist condition, the mean number of primary branches was maximum in control treatment (1.95) followed by IBA 2000 ppm (1.82) and IBA 4000 ppm (1.42). In *Jasminum grandiflorum* also, of all the treatments tried, control ranked first with regard to this parameter. Under mist condition, the mean number of primary branches produced in control was 2.23 while under open it was only 1.28.

The pooled analysis of the data to find out the effect of different growth regulators on number of primary branches produced by cutting are presented in Table 11 and Figures 5 and 6. It is evident from the table that there was significant difference between different treatments in both *Jasminum auriculatum* and *Jasminum grandiflorum*. In *Jasminum auriculatum* control treatment recorded maximum mean number of primary branches followed by IBA 2000 ppm while in *Jasminum grandiflorum*, control and treatment with IBA 3000 ppm resulted a mean number of 1.93 primary branches. However, in these two

Table 10. Effect of growth regulators and mist on number of primary branches/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
IBA 2000 ppm												
mist	1.91	1.91	1.38	1.71	2.20	1.82	2.00	1.71	1.78	2.00	1.73	1.84
open	1.00	1.23	1.50	1.60	1.25	1.32	1.25	1.00	1.00	0	2.00	1.05
IBA 3000 ppm												
mist	1.25	1.26	1.67	1.64	1.27	1.42	2.50	1.83	1.75	2.31	2.17	2.11
open	1.00	1.00	1.00	1.30	1.00	1.06	1.75	1.14	1.20	0	1.00	1.02
IBA 4000 ppm												
mist	1.64	1.30	1.53	1.21	1.25	1.39	2.43	1.56	1.63	1.71	1.25	1.72
open	1.67	1.00	1.00	1.20	0	0.97	1.00	1.33	1.00	1.33	1.00	1.13
NAA 2000 ppm												
mist	1.25	1.57	1.62	1.31	1.21	1.39	1.50	2.10	1.80	1.50	1.64	1.71
open	1.00	1.00	1.00	1.00	1.33	1.07	1.00	0	0	0	0	0.20
NAA 3000 ppm												
mist	1.91	1.28	0	1.57	2.00	1.35	1.50	0	1.00	2.00	2.50	1.40
open	0	1.22	0	0	1.33	0.57	1.33	0	0	0	0	0.27
NAA 4000 ppm												
mist	1.25	1.29	0	0	1.00	0.71	1.00	1.50	1.00	0	1.00	0.90
open	0	1.00	2.00	0	1.00	0.80	2.00	0	0	0	0	0.40
Control												
mist	2.00	1.60	1.88	2.15	2.14	1.95	2.47	2.09	2.50	2.00	2.10	2.23
open	2.00	1.15	1.00	1.25	1.13	1.38	1.73	1.50	1.08	1.00	1.10	1.28
CD	0.27	0.27	0.26	0.30	0.31		0.35	0.31	0.29	0.26	0.28	
SEm±	0.03	0.03	0.03	0.03	0.03		0.04	0.03	0.03	0.03	0.03	

DAP = Days after planting
CD = Critical difference
SEm = Standard error of mean

Table 11. Effect of growth regulators on number of primary branches/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
IBA 2000 ppm	1.83	1.54	1.33	1.67	1.53	1.58	1.73	1.63	1.70	2.00	1.75	1.76
IBA 3000 ppm	1.19	1.20	1.33	1.48	1.17	1.27	2.20	1.53	1.57	2.31	2.05	1.93
IBA 4000 ppm	1.65	1.28	1.47	1.21	1.25	1.37	1.83	1.44	1.38	1.60	1.17	1.48
NAA 2000 ppm	1.20	1.40	1.47	1.22	1.25	1.31	1.33	2.11	1.80	1.50	1.64	1.68
NAA 3000 ppm	1.91	1.26	0	1.57	1.86	1.32	1.40	0	1.00	2.00	2.50	1.38
NAA 4000 ppm	1.25	1.25	2.00	0	1.00	1.10	1.50	1.50	1.00	0	1.00	1.00
Control	2.00	1.42	1.60	1.81	1.71	1.71	2.20	1.94	1.90	1.86	1.77	1.93
CD	NS	0.23	0.22	0.24	0.25		0.27	0.25	0.24	0.24	0.25	
SEm±	0.03	0.03	0.03	0.03	0.03		0.04	0.04	0.03	0.03	0.03	

DAP = Days after planting

CD = Critical difference

SEm = Standard error of mean

FIGURE . 5. EFFECT OF GROWTH REGULATORS ON NUMBER OF PRIMARY BRANCHES/ CUTTING IN *J. auriculatum*

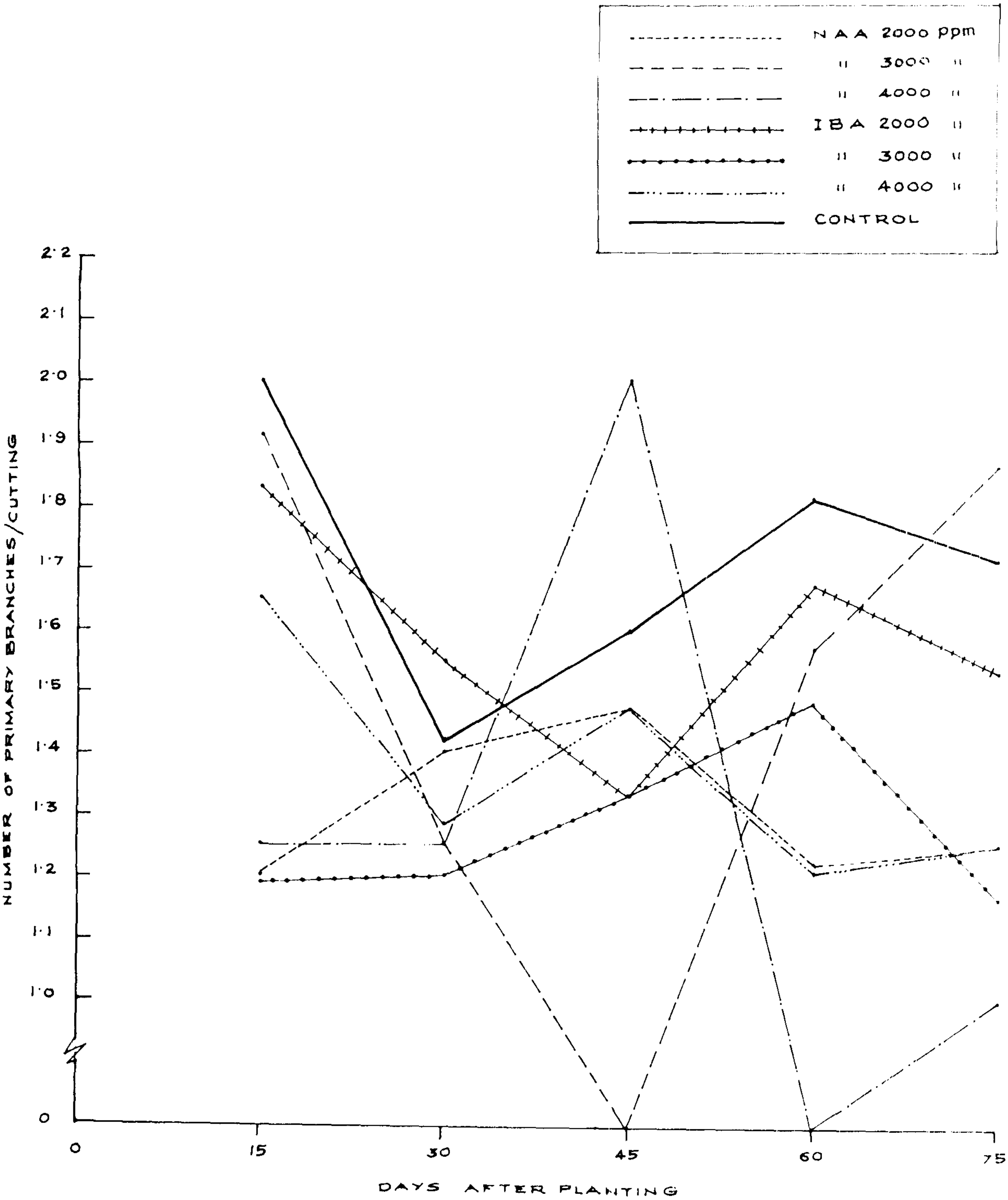
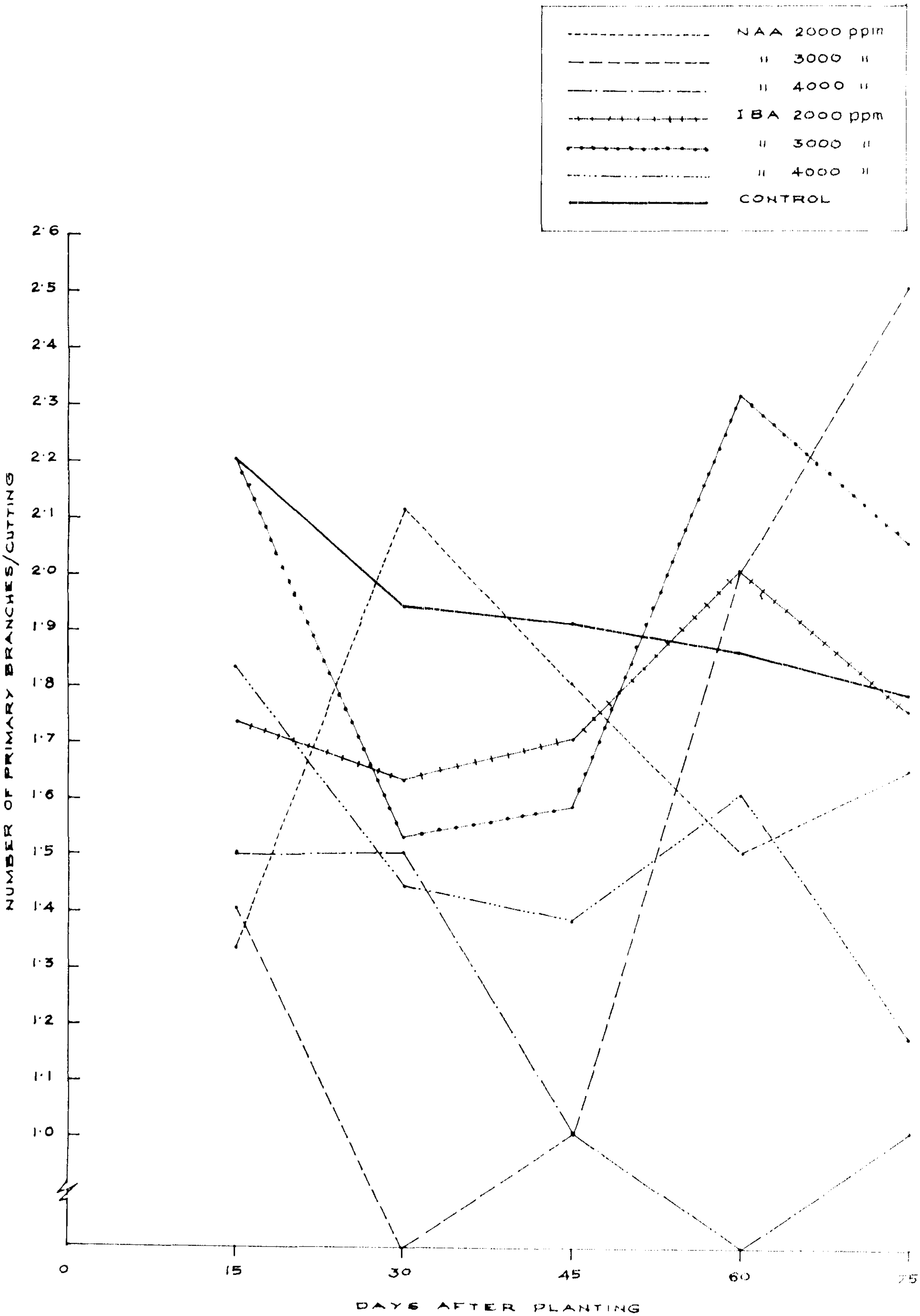


FIGURE 6. EFFECT OF GROWTH REGULATORS ON NUMBER OF PRIMARY BRANCES/ CUTTING IN *J. grandiflorum*



species, NAA 4000 ppm produced the least number of primary branches.

The pooled data on the effect of mist on the production of primary branches presented in Table 12 and Figures 7 and 8 clearly indicated the beneficial effect of mist on this parameter. The mean number of primary branches produced by cuttings under mist condition was 1.55 and 2.00 in *Jasminum auriculatum* and *Jasminum grandiflorum* respectively while in the open condition the mean number was only 1.16 and 1.23 respectively.

4.1.1.4 Length of primary branches

The data presented in Table 13 indicated the effect of growth regulators and mist on the length of primary branches produced by cuttings. It is evident from the table that there was significant difference between the treatments with regard to this parameter. Cuttings planted under mist condition in general produced longer primary branches compared to cuttings planted under open condition. In *Jasminum auriculatum* under mist, primary branches of maximum mean length were produced by control (3.28 cm) followed by NAA 2000 ppm (2.60 cm) and IBA 4000 ppm (2.46 cm). NAA at 3000 and 4000 ppm were proved inferior with regard to this parameter especially under open condition.

Table 12. Effect of mist on number of primary branches/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
Mist	1.61	1.43	1.64	1.40	1.66	1.55	2.30	1.90	1.89	2.04	1.88	2.00
Open	1.38	1.15	1.06	1.04	1.18	1.16	1.52	1.28	1.10	1.14	1.12	1.23
CD	0.11	0.12	0.12	0.13	0.14		0.15	0.14	0.13	0.13	0.13	
SEm±	0.03	0.03	0.03	0.03	0.03		0.04	0.04	0.03	0.03	0.03	

DAP = Days after planting

CD = Critical difference

SEm = Standard error of mean

FIGURE 7. EFFECT OF MIST ON NUMBER OF PRIMARY BRANCHES/CUTTING IN *J. auriculatum.*

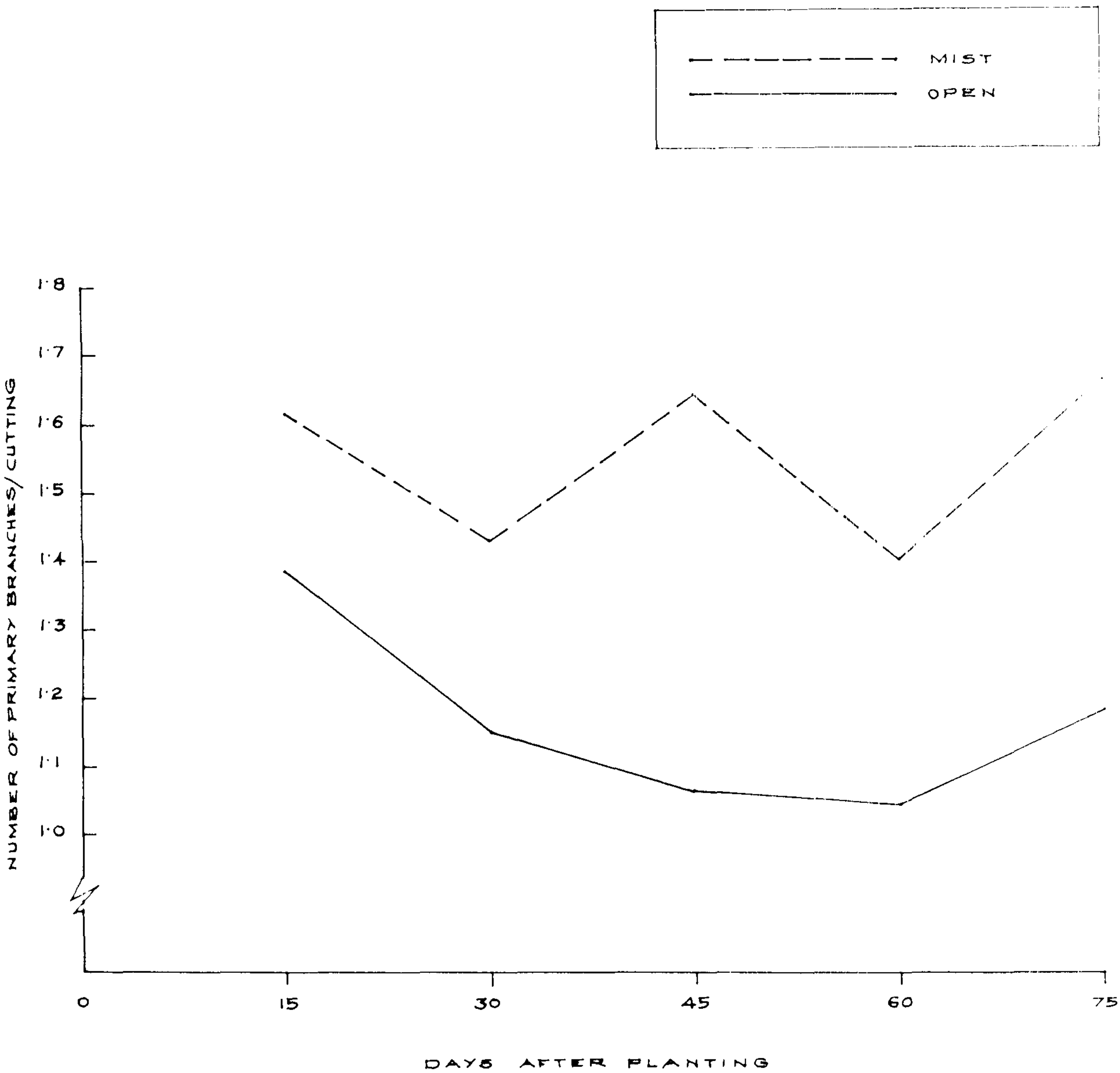


FIGURE. 8. EFFECT OF MIST ON NUMBER OF PRIMARY BRANCHES/CUTTING IN *J. grandiflorum*.

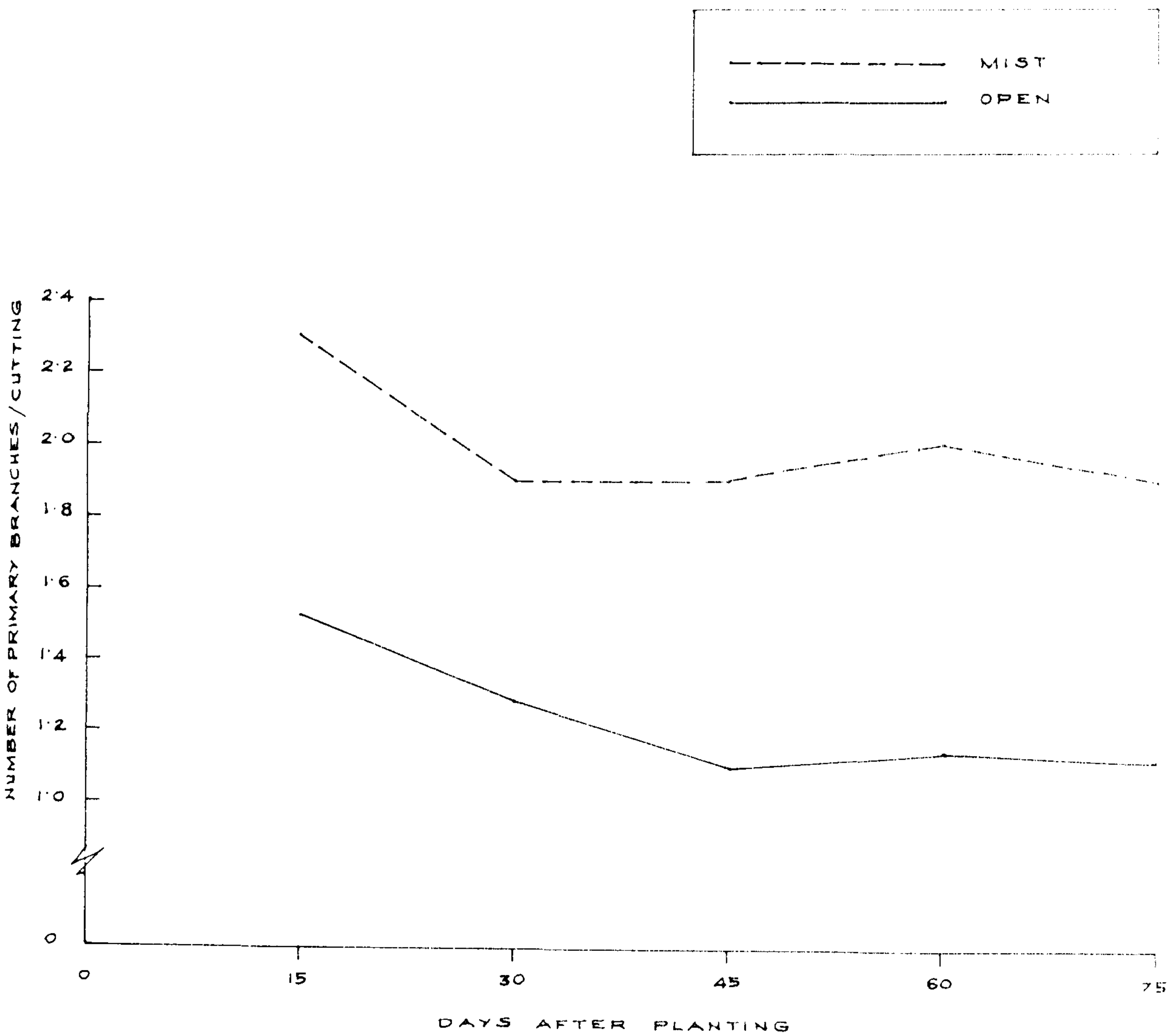


Table 13. Effect of growth regulators and mist on length of primary branches(cm)/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
IBA 2000 ppm												
mist	1.90	2.60	2.50	1.89	2.32	2.24	1.82	5.15	8.28	9.18	21.53	9.19
open	4.20	2.41	1.05	1.15	2.65	2.29	3.94	7.50	5.60	0	3.75	4.16
IBA 3000 ppm												
mist	1.48	2.04	2.60	2.59	2.84	2.31	2.28	4.91	7.79	10.96	16.73	8.53
open	2.05	3.00	2.02	2.70	3.37	2.63	2.95	2.71	3.19	0	7.50	3.27
IBA 4000 ppm												
mist	0.99	2.77	2.63	2.56	2.33	2.46	2.19	4.81	7.71	9.48	23.74	9.56
open	0.35	3.75	1.30	1.68	0	1.42	3.98	4.33	7.16	3.37	6.48	5.06
NAA 2000 ppm												
mist	1.74	2.65	1.56	3.67	3.38	2.60	2.48	4.47	4.91	20.00	13.59	9.09
open	1.00	1.90	2.45	3.20	4.13	2.54	2.20	0	0	0	0	0.44
NAA 3000 ppm												
mist	2.38	2.55	0	2.70	2.73	2.07	2.68	0	4.50	8.58	20.59	7.27
open	0	1.30	0	0	2.40	0.74	2.05	0	0	0	0	0.41
NAA 4000 ppm												
mist	1.60	2.30	0	0	3.75	1.53	0.20	2.83	4.87	0	15.20	4.62
open	0	0.50	2.25	0	3.20	1.19	2.55	0	0	0	0	0.51
Control												
mist	2.16	3.88	3.40	3.50	3.44	3.28	2.20	3.95	4.86	5.00	7.52	4.71
open	1.26	2.24	2.93	2.90	4.17	2.70	2.52	4.14	3.22	4.80	4.85	3.91
CD	0.30	0.57	0.47	0.55	0.61		0.46	0.76	1.08	1.37	2.71	
SEm±	0.03	0.06	0.05	0.06	0.06		0.05	0.08	0.11	0.14	0.28	

DAP = Days after planting
CD = Critical difference
SEm = Standard error of mean

In *Jasminum grandiflorum*, IBA 4000 ppm produced the longest primary branches (9.56 cm) followed by IBA 2000 ppm (9.19 cm) and NAA 2000 ppm (9.09 cm) when cuttings were planted under mist condition. NAA at higher concentrations produced poor results with regard to this parameter particularly under open condition.

The pooled analysis of the data on the effect of different growth regulators presented in Table 14 and Figures 9 and 10 indicated that in *Jasminum auriculatum*, control produced the longest primary branches followed by NAA 2000 ppm and IBA 3000 ppm. But in *Jasminum grandiflorum* the mean length of primary branches was maximum with IBA 2000 ppm (9.13 cm) followed by NAA 2000 ppm (9.07 cm) and IBA 4000 ppm (8.13 cm). In both the species, the highest concentrations of NAA tried viz. NAA 4000 and 3000 ppm were found to be significantly inferior with regard to this parameter compared to all other treatments.

The profound influence of mist on the length of primary branches produced by cuttings is evident from the data presented in Table 15 and Figures 11 and 12. In both the species of Jasminum, the length of primary branches produced by cuttings under mist was higher than that produced under open

Table 14. Effect of growth regulators on length of primary branches (cm)/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
IBA 2000 ppm	2.09	2.50	2.02	1.58	2.55	2.15	2.59	5.44	8.01	9.18	20.42	9.13
IBA 3000 ppm	1.62	2.27	2.31	2.64	3.05	2.38	2.55	3.95	6.25	10.96	15.80	7.90
IBA 4000 ppm	0.88	2.85	2.49	2.33	3.33	2.38	2.94	4.57	7.50	7.64	17.98	8.13
NAA 2000 ppm	1.59	2.43	1.77	3.54	3.60	2.59	2.38	4.47	4.91	20.00	13.59	9.07
NAA 3000 ppm	2.38	2.13	0	2.70	2.66	1.97	2.30	0	4.50	8.58	20.90	7.26
NAA 4000 ppm	1.60	2.08	2.25	0	3.57	1.90	1.38	2.83	4.87	0	15.20	4.86
Control	1.77	3.23	3.25	3.28	3.75	3.06	2.31	4.00	4.13	4.97	6.66	4.42
CD	NS	0.47	0.38	0.43	0.48		0.35	0.61	0.89	1.13	2.30	
SEm	0.03	0.06	0.05	0.06	0.07		0.05	0.08	0.12	0.15	0.31	

DAP = Days after planting

CD = Critical difference

SEm = Standard error of mean

NS = Non significant

FIGURE. 9. EFFECT OF GROWTH REGULATORS ON LENGTH OF PRIMARY BRANCES/ CUTTING IN *J. auriculatum*.

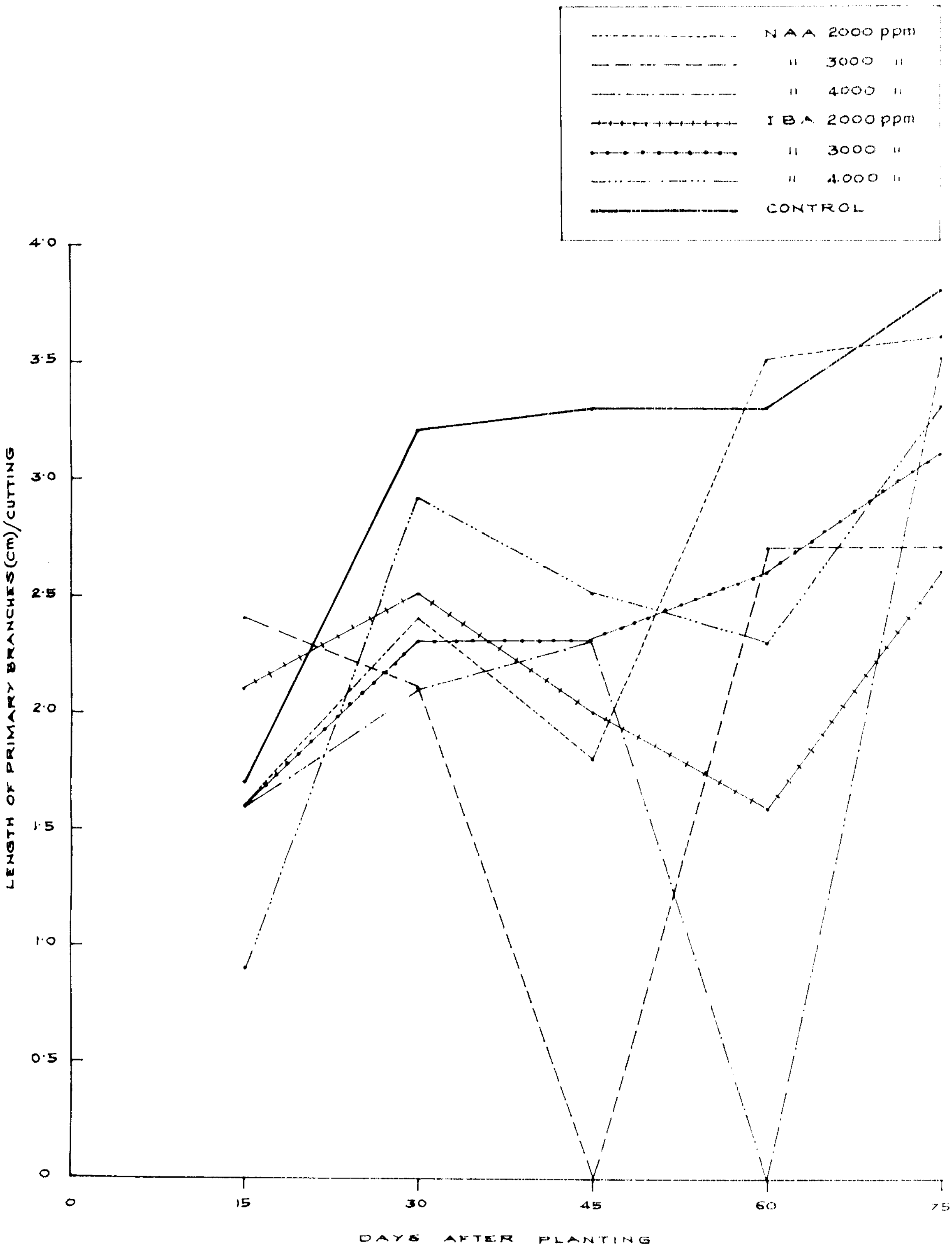


FIGURE. 10. EFFECT OF GROWTH REGULATORS ON LENGTH OF PRIMARY BRANCHES/CUTTING IN *J. grandiflorum*.

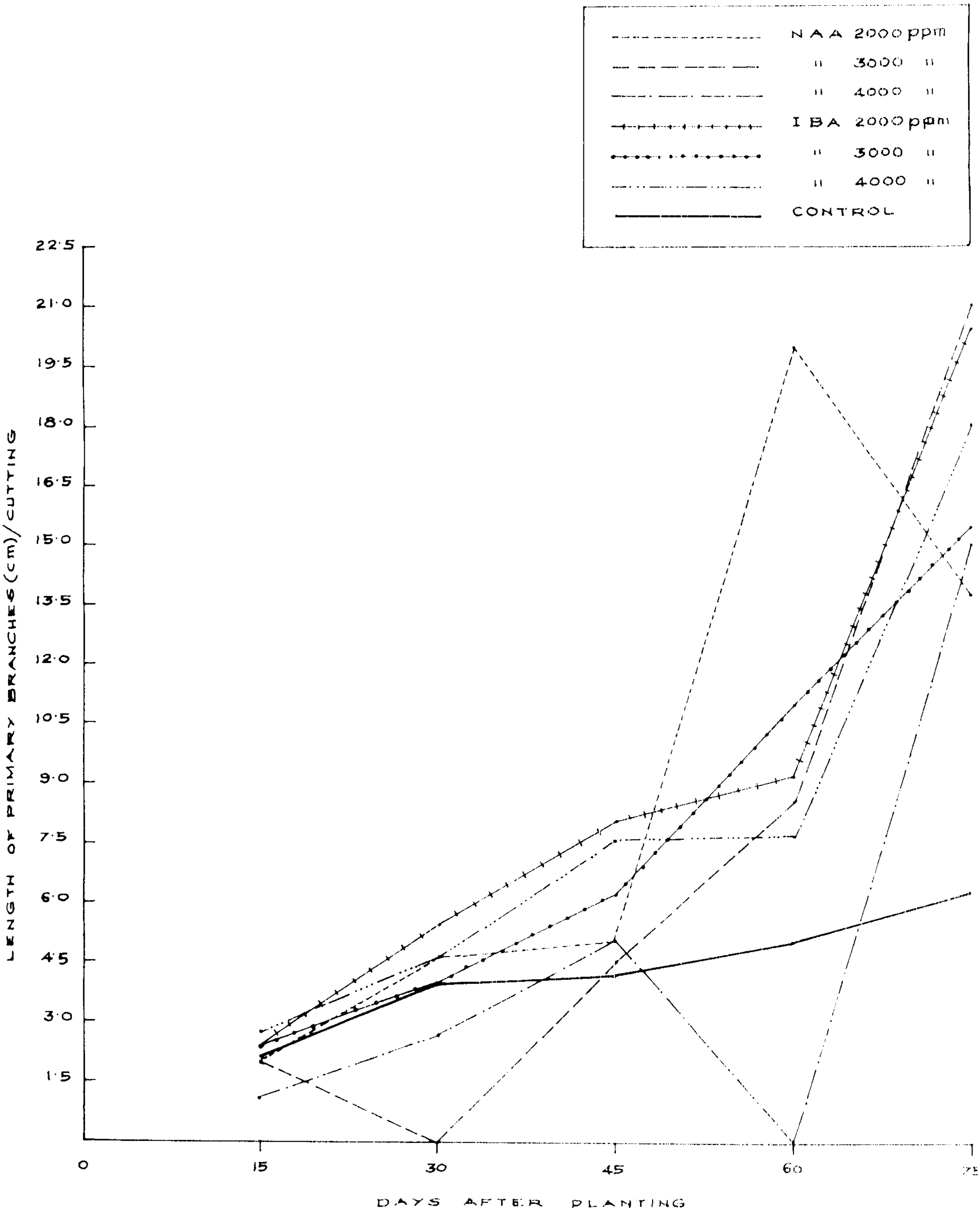


Table 15. Effect of mist on length of primary branches (cm)/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
Mist	1.68	2.75	2.60	2.98	3.16	2.63	2.15	4.48	6.46	8.22	15.50	6.92
Open	1.47	2.21	2.14	2.48	3.49	2.36	2.96	3.67	3.97	4.19	5.47	4.55
CD	0.13	0.26	0.21	0.24	0.27		NS	0.34	0.48	0.60	1.17	
SEm±	0.03	0.07	0.05	0.06	0.07		0.05	0.09	0.12	0.15	0.30	

DAP = Days after planting

CD = Critical difference

SEm = Standard error of mean

NS = Non significant

FIGURE 11. EFFECT OF MIST ON LENGTH OF PRIMARY BRANCHES/CUTTING IN *J. auriculatum*.

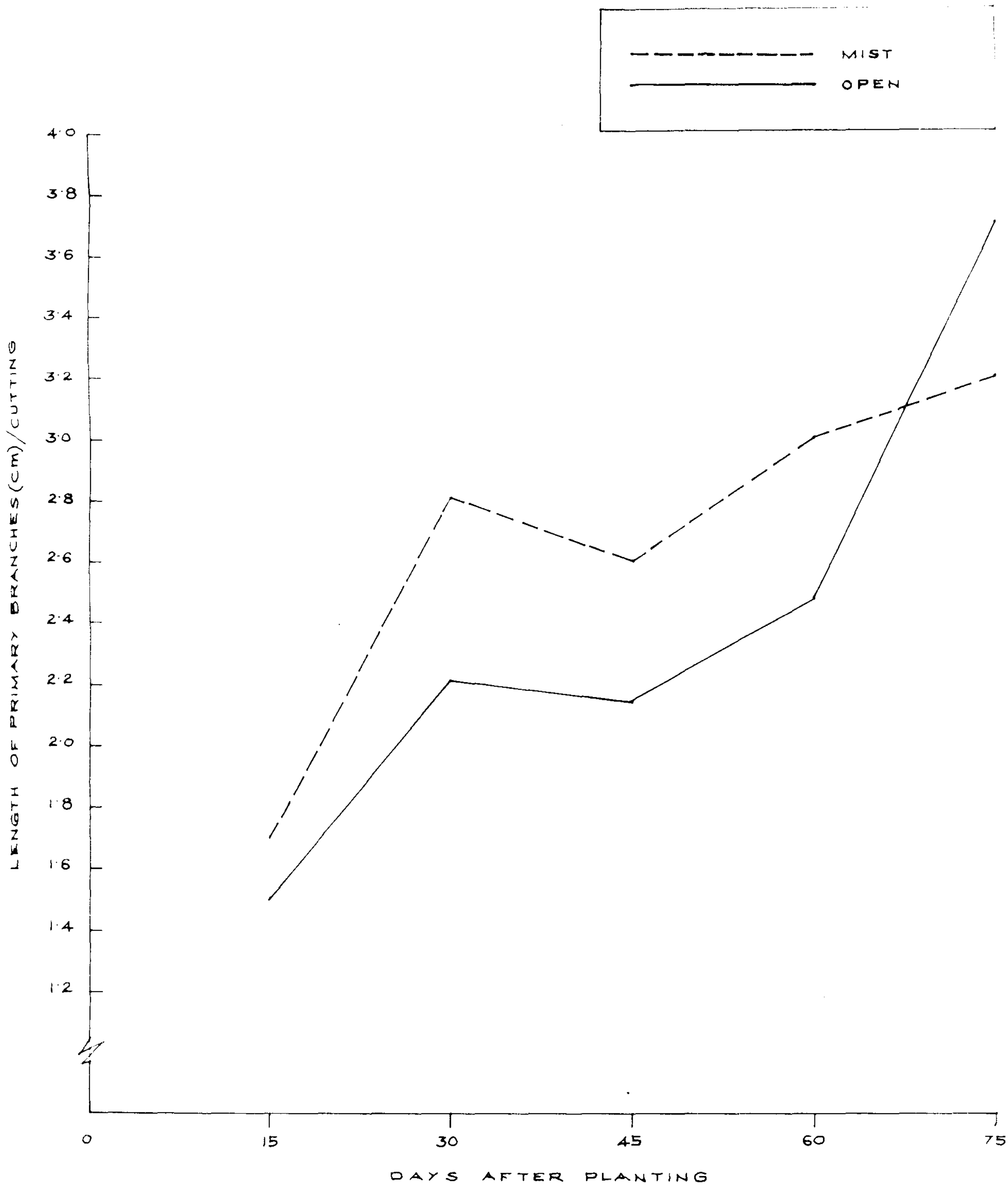
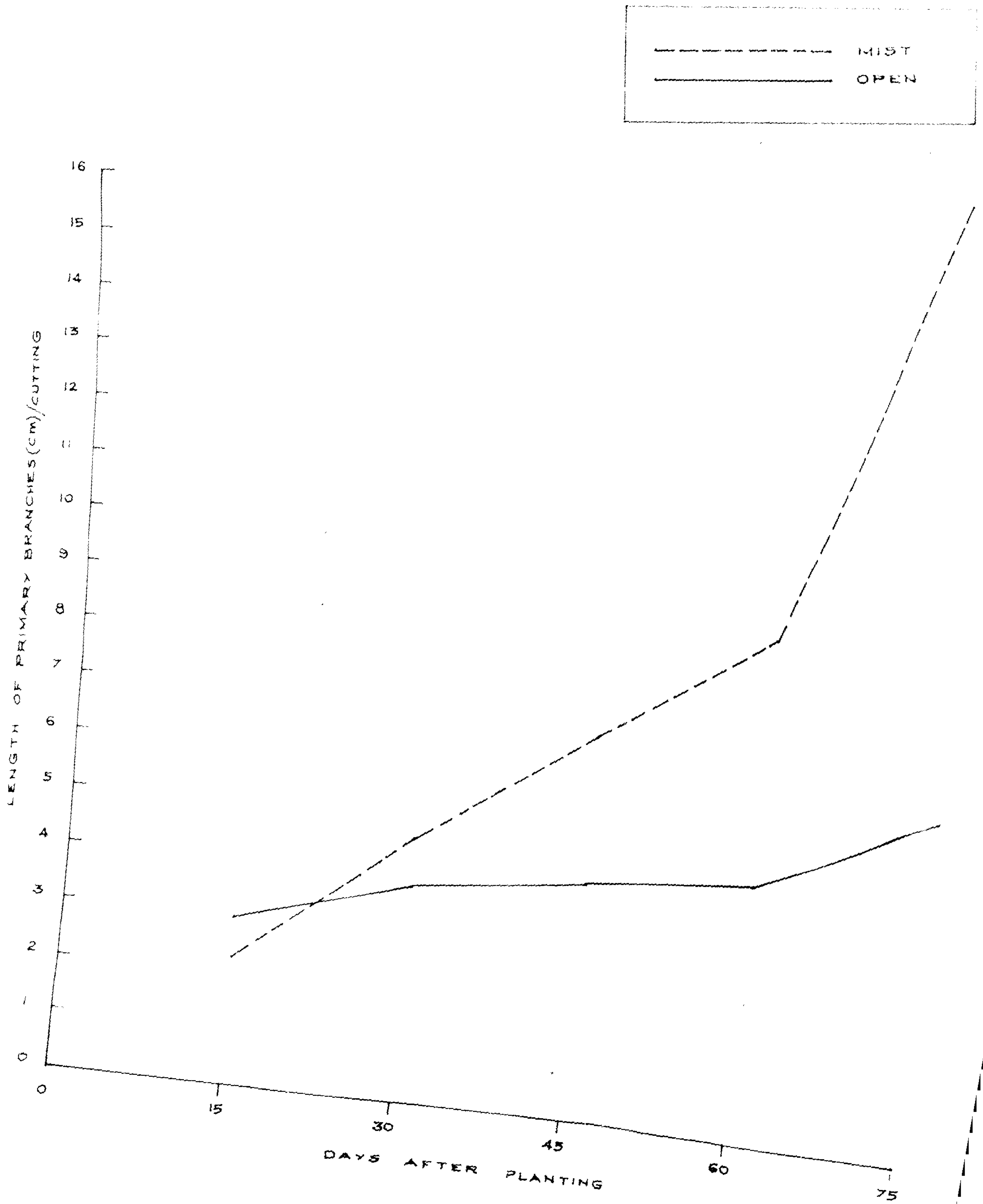


FIGURE 12 EFFECT OF MIST ON LENGTH OF PRIMARY BRANCHES / CUTTING IN *J. grandiflorum*.



condition. In *Jasminum auriculatum*, the mean length of primary branches produced by cuttings under mist and open condition were 2.63 and 2.36 cm respectively while in *Jasminum grandiflorum* the lengths were 6.92 and 4.55 cm respectively.

4.1.1.5 Number of roots

The results of the analysis of the data on the effect of growth regulators and mist on number of roots produced by cuttings are presented in Tables 16 to 18. In *Jasminum auriculatum* all the treatments were on par with regard to this parameter. However, there seems to be tendency to produce more number of roots under mist condition compared to open in all the treatments tried.

In *Jasminum grandiflorum*, there existed a significant difference between the treatments. All the treatments produced a good number of roots under mist even on the 15th day of planting the cuttings while under open condition, the production of roots was very poor. It can be seen from the table that under open condition on 15th, 30th and 45th day of planting the cuttings, there was no rooting at all for most of the treatments. Data also indicated that under mist, IBA 2000 ppm ranked first with regard to this parameter followed by NAA 4000 ppm

Table 16. Effect of growth regulators and mist on number of roots/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
IBA 2000 ppm												
mist	0	1.00	1.00	1.00	2.00	1.00	11.20	9.83	6.00	6.00	8.13	8.23
open	0	1.00	0	0	1.00	0.40	0	0	0	0	1.00	0.20
IBA 3000 ppm												
mist	3.00	1.00	2.00	2.00	2.00	2.00	4.00	5.30	7.80	8.70	8.58	6.88
open	1.00	0	1.00	1.00	1.00	0.80	4.25	0	0	0	0	0.85
IBA 4000 ppm												
mist	2.00	1.50	1.50	2.00	1.75	1.75	0	5.00	6.00	5.50	12.67	5.83
open	0	0	0	1.00	0	0.20	6.33	3.67	5.00	0	0	3.40
NAA 2000 ppm												
mist	0	1.00	1.00	1.67	1.33	1.00	6.00	7.40	2.68	6.00	7.00	5.86
open	0	0	0	1.00	1.33	0.47	10.33	0	0	0	0	2.07
NAA 3000 ppm												
mist	0	0	0	0	1.50	0.30	5.90	3.00	3.50	6.50	3.83	4.55
open	0	0	0	0	1.00	0.20	7.00	0	0	0	0	1.40
NAA 4000 ppm												
mist	0	3.67	0	0	1.00	0.93	11.75	7.60	10.67	3.00	8.00	8.20
open	0	0	0	0	0	0	8.33	0	0	0	0	1.67
Control												
mist	0	0	1.00	1.00	2.00	0.80	0	2.20	5.20	5.83	4.00	3.45
open	0	0	0	0	1.00	0.20	0	2.00	0	0	2.00	0.80
CD	NS	0.15	NS	NS	NS		1.67	0.89	0.63	0.73	1.01	
SEm±	0.01	0.02	0.02	0.01	0.02		0.17	0.09	0.09	0.08	0.10	

DAP = Days after planting
CD = Critical difference
SEm = Standard error of mean
NS = Non significant

Table 17. Effect of growth regulators on number of roots/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
IBA 2000 ppm	0	1.00	1.00	1.00	1.50	0.90	11.20	9.83	6.00	6.00	7.69	8.14
IBA 3000 ppm	2.00	1.00	1.50	1.50	1.50	1.50	4.17	5.30	7.80	8.70	8.58	6.91
IBA 4000 ppm	2.00	1.50	1.50	1.50	1.75	1.65	8.33	4.33	5.63	5.50	12.67	7.29
NAA 2000 ppm	0	1.00	1.00	1.50	1.33	0.97	8.36	7.40	2.88	6.00	7.00	6.33
NAA 3000 ppm	0	0	0	0	1.40	0.28	6.21	3.00	3.50	6.50	3.83	4.61
NAA 4000 ppm	0	3.67	0	0	1.00	0.90	9.94	7.60	10.67	3.00	8.00	7.84
Control	0	0	1.00	1.00	1.50	0.70	0	2.18	5.20	5.83	3.43	3.33
CD	NS	NS	NS	NS	NS		1.30	NS	NS	0.58	0.87	
SEm±	0.01	0.02	0.01	0.01	0.02		0.18	0.10	0.30	0.08	0.12	

DAP = Days after planting

CD = Critical difference

SEm = Standard error of mean

NS = Non significant

Table 16. Effect of mist on number of roots/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
Mist	2.50	2.00	1.29	1.44	1.65	1.78	8.23	5.49	5.95	6.81	8.55	7.01
Open	1.00	1.00	1.00	1.00	1.11	1.02	7.96	3.25	5.00	0	1.67	4.15
CD	NS	0.06	0.03	0.04	0.06		NS	0.36	0.35	0.31	0.45	
SEm±	0.01	0.02	0.01	0.01	0.02		0.18	0.09	0.09	0.08	0.11	

DAP = Days after planting

CD = Critical difference

SEm = Standard error of mean

NS = Non significant

and IBA 3000 ppm.

From the results of the pooled analysis of the data on the effect of growth regulators on number of roots produced by cuttings, it is clear that in *Jasminum auriculatum* there was no significant difference between the treatments while in *Jasminum grandiflorum*, the treatment differed significantly with regard to this parameter.

The result of the pooled analysis of the observations furnished in Table 18 on the effect of mist on the number of roots produced by cuttings clearly indicated that the number of roots produced by cuttings under mist was significantly high compared to number of roots produced under open condition.

4.1.1.6 Length of roots

The effect of different growth regulators and mist on the length of roots produced by cuttings are tabulated in Tables 19 2o 21. It is evident from the data that in general, treatments under mist produced longer roots compared to treatments tried under open condition. In *Jasminum auriculatum*, all the treatments were on par with regard to this parameter. However, IBA tended to produce roots of

Table 19. Effect of growth regulators and mist on length of roots(cm)/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
IBA 2000 ppm												
mist	0	2.80	3.60	6.40	6.30	3.82	1.99	2.95	6.45	3.62	5.93	4.19
open	0	1.90	0	0	5.60	1.50	0	0	0	0	7.60	1.52
IBA 3000 ppm												
mist	1.60	2.60	3.20	4.70	8.05	4.03	2.84	3.62	9.45	9.75	11.52	7.44
open	4.00	0	2.60	5.60	7.05	3.85	2.06	0	0	0	0	0.41
IBA 4000 ppm												
mist	1.50	2.83	3.83	3.90	7.06	3.82	0	5.27	5.10	9.41	8.76	5.71
open	0	0	0	2.80	0	0.56	2.50	1.07	4.27	0	0	1.57
NAA 2000 ppm												
mist	0	2.97	3.10	6.00	6.28	3.67	1.12	3.66	3.10	5.85	6.75	4.10
open	0	0	0	5.30	4.92	2.04	2.47	0	0	0	0	0.49
NAA 3000 ppm												
mist	0	0	0	0	5.21	1.04	1.42	2.82	2.82	6.54	6.87	4.00
open	0	0	0	0	5.00	1.00	1.85	0	0	0	0	0.37
NAA 4000 ppm												
mist	0	1.47	0	0	3.50	0.99	1.22	3.26	3.14	2.17	12.57	4.47
open	0	0	0	0	0	0	1.42	0	0	0	0	0.28
Control												
mist	0	0	2.70	3.90	4.53	2.23	0	5.82	3.34	6.69	7.16	4.60
open	0	0	0	0	14.25	2.85	0	12.80	0	0	8.25	4.21
CD	NS	0.16	NS	NS	NS		0.28	0.57	0.76	0.83	1.05	
SEm±	0.01	0.02	0.02	0.04	0.07		0.03	0.06	0.08	0.09	0.11	

DAP = Days after planting
CD = Critical difference
SEm = Standard error of mean
NS = Non significant

greater length compared to NAA and control, particularly under mist condition.

In *Jasminum grandiflorum*, IBA 3000 ppm produced the longest roots on 45th and 75th day after planting under mist condition. The mean length of roots was also highest (7.44 cm) in this treatment. The length of roots was found to be very poor in cuttings treated with all concentrations of NAA compared to IBA.

The pooled data furnished in Table 20 revealed the effect of different growth regulators on length of roots produced by cuttings. In *Jasminum auriculatum*, none of the treatments were found to be significantly different with regard to this parameter. However, IBA treatments tended to produce better results compared to NAA treatments.

With regard to the length of roots the treatments differed significantly in *Jasminum grandiflorum*. IBA 3000 ppm produced roots of maximum mean length (7.33 cm) followed by treatment with IBA 4000 ppm (5.72 cm) and control (4.79 cm).

The result of the pooled analysis of the data on the effect of mist on length of roots produced by cuttings indicated the beneficial effect of mist on the production of longer roots (Table 21). In *Jasminum auriculatum*, the mean length of roots under mist and

Table 20. Effect of growth regulators on length of roots(cm)/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
IBA 2000 ppm	0	2.35	3.60	6.40	5.95	3.66	1.99	2.95	6.45	3.62	6.03	4.21
IBA 3000 ppm	1.50	2.60	2.90	5.15	7.55	3.94	2.32	3.62	9.45	9.75	11.52	7.33
IBA 4000 ppm	1.50	2.83	3.83	3.25	7.06	2.30	2.50	3.16	4.79	9.41	8.76	5.72
NAA 2000 ppm	0	2.97	3.10	5.83	5.60	3.50	1.86	3.66	3.10	5.85	6.75	4.24
NAA 3000 ppm	0	0	0	0	5.17	1.03	1.55	2.82	2.82	6.54	6.87	4.12
NAA 4000 ppm	0	1.47	0	0	3.50	0.99	1.33	3.26	3.14	2.17	12.57	4.49
Control	0	0	2.70	3.90	9.39	3.20	0	6.46	3.34	6.69	7.47	4.79
CD	NS	NS	NS	NS	NS		0.21	0.45	0.61	0.67	0.86	
SEm±	0.01	0.02	0.02	0.04	0.07		0.03	0.06	0.08	0.09	0.12	

DAP = Days after planting

CD = Critical difference

SEm = Standard error of mean

NS = Non significant

Table 21. Effect of mist on length of roots(cm)/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
Mist	1.55	2.41	3.34	5.24	6.05	3.72	1.51	4.04	5.52	7.76	8.13	5.39
Open	1.40	1.90	2.60	4.57	7.55	3.60	1.95	3.99	4.27	0	8.03	3.65
CD	NS	0.07	0.07	0.14	NS		NS	0.24	0.33	0.36	0.45	
SEm±	0.01	0.02	0.02	0.04	0.07		0.03	0.06	0.08	0.09	0.11	

DAP = Days after planting

CD = Critical difference

SEm = Standard error of mean

NS = Non significant

open conditions was 3.72 and 3.60 cm respectively while in *Jasminum grandiflorum* the mean lengths under these two conditions were 5.39 and 3.65 cm respectively.

4.1.1.7 Fresh weight of roots

The result of the statistical analysis of the data on the effect of growth regulators and mist on fresh weight of roots per cutting are presented in Tables 22 to 24. In *Jasminum auriculatum*, the treatments were on par with regard to this parameter. But treating the cuttings with IBA produced slightly better root weight compared to NAA treatments.

In *Jasminum grandiflorum*, all the treatments differed significantly, with regard to fresh weight of roots. Under mist, the maximum fresh weight of 28.10 mg was recorded for treatment with IBA 2000 ppm after 15 days of planting the cuttings. But after 75 days of planting the cuttings, IBA 4000 ppm recorded the maximum fresh weight of roots (389.37 mg). The mean fresh weight of roots was also maximum in this treatment both under mist and open condition.

The pooled data as evidenced from Table 23 on the effect of growth regulators on fresh weight of roots indicated that in *Jasminum auriculatum* none of the treatments were significantly different while in *Jasminum grandiflorum* the treatments differed significantly with regard to this parameter. Here the

Table 22. Effect of growth regulators and mist on fresh weight of roots(mg)/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
IBA 2000 ppm												
mist	0	40.00	45.00	37.80	165.00	57.56	28.10	81.75	126.67	290.00	87.33	122.77
open	0	35.00	0	0	80.65	23.13	0	0	0	0	60.00	12.00
IBA 3000 ppm												
mist	65.00	24.00	95.00	95.80	220.30	100.02	27.50	96.05	179.00	397.00	246.25	189.16
open	20.00	0	30.00	25.00	67.50	28.50	25.15	0	0	0	0	5.03
IBA 4000 ppm												
mist	40.00	39.88	52.65	120.00	201.43	90.79	0	70.17	159.00	350.00	389.37	193.71
open	0	0	0	30.00	0	6.00	20.15	93.33	70.00	0	0	36.70
NAA 2000 ppm												
mist	0	45.00	27.50	293.33	173.33	107.83	17.13	56.00	28.75	62.50	146.65	62.25
open	0	0	0	180.00	167.71	69.54	22.97	0	0	0	0	4.59
NAA 3000 ppm												
mist	0	0	0	0	137.63	27.53	16.61	25.13	45.00	280.00	162.50	105.66
open	0	0	0	0	45.00	9.00	16.25	0	0	0	0	3.25
NAA 4000 ppm												
mist	0	217.12	0	0	50.00	53.42	26.32	70.00	95.00	125.00	290.00	121.26
open	0	0	0	0	0	0	11.67	0	0	0	0	2.33
Control												
mist	0	0	50.56	47.50	80.43	35.71	0	47.10	98.12	153.33	87.00	77.11
open	0	0	0	0	112.98	22.60	0	60.00	0	0	30.00	18.00
CD	NS	NS	NS	13.81	NS		3.61	11.03	16.38	36.18	30.85	
SEm±	0.16	1.11	0.30	1.23	1.65		0.37	1.14	1.69	3.73	3.18	

DAP = Days after planting
CD = Critical difference
SEm = Standard error of mean
NS = Non significant

maximum mean fresh weight of 193.38 mg was recorded in IBA 4000 ppm followed by 188.84 mg in IBA 3000 ppm and 122.43 mg in IBA 2000 ppm.

Mist had profound influence in inducing better root growth and the pooled data pertaining to the effect of mist on fresh weight of roots are presented in Table 24. The mean fresh weights of roots in Jasminum auriculatum were 98.74 and 54.62 mg under mist and open conditions respectively while in Jasminum grandiflorum, the mean fresh weights of roots under these two conditions were 133.68 and 42.61 mg respectively.

4.1.1.8 Dry matter content

The data presented in Table 25 indicated the effect of different growth regulators and mist on dry matter content of roots produced by cuttings. In Jasminum auriculatum, under mist, the maximum mean dry matter content of roots was noticed for treatment with IBA 3000 ppm followed by IBA 4000 ppm and NAA 2000 ppm. Under open condition NAA 2000 ppm recorded the maximum dry matter content of roots. There was no significant difference between the treatments with regard to this parameter on 15th and 45th day of planting the cuttings.

In Jasminum grandiflorum the mean dry

Table 23. Effect of growth regulators on fresh weight of roots(mg)/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
IBA 2000 ppm	0	37.50	45.00	37.80	122.83	48.63	28.10	81.75	126.67	290.00	85.63	122.43
IBA 3000 ppm	42.50	24.00	62.50	60.40	143.90	66.66	25.93	96.05	179.00	397.00	246.25	188.84
IBA 4000 ppm	40.00	39.88	52.65	75.00	201.43	81.79	20.15	81.75	125.63	350.00	389.36	193.38
NAA 2000 ppm	0	45.00	27.50	265.00	170.20	101.54	20.45	56.00	28.75	62.50	146.85	62.91
NAA 3000 ppm	0	0	0	0	119.10	23.80	16.54	25.13	45.00	280.00	162.50	105.83
NAA 4000 ppm	0	217.12	0	0	50.00	53.42	18.56	70.00	95.00	62.50	290.00	107.21
Control	0	0	50.60	47.50	96.70	38.96	0	48.27	98.12	153.30	70.71	74.08
CD	NS	NS	NS	9.24	NS		2.74	8.67	13.07	28.62	24.63	
SEm±	0.16	1.12	0.30	1.26	1.66		0.37	1.18	1.78	3.90	3.36	

DAP = Days after planting

CD = Critical difference

SEm = Standard error of mean

NS = Non significant

Table 24. Effect of mist on fresh weight of roots (mg)/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
Mist	52.50	91.99	50.13	140.70	158.39	98.74	21.99	66.58	113.86	284.44	181.54	133.68
Open	20.00	35.00	30.00	78.33	109.76	54.62	18.03	85.00	70.00	0	40.00	42.61
CD	NS	NS	1.18	5.02	6.55		NS	4.57	6.93	15.43	12.97	
SEm±	0.16	1.12	0.30	1.27	1.65		0.38	1.15	1.75	3.90	3.28	

DAP = Days after planting

CD = Critical difference

SEm = Standard error of mean

NS = Non significant

able 25. Effect of growth regulators and mist on dry matter content of roots(mg)/cutting

reatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
BA 2000 ppm												
mist	0	10.00	10.86	12.95	35.62	13.89	2.30	17.56	17.92	110.31	24.69	34.56
open	0	10.00	0	0	25.00	7.00	0	0	0	0	10.00	2.00
BA 3000 ppm												
mist	10.30	0.89	35.35	30.62	84.69	32.37	0.34	10.39	48.86	108.87	53.69	44.43
open	0.12	0	10.00	10.00	15.31	7.09	0.31	0	0	0	0	0.06
BA 4000 ppm												
mist	10.00	5.45	15.40	35.30	68.93	27.02	0	10.44	42.62	150.48	87.22	58.15
open	0	0	0	10.00	0	2.00	7.00	20.37	10.33	0	0	7.54
AA 2000 ppm												
mist	0	15.00	8.15	34.13	57.07	23.07	0.48	12.24	1.52	15.50	25.30	11.01
open	0	0	0	10.67	56.40	13.41	2.14	0	0	0	0	0.43
AA 3000 ppm												
mist	0	0	0	0	13.08	2.62	0.22	1.09	4.49	119.55	35.00	25.07
open	0	0	0	0	0.16	0.03	2.62	0	0	0	0	0.52
AA 4000 ppm												
mist	0	33.33	0	0	0.68	13.54	0.48	3.91	25.23	20.00	41.00	18.12
open	0	0	0	0	0	0	0.39	0	0	0	0	0.08
ontrol												
mist	0	0	10.00	12.65	30.30	10.59	0	8.34	18.24	46.77	24.07	19.48
open	0	0	0	0	25.35	5.07	0	10.50	0	0	5.45	3.19
D	NS	1.75	NS	1.63	5.99		NS	1.73	4.16	12.53	7.34	
Em±	0.16	0.10	0.15	0.54	0.56		0.05	0.18	0.43	1.29	0.76	

AP = Days after planting
D = Critical difference
Em = Standard error of mean
S = Non significant

matter content of roots was maximum with IBA 4000 ppm both under mist (58.15 mg) and open (7.5 mg) condition.

The pooled analysis of the data on the effect of growth regulators on dry matter content of roots presented in Table 26 clearly indicated that all the treatments were on par in the case of *Jasminum auriculatum* while in *Jasminum grandiflorum* all the treatments differed significantly. It can also be seen that IBA 4000 ppm recorded the maximum dry matter content of roots during 60th and 75th day of planting the cuttings. The mean dry matter content was also high for this treatment (98.80 mg) which was followed by IBA 3000 ppm (44.43 mg) and 2000 ppm (34.37 mg).

The results of the data on the effect of mist on dry matter content of roots are pooled in Table 27. It is clear from the table that both in *Jasminum auriculatum* and *Jasminum grandiflorum* mist had profound influence on dry matter content of roots throughout the period of observation.

4.1.1.9 Carbon and nitrogen content of cuttings

The data on the organic carbon (C) and total nitrogen (N) content of cuttings are summarised in Tables 28 to 30. It is evident from the data that initially the organic carbon content was significantly high and this gradually decreased as rooting progressed

Table 26. Effect of growth regulators on dry matter content of roots(mg)/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
IBA 2000 ppm	0	10.00	10.86	12.95	30.31	12.82	2.30	17.56	17.92	110.31	23.77	34.37
IBA 3000 ppm	5.21	0.89	22.68	20.31	50.00	19.82	0.33	10.39	48.86	108.87	53.69	44.43
IBA 4000 ppm	10.00	5.44	15.40	22.65	68.93	30.65	7.00	15.40	30.51	150.48	87.22	98.80
NAA 2000 ppm	0	15.00	8.15	29.02	56.73	21.78	1.39	12.24	1.52	15.50	25.30	11.19
NAA 3000 ppm	0	0	0	0	10.49	2.10	0.90	2.73	4.49	119.55	35.00	32.53
NAA 4000 ppm	0	33.33	0	0	0.68	6.80	0.43	6.26	25.23	20.00	41.00	18.60
Control	0	0	10.00	12.82	27.88	10.14	0	8.54	18.24	46.72	18.75	18.45
CD	NS	NS	NS	NS	NS		NS	NS	3.39	9.78	5.82	
SEm±	0.03	0.16	0.10	0.15	0.54		0.05	0.19	0.46	1.33	0.79	

DAP = Days after planting
CD = Critical difference
SEm = Standard error of mean
NS = Non significant

Table 27. Effect of mist on dry matter content of roots (mg)/cutting

Treatments	*Jasminum auriculatum*						*Jasminum grandiflorum*					
	15DAP	30DAP	45DAP	60DAP	75DAP	Mean	15DAP	30DAP	45DAP	60DAP	75DAP	Mean
Mist	10.15	14.77	14.76	24.76	45.03	21.89	0.69	9.94	25.57	91.92	40.87	33.69
Open	0.12	10.00	10.00	10.22	30.65	12.20	1.89	8.87	10.33	0	6.96	5.61
CD	NS	0.62	0.38	0.59	2.13		NS	0.73	1.79	5.25	3.07	
SEm±	0.07	0.16	0.10	0.15	0.54		0.05	0.18	0.45	1.33	0.77	

DAP = Days after planting

CD = Critical difference

SEm = Standard error of mean

NS = Non significant

both under mist and open condition. In *Jasminum auriculatum*, the mother plant recorded an organic carbon content of 41.12 per cent while it was 42.18 per cent in *Jasminum grandiflorum*. It is also evident from the table that there was no significant change in the content of organic carbon under mist and open condition within a particular treatment.

In *Jasminum auriculatum*, there was a negative correlation between percentage of rooting and organic carbon content both under mist and open condition. The correlation coefficient computed in *Jasminum grandiflorum*, under mist indicated that there was a negative relation between percentage of rooting and organic carbon content while under open condition these two were found to be positively correlated though not significant (Appendic es I to IV).

The total nitrogen content of cuttings presented in Table 29 revealed that the nitrogen content decreased as rooting progressed. In both the species, there was no significant change in the nitrogen content between treatments under mist and open condition. The nitrogen content in the mother plant of *Jasminum auriculatum* was 1.03 per cent while it was 0.99 per cent in *Jasminum grandiflorum*. In *Jasminum auriculatum* both under open and mist condition

Table 1[illegible]. Organic carbon content (%) of the cuttings at fortnightly intervals

Treatments	15 days		30 days		45 days		60 days		75 days		Mean	
	Jasminum auriculatum	Jasminum grandiflorum	Jasminum auriculatum	Jasminum grandiflorum	Jasminum auriculatum	Jasminum grandiflorum	Jasminum auriculatum	Jasminum grandiflorum	Jasminum auriculatum	Jasminum grandiflorum	Jasminum auriculatum	Jasminum grandiflorum
IBA 2000 ppm												
Mist	34.16	28.12	32.16	24.12	30.14	26.12	29.18	25.12	27.16	23.12	30.56	25.32
Open	[illegible]	31.20	37.16	33.00	35.53	31.00	34.12	29.80	32.16	28.60	35.63	30.72
IBA 3000 ppm												
Mist	30.14	27.38	32.18	30.14	30.16	28.16	29.17	26.13	28.18	25.10	30.57	27.38
Open	29.16	29.80	27.16	28.60	24.14	27.15	23.14	25.42	25.90	24.80	25.90	27.15
IBA 4000 ppm												
Mist	29.18	30.14	27.14	29.18	26.14	26.16	25.00	23.10	24.80	22.14	26.45	26.14
Open	32.10	31.10	30.14	30.80	29.16	31.00	27.10	29.30	24.10	28.60	28.52	30.66
NAA 2000 ppm												
Mist	24.16	29.12	23.14	27.12	22.18	24.01	20.13	20.18	20.10	18.12	21.94	23.71
Open	18.10	28.16	19.16	27.40	18.18	26.12	18.10	26.60	18.11	25.21	18.39	26.70
NAA 3000 ppm												
Mist	38.10	30.12	37.80	30.42	34.18	30.01	30.10	24.12	32.14	23.18	34.46	27.57
Open	31.10	38.20	30.18	34.60	29.12	34.20	26.13	32.80	24.19	31.20	28.14	34.20
NAA 4000 ppm												
Mist	34.16	40.12	33.18	39.32	31.66	32.74	30.14	33.12	28.16	33.18	31.46	35.80
Open	32.40	41.12	34.16	43.20	30.16	41.20	29.12	40.20	28.16	39.80	30.80	41.10
Control												
Mist	31.80	29.12	30.70	28.12	29.30	26.12	26.40	25.12	24.30	24.12	28.60	26.53
Open	35.10	25.48	34.16	24.40	33.10	25.20	32.10	26.20	31.30	24.10	33.35	25.48

Table 19. Nitrogen content (%) of the cuttings at fortnightly intervals

Treatments	15 days		30 days		45 days		60 days		75 days		Mean	
	Jasminum auriculatum	*Jasminum grandiflorum*	*Jasminum auriculatum*	*Jasminum grandiflorum*	*Jasminum auriculatum*	*Jasminum grandiflorum*	*Jasminum auriculatum*	*Jasminum grandiflorum*	*Jasminum auriculatum*	*Jasminum grandiflorum*	*Jasminum auriculatum*	*Jasminum grandiflorum*
IBA 2000 ppm												
mist	0.92	0.61	0.91	0.60	0.91	0.59	0.91	0.52	0.91	0.50	0.91	0.56
open	0.74	0.68	0.70	0.63	0.67	0.54	0.65	0.51	0.60	0.50	0.67	0.57
IBA 3000 ppm												
mist	0.91	0.60	0.83	0.63	0.80	0.60	0.69	0.59	0.60	0.59	0.77	0.60
open	0.80	0.60	0.82	0.59	0.81	0.56	0.74	0.53	0.79	0.53	0.79	0.56
IBA 4000 ppm												
mist	0.64	0.54	0.80	0.60	0.70	0.57	0.62	0.51	0.63	0.49	0.72	0.56
open	0.81	0.63	0.83	0.62	0.81	0.60	0.80	0.59	0.79	0.54	0.81	0.60
NAA 2000 ppm												
mist	0.74	0.80	0.73	0.76	0.74	0.71	0.62	0.72	0.63	0.72	0.69	0.76
open	0.77	0.81	0.81	0.76	0.80	0.73	0.74	0.74	0.71	0.73	0.77	0.75
NAA 3000 ppm												
mist	0.81	0.81	0.80	0.72	0.81	0.71	0.79	0.70	0.74	0.62	0.79	0.71
open	0.80	0.80	0.81	0.79	0.82	0.74	0.80	0.72	0.73	0.76	0.81	0.76
NAA 4000 ppm												
mist	0.81	0.71	0.80	0.70	0.81	0.71	0.74	0.70	0.71	0.67	0.77	0.70
open	0.80	0.69	0.80	0.67	0.76	0.66	0.73	0.62	0.70	0.59	0.76	0.65
Control												
mist	0.91	0.59	0.92	0.52	0.96	0.99	0.97	0.43	0.97	0.43	0.95	0.60
open	0.73	0.52	0.74	0.54	0.72	0.54	0.70	0.52	0.71	0.52	0.73	0.53

a negative correlation was observed between total nitrogen content and percentage of rooting.

In *Jasminum grandiflorum* under mist condition there existed a negative correlation between total nitrogen content and percentage of rooting while under open condition it was found to be positively related with percentage of rooting.

The C/N ratio of cuttings is presented in Table 30. In *Jasminum auriculatum*, the C/N ratio was found to negatively correlated with percentage of rooting both under mist and open condition, though the correlation coefficient was not statistically significant.

In *Jasminum grandiflorum*, under open condition there was a positive though not significant correlation, between C/N ratio and percentage of rooting.

4.2 Propagation through layering

For layering studies only one species of jasmine viz. *Jasminum auriculatum* maintained in the All India Coordinated Floriculture Improvement Project, Vellanikkara was made use of. Layering was done at monthly intervals for a period of one year from August, 1985 to July 1986.

Table 30. C/N ratio of the cuttings at fortnightly intervals

Treatments	15 days		30 days		45 days		60 days		75 days		Mean	
	Jasminum auriculatum	*Jasminum grandiflorum*	*Jasminum auriculatum*	*Jasminum grandiflorum*	*Jasminum auriculatum*	*Jasminum grandiflorum*	*Jasminum auriculatum*	*Jasminum grandiflorum*	*Jasminum auriculatum*	*Jasminum grandiflorum*	*Jasminum auriculatum*	*Jasminum grandiflorum*
IBA 2000 ppm												
mist	37.13	46.10	35.34	40.20	33.1	44.27	31.07	48.31	[illegible]	46.24	33.50	45.02
open	51.95	45.88	53.09	52.38	53.03	57.43	51.49	58.43	53.60	57.21	53.03	54.26
IBA 3000 ppm												
mist	36.42	41.69	38.77	47.64	37.70	46.90	38.10	44.29	46.97	42.54	39.59	45.44
open	36.45	49.67	33.12	48.47	29.80	45.48	31.27	47.96	32.78	46.79	32.68	46.27
IBA 4000 ppm												
mist	34.74	47.09	33.93	48.60	37.34	41.89	42.28	41.29	38.07	41.16	37.51	48.41
open	39.63	49.37	36.31	52.90	36.08	51.67	33.88	50.51	30.51	51.96	35.27	51.48
NAA 2000 ppm												
mist	32.65	32.36	31.70	35.68	29.97	33.82	32.46	28.02	31.90	25.17	31.74	31.01
open	23.88	34.76	23.65	36.05	22.73	35.79	24.46	35.96	25.51	34.83	24.05	35.41
NAA 3000 ppm												
mist	47.14	37.19	47.25	42.25	42.20	41.11	38.10	34.41	43.43	37.39	43.61	38.71
open	34.16	47.75	37.26	43.80	35.51	46.11	31.60	45.50	33.14	41.05	34.62	44.87
NAA 4000 ppm												
mist	42.17	56.51	41.48	56.89	39.19	40.11	40.71	47.31	39.60	45.52	40.63	51.27
open	39.51	59.59	42.70	64.45	39.69	62.42	39.86	64.84	40.03	67.49	40.47	63.74
Control												
mist	34.95	49.36	33.37	54.08	31.64	26.38	40.32	52.33	[illegible]	[illegible]	33.95	47.68
open	48.95	49.00	46.10	48.89	43.97	44.67	45.86	50.38	44.79	46.35	46.33	48.24

4.2.1 Effect of growth regulators and season

4.2.1.1 Rooting of layers

The results of the statistical analysis of the data on the effect of growth regulators and season on rooting of layers are presented in Tables 31 to 33. The observations revealed that during the months of January, February, March, November and December there was no rooting at all for any of the treatments. It is evident from the data that shoots layered in April produced roots only after 90 days of layering and maximum rooting of 26.67 per cent was recorded in treatments with NAA and IBA at 100 ppm. Plants layered in May also recorded maximum rooting of 53.33 per cent with NAA 100 ppm, followed by control (50.00 per cent) and IBA 100 ppm (33.33 per cent). However, there was no significant difference between the treatments with regard to rooting. Among all the treatments tried, the highest rooting of 80 per cent was recorded on 90th day when layering was done in August with IBA 100 ppm (Plates VIII to IX).

The results of pooled analysis of the data on the effect of growth regulators on rooting of layers clearly indicated that none of the treatments was significantly different with regard

Table 31. Effect of growth regulators and season on percentage rooting of layers

Month	Interval of separation of layers	Treatments					χ^2 Value
		IAA 100 ppm	IBA 250 ppm	NAA 100 ppm	PAA 250 ppm	Control	
April	30 days	-	-	-	-	-	-
	60 days	-	-	-	-	-	-
	90 days	26.67	13.33	26.67	13.33	-	2.74^{NS}
May	30 days	-	-	-	-	-	-
	60 days	6.67	6.67	6.67	20.00	-	2.65^{NS}
	90 days	33.33	20.00	53.33	20.00	50.00	5.64^{NS}
June	30 days	-	6.67	6.67	-	-	2.27^{NS}
	60 days	20.00	53.33	26.67	33.33	66.67	5.50^{NS}
	90 days	20.00	60.00	-	33.33	50.00	14.50^{**}
July	30 days	-	-	-	13.33	-	6.61^{NS}
	60 days	13.33	-	20.00	-	-	6.43^{NS}
	90 days	20.00	26.67	20.00	33.33	-	2.33^{NS}
August	30 days	13.33	13.33	-	26.67	-	5.27^{NS}
	60 days	40.00	26.67	13.33	53.33	6.67	6.00^{NS}
	90 days	80.00	40.00	40.00	20.00	6.67	12.19^{**}
September	30 days	6.67	-	6.67	6.67	-	1.26^{NS}
	60 days	13.33	33.33	26.67	6.67	-	5.07^{NS}
	90 days	6.67	13.33	20.00	6.67	-	2.41^{NS}
October	30 days	-	-	-	-	-	-
	60 days	6.67	26.67	6.67	6.67	-	4.95^{NS}
	90 days	6.67	-	-	-	-	3.32^{NS}

NS = Non significant
** = Significant at 1 per cent level of probability

Table 32. Effect of growth regulators on percentage rooting of layers

Treatments	Interval of separation of layers		
	30 days	60 days	90 days
IBA 100 ppm	1.67	8.33	16.11
IBA 250 ppm	1.67	12.22	13.89
NAA 100 ppm	1.11	8.33	13.89
NAA 250 ppm	3.89	10.00	10.56
Control	-	8.33	10.42
Chi-square value	4.98^{NS}	2.18^{NS}	2.84^{NS}

NS = Non significant

Table 33. Effect of season on percentage rooting of layers

Month	Interval of separation of layers		
	30 days	60 days	90 days
January	-	-	-
February	-	-	-
March	-	-	-
April	-	-	18.75
May	-	9.52	32.81
June	3.17	34.92	29.69
July	3.17	7.94	23.44
August	12.70	33.33	43.75
September	4.76	19.05	10.94
October	-	11.11	1.56
November	-	-	-
December	-	-	-
Chi-square value	50.86**	122.61**	141.41**

** = Significant at 1 per cent level of probability

FIGURE 13 EFFECT OF GROWTH REGULATORS ON ROOTING OF LAYERS IN J auriculatum

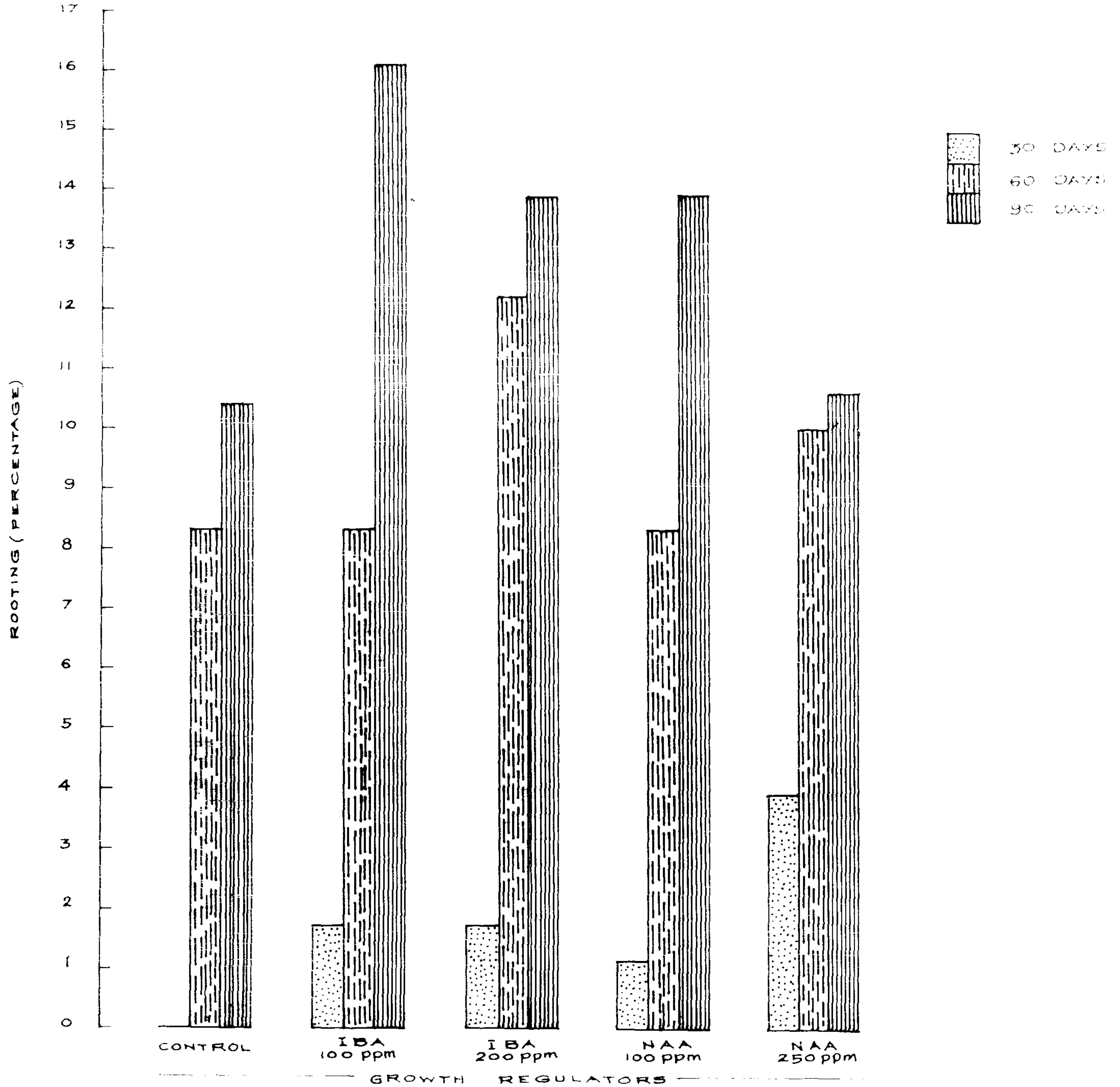
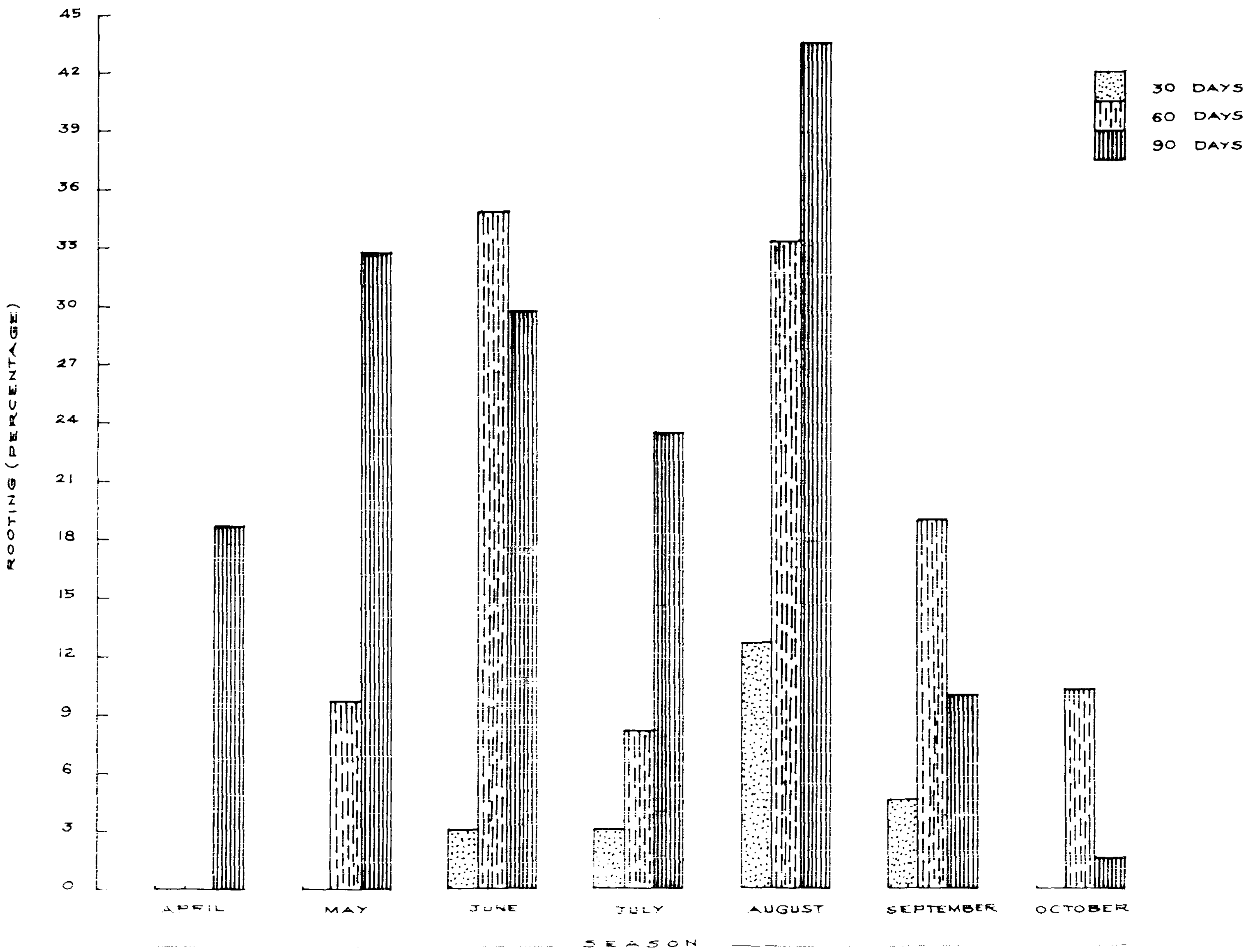


FIGURE 14. EFFECT OF SEASON ON ROOTING OF LAYERS IN *J. auriculatum*.



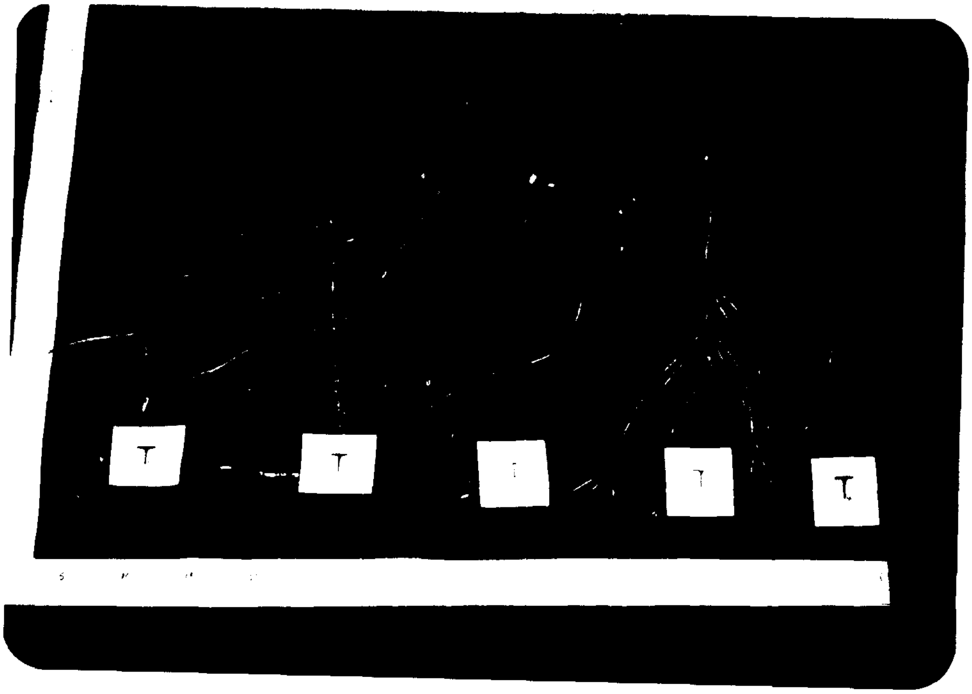


Plate XIII

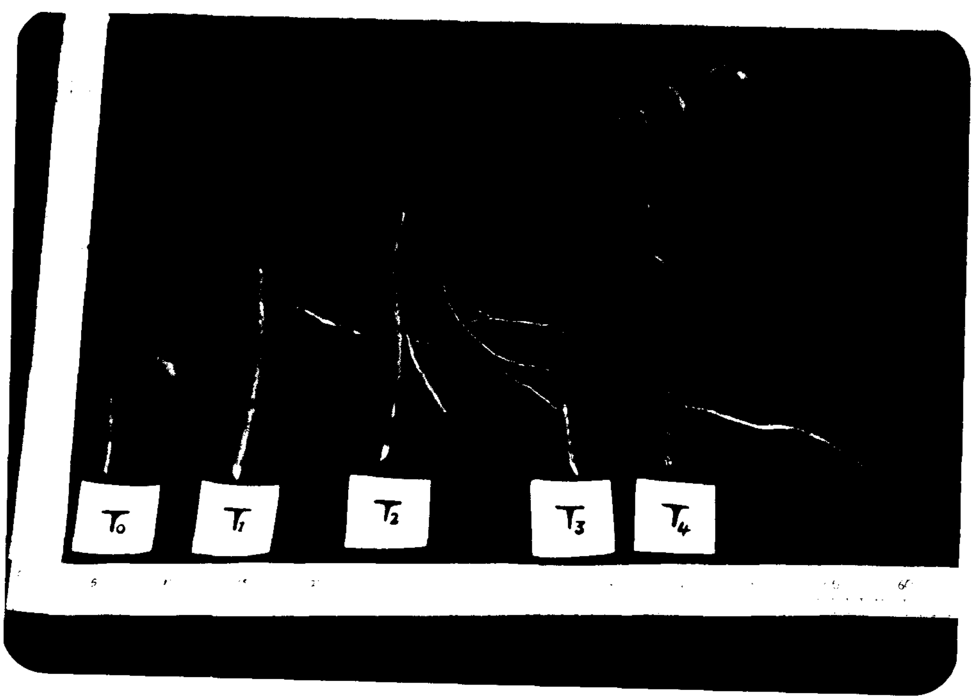


Plate XIV

to rooting (Table 32 and Figure 13). However, IBA 100 ppm produced maximum rooting (16.11 per cent) after 90 days of layering, followed by 13.89 per cent in IBA 250 ppm and NAA 100 ppm. Rooting was minimum (10.42 per cent) in control. All the growth regulator treatments produced roots within 30 days of layering where as control failed to produce any roots on the 30th day. Rooting seemed to be gradually increased as the cutting interval of layers extended from 30 to 90 days.

The pooled data on the effect of season on rooting of layers clearly indicated that rooting was mainly confined to rainy season only especially during the period from June to September, while the months of January, February, March, November and December were found to be highly unsuitable for layering when there was no rooting at all. Maximum rooting of 43.75 per cent was recorded in August (Table 33 and Figure 14) on the 90th day of layering. From August onwards there was a decrease in rooting.

4.2.1.2 Number of roots

The effect of growth regulators and season on the number of roots produced by layers are presented in Tables 34 to 36. It is evident from the tables that the number of roots was less initially but gradually increased from 30th to 90th day of

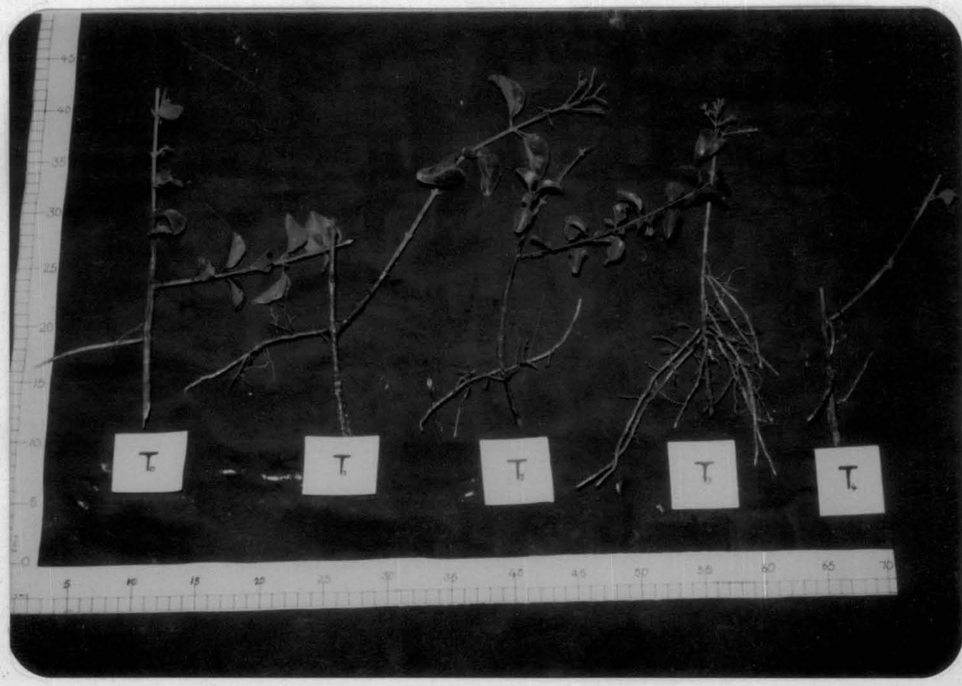


Plate VIII

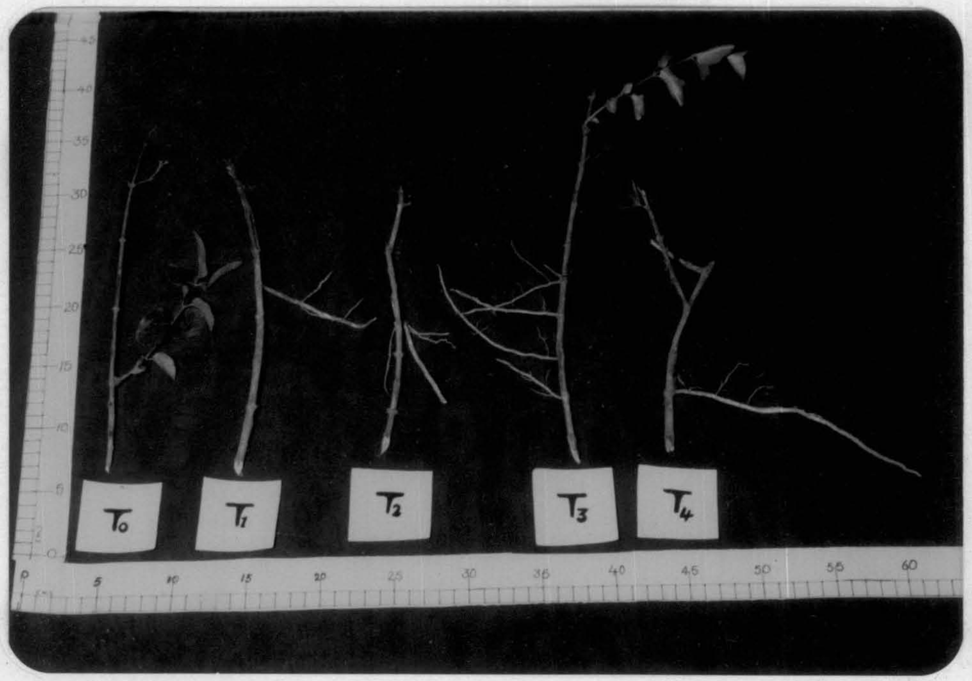


Plate IX

Table 34. Effect of growth regulators and season on number of roots/layer

Treatments	April				May				June				July			
	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean
IBA 100 ppm	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]
IBA 250 ppm	-	-	[illegible]	1.27	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]
NAA 100 ppm	-	-	1.75	[illegible]	-	[illegible]	[illegible]	1.33	[illegible]	[illegible]	-	[illegible]	-	[illegible]	[illegible]	[illegible]
NAA 250 ppm	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	1.33	-	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	1.47
Control	-	-	-	-	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	-	-	-
CD			[illegible]			[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
SEm±			0.06			[illegible]	[illegible]		[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	

Treatments	August				September				October			
	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean
IBA 100 ppm	1.50	2.17	2.50	2.06	1.00	2.00	1.00	1.33	-	1.00	1.00	0.67
IBA 250 ppm	1.00	1.25	3.00	1.75	-	1.80	2.50	1.76	-	1.50	-	0.50
NAA 100 ppm	-	2.00	2.00	1.33	1.00	2.75	1.33	1.69	-	1.00	-	0.33
NAA 250 ppm	3.00	3.50	2.00	2.83	1.00	2.00	2.00	1.67	-	2.00	-	0.67
Control	-	5.00	1.00	2.20	-	-	-	-	-	-	-	-
CD	NS	0.37	0.39		NS	NS	NS			NS	NS	
SEm±	0.04	0.07	0.07		0.02	0.05	0.04			0.03	0.01	

CD = Critical difference
SEm = Standard error of mean
NS = Non significant

Table 35. Effect of growth regulators on number of roots/layer

Treatments	Interval of separation of layers			Mean
	30 days	60 days	90 days	
IBA 100 ppm	1.33	1.87	2.13	1.78
IBA 250 ppm	1.00	1.55	3.00	1.85
NAA 100 ppm	1.50	2.53	2.32	2.12
NAA 250 ppm	2.14	3.78	4.42	3.45
Control	-	2.33	1.60	1.31
CD	NS	NS	NS	
SEm±	0.01	0.02	0.03	

CD = Critical difference

SEm = Standard error of mean

NS = Non significant

layering. The beneficial effect of growth regulators on production of roots is also evident from the tables, though the effect is not statistically significant.

The pooled analysis of the data on the effect of growth regulators on number of roots produced by layers indicated that there was no significant difference between the treatments. Among the treatments, NAA 250 ppm tended to produce maximum number of roots (4.42) on 90th day of layering followed by IBA 250 ppm (3.00) and NAA 100 ppm (2.32). The mean number at roots produced in control was only 1.31.

The pooled analysis of the data furnished in Table 36 indicated a significant effect of season on rooting of layers. Maximum mean number of roots (2.94) was produced in June followed by August (2.38) and July (2.04). There was a gradual decrease in the number of roots produced by layers from August onwards but from November to March there was no rooting at all.

4.2.1.3 Length of roots

The data presented in Tables 37 to 39 indicated the effect of growth regulators and season on length of roots produced by layers. The maximum length of roots was recorded when layers were treated with IBA 250 ppm during the month of June. From 30th

Table 36. Effect of season on number of roots/layer

Month	Interval of separation of layers			Mean
	30 days	60 days	90 days	
January	-	-	-	-
February	-	-	-	-
March	-	-	-	-
April	-	-	2.42	0.81
May	-	1.00	2.81	1.27
June	1.50	3.00	4.32	2.94
July	1.00	2.60	2.53	2.04
August	2.13	2.62	2.39	2.38
September	1.00	2.16	1.71	1.62
October	-	1.43	1.00	0.81
November	-	-	-	-
December	-	-	-	-
CD	0.06	0.15	0.18	
SEm±	0.01	0.02	0.02	

CD = Critical difference

SEm = Standard error of mean

day onwards all the growth regulator treatments produced better root growth compared to control.

The results of the pooled analysis of the observation on the effect of growth regulators on length of roots revealed that the treatments were on par with regard to this parameter (Table 38). However, treating the cut portion of the shoots with growth regulator before doing layering was found to be beneficial compared to control. IBA 250 ppm produced maximum mean length of 6.83 cm followed by NAA 100 ppm (5.47 cm) and IBA 100 ppm (5.44 cm) while control recorded a mean length of only 4.37 cm. A gradual increase in the length of roots was observed from 30th to 90th day of layering.

The profound influence of season on length of roots produced by layers is evident from the pooled data furnished in Table 39. In the present study, roots of more length were found to be produced during rainy season, from May to August. The highest mean length of roots (7.58 cm) was observed in the month of June followed by 5.70 cm in July and 5.12 cm in May. The root length was minimum during April (1.95 cm).

4.2.1.4 Fresh weight of roots

The effect of different growth regulators

Table 37. Effect of growth regulators and season on length of roots (cm)/layer

Treatments	April				May				June				July			
	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean
IBA 100 ppm	-	-	[illegible]	1.53	-	[illegible]	13.41	[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]
IBA 250 ppm	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]
NAA 100 ppm	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	-	[illegible]	[illegible]	[illegible]
NAA 250 ppm	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	5.10	[illegible]	-	[illegible]	[illegible]
Control	-	-	-	-	-	-	7.55	[illegible]	-	[illegible]	[illegible]	[illegible]	-	-	-	-
CD			[illegible]			[illegible]	[illegible]		[illegible]	4.15	[illegible]		[illegible]	[illegible]	[illegible]	
SEm±			[illegible]			[illegible]	[illegible]		0.08	0.75	0.54		0.05	0.16	[illegible]	

Treatments	August				September				October			
	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean
IBA 100 ppm	1.55	3.76	7.95	4.42	2.20	5.23	5.10	4.18	-	10.10	5.50	7.20
IBA 250 ppm	0.80	4.75	8.15	4.57	-	5.29	1.69	5.66	-	6.14	-	2.05
NAA 100 ppm	-	3.29	6.16	4.72	0.50	6.56	5.55	4.20	-	18.20	-	6.07
NAA 250 ppm	1.37	2.84	6.62	3.61	3.00	2.25	4.35	3.20	-	2.50	-	0.83
Control	-	3.42	10.10	4.54	-	-	-	-	-	-	-	-
CD	NS	NS	2.62		NS	NS	NS			NS	NS	
SEm±	0.06	0.24	0.47		0.06	0.29	0.33			0.45	0.51	

CD = Critical difference
SEm = Standard error of mean
NS = Non significant

Table 38. Effect of growth regulators on length of roots (cm)/layer

Treatments	Interval of separation of layers			Mean
	30 days	60 days	90 days	
IBA 100 ppm	1.76	6.34	8.22	5.44
IBA 250 ppm	1.93	8.63	9.93	6.83
NAA 100 ppm	1.43	6.91	8.07	5.47
NAA 250 ppm	1.89	4.16	8.34	4.80
Control	-	3.97	9.14	4.37
CD	NS	NS	NS	
SEm±	0.03	0.18	0.21	

CD = Critical difference

SEm = Standard error of mean

NS = Non significant

Table 39. Effect of season on length of roots (cm)/layer

Month	Interval of separation of layers			Mean
	30 days	60 days	90 days	
Janaury	-	-	-	-
February	-	-	-	-
March	-	-	-	-
April	-	-	5.85	1.95
May	-	4.87	10.48	5.12
June	3.28	10.22	9.23	7.58
July	2.35	4.06	10.68	5.70
August	1.28	3.55	7.55	4.13
September	1.90	5.45	7.07	4.81
October	-	8.76	5.50	4.75
November	-	-	-	-
December	-	-	-	-
CD	NS	1.17	1.45	
SEm±	0.03	0.17	0.20	

CD = Critical difference

SEm = Standard error of mean

NS = Non significant

and season on fresh weight of roots is furnished in Tables 40 to 42. The analysis of the data revealed that fresh weight of roots did not differ significantly between treatments. However, in the month of June, NAA 250 ppm tended to produce maximum mean fresh (1717.33 mg) followed by IBA 250 ppm (1127.45 mg) while the least was noticed for control (266.67 mg).

Eventhough the different growth regulator treatments did not differ significantly as indicated by the pooled analysis of the data, all of them seemed to be superior to control with regard to fresh weight of roots produced by layers. Treatment with growth regulators produced roots within 30 days of layering while no rooting was observed in control. The mean fresh weight was maximum with NAA 250 ppm (947.66 mg) followed by IBA 250 ppm (779.28 mg) and NAA 100 ppm (624.00 mg) where as in control fresh weight of roots was only 224.33 mg (Table 41). The fresh weight of roots increased as the interval of cutting of layers extended from 30 to 90 days.

The pooled analysis of the data on the effect of season on fresh weight of roots clearly indicated the profound influence of season on this parameter (Table 42). The fresh weight of roots was maximum during rainy months. The maximum record fresh weight of 1895.71 mg was noticed in the month

Table 40. Effect of growth regulators and season on fresh weight of roots (mg)/layer

Treatments	April				May				June				July			
	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean
IBA 100 ppm	-	-	432.50	144.17	-	300.00	1740.00	680.00	-	1056.67	566.67	541.11	-	155.00	1500.00	551.67
IBA 250 ppm	-	-	1740.00	580.00	-	90.00	1293.30	461.11	70.00	1011.25	1431.11	[illegible]	-	-	910.67	303.55
NAA 100 ppm	-	-	1011.30	337.10	-	340.00	1806.30	715.40	90.00	1360.11	-	483.36	-	570.00	1340.00	303.33
NAA 250 ppm	-	-	465.00	155.00	-	120.00	3780.00	1300.00	-	3210.00	1942.00	1717.33	170.00	-	1664.00	611.33
Control	-	-	-	-	-	-	475.00	158.33	-	165.00	635.00	266.67	-	-	-	-
CD			NS			NS	NS		NS	NS	559.00		NS	NS	NS	
SEm±			61.96			4.36	156.39		1.90	143.93	100.86		4.04	18.57	117.93	

Treatments	August				September				October			
	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean
IBA 100 ppm	33.55	80.05	434.42	182.67	40.20	130.25	70.00	80.15	-	480.00	60.00	180.00
IBA 250 ppm	20.25	105.80	570.00	232.22	-	286.00	1250.00	512.00	-	172.50	-	57.50
NAA 100 ppm	-	67.85	229.17	99.00	10.00	525.25	156.67	230.64	-	980.00	-	326.67
NAA 250 ppm	147.80	313.75	188.33	216.63	40.00	130.00	270.00	146.67	-	40.00	-	13.33
Control	-	260.70	160.50	140.40	-	-	-	-	-	-	-	-
CD	26.68	NS	NS		NS	NS	NS			NS	NS	
SEm±	4.81	27.22	51.58		0.96	24.29	31.73			18.98	1.00	

CD = Critical difference
SEm = Standard error of mean
NS = Non significant

Table 41. Effect of growth regulators on fresh weight of roots (mg)/layer

Treatments	Interval of separation of layers			Mean
	30 days	60 days	90 days	
IBA 100 ppm	35.77	333.39	757.69	375.62
IBA 250 ppm	36.80	731.05	1238.80	779.28
NAA 100 ppm	50.00	731.81	1108.20	624.00
NAA 250 ppm	138.74	1058.72	1645.53	947.66
Control	-	196.90	476.10	224.33
CD	9.32	NS	NS	
SEm±	1.68	27.79	38.63	

CD = Critical difference

SEm = Standard error of mean

NS = Non significant

Table 42. Effect of season on fresh weight of roots (mg)/layer

Month	Interval of separation of layers			Mean
	30 days	60 days	90 days	
January	-	-	-	-
February	-	-	-	-
March	-	-	-	-
April	-	-	855.83	285.08
May	-	176.67	1895.71	690.79
June	80.00	1747.30	1440.00	1089.10
July	170.00	404.00	1523.33	699.11
August	87.35	181.13	383.33	217.27
September	30.06	326.79	472.86	276.57
October	-	312.86	60.00	124.29
November	-	-	-	-
December	-	-	-	-
CD	NS	174.37	275.71	
SEm±	1.74	25.68	37.59	

CD = Critical difference

SEm = Standard error of mean

NS = Non significant

of May on 90th day of layering followed by 1747.30 mg in June on the 60th day of layering. However, the mean fresh weight of roots was maximum in June (1089.10 mg) while it was minimum in October (124.29 mg).

4.2.1.5 Dry matter content

From the results of analysis of the data presented in Tables 43 to 45, it is evident that growth regulator treatments have no significant effect on dry matter content of roots. However, compared to control, treatment with growth regulators seemed to be superior with regard to this parameter. NAA 250 ppm recorded maximum mean dry matter content in the month of May, June and August (Table 43). In July, maximum mean dry matter content (169.31 mg) was recorded for treatment with NAA 100 ppm while IBA 250 ppm produced maximum mean dry matter content in April (360.00 mg) and September (175.00 mg).

The pooled analysis of the data on the effect of growth regulators on dry matter content of roots furnished in Table 44 revealed that the treatments were on par. However, treatment with growth regulators tended to produce more dry matter content compared to control. On the 90th day of layering, maximum dry matter was produced in treatment

Table 43. Effect of growth regulators and season on dry matter content of roots (mg)/layer

Treatments	April				May				June				July			
	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean
IBA 100 ppm	-	-	[illegible]	[illegible]	-	60.00	312.00	124.00	-	[illegible]	176.67	100.00	-	30.00	250.00	93.33
IBA 250 ppm	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	74.44	[illegible]	[illegible]	[illegible]	[illegible]	-	-	208.33	[illegible]
NAA 100 ppm	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	-	[illegible]	[illegible]	[illegible]
NAA 250 ppm	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]
Control	-	-	-	-	-	-	[illegible]	[illegible]	-	[illegible]	[illegible]	78.33	-	-	-	-
CD			NS			NS	NS		NS	NS	NS		NS	NS	NS	
SEm±			[illegible]			[illegible]	[illegible]		[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	

Treatments	August				September				October			
	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean	30 days	60 days	90 days	Mean
IBA 100 ppm	5.71	22.81	93.50	40.68	10.00	35.00	20.00	21.67	-	100.00	15.00	38.33
IBA 250 ppm	10.00	28.75	85.00	41.25	-	88.00	175.00	87.67	-	67.50	-	22.50
NAA 100 ppm	-	15.25	52.58	22.61	0.21	77.50	38.33	38.68	-	260.00	-	86.67
NAA 250 ppm	22.70	64.54	50.00	45.75	10.00	45.00	106.00	53.67	-	10.00	-	3.33
Control	-	35.00	56.00	30.33	-	-	-	-	-	-	-	-
CD	NS	NS	35.00		NS	NS	NS			NS	NS	
SEm±	0.86	4.81	6.31		0.24	4.80	4.72			5.10	0.25	

CD = Critical difference
SEm = Standard error of mean
NS = Non significant

Table 44. Effect of growth regulators on dry matter content of roots (mg)/layer

Treatments	Interval of separation of layers			Mean
	30 days	60 days	90 days	
IBA 100 ppm	7.14	65.13	150.59	74.29
IBA 250 ppm	13.33	131.36	275.60	140.10
NAA 100 ppm	10.11	123.70	189.22	107.68
NAA 250 ppm	19.40	171.48	295.84	162.24
Control	-	21.67	129.20	50.29
CD	1.53	NS	NS	
SEm±	0.28	4.46	7.29	

CD = Critical difference

SEm = Standard error of mean

NS = Non significant

Table 45. Effect of season on dry matter content of roots (mg/layer

Month	Interval of separation of layers			Mean
	30 days	60 days	90 days	
January	-	-	-	-
February	-	-	-	-
March	-	-	-	-
April	-	-	158.33	52.78
May	-	31.67	301.67	111.11
June	20.00	265.68	366.05	217.24
July	17.50	100.00	287.00	134.83
August	15.28	39.72	76.91	43.97
September	6.74	72.08	84.43	54.42
October	-	91.43	15.00	35.48
November	-	-	-	-
December	-	-	-	-
CD	NS	28.50	52.09	
SEm±	0.20	8.20	7.10	

CD = Critical difference

SEm = Standard error of mean

NS = Non significant

with NAA 250 ppm (295.84 mg) followed by IBA 250 ppm (275.60 mg) while control produced a dry matter content of 129.20 mg only. The mean dry matter content (162.24 mg) was also found to be highest in treatment with NAA 250 ppm.

The results of the pooled analysis of the data on the effect of season on dry matter content of roots (Table 45) indicated that the dry matter production was maximum during the rainy season from May to August. On 90th day of layering, the maximum dry matter content of 366.05 mg was recorded in June followed by May (301.67 mg) and 287 mg in July. The dry matter content of roots increased gradually from 30th to 90th day of layering.

Discussion

DISCUSSION

Jasmines, one of the most important commercially cultivated ornamental crops, are grown in the homesteads of tropics and subtropics for their sweetly scented flowers and essential oil. They are mainly propagated vegetatively through cuttage and layers. Application of growth regulators at proper concentrations have been found to increase the rooting percentage of cuttings and layers in jasmine (El-Hakim, 1954; Bajpai and Parmar, 1958; Bose and Mondal, 1975; Bose *et al*., 1972 and 1975; Bryzgalova, 1974; Muthuswamy and Pappiah, 1976; Singh, 1976 and Singh and Motial, 1982). Though jasmines are difficult to root by stem cuttings, mist propagation helps significantly for root initiation and development and the rooting response has been found to vary from place to place depending upon environmental factors (Bose et al., 1972). In view of this fact it becomes necessary to standerdise the concentration of growth regulator by detailed experimentation in any particular agroclimatic situation.

5.1 Propagation through cuttings

5.1.1 Effect of growth regulators on rooting of cuttings

The results of the present studies clearly indicated that in Jasminum auriculatum the growth regulators had no significant effect on rooting of cuttings. The shy rooting behaviour of this species of jasmine even with growth regulators may perhaps be due to the presence of endogenous inhibitors that are related with root initiation. Veeraraghavathatham et al. (1983) have reported an increased activity of auxin degrading enzymes namely IAA oxidase and peroxidase in stem tissues of Jasminum auriculatum which might have contributed for the shy rooting behaviour in this species. However, in Jasminum grandiflorum there was a significant effect of growth regulators in enhancing rooting of cuttings. Among the two growth regulators tried viz. IBA and NAA, the former appeared to be more effective in terms of percentage of rooting of cuttings. A concentration of 2000 ppm IBA resulted maximum success on the 75th day of planting the cuttings. The effectiveness of auxin in general and IBA in particular for induction of rooting of cuttings have been well amplified by several workers in a variety of horticultural crops (El-Hakim, 1954; Bajpai and Parmar, 1958; Audus, 1959; Shanmugavelu, 1960; Mukhopadhyay and Bose, 1966; Umali, 1970; Bose and Mondal, 1972; Bose et al., 1972 and 1975; Bryzgalova, 1974; Kachecheba, 1975; Muthuswamy and Pappiah, 1976, Singh, 1976, 1977, 1980, 1981 and 1982; Singh and Raothre, 1977; Singh and Motial, 1979 and 1982;

Philip and Gopalakrishnan, 1981; Kumar, 1982; Verghese, 1984; Kumar and Vijayakumar, 1984 and Aishabi, 1985).

The Rooting efficiency of growth regulators are generally assessed by the number of roots produced by the cuttings and their length and weight since these parameters ultimately decide the final percentage of establishment of the rooted cuttings in the main field (Hartmann and Kester, 1975). In _Jasminum grandiflorum_, cuttings treated with IBA 2000 ppm produced maximum number of roots which is indicative of the fact that the number of roots produced has a definite bearing on the perantage of success in rooting. The external application of growth regulators would have perhaps increased the meristematic activity and root differentiation as has been reported by Pontikis _et al_. (1979). Moreover, the production of more number of roots in auxin treated cuttings is often attributed to the mobilisation of more reserve food material from the terminal to the basal portion of the cuttings (Strydom and Hartmann, 1960).

In _Jasminum auriculatum_, although the length of roots was not influenced significantly by growth regulators, cuttings treated with auxins particularly with IBA tended to produce longer roots. But in _Jasminum grandiflorum_, the effect of IBA on production of longer roots was clearly evident from the present series of studies. The beneficial effect of auxins particularly IBA in producing longer roots in cuttings of several ornamental species has been demonstrated by several workers (Kunisaki and Sagawa, 1971; Kale and Bhujpal, 1972; Bose *et al.*, 1975; Singh, 1980; Kumar, 1982 and Verghese, 1984).

The results of the present study also revealed that auxin treatment had a pronounced effect on weight of roots produced by cuttings. In *Jasminum auriculatum*, the effect was not statistically significant. On the other hand in *Jasminum grandiflorum* there was a significant effect of growth regulators on both fresh and dry weight of roots. This increase in fresh weight of roots and dry matter production by the external application of growth regulators has been well established in several other ornamental species (Beck and Sink, 1974; Kachecheba, 1975; Singh, 1982 and Singh and Motial, 1982).

Hartmann and Kester (1975) stated that in most of the plants sprouting of shoots is an indication of the root initiation in cuttings. However, in jasmine from the present study it was observed that the initial sprouting of shoots is not indicative of the root strike.

In *Jasminum auriculatum*, the vegetative growth parameters like number of leaves, primary branches and length of primary branches were not influenced significantly by growth regulators but in *Jasminum grandiflorum*, these growth parameters were highly and positively influenced particularly by IBA 2000 and 3000 ppm. The beneficial effect of IBA at higher concentrations on the production of better shoot growth in cuttings was also observed by Bose and Mondal (1972), Kale and Bhujpal (1972) and Singh (1981). Veitez and Veitez (1983) in their studies established that external application of IBA enhanced the callus tissue development which resulted better shoot development in cuttings.

5.1.2 Effect of mist on rooting of cuttings

The pooled analysis of the data indicated that in *Jasminum auriculatum*, though there was no statistical difference between the treatments, cuttings planted under mist tended to record more rooting compared to open condition throughout the course of investigation while in *Jasminum grandiflorum* the beneficial effect of mist on rooting of cuttings was highly significant. The significant increase in rooting of jasmine cuttings under mist condition has been reported by several workers (Bose *et al*., 1972; Singh, 1976 and 1980 and Singh and Motial, 1981). The superiority of mist was also clearly apparent with regard to other root growth parameters such as number, length, fresh weight and dry matter production of roots in both the species.

Mist had also profound influence on sprouting of cuttings. In both the species of Jasminum, the number of leaves and primary branches and length of primary branches were highest under mist condition. The beneficial effect of mist may be attributed to the presence of very high humidity which reduces transpiration and respiration rate. This results most ideal conditions for rooting and sprouting (Bose et al., 1972; Singh, 1976 and 1980 and Singh and Motial, 1981).

5.1.3 Organic carbon and nitrogen content of cuttings

The reduction in the content of carbon in the cuttings as the rooting progressed suggested that the carbohydrate was utilised for root production. However, its content under mist and open condition was not directly correlated with rooting in *Jasminum auriculatum*. In *Jasminum grandiflorum*, under mist condition, there was a negative correlation between organic carbon and rooting while under open condition there was a positive though not significant correlation between the two.

In *Jasminum auriculatum*, the nitrogen content of the cuttings was negatively related with rooting both under mist and open condition. Basu and Ghosh (1974) observed that rooting cofactor activity was inversely related with the nitrogen content of cuttings and rooting was maximum at low nitrogen levels.

In the present study there was no significant correlation between C/N ratio and rooting of cuttings which is in agreement with the results obtained by Fahn (1983) who also did not observe any significant effect of C/N ratio on rooting of cuttings.

5.2 Propagation through layering

5.2.1 Effect of growth regulators on rooting of layers

In the present study, it was observed that growth regulators did not significantly improve the rooting of layers. However, compared to control all the growth regulator treatment seemed to be slightly superior with regard to rooting. Among the growth regulators tried, IBA particularly at 100 ppm produced maximum rooting. The beneficial effects of IBA on rooting of layers have been demonstrated by several workers in various ornamentals (Lingaraj, 1960; Raman *et al*., 1969; Venkata Rajappa *et al*., 1978; Mithra *et al*., 1980; Misra and Majumdar, 1983; Channaveerappa and Gowda, 1984; Tewari and Pathak, 1984).

With regard to number, length, fresh weight and dry matter production of roots, all the growth regulator treatments were found to be superior to control though their effect was not statistically significant. This is in agreement with the reports made by several workers in various ornamental and fruit plants (Chhonkar and Singh, 1967; Raman *et al.*, 1969 and Lingarappan, 1982). The beneficial effect of growth regulators in rooting may be attributed to the hormonal effect and accumulation of other internal rooting substances at the layered portion.

5.2.2 Effect of season on layering

In the present study, it was observed that rooting of layers was confined to rainy season only particularly during the period from June to September. The number, fresh weight and dry matter production of roots were also maximum during this period. Studies conducted on jasmine at Agricultural College and Research Institute, TNAU, Coimbatore (1970) have also well established the suitability of rainy season for layering operation. The beneficial effect of season may be attributed to the reduced soil temperature and high humidity which make ideal conditions for the differentiation of callus to roots. Shippy (1930) stated that low moisture and humidity prevailing during summer months inhibit callus formation and result cell desiccation. The present study indicated that the season of operation is slightly critical for the ultimate success in layering. However, further studies to find out the role of inhibitory substances present in the shoots may perhaps yield fruitful results.

Summary

SUMMARY

The present investigations on the effect of growth regulators on rooting of cuttings and layers in jasmine were carried out in the Department of Pomology and Floriculture, College of Horticulture, Vellanikkara during the period of August 1985 to October 1986. The salient results of the studies are summarised below:

1) In *Jasminum auriculatum*, all the treatments were on par with regard to rooting of cuttings while in *Jasminum grandiflorum* rooting was significantly influenced by growth regulators compared to control. Among all the treatments, IBA 2000 ppm recorded maximum rooting followed by IBA 3000 ppm.

   In both the species of Jasminum, with regard to other root growth parameters viz. number, length, fresh weight and dry matter production, IBA treatments in general were found to be superior to NAA and control

2) In *Jasminum auriculatum*, vegetative growth parameters in terms of number of leaves and primary branches and length of primary

branches were maximum in control while in *Jasminum grandiflorum* treatment with IBA resulted maximum with regard to these parameters.

3) Irrespective of the growth regulator treatments, mist had profound influence on rooting of cuttings as well as vegetative growth parameters in both the species of Jasminum studied.

4) Organic carbon, nitrogen as well as C/N ratio were negatively correlated with rooting of cuttings in *Jasminum auriculatum* and *Jasminum grandiflorum*.

5) Layering studies carried out in *Jasminum auriculatum* proved the superiority of all the growth regulator treatments over control with regard to rooting though their effect was not statistically significant. Among the treatments IBA 100 ppm recorded maximum rooting on 90th day of layering whereas the longest roots were produced in treatment with IBA 250 ppm. Rooting seemed to be gradually increased as the cutting interval of layers extended from 30 to 90 days.

Other root growth parameters viz. number, fresh weight and dry matter production of roots were maximum with NAA 250 ppm.

6) Regardless of the growth regulator treatments, rooting was mainly confined to rainy season particularly the period from June to September, while the months of January, February, March, November and December were found to be highly unsuitable for layering when there was no rooting at all. Number, fresh weight and dry matter production of roots were also maximum during the rainy season.

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* Originals not seen

Appendices

Appendix - I Correlation matrix among organic carbon content, total nitrogen, C/N ratio and percentage of rooting of cuttings of *Jasminum auriculatum* under mist condition

	Total nitrogen	C/N	Percentage of rooting
Organic carbon	0.397	0.749	- 0.746
Total nitrogen		-0.276	- 0.577
C/N ratio			- 0.320

Appendix - II Correlation matrix among organic carbon content, total nitrogen, C/N ratio and percentage of rooting of cuttings of *Jasminum auriculatum* under open condition

	Total nitrogen	C/N	Percentage of rooting
Organic carbon	- 0.590	0.967	- 0.447
Total nitrogen		-0.775	- 0.048
C/N ratio			- 0.334

Appendix - III Correlation matrix among organic carbon content, total nitrogen, C/N ratio and percentage of rooting of cuttings of _Jasminum grandiflorum_ under mist condition

	Total nitrogen	C/N	Percentage of rooting
Organic carbon	0.1997	0.637	- 0.338
Total nitrogen		- 0.606	- 0.351
C/N ratio			- 0.027

Appendix - IV Correlation matrix among organic carbon content, total nitrogen, C/N ratio and percentage of rooting of cuttings of _Jasminum grandiflorum_ under open condition

	Total nitrogen	C/N	Percentage of rooting
Organic carbon	0.317	0.706	0.485
Total nitrogen		- 0.445	0.274
C/N ratio			0.255

EFFECT OF GROWTH REGULATORS ON ROOTING OF CUTTINGS AND LAYERS IN JASMINE

(Jasminum auriculatum Vahl.)

By

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ABSTRACT OF A THESIS

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ABSTRACT

Systematic studies were carried out to standardise various aspects of asexual propagation in jasmine through cutting and layering. For propagation studies using cuttings, semihard wood cuttings of *Jasminum auriculatum* and *Jasminum grandiflorum* were treated with IBA and NAA each at 2000, 3000 and 4000 ppm concentrations and planted under mist and open conditions. The results revealed that all the auxin treatments particularly IBA were superior to control with regard to rooting percentage. Other root growth parameters such as number, length, fresh weight and dry matter production of roots were also maximum with IBA treatments. However, in *Jasminum auriculatum*, the effect of growth regulators was not statistically significant and this may be attributed to the shy rooting behaviour of this species due to some endogenous inhibitors.

Regardless of the growth regulator treatments mist had profound influence on root growth as well as vegetative growth parameters in both the species of Jasminum studied.

To find out the effect of growth regulators and season on rooting of layers, layering was done at monthly intervals with IBA and NAA each at a concentration of 100 and 250 ppm. The results

indicated that all the growth regulator treatments were superior to control with regard to rooting percentage, number, length, fresh weight and dry matter production of roots.

Study on seasonal effect on success of layering has clearly shown that layering should be done during the rainy season particularly from June to September for getting maximum success. However, further studies to find out the role of inhibitory substances present in the shoots which cause failure of rooting of cuttings and layers may perhaps yield valuable results.