“STANDARDIZATION OF PRUNING AND PROPAGATION TECHNIQUE IN ARABIAN JASMINE (*Jasminum sambac*)”

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Dr. Y.S.R. HORTICULTURAL UNIVERSITY

OCTOBER, 2013

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By

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B. Sc. (Hons.) Horticulture

THESIS SUBMITTED TO THE

Dr.Y.S.R. HORTICULTURAL UNIVERSITY

IN PARTIAL FULFILMENT OF THE REQUIREMENT

FOR THE AWARD OF THE DEGREE OF

MASTER OF SCIENCE IN HORTICULTURE

(FLORICULTURE AND LANDSCAPE ARCHITECTURE)

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Dr. Y.S.R. HORTICULTURAL UNIVERSITY

OCTOBER, 2013

DECLARATION

I, Mr. R. POORNA CHAITANYA, hereby declare that the thesis entitled **"Standardization of pruning and propagation technique in Arabian jasmine (*Jasminum sambac*)"**submitted to the Dr. Y.S.R. Horticultural University, Venkataramannagudem, for the degree of Master of Science in Horticulture(Floriculture and Landscape Architecture) is the result of original research work done by me. I declare that no material contained in the thesis has been published earlier in any manner.

Place: Venkataramannagudem **Name:** R. POORNA CHAITANYA

Date: **I.D.No:**VHM/11-10

CERTIFICATE

Mr. R. POORNA CHAITANYA has satisfactorily prosecuted the course of research and that the thesis entitled **"Standardization of pruning and propagation technique in Arabian jasmine (*Jasminum sambac*)"**submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination.

I certify that neither the thesis nor its part thereof has been previously submitted by him for a degree of any university.

Place: Venkataramannagudem **(C. CHANDRASEKHARA RAO)**

Date: **Chairman**

CERTIFICATE

This is to certify that the thesis entitled "**Standardization of pruning and propagation technique in Arabian jasmine (*Jasminum sambac*)**"submitted in partial fulfillment of the requirements for the degree of Master of Science in Horticulture (Floriculture and Landscape Architecture) of Dr.Y.S.R. Horticultural University, Venkataramannagudem, is a record of the bonafide research work carried out by Mr. R. POORNA CHAITANYA under our guidance and supervision.

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

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ACKNOWLEDGEMENTS

Accomplishment of this thesis is the result of benevolence of ***LORD JESUS CHRIST,*** *blessings of* **my teachers** *and love of* **my parents**.

I fall in short of words in expressing mere gratitude and sincere regards and heartfelt thanks to my Major Advisor and Chairman of Advisory Committee ***Dr. C.CHANDRASEKHARA RAO,*** *Associate professor, Department of Horticulture, Horticultural College and Research Institute, V.R. Gudem for his encouragement and moral support showed on me and inspiring guidance, scientific proficiency, constructive criticism, constant encouragement and whole hearted cooperation in the preparation of this manuscript. I further wish to express my bountiful appreciation and thanks for the pains he has taken for critically going through the manuscripts and for the assistance rendered during the preparation of the thesis.*

I am extremely thankful and sincere gratitude to ***Dr. V. SUCHITRA,*** *Scientist, Department of Horticulture, Vijayarai and member of my Advisory Committee who rendered valuable help, suggestions, genuine cooperation and constant encouragement provided at every stage of the thesis preparation.*

I am humbly offer my sincere thanks to ***Dr. D. R. SALOMI SUNEETHA*** *Associate Professor, Department of Biochemistry, Horticulture College and Research Station, Venkataramannagudem, and member of my Advisory Committee, for his counsel esteemed suggestions, timely help and attention bestowed in the production of thesis.*

I am thankful to ***Dr*. *D. SRIHARI,*** *Dean of PG studies for their constructive criticism during my research work.*

I am greatly beholden of vocabulary and owe a deep of honour to my beloved parents ***Sri R.J.C. Prakash Babu*** *and* ***Smt. Vijaya Kumari*** *and* ***Sri R.I.V. Prasad Babu*** *and* ***Smt. Kezia*** *for their love and dedicated efforts in shaping my career since childhood. There is no match to the affection and cooperation given to me by my beloved sisters* ***Raja Vardhini, Sowjanya****, and my brothers* **Anand, Sukumar.**

I have no words to express my deep of honour towards my grandparents ***Late.R.Paul raj and P. Sakkubai*** *for their love and building my career step by step from my secondary education to professional degree.*

I feel in dearth of diction to express my thankfulness to my friends ***Shankar, Baburao, Ajay, Sahitya, Kranthi, GangadharRao, Rohith, Janaki, Ratnamala, Anitha, Lakshmidurga, Vardhini, Chandana, Ravikiran*** *& beloved juniors* ***Raviteja, Shiva kedari, Prabhanth, Chandra Surya, Swagath, Rajeev Reddy, Lokesh, Sravan, Bhanukiran, Shaheel, N.Sudheer, D.Sudheer, Srinivas, Durganaik*** *who was really showed magnificent support and affection in all the situations in completing my thesis and research work .*

I wish to take this opportunity to thank all my seniors ***Vijay, Durgaprasad, Sivakumar, Harshavardhan*** *and classmates for their co-operation and whole hearted help during the course of investigation.*

I am also thankful to the Teaching and Non-Teaching Staff members of Horticultural College and Research Institute, Venkataramannagudem, Dr. Y.S.R.H.U, of their help and cooperation during the course of my research work.

My sincere thanks are also to those who helped me directly or indirectly during my work that I couldn't include individually.

I am overwhelmed with gratitude to all my respondents, without whose whole hearted co-operation, this study would not have been fruitful.

I extend my gratitude to the Dr.Y.S.R. Horticultural University, Venkataramannagudem for providing financial support in the form of stipend during my course of study.

Venkataramannagudem

Date: ***(REVULAGADDA POORNA CHAITANYA)***

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LIST OF SYMBOLS AND ABBREVIATIONS

%	:	per cent
&	:	and
/	:	per
@	:	at the rate of
<	:	Less than
>	:	Greater than
^{0}	:	Degrees
^{0}C	:	Degree Celsius
A.P.	:	Andhra Pradesh
CBR	:	Cost Benefit Ratio
C: N ratio	:	Carbon to Nitrogen ratio
CD (P=0.05%)	:	Critical Difference at 5 per cent level
cm	:	Centimeter
cm^2	:	square centimeter
cv.	:	Cultivar
DAP	:’	Diammonium phosphate
Dr. YSRHU	:	Dr Y S Rajasekhar Reddy Horticultural University
dSm^{-1}	:	Decisiemen per metre
E	:	East
EC	:	Electrical conductivity
et al.	:	and others
etc.,	:	and so on; and other people/things
F. test	:	Fisher’s test
Fig.	:	Figure
FRBD	:	Factorial Randomized Block Design

FYM	:	Farm yard manure
G	:	Genotype
g	:	gram
h	:	Hour
ha	:	Hectare
HC & RI	:	Horticulture College and Research Institute
HRS	:	Horticulture Research Station
i.e.,	:	that is
IAA	:	Indole, 3 Acetic Acid
IBA	:	Indole Butyric Acid
INR	:	Indian National Rupees
kg ha^{-1}	:	kilogram per hectare
kg	:	kilogram
KNO_3	:	Potassium Nitrate
L	:	Liter
LA	:	Leaf area
m	:	meter
m^2	:	meter square
Max	:	Maximum
mg	:	milligram
Min	:	Minimum
mm	:	millimeter
MOP	:	Muriate of potash
MSL	:	Mean Sea Level
N	:	North
NaCl	:	Sodium Chloride
no.	:	Number

NS	:	Non-Significant
P.M	:	After noon/ Post Meridian
pH	:	puissance de hydrogen
PH	:	Plant height
ppm	:	Parts per million
PQD	:	Paraquat Dichloride
RBD	:	Randomized Block Design
RH	:	Relative humidity
Rs	:	Rupees
S. Em ±	:	Standard error mean ±
SSP	:	Single Super Phosphate
t	:	Tonne
t/ha	:	Tonne per hectare
viz.,	:	Namely
W. G. Dist.	:	West Godavari District
X	:	Grand mean

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Title of thesis : **"STANDARDIZATION OF PRUNING AND PROPAGATION TECHNIQUE IN ARABIAN JASMINE (*Jasminum sambac*)"**

Degree to which it is

submitted : **MASTER OF SCIENCE IN HORTICULTURE**

Faculty : **HORTICULTURE**

Department : **FLORICULTURE AND LANDSCAPE ARCHITECTURE**

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Year of submission : **2013**

ABSTRACT

The present experiment entitled **"STANDARDIZATION OF PRUNING AND PROPAGATION TECHNIQUE IN ARABIAN JASMINE (*Jasminum sambac*)"**was carried out during November 2012 to June 2013at Horticultural College and Research Institute, Dr. Y.S.R. Horticultural University, Venkataramannagudem, West Godavari district of A.P.The present investigation was taken up in three experiments *i.e.,*

i) Effect of pruning date and intensity of pruning on growth and flowering of *Jasminum sambac* genotypes.

ii) Effect of defoliating chemicals (chemical defoliation) on growth and flower yield of *Jasminum sambac.*

iii) Effect of auxin concentration and number of nodes on rooting and per cent establishment of *Jasminum sambac* cv. "Double Mogra".

The experiment (i) was laid out in split plot design replicated thrice with 36 treatment combinations, comprising of three genotypes (main treatments)*viz.,* Nityamalli (T_1), Tuppamalli (T_2) and Starmalli (T_3) at three different pruning dates (sub treatments)*viz.,* pruning in November 10th of 2012 (ST_1), December 10th of 2012 (ST_2), January 10th of 2013 (ST_3) and four levels of pruning heights(sub - sub treatments) *viz.,* 25 cm from ground level (SST_1), 50 cm from ground level (SST_2), 75 cm from ground level (SST_3) and un pruned bushes (SST_4). The experiment (ii) was laid out in Randomized Block Design replicated thrice with16 treatment combinations Three genotypes or local varieties of *Jasminum sambac* Nityamalli (T_1), Tuppamalli (T_2) and Starmalli (T_3) with 16 chemical concentrations *viz.,* manual defoliation, paraquat dichloride (500ppm, 1000ppm, 1500ppm, 2000ppm and 2500ppm), sodium chloride (1000ppm, 2000 ppm, 3000 ppm and 4000 ppm),potassium nitrate (1 %, 2 %, 3 %, 4 % and 5 %)and control (water spray).The experiment (iii) was laid out in Factorial

Randomized Block Design replicated thrice with 16 treatments *viz.*, Factor 1: number of nodes T_1: 1st node, T_2: 2nd node, T_3: 3rd node and T_4: 4th node. Factor 2: chemical concentrations (IBA) C_1: 1000 ppm, C_2: 2000 ppm, C_3: 3000 ppm and C_4: control.

Among the genotypes, Nityamalli pruned in December'12 at 50 cm height from ground level has exhibited the highest the number of laterals per primary shoot, productive shoots per plant, leaves per primary shoot, leaf area per shoot, number of petals per flower, flower bud diameter, weight of flower buds/plant (g), weight of flower bud/m^2 plot (kg) and weight of flower bud/hectare (tonnes). Whereas the trait, days to flower bud development was recorded minimum in Nityamalli pruned in January'13 at 75 cm height from ground level. The duration of flowering was more in Nityamalli pruned in November'12 at 50 cm height from ground level.

The traits *viz.*, longer primary shoot length, shoot thickness and weight of 50 flower buds were found to be elite in Tuppamalli pruned in December'12 at 50 cm height from ground level. Maximum flower bud length was recorded in Tuppamalli pruned in January'13 at 25 cm height from ground level. Characters *viz.*, inter nodal length and days to first flower bud initiation after pruning was recorded minimum in Starmalli pruned in January'13 at 75 cm height from ground level. Among all the interaction treatments, Nityamalli pruned in December'12 at 50 cm height from ground level was found to be elite for maximum characters.

In experiment (ii) the traits *viz.*, weight of defoliated leaves and total arial biomass per plant was recorded high in Tuppamalli sprayed with 1000 ppm Paraquat dichloride. The days taken for complete defoliation was recorded minimum in the genotype Starmalli sprayed with 2500 ppm paraquat dichloride. The days taken for new leaf emergence after chemical defoliation was recorded minimum in the genotype Nityamalli sprayed with 2000 ppm paraquat dichloride. The highest flower yield per plant was obtained in the genotype Nityamalli sprayed with 1000ppm Paraquat dichloride. Hence, the treatment Paraquat dichloride @1000ppm would be recommended to the farmers.

In experiment (iii) the 3rd node cuttings treated with IBA @ 2000 ppm exhibited significant increase in rooting percentage, root length, root number, root fresh weight, maximum sprout diameter, fresh and dry weight of rooted cuttings. The traits *viz.*, number of days taken for sprouting and propagation cycle was recorded minimum in 3rd node cuttings treated with IBA @ 2000 ppm. Whereas 4th node cutting treated with 2000 ppm of IBA and 3rd node cutting treated with 3000 ppm of IBA has obtained more number of sprouts and maximum number of leaves per cutting. Among all the treatment combinations, 3rd node cutting treated with IBA @ 2000 ppm has shown best results regarding maximum traits.

Chapter I

INTRODUCTION

Jasmine was one of the important fragrant flowers used even from very ancient days in India. It was highly esteemed for its attractive, white coloured and a fragrant flower has a pride of place in the heart of every south Indian woman. In Fragrance industry, jasmine has unique importance and popularity due to its unique odour like that of Rose, vettiver and represents a type that cannot be exactly imitated at present by a mixture of any known synthetic aroma chemicals or natural isolates. It would be necessary that Government of India should consider the export oriented jasmine industry as a thrust area for growth and support. In India, the flowers were harvested manually at well-developed but still unopened buds for both fresh loose flower market and concrete (Essential oil) extraction. The extracts of jasmine used for flavouring or preparation of ‘Jasmine scented Tea’ in China, ‘Jasmine rice’ in Bangkok, Thailand. The antioxidant properties, potential to induce weight loss and to reduce serum and hepatic lipid levels through increase of leptin level, address the burning problems of fattiness and obesity (Li Zhen *et al.* 2011). Jasmine will definitely emerge as an important “Industrial flower crop”. The essential oil was being used in cosmetic, perfumery, source of aroma chemicals and food flavouring industries.

Jasmine was grown globally ‘Grasse region’ of Southern France, Syria, Algeria, Sicily, Calabria and Morocco apart from India. India exports fresh jasmine flowers to the neighbouring countries like Sri Lanka, Singapore, Malaysia and the Gulf. Jasmine flower crop was grown on commercial scale throughout India but extensively in Tamil Nadu (14,318 ha area and 1, 17,848MT production, 2010-11), Karnataka (12,000 ha), Andhra Pradesh (10,440 ha area and 52,101MT), Uttar Pradesh, around Lucknow (600ha), Maharashtra and West Bengal in an area of 40,000 ha (*www.indostat.com*, 2011). In Andhra Pradesh, jasmine was grown extensively in Krishna, Guntur, Chittor, Ananthapur, Kurnool, Medak and Ranga Reddy districts. Specialized jasmine flower market was located at vedullapalli, near Bapatla, Guntur district.

Jasminum sambac was commonly known as the “Arabian Jasmine” or “Tuscan Jasmine” belongs to the family oleaceae. The term Jasmine was derived from Arabic word ‘Jessamine’ (Bailey, 1947). *Jasminum sambac* was distributed in Andhra Pradesh, Karnataka, Tamil Nadu and to some extent in West Bengal states of India (Randhawa and Mukhopadhyay, 1986).This species grow both in plains and hills up to 3,030 m above MSL. Hence, the great extent of variability was available in *J. sambac* from this region. The distribution pattern of as many as 72 out of 89 species found in India, Malaysia and China, about 40 species reported to occur in India (Bhattacharjee, 1980) provides a strong base to claim that India might be one of the primary centres of origin of jasminum species. The commercially important species grown for its loose flowers and perfumery industry were *J. sambac*, *J. grandiflorum* and *J. auriculatum* (Rimando, 2003).

The jasmine is evergreen twiner or dwarf growing shrub, leaves simple, opposite or in threes, cordate to oblong almost sessile having wavy margins and dark green in colour. Flowers are white, highly scented, borne in clusters of 3-12, usually in small, three forked cymes. Flowers based on number of whorls are single, semi double, small double, the large double and perfectly double like a white rose with 8-10 whorls in cultivar Double Mogra. The shrubs were pruned to regulate growth in untidy bushes and encourage flower production as flowering was observed on current season growth. The pruning date and pruning intensity also influences quality and quantity of flower production. Defoliation of old leaves reduces epical dominance, promotes sprouting of auxiliary buds, enhances continuous and synchronous flowering. Manual defoliation was a labour intensive practice which increases cost of production due to increased labour wages to a great extent in recent years. Regulation of flowering in jasmine has great commercial and practical value due to seasonal nature of flowering and peak productivity confined to certain months of the year was a major problem in jasmine flower production.

In the present scenario of increased labour wages, unavailability of labour force timely increases cost of production. To reduce the cost of production and performing timely defoliation of jasmine bushes for obtaining off season flower production chemical defoliants need to be identified. Hence, it is the need to identify the effective chemical with maximum defoliation at low concentration without affecting plant growth and crop productivity, biologically safe, eco-friendly without disturbing the ecological niche in long run and without chemical residues in the end product.

Being industrial flower crop large quantities of flowers need to be produced continuously for longer period of the year to meet the break even production of essential oil industry. Hence, flower production programme need to be scheduled and will further escalate the area under this important jasmine flower crop. To achieve large quantitative production requirement of flowers either by area expansion *i.e.*, larger areas need to be planted and increasing productivity. These activities require uniform, vigorous and healthy, pest and disease free planting material in large numbers. To provide the quality planting material in sufficient quantity at appropriate price to the growers, quick, cost effective and efficient mass multiplication technique need to be standardised. Keeping the above points in view, the research proposal was formulated with the following objectives.

Objectives:

1. To extend the period of availability of flowers in the market *i.e.*, off-season flower production.
2. To identify a jasmine genotype or local varieties for higher flower yield.
3. To standardize pruning technique for higher flower productivity in *Jasminum sambac*.
4. To standardize propagation technique for quick and cost effective and efficient mass multiplication of *Jasminum sambac* cv. “Double Mogra.

Chapter II

REVIEW OF LITERATURE

Jasmine is an ancient fragrant flower grown from time immemorial, which was mentioned in “Rigveda” as Puu and its depictions, conveys the message that jasmine was the most accepted and familiar among the ancient people. This provides the strong basis to prove this important flower crop originated from India apart from the large diversity for number of species, varieties and strains to obtain Geographical Indicator recognition under World Trade Organization. A wide range of diversity exists in flower shape, size, colour and fragrance among different cultivars. Among the different species of *Jasminum grandiflorum*, *J. auriculatum* and *J. sambac* grown for commercial purposes. *Jasminum grandiflorum*, *J. auriculatum* grown for essential oil extraction purpose whereas *J. sambac* for loose flower production. The world famous jasmine oil extracted from *Jasminum grandiflorum.* Arabian jasmine (*Jasminum sambac*) species distributed extensively in Karnataka and Andhra Pradesh states, the variability or strains need to be collected, conserved for future use and obtaining Geographical Indicator status of jasmine species a detailed study need to be conducted.

In this chapter the review of literature pertaining to the pruning, defoliation and propagation through stem cuttings of jasmine. Since, information available on jasmine on these species was very scanty. Hence, information available on other related flowers regarding growth, flowering and yield attributes under varied agro-climatic conditions have been compiled to enable better understanding of the varieties, pruning, propagation and suitable growth conditions.

2.1 Effect of pruning date and intensity of pruning on growth and flowering of *Jasminum sambac g*enotypes.

2.2 Effect of defoliating chemicals (chemical defoliation) on growth and flower yield of *Jasminum sambac*.

2.3 Effect of auxin (IBA) concentration and number of nodes on rooting and percent establishment of *Jasminum sambac* cv. "Double Mogra".

2.1EFFECT OF PRUNING DATE AND INTENSITY OF PRUNING ON GROWTH AND FLOWERING OF *Jasminum sambac* GENOTYPES

General importance of pruning

Though pruning was one of the oldest cultural practices, it is the least understood of the horticultural practices (Gardner, 1951). Pruning was an important practice normally done in deciduous and temperate ornamental crops such as rose, to bring about a balance in vegetative and reproductive functions of the plant for better results. The extent and intensity of pruning on the same shrub varies from year to year, depending on the growth of the shrubs, its bearing habit and season, even time of pruning plays an important role in getting higher yield. The following were the main objectives of pruning according to Gardner (1951).

To maintain the growth and vigour of the shrubs and to maintain a balance between the vegetative vigour and flowering so as to be conducive for production of optimum crop of best quality. To regulate the size and quality of produce by way of proper distribution of the flowering area, to regulate the succession of crop and to spread the shrub or tree for convenience of economy in orchard management.

2.1.1 Primary shoot length

Mendhe *et al*. (2011) observed significantly superior increase in plant height (76.45 cm) in rose (*Rosa indica* L.) cv. Gladiator pruned at 60 cm from ground level.

Abdou and Badran (2003) observed the greatest plant height when pruned on 20 December, whereas pruning on 20 February gave the lowest values in *Jasminum sambac*.

Sumangala *et al*. (2003) found longer primary shoot length of 153.3 cm when pruned in mid December on six years old plants of *Jasminum sambac*.

Jadhav*et al.* (2003) observed highest flowering shoot length in hard pruning (70.45 cm) and lowest in the control (50.99 cm) in Rose cv. First Red.

Siddagangaiah and Muthapparai (1988) recorded significantly longer primary shoot length in *Jasminum sambac* bushes pruned in March, April and May.

Moe (1973) observed very severe pruning to one dormant bud or light pruning to six or seven buds resulted in shorter stems as compared to less severe pruning to three dormant buds in Rose cv. *Baccara, Zarina* and Larel.

Depauw (1975) revealed the stem length was slightly affected by the time of pruning in rose.

Lindenman (1972) observed longer stem length in severe pruning as compared to unpruned plants in rose.

2.1.2 Shoot thickness (cm)

Anil (2009) recorded maximum diameter of shoot in bushes pruned with retaining 7 basal shoots per plant in rose.

Mendhe *et al.* (2011) observed maximum flowering shoot diameter in bushes pruned at 10 cm from ground level in Hybrid Tea Rose cv. Gladiator.

Siddagangaiah and. Muthapparai (1988) observed more stem thickness in bushes pruned in March, April and May and the lowest in August, June pruned bushes in *Jasminum sambac*.

Holley (1973a) reported that the thickness of flower cane (basic arm) influences the stem length of cut flowers rose, for each millimeter increase in diameter of flower cane increased 10cm in cut stem length of Rose.

2.1.3 Inter nodal length (B/W 3rd and 4th inter node) cm

Siddagangaiah and Muthapparai (1988) reported more inter nodal length in March, April and May pruned bushes of *Jasminum sambac*.

2.1.4 Number of laterals

Sumangala *et al*. (2003) observed more number of laterals (9.0) per primary shoot in mid-December pruned six year old plants of *Jasminum sambac*.

Abdouand Badran (2003) found more number and diameter of lateral branches through pruning on 20th December in *Jasminum sambac*.

Bal and Gupta (1956) observed more lateral branching and flowering, through pruning the plants during January to February and July month in *Jasminum auriculatum*.

2.1.5 Number of productive shoots

Sumangala *et al*. (2003) found more number of productive shoots (204.8) in mid-December pruned plants of six years old in *Jasminum sambac*.

Muthuswamy *et al.* (1973) observed the pruning promoted appreciably large quantum of productive shoots per plant (7.45 in pruned plants against 1.02 in controls) in *Jasminum sambac*.

2.1.6 Number of leaves per primary shoot

Sumangala *et al*. (2003) revealed more number of leaves per primary shoot in early mid-pruning (December) in *Jasminum sambac*.

Abdou and Badran (2003) reported that pruning on 20 December recorded more number, area and fresh weight of leaves, whereas pruning on 20 February gave the lowest values for these parameters in *Jasminum sambac*. The last week of November pruning produced plants with a significantly lower number of leaves per primary shoot in *Jasminum auriculatum* (Hugar and Nalawadi, 1994)

2.1.7 Leaf area (cm^2) per shoot

Mendhe *et al*. (2011) obtained maximum leaf area per flowering shoot (1306.18 cm^2) was pruned at 10 cm from ground level in rose cultivar Gladiator

Sumangala *et al*. (2003) observed more leaf area per shoot (63.6 m^2/shoot) in six year old bushes pruned in mid-December of *Jasminum sambac*.

Hugar and Nalawadi (1994) recorded significantly higher leaf area per plant pruned in the last week of November of *Jasminum auriculatum*.

2.1.8 Days to first flower bud initiation

Nair *et al.* (2009) reported that September pruned plants recorded the minimum number of days for bud initiation and maximum in November pruned plants (53.2 days) in *Jasminum sambac.*

Sumangala *et al.* (2003) observed the days taken for initiation of flowering was more in bushes pruned in November and comparatively decreased in December and January pruned bushes of *Jasminum sambac*.

Sharma and Singh (1991) obtained appreciably early flowering in plants pruned to 28, 24 and 16 branches in *Jasminum sambac* cv. Gundumalli. Earliest flowering was noticed within 50.50 or 51.33 days after pruning.

Siddagangaiah and Muthapparai (1988) observed less number of days to flowering in bushes pruned in October, November, December and January in *Jasminum sambac*.

Nedumaran (1977) found February and March pruned plants took less number of days for flower bud initiation in *Jasminum auriculatum.*

2.1.9 Days to flower bud development.

Sun *et al*. (1998) observed pruning intensity had little influence on bud development in rose.

Nedumaran (1977) observed the number of days taken for flower bud appearance from initiation ranged from 10 to 15 days in November, December, February and March month pruned plants in *Jasminum auriculatum.*

2.1.10 Duration of flowering in days

Nair *et al.* (2009) revealed the highest duration of flowering in October pruning followed by august pruning during winter in *Jasminum sambac* .

Siddagangaiah and Muthapparai (1988) observed the duration of flowering was significantly higher in bushes pruned in the month of October and November while it was significantly lower in the bushes pruned in May and April in *Jasminum sambac*.

Holley (1973b) recorded the plants pruned in June 15 reached peak flowering earlier than those pruned on July 1 and July 15 in Rose cv. Town crier and bridal pink.

Srivastava (1973) obtained early flowering in plants pruned on January 15 compared to those pruned on October 15, November 15 and December 15 in *Rosa damascena*.

Muthuswamy *et al.* (1974) reported that the flowering can be staggered over the whole year as against the unpruned plants by pruning in different months of the year.

2.1.11 Size of flower bud cm (length & diameter)

Nair *et al.* (2009) reported maximum average bud length in September pruned plants followed by August pruned plants. November pruning resulted in minimum bud length in *Jasminum sambac*.

Nair *et al.* (2009) observed maximum bud diameter in October pruned plants whereas small size flowers in November pruned plants of *Jasminum sambac*

Ghulam Zarina *et al.* (2004) obtained the largest flower size (11 cm^2) by moderate pruning at 37 cm from ground level in six exotic rose cultivars.

Sumangala *et al.* (2003) observed there was no significant difference regarding flower bud length and diameter with respect to dates of pruning in *Jasminum sambac*.

Jadhav *et al* (2003) recorded the highest flower bud diameter (2.30 cm), flower bud length (2.86 cm) in hard pruned bushes and lowest in control in Rose cultivar First Red.

2.1.12 Number of petals for flower

Khattak *et al.* (2011) obtained maximum number of petals in bushes of summer pruned rose cv. Baby Bray.

Bihari *et al*. (2010) obtained quality blooms with increase in severity of pruning up to one bud level in Rose.

Malik and Dadlani (1984) obtained good quality flowers with long stem in hard pruned bushes at 10 cm height from bud joint in Super star and Happiness cultivars of hybrid tea roses.

Christensen (1970) recorded the best quality flowers by pruning on 1 or 15 May or 1 or 15 June in Azaleas cv. Ambrosium.

Van Marsbergan (1969) observed better flower quality in slightly pruned bushes than very severely pruned plants in rose.

2.1.13 Weight of 50 flower buds at harvest (g)

Nair *et al.(*2009) observed the high hundred-bud weight in September pruned plants during the first, second and third year (21.56 g, 24.25 g and 23.50 g respectively), followed by August pruned plants (22.43 g) and lowest in November pruned plants (14.22 g) in *Jasminum sambac*.

Sumangala *et al.* (2003) recorded the greater 100 flower bud weight in bushes pruned in mid-December followed by late mid pruned bushes in January in *Jasminum sambac*.

Nedumaran (1977) obtained positive and highly significant correlation between corolla tube length, width of flower bud and 100-bud weight to the flower yield of *Jasminum auriculatum* cv. Parimullai.

2.1.14 Number of flower buds per plant

Sumangala *et al.* (2003) revealed more numbers of flower buds per plant in bushes pruned in the month of December in *Jasminum sambac*.

Sharma and Singh (1991) observed maximum flower number and flower yield per plant on plants pruned to 28 branches followed by 24 branches with acceptable flower quality in *Jasminum sambac*.

Pal *et al.* (1984) obtained maximum flower production from plants pruned in January in *J. sambac*, where as maximum flower yield produced in November or February pruned plants in *Jasminum auriculatum.*

Irulappan *et al.* (1983) recorded highest number of flowers per plant in second fortnight of November pruned plants where as lowest number from September pruned plants in *Rosa borboniana*.

2.1.15 Weight of flower buds per plant (g)

Anil (2009) found significant increase in number of flowers per plant per year and flower yield per plant per year with retaining 9 basal shoots per plant followed by 7 basal shoots per plant in rose.

Sumangala *et al.* (2003) obtained more weight of flower buds per plant in bushes pruned in the month of December followed by January and November in *Jasminum sambac*.

Abdou and Badran (2003) observed early pruning (20 December) increased the total number and fresh weight of flowers followed by moderately late pruning (20 January) in *Jasminum sambac.*

Paul *et al*. (1995) observed maximum number of flowers (74.66/plant; 164.38 g/plant) for plants pruned at 40 cm above ground level in *R. damascena*.

Hugar and Nalawadi (1994) observed significantly higher flower weight and flower number in last week of December pruned plants of *Jasminum auriculatum*.

Siddagangaiah and Muthapparai (1988) revealed significantly higher flower yield in December pruned bushes, where as significantly lower yield in April and May pruned bushes in *Jasminum sambac.*

Singh and Moe (1980) observed maximum flower yield per plant in bushes pruned at 75 cm height in *J. sambac* and at 30 cm height in *J. auriculatum.*

Raman (1973) found highly significant and positive correlation between the weight of pruning and the yield of flowers. The yield of flowers per unit weight of growth of the bush revealed that 'soojimalli' recorded the highest value (1.70 kg) followed by 'iruvachi' (0.93 kg) and 'gundumalli' (0.60 kg).

2.1.16 Weight of flower buds per m^2 plot (kg)

Sujatha and Singh (2003) reported the increased production per unit area per annum with pruning once a year in rose cv. Happiness.

Pal *et al*. (1981) observed the highest yield of 979.0 g/4m^2 pruned at 40 cm height in January in *Jasminum sambac* cv. Khoya.

2.1.17 Weight of flower yield (buds) per hectare (tonnes)

Nair *et al.* (2009) recorded maximum flower yield in bushes pruned in September whereas the lowest in October pruned bushes of *Jasminum sambac.*

Sambamurthi *et al*. (1980) reported that the average yield per hectare is 10.71 tones with spacing of 2 x 1.5 m in 3 year trail on *Jasminum grandiflorum*.

Subramaniam (1977) recorded maximum yield in jasmine bushes pruned during the second fortnight of December in *Jasminum sambac* cv. Jathimallige

Srivastava (1973) observed the late pruning reduced the flower yield in *Rosa damascena.*

2.2 EFFECT OF DEFOLIATING CHEMICALS (CHEMICAL DEFOLIATION) ON GROWTH AND FLOWER YIELD OF *Jasminum sambac*

In the present scenario of increased labour wages, unavailability of labour force timely increases the cost of jasmine flower production. To reduce the cost of production, timely defoliation of jasmine bushes and to reduce human drudgery in manual defoliation chemical defoliants need to be identified or robotics or flower harvesters for farm mechanization need to be developed. Hence, it is the need to identify the effective chemical with maximum defoliation at low concentration without affecting plant growth and crop productivity, without any ecological problems in long run, chemical residues, biologically safe and eco-friendly.

The literature was searched extensively but very meager information was available on the subject defoliation of jasmine through chemicals.

2.2.1 Weight of defoliated leaves

Muthuswami *et al.* (1974) observed quickest and heaviest defoliation by paraquat dichloride on *Jasminum auriculatum*

2.2.2 Per cent of leaf area loss i.e., Necrosis of leaf lamina observed from 1st day to leaf fall (days)

Nanra *et al.* (2001) reported that the spray of KNO_3 on sardar guava shown lowest per cent of defoliation.

2.2.3 Days to new leaf emergence after defoliation

Nanra *et al*. (2001) recorded maximum number of days to new leaf emergence (25) days through spray of 4 % KNO_3 on Sardar guava.

2.2.4 Flower yield per plant (g).

Muthuswami *et al*. (1974) observed the plants treated with pentachlorophenol and sodium chloride shown higher yield than the un pruned plants in *Jasminum auriculatum*.

2.3 EFFECT OF AUXIN (IBA) CONCENTRATION AND NUMBER OF NODES ON ROOTING AND PER CENT ESTABLISHMENT OF *Jasminum sambac* cv. "DOUBLE MOGRA"

Traditionally, jasmine was propagated by layers which was slow and time taking process. To achieve large quantitative production requirement of flowers by the industry and fresh flower use for decoration either by area expansion i.e., bringing larger areas under the crop and increasing productivity. These activities require uniform, vigorous and healthy, pest and disease free rooted cuttings in large numbers. To provide the quality planting material in sufficient quantity at appropriate price to the growers, the rapid and mass multiplication technique need to be developed.

2.3.1 Rooting percentage

Deshmukh and Barad (2006) found significant increase in rooting percentage with 6000 ppm IBA on stem cutting of *Bougainvillea buttiana* var. Mahara.

Singh (2002) observed maximum rooting percentage with 2000 ppm IBA on regeneration of *Bougainvillea peruviana* cv. Thimma.

Singh (2001) found the effect of IBA 2000 ppm conspicuously gave significant increase in rooting of stem cuttings of *Jasminum sambac* Ait.

Basavarajeshwari and Kannamadi (1998) recorded the maximum percentage of rooting with 4000 ppm IBA in cuttings *of Jasminum grandiflorum, J. auriculatum* and *J. sambac.*

Zhang *et al*. (1997) obtained best rooting in 300 mg IBA in different sections of cuttings of a Taiwanese cultivar of Arabian jasmine (*Jasminum sambac*)

Sreelatha *et al.* (1991) found the greatest rooting percentage 75 days after planting in cuttings treated with IBA 4000 ppm or 3000 ppm for *J. auriculatum*

Paulas (1980) observed the highest rooting (100 per cent) in one node cutting with single leaf and highest plant survival after transplanting (98.3per cent) with one node cuttings with a pair of leaves in *Jasminum sambac* Ait. cv. Gundumalli.

Singh (1976) reported that the application of IBA at 4000 ppm to the cuttings of *Jasminum sambac* cv. Motia produced the highest percentage of rooting under intermittent mist.

Papaiah and Muthuswamy (1976) observed significant rooting percentage with IBA 2000 ppm and the cuttings taken from two years *Jasminum sambac* rooted well with IAA 25 ppm for 24 hours.

El-Hakim (1954) reported that the optimum concentration of IAA for rooting in cuttings of Arabian jasmine (*Jasminum sambac*) was 25 ppm.

2.3.2 Root length (cm)

Singh *et al.* (2010) observed maximum root length with the use of 1000 ppm IBA in stem cuttings of bougainvillea.

Deshmukh and Barad (2006) obtained maximum root length in stem cuttings of bougainvillea treated with 6000 ppm IBA.

Sharma *et al.* (2005) observed maximum root length (3.18 cm) in cuttings treated with 1000 ppm IBA in *Grewia optiva*.

Tewary *et al.* (2004) recorded the highest root length 25 cm in cuttings treated with IBA (2000 ppm) in *Vitex negundo* L.

Singh (2001) found significant increase in length of root with IBA 2000 ppm on regeneration of stem cuttings in *Jasminum sambac* Ait.

Patil *et al.* (2000) observed maximum root length (29.8cm) in stem cuttings of grape treated with IBA at 300 ppm. Maximum length of root recorded in *Jasminum garandiflorum* at 4000 ppm IBA (Nagaraja *et al.* 1991).

2.3.3 Root number

Asl *et al*. (2012) obtained more number of roots (8.67 roots per plant) at 2000 ppm IBA in semi-hardwood cuttings of Bougainvillea.

Singh *et al.* (2010) observed the use of 1000 ppm IBA on bougainvillea cuttings increased number of primary roots (19.73), secondary roots (28.8) and tertiary roots (49.19) per cutting.

Deb *et al.* (2009) observed maximum numbers of roots in semi hardwood cuttings of lemon treated with IBA 2500 ppm under Calcutta condition.

Reddy *et al.* (2008) obtained maximum numbers of roots in both hard wood and semi hard wood cuttings treated with 2500 ppm IBA + 2500 ppm NAA on fig.

Saroj *et al.* (2008) revealed IBA 2500 ppm produced maximum number of roots in hardwood and semi hardwood type of cuttings of pomegranate.

Upadhyay and Badyal (2007) reported that the pomegranate hardwood cuttings treated with IBA 2000 ppm produced maximum number of primary roots followed by NAA100 ppm +IBA 2000 ppm treatment under palampur condition.

Singh (2001) observed increased root number in cuttings treated with the IBA 2000ppm in *Jasminum sambac*.

Sontakke *et al.* (1996) recorded maximum number of roots in fig cv. Daulatabad semi hardwood cutting treated with 25 ppm NAA followed by 300 ppm IAA under Parbhani condition.

Carvalho *et al.* (1995) observed increased the number of roots by treating stem cuttings with IAA and IBA promoted rooting in *Stevia*.

Panwar *et al.* (1994) observed maximum root number in hardwood cutting of bougainvillea followed by semi hardwood cuttings treated with 2000 ppm IBA for 2 minutes.

Farooqi *et al.* (1994) found the number of roots per cutting increases with increasing concentration of IBA 100 ppm to 300 ppm on *Rosa damascena* Mill.

Bhattacharjee and Balakrishna (1993) found cent per cent rooting in stem cuttings treated with IBA and NAA at 4000 ppm each and IAA and IBA at 6000ppm each in *Ixora singaporensis.*

Nagaraja *et al.* (1991) reported that the use of IBA 4000 ppm on *Jasminum grandiflorum* cuttings increased the production of number of primary roots.

Ghosh *et al.* (1988) recorded maximum number of root in hardwood cuttings of pomegranate treated with 10,000 ppm IBA.

Prasad *et al*. (1988) observed maximum number of roots in hardwood cuttings of guava treated with 2500ppm IBA under optimum bottom heat (30 $\pm$ 2^0C) condition.

Reddy and Singh (1987) observed maximum number of roots in mango cuttings with IBA at 5000 ppm concentration increased significantly.

Purohit and Shekharappa (1985) found maximum number of roots in hardwood cuttings of pomegranate with 5000 ppm IBA.

Bhattacharjee and Balakrishnan (1983) observed maximum number of roots when bougainvillea cuttings were treated with IBA 4000 ppm under Bangalore condition.

2.3.4 Root fresh weight (g)

Deshmukh and Barad (2006) found significantly increase in root fresh weight in stem cuttings treated with 6000 ppm IBA in *Bougainvillea buttiana* cv. Mahara.

Parminder and Kushal (2003) obtained best root fresh weight in stem cuttings treated with 1000 ppm IBA in Bougainvillea cv. Cherry Blossom.

Singh (2001) reported that the increase in fresh weight of root in the *Jasminum sambac* cuttings treated with the IBA 2000 ppm. Maximum fresh weight (36.43 g) and dry weight (14.57 g) obtained in basal cuttings of pomegranate cuttings compared to apical and sub-apical cuttings (Purohit and Sekharappa, 1985).

2.3.5Number of sprouts per cutting

Singh (2001) recorded maximum number of sprouts in stem cuttings treated with 2000 ppm IBA of *Jasminum sambac*.

Nagaraja *et al.* (1991) observed maximum number of sprouts in *Jasminum grandiflorum* cuttings treated with 3000 ppm IBA.

2.3.6 Number of leaves per cutting

Deb *et al.* (2009) observed maximum number of leaves in semi hardwood cutting of lemon treated with 2500 ppm IBA. Maximum number of leaves obtained when fig tree apical cuttings treated with IBA at 2000 ppm under greenhouse condition (Rafael *et al*, 2006).

Singh (2001) found maximum number of leaves per cutting treated with IBA 2000 ppm in *Jasminum sambac*.

Shepherd and Winston (2000) found highest number of leaves per cutting with IBA 125 ppm concentration in *Bougainvillea* cv. Thimma.

Sontakke *et al.* (1996) reported that fig cv. Daulatabad cutting gave the maximum number of leaves when fig cuttings were treated with NAA 25 ppm under Parbhani condition.

Kumar *et al.* (1995) obtained maximum number of leaves in hardwood cuttings of lemon cv. Baramasi with increase in concentration of IBA in July month.

Kale and Bhujbal (1972) obtained maximum number of leaves (3) per cutting of bougainvillea variety Mary palmer treated with 1500ppm IBA.

Chauhan and Maheshwari (1970) found the highest leaf number per stem cutting of peach variety Sharbati when treated with IBA.

2.3.7 Sprout diameter

Singh (2001) observed significant increase in diameter of sprout treated with IBA 2000 ppm in the stem cuttings of *Jasminum sambac.*

2.3.8 Days to sprouting

Umesha *et al.* (2011) observed early sprouting (24.1 days) five noded cuttings of vanilla (*Vanilla planifolia* Andrews) in green house with mist.

Parmar *et al.* 2010 recorded the minimum number of days taken for sprouting at 4000 ppm IBA on hardwood cuttings of *Bougainvillea peruviana* cv. Touch Glory.

Shiva and Sujatha (2009) obtained earlier sprouting in cuttings of hibiscus when treated with rooting hormone and kept under shade net.

Noor *et al.* (2004) observed soft cuttings of guava sprouted earlier (17.68 days) than other type of cuttings.

Bagheland Saraswath (1988) reported that the hardwood cuttings sprouted early (14.03 days) compared to semi-hardwood cuttings (12.16 days) in pomegranate (*Punica granatum* L.).

2.3.9 Fresh weight of plant at fully grown rooted cutting (g)

Severino *et al.* (2011) reported that the basal cuttings produced the highest shoot dry matter (10.1g) and root dry matter (0.47g) accumulation compared to middle and apical cuttings in *Jatropha curcas*.

Farooqi *et al.* (1994) found the fresh weight of root with increasing concentration of IBA from 100 ppm to 300 ppm in *Rosa damascene* Mill.

Purohit and Sekharappa (1985) obtained maximum fresh weight (36.43 g) and dry weight (14.57g) in basal cuttings of pomegranate cuttings compared to apical and sub-apical cuttings.

2.3.10 Dry weight of rooted cutting (g).

Severino *et al*. (2011) observed the basal cuttings accumulated the highest root dry matter (0.47g) compared to middle and apical cuttings in Jatropha.

Deshmukh and Barad (2006) found the highest root and shoot dry weight in stem cuttings treated with 6000 ppm IBA in *Bougainvillea buttiana* cv. Mahara.

Farooqi *et al.* (1994) found the dry weight of root with increasing concentration of IBA from 100 ppm to 300 ppm in *Rosa damascene* Mill.

Shirol and Patil (1992) obtained the highest root dry weight per cutting treated with IBA 4000 ppm + NAA 4000 ppm in *Ixora.*

Purohit and Sekharappa (1985) obtained the less dry weight of rooted cutting was in apical cuttings compare to basal and top portion cuttings treated with IBA rooting hormone in *Punica granatum*.

2.3.11 Propagation cycle (Batch Period) in days.

Singh (2001) recorded the maximum number of days for full establishment of *Jasminum sambac* cutting was 75 days. Maximum number of days for rooting was recorded in *Jasminum grandiflorum* cutting was 60 days (Nagaraja *et al.* 1991).

Papaiah *et al.* (1980) found the number of days taken for rooting differ with different species being 45 days in *J. grandiflorum*, 70 days in *J. auriculatum* and 68 days in case of *J. sambac.*

Chapter III

MATERIAL AND METHODS

The present investigation entitled **"Standardization of pruning and propagation technique in Arabian jasmine (*Jasminum sambac*)"** was undertaken to extend the period of availability of flowers in the market *i.e.*, off-season flower production, to identify a genotype for higher flower yield, to standardize pruning technique for higher flower productivity and to standardize propagation technique for quick and cost effective and efficient mass multiplication of *Jasminum sambac* cv. "Double Mogra".

The present investigation was conducted on the existing four genotypes of *Jasminum sambac* of three year old Jasmine plantation, details pertaining to methodology adopted, materials employed and statistical analysis followed during the course of this investigation were presented in this chapter.

LOCATION OF EXPERIMENTAL SITE

The experimental site was located at Horticultural College and Research Institute, Dr. Y. S. R. Horticultural University, Venkataramannagudem, West Godavari District. The location falls under Agro-climatic zone-10, humid, East Coast Plain and Hills (Krishna-Godavari zone) with an average rainfall of 900 mm at an altitude of 34 m (112 feet) above mean sea level. The geo-graphical situation is $16^{0}63^{'}120^{''}$N latitude and $81^{0}27^{'}568^{''}$ E longitude. It experiences hot humid summer and mild winters. It experiences hot humid summer, rainy and mild winters.

WEATHER DURING CROP PERIOD

The meteorological data pertaining to rainfall, mean maximum and mean minimum temperatures, relative humidity, wind speed and sunshine hours in weekly averages during the period of investigation recorded at Horticultural Research Station (HRS) Venkataramannagudem were presented in Appendix- A.

Plate1: General view of experimental plot of jasmine

DETAILS OF THE EXPERIMENT

The present investigation was taken up in three experiments *i.e.,*

3.1. Effect of pruning date and intensity of pruning on growth and flowering of *Jasminum sambac*" genotypes.

3.2. Effect of defoliating chemicals (chemical defoliation) on growth and flower yield of *Jasminum sambac.*

3.3. Effect of Auxin concentration and number of nodes on rooting and percent establishment of *Jasminum sambac* cv. "Double Mogra".

3.1 EFFECT OF PRUNING DATE AND INTENSITY OF PRUNING ON GROWTH AND FLOWERING OF *Jasminum sambac* GENOTYPES

3.1.1 Experimental material

The present investigation was conducted on the existing three genotypes of *Jasminum sambac* of three year old jasmine plantation of three local varieties T_1**:** Nityamalli, T_2**:** Tuppamalli and T_3**:** Starmalli. The plating material was procured from the local jasmine growers of Andhra Pradesh.

3.1.2 Layout of experiment

The experiment was laid out in split-plot design with three replications. Two thousand five hundred plants of three years old of each variety were available in each block (2years old plants were planted on 11-09-2011).

Details of Layout

Design	: Split Plot Design
Treatments	: 36
Main treatments	**:** 3 Genotypes or local cultivars
Sub treatments	**:** Pruning date (3)
Sub-sub treatments	**:** Pruning height (4)
Age of plantation	**:** 3 years
Replications	: 3
Spacing	**:** 50 cm x 50cm (40,000 plants ha^{-1})

N

SST_4	SST_2	SST_4	SST_3	SST_2	SST_4	SST_3	SST_2	SST_4
SST_2	SST_3	SST_1	SST_4	SST_1	SST_2	SST_4	SST_1	SST_2
SST_3	SST_1	SST_3	SST_2	SST_3	SST_1	SST_2	SST_4	SST_3
SST_1	SST_4	SST_2	SST_1	SST_4	SST_3	SST_1	SST_3	SST_1
R1	**R2**	**R3**	**R1**	**R2**	**R3**	**R1**	**R2**	**R3**
T_1ST_1			**T_1ST_2**			**T_1ST_3**		

IRRIGATION CHANNEL

SST_3	SST_1	SST_2	SST_4	SST_2	SST_4	SST_3	SST_2	SST_4
SST_4	SST_2	SST_1	SST_2	SST_3	SST_1	SST_4	SST_1	SST_2
SST_2	SST_3	SST_4	SST_3	SST_1	SST_3	SST_2	SST_3	SST_1
SST_1	SST_4	SST_3	SST_1	SST_4	SST_2	SST_1	SST_4	SST_3
R1	**R2**	**R3**	**R1**	**R2**	**R3**	**R1**	**R2**	**R3**
T_2ST_1			**T_2ST_2**			**T_2ST_3**		

IRRIGATION CHANNEL

SST_3	SST_4	SST_1	SST_2	SST_1	SST_3	SST_2	SST_1	SST_4
SST_4	SST_2	SST_3	SST_1	SST_2	SST_4	SST_1	SST_3	SST_2
SST_2	SST_1	SST_2	SST_4	SST_3	SST_2	SST_3	SST_4	SST_3
SST_1	SST_3	SST_4	SST_3	SST_4	SST_1	SST_4	SST_2	SST_1
R1	**R2**	**R3**	**R1**	**R2**	**R3**	**R1**	**R2**	**R3**
T_3ST_1			**T_3ST_2**			**T_3ST_3**		

Fig. 3.1 Layout and design of experimental plot

3.1.3 Treatmental details

MAIN TREATMENTS: Three genotypes or local varieties of *Jasminum sambac*

T_1**:** Nityamalli

T_2**:** Tuppamalli

T_3**:** Starmalli

SUB -TREATMENTS: Pruning Dates

ST_1**:**10th NOVEMBER, 2012

ST_2**:**10th DECEMBER, 2012

ST_3**:**10th JANUARY, 2013

SUB –SUB-TREATMENTS: Pruning height

SST_1**:** 25 cm from ground level

SST_2**:**50 cm from ground level

SST_3**:** 75cm from ground level

SST_4**:** Control without pruning

Nityamalli pruned at 25 cm

Nityamalli pruned at 50 cm

Nityamalli pruned at 75 cm

Plate 2: Pruning intensities of Nityamalli genotype of *Jasminum sambac*

Tuppamalli pruned at 25 cm

Tuppamalli Pruned at 50cm

Tuppamalli Pruned at 75cm

Plate 3: Pruning intensities of Tuppamalli genotype of *Jasminum sambac*

Starmalli pruned at 25 cm Starmalli Pruned at 50cm Starmalli Pruned at 75cm

Plate 4: Pruning intensities of Starmalli genotype of *Jasminum sambac*

3.1.4 Cultural practices

3.1.4.1 Characteristics of experimental soil

Red sandy loam soil with good drainage and moderate water holding capacity was selected. The physical composition of the soil was sand 70%, silt 20% and clay 15%. The soil pH was at 6.87 and the E.C of soil was 0.3dSm^{-1}. The available nitrogen of the soil was at 512 kg ha^{-1}, the available phosphorus was at 17.52 kg ha^{-1} and the available potassium was at 217.5 kg ha^{-1}. The available organic carbon of the soil was 0.34%.

3.1.4.2 Land preparation

The land was brought to fine tilth by repeated ploughing and harrowing. The experimental area was divided into plots of 4 blocks based on the soil gradient. Irrigation channels of 1 m width were provided between the blocks. Pits of 30 cm x30cm x 30 cm (30 cubic centimeter) were dug and filled with top soil, well decomposed FYM (farmyard manure) at 10 t ha^{-1} incorporated with SSP @ 10gm per pit well mixed and the soil mixture was incorporated into all the pits uniformly as basal application during planting. Standard recommended cultural practices were followed during the entire crop period 2012-13. The interspaces were manually harrowed periodically with spades and hand hoes.

3.1.4.3 Manures and Fertilizers

The recommended dosage of N, P_2O_5 and K_2O 300:600:600 kg ha^{-1} was applied in the form of urea, DAP, SSP and MOP respectively. The entire dose of phosphorus was applied at the time of pruning as basal dose. The FYM was applied at the rate of 10 kg per plant. The manure and fertilizers were given or applied in 15 cm deep in rings and 30 cm away from the main stem. DAP was applied once a week @ 2 gm per plant. Potash was applied from active vegetative growth phase and during the flowering phase of growth period @ 1 gm per plant.

3.1.4.4 Weeding and irrigation

The experimental site was kept free from weeds by periodical hand weeding. Irrigation was given at an interval of 6-8 days depending on the soil moisture condition.

3.1.4.5 Plant protection

Timely and suitable plant protection measures were taken up to protect the shrubs from pest and diseases incidence. Plants were sprayed with 0.1% copper oxy-chloride soon after pruning. The budworm *Hendicasis duplifasciallis* was controlled during flowering period by three sprays of monocrotophos 1.6 ml per litre.

3.1.5 Observations recorded

Among the plants of the net plot area, leaving the outer rows of plants to avoid the border effects. A sample of five plants with uniform vigour was selected and tagged for recording observations on all vegetative and floral parameters.

Vegetative characters

Observations on all the growth parameters were recorded from the five randomly selected plants in each sub-subplot and each replication of the sub-sub treatment.

3.1.5.1 Primary shoot length (cm):

The primary shoot length was recorded by measuring the length from the base of the primary shoot to the tip of primary shoot and expressed in centi meters at harvest from the five tagged plants per replication per sub-sub treatment and averages were worked out.

3.1.5.2 Shoot thickness (cm)

Shoot thickness was recorded at the base of the shoot by using LCD digital vernier calliper (Systronics-150 mm-11, 1PC calliper- micrometer) from the five tagged plants per replication per sub-sub treatment and averages were worked out and expressed in centimeters.

3.1.5.3 Inter nodal length (Between 3rd and 4th inter nodes) (cm)

The inter-nodal length was measured between the 3rd and 4th internodes from the base of the stem by using LCD digital vernier calliper (Systronics-150 mm-11, 1PC calliper- micrometer) from the five tagged plants per replication per sub-sub treatment and averages were worked out and expressed in centimeters.

3.1.5.4 Number of laterals per primary shoot

Number of secondary shoots or laterals produced on the primary shoot was noted by counting the branches on the primary shoot of the plant of five tagged plants per replication per sub-sub treatment and averages were worked out.

3.1.5.5 Number of productive shoots per plant

Total number of productive shoots developed after pruning per plant at flowering stage was recorded from the five tagged plants per replication per treatment and averages were worked out.

3.1.5.6 Number of leaves per primary shoot

Number of leaves produced on the primary shoot was noted by counting the leaves per primary shoot from the five tagged plants per replication per sub-sub treatment and averages were worked out.

3.1.5.7 Leaf area (cm^2) per shoot

Leaf area was recorded with the help of a digital leaf area meter (Systronics-211 model) per primary shoot of each plant individually from the five tagged plants per replication per sub-sub treatment at flower bud initiation stage and averages were worked out. It was expressed in square centimetres.

Yield Parameters

3.1.5.8 Days required to flower bud initiation

Number of days taken for flower bud initiation after pruning from ten randomly tagged inflorescences (cyme) per plant was recorded from each plant individually for five tagged plants per replication per sub-sub treatment and averages were worked out.

3.1.5.9 Days required for flower bud development

Number of days taken from flower bud initiation to fully developed tight bud with commercial marketable size from, ten randomly tagged inflorescences (cyme) per plant was recorded from each plant individually for five tagged plants per replication per sub-sub treatment and averages were worked out.

3.1.5.10 Duration of flowering (days)

The period between the first flower bud with commercial marketable size (opening during night) to the end of flowering season expressed in days. The observations were recorded from each plant individually for five tagged plants per replication per sub-sub treatment and averages were worked out.

3.1.5.11 Size of flower bud (cm) *i.e.*, length & diameter

Bud length: The length from the base of the flower bud to tip was recorded by using LCD digital vernier caliper (Systronics-150 mm-11, 1PC calliper-micrometer) and expressed in centi meters. Bud width: Maximum bud diameter was recorded by using LCD digital vernier caliper (Systronics-150 mm-11, 1PC calliper- micrometer) in centi meters. The observations were recordedfrom hundred flower buds from five tagged plants per replication per sub-sub treatment and averages were worked out.

3.1.5.12 Number of petals per flower

The number of well developed petals were counted in numbers during full bloom stage and recorded per flower from each plant individually from five tagged plants per replication per sub-sub treatment and averages were worked out.

3.1.5.13 Weight of 50 flower buds (g)

Weight of flower bud at fully developed tight bud with commercial marketable (maximum) size outer petals curve loosen along with calyx was recorded and expressed in grams from each plant individually for five tagged plants per replication per sub-sub treatment and averages were worked out.

3.1.5.14 Number of flower buds per plant

Summation of average number of flower buds produced per day during flowering was expressed in numbers per plant individually for five tagged plants per replication per sub-sub treatment and averages were worked out.

3.1.5.15 Weight of flower buds per plant (kg)

The yield of flowers per plant was summation of daily harvest of flowers in grams produced during flowering season per plant expressed in grams weighed by using electronic balance (M/s Shimadzu make, AUX220 Japan) 0.1 mg precision, individually for five tagged plants per replication per sub-sub treatment and averages were worked out. This fresh weight was expressed in kilo grams.

3.1.5.16 Weight of flower bud per m^2 plot (kg)

The observations on yield of flower buds per plot was recorded based on the observations recorded on flower buds per m^2 after harvesting weighed by using electronic balance per replication per sub-sub treatment and averages were worked out on fresh weight basis in kilograms.

3.1.5.17 Weight of flower buds per hectare (tonnes)

The flower yield per hectare was estimated by multiplying the weight of flower buds recorded per m^2 by multiplying with 10,000 per replication per sub-sub treatment.

3.1.5.18 Cost benefit ratio of jasmine flower production

The total expenditure incurred on cost of cultivation from land preparation, cost of planting material, labour cost, input cost like irrigation, manures and fertilizers, micronutrients, plant protection chemicals *i.e.,* pesticides and fungicides, packaging material and transportation cost including any miscellaneous expenditure. The total returns were calculated based on the average price of the wholesale market with the estimated total flower production per hectare. The cost benefit ratio was calculated as the ratio between gross returns and cost of cultivation.

3.1.5.19Statistical analysis

The data recorded was subjected to statistical analysis in split-plot experimental design as per the method outlined by Panse and Sukhatme (1978).

3.2 EFFECT OF DEFOLIATING CHEMICALS (CHEMICAL DEFOLIATION) ON GROWTH AND FLOWER YIELD OF *Jasminum sambac*

Details of lay out

Location : HC&RI, V. R. Gudem

Crop : Arabian Jasmine (*Jasminum sambac*.)

Spacing : 50 cm x 50cm

Season : Rabi2012-13

Statistical design : RBD

Treatments (Factor 1) : 3 genotypes or local varieties

Treatments (Factor2) : 16

Number of replications : 3

Age of plantation : 3 years

Date of planting : 11-09-2011 (2 year old plants)

3.2.1 Treatmental details

Three genotypes or local varieties of *Jasminum sambac*

T_1: Nityamalli

T_2: Tuppamalli

T_3: Starmalli

TREATMENTS: 16 chemical concentrations

ST_1: Manual defoliation

ST_2: Paraquat dichloride : 500ppm

ST_3: Paraquat dichloride : 1000ppm

ST_4: Paraquat dichloride : 1500ppm

ST_5: Paraquat dichloride : 2000ppm

ST_6: Paraquat dichloride : 2500ppm

ST_7: Sodium chloride : 1000ppm

ST_8: Sodium chloride : 2000ppm

ST_9: Sodium chloride : 3000ppm

ST_{10}: Sodium chloride : 4000ppm

ST_{11}: Potassium nitrate **:** 1%

ST_{12}: Potassium nitrate **:** 2%

ST_{13}: Potassium nitrate **:** 3%

ST_{14}: Potassium nitrate **:** 4%

ST_{15}: Potassium nitrate **:** 5%

ST_{16}: Control (water spray)**:**H_2O

3.2.2 Materials used

The chemicals like Paraquat dichloride, Sodium chloride, Potassium nitrate at different concentrations were tested for defoliation as per the treatment.

Preparation of chemical solution for defoliation

Defoliant chemicals were prepared according to concentrations mentioned by dissolving the appropriate quantity of chemicals in the distilled water.

3.2.3 Observations recorded

3.2.3.1 Weight of defoliated leaves

The defoliated leaves at each treated bush was collected after imposition of treatmeant and weighed by using electronic balance (M/s Shimadzu make, AUX220, Japan) with 0.1mg precision, individually for five tagged plants per replication per treatment, genotype and averages were worked out. This weight was expressed in grams.

3.2.3.2 Days taken for complete defoliation

Number of days taken for complete defoliation in more than ninety per cent of plants after imposition of treatment was recorded from each replication per treatment and genotype, average were worked out.

3.2.3.3 Days taken for new leaf emergence after defoliation.

Number of days taken for new leaf development after defoliation was recorded from each plant individually for five tagged plants per replication per treatment and genotype, averages were worked out.

3.2.3.4 Total areal biomass production per plant in a season

The aerial biomass i.e., the fresh weight of leaves, stem, flowers produced per plant during the season was weighed individually for five tagged plants per replication per treatment. The biomass produced per plant (g) during the season dried in hot air oven by gravimetric method and averages were worked out.

3.2.3.5 Flower yield per plant (g).

The yield of fresh flowers produced per plant after emergence of flush on defoliated plant during the season was weighed by using electronic balance (M/s Shimadzu make, AUX220 Japan) with 0.1mg precision, individually for five tagged plants per replication per treatment and averages were worked out. This fresh weight was expressed in kilo grams.

3.2.3.6 Cost Benefit Ratio of Jasmine flower production

The total expenditure incurred on cost of cultivation from land preparation, cost of planting material, Defoliating chemicals, labour cost, input cost like irrigation, manures and fertilizers, micronutrients, plant protection chemicals i.e., pesticides and fungicides, packaging material and transportation cost including any miscellaneous expenditure. The total returns were calculated based on the average price of the wholesale market with the estimated total flower production per hectare. The cost benefit ratio was calculated as the ratio between gross returns and cost of cultivation.

3.2.3.7 Statistical Interpretation of data

The data recorded for different characters was subjected to statistical analysis on the basis of the model suggested by Cocharn and Cox (1950) for RBD.

3.3 EFFECT OF AUXIN CONCENTRATION AND NUMBER OF NODES ON ROOTING AND PER CENT ESTABLISHMENT OF *Jasminum sambac* cv. "DOUBLE MOGRA".

Details of lay out

Crop **:** Arabian Jasmine (*Jasminum sambac*.)

Cultivar **:** Double mogra

Design **:** Factorial Randomized Block Design

Number of treatments **:** 16

Number of replications **:** 3

Season **:** Kharif 2012-13

3.3.1 Treatment details

Factor 1: number of nodes

$\mathbf{T_1}$ **:** 1 node

$\mathbf{T_2}$ **:** 2 node

$\mathbf{T_3}$ **:** 3node

$\mathbf{T_4}$ **:** 4 node

Factor 2: chemical concentrations (IBA)

$\mathbf{C_1}$**:**1000 ppm

$\mathbf{C_2}$**:**2000 ppm

$\mathbf{C_3}$**:**3000 ppm

$\mathbf{C_4}$**:** Control

3.3.2 Observations recorded

The stem cuttings were collected from mature one year old branches of the *Jasminum sambac* cv. Double Mogra of three year old shrubs. The cuttings were treated with auxin (IBA) as per treatment and observations recorded as follows.

3.3.2.1 Rooting percentage

The number of stem cuttings sprouted, well rooted and fully developed into a seedling out of hundred cuttings planted per replication per treatment and averages were worked out and expressed in per cent.

$$\text{Percentage of rooted cuttings (\%)} = \frac{\text{Number of cuttings rooted}}{\text{Total number of cuttings planted}} \times 100$$

3.3.2.2 Root length of Rooted Cuttings

The length of roots developed in the cuttings was measured from the base of the stem cutting to the end of roots by using LCD digital vernier calliper (Systronics-150 mm-11, 1PC calliper- micrometer) from the fully developed five tagged rooted cuttings per replication per treatment and averages were worked out and expressed in centimeters.

3.3.2.3 Root number per cutting

The number of fully developed adventitious roots per stem cutting were counted in numbers during the rooting process and recorded from each cutting individually from five tagged rooted cuttings per replication per treatment and averages were worked out.

3.3.2.3 Root fresh weight

The fresh weight of roots developed in fully grown cutting was weighed by using electronic balance (M/s Shimadzu make, AUX220 Japan) with 0.1mg precision, individually for ten cuttings per replication per treatment and averages were worked out for single cutting. This weight was expressed in grams.

3.3.2.4 Number of sprouts per cutting

The number of well developed sprouts with leaf primordial and leaf blade with petioles were counted in numbers during rooting stage was recorded per cutting individually from five randomly tagged sprouted cuttings per replication per treatment and averages were worked out.

3.3.2.5 Number of leaves per cutting

The number of well developed leaves present on rooted cutting was counted in numbers during rooting process was recorded per cutting, individually from five randomly tagged sprouted cuttings per replication per treatment and averages were worked out.

3.3.2.6 Sprout diameter

Fully developed vigorous growing sprout diameter was measured at the base of the sprout on rooted stem cutting by using LCD digital vernier calliper (Systronics-150 mm-11, 1PC calliper- micrometer) individually from five randomly tagged sprouted cuttings per replication per treatment and averages were worked out and expressed in millimeters (mm).

3.3.2.7 Days to sprouting

Number of days taken for sprouting of buds on the stem cuttings placed for rooting was recorded individually from five randomly tagged sprouted cuttings per replication per treatment and averages were worked out.

3.3.2.8 Fresh weight of plant at fully grown rooted cutting (g)

The fresh weight of fully grown rooted cutting washed thoroughly without any soil and shade dried was weighed by using electronic balance (M/s Shimadzu make, AUX220 Japan) with 0.1mg precision, individually for five tagged plants per replication per treatment and averages were worked out. This weight was expressed in grams.

3.3.2.9 Dry weight of rooted cutting (g)

The fully grown rooted cuttings without any breaking of roots of ten numbers were washed thoroughly without any soil initially shade dried and placed in hot air oven at 55^{0}C for 4-6 hours. These dried cuttings were weighed daily continuously for six to nine day stil complete dehydration takes place *i.e.*, constant dry weight obtained on successive days.The dry matter was weighed by using electronic balance (M/s Shimadzu make, AUX220 Japan) with 0.1mg precision, individually per replication per treatment and averages were worked out. This weight was expressed in grams.

3.3.2.10 Propagation cycle (Batch Period) in days

Number of days taken from etiolation or pre-curing of stem cuttings to rooted cutting ready for planting in the main field *i.e.*, the cuttings planted in rooting media kept for rooting in mist chamber to complete development of roots, leaves on the cutting and its hardening process.

3.3.2.11 Costbenefit ratio of jasmine propagation

The total expenditure incurred on establishment and maintenance of mother plants of jasmine, initial establishment of mist chamber and Shade net houses, land rent, input cost like cost of growing media, cost of poly bags, plant growth regulators, irrigation, manures and fertilizers, micronutrients, plant protection chemicals *i.e.*, pesticides and fungicides, packaging material, labour wages and transportation cost including any miscellaneous expenditure. The total returns were calculated based on the average sale price at farm gate with the estimated successful fully developed rooted cuttings. The cost benefit ratio was calculated as the ratio between gross returns and cost of production.

3.3.2.12 Statistical Interpretation of data

Observations recorded during the conduct of experiment was subjected to statistical analysis as per the methods outlined by Panse and Sukhatme (1978). Statistical significance was tested by F value at 5 per cent level.

CHAPTER IV

RESULTS AND DISCUSSION

The present investigation entitled **"Standardization of pruning and propagation technique in Arabian jasmine (*Jasminum sambac*)"** was undertaken during November 2012 to June 2013, at College farm, HC&RI, Venkataramannagudem, and West Godavari. (Dist.), A.P. Observations were recorded for all the characters for five plants per sub-sub-plot. The entire recorded data was subjected to statistical analysis to get information on mean values and the results were presented here under the following subheads with appropriate discussion.

4.1. Effect of pruning date and intensity of pruning on growth and flowering of *Jasminum sambac*" genotypes.

4.2. Effect of defoliating chemicals (Chemical Defoliation) on growth and flower yield of *Jasminum sambac.*

4.3. Effect of auxin concentration and number of nodes on rooting and percent establishment of *Jasminum sambac* cv. "Double Mogra".

4.1EFFECT OF PRUNING DATE AND INTENSITY OF PRUNING ON GROWTH AND FLOWERING OF *Jasminum sambac* GENOTYPES

4.1.1. Primary shoot length (cm)

Primary shoot length (cm) significantly affected by the genotypes, pruning dates, pruning heights and their interactions (Table 4.1a, b, c & d)

The highest primary shoot length was recorded by Tuppamalli (53.61cm) followed by Nityamalli (48.91 cm) and the lowest was recorded in Starmalli (46.88cm).

The longest primary shoot length recorded in December'12 pruned bushes (52.47 cm) followed by November'12 pruned bushes (49.88 cm) and lowest was recorded in January'13 pruned bushes (47.07 cm).

The highest primary shoot length was recorded at pruning height at 50 cm (62.35 cm) from ground level among the various pruning heights, which was followed by pruning height at 25 cm (56.67 cm) and the lowest was recorded in unpruned bushes (38.63 cm).

The interaction between genotypes and pruning dates for this trait was found significant (Table and Fig. 4.1a). The highest primary shoot length was recorded in Tuppamalli jasmine shrubs pruned in December'12 (57.96 cm) followed by Tuppamalli November'12 pruned bushes (53.12 cm) and the lowest primary shoot length was recorded in Starmalli, January'13 pruned bushes (42.98 cm).

The interaction between genotypes and pruning heights for this trait was also found significant (Table and Fig. 4.1b). The highest primary shoot length was found in Tuppamalli, pruning height at 50cm (70.30cm), followed by Nityamalli, pruning height at 50 cm (60.01cm) which was statistically on par with Tuppamalli, pruning height at 25 cm (58.91 cm) and lowest was recorded in Starmalli unpruned bushes (35.37cm).

The interaction between pruning date and pruning height for this trait was found to be significant (Table and Fig. 4.1c). The highest primary shoot length was recorded in December'12, pruning height at 50 cm from ground level (65.42cm) which was statistically on par with November'12, pruning height at 50 cm (62.63cm) compared with rest of the treatments and lowest was recorded in November'12, unpruned bushes (37.37cm), which was statistically on par with other pruning dates, unpruned bushes.

The interactions of genotypes, pruning date, pruning heights for this trait was found significant (Table and Fig. 4.1d). The highest primary shoot length was recorded in the treatment *i.e.*, "Tuppamalli, December'12 and pruning height at 50cm" (76.00 cm) followed by the treatment "Tuppamalli, November'12 and pruning height at 50cm" (68.56 cm) and the lowest was recorded in the treatment "Starmalli, November'12 and unpruned bushes" (31.76 cm).

The longest primary shoot was produced in Tuppamalli genotype, which might be due to the internal or genetic factors present in the genotype. Whereas the jasmine shrubs pruned in December'12 produced relatively longer primary

Table 4.1a Primary shoot length (cm) of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

T X ST				
Pruning date(ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T1	48.78	49.50	48.45	**48.91**
T2	53.12	57.96	49.77	**53.61**
T3	47.73	49.94	42.98	**46.88**
Mean (ST)	**49.88**	**52.47**	**47.07**	**49.80**
	T	**ST**	**T X ST**	
S.E m±	0.29	0.52	0.90	
C.D (P=0.05)	0.87	1.56	2.70	

Table 4.1b Primary shoot length (cm) of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height (SST)					
Genotype (T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T1	55.16	60.01	41.32	39.14	**48.91**
T2	58.91	70.30	43.88	41.36	**53.61**
T3	55.95	56.76	39.41	35.37	**46.87**
Mean (SST)	**56.67**	**62.35**	**41.54**	**38.63**	
	T	**SST**	**T X SST**		
S.E m±	0.29	0.70	1.21		
C.D (P=0.05)	0.87	2.10	3.65		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV ’12 ST_2**:**10^{th} DEC’12 ST_3**:**10^{th} JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table 4.1c Primary shoot length (cm) of *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 To June 2013.

ST X SST					
Pruning height (SST)					
Pruning date(ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (ST)**
ST_1	59.02	62.63	40.47	37.37	**49.87**
ST_2	61.23	65.42	43.61	39.56	**52.45**
ST_3	49.77	59.02	40.53	38.94	**47.06**
Mean (SST)	**56.67**	**62.35**	**41.54**	**38.63**	
	ST	**SST**	**STX SST**		
S.E m±	0.52	0.70	1.21		
C.D (P=0.05)	1.56	2.10	3.65		

Table 4.1d Primary shoot length (cm) as effected by genotype pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June2013.

Genotype (T)	Pruning date (ST)	T X ST X SST				Mean (T X ST)
		Pruning height (SST)				
		SST1	**SST2**	**SST3**	**SST4**	
T1	**ST_1**	54.46	61.2	41.2	38.26	**48.78**
	ST_2	56.67	59.3	42.10	40.03	**49.52**
	ST_3	54.46	59.53	40.66	39.13	**48.44**
T2	**ST_1**	59.53	68.56	42.26	42.10	**53.12**
	ST_2	67.56	76.00	47.53	40.73	**57.96**
	ST_3	49.63	66.33	41.86	41.26	**49.77**
T3	**ST_1**	63.06	58.13	37.96	31.76	**47.73**
	ST_2	59.66	60.96	41.2	37.93	**49.94**
	ST_3	45.23	51.2	39.06	36.43	**42.98**
MEAN(TX SST)		**56.69**	**62.35**	**41.53**	**38.62**	**49.08 (X)**

Factors	T X ST X SST
S.E m±	2.11
C.D (P=0.05)	6.32

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10th NOV '12 ST_2**:**10th DEC'12 ST_3**:**10th JAN' 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

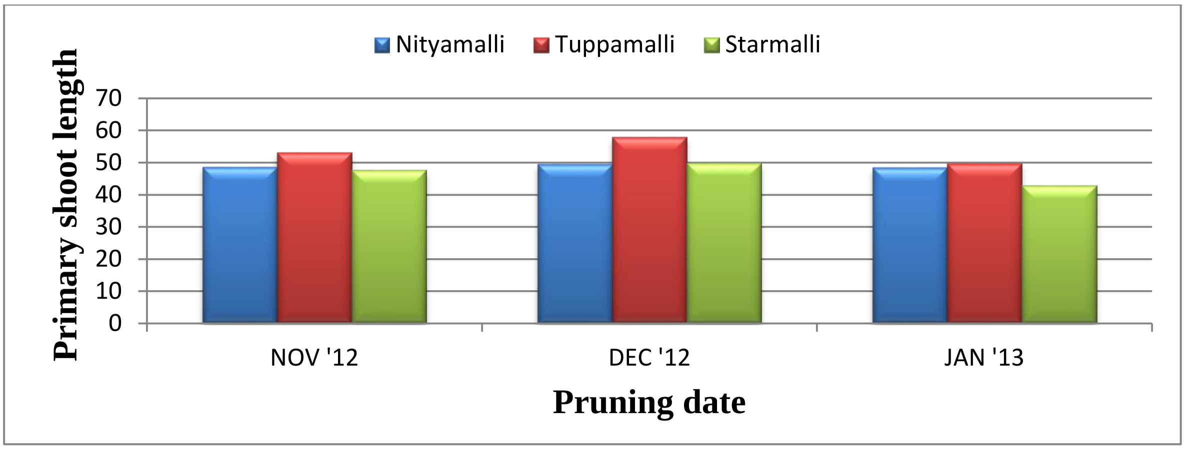

Fig.4.1a Primary shoot length of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

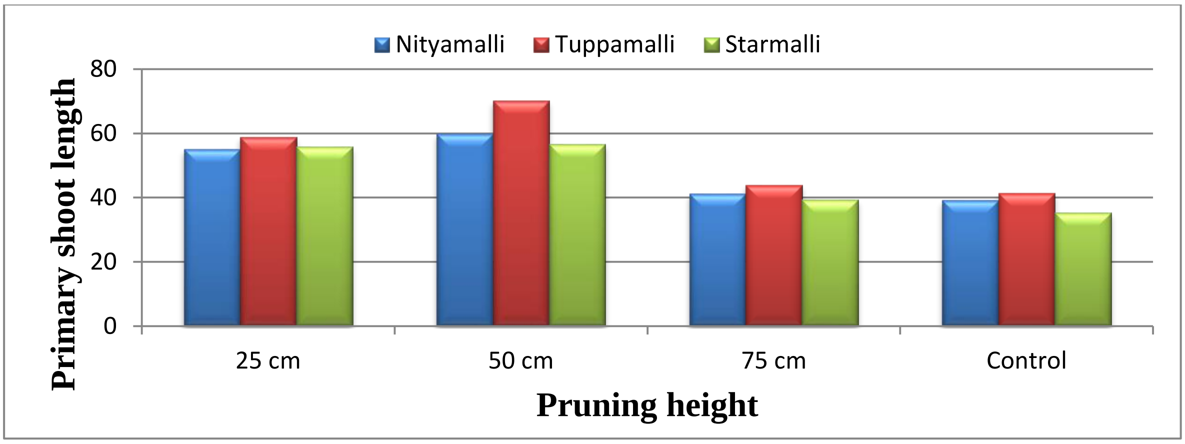

Fig.4.1b Primary shoot length of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

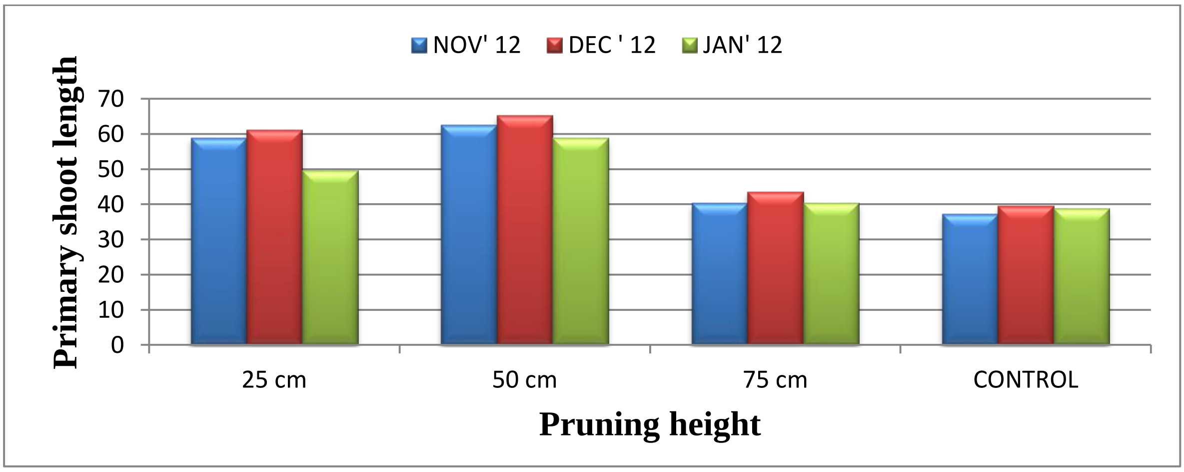

Fig.4.1c Primary shoot length of *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June2013.

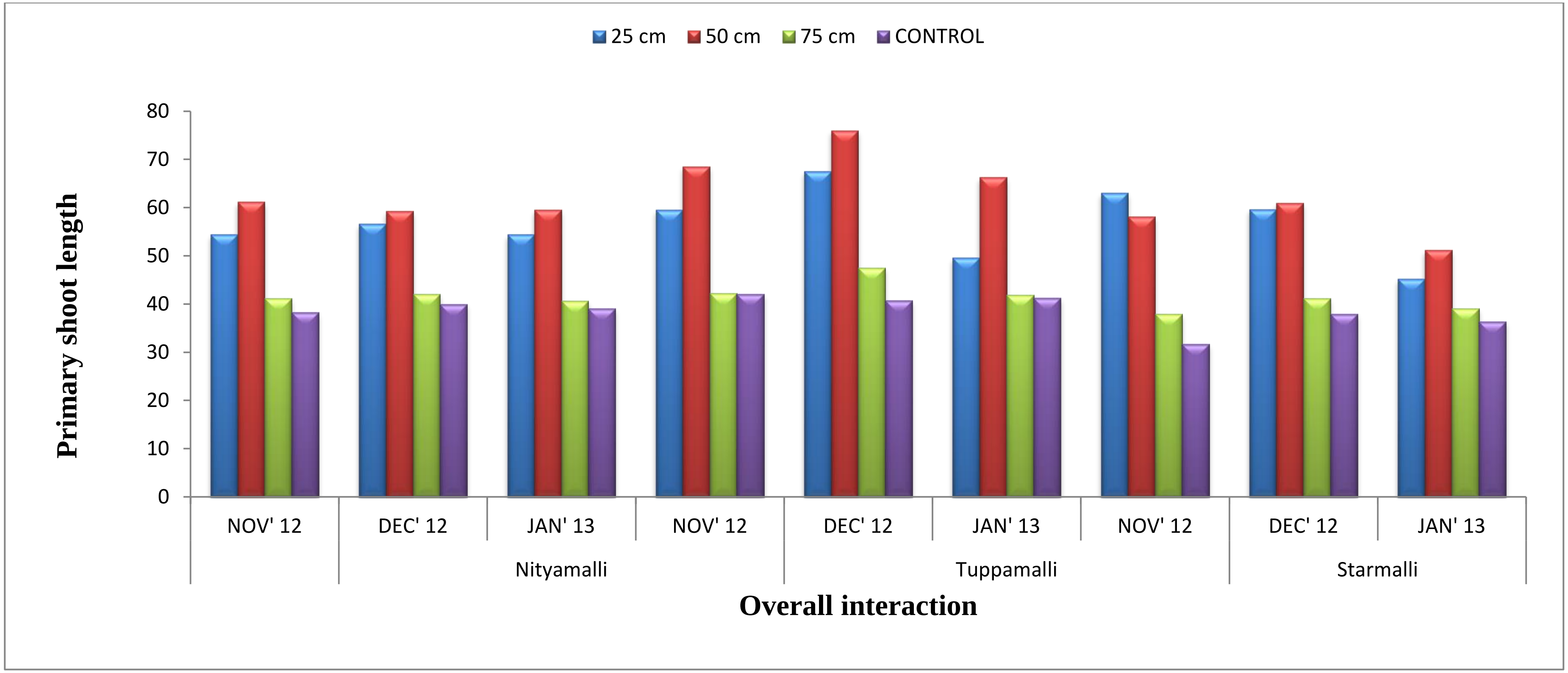

Fig.4.1d Primary shoot length as effected by genotype pruning date and pruning height of *Jasminum sambac* during Nov.2012 to June 2013.

shoots. This could be due to more polysaccharide content in plants pruned in December'12 (Sumangala *et al.*, 2003). Jasmine bushes pruned at 50cm pruning height produced the highest primary shoot length followed by pruning height at 25cm, which might be due to pruning encouraged the shoot length but severe and minimum pruning discouraged the shoot length (Sharma and Singh, 1991), Bernier *et al.* (1981).

4.1.2. Shoot thickness (cm) at base

Different genotypes, pruning dates, pruning heights and their interactions significantly affected the shoot thickness at base (Table 4.2a, b, c &d).

Among genotypes Tuppamalli recorded highest diameter of primary shoot thickness (0.47cm). Whereas the lowest shoot thickness was recorded in Starmalli (0.42cm) and Nityamalli (0.43cm) which were on par.

The highest shoot thickness was recorded in pruning date December'12 (0.46 cm) followed by January'13 pruning (0.43 cm).

The highest shoot thickness was recorded in pruning height at 50cm (0.51 cm), followed by pruning height at 25 cm (0.47cm) pruned bushes. Lowest thickness was recorded in unpruned bushes (0.36 cm).

The interaction between genotypes and pruning date for this trait was found significant (Table and Fig. 4.2a). The highest shoot thickness was found in Tuppamalli pruned in December'12 (0.49 cm) which was on par with Tuppamalli pruned in January'13 (0.47 cm) and thinnest shoots was recorded in Starmalli bushes pruned in January'13 (0.38 cm).

The interaction between genotypes and pruning height for this trait was found significant (Table and Fig. 4.2b). The highest primary shoot thickness was found in Tuppamalli, pruning height at 50 cm (0.52 cm) followed by Nityamalli pruning height at 50 cm (0.51cm) and the lowest was recorded in unpruned bushes of Starmalli (0.33 cm).

The interaction between pruning date and pruning height for this trait was found significant (Table and Fig. 4.2c). The highest shoot thickness was found in December'12, pruning height at 50cm (0.54 cm), followed by December'12, pruning height at 25cm (0.50 cm) and November'12, pruning height at 50 cm

Table 4.2a Primary shoot thickness (cm) of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

T X ST				
Pruning date (ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T_1	0.40	0.45	0.43	**0.43**
T_2	0.45	0.49	0.47	**0.47**
T_3	0.42	0.46	0.38	**0.42**
Mean (ST)	**0.42**	**0.46**	**0.43**	
	T	**ST**	**T X ST**	
S.E m±	0.01	0.00	0.00	
C.D (P = 0.05)	0.03	0.01	0.02	

Table 4. 2b Primary shoot thickness (cm) of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height (SST)					
Genotype (T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T_1	0.46	0.51	0.38	0.34	**0.42**
T_2	0.49	0.52	0.47	0.39	**0.47**
T_3	0.46	0.50	0.37	0.33	**0.42**
Mean (SST)	**0.47**	**0.51**	**0.41**	**0.36**	
	T	**SST**	**T X SST**		
S.E m±	0.01	0.00	0.00		
C.D (P = 0.05)	0.03	0.01	0.02		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10th NOV '12 ST_2**:**10th DEC'12 ST_3**:**10th JAN' 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table 4.2c Primary shoot thickness (cm) of *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

ST X SST					
Pruning height(SST)					
Pruning date (ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (SST)**
ST_1	0.45	0.50	0.39	0.34	**0.42**
ST_2	0.50	0.54	0.44	0.36	**0.46**
ST_3	0.46	0.49	0.40	0.37	**0.43**
Mean (SST)	**0.47**	**0.51**	**0.41**	**0.36**	
	ST	**SST**	**ST X SST**		
S.E m±	0.00	0.00	0.00		
C.D (P = 0.05)	0.01	0.01	0.02		

Table 4.2d Primary shoot thickness (cm) as effected by genotype, pruning date, and pruning height of *Jasminum sambac* during NOV' 2012 to June 2013.

Genotype (T)	Pruning date (ST)	T X ST X SST				Mean (T XST)
		Pruning height (SST)				
		SST_1	**SST_2**	**SST_3**	**SST_4**	
T_1	**ST_1**	0.42	0.50	0.36	0.33	**0.40**
	ST_2	0.51	0.52	0.41	0.34	**0.44**
	ST_3	0.45	0.53	0.39	0.36	**0.43**
T_2	**ST_1**	0.44	0.49	0.47	0.38	**0.44**
	ST_2	0.51	0.56	0.49	0.39	**0.48**
	ST_3	0.51	0.52	0.45	0.41	**0.47**
T_3	**ST_1**	0.49	0.50	0.36	0.32	**0.41**
	ST_2	0.49	0.55	0.41	0.35	**0.45**
	ST_3	0.41	0.44	0.36	0.33	**0.38**
Mean(STXSST)		**0.47**	**0.51**	**0.41**	**0.35**	**0.43 (X)**

Factors	T X ST X SST
S.E m±	0.01
C.D (P = 0.05)	0.03

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10th NOV '12 ST_2**:**10th DEC'12 ST_3**:**10th JAN' 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

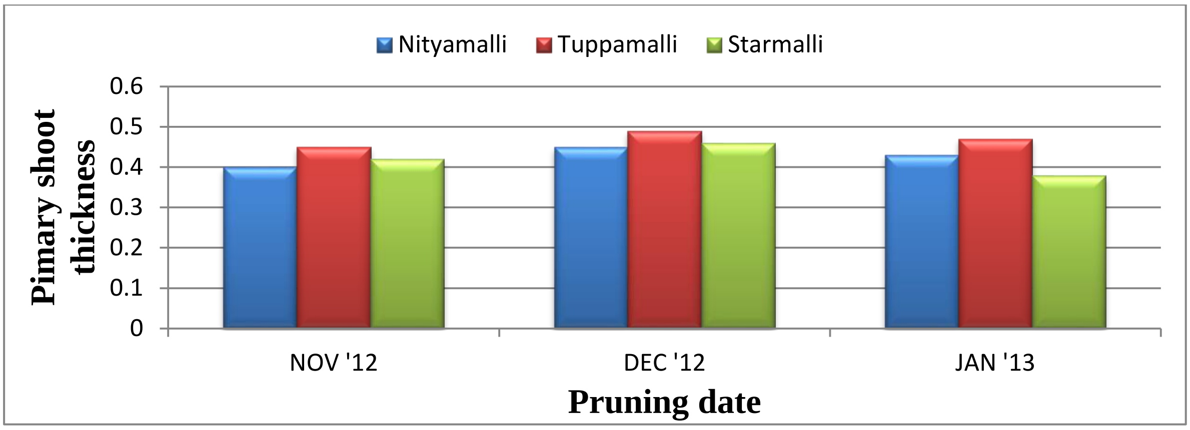

Fig.4.2a Primary shoot thickness of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

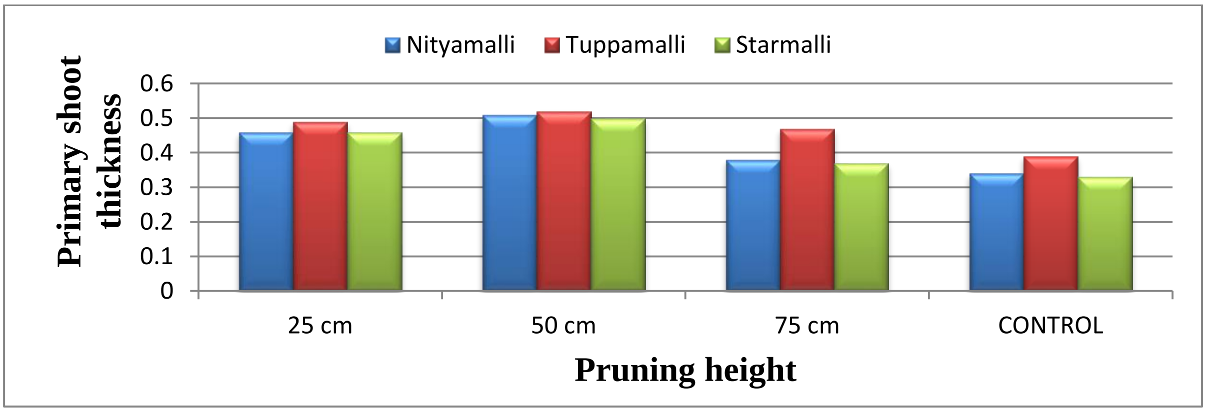

Fig.4.2b Primary shoot thickness of *Jasminum sambac* as effected by genotype and pruning height during Nov.2012 to June 2013.

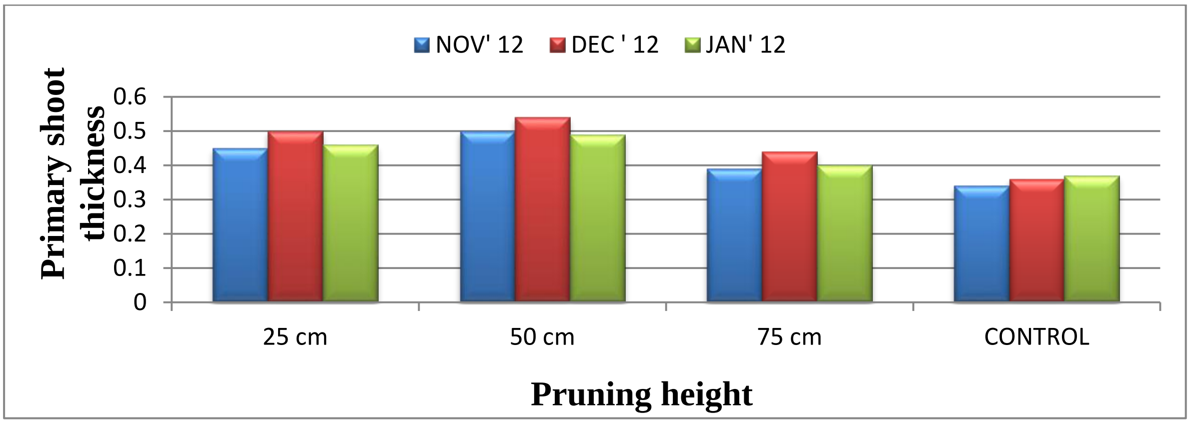

Fig.4.2c Primary shoot thickness of *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

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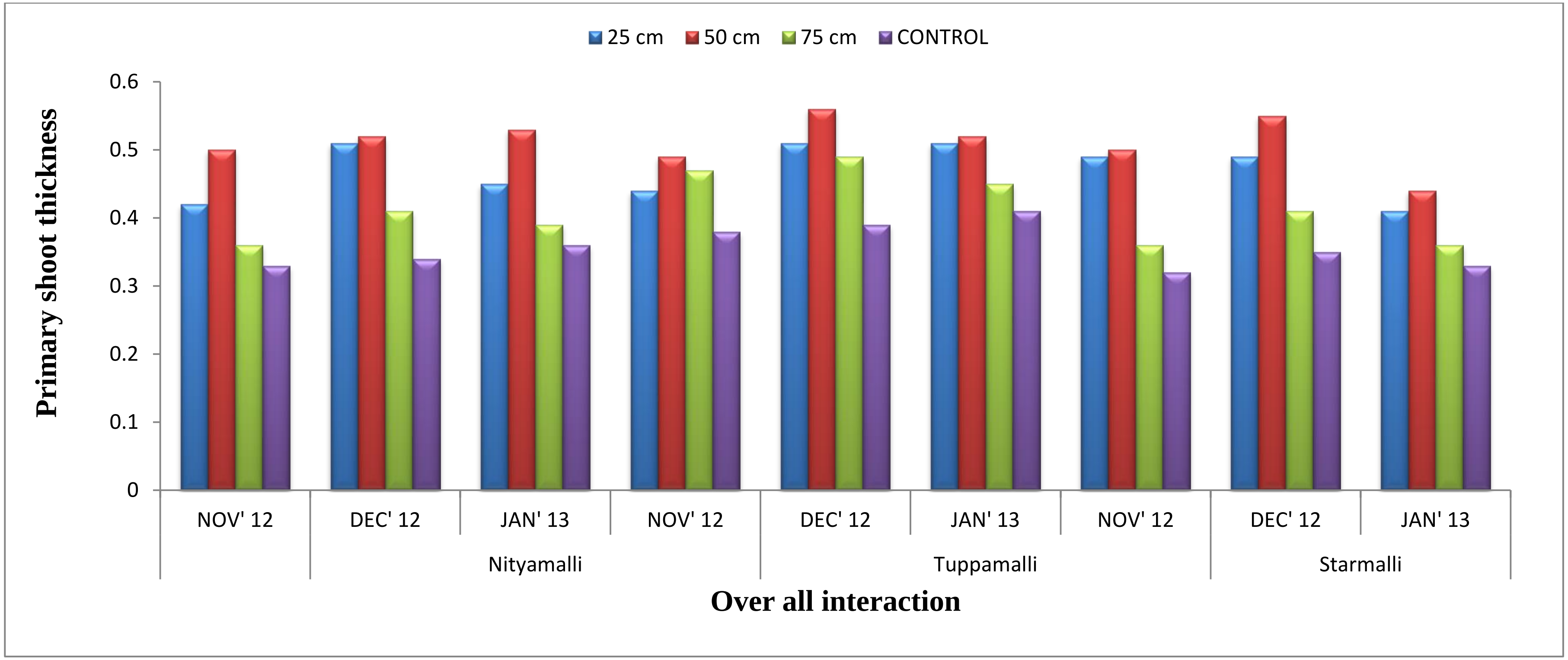

Fig.4.2d Primary shoot thickness as effected by genotype, pruning date, and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

(0.50 cm). The thinnest shoots were recorded in unpruned bushes of November'12 (0.34 cm).

The interaction among genotypes, pruning dates and pruning heights for this trait was found significant (Table and Fig. 4.2d). The highest primary shoot thickness was found in treatment "Tuppamalli, December'12 and pruning heights at 50 cm" (0.56 cm) which was statistically on par with the treatment "Starmalli, December'12 pruning height at 50 cm" (0.55 cm) and thinnest shoots were recorded in un pruned bushes of Starmalli, Nityamalli in three pruning dates (0.32-0.36 cm), which were on par.

The thickest primary shoot was produced in Tuppamalli genotype, which might be due to the internal or genetic factors present in the genotype and its adoptability to the local environment. Whereas the jasmine shrubs pruned in December'12 produced relatively more thickness of primary shoots. This could be due to good light conditions and high rate of photosynthesis favoured better growth (Bernier *et al*. 1981). Jasmine bushes pruned at 50cm and at 25cm pruning height from the ground produced the thicker primary shoot which might be due to high vigorous shoots and rejuvenation caused due to pruning. Similar results were observed by Raman (1973), Sharma and Singh (1991), Bernier *et al.* (1981).

4.1.3 Inter nodal length between 3rd and 4th inter node

Inter-nodal length was significantly affected by genotypes, pruning dates and pruning heights (Table 4.3a, b, c & d).

Among the genotypes Starmalli (3.60 cm) recorded the shortest inter-nodal length followed by Nityamalli (3.84cm), whereas the longest internodes were found in Tuppamalli (4.47cm).

Lowest internodal length was observed in January'13 pruned bushes (3.71 cm) followed by December'12 pruned bushes (3.89cm)

Shortest inter-nodal length was recorded in pruning height at 75cm (3.35cm) followed by pruning height at 50cm (3.91cm) and longest internodes was recorded in unpruned bushes (4.53 cm).

The interaction between genotype and pruning date was found significant (Table and Fig. 4.3a). The shortest inter-nodal length was observed in Starmalli

Table 4.3a Internodal length between 3rd and 4th node (cm) of *Jasminum sambac* as effected by genotype and Pruning Date during Nov. 2012 to June 2013.

T X ST				
Pruning date (ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T_1	4.15	3.75	3.62	**3.84**
T_2	4.95	4.34	4.12	**4.47**
T_3	3.82	3.59	3.38	**3.60**
Mean (ST)	**4.31**	**3.89**	**3.71**	
	T	**ST**	**T X ST**	
S.E m±	0.03	0.03	0.05	
C.D (P = 0.05)	0.10	0.10	0.17	

Table 4.3b Internodal length between 3rd and 4th node (cm) of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height (SST)					
Genotype (T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T_1	3.86	3.70	3.38	4.43	**3.84**
T_2	4.57	4.58	3.87	4.85	**4.47**
T_3	3.82	3.46	2.80	4.31	**3.60**
Mean (SST)	**4.08**	**3.91**	**3.35**	**4.53**	
	T	**SST**	**T X SST**		
S.E m±	0.03	0.02	0.05		
C.D (P = 0.05)	0.10	0.08	0.15		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10th NOV ’12 ST_2**:**10th DEC’12 ST_3**:**10th JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table 4.3c Internodal length between 3rd and 4th node (cm) of *Jasminum sambac* as effected by pruning date and pruning height during Nov.2012 to June 2013.

ST X SST					
Pruning height (SST)					
Pruning date (ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (ST)**
ST_1	4.54	4.33	3.70	4.66	**4.31**
ST_2	3.92	3.82	3.22	4.61	**3.89**
ST_3	3.79	3.58	3.13	4.32	**3.71**
Mean (SST)	**4.08**	**3.91**	**3.35**	**4.53**	
	ST	**SST**	**ST X SST**		
S.E m±	0.03	0.02	0.05		
C.D (P = 0.05)	0.10	0.08	0.15		

Table 4.3d Internodal length between 3rd and 4th node (cm) as effected by genotype and pruning date, pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Genotype (T)	**Pruning date (ST)**	**T X ST X SST**				**Mean (T X ST)**
		Pruning height (SST)				
		SST_1	**SST_2**	**SST_3**	**SST_4**	
T_1	**ST_1**	4.34	4.16	3.56	4.53	**4.14**
	ST_2	3.70	3.56	3.33	4.43	**3.75**
	ST_3	3.53	3.36	3.26	4.33	**3.62**
T_2	**ST_1**	5.13	5.13	4.50	5.03	**4.94**
	ST_2	4.33	4.40	3.56	5.06	**4.33**
	ST_3	4.26	4.21	3.56	4.45	**4.12**
T_3	**ST_1**	4.15	3.69	3.06	4.41	**3.82**
	ST_2	3.73	3.51	2.76	4.35	**3.58**
	ST_3	3.59	3.17	2.58	4.19	**3.38**
Mean(STX SST)		**4.08**	**3.91**	**2.58**	**4.53**	**3.96 (X)**

Factors	**T X ST X SST**
S.E m±	**-**
C.D (P=0.05)	NS

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10th NOV ’12 ST_2**:**10th DEC’12 ST_3**:**10th JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

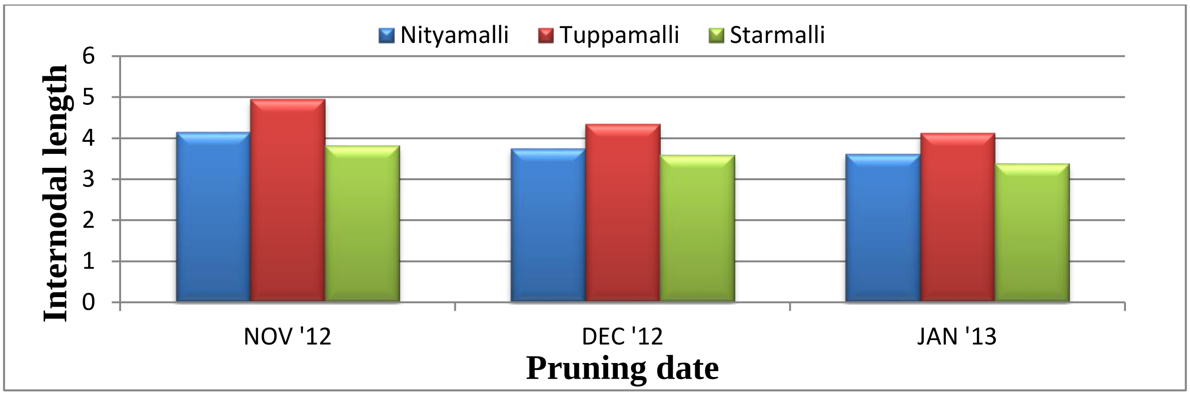

Fig.4.3a Internodal length between 3rd and 4th node (cm) of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

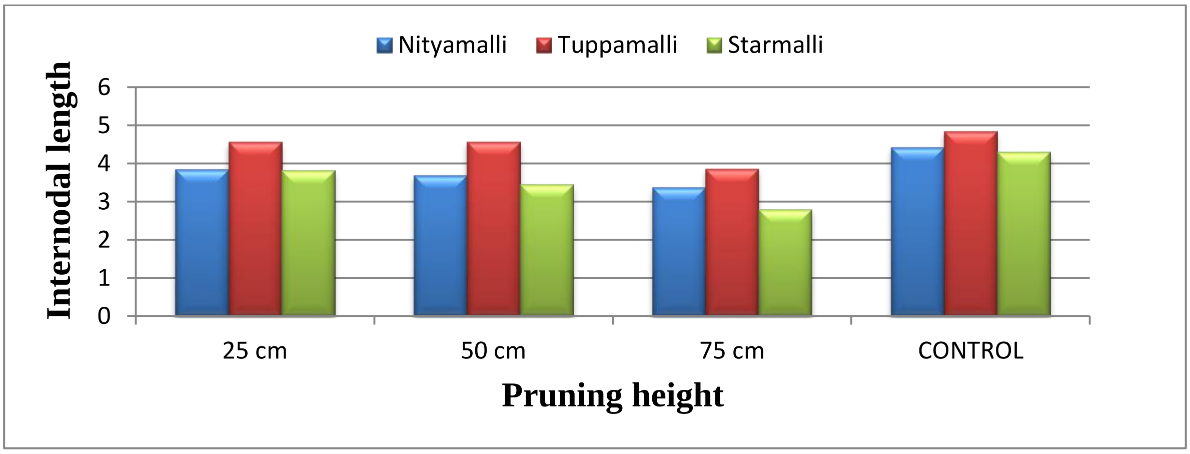

Fig.4.3b Internodal length between 3rd and 4th node (cm) of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

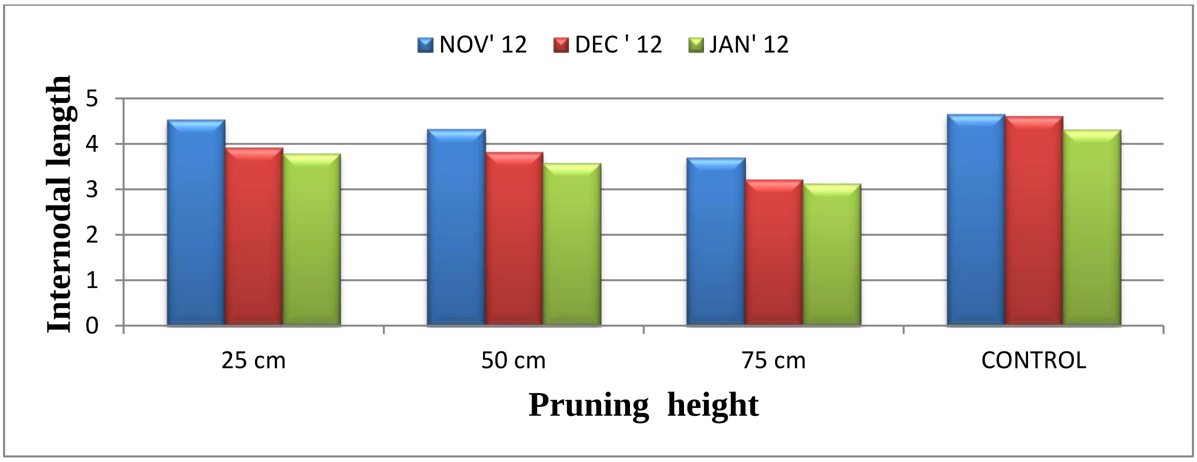

Fig.4.3c Internodal length between 3rd and 4th node (cm) of *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

pruned in January’13 (3.38 cm) followed by Starmalli pruned in December’12 (3.59cm) which was on par with Nityamalli pruned in January’13 (3.62 cm). Longest inter-nodal length was recorded in Tuppamalli pruned in November’12 (4.95 cm).

The interaction between the genotype and pruning height was found significant (Table and Fig. 4.3b). The shortest inter nodal length was recorded in Starmalli, pruning height at 75 cm (2.80cm) followed by Nityamalli, pruning height at 75 cm (3.38cm) and longest inter nodal length was found in Tuppamalli, unpruned bushes (4.85 cm)

The interaction between pruning date and pruning height was found significant (Table and Fig. 4.3c). The shortest inter nodal length was recorded in January’13, pruning height at 75cm (3.13cm),which was on par with December’12, pruning height at 75cm (3.22 cm) and longest inter nodal length was recorded in November’12, unpruned bushes (4.66cm).

The interaction among the genotype, pruning date and pruning height on inter-nodal length was found not significant (Table 4.3d).

The longest inter nodal length was observed in genotype Tuppamalli, which might be due to the genetic factors responsible for higher gibberellins production (Muradi *et al.,* 2003). The jasmine shrubs pruned in November’12 produced the longest inter nodes might be due to the prevailing short day length, which might have promoted the higher production of gibberellins (Rakesh *et al.* 2003) in chrysanthemum. The longest inter nodes were observed in the unpruned jasmine bushes compared with the pruned bushes, which might be due to the higher concentration of gibberellins in jasmine shoots which may retain the jasmine bushes in vegetative phase (Khan and Tiwari, 2003 in dahlia).

4.1.4 Number of laterals per primary shoot

Different genotypes, pruning dates, pruning heights and their interactions significantly affected the number of laterals per primary shoot (Table 4.4a,b,c &d).

Among the genotypes Nityamalli recorded highest number of laterals per primary shoot (10.32) followed by Starmalli (9.30) and lowest number of lateral was recorded in Tuppamalli (8.02).

The highest number of laterals per primary shoot was recorded in December’12 pruning (9.82) followed by January’13 (9.13) while lowest in November’12 (8.68).

The highest number of laterals per primary shoot was recorded in pruning height at 50cm (11.41) followed by pruning height at 25 cm (10.05). Lowest number of laterals was recorded in unpruned bushes (6.74).

The interaction between genotypes and pruning date was found significant (Table and Fig. 4.4a). The highest number of laterals per primary shoot was found in Nityamalli pruned in December’12 (11.01) followed by Nityamalli pruned in January’13 (10.19) and the lowest in Tuppamalli bushes pruned in November’12 (7.61).

The interaction between genotypes and pruning height was found significant (Table and Fig. 4.4b). The highest number of laterals per primary shoot was found in Starmalli, pruning height at 50cm (12.29), Nityamalli, pruning height at 50cm (12.28) which were on par. The lowest number of laterals per primary shoot was recorded in un-pruned bushes of Tuppamalli (5.79).

The interaction between pruning date and pruning height was found significant (Table and Fig. 4.4c). The highest number of laterals per primary shoot was found in bushes pruned in December’12, pruning height at 50cm (12.32), followed by January’13, pruning height at 50cm (11.25). The lowest number of lateral branches was recorded in November’12, un-pruned bushes (6.43).

The interaction among genotypes, pruning date and pruning height was found significant (Table and Fig. 4.4d). The highest number of laterals per primary shoot was found in the treatment “Nityamalli, December’12, pruning height at 50cm” (13.49) followed by the treatment “Starmalli, December’12, pruning height at 50 cm” (13.16) and lowest was recorded in Tuppamalli, November’12 un-pruned bushes (5.40).

The genotype Nityamalli produced highest number of laterals per primary shoot, which might be due to inherent genetic factors promote the higher production of substances like Malic hydrazide (MH), auxins and cytokinin

Table 4.4a Number of laterals per primary shoot of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

T X ST				
Pruning date (ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T_1	9.76	11.01	10.19	**10.32**
T_2	7.61	8.58	7.87	**8.02**
T_3	8.67	9.88	9.34	**9.30**
Mean (ST)	**8.68**	**9.82**	**9.13**	
	T	**ST**	**T X ST**	
S.E m±	0.04	0.03	0.05	
C.D (P = 0.05)	0.14	0.09	0.17	

Table 4.4b Number of laterals per primary shoot of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height (SST)					
Genotype (T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T_1	10.74	12.28	9.66	8.60	**10.32**
T_2	8.77	9.65	7.86	5.79	**8.02**
T_3	10.64	12.29	8.44	5.83	**9.30**
Mean (SST)	**10.05**	**11.41**	**8.65**	**6.74**	
	T	**SST**	**T X SST**		
S.E m±	0.04	0.04	0.08		
C.D (P = 0.05)	0.14	0.14	0.25		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10th NOV ’12 ST_2**:**10th DEC’12 ST_3**:**10th JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table 4.4c Number of laterals per primary shoot of *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

ST X SST					
	Pruning height (SST)				
Pruning date (ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (ST)**
ST_1	9.54	10.66	8.09	6.43	**8.64**
ST_2	10.54	12.32	9.20	7.23	**9.82**
ST_3	10.07	11.25	8.67	6.55	**9.13**
Mean (SST)	**10.05**	**11.41**	**8.65**	**6.74**	
	ST	**SST**	**ST X SST**		
S.E m±	0.03	0.04	0.08		
C.D (P = 0.05)	0.09	0.14	0.25		

Table 4.4d Number of laterals per primary shoot as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Genotype (T)	**Pruning date (ST)**	**T X ST X SST**				**Mean (T X ST)**
		Pruning height (SST)				
		SST_1	**SST_2**	**SST_3**	**SST_4**	
T_1	ST_1	9.89	11.46	9.24	8.44	**9.75**
	ST_2	11.24	13.49	10.27	9.06	**11.01**
	ST_3	11.11	11.90	9.47	8.29	**10.19**
T_2	ST_1	8.30	9.23	7.50	5.40	**7.60**
	ST_2	9.23	10.32	8.27	6.49	**8.57**
	ST_3	8.77	9.42	7.82	5.49	**7.87**
T_3	ST_1	10.42	11.29	7.53	5.46	**8.67**
	ST_2	11.17	13.16	9.06	6.15	**9.88**
	ST_3	10.33	12.43	8.73	5.88	**9.34**
Mean (ST X SST)		**10.05**	**11.41**	**8.65**	**6.74**	**9.21 (X)**

Factors	**T X ST X SST**
S.E m±	0.14
C.D (P = 0.05)	0.44

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV '12 ST_2**:**10^{th} DEC'12 ST_3**:**10^{th} JAN' 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

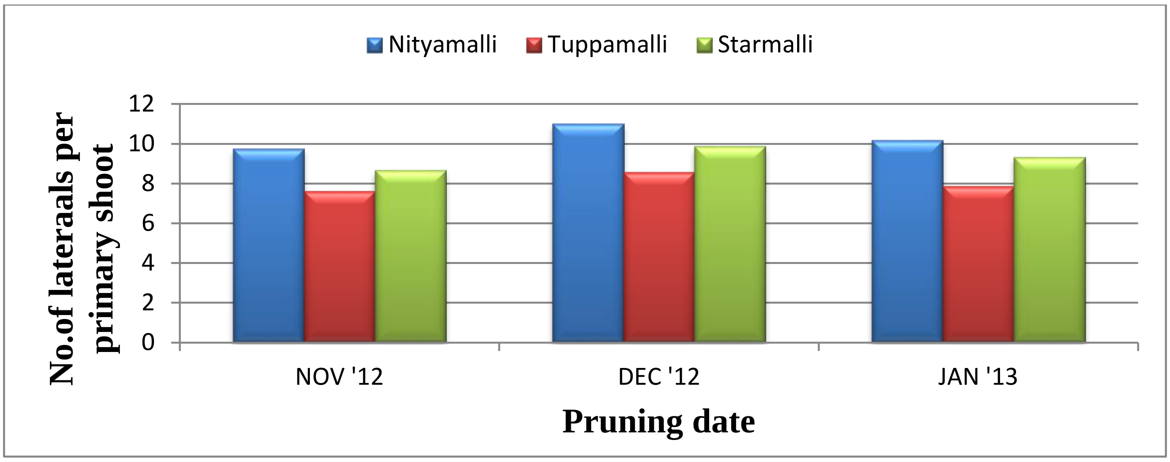

Fig.4.4a Number of laterals per primary shoot of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

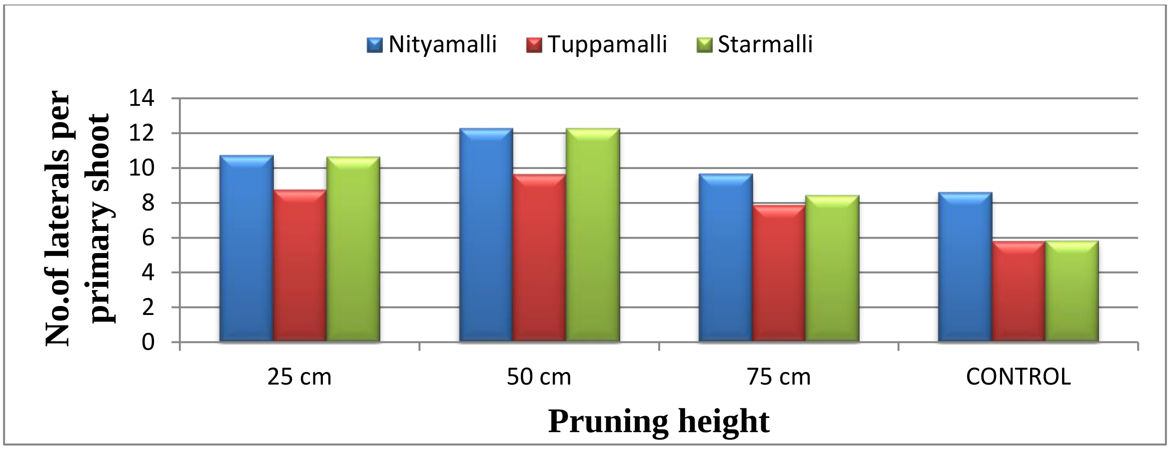

Fig.4.4b Number of laterals per primary shoot of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June2013.

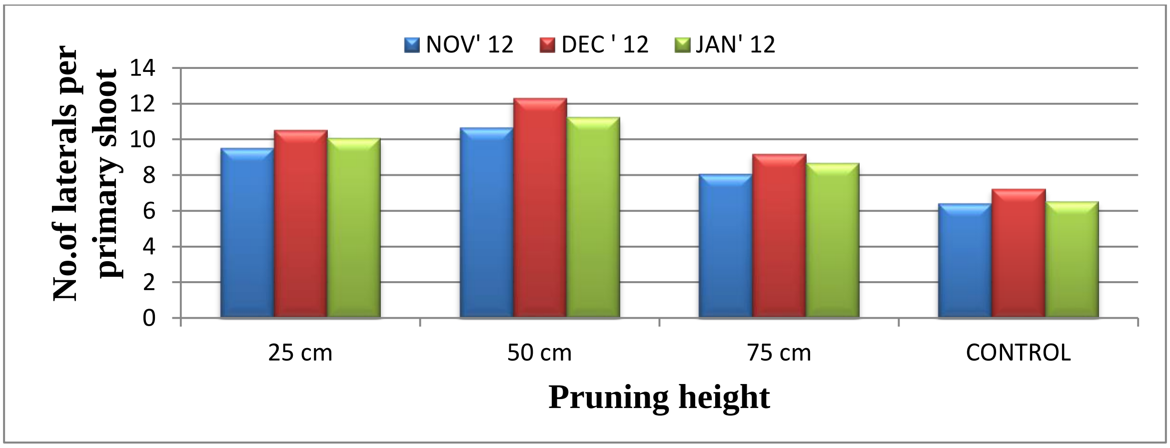

Fig.4.4c Number of laterals per primary shoot of *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

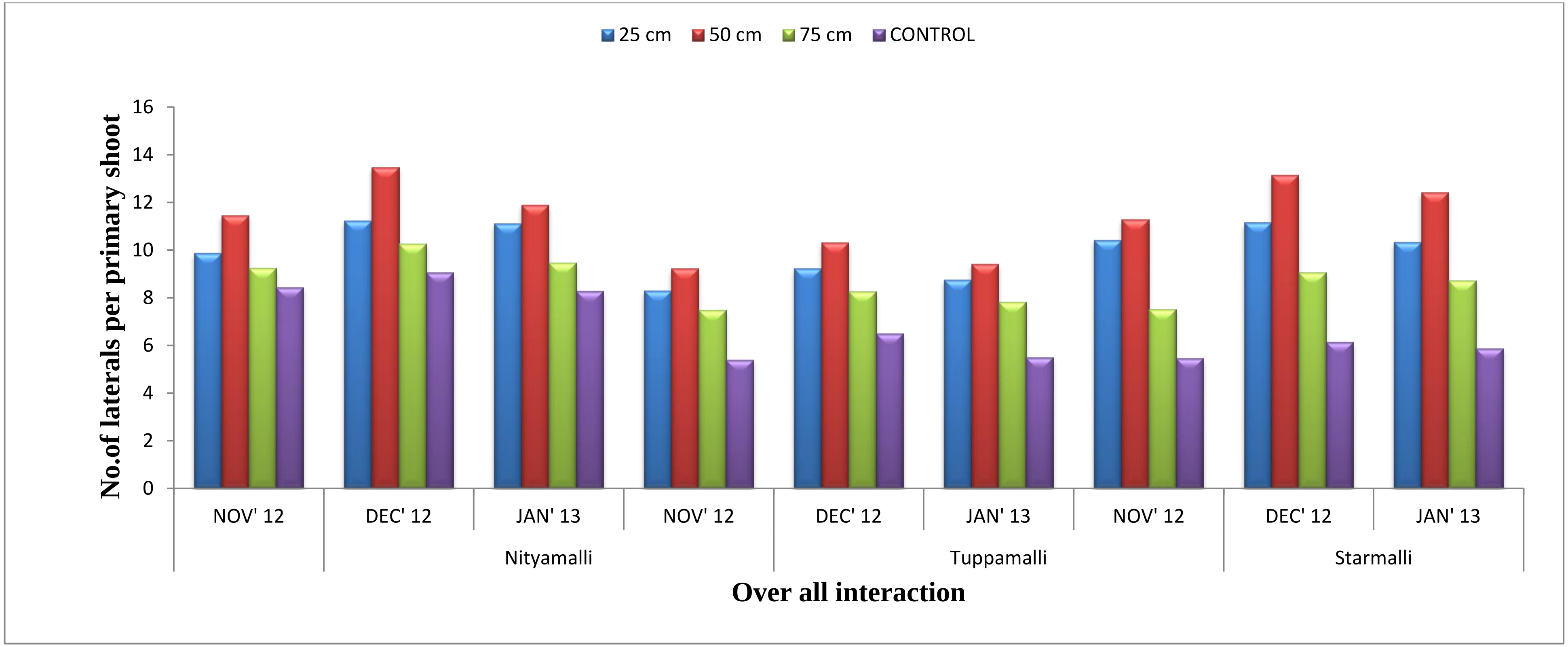

Fig.4.4d Number of laterals per primary shoot as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

growth retardants cut of the besipetal flow of auxins and induce the production of more number of shoots Muradi *et al.* (2003), Bhattacharjee (1989) and Papaiah and Muthuswamy (1977).

The highest number of laterals per primary shoot were produced in December'12 pruned bushes which might be due to better availability and uptake of nutrients (Pal *et al.*, 1984) and congenial climatic conditions promote production of cytokinins and auxins (Ahmad and Shankar, 1990).

Maximum number of lateral shoots per primary shoot was produced in jasmine bushes pruned at 50 cm height from the ground followed by pruning height at 25 cm over other treatments. The dormant buds from the mature shoots needs some mechanical stimulus like pruning to enhance sprouting new growth and flowering. Similar results were observed in Rose by Borrelli (1978), Jadhav *et al.* (2003).

4.1.5 Productive shoots per plant

Different genotypes, pruning dates, pruning heights and their interactions significantly affected the productive shoots per plant (Table 4.5a, b, c & d).

Among the genotypes Starmalli recorded highest productive shoots per plant (124.34) which was on par with Nityamalli (123.92) and lowest was recorded in Tuppamalli (083.39).

The highest productive shoots per plant were recorded in December'12 pruning date (119.57) followed by January'13 pruning date (112.13) and lowest in November'12 pruning date (99.96).

The highest number of productive shoots per plant was recorded in pruning height at 50 cm (141.90), followed by pruning height at 25 cm (117.72). Minimum number of productive shoots per plant was recorded in unpruned bushes (77.00).

The interaction between genotypes and pruning date on this trait was found significant (Table and Fig. 4.5a). The maximum number of productive shoots per plant was found in Starmalli pruned in December'12 (134.40) followed by Nityamalli pruned in December'12 (133.86), which were on par. The minimum number was recorded in Tuppamalli November'12 pruned bushes (75.58).

The interaction between genotypes and pruning heights on this trait was found significant (Table and Fig. 4.5b). The highest number of productive shoots per plant was found in Nityamalli, pruning height at 50 cm (161.53) followed by Starmalli, pruning height at 50 cm (152.36) and the lowest was recorded in Tuppamalli un-pruned bushes (48.66).

The interaction between pruning date and pruning height on this trait was found significant (Table and Fig. 4.5c). The highest number of productive shoots per plant was found in December'12 pruning height at 50 cm (156.70) followed by January'13, pruning height at 50 cm (143.23). The lowest number was recorded in November'12, un-pruned bushes (71.34).

The interaction among genotypes, pruning date and pruning height on this trait was found significant (Table and Fig. 4.5d). The highest number of productive shoots per plant was found in the treatment "Nityamalli, December'12, pruning height at 50 cm" (181.26) followed by Starmalli pruned in December'12, pruning height at 50 cm (163.03) and minimum number was recorded in Tuppamalli, November'12 un-pruned bushes (45.60).

The genotypes Nityamalli and Starmalli produced more number of productive shoots per plant which were on par, which might be due to inherent genetic factors that promote the higher production of auxiliary buds develop into shoots due to production of substances like Malic hydrazide (MH), auxins and cytokinins, growth retardants cut of the besipetal flow of auxins and induce the production of more number of shoots Muradi *et al.* (2003), Bhattacharjee (1989) and Papaiah and Muthuswamy (1977).

The highest number of productive shoots per plant were produced in December'12 pruned bushes which might be due to more number of primary shoots per plant, more number of lateral shoots per primary branch, better availability and uptake of nutrients (Pal *et al.*, 1984) and congenial climatic conditions promote production of cytokinins and auxins (Ahmad and Shankar, 1990).

Maximum number of productive shoots per plant was produced in jasmine bushes pruned at 50 cm height from the ground followed by pruning height at 25 cm over other treatments. The dormant buds from the mature shoots needs some

Table 4.5a Number of productive shoots plant^{-1} of *Jasminum Sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

T X ST				
Pruning date (ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T_1	112.41	133.86	125.49	**123.92**
T_2	75.58	90.44	84.16	**83.39**
T_3	111.8	134.40	126.74	**124.34**
Mean (ST)	**99.96**	**119.57**	**112.13**	
	T	**ST**	**T X ST**	
S.E m±	0.40	0.29	0.51	
C.D (P = 0.05)	1.21	0.89	1.54	

Table 4.5b Number of productive shoots plant^{-1} of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height (SST)					
Genotype (T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T_1	127.97	161.53	115.72	90.46	**123.92**
T_2	90.97	111.82	82.12	48.66	**83.39**
T_3	134.22	152.36	118.90	91.88	**124.34**
Mean (SST)	**117.72**	**141.90**	**105.58**	**77.00**	
	T	**SST**	**TX SST**		
S.E m±	0.40	0.30	0.52		
C.D (P = 0.05)	1.21	0.90	1.57		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10th NOV ’12 ST_2**:**10th DEC’12 ST_3**:**10th JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table 4.5c Number of productive shoots plant^{-1} of *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

ST X SST					
Pruning height (SST)					
Pruning date (ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (ST)**
ST_1	108.94	125.78	93.76	71.34	**99.96**
ST_2	125.08	156.70	113.54	82.95	**119.57**
ST_3	119.14	143.23	109.43	76.72	**112.13**
Mean (SST)	**117.72**	**141.90**	**105.58**	**77.00**	
	ST	**SST**	**ST X SST**		
S.E m±	0.29	0.30	0.51		
C.D (P = 0.05)	0.89	0.90	1.54		

Table 4.5d Number of productive shoots plant^{-1} as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Genotype (T)	**Pruning date (ST)**	**T X ST X SST**				**Mean (T X ST)**
		Pruning height (SST)				
		SST_1	**SST_2**	**SST_3**	**SST_4**	
T_1	**ST_1**	116.93	141.73	101.60	89.40	**112.41**
	ST_2	135.06	181.26	125.90	93.23	**133.86**
	ST_3	131.93	161.60	119.66	88.76	**125.48**
T_2	**ST_1**	86.66	93.40	76.66	45.60	**75.58**
	ST_2	97.13	125.80	86.20	52.63	**90.44**
	ST_3	89.13	116.26	83.50	47.76	**84.16**
T_3	**ST_1**	123.23	142.23	103.03	79.03	**111.88**
	ST_2	143.06	163.03	128.53	103.00	**134.40**
	ST_3	136.36	151.83	125.13	93.63	**126.73**
Mean (ST X SST)		**117.72**	**141.90**	**105.57**	**77.00**	**108.53 (X)**

Factors	**T X ST X SST**
S.E m±	0.90
C.D (P = 0.05)	2.72

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10th NOV '12 ST_2**:**10th DEC'12 ST_3**:**10th JAN' 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

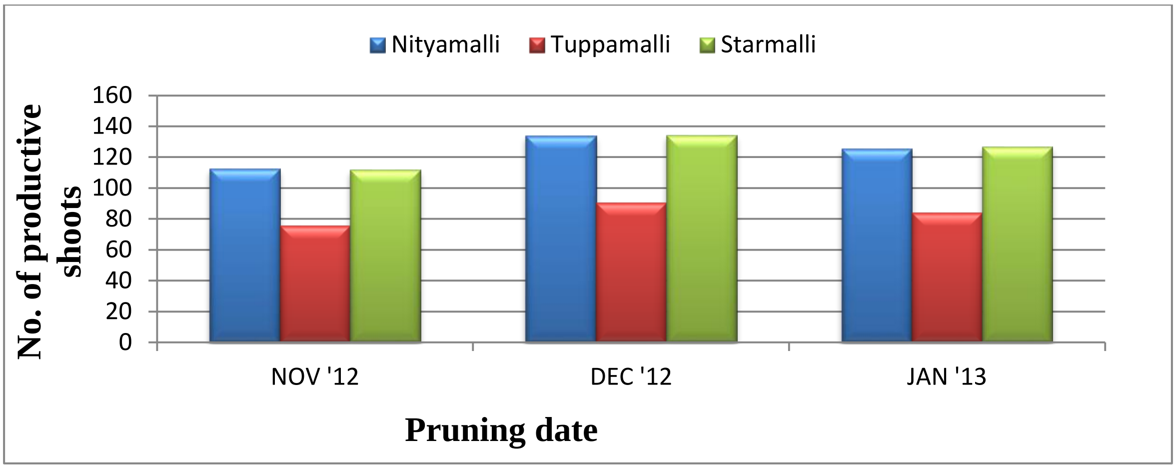

Fig.4.5a Number of productive shoots of *Jasminum sambac* as effected by genotype and pruning date during Nov.2012 to June 2013.

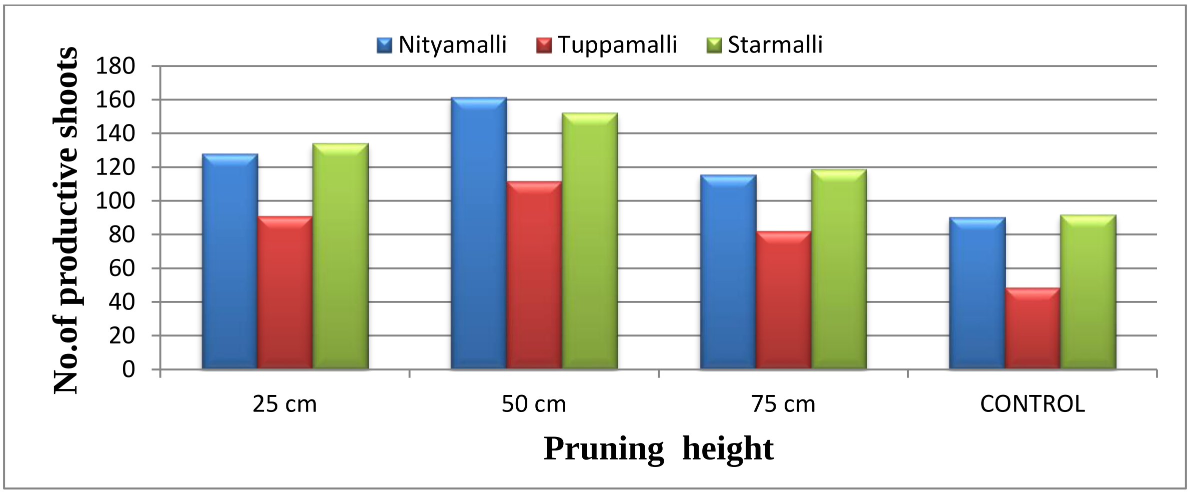

Fig.4.5b Number of productive shoots of *Jasminum sambac* as effected by genotype and pruning height during Nov.2012 to June2013.

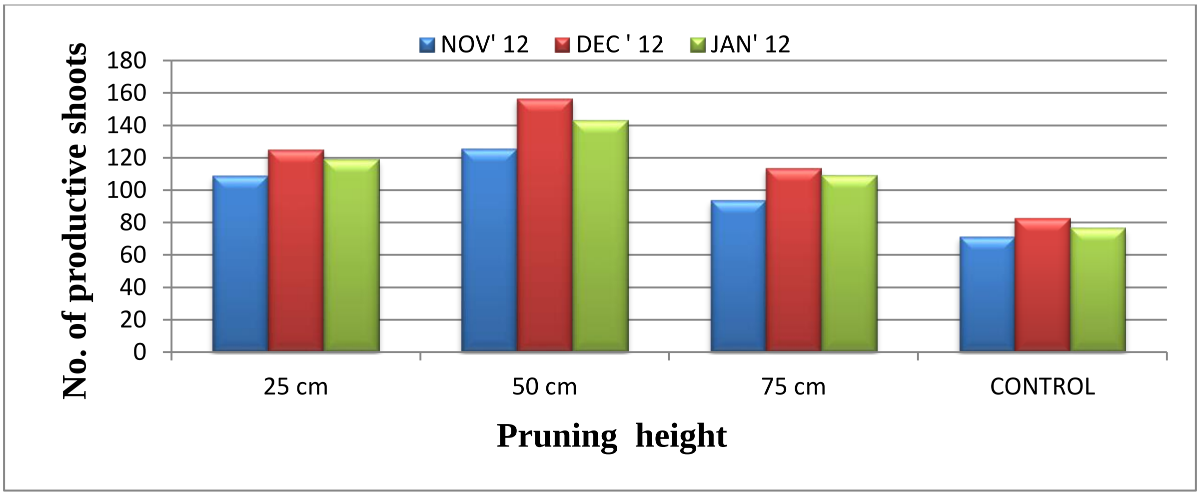

Fig.4.5c Number of productive shoots of *Jasminum sambac* as effected by pruning date and pruning height during Nov.2012 to June 2013.

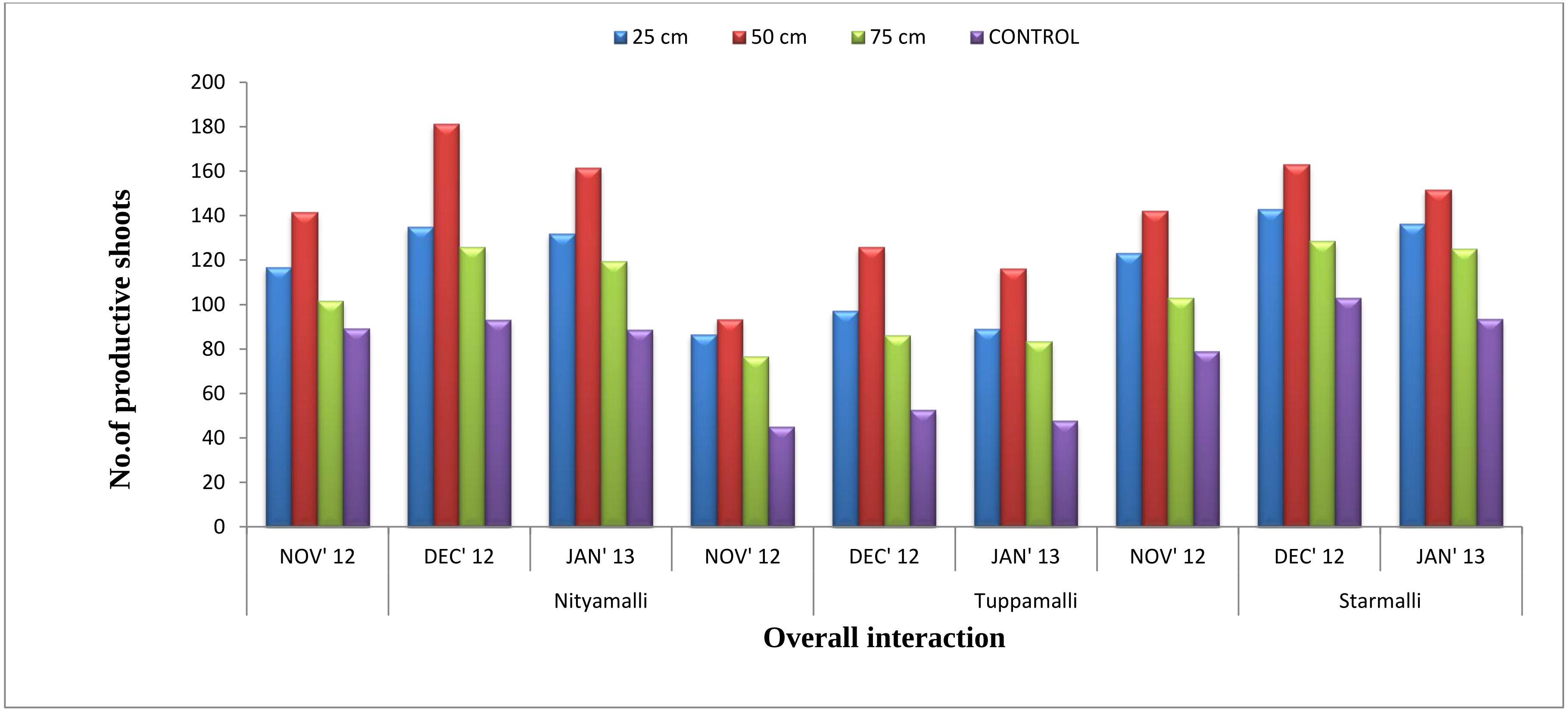

Fig.4.5d Number of productive shoots as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov.2012 to June 2013.

mechanical stimulus like pruning to enhance sprouting new growth and flowering. Similar results were observed in rose by Borrelli (1978), Jadhav *et al.* (2003).

4.1.6 Number of leaves per primary shoot

Different genotypes, pruning dates pruning heights and their interactions significantly affected the number of leaves per primary shoot (Table 4.6a, b, c & d).

Among the genotypes Nityamalli recorded highest number of leaves per primary shoot (65.74) followed by Starmalli (58.64) and minimum number recorded in Tuppamalli (48.82).

The highest number of leaves per primary shoot was recorded in December’12 pruning date (64.68) followed by January’13 (57.42) and lowest in November’12 pruned bushes (51.09).

The highest number of leaves per primary shoot was recorded in pruning height at 50 cm (80.71), followed by pruning height at 25 cm (58.46). Lowest number of leaves (40.93) was recorded in un-pruned bushes.

The interaction between genotypes and pruning date on this trait was found significant (Table and Fig. 4.6a). The highest number of leaves per primary shoot was found in Nityamalli, December’12 (74.65) followed by Starmalli pruned in December’12 (64.87) which was on par with Nityamalli pruned in January’13 (64.71) and minimum number was recorded in Tuppamalli pruned in November’12 (42.18).

The interaction between genotypes and pruning height on this trait was found significant (Table and Fig. 4.6b). The highest number of leaves per primary shoot was found in Nityamalli, pruning height at 50 cm (92.15) followed by Starmalli, pruning height at 50 cm (84.81) and minimum number of leaves was recorded in un-pruned bushes of Tuppamalli (38.27).

The interaction between pruning date and pruning height on this trait was found significant (Table and Fig. 4.6c). The highest number of leaves per primary shoot was found in December’12 pruning height at 50cm (94.40), followed by January’13, pruning height at 50 cm (79.88). The lowest number of leaves were recorded in November’12, un-pruned bushes (37.03).

Table 4.6a Number of leaves per primary shoot of *Jasminum Sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

T X ST				
Pruning date (ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T_1	57.87	74.65	64.71	**65.74**
T_2	42.18	54.52	49.76	**48.82**
T_3	53.23	64.87	57.84	**58.64**
Mean (ST)	**51.09**	**64.68**	**57.42**	
	T	**ST**	**T X ST**	
S.E m±	0.16	0.24	0.42	
C.D (P = 0.05)	0.48	0.72	1.26	

Table 4.6b Number of leaves per primary shoot of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height (SST)					
Genotype (T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T_1	67.13	92.15	57.97	45.72	**65.74**
T_2	48.35	65.17	43.49	38.27	**48.82**
T_3	59.90	84.81	51.07	38.81	**58.64**
Mean (SST)	**58.46**	**80.71**	**50.84**	**40.93**	
	T	**SST**	**T X SST**		
S.E m±	0.16	0.23	0.40		
C.D (P = 0.05)	0.48	0.70	1.21		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10th NOV '12 ST_2**:**10th DEC'12 ST_3**:**10th JAN' 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table 4.6c Number of leaves per primary shoot of *Jasminum sambac* as effected by pruning date and Pruning height during Nov. 2012 to June 2013.

ST X SST					
Pruning height (SST)					
Pruning date (ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (ST)**
ST_1	53.73	67.85	45.75	37.03	**51.09**
ST_2	64.42	94.40	56.55	43.37	**64.68**
ST_3	57.23	79.88	50.23	42.40	**57.42**
Mean (SST)	**58.46**	**80.71**	**50.84**	**40.93**	
	ST	**SST**	**ST X SST**		
S.E m±	0.24	0.23	0.40		
C.D (P = 0.05)	0.72	0.70	1.21		

Table 4.6d Number of leaves per primary shoot as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Genotype (T)	Pruning date (ST)	T X ST X SST				Mean (T X ST)
		Pruning height (SST)				
		SST_1	**SST_2**	**SST_3**	**SST_4**	
T_1	**ST_1**	61.58	76.52	52.18	41.18	**57.86**
	ST_2	74.23	107.06	67.89	49.44	**74.65**
	ST_3	65.59	92.85	53.85	46.55	**64.71**
T_2	**ST_1**	45.04	51.80	37.72	34.16	**42.18**
	ST_2	51.85	80.84	45.09	40.33	**54.52**
	ST_3	48.16	62.88	47.67	40.33	**49.76**
T_3	**ST_1**	54.56	75.23	47.36	35.76	**53.22**
	ST_2	67.18	95.29	56.68	40.33	**64.87**
	ST_3	57.96	83.90	49.17	40.33	**57.84**
Mean (ST X SST)		**58.46**	**80.70**	**50.84**	**40.93**	**57.73 (X)**

Factors	T X ST X SST
S.E m±	0.70
C.D (P = 0.05)	2.10

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10th NOV ’12 ST_2**:**10th DEC’12 ST_3**:**10th JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

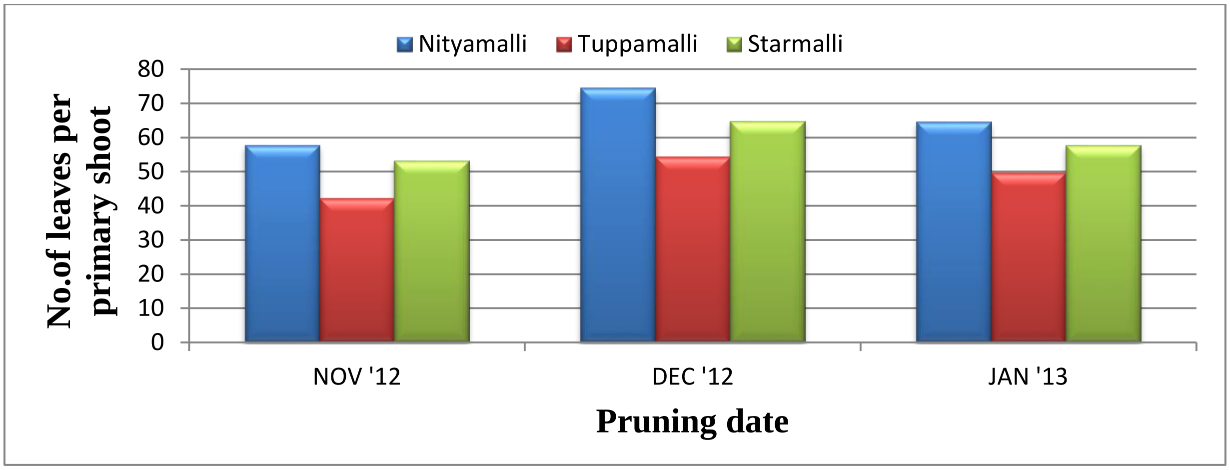

Fig 4.6a Number of leaves per primary shoot of *Jasminum sambac* as effected by genotype and pruning date during Nov.2012 to June 2013.

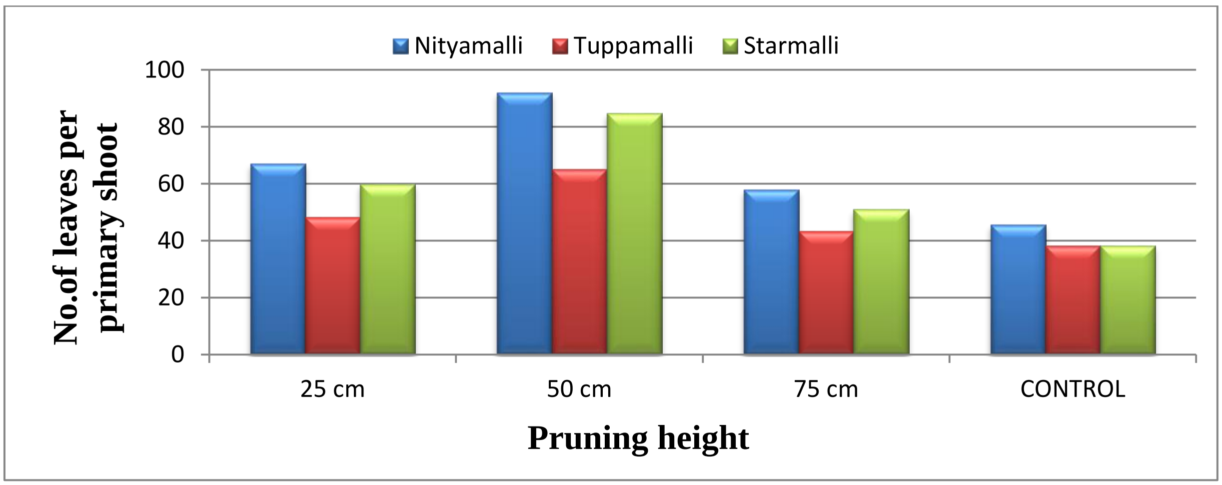

Fig.4.6b Number of leaves per primary shoots of *Jasminum sambac* as effected by genotype and pruning height during Nov.2012 to June 2013.

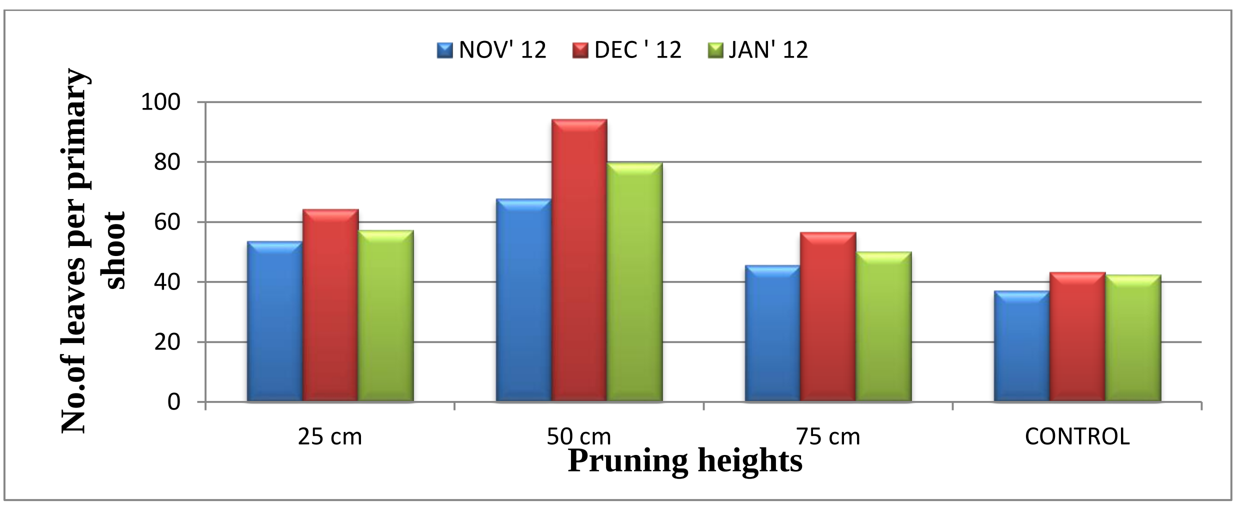

Fig.4.6c Number of leaves per primary shoot of *Jasminum sambac* as effected by pruning date and Pruning height during Nov.2012 to June 2013.

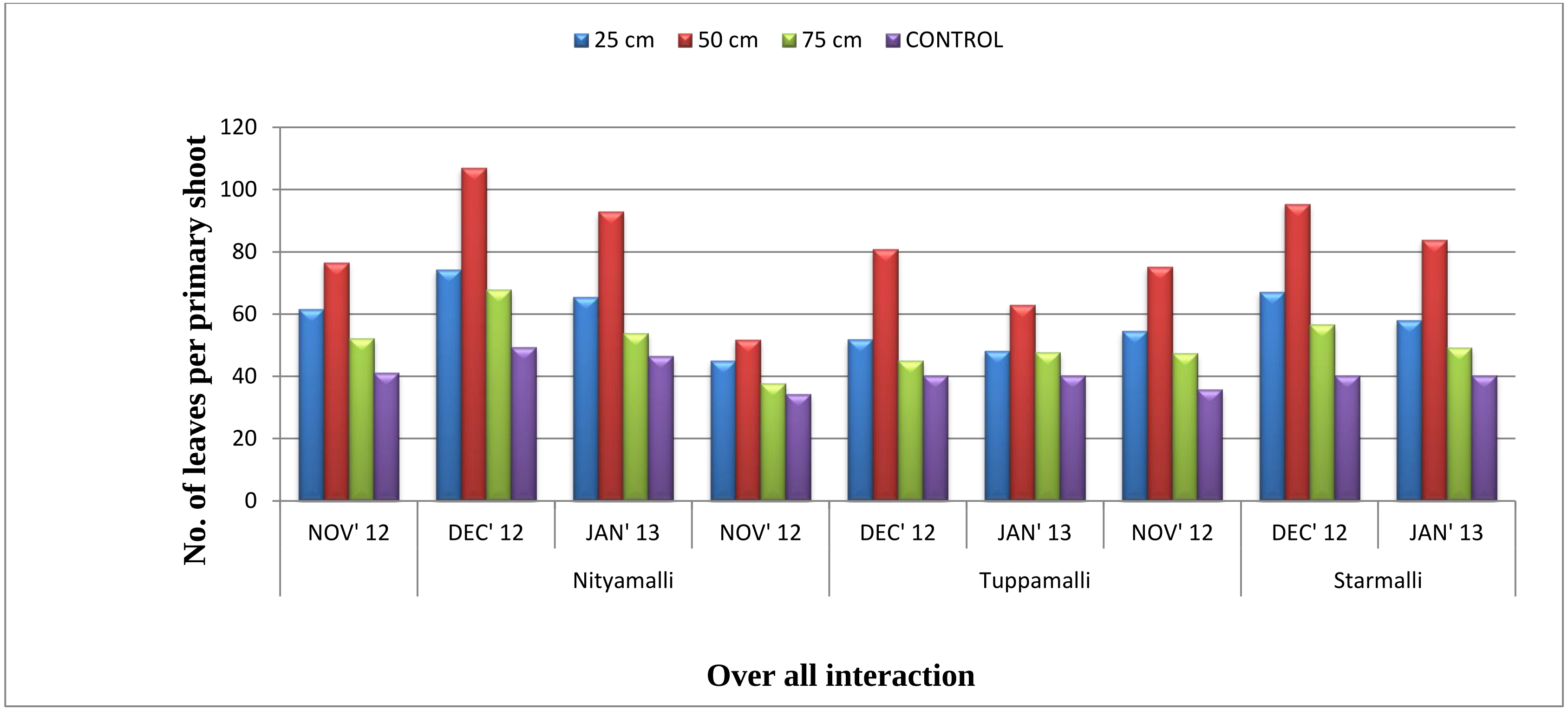

Fig 4.6d Number of leaves per primary shoot as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

The interaction among the factors genotypes, pruning date and pruning height on this trait was found significant (Table and Fig. 4.6d). The highest number of leaves per primary shoot was found in the treatment “Nityamalli, December’12, pruning height at 50 cm” (107.06) followed by “Starmalli, December’12, pruning height at 50 cm” (95.29) and minimum number of leaves was recorded in Tuppamalli, November’12 un-pruned bushes (34.16).

The genotype Nityamalli produced maximum number of leaves per primary shoot, which might be due to inherent genetic factors, shortest internodal length, higher sprouting of axillary buds, endogenous production of cytokinins, auxins and gibberillins Muradi *et al.* (2003), Bhattacharjee (1989) and Papaiah and Muthuswamy (1977).

The highest number of leaves per primary shoot were produced in December’12 pruned bushes which might be due to favorable agro climatic conditions, better availability and uptake of nutrients (Pal *et al.,* 1984) and congenial climatic conditions promote endogenous production of cytokinins, gibberellins and auxins (Ahmad and Shankar, 1990), and more total polysaccharide content in plants pruned in December month (Sumangala *et al.,* 2003).

Maximum number of leaves per primary shoot was produced in pruning height at 50cm from the ground level over other treatments might be due to sprouting of higher number of axillary buds, short internodes produced by the December’12 pruned jasmine bushes received the longer photo periodic stimulus resulting in better vegetative growth. Similar results were reported by Nair *et al.* (2009) *in Jasminum sambac.* It might be due to the dormant buds from the mature shoots needs some mechanical stimulus like pruning to enhance sprouting new growth and flowering. Similar results were observed in Rose by Borrelli (1978), Jadhav *et al.* (2003)

4.1.7 Leaf area (cm^2) per shoot

Different genotypes, pruning dates, pruning heights and their interactions significantly affected the leaf area per shoot (cm^2) (Table 4.7a, b, c & d).

Among the genotypes Nityamalli recorded highest leaf area per shoot (1871.27 cm^2) followed by Tuppamalli (1409.58 cm^2) and lowest in Starmalli (1215.35 cm^2).

The highest leaf area per shoot was recorded in December'12 pruning date (1699.23 cm^2) followed by January'13 pruning date (1449.83 cm^2) and lowest in November'12 pruned bushes (1347.14 cm^2).

The highest leaf area per shoot was recorded in pruning height at 50 cm (2056.33 cm^2), followed by pruning height at 25cm (1540.66 cm^2). Minimum leaf area was recorded in un-pruned bushes (1067.15 cm^2).

The interaction between genotype and pruning date on this trait was found significant (Table and Fig. 4.7a). The highest leaf area per shoot was found in Nityamalli, December'12 (2152.36 cm^2) followed by Nityamalli, January'13 (1774.30 cm^2) and minimum leaf area was recorded in Starmalli, November'12 (1111.81cm^2).

The interaction between genotype and pruning height on this trait was found significant (Table and Fig. 4.7b). The highest leaf area per shoot was found in Nityamalli, pruning height at 50 cm (2490.58 cm^2) followed by in Nityamalli, pruning height at 25 cm (1933.88 cm^2) and the lowest was recorded in Starmalli, un-pruned bushes (786.66 cm^2).

The interaction between pruning dates and pruning heights on this trait was found significant (Table and Fig. 4.7c). The highest leaf area per shoot was found in December'12, pruning height at 50 cm (2438.17 cm^2), followed by January'13, pruning height at 50 cm (1943.98 cm^2). The lowest was recorded in November'12, un-pruned bushes (970.88 cm^2).

The interaction among genotype, Pruning date and pruning height was found significant (Table and Fig. 4.7d). The highest leaf area per primary shoot was found in Nityamalli, December'12, pruning height at 50 cm (2978.00 cm^2) followed by Tuppamalli, December'12, pruning height at 50 cm (2356.34 cm^2) and lowest was recorded in Starmalli, November'12, un-pruned bushes (735.22 cm^2).

The highest leaf area per shoot was found in the genotype Nityamalli, which might be due to inherent genetic factors, more number of lateral shoots per

Table 4.7a Leaf area (cm^2) per primary shoot of *Jasminum Sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

T X ST				
Pruning date (ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T_1	1687.14	2152.36	1774.30	**1871.27**
T_2	1242.47	1601.32	1384.95	**1409.58**
T_3	1111.81	1344.00	1190.24	**1215.35**
Mean (ST)	**1347.14**	**1699.23**	**1449.83**	
	T	**ST**	**T X ST**	
S.E m±	1.68	0.88	1.53	
C.D (P = 0.05)	5.05	2.65	4.59	

Table 4.7b Leaf area (cm^2) per primary shoots of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height (SST)					
Genotype (T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T_1	1933.88	2490.58	1726.04	1334.57	**1871.27**
T_2	1430.04	1915.58	1212.48	1080.22	**1409.58**
T_3	1258.06	1762.82	1053.86	786.66	**1215.35**
Mean (SST)	**1540.66**	**2056.33**	**1330.79**	**1067.15**	
	T	**SST**	**T X SST**		
S.E m±	1.68	1.07	1.85		
C.D (P = 0.05)	5.05	3.21	5.57		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV '12 ST_2**:**10^{th} DEC'12 ST_3**:**10^{th} JAN' 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table 4.7c Leaf area (cm^2) per primary shoot of *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

ST X SST					
Pruning height (SST)					
Pruning date (ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (ST)**
ST_1	1431.90	1786.83	1198.94	970.88	**1347.14**
ST_2	1708.95	2438.17	1498.69	1151.50	**1699.23**
ST_3	1481.14	1943.98	1294.74	1079.47	**1449.83**
Mean (SST)	**1540.66**	**2056.33**	**1330.79**	**1067.15**	
	ST	**SST**	**ST X SST**		
S.E m±	0.88	1.07	1.85		
C.D (P = 0.05)	2.65	3.21	5.57		

Table 4.7d Leaf area (cm^2) per primary shoot as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Genotype (T)	**Pruning date (ST)**	**T X ST X SST**				**Mean (T X ST)**
		Pruning height (SST)				
		SST_1	**SST_2**	**SST_3**	**SST_4**	
T_1	**ST_1**	1800.24	2241.19	1532.91	1174.24	**1687.14**
	ST_2	2185.86	2978.00	1991.67	1453.91	**2152.36**
	ST_3	1815.55	2252.56	1653.54	1375.56	**1774.30**
T_2	**ST_1**	1327.33	1536.18	1103.17	1003.18	**1242.46**
	ST_2	1537.90	2356.34	1328.16	1182.90	**1601.32**
	ST_3	1424.89	1854.22	1206.12	1054.57	**1384.95**
T_3	**ST_1**	1168.13	1583.13	960.75	735.22	**1111.80**
	ST_2	1403.09	1980.18	1176.26	816.49	**1344.00**
	ST_3	1202.97	1725.15	1024.57	808.27	**1190.24**
Mean (ST X SST)		**1540.66**	**2056.32**	**1330.79**	**1067.14**	**1498.73 (X)**

Factors	**T X ST X SST**
S.E m±	3.21
C.D (P = 0.05)	9.65

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV ’12 ST_2**:**10^{th} DEC’12 ST_3**:**10^{th} JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

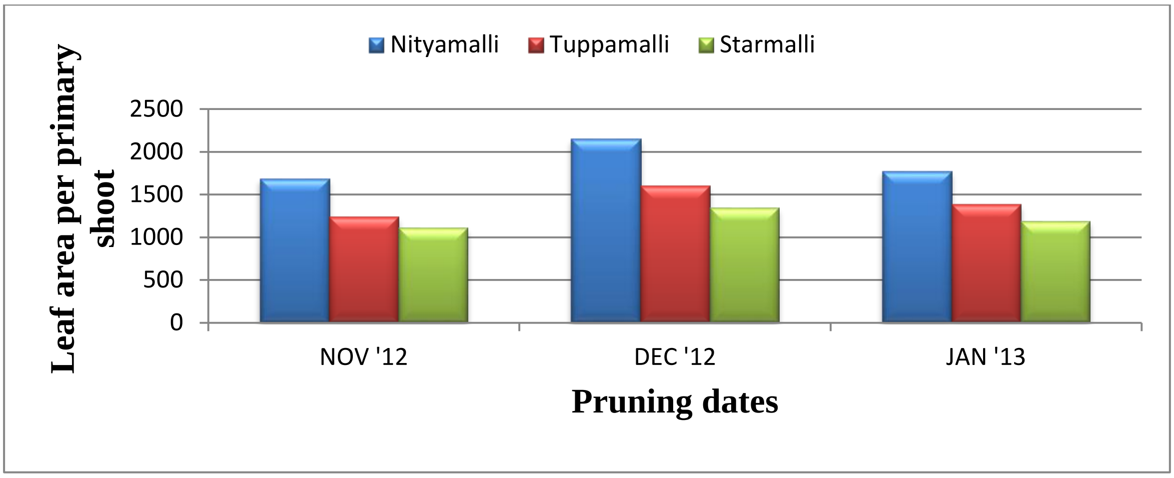

Fig.4.7a Leaf area (cm^2) per primary shoot of *Jasminum sambac* as effected by genotype and pruning date during Nov.2012 to June 2013.

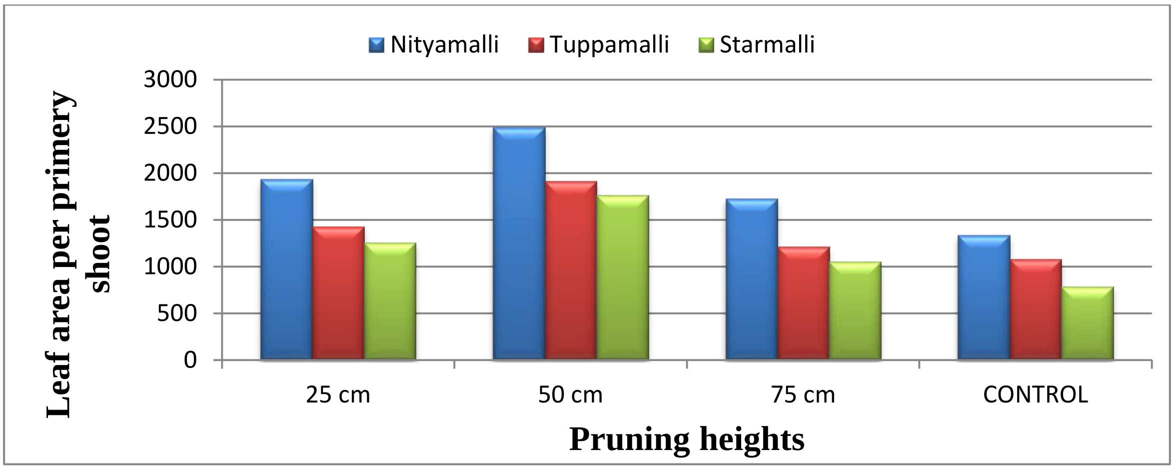

Fig.4.7b Leaf area (cm^2) per primary shoots of *Jasminum sambac* as effected by genotype and pruning height during Nov.2012to June2013.

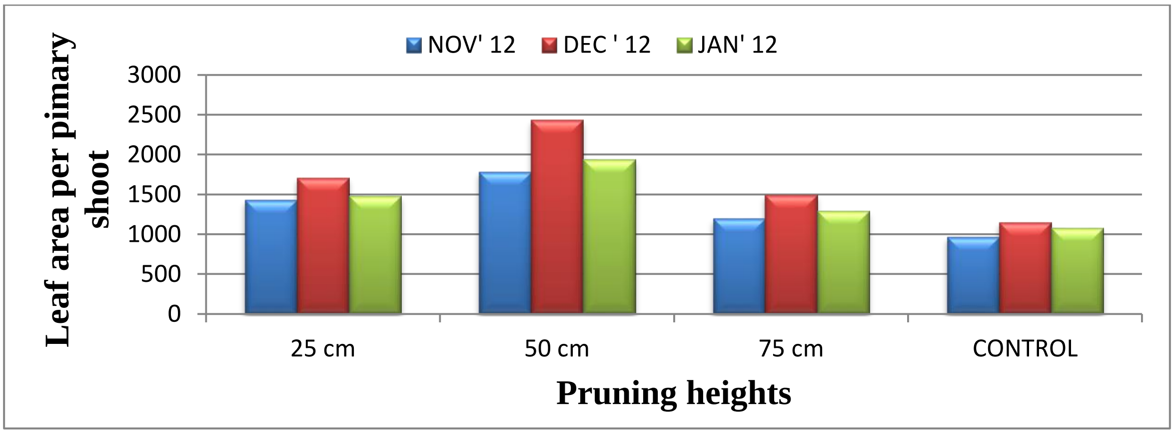

Fig 4.7c Leaf area (cm^2) per primary shoot as effected by pruning date and pruning height of *Jasminum sambac* during Nov.2012 to June 2013.

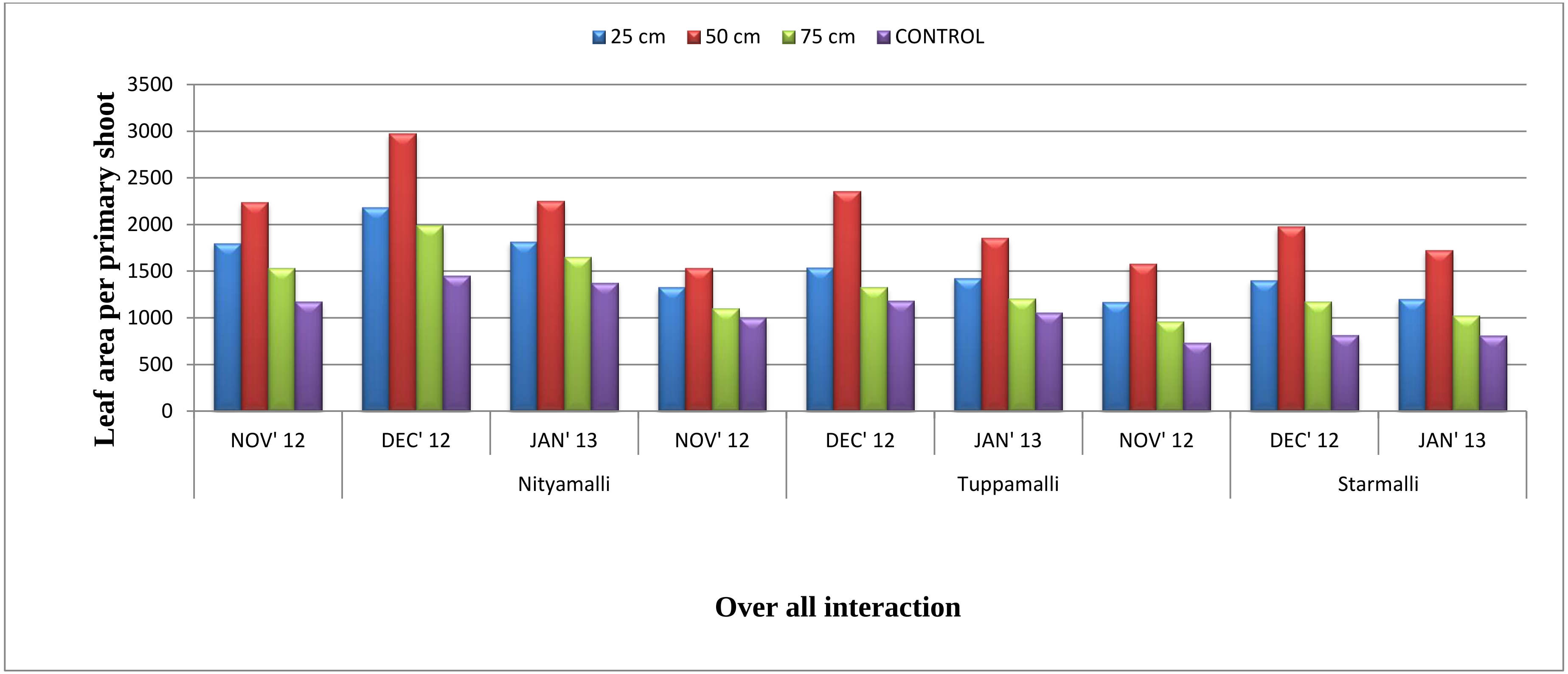

Fig 4.7d Leaf area (cm^2) per primary shoot as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov.2012 to June 2013.

primary branch and more number of leaves per primary shoot. Similar results were reported in Rosa x hybrida (Janaki, 2013).

Among the pruning dates, the jasmine shrubs pruned during December'12 produced the highest leaf area per shoot which might be due to production of highest number of laterals and leaves per shoot (Sumangala *et al.*, 2003).

The jasmine bushes pruned at 50cm height produced the highest leaf area per primary shoot which might be due to production of highest number of lateral shoots as well as maximum number of leaves. Similar kind of observations was reported by Sharma and Singh (1991).

4.1.8 Days to first flower bud initiation (days)

Significant difference was recorded for days to flower bud initiation among genotype, pruning date, pruning height and their interaction (Table 4.8a, b, c & d).

Among the genotypes, Starmalli recorded the lowest number of days for flower bud initiation (43.59 days), followed by Nityamalli (48.88 days). Maximum number of days took for bud initiation in Tuppamalli (59.01days).

The pruning date January'13 recorded minimum number of days for flower bud initiation (42.83 days) followed by December'12 pruning (51.26 days) among the pruning dates. Maximum number of days was noted for flower bud initiation in November'12 (57.39 days).

Among the pruning heights, pruning height at 75 cm recorded minimum number of days for flower bud initiation (41.78days) followed by pruning height at 50 cm (47.86days), whereas the maximum number of days was recorded for flower bud initiation in unpruned bushes (59.30days).

The interaction between genotype and pruning date on this trait was found significant (Table and Fig. 4.8a). The treatment Starmalli, January'13 took minimum number of days for flower bud initiation (36.93 days), followed by Nityamalli, January'13 (40.54 days). Whereas maximum number of days taken by Tuppamalli, November'12 (65.23 days) for flower bud initiation.

The interaction between genotype and pruning height on this trait was found significant (Table and Fig. 4.8b). The treatment Starmalli, pruning height at 75 cm recorded minimum number of days for flower bud initiation (34.47 days) followed by Starmalli, pruning height at 50 cm (40.42 days). Maximum number of days noted for flower bud initiation in unpruned bushes of Tuppamalli (67.81days).

The interaction between pruning date and pruning height on this trait was found significant (Table and Fig. 4.8c). The treatment January'13, pruning height at 75 cm recorded minimum number of days for flower bud initiation (35.53 days) followed by December'12, pruning height at 75 cm (41.46 days). The maximum number of days was recorded for flower bud initiation by November'12, un-pruned bushes (65.73 days).

The interaction among genotype, pruning date and pruning height on this trait was found significant (Table and Fig. 4.8d). The treatment Starmalli, January'13, pruning height at 75 cm recorded minimum number of days for flower bud initiation (30.83 days), followed by the treatment Starmalli, December'12, pruning height at 75 cm (32.43 days). Maximum number of days was recorded for flower bud initiation in unpruned bushes of Tuppamalli, November'12 (74.50 days).

Early flowering was observed in the genotype Starmalli and Nityamalli, which might be due to the inherent genetic factors and production of plant growth hormones like auxins, cytokinins, gibberellins and ethylene. The jasmine shrubs pruned in January'13 produced early flowering than other pruning dates, which might be due to the prevailing day lengths and climatic conditions (Nair *et al.,* 2009). Whereas the jasmine bushes pruned in November'12 took more number of days for first flower bud initiation which might be due to low temperature and with shorter sunshine hours Moe (1975), Siddagangaiah and Muthapparai (1988) and Sumangala *et al.* (2003) reported the similar results in *Jasminum sambac.*

The jasmine bushes pruned at pruning height 75cm produced flower buds early compared with other pruning treatments, which might be due to higher reserve food materials (Sharma and Singh, 1991). The un-pruned jasmine shrubs took longer duration for flower bud initiation over pruning treatments which might be due to higher concentration of growth inhibitory substances and low concentration of auxins, cytokinins and gibberellins. In *O. europaea*, gibberellins

Table 4.8a Days to first flower bud initiation of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

T X ST				
Pruning date (ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T_1	55.81	50.28	40.54	**48.88**
T_2	65.23	60.79	51.03	**59.01**
T_3	51.12	42.70	36.93	**43.59**
Mean (ST)	**57.39**	**51.26**	**42.83**	
	T	**ST**	**T X ST**	
S.E m±	0.30	0.30	0.51	
C.D (P = 0.05)	0.92	0.90	1.55	

Table 4.8b Days to first flower bud initiation of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height (SST)					
Genotypes (T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T_1	51.96	47.17	39.93	56.44	**48.88**
T_2	61.32	55.98	50.96	67.81	**59.01**
T_3	45.80	40.42	34.47	53.65	**43.59**
Mean (SST)	**53.03**	**47.86**	**41.78**	**59.30**	
	T	**SST**	**T X SST**		
S.E m±	0.30	0.30	0.53		
C.D (P = 0.05)	0.92	0.92	1.59		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV ’12 ST_2**:**10^{th} DEC’12 ST_3**:**10^{th} JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table 4.8c Days to first flower bud initiation of *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

ST X SST					
Pruning height (SST)					
Pruning date (ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (ST)**
ST_1	59.93	55.53	48.36	65.73	**57.39**
ST_2	54.37	48.45	41.46	60.74	**51.26**
ST_3	44.77	39.60	35.53	51.43	**42.83**
Mean (SST)	**53.03**	**47.86**	**41.78**	**59.30**	
	ST	**SST**	**ST X SST**		
S.E m±	0.30	0.30	0.53		
C.D (P = 0.05)	0.90	0.92	1.59		

Table 4.8d Days to first flower bud initiation as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Genotype (T)	Pruning date (ST)	T X ST X SST				Mean (T X ST)
		Pruning height (SST)				
		SST_1	**SST_2**	**SST_3**	**SST_4**	
T_1	**ST_1**	59.86	54.50	47.40	61.50	**55.81**
	ST_2	53.60	49.96	39.03	58.53	**50.28**
	ST_3	42.43	37.06	33.36	49.30	**40.53**
T_2	**ST_1**	66.40	62.50	57.53	74.50	**65.23**
	ST_2	65.23	56.80	52.93	68.20	**60.79**
	ST_3	52.33	48.65	42.41	60.73	**51.03**
T_3	**ST_1**	53.53	49.60	40.16	61.20	**51.12**
	ST_2	44.30	38.60	32.43	55.50	**42.70**
	ST_3	39.56	33.08	30.83	44.26	**36.93**
Mean (ST X SST)		**53.02**	**47.86**	**41.78**	**59.30**	**50.49 (X)**

Factors	T X ST X ST
S.E m±	0.91
C.D (P = 0.05)	2.75

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV ’12 ST_2**:**10^{th} DEC’12 ST_3**:**10^{th} JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

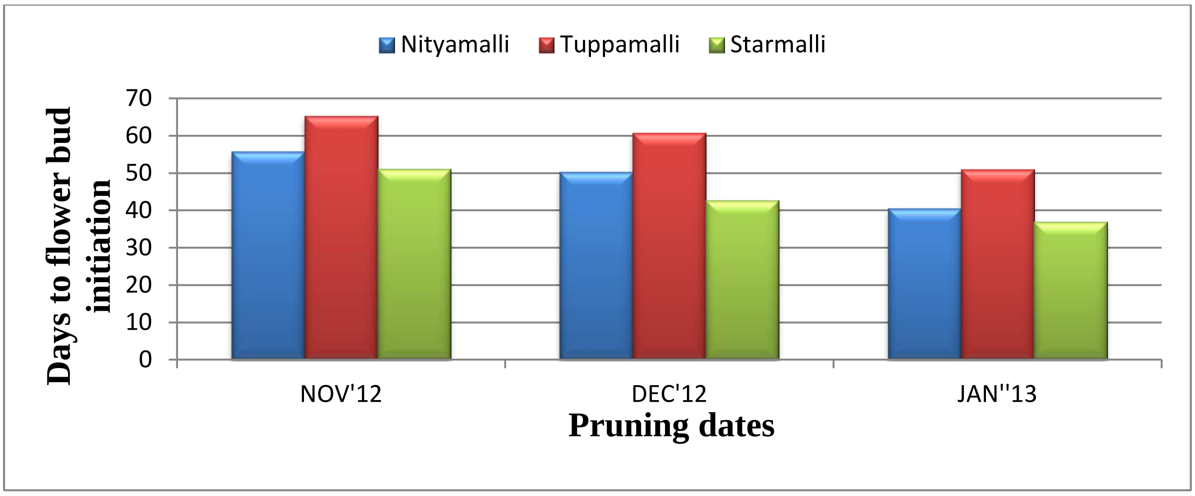

Fig.4.8a Days to first flower bud initiation of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

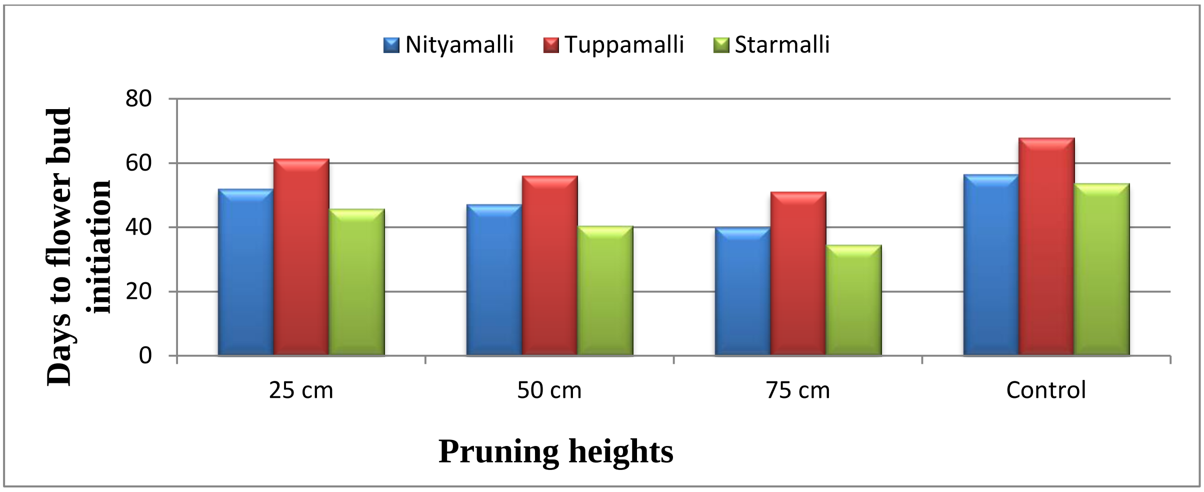

Fig.4.8b Days to first flower bud initiation of *Jasminum sambac* as effected by genotype and pruning height during Nov.2012 to June 2013.

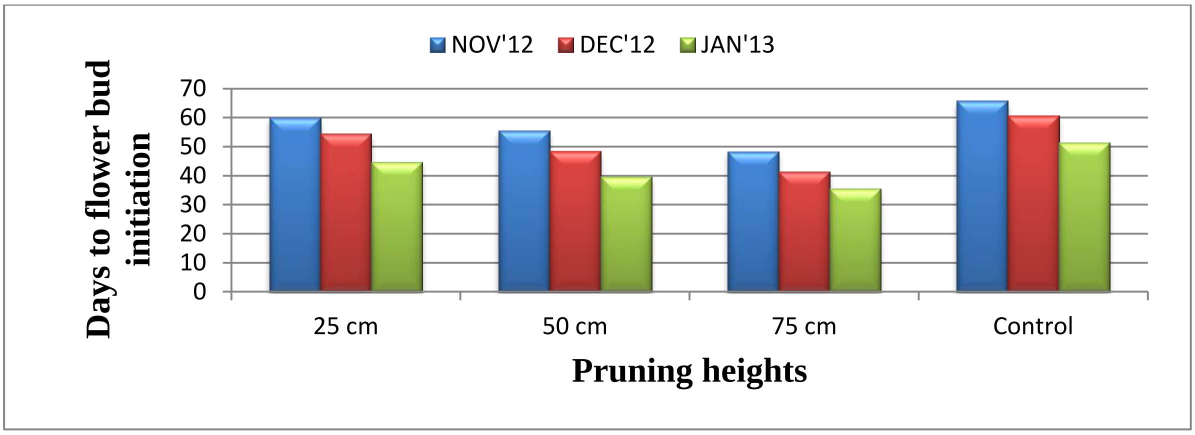

Fig.4.8c Days to first flower bud initiation of *Jasminum sambac* as effected by pruning date and pruning height during Nov.2012 to June 2013.

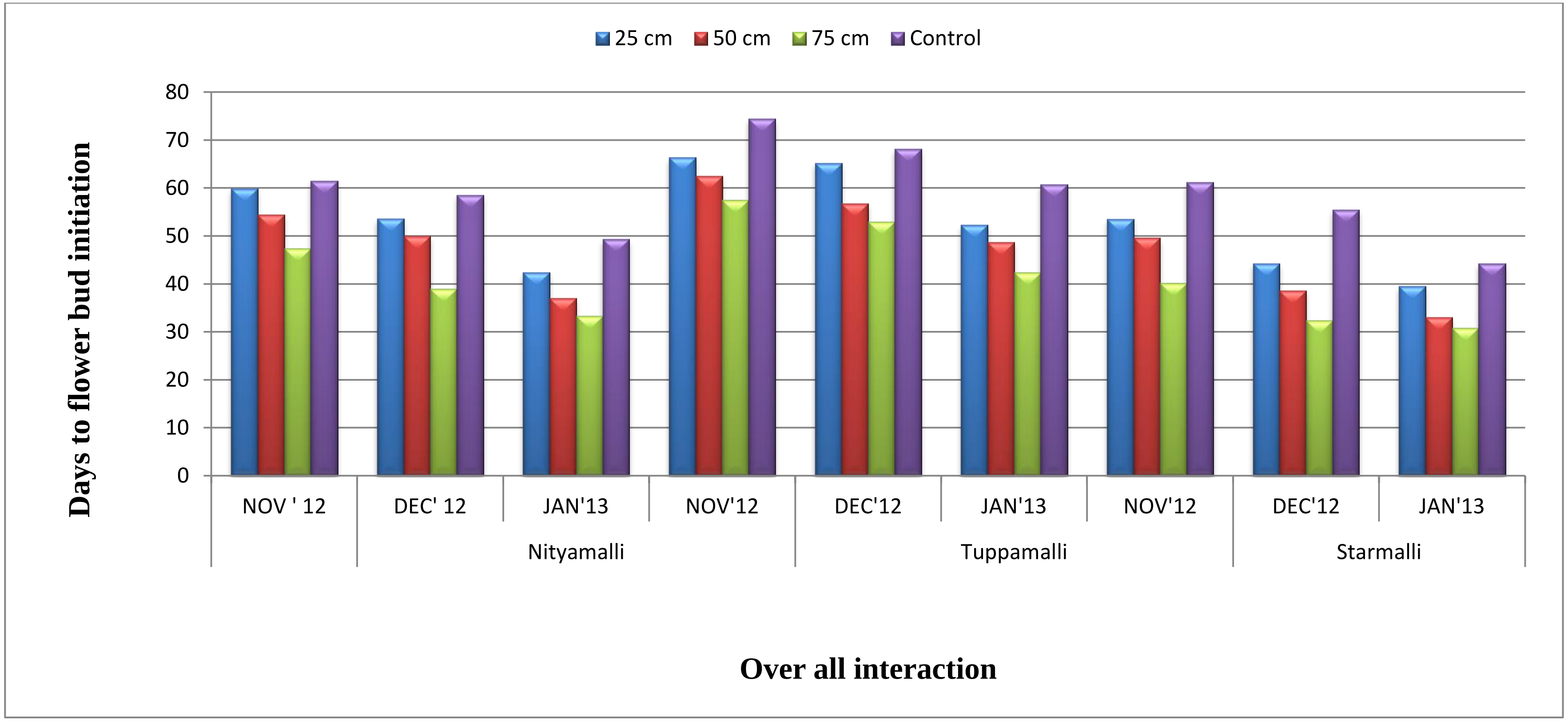

Fig.4.8d Days to first flower bud initiation as effected by Genotype, pruning date and pruning height of *Jasminum sambac* during Nov.2012 to June 2013.

like substances accumulate progressively during the low temperature period, reaching maximum shortly before floral initiation (Badr *et al.,* 1970), however, others have reported that in this species, although a high GA_3 level was inhibitory, a high GA_4 level had a positive effect on flower formation (Ulger *et al.,* 2004). A positive effect of high endogenous cytokinin levels on flower formation has been widely reported (Villacorta *et al.,* 2008; Campos and Kerbauy, 2004).

4.1.9 Days to flower bud development

Different genotypes, pruning dates, pruning heights and their interactions significantly affected the days to flower bud development (Table 4.9a, b, c & d).

Among the genotypes Starmalli (14.85 days) and Nityamalli (14.96 days) recorded shortest duration for flower bud development from flower bud initiation. The lowest number of days to flower bud development was recorded in bushes pruned in January'13 (14.65 days) followed by bushes pruned in December'12 (14.90 days). The pruning height at 50 cm and 75 cm treatments recorded lowest number of days to flower bud development from flower bud initiation (14.82 days). Whereas the higher number of days were recorded in pruning height at 25 cm (14.94 days). The highest duration of flower bud development was recorded in control *i.e.,* unpruned bushes. (15.43 days).

The interaction between genotype and pruning date for this trait was found significant (Table and Fig. 4.9a). The lowest number of days was recorded for flower bud development in Starmalli, pruning date January'13 (14.46 days) followed by Nityamalli pruned in January'13 (14.60 days). Maximum number of days was recorded in Tuppamalli bushes pruned in November'12 (15.73 days).

The interaction between genotype and pruning height was found significant for this trait (Table and Fig. 4.9b). The unpruned jasmine bushes recorded longer period for flower bud development over the pruned bushes (15.11 to 15.61 days) from flower bud initiation. The lowest number of days for flower bud development after flower bud initiation was recorded in Nityamalli pruning height at 50cm (14.65days), Nityamalli, Pruning height at 75cm (14.68days) and Starmalli, pruning height at 25 cm (14.72days) which were on par.

Table 4.9a Days to flower bud development of *Jasminum Sambac* as effected by genotype and pruning Date during Nov. 2012 to June 2013.

T X ST				
Pruning date (ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T_1	15.38	14.89	14.60	**14.96**
T_2	15.73	14.98	14.89	**15.20**
T_3	15.24	14.84	14.46	**14.85**
Mean (ST)	**15.45**	**14.90**	**14.65**	
	T	**ST**	**T X ST**	
S.E m±	0.01	0.01	0.02	
C.D (P = 0.05)	0.05	0.04	0.07	

Table 4.9b Days to flower bud development of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height (SST)					
Genotype(T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T_1	14.93	14.65	14.68	15.56	**14.96**
T_2	15.18	15.02	14.99	15.61	**15.20**
T_3	14.72	14.79	14.79	15.11	**14.85**
Mean (SST)	**14.94**	**14.82**	**14.82**	**15.43**	
	T	**SST**	**T X SST**		
S.E m±	0.01	0.01	0.02		
C.D (P = 0.05)	0.05	0.03	0.06		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV ’12 ST_2**:**10^{th} DEC’12 ST_3**:**10^{th} JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table 4.9c Days to flower bud development of *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

ST X SST					
Pruning height (SST)					
Pruning date (ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (ST)**
ST_1	15.29	15.27	15.28	15.96	**15.45**
ST_2	15.04	14.67	14.64	15.27	**14.90**
ST_3	14.51	14.51	14.54	15.04	**14.65**
Mean (SST)	**14.94**	**14.82**	**14.82**	**15.43**	
	ST	**SST**	**ST X SST**		
S.E m±	0.01	0.01	0.02		
C.D (P = 0.05)	0.04	0.03	0.06		

Table 4.9d Days to flower bud development as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Genotype (T)	Pruning date (ST)	T X ST X SST				Mean (T X ST)
		Pruning height (SST)				
		SST_1	**SST_2**	**SST_3**	**SST_4**	
T_1	**ST_1**	15.05	15.15	15.18	16.15	**15.38**
	ST_2	15.42	14.52	14.44	15.18	**14.89**
	ST_3	14.32	14.29	14.42	15.37	**14.60**
T_2	**ST_1**	15.75	15.54	15.51	16.01	**15.70**
	ST_2	14.92	14.76	14.75	15.50	**14.98**
	ST_3	14.86	14.76	14.71	15.22	**14.88**
T_3	**ST_1**	15.06	15.13	15.13	15.64	**15.24**
	ST_2	14.76	14.75	14.74	15.13	**14.84**
	ST_3	14.35	14.48	14.49	14.54	**14.46**
Mean (STX SST)		**14.94**	**14.82**	**14.81**	**15.41**	**15.00 (X)**

Factors	T X ST X ST
S.E m±	0.03
C.D (P = 0.05)	0.11

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10th NOV '12 ST_2**:**10th DEC'12 ST_3**:**10th JAN' 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

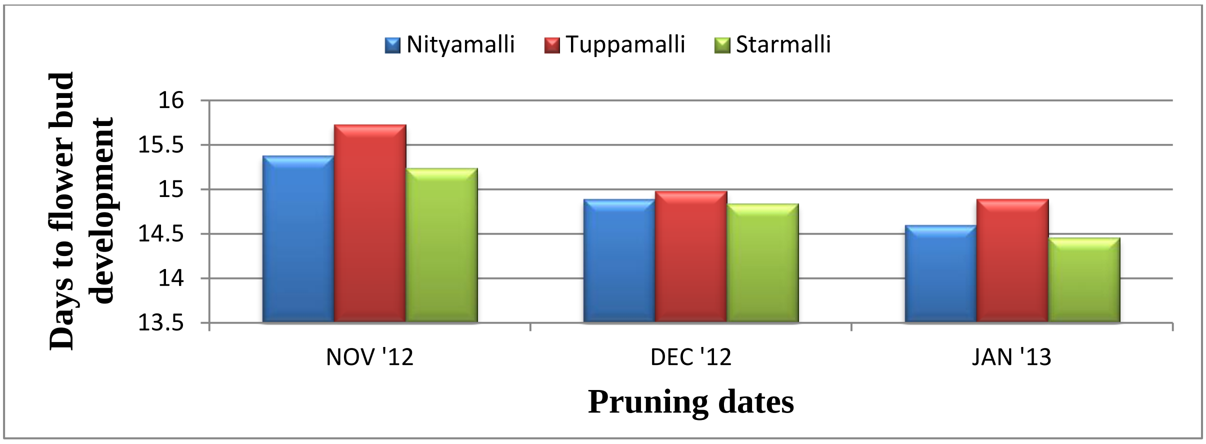

Fig.4.9a Days to flower bud development of *Jasminum sambac* as effected by genotype and pruning Date during Nov.2012 to June2013.

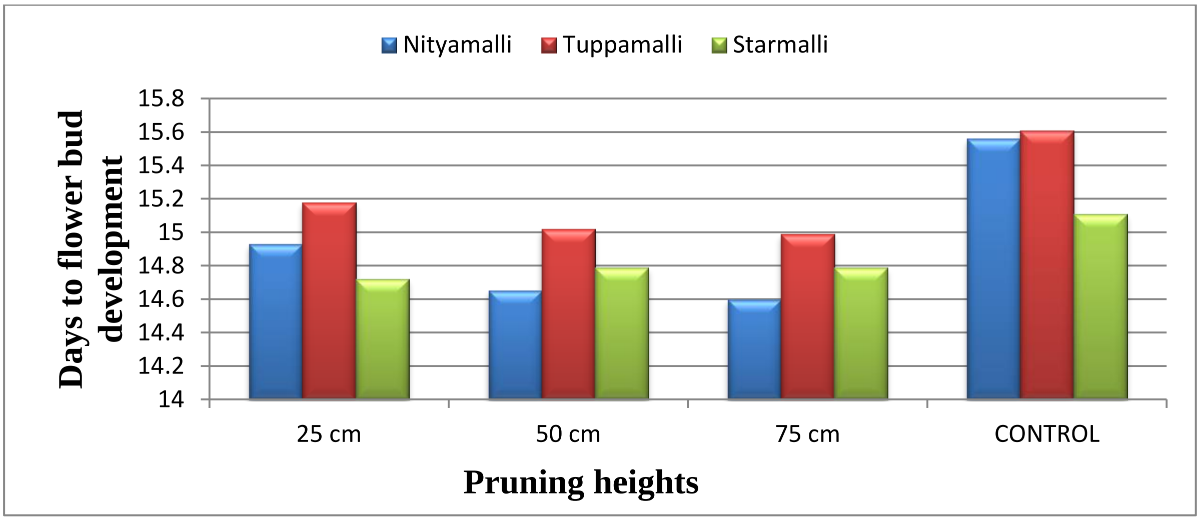

Fig.4.9b Days to flower bud development of *Jasminum sambac* as effected by genotype and pruning height during Nov.2012 to June2013.

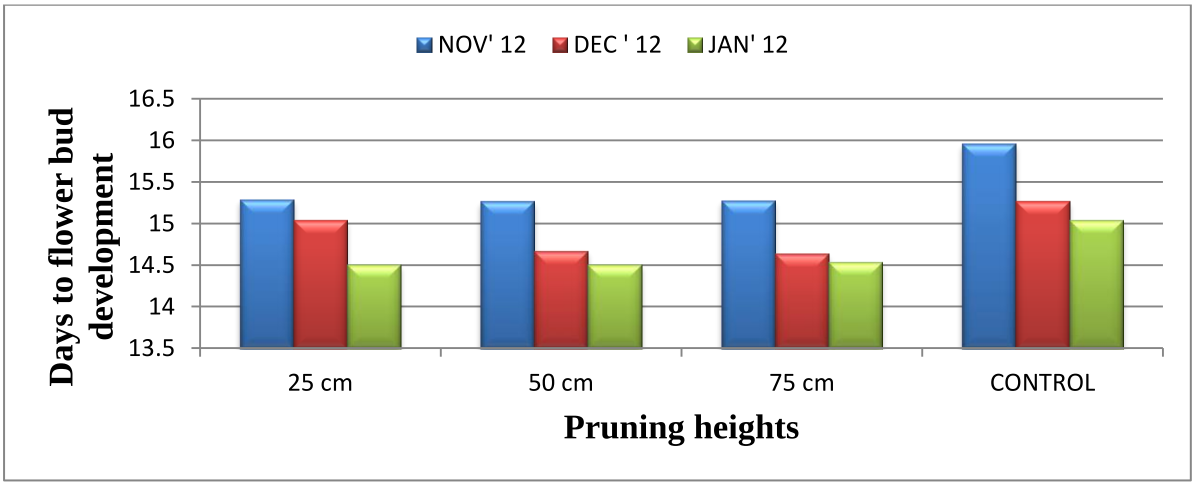

Fig.4.9c Days to flower bud development of *Jasminum sambac* as effected by pruning date and pruning height during Nov.2012 to June 2013.

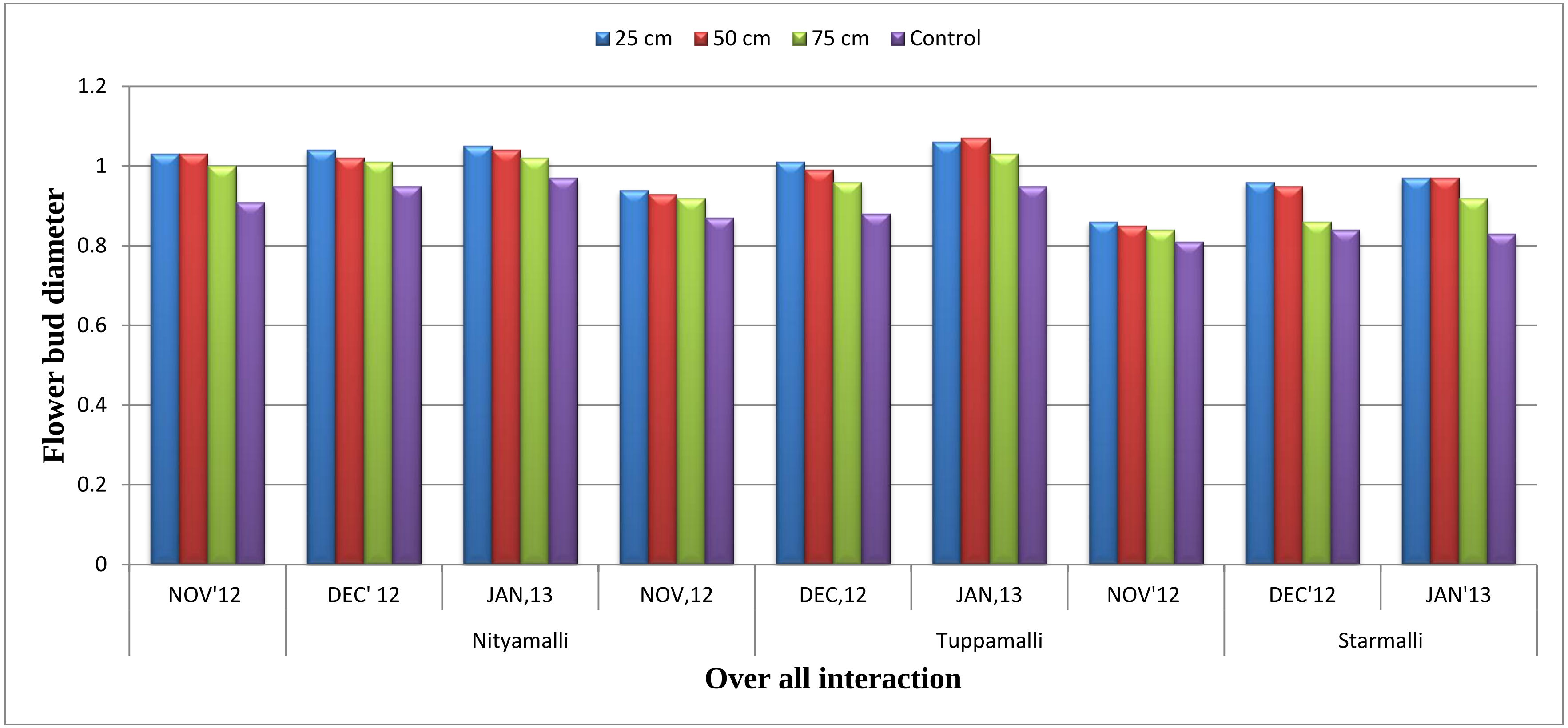

Fig.4.9d Days to flower bud development as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov.2012 to June 2013.

The interaction between pruning date and pruning height for this trait was found significant (Table and Fig. 4.9c). The treatment November'12, unpruned jasmine shrubs recorded maximum number of days (15.96 days) for flower bud development whereas the treatment January'13, pruning height at 25 cm and 50 cm recorded lowest number of days for bud development (14.51days).

The interaction among genotype, pruning date and pruning height for this trait was found significant (Table and Fig. 4.9d). The data revealed that the treatment Nityamalli, November'12, unpruned bushes recorded maximum number of days (16.15days) for flower bud development followed by the treatment Tuppamalli, November'12, unpruned bushes (16.01days). The genotype Nityamalli pruning date January '13 at pruning height 50cm recorded lowest number of days (14.29 days).

The present study revealed that number days taken for flower bud development was ranged 13 to 15 days in all pruned bushes. Similar results was reported by Nedumaran (1977), observed the number of days taken for flower bud appearance from initiation ranged from 10 to 15 days in November, December, February and March month pruned plants in *Jasminum auriculatum*.

4.1.10 Duration of flowering (days)

Significant differences were recorded for the character duration of flowering as affected by the genotype, pruning date, pruning height and their interaction (Table 4.10a, b, c & d).

The longest duration of flowering was observed in Nityamalli (145.29 days) followed by Starmalli (136.32 days) whereas shortest duration of flowering was recorded in Tuppamalli (103.22 days).

Among pruning dates, longest duration of flowering was observed in November'12 pruned bushes (135.64 days) followed by December'12 pruned bushes (129.90 days). Shortest duration of flowering was recorded in January'13 pruned bushes (119.28 days).

Among pruning heights, maximum duration of flowering was recorded in pruning height at 50cm (147.22 days) followed by pruning height at 25cm (132.89 days) and the minimum duration of flowering was recorded in unpruned bushes (107.18 days).

Table 4.10a Duration of flowering of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

T X ST				
Pruning date (ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T_1	151.56	146.91	137.40	**145.29**
T_2	110.61	104.43	94.62	**103.22**
T_3	144.75	138.37	125.84	**136.32**
Mean (ST)	**135.64**	**129.90**	**119.28**	
	T	**ST**	**T X ST**	
S.E m±	0.47	0.36	0.63	
C.D (P = 0.05)	1.42	1.10	1.90	

Table 4.10b Duration of flowering of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height (SST)					
Genotype (T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T_1	147.11	163.45	144.34	126.26	**145.29**
T_2	108.92	122.66	96.98	84.32	**103.22**
T_3	142.64	155.54	136.15	110.95	**136.32**
Mean (SST)	**132.89**	**147.22**	**125.83**	**107.18**	
	T	**SST**	**T X SST**		
S.E m±	0.47	0.42	0.72		
C.D (P = 0.05)	1.42	1.26	2.18		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV ’12 ST_2**:**10^{th} DEC’12 ST_3**:**10^{th} JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table 4.10c Duration of flowering of *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

ST X SST					
	Pruning height (SST)				
Pruning date (ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (ST)**
ST_1	140.67	160.54	130.75	110.61	**135.64**
ST_2	133.93	147.25	129.73	108.71	**129.90**
ST_3	124.06	133.86	117.00	102.22	**119.28**
Mean (SST)	**132.89**	**147.22**	**125.83**	**107.18**	
	ST	**SST**	**ST X SST**		
S.E m±	0.36	0.42	0.72		
C.D (P = 0.05)	1.10	1.26	2.18		

Table 4.10d Duration of flowering as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Genotype (T)	Pruning date (ST)	T X ST X ST				Mean (TX ST)
		Pruning height (SST)				
		SST_1	**SST_2**	**SST_3**	**SST_4**	
T_1	**ST_1**	153.66	174.86	145.73	132.00	**151.56**
	ST_2	144.80	163.73	153.16	125.96	**146.91**
	ST_3	142.86	151.76	134.13	120.83	**137.39**
T_2	**ST_1**	117.66	134.03	103.50	87.26	**110.61**
	ST_2	114.83	125.50	97.13	80.26	**104.43**
	ST_3	94.26	108.46	90.33	85.43	**94.62**
T_3	**ST_1**	150.70	172.73	143.03	112.56	**144.75**
	ST_2	142.16	152.53	138.90	119.90	**138.37**
	ST_3	135.06	141.36	126.53	100.40	**125.83**
Mean (ST X SST)		**132.88**	**147.21**	**125.82**	**107.17**	**128.27 (X)**

Factors	T X ST X ST
S.E m±	1.26
C.D (P = 0.05)	3.78

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1:10th NOV '12 ST_2:10th DEC'12 ST_3:10th JAN' 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

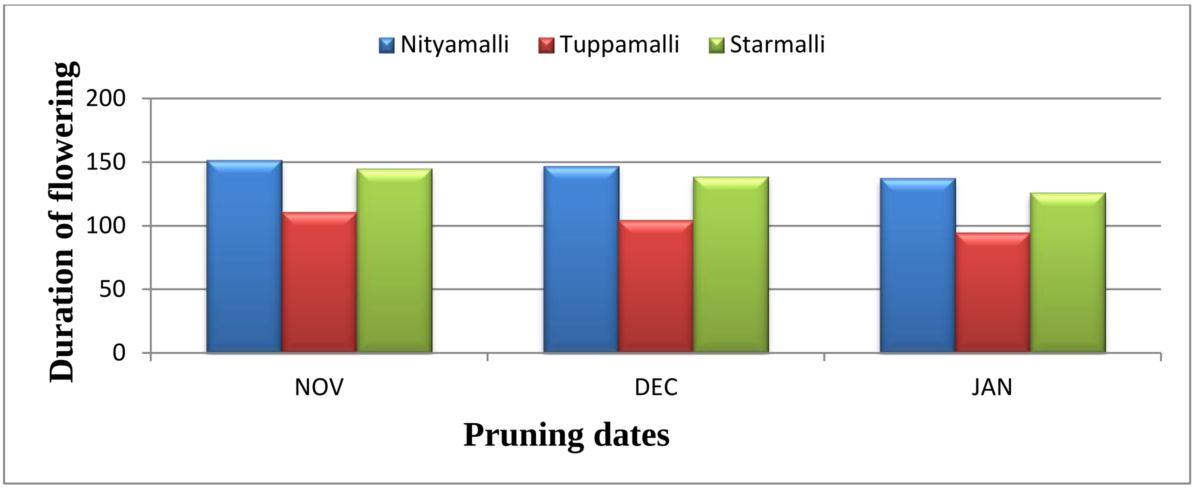

Fig.4.10a Duration of flowering of *Jasminum sambac* as effected by genotype and pruning date during Nov.2012 to June 2013.

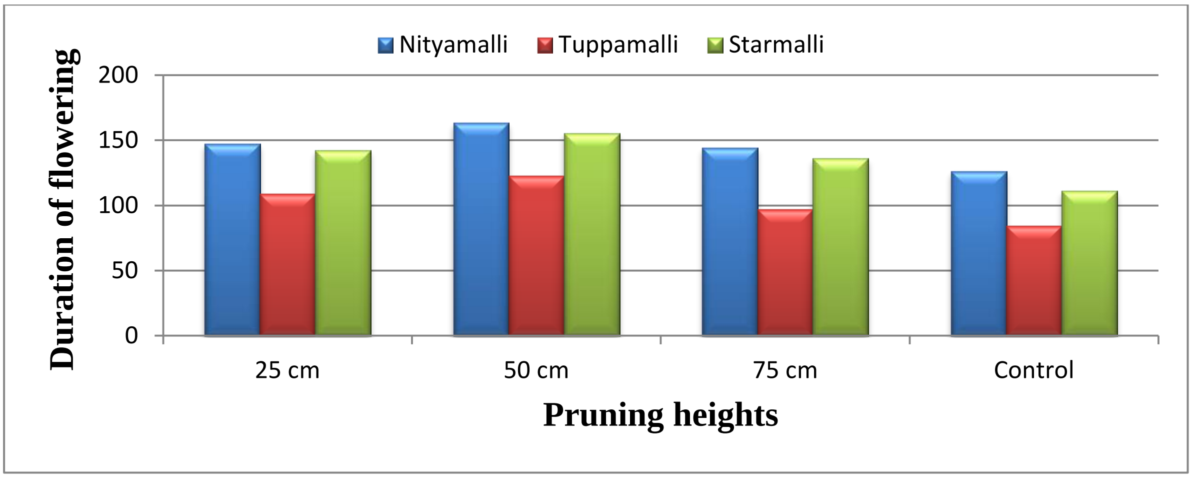

Fig.4.10b Duration of flowering of *Jasminum sambac* as effected by genotype and pruning height during Nov.2012 to June 2013.

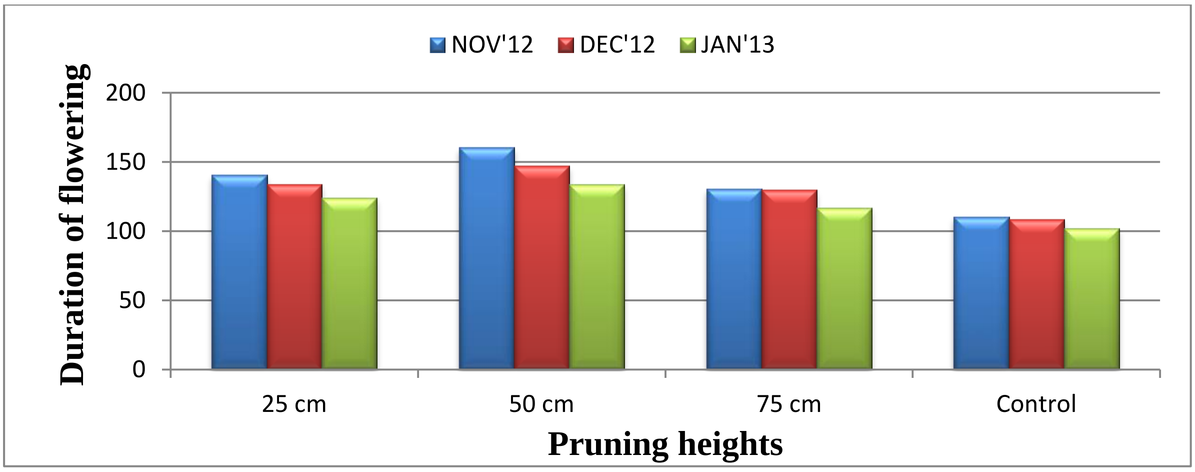

Fig.4.10c Duration of flowering of *Jasminum sambac* as effected by pruning date and pruning height during Nov.2012 to June 2013.

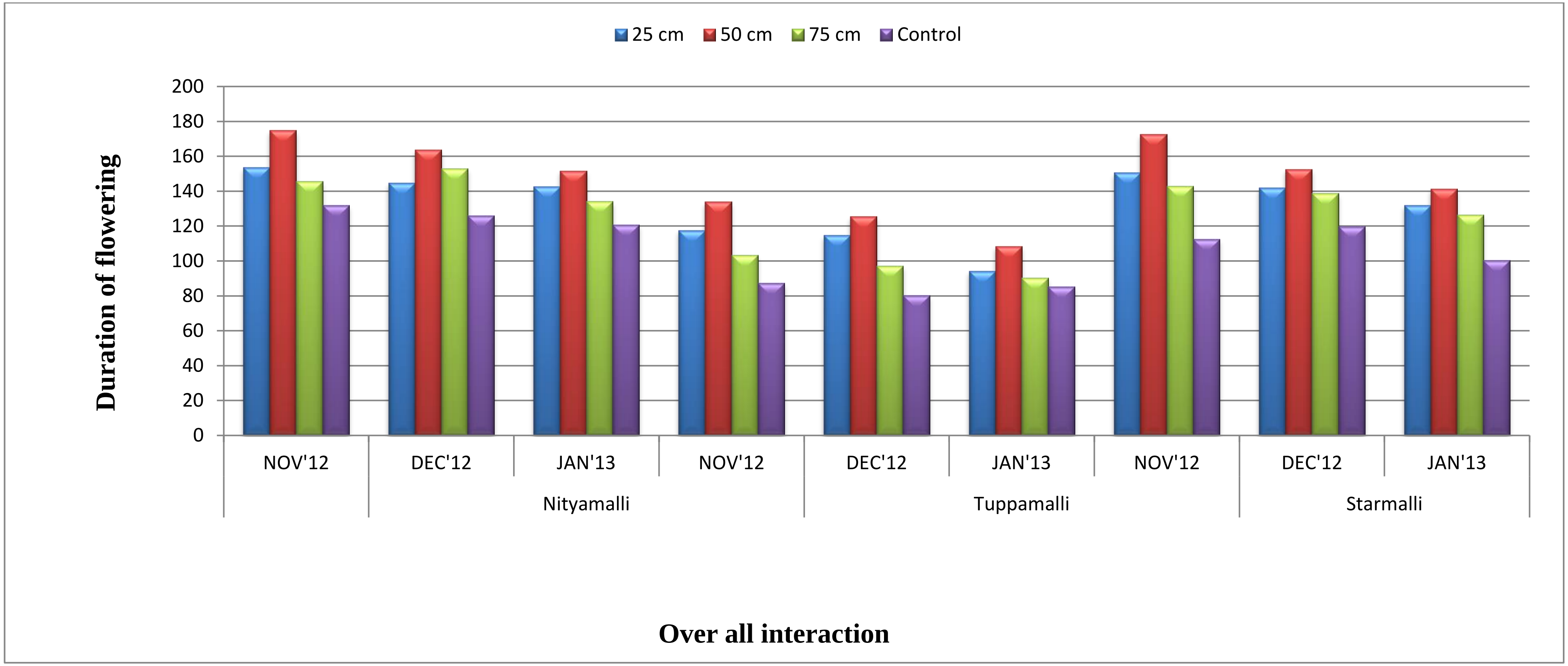

Fig.4.10d Duration of flowering as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov.2012 to June 2013.

The interaction between genotype and pruning date for this trait was found significant (Table and Fig. 4.10a). The treatment Nityamalli pruned in November'12 recorded highest duration of flowering (151.56days) which was followed by Nityamalli December'12 pruned bushes (146.91days). The lowest duration of flowering was recorded in Tuppamalli pruned in January'13 (94.62days).

The interaction between genotype and pruning height for this trait was found significant (Table and Fig. 4.10b). The treatment Nityamalli, pruning height at 50 cm recorded maximum flowering duration (163.45days) followed by Starmalli, pruning height at 50 cm (155.54days) and the lowest duration of flowering was recorded in Tuppamalli, unpruned bushes (84.32days).

The interaction between pruning date and pruning height for this trait was found significant (Table and Fig. 4.10c). The treatment November'12, pruning height at 50cm recorded longest duration of flowering (160.54days) followed by December'12, pruning height at 50cm (147.25days) and the shortest duration was recorded in January'13 unpruned bushes (102.22days).

The interaction among genotype, pruning date and pruning height for this trait was found significant (Table and Fig. 4.10d). The treatment Nityamalli, November'12, pruning height at 50 cm recorded longest duration of flowering (174.86 days) which was statistically on par with Starmalli, November'12, pruning height at 50 cm (172.73 days). The shortest duration of flowering was recorded in Tuppamalli, December'12, unpruned bushes (80.26days).

The duration of flowering was significantly higher in the jasmine bushes pruned in November'12. It was significantly lower in the bushes pruned in January'13. This might be due to higher maximum and minimum temperature and short days prevailing during December to March months. The flowering was ceased in the month of July which might be due to higher temperature and longer sunshine hours. The similar results were reported by Nair *et al.* (2009).

4.1.11. Size of flower bud in cm (length & diameter)

4.1.11A. Flower Bud diameter (cm)

Different genotypes, pruning dates, pruning heights and their interactions significantly affected the flower bud diameter of jasmine (Table 4.11A)

Nityamalli recorded the largest flower bud diameter (1.00 cm) followed by Tuppamalli (0.97 cm) and Starmalli (0.89 cm).

Among the pruning dates January'13 recorded larger flower bud diameter (0.99 cm) followed by December'12 (0.95 cm) and November'12 (0.92 cm).

Among the pruning heights, Pruning height at 25 cm recorded the largest flower bud diameter (0.99 cm) followed by Pruning height at 50 cm (0.98 cm), whereas the smallest flower bud diameter was recorded in un-pruned bushes (0.89 cm).

The interaction between genotype and pruning date for this trait was found significant (Table and Fig. 4.11A-a). The treatment Tuppamalli, January'13 and Nityamalli, January'13 recorded the highest flower bud diameter (1.03 cm & 1.02 cm respectively) which were on par, where as lowest flower bud diameter was recorded in Starmalli, November'12 (0.84 cm).

The interaction between genotype and pruning height for this trait was found significant (Table and Fig. 4.11A-b). The treatment Nityamalli, pruning height at 25 cm and Nityamalli, pruning height at 50 cm recorded the maximum flower bud diameter of (1.04 cm & 1.03 cm respectively), which were on par. The lowest flower bud diameter was recorded in Starmalli, pruning height at 25 cm (0.83cm).

The interaction between pruning date and pruning height for this trait was found significant (Table and Fig. 4.11A-c). The highest flower bud diameter was recorded in the treatment January'13, pruning height at 25cm and January'13, pruning height at 50cm (both at 1.02cm) whereas lowest flower bud diameter was recorded in Nityamalli, un-pruned bushes (0.86cm).

The interaction among genotype, pruning date and pruning height for this trait was found significant (Table and Fig. 4.11A-d). The treatment Nityamalli, January'13, pruning height at 25 cm recorded highest flower bud diameter (1.05 cm). The lowest flower bud diameter was recorded in Starmalli, November'12, un-pruned bushes (0.81cm).

Size of flower bud (length and diameter) was significantly affected by genotype, pruning date and pruning height. November'12 pruned bushes produced shortest flower bud length compared to December'12 and January'13

4.11A-a Flower bud diameter (cm) of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June2013.

T X ST				
Pruning date (ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T_1	0.99	1.00	1.02	**1.00**
T_2	0.91	0.96	1.03	**0.97**
T_3	0.84	0.90	0.92	**0.89**
Mean (ST)	**0.92**	**0.95**	**0.99**	
	T	**ST**	**T X ST**	
S.E m±	0.00	0.00	0.00	
C.D (P = 0.05)	0.009	0.005	0.01	

Table 4.11A-b Flower bud diameter (cm) of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height (SST)					
Genotype (T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T_1	1.04	1.03	1.01	0.94	**1.00**
T_2	1.00	1.00	0.97	0.90	**0.97**
T_3	0.83	0.84	0.83	0.83	**0.89**
Mean (SST)	**0.99**	**0.98**	**0.95**	**0.89**	
	T	**SST**	**T X SST**		
S.E m±	0.00	0.00	0.00		
C.D (P = 0.05)	0.009	0.006	0.01		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV ’12 ST_2**:**10^{th} DEC’12 ST_3**:**10^{th} JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table 4.11A-c Flower bud diameter (cm) of *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

ST X SST					
Pruning height(SST)					
Pruning date(ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (ST)**
ST_1	0.94	0.94	0.92	0.86	**0.92**
ST_2	1.00	0.99	0.94	0.89	**0.95**
ST_3	1.02	1.02	0.99	0.91	**0.99**
Mean (SST)	**0.99**	**0.98**	**0.95**	**0.89**	
	ST	**SST**	**STX SST**		
S.E m±	0.00	0.00	0.00		
C.D (P = 0.05)	0.005	0.006	0.01		

Table 4.11A-d Flower bud diameter (cm) as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Genotype (T)	Pruning date (ST)	T X ST X SST				Mean (T X ST)
		Pruning height(SST)				
		SST_1	**SST_2**	**SST_3**	**SST_4**	
T_1	**ST_1**	1.03	1.03	1.00	0.91	**0.99**
	ST_2	1.04	1.02	1.01	0.95	**1.00**
	ST_3	1.05	1.04	1.02	0.97	**1.02**
T_2	**ST_1**	0.94	0.93	0.92	0.87	**0.91**
	ST_2	1.01	0.99	0.96	0.88	**0.96**
	ST_3	1.06	1.07	1.03	0.95	**1.02**
T_3	**ST_1**	0.86	0.85	0.84	0.81	**0.84**
	ST_2	0.96	0.95	0.86	0.84	**0.90**
	ST_3	0.97	0.97	0.92	0.83	**0.92**
Mean (STX SST)		**0.99**	**0.98**	**0.95**	**0.89**	**0.95 (X)**

Factors	T XSTX SST
S.E m±	0.00
C.D (P = 0.05)	0.01

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV ’12 ST_2**:**10^{th} DEC’12 ST_3**:**10^{th} JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

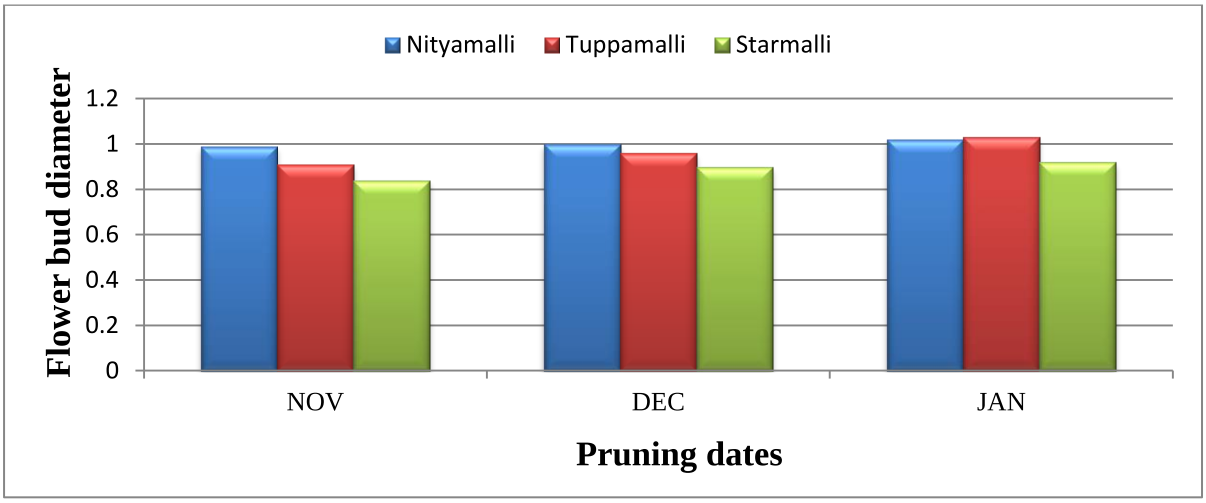

Fig.4.11A-a Size of Flower Bud Diameter of *Jasminum sambac* as effected by genotype and pruning date during Nov.2012 to June2013.

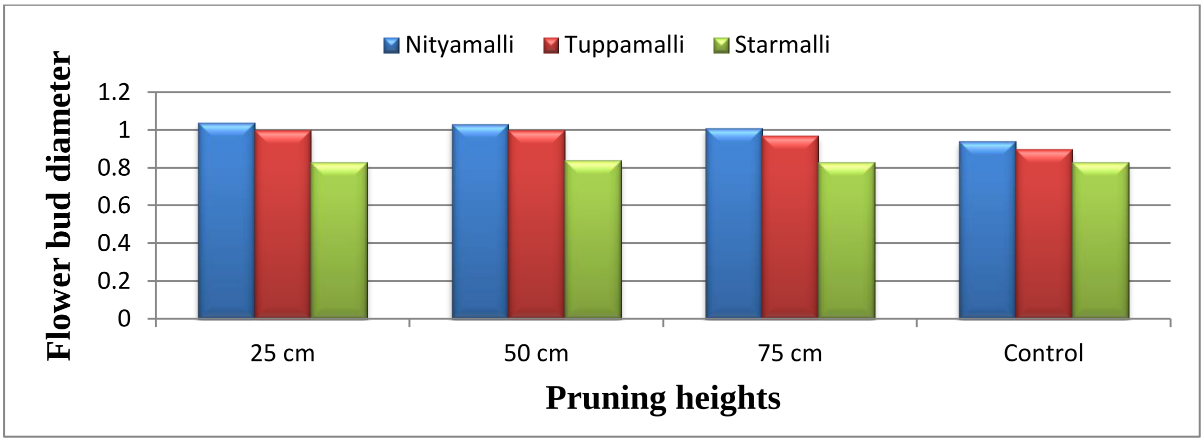

Fig.4.11A-b Size of Flower bud diameter of *Jasminum sambac* as effected by genotype and pruning height during Nov.2012 to June 2013.

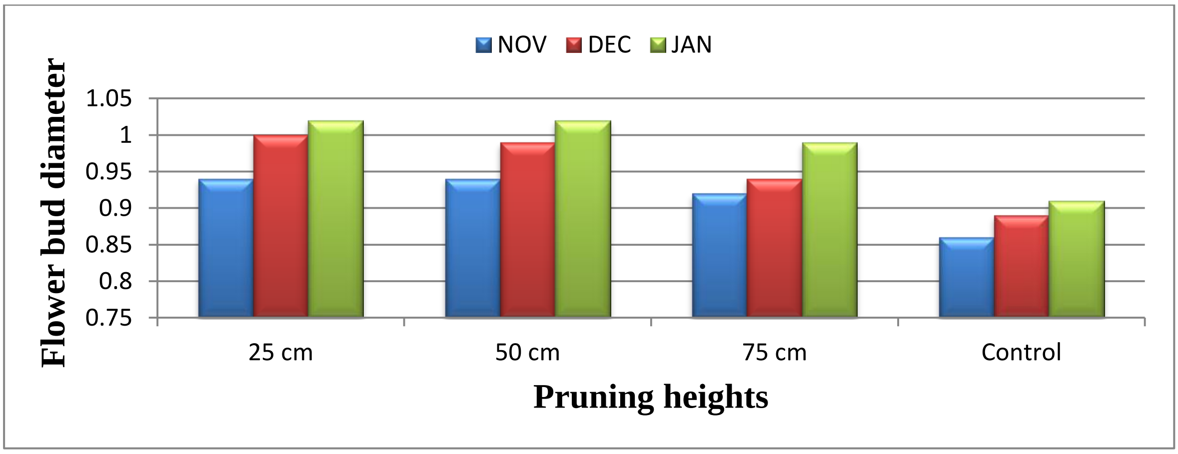

Fig.4.11A-c Size of Flower bud diameter of *Jasminum sambac* as effected by pruning date and pruning height during Nov.2012 to June 2013.

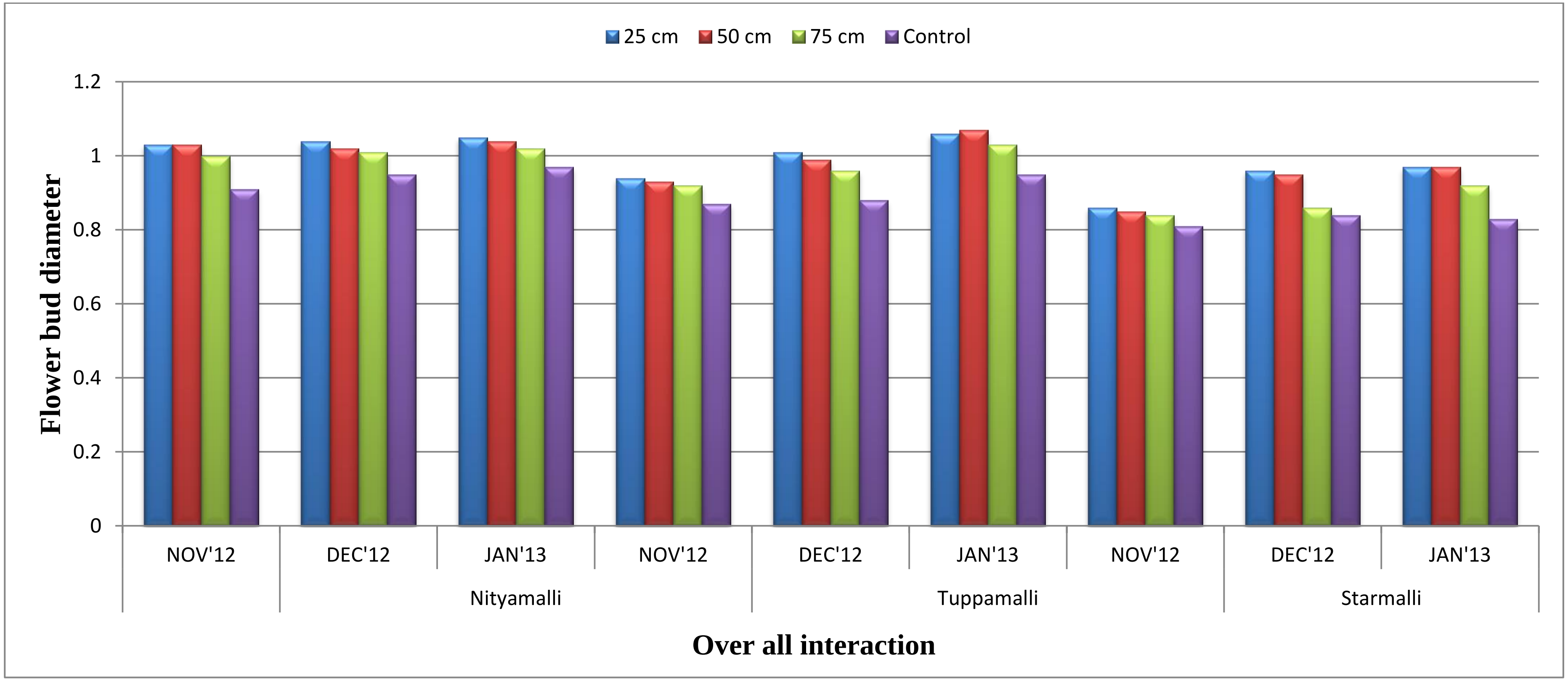

Fig.4.11A-d Flower bud diameter as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov.2012 to June 2013.

pruned bushes. The better size of flowers was obtained due to better vegetative growth, congenial climatic conditions and production of large quantities of reserve food in comparison with the November'12 month pruning. The results were in conformity with the work of Nair *et al.* (2009).

Significant differences were noticed in flower bud diameter with the pruning height the plants pruned severely pruning height at 25 cm has recorded the maximum flower bud diameter followed by pruning height at 50 cm and the lowest bud length and diameter was noticed with unpruned bushes. Similar results were reported by Sharma and Singh (1991) on *Jasminum sambac* and Jadhav *et al.* (2003) in rose cultivar First Red.

4.11B. Flower bud length (cm)

Significant differences were observed for flower bud length among genotypes, pruning date and pruning height and their interaction (Table 4.11B).

Among the genotypes, Tuppamalli recorded the highest flower bud length (4.03 cm) followed by Nityamalli (3.88 cm). The lowest flower bud length was observed in Starmalli (2.66 cm).

Among the pruning dates, December'12 recorded maximum flower bud length (3.21 cm) followed by January'13 (3.11 cm). Minimum flower bud length was recorded in November'12 (3.00 cm).

The pruning height at 25 cm and pruning height at 50cm recorded longest flower bud length (3.60 cm & 3.59 cm respectively) and minimum flower bud length was recorded in un-pruned bushes (3.40 cm).

The interaction between genotype and pruning date for this trait was found significant (Table and Fig. 4.11B-a). The highest flower bud length was recorded in the treatment Tuppamalli, January'13 (4.12 cm) over rest of the treatments. The lowest flower bud length was recorded in Starmalli, November'12 (2.44 cm).

The interaction between and pruning height for this trait was found significant (Table and Fig. 4.11B-b). The highest flower bud length was recorded for the treatment Tuppamalli, pruning height at 25 cm (4.12 cm) over rest of the treatments. The lowest flower bud length was recorded in the treatment Starmalli, unpruned bushes (2.53 cm).

Table 4.11B-a Flower bud length (cm) of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

T X ST				
Pruning date (ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T_1	3.80	3.87	3.97	**3.88**
T_2	3.97	4.01	4.12	**4.03**
T_3	2.44	2.52	3.01	**2.66**
Mean (ST)	**3.00**	**3.21**	**3.11**	
	T	**ST**	**T X ST**	
S.E m±	0.00	0.00	0.00	
C.D (P = 0.05)	0.01	0.009	0.01	

Table 4.11B-b Flower bud length (cm) of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height(SST)					
Genotype (T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T_1	3.92	3.91	3.88	3.80	**3.88**
T_2	4.12	4.10	4.05	3.86	**4.03**
T_3	2.75	2.75	2.60	2.53	**2.66**
Mean (SST)	**3.60**	**3.59**	**3.51**	**3.40**	
	T	**SST**	**T X SST**		
S.E m±	0.00	0.00	0.00		
C.D (P = 0.05)	0.01	0.008	0.01		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV ’12 ST_2**:**10^{th} DEC’12 ST_3**:**10^{th} JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table 4.11B-c Flower bud length (cm) of *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

ST X SST					
Pruning height (SST)					
Pruning date(ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (ST)**
ST_1	3.47	3.45	3.40	3.30	**3.40**
ST_2	3.52	3.52	3.46	3.36	**3.47**
ST_3	3.13	3.13	3.12	3.08	**3.70**
Mean (SST)	**3.60**	**3.59**	**3.51**	**3.40**	
	ST	**SST**	**ST X SST**		
S.E m±	0.00	0.00	0.00		
C.D (P = 0.05)	0.009	0.008	0.01		

Table 4.11B-d Flower bud length (cm) as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Genotype (T)	Pruning date (ST)	T X ST X SST Pruning height (SST) SST_1	SST_2	SST_3	SST_4	Mean (T XST)
T_1	**ST_1**	3.84	3.83	3.81	3.74	**3.80**
	ST_2	3.91	3.91	3.86	3.79	**3.86**
	ST_3	4.02	4.01	3.99	3.86	**3.97**
T_2	**ST_1**	4.06	4.02	3.98	3.81	**3.96**
	ST_2	4.11	4.11	4.01	3.83	**4.01**
	ST_3	4.20	4.19	4.15	3.95	**4.12**
T_3	**ST_1**	2.51	2.51	2.41	2.35	**2.44**
	ST_2	2.55	2.55	2.51	2.47	**2.52**
	ST_3	3.01	3.19	2.89	2.78	**2.96**
Mean (ST X SST)		**3.57**	**3.59**	**3.51**	**3.39**	**3.52 (X)**

Factors	T X ST X SST
S.E m±	0.00
C.D (P = 0.05)	0.02

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1:10th NOV '12 ST_2:10th DEC'12 ST_3:10th JAN' 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

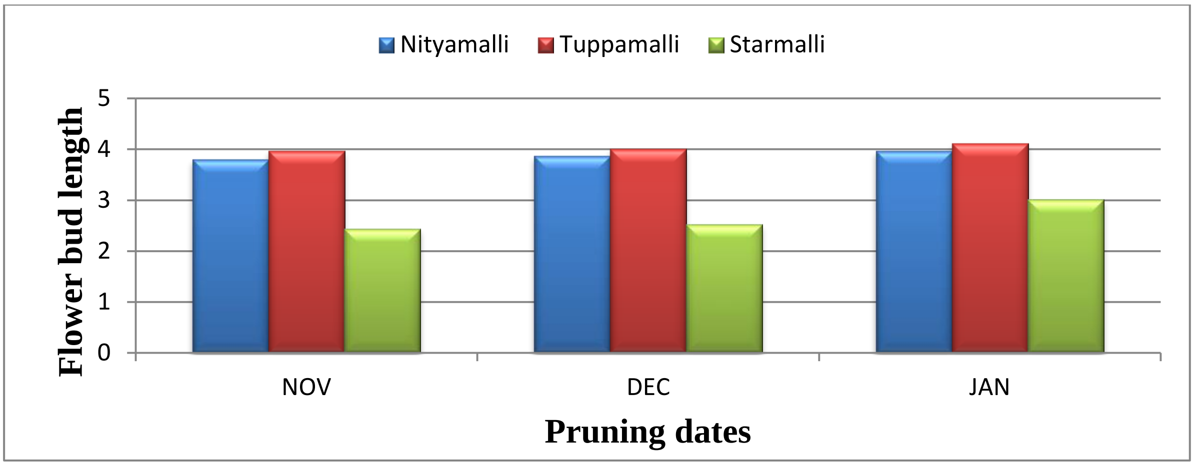

Fig.4.11B-a Size of Flower bud length of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

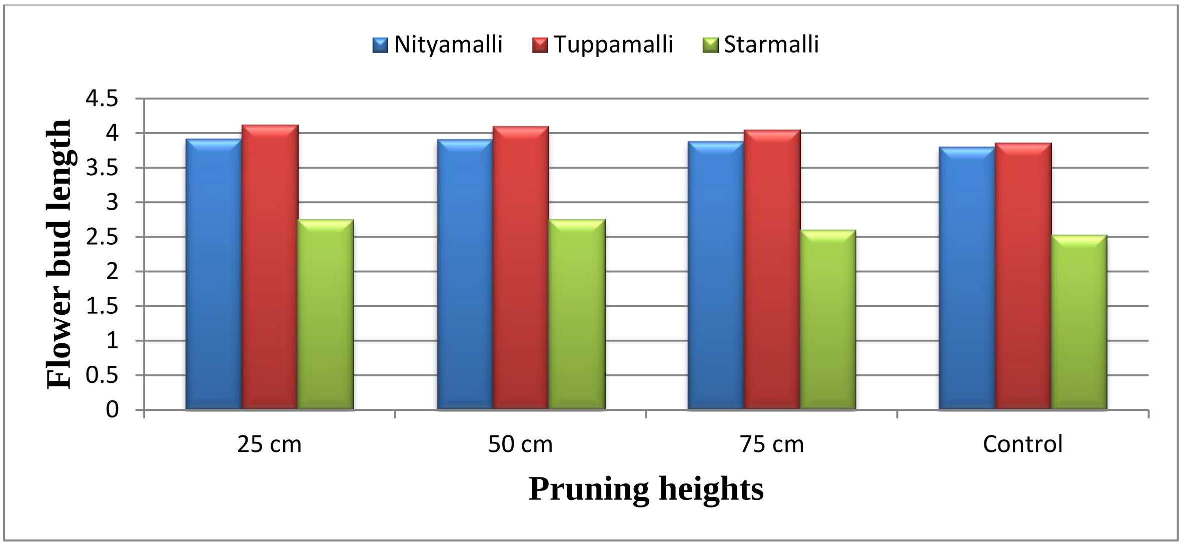

Fig.4.11B-b Size of Flower bud length of *Jasminum sambac* as effected by genotype and pruning height during Nov.2012 to June2013.

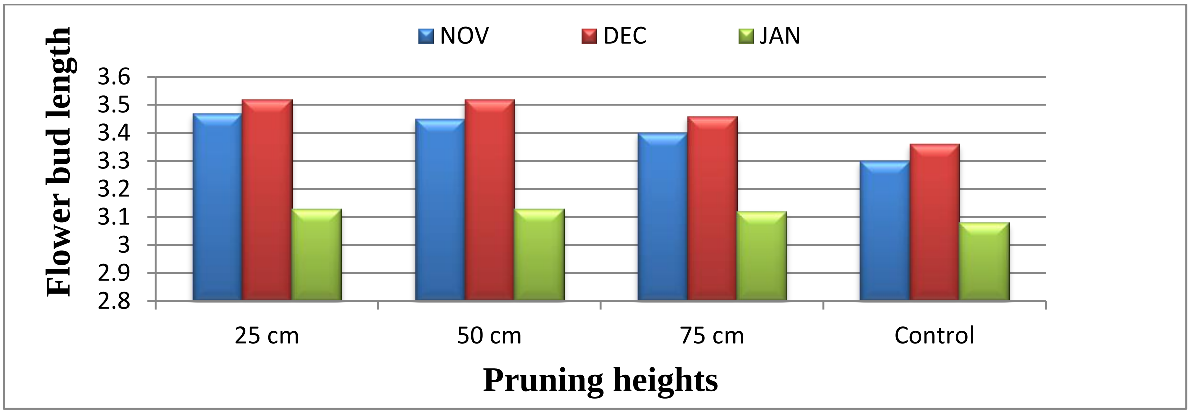

Fig.4.11B-c Size of Flower bud length of *Jasminum sambac* as effected by pruning date and pruning height during Nov.2012 to June 2013.

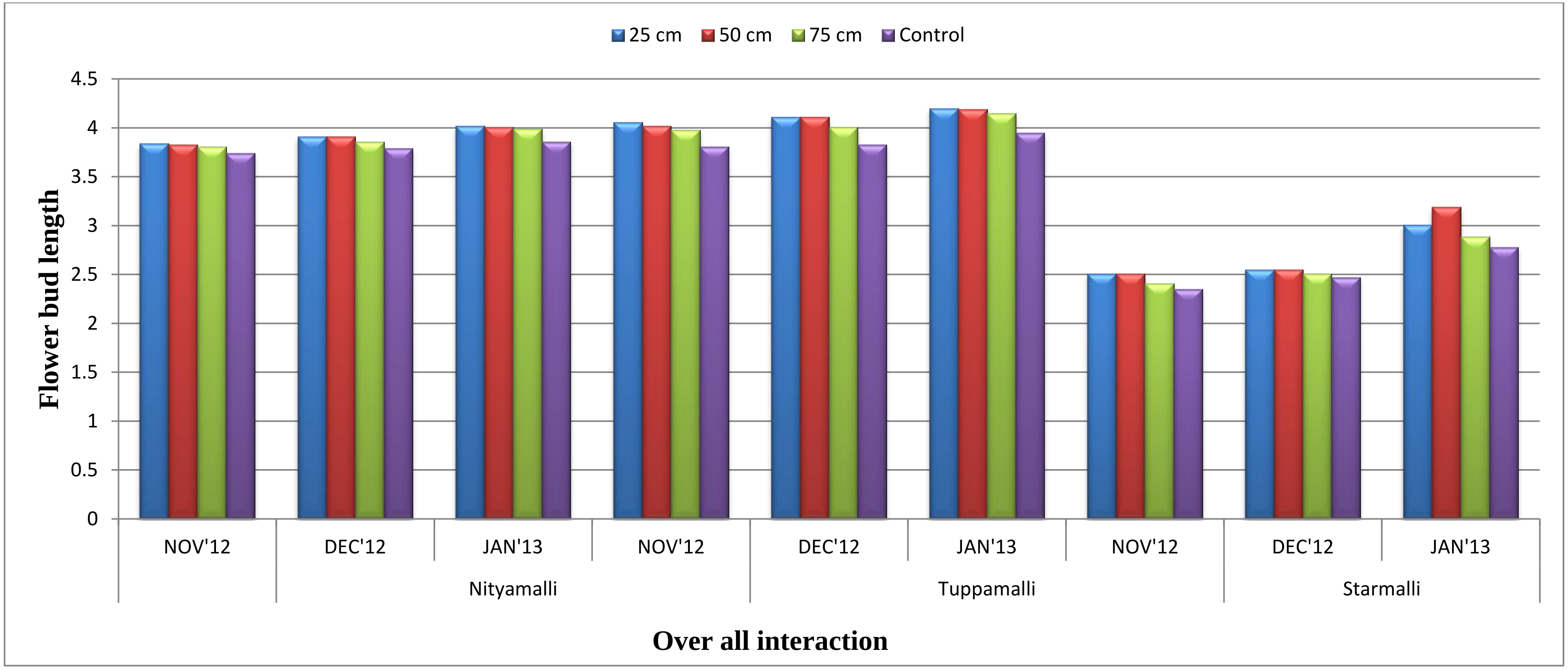

Fig.4.11B-d Flower bud length as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov.2012 to June 2013.

Plate 5: Bud length of three different genotypes

The interaction between pruning date and pruning height for this trait was found significant (Table and Fig. 4.11B-c). The highest flower bud length was recorded in the treatment December'12, pruning height at 25cm (3.52 cm) and December'12, pruning height at 50 cm (3.52 cm) over rest of the treatments. The lowest flower bud length was recorded in the treatment January'13, un-pruned bushes (3.08 cm).

The interaction among genotype, pruning date and pruning height for this trait was found significant (Table and Fig. 4.11B-d). The longest flower bud length was produced in the treatment Tuppamalli, January'13 and Pruning height at 25 cm (4.20 cm) over the rest of the treatment. The shortest flower bud length was found in Starmalli, November'12, un-pruned bushes (2.35 cm).

The observations revealed that the genotypes Tuppamalli (4.03 cm) and Nityamalli (3.88 cm) produced the longest flower bud length which might be due the inherent genetic factors. The Tuppamalli, jasmine bushes pruned in January'13 (4.12 cm) produced the longest flower bud length, which might be due to favourable climatic conditions.

4.1.12. Number of petals per flower

The data recorded on jasmine genotypes, pruning dates, pruning heights and their interaction effects on number of petals per flower was presented in Table 4.12.

The effect of genotype on number of petals per flower was found significant (Table and Fig. 4.12a). The highest number of petals per flower was recorded in Nityamalli (23.21) followed by Tuppamalli (18.17) and lowest number of petals per flower was recorded in Starmalli (15.41).

The effect of pruning dates on number of petals per flower was found not significant (Table 4.12a).

The effect of pruning height on number of petals per flower was found not significant (Table 4.12b).

The interaction between genotype and pruning date for this trait was also found not significant (Table 4.12a). The interaction between genotype and pruning height for this trait was also found not significant (Table 4.12b). The

Table 4.12a Number of petals per flower of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

T X ST				
Pruning date (ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T_1	23.21	23.21	23.20	**23.21**
T_2	18.18	18.18	18.16	**18.17**
T_3	15.41	15.41	15.41	**15.41**
Mean (ST)	**18.94**	**18.94**	**18.92**	
	T	**ST**	**T X ST**	
S.E m±	0.00	**-**	**-**	
C.D (P = 0.05)	0.01	**N.S**	**NS**	

Table 4.12b Number of petals per flower of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height					
Genotype (T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T_1	23.22	23.22	23.20	23.20	**23.21**
T_2	18.21	18.19	18.17	18.13	**18.17**
T_3	15.42	15.42	15.41	15.40	**15.41**
Mean (SST)	**18.95**	**18.94**	**18.92**	**18.92**	
	T	**SST**	**T X SST**		
S.E m±	0.00	**-**	**-**		
C.D (P = 0.05)	0.01	**NS**	**NS**		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV '12 ST_2**:**10^{th} DEC'12 ST_3**:**10^{th} JAN' 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

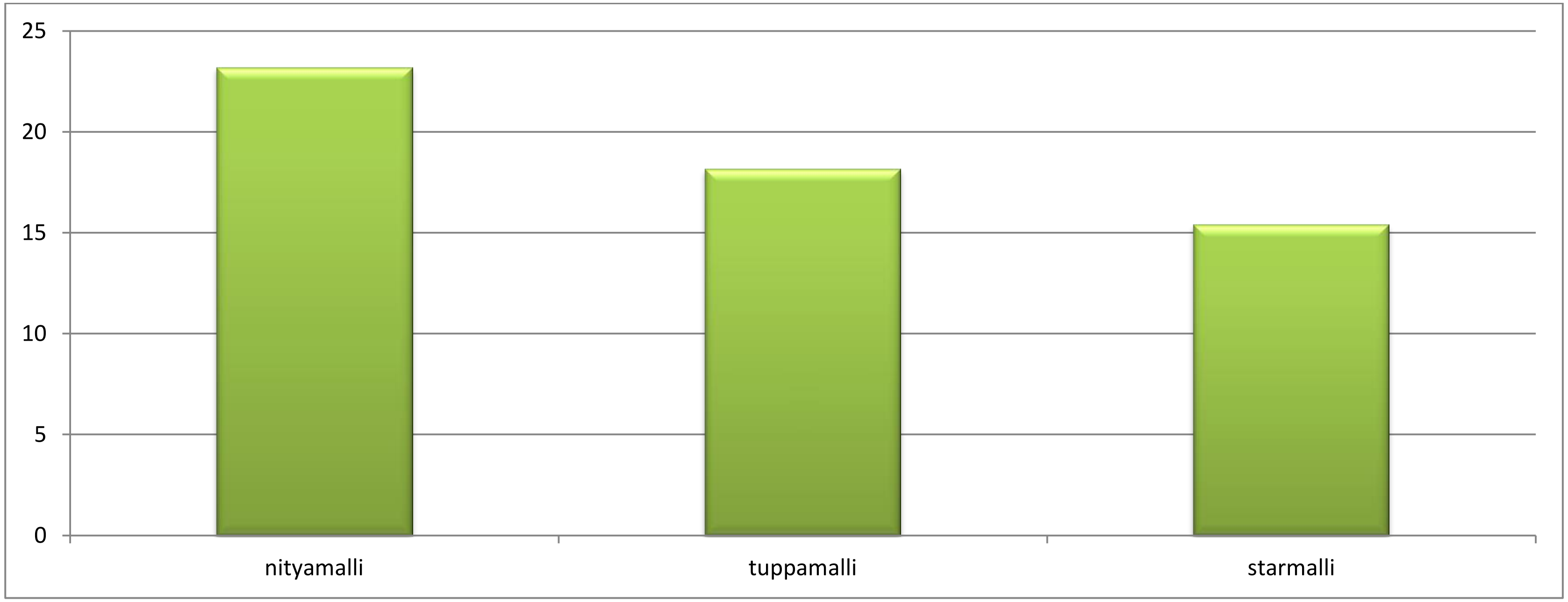

Fig.4.12a Number of petals per flower of *Jasminum sambac* as effected by genotype Nov.2012 to June 2013.

Table 4.12c Number of petals per flower of *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

ST X SST					
Pruning height(SST)					
Pruning date (ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (ST)**
ST_1	18.95	18.94	18.93	18.92	**18.94**
ST_2	18.95	1.95	18.92	18.92	**18.94**
ST_3	18.95	18.92	18.92	18.91	**18.92**
Mean (SST)	**17.95**	**18.94**	**18.92**	**18.92**	
	ST	**SST**	**ST X SST**		
S.E m±	**-**	**-**	**-**		
C.D (P=0.05)	**NS**	**NS**	**NS**		

Table 4.12d Number of petals per flower as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Genotype (T)	Pruning date (ST)	T X ST X SST				Mean (T X ST)
		Pruning height(SST)				
		SST_1	**SST_2**	**SST_3**	**SST_4**	
T_1	**ST_1**	23.21	23.22	23.21	23.21	**23.21**
	ST_2	23.21	23.23	23.21	23.21	**23.21**
	ST_3	23.23	23.22	23.19	23.17	**23.20**
T_2	**ST_1**	18.21	18.20	18.17	18.14	**18.18**
	ST_2	18.21	18.21	18.17	18.13	**18.18**
	ST_3	18.21	18.15	18.16	18.14	**18.16**
T_3	**ST_1**	15.42	15.42	15.41	15.41	**15.41**
	ST_2	15.43	15.42	15.42	15.39	**15.41**
	ST_3	15.41	15.42	15.42	15.39	**15.41**
Mean (ST X SST)		**18.94**	**18.94**	**18.92**	**18.91**	**18.93 (X)**

Factors	T X ST X SST
S.E m±	**-**
C.D (P = 0.05)	**NS**

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10th NOV ’12 ST_2**:**10th DEC’12 ST_3**:**10th JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Nityamalli buds

Nityamalli petals

Tuppamalli buds

Tuppamalli petals

Starmalli buds

Starmalli petals

Plate 6: Flower buds of three genotypes

interaction between pruning date and pruning height for this trait was also found not significant (Table 4.12c).

The interaction among genotype, pruning date and pruning height on number of petals per flower was found not significant (4.12d).

The observations recorded on this trait revealed that significant differences were found among the genotypes. Nityamalli recorded the maximum number of petals per flower (23.21) followed by Tuppamalli (18.17), which might be due to inherent genetic factors.

4.1.13 Weight of fifty flower buds

Significant differences were observed for the trait weight of fifty flower buds among the genotypes, pruning date and pruning height (Table 4.13a, b, c & d).

The genotype Tuppamalli recorded highest 50flower bud weight (18.05 g) followed by Nityamalli (16.17 g) and the lowest in Starmalli (13.82 g).

Among different pruning dates December'12 recorded highest weight of 50 flower buds (16.15 g) followed by January'13 pruning (16.04 g) and lowest was found in November'12 pruning (15.85 g).

Among the pruning heights, the lowest fifty flower bud weight was recorded in un-pruned bushes (15.46 g) over the pruned bushes. The differences for fifty flower buds weight among pruning treatments (16.19 g - 16.21 g) which were at par.

Interaction among the genotype and pruning date on fifty flower bud weight was found significant (Table and Fig. 4.13a). The treatment Tuppamalli, December'12 recorded highest fifty flower bud weight (18.19 g) followed by Tuppamalli, January'13 (18.04 g). The lowest fifty-flower bud weight was recorded in Starmalli, November'12 (13.48 g).

The interaction between genotype and pruning height on fifty flower bud weight was found significant (Table and Fig. 4.13b). The genotype Tuppamalli, pruning height at 75 cm recorded highest 50 flower bud weight (18.29 g), but which were on par with Tuppamalli, pruning height at 50 cm (18.28 g). The lowest 50 flower bud weight was recorded in Starmalli in un-pruned bushes (13.29 g).

Table 4.13a Weight of 50 flower buds at harvest (g) of *Jasminum Sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

T X ST				
Pruning date (ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T_1	16.15	16.23	16.13	**16.17**
T_2	17.92	18.19	18.04	**18.05**
T_3	13.48	14.03	13.97	**13.82**
Mean (ST)	**15.85**	**16.15**	**16.04**	
	T	**ST**	**T X ST**	
S.E m±	0.03	0.01	0.02	
C.D (P = 0.05)	0.11	0.04	0.07	

Table 4.13b Weight of 50 flower buds at harvest (g) of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height (SST)					
Genotype (T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T_1	16.33	16.31	16.29	15.74	**16.17**
T_2	18.26	18.28	18.29	17.35	**18.05**
T_3	13.97	14.00	14.04	13.29	**13.82**
Mean (SST)	**16.19**	**16.20**	**16.21**	**15.46**	
	T	**SST**	**T X SST**		
S.E m±	0.00	0.01	0.03		
C.D (P = 0.05)	0.01	0.05	0.10		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10th NOV ’12 ST_2**:**10th DEC’12 ST_3**:**10th JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table 4.13c Weight of 50 flower buds at harvest (g) *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

ST X SST					
Pruning height (SST)					
Pruning date (ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (ST)**
ST_1	16.06	16.02	16.03	15.33	**15.85**
ST_2	16.33	16.32	16.34	15.06	**16.15**
ST_3	16.22	16.25	16.25	15.46	**16.04**
Mean (SST)	**16.19**	**16.20**	**16.21**	**15.46**	
	ST	**SST**	**ST X SST**		
S.E m±	0.01	0.01	-		
C.D (P = 0.05)	0.04	0.05	NS		

Table 4.13d Weight of 50 flower buds at harvest (g) as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Genotype (T)	**Pruning date (ST)**	T X ST X SST				**Mean (T X ST)**
		Pruning height (SST)				
		SST_1	**SST_2**	**SST_3**	**SST_4**	
T_1	**ST_1**	16.22	16.22	16.20	15.97	**16.15**
	ST_2	16.45	16.40	16.40	15.68	**16.23**
	ST_3	16.32	16.32	16.29	15.58	**16.12**
T_2	**ST_1**	18.13	18.16	18.17	17.21	**17.91**
	ST_2	18.37	18.40	18.40	17.58	**18.18**
	ST_3	18.28	18.30	18.30	17.28	**18.04**
T_3	**ST_1**	13.69	13.69	13.72	12.82	**13.48**
	ST_2	14.18	14.16	14.23	13.53	**14.02**
	ST_3	14.05	14.14	14.16	13.52	**13.96**
Mean (ST X SST)		**16.18**	**16.19**	**16.20**	**15.46**	**16.01 (X)**

Factors	**T X ST X SST**
S.E m±	0.05
C.D (P = 0.05)	0.17

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV ’12 ST_2**:**10^{th} DEC’12 ST_3**:**10^{th} JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

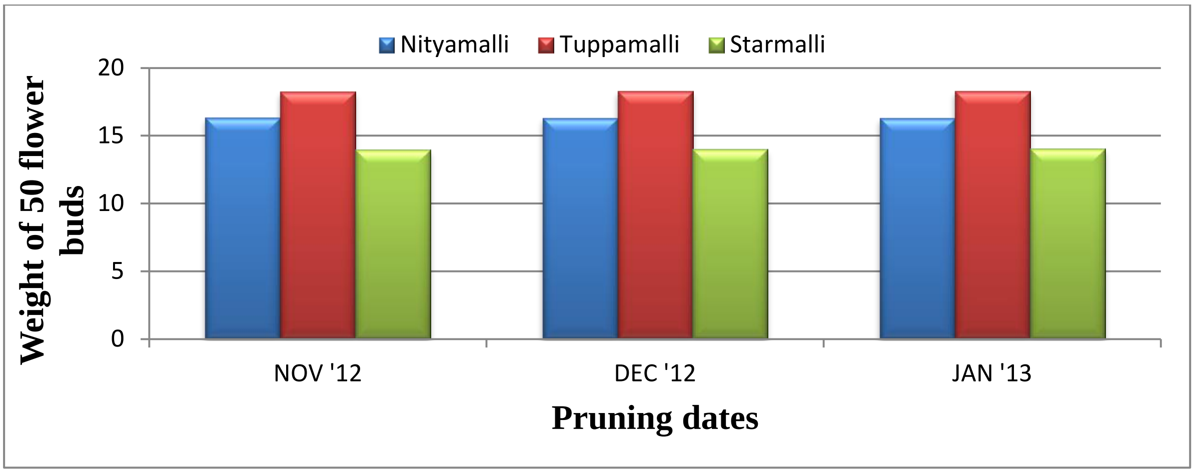

Fig.4.13a Weight of 50 flower buds at harvest (g) of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

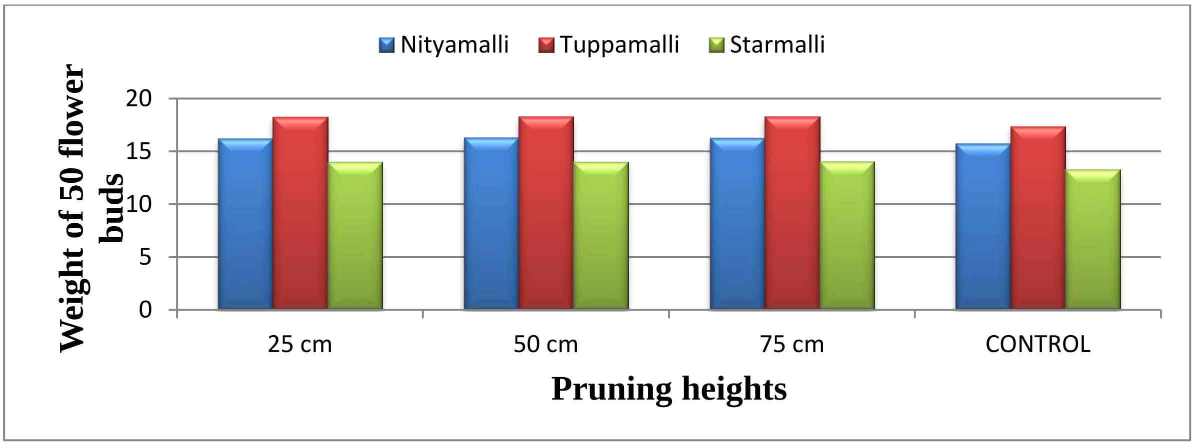

Fig.4.13b Weight of 50 flower buds at harvest (g) of *Jasminum sambac* as effected by genotype and pruning height during Nov.2012 to June 2013.

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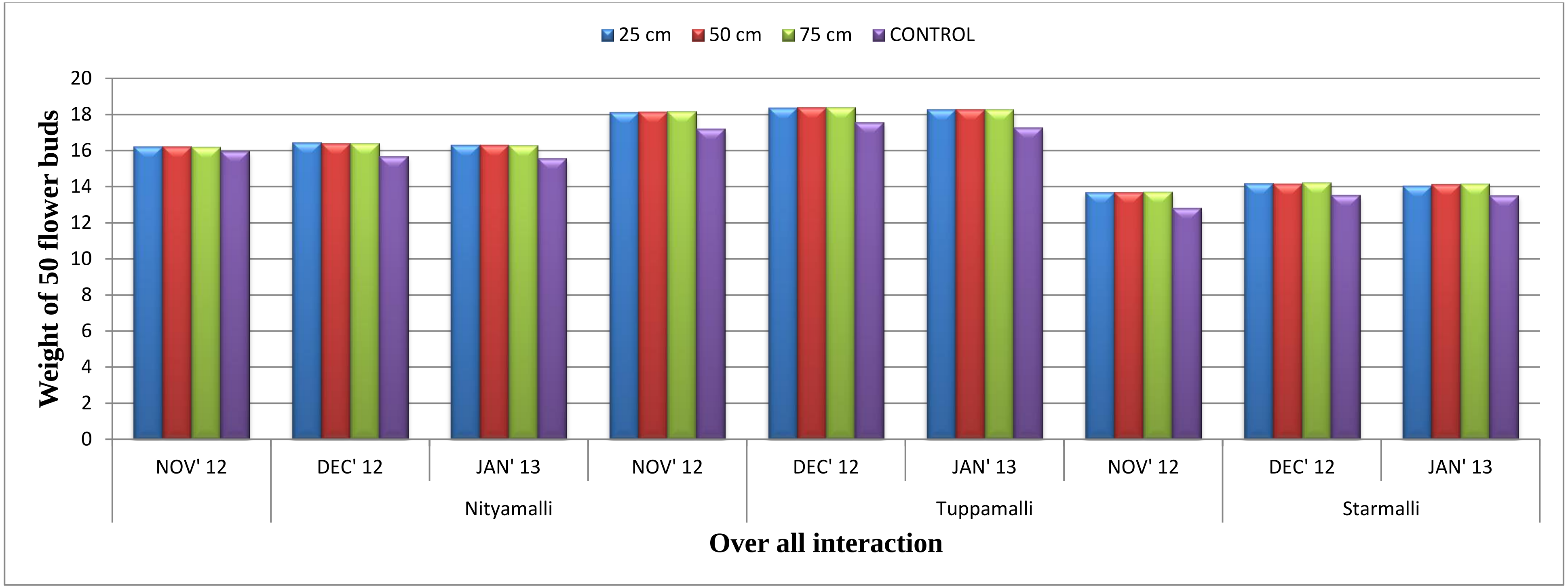

Fig.4.13d Weight of 50 flower buds at harvest (g) as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov.2012 to June 2013.

The interaction between pruning date and pruning height on fifty flower bud weight was found not significant (Table 4.13c).

The interaction effects among genotype, pruning date and pruning height for this trait was found significant (Table and Fig. 4.13d). The treatment " Tuppamalli , December'12 and Pruning height at 50 and 75 cm recorded the highest fifty flower bud weight (18.40 g) over rest of the treatments.

Fifty flower buds weight was significantly influenced by genotype, pruning date, and pruning height. Tuppamalli (18.05 g) recorded the highest fifty flower buds weight, Shrubs pruned in December'12 recorded highest fifty flower bud weight (16.15 g) and all the pruned bushes produced the highest weight of fifty flower buds over unpruned bushes. The highest fifty flower bud weight might be due to longer sunshine hours and longer flower bud length and flower bud size may contribute to increase in fifty flower bud weight. The results obtained were in accordance with the results of Nedumaran (1977) in *Jasminum auriculatum* and Sumangala *et al.* (2003) in *Jasminum sambac.*

4.1.14. Number of flower buds per plant

Different genotypes, pruning dates and pruning heights significantly affected number of flower buds per plant (Table 4.14a, b, c & d).

The highest number of flower buds per plant was recorded in Nityamalli (1617.73) and Starmalli (1612.34), which were on par. The lowest number of flower buds per plant was noted in Tuppamalli (673.61).

Among the pruning dates December'12 recorded maximum number of flower buds per plant (1334.21) followed by January'13 pruning date (1288.65) whereas lowest number of flower buds per plant was recorded in November'12 pruned bushes (1230.82).

Among the various pruning heights, pruning height at 50cm recorded highest number of flower buds per plant (1560.51) followed by pruning height at 25cm (1372.75). The lowest number of flower buds per plant was recorded in unpruned bushes (1056.36).

The interaction between genotypes and pruning date on number of flower buds per plant was found significant (Table and Fig. 4.14a). Starmalli pruned in December'12 recorded maximum number of flower buds per plant (1736.24)

Table 4.14a Number of flower buds per plant of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

T X ST				
Pruning date (ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T_1	1555.30	1676.07	1621.81	**1617.73**
T_2	625.02	740.31	655.51	**673.61**
T_3	1512.15	1736.24	1588.63	**1612.34**
Mean (ST)	**1230.82**	**1334.21**	**1288.65**	
	T	**ST**	**T X ST**	
S.E m±	3.89	2.30	3.98	
C.D (P = 0.05)	11.67	6.90	11.96	

Table 4.14b Number of flower buds per plant of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height (SST)					
Genotype (T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T_1	1664.31	1875.46	1524.01	1407.13	**1617.73**
T_2	732.28	879.91	610.30	471.95	**673.61**
T_3	1721.66	1926.18	1510.73	1290.79	**1612.34**
Mean (SST)	**1372.75**	**1560.51**	**1215.01**	**1056.36**	
	T	**SST**	**T X SST**		
S.E m±	3.89	2.46	4.27		
C.D (P = 0.05)	11.67	7.40	12.82		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV ’12 ST_2**:**10^{th} DEC’12 ST_3**:**10^{th} JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table 4.14c Number of flower buds per plant of *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

ST X SST					
Pruning height (SST)					
Pruning date(ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (SST)**
ST_1	1328.57	1452.27	1145.30	997.16	**1230.82**
ST_2	1440.53	1706.92	1281.02	1108.36	**1384.21**
ST_3	1349.16	1522.36	1218.72	1064.37	**1288.65**
Mean (H)	**1372.75**	**1560.51**	**1215.01**	**1056.63**	
	ST	**SST**	**ST X SST**		
S.E m±	2.30	2.46	4.27		
C.D (P = 0.05)	6.90	7.40	12.82		

Table 4.14d Number of flower buds per plant as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Genotype (T)	Pruning date (ST)	T X ST X SST Pruning height (SST) SST_1	SST_2	SST_3	SST_4	Mean (T X ST)
T_1	**ST_1**	1667.38	1778.93	1438.01	1336.87	**1555.29**
	ST_2	1684.87	1986.42	1580.80	1452.21	**1676.07**
	ST_3	1640.68	1861.02	1553.22	1432.33	**1621.81**
T_2	**ST_1**	680.34	829.30	570.37	420.06	**625.01**
	ST_2	783.01	946.46	680.68	551.07	**740.30**
	ST_3	733.50	863.96	579.84	444.74	**655.51**
T_3	**ST_1**	1637.98	1748.57	1427.52	1234.54	**1512.15**
	ST_2	1853.72	2187.83	1581.58	1321.80	**1736.23**
	ST_3	1673.30	1842.10	1523.10	1316.04	**1588.63**
Mean (ST X SST)		**1372.75**	**1560.51**	**1215.01**	**1056.62**	**1301.22 (X)**

Factors	T X ST X SST
S.E m±	7.39
C.D (P = 0.05)	22.19

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1:10th NOV ’12 ST_2:10th DEC’12 ST_3:10th JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

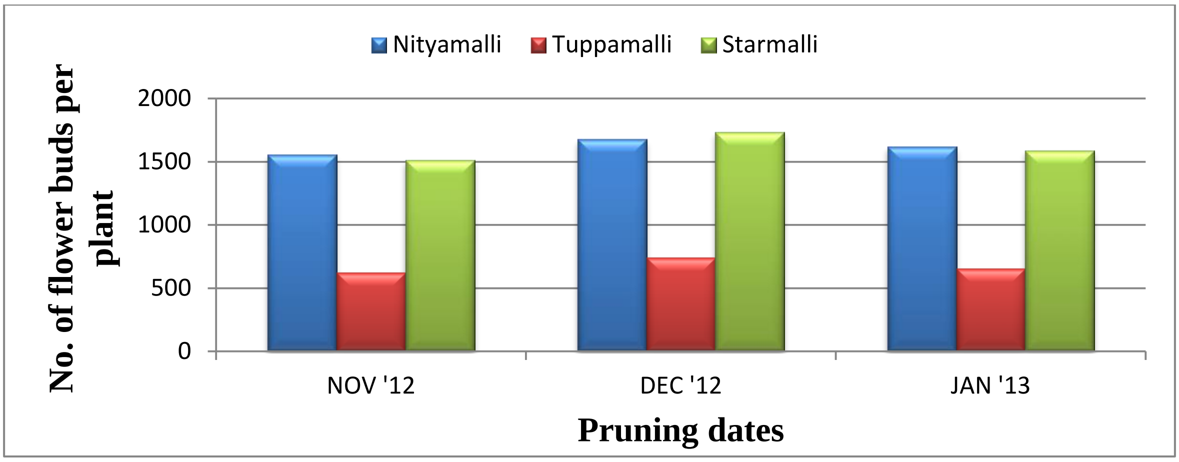

Fig.4.14a Number of flower buds per plant of *Jasminum sambac* as effected by genotype and pruning date during Nov.2012 to June 2013.

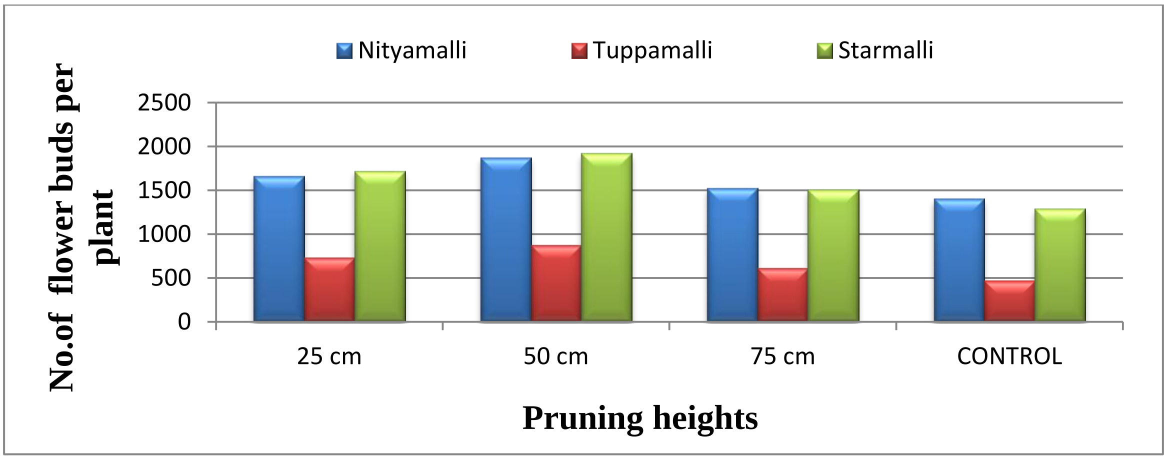

Fig.4.14b Number of flower buds per plant of *Jasminum sambac* as effected by genotype and pruning height during Nov.2012 to June 2013.

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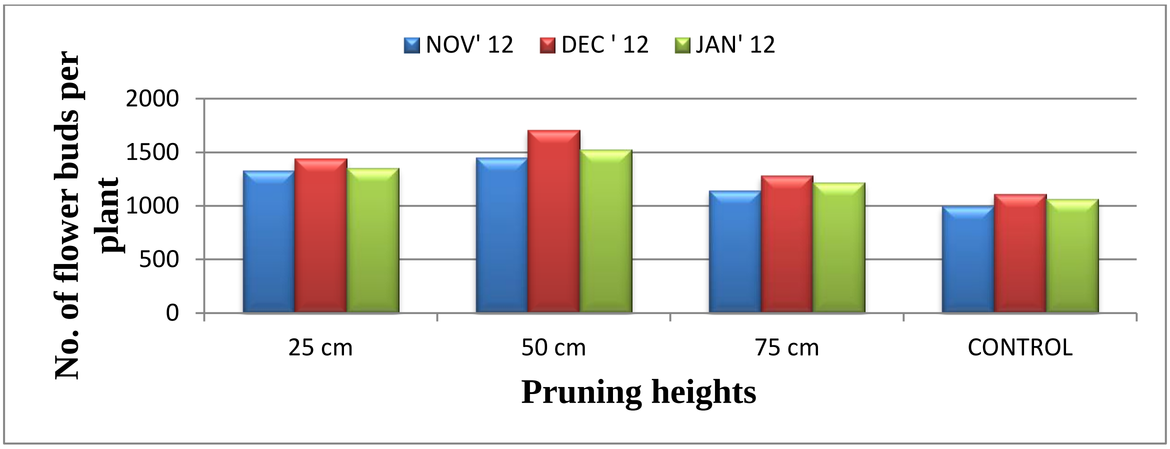


Fig.4.14c Number of flower buds per plant of *Jasminum sambac* as effected by pruning date and pruning height duringNov.2012 to June 2013.

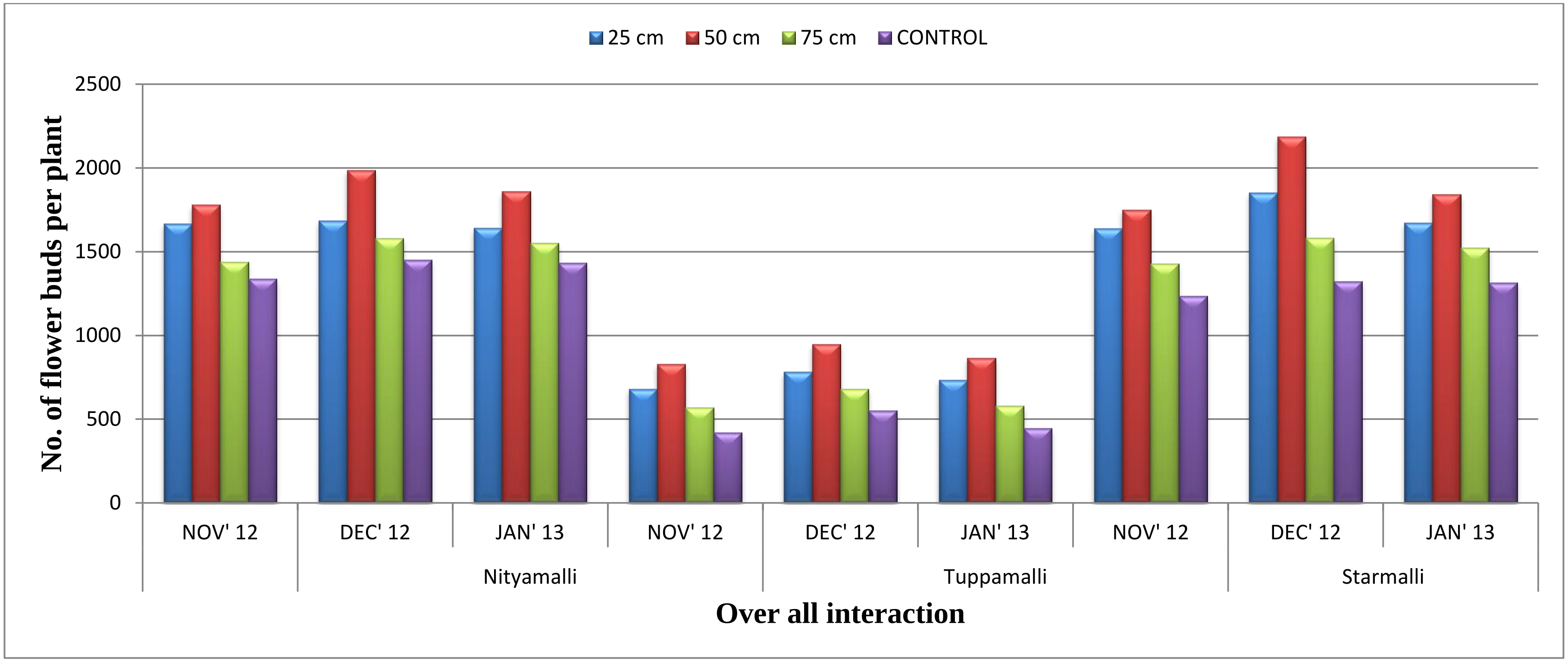


Fig 4.14d Number of flower buds per plant as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov.2012 to June 2013.

followed by Nityamalli pruned in December'12 (1676.07) whereas lowest number of flower buds per plant were recorded in Tuppamalli pruned in November'12 (625.02).

The interaction between genotypes and pruning height on number of flower buds per plant was found significant (Table and Fig. 4.14b). The treatment Starmalli, pruning height at 50 cm recorded maximum number of flower buds per plant (1926.18) followed by Nityamalli, pruning height at 50cm (1875.46) whereas lowest number of flower buds was recorded in Tuppamalli, unpruned bushes (471.95).

The interaction between pruning date and pruning height on number of flower buds per plant was found significant (Table and Fig. 4.14c). The treatment December'12, pruning height at 50cm recorded maximum number of flower buds per plant (1706.92), followed by January'13, pruning height at 50cm (1522.36), whereas lowest number of flower buds per plant was recorded in November'12, unpruned bushes (997.16).

The interaction among genotype, pruning date and pruning height on number of flower buds per plant was found significant (Table and Fig. 4.14d).The treatment "Starmalli, December'12 and pruning height at 50 cm" recorded maximum number of flower buds per plant (2187.83) followed by Nityamalli, December'12, pruning height at 50 cm (1986.42) over the rest of the treatments.

The observations recorded on number of flower buds per plant revealed that Nityamalli and Starmalli produced the highest number of flower buds per plant, which might be due to genetic factors, higher number of primary branches and secondary branches produced per plant and higher photosynthetic efficiency. Maximum number of flower buds produced on the bushes pruned in December'12, which might be due to congenial climatic conditions *i.e.,* longer sunshine hours. These results obtained were in accordance with the results of Sharma and Singh (1991).

4.1.15. Weight of flower buds per plant

Significant differences were observed among genotype, pruning date and pruning height over weight of flower buds per plant (Table 4.15a, b, c & d).

The highest weight of flower buds per plant (flower yield per plant) was recorded in the genotype Nityamalli (466.99 g) followed by Starmalli (415.36 g) whereas the lowest flower yield per plant was recorded in Tuppamalli (269.19 g).

Among the pruning dates, December'12 recorded maximum weight of flower buds per plant (425.38 g) followed by January'13 (377.49 g).

Among the pruning heights, pruning height at 50cm recorded maximum weight of flower buds per plant (448.18 g) followed by pruning height at 25 cm (408.23 g). Whereas the lowest weight of flower buds per plant was recorded in un-pruned bushes (306.56 g).

The interaction between genotype and pruning dates for weight of flower buds per plant was found significant (Table and Fig. 4.15a). The treatment Nityamalli, December'12 recorded maximum weight of flower buds per plant (513.89 g) whereas the lowest weight of flower buds per plant was recorded for the treatment Tuppamalli, November'12 (227.86 g).

The interaction between genotype and pruning height on weight of flower buds per plant was found significant (Table and Fig. 4.15b). The treatment Nityamalli, pruning height at 50 cm recorded the highest weight of flower buds per plant (533.00 g) followed by the treatment Nityamalli, pruning height at 25 cm (510.08 g) whereas the lowest weight of flower buds per plant was recorded in Tuppamalli, un-pruned bushes (214.60 g)

The interaction between pruning date and pruning height on weight of flower buds per plant was found significant (Table and Fig. 4.15c). The treatment December'12, pruning height at 50cm recorded the maximum weight of flower buds per plant (499.72 g) over rest of the interaction treatments.

The interaction among genotype, pruning date and pruning height over weight of flower buds per plant was found significant (Table and Fig. 4.15d). The treatment Nityamalli, December'12, pruning height at 50cm recorded highest weight of flower buds per plant (571.39 g) over rest of the treatments. Whereas lowest weight of flower buds per plant was recorded in treatment Tuppamalli, November'12, in unpruned bushes (147.25 g).

The observations recorded on weight of flower buds per plant revealed that Nityamalli recorded highest weight of flower buds per plant, which might be

Table 4.15a Weight of flower buds per plant (g) of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

T X ST				
Pruning date (ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T_1	424.29	513.89	462.79	**466.99**
T_2	227.86	314.26	265.46	**269.19**
T_3	393.90	447.99	404.20	**415.36**
Mean (ST)	**348.68**	**425.38**	**377.49**	
	T	**ST**	**TX ST**	
S.E m±	1.84	1.50	2.60	
C.D (P = 0.05)	5.53	4.51	7.81	

Table 4.15b Weight of flower buds per plant (g) of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height (SST)					
Genotype(T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T_1	510.08	533.00	459.91	364.98	**466.99**
T_2	287.41	318.59	256.16	214.60	**269.19**
T_3	427.22	492.93	401.22	340.09	**415.36**
Mean (SST)	**408.23**	**448.18**	**372.43**	**306.56**	
	T	**SST**	**T X SST**		
S.E m±	1.84	1.62	2.82		
C.D (P = 0.05)	5.53	4.88	8.46		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10th NOV ’12 ST_2**:**10th DEC’12 ST_3**:**10th JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table4.15c. Weight of flower buds per plant (g) *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

ST X SST					
Pruning height (SST)					
Pruning date (ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (ST)**
ST_1	377.11	419.24	341.37	257.02	**348.68**
ST_2	440.82	499.72	417.01	343.97	**425.38**
ST_3	406.77	425.57	358.92	318.68	**377.49**
Mean (SST)	**408.23**	**448.18**	**372.43**	**306.56**	
	ST	**SST**	**ST X SST**		
S.E m±	1.50	1.62	2.82		
C.D (P = 0.05)	4.51	4.88	8.46		

Table 4.15d. Weight of flower buds per plant (g) as effected by genotype and pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Genotype (T)	Pruning date (ST)	T X ST X SST				Mean (T X ST)
		Pruning height (SST)				
		SST_1	**SST_2**	**SST_3**	**SST_4**	
T_1	**ST_1**	443.54	524.92	395.40	333.31	**424.29**
	ST_2	552.37	571.39	543.57	388.22	**513.88**
	ST_3	534.34	502.70	440.75	373.40	**462.79**
T_2	**ST_1**	251.58	265.89	246.72	147.25	**227.86**
	ST_2	328.03	386.79	278.79	263.42	**314.25**
	ST_3	282.62	303.10	242.99	233.15	**265.46**
T_3	**ST_1**	436.22	466.91	381.99	290.50	**393.90**
	ST_2	442.07	540.97	428.66	380.26	**447.99**
	ST_3	403.37	470.92	393.02	349.51	**404.20**
Mean (ST X SST)		**408.23**	**448.17**	**372.43**	**306.55**	**383.85 (X)**

Factors	T X ST X SST
S.E m±	4.88
C.D (P = 0.05)	14.65

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV ’12 ST_2**:**10^{th} DEC’12 ST_3**:**10^{th} JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

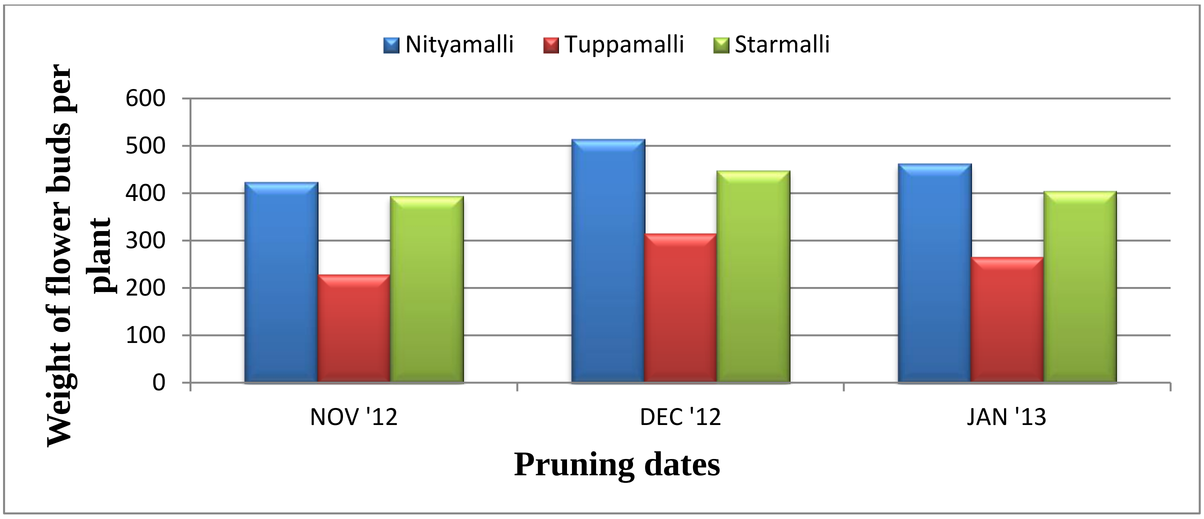


Fig.4.15a Weight of flower buds per plant (g) of *Jasminum sambac* as effected by genotype and pruning date during Nov.2012 to June 2013.

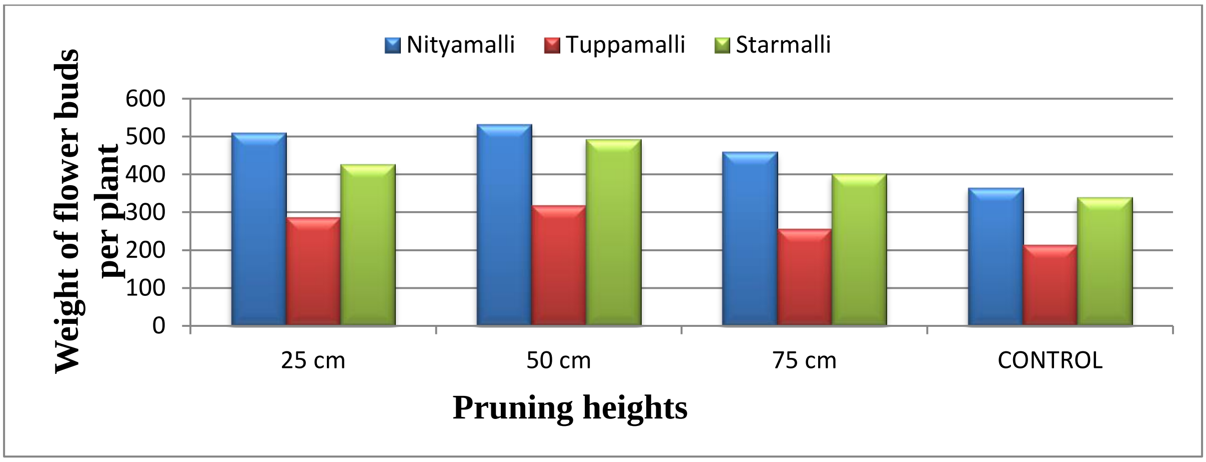


Fig.4.15b Weight of flower buds per plant (g) of *Jasminum sambac* as effected by genotype and pruning height during Nov.2012 to June 2013.

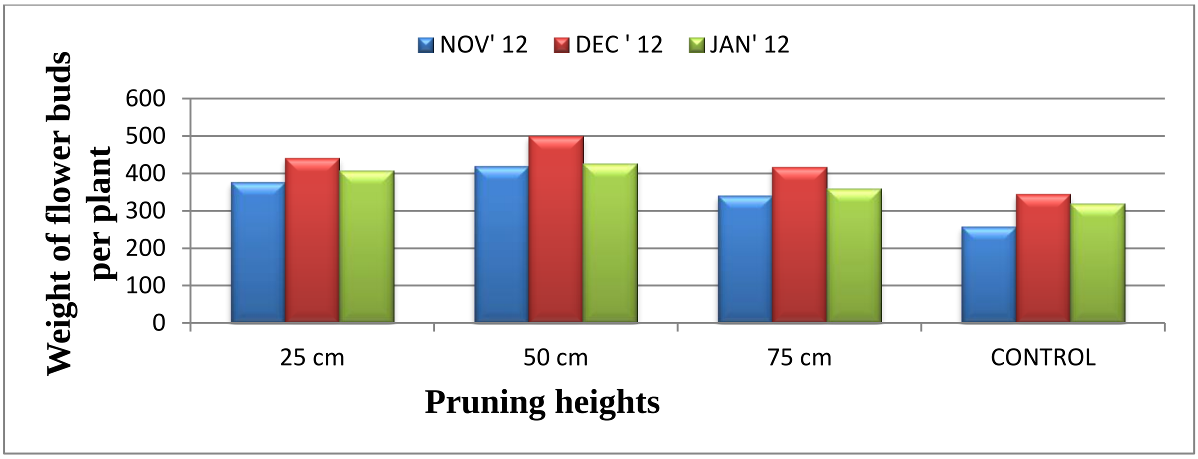


Fig.4.15c. Weight of flower buds per plant (g) *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

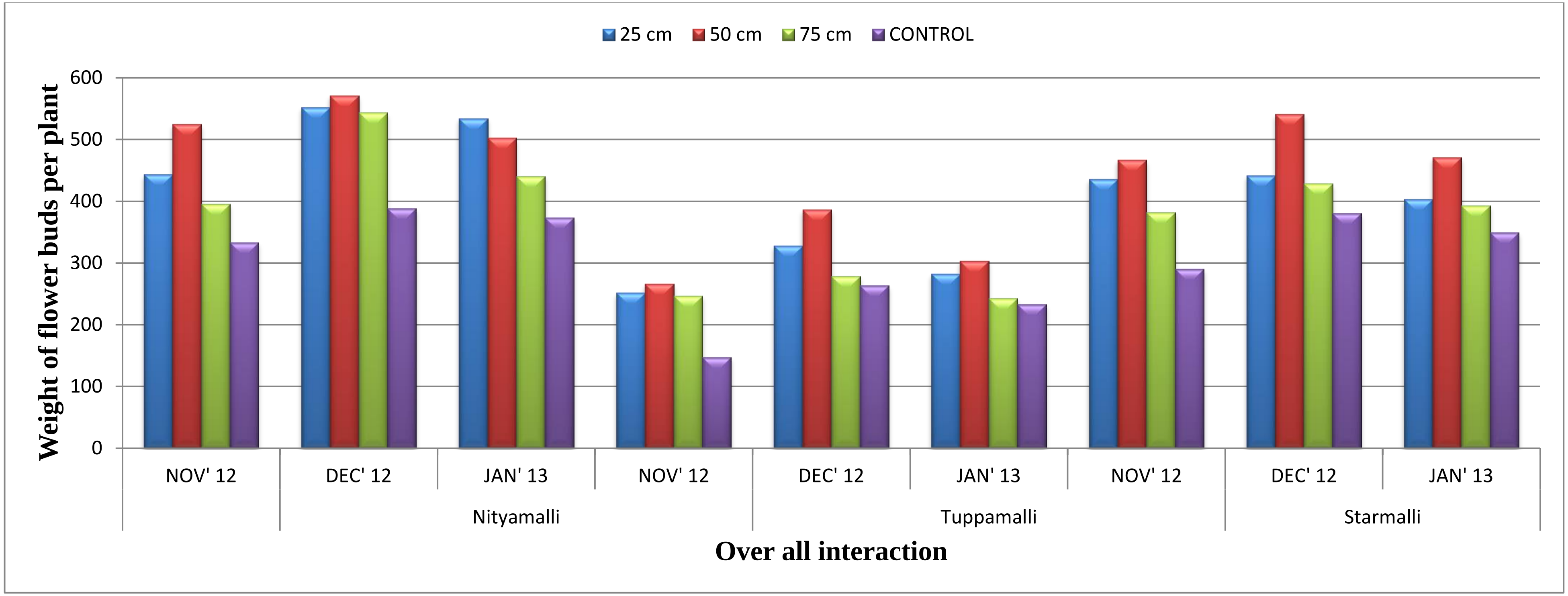


Fig.4.15d Weight of flower buds per plant (g) as effected by genotype and pruning date and pruning height of *Jasminum sambac* during Nov.2012 to June 2013.

due to genetic factors, highest weight of fifty flower buds weight and highest number of flowers per plant. Among the pruning dates December'12 produced the maximum weight of flower buds per plant, which might be due production of large number of laterals per plant. The pruning height at 50cm produced the highest weight of flower buds per plant, which might be due to highest number of primary shoots and laterals produced per plant.

4.1.16. Weight of flower buds per m^2 plot (kg)

A significant difference for weight of flower buds per m2 plot (kg) was observed among the genotypes, pruning date and pruning height (Table 4.16a, b, c & d).

Among the genotypes, Nityamalli recorded highest weight of flower buds per m^2 plot (flower yield per m^2) (1.86 kg/m^2) followed by Starmalli (1.65 kg/m^2) and lowest flower yield was recorded in Tuppamalli (1.07 kg/m^2).

Among pruning dates, jasmine shrubs pruned in December'12 recorded the highest flower yield per m^2 plot (1.69 kg/m^2) followed by the pruning date January'13 (1.50 kg/m^2), whereas, the lowest flower yield was recorded in pruning date November'12 (1.39 kg/m^2).

Among, the pruning heights significant variations observed for weight of flower buds per m^2 plot (Table 4.16b). The pruning height at 50 cm recorded the highest weight of flower buds per m^2 plot (1.78 kg/m^2), followed by pruning height at 25 cm (1.62 kg/m^2). The lowest flower bud weight was recorded in unpruned bushes (1.22 kg/m^2).

The interaction between genotype and pruning date on weight of flower buds per m^2 plot was found significant (Table and Fig. 4.16a). The treatment Nityamalli pruned in December'12 recorded maximum flower weight per m^2 plot (2.05 kg/m^2) followed by Nityamalli pruned in January'13 (1.84 kg/m^2) compared to other treatments. The lowest flower weight was recorded in the treatment Tuppamalli pruned in November'12 (0.90 kg/m^2).

The interaction between genotype and pruning height on weight of flower buds per m^2 plot was found significant (Table and Fig. 4.16b). The treatment "Nityamalli pruning height at 50cm" recorded the highest flower weight per m^2 plot (2.12 kg/m^2) followed by Nityamalli pruning height at 25 cm (2.03 kg/m^2).

Table 4.16a Weight of flower buds per m^2 plot (kg) of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

T X ST				
Pruning date (ST)				
Genotype(T)	**ST1**	**ST2**	**ST3**	**Mean (T)**
T1	1.69	2.05	1.84	**1.86**
T2	0.90	1.24	1.05	**1.07**
T3	1.57	1.78	1.61	**1.65**
Mean (ST)	**1.39**	**1.69**	**1.50**	
	T	**ST**	**T X ST**	
S.E m±	0.00	0.00	0.01	
C.D (P = 0.05)	0.02	0.01	0.03	

Table 4.16b Weight of flower buds per plot (kg) of *Jasminum sambac* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height (SST)					
Genotype(T)	**SST1**	**SST2**	**SST3**	**SST4**	**Mean (T)**
T1	2.03	2.12	1.83	1.45	**1.86**
T2	1.14	1.26	1.02	0.85	**1.07**
T3	1.70	1.96	1.60	1.35	**1.65**
Mean (SST)	**1.62**	**1.78**	**1.48**	**1.22**	
	T	**SST**	**T X SST**		
S.E m±	0.00	0.00	0.01		
C.D (P = 0.05)	0.02	0.02	0.03		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV ’12 ST_2**:**10^{th} DEC’12 ST_3**:**10^{th} JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table 4.16c Weight of flower buds per m^2 plot (kg) *Jasminum sambac* as effected by pruning date and pruning height during Nov.2012 to June 2013.

ST X SST					
Pruning height					
Pruning date (ST)	**SST1**	**SST2**	**SST3**	**SST4**	**Mean (ST)**
ST1	1.50	1.67	1.36	1.02	**1.39**
ST2	1.75	1.99	1.66	1.37	**1.69**
ST3	1.62	1.69	1.43	1.27	**1.50**
Mean (SST)	**1.62**	**1.78**	**1.48**	**1.22**	
	ST	**SST**	**ST X SST**		
S.E m±	0.00	0.00	0.01		
C.D (P = 0.05)	0.01	0.02	0.03		

Table 4.16d Weight of flower buds per m^2 plot (kg) as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Genotype (T)	Pruning date (ST)	T X ST X SST				Mean (T X ST)
		Pruning height (SST)				
		SST_1	SST_2	SST_3	SST_4	
T_1	ST_1	1.17	2.09	1.55	1.33	**1.68**
	ST_2	2.20	2.28	2.17	1.54	**2.04**
	ST_3	2.13	2.00	1.76	1.49	**1.84**
T_2	ST_1	1.00	1.06	0.98	0.58	**0.90**
	ST_2	1.31	1.52	1.11	1.05	**1.24**
	ST_3	1.12	1.20	0.96	0.93	**1.05**
T_3	ST_1	1.74	1.86	1.52	1.16	**1.57**
	ST_2	1.76	2.16	1.71	1,51	**1.87**
	ST_3	1.61	1.88	1.56	1.39	**1.61**
Mean (ST X SST)		**1.62**	**1.78**	**1.48**	**1.18**	**1.51 (X)**

Factors	T XST X SST
S.E m±	0.01
C.D (P = 0.05)	0.05

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10th NOV '12 ST_2**:**10th DEC'12 ST_3**:**10th JAN' 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

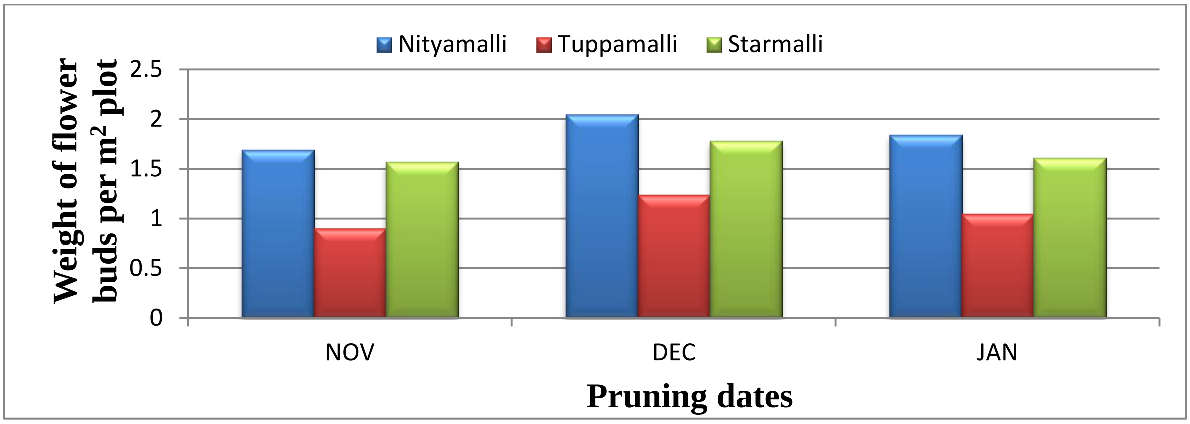


Fig.4.16a Weight of flower buds per m^2 plot (kg) of *Jasminum sambac* as effected by genotype and pruning date during Nov.2012 to June 2013.

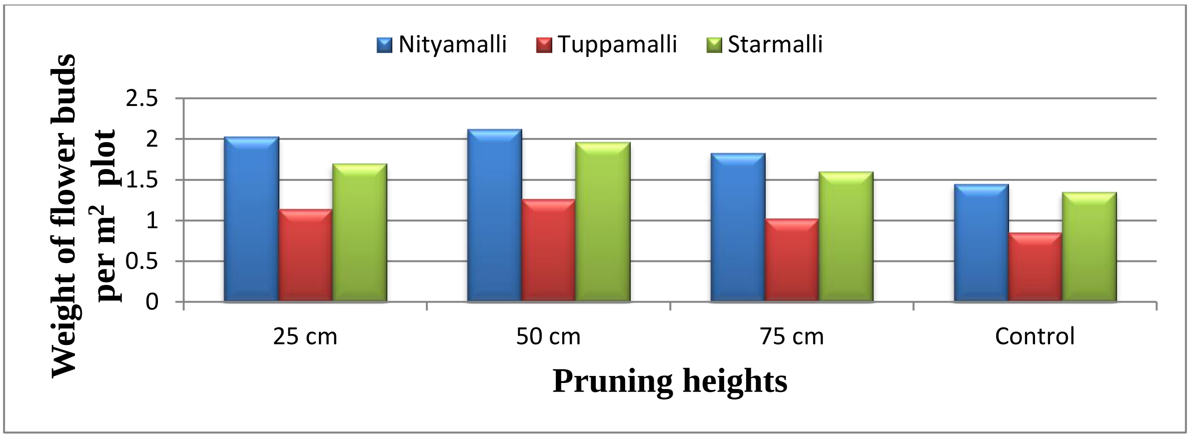


Fig.4.16b Weight of flower buds per plot (kg) of *Jasminum sambac* as effected by genotype and pruning height during Nov.2012 to June 2013.

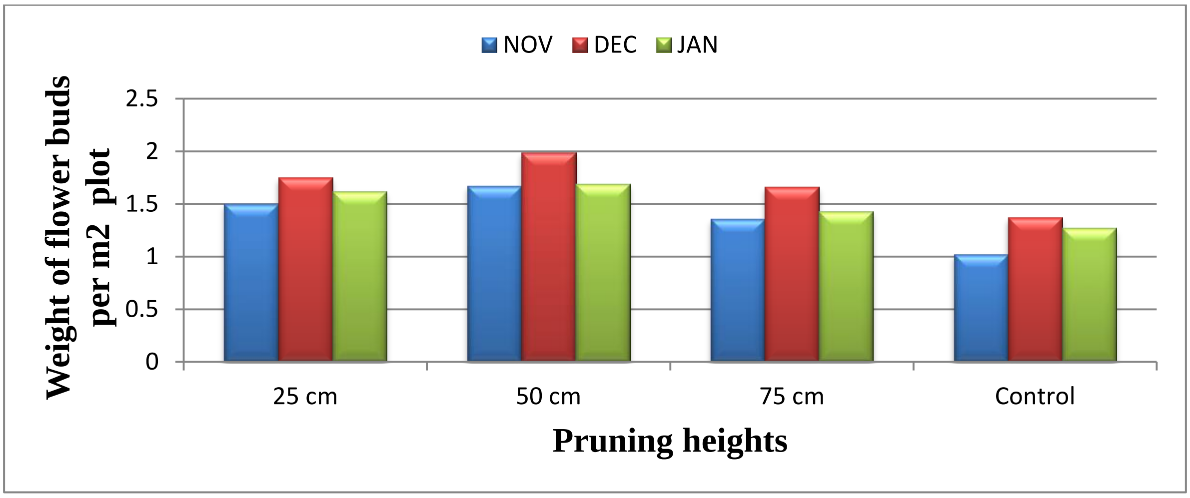


Fig.4.16c Weight of flower buds per m^2 plot (kg) *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

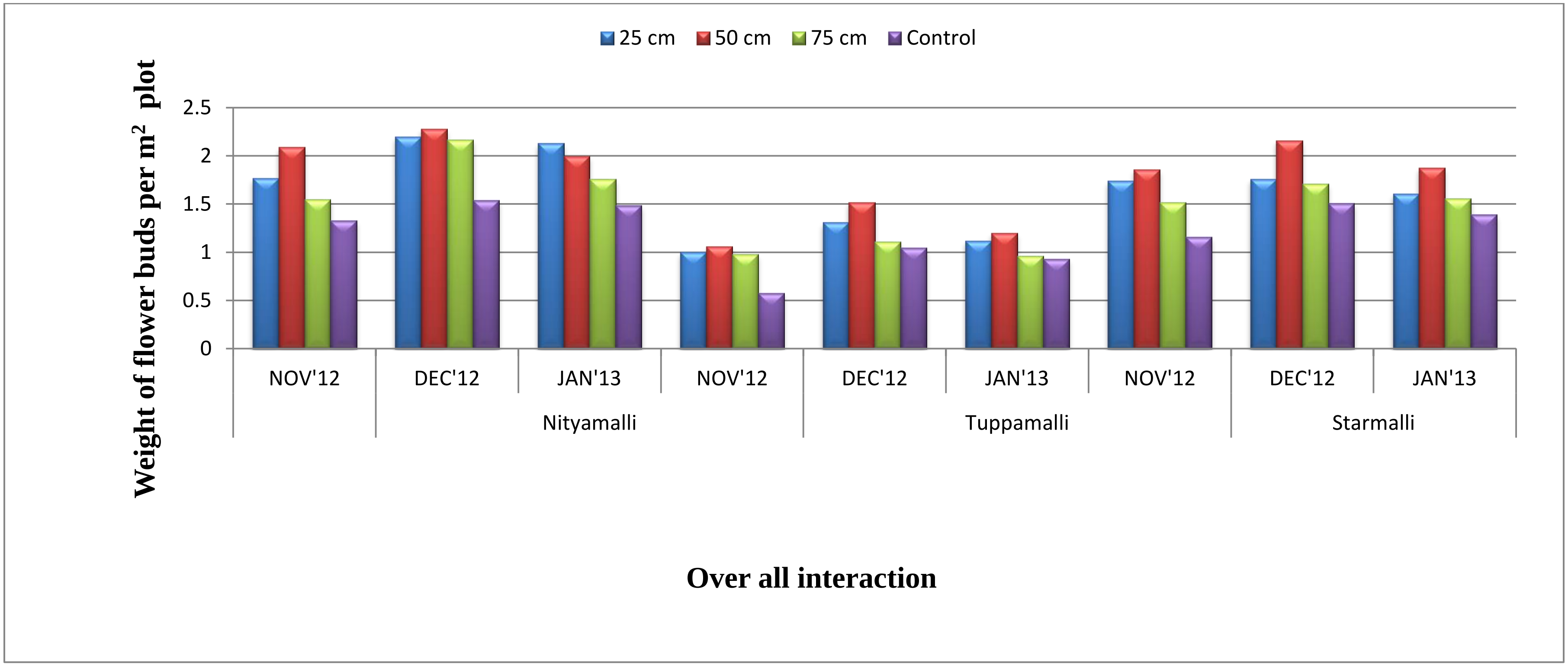


Fig.4.16d Weight of flower buds per m^2 plot (kg) as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Whereas the lowest flower buds weight was recorded in the treatment Tuppamalli unpruned bushes (0.85 kg/m^2).

The interaction between pruning date and pruning height on weight of flower buds per m^2 plot was also found significant (Table and Fig. 4.16c). The highest flower bud weight was recorded in December'12 with pruning height at 50cm (1.99 kg/m^2) followed by the treatment December'12 with pruning height at 25cm (1.75 kg/m^2) compared with the rest of treatments. The lowest flower bud weight per m^2 plot was recorded in treatment in November'12 unpruned bushes (1.02 kg/m^2).

The interaction among genotype, pruning date and pruning height on weight of flower buds per m^2 plot was also found significant (Table and Fig. 4.16d). The treatment Nityamalli, December'12 with pruning height at 50cm recorded the highest flower bud weight (2.28 kg/m^2) followed by Nityamalli, December'12 & pruning height at 25 cm (2.20 kg/m^2) compared with the rest of treatments. The lowest flower bud weight per m^2 plot was observed with the treatment Tuppamalli, November'12 unpruned bushes (0.58 kg/m^2).

The observations recorded on weight of flower buds per m^2 of *Jasminum sambac* revealed that Nityamalli recorded the highest weight of flower buds per m^2 followed by Starmalli, which might be due to genetic factors, highest number of primary and secondary branches per plant. Highest weight of flower buds per m^2 was observed in December'12 pruning date followed by January'13, which might be due to production of more number of primary and secondary branches per plant. Jasmine shrubs pruned at 50 cm produced the highest weight of flower buds per m^2 followed by pruning height at 25 cm which might be due to potent vigour of the dormant buds develop into secondary and lateral branches produced on pruned shoots.

4.1.17. Weight of flower buds per hectare (tonnes)

Significant differences for weight of flower buds per ha (Flower yield t ha^{-1}) was observed among genotypes, pruning dates, pruning heights and their interactions (Table 4.17a, b, c & d).

Nityamalli recorded highest flower yield per ha (16.22 t ha^{-1}) followed by Starmalli (15.11 t ha^{-1}) and lowest flower yield was recorded in Tuppamalli (9.60 t ha^{-1}).

Among pruning dates, jasmine shrubs pruned in December'12 recorded the highest flower yield (15.14 t ha^{-1}) followed by the pruning date January '13 (13.39 t ha^{-1}) whereas, the lowest flower yield was recorded in November'12 (12.40 t ha^{-1}).

The pruning height at 50 cm recorded the highest weight of flower buds per ha (16.07 t ha^{-1}), followed by pruning height at 25 cm (14.22 t ha^{-1}). The lowest flower bud weight was recorded in unpruned bushes (11.09 t ha^{-1}).

The interaction between genotype and pruning date over flower yield per ha was found significant (Table and Fig. 4.17a). The treatment Nityamalli, December'12 recorded the highest flower yield (18.24 t ha^{-1}) followed by Starmalli, December'12 (16.15 t ha^{-1}) compared with other treatments. The lowest flower yield was recorded in the treatment Tuppamalli, November'12 (8.46 t ha^{-1}).

The interaction between genotype and pruning height on flower yield per ha was found significant (Table and Fig. 4.17b). The treatment Nityamalli, pruning height at 50cm recorded the highest flower yield t/ ha (18.86 t ha^{-1}) followed by Starmalli, pruning height at 50cm (17.81t ha^{-1}), whereas the lowest flower yield was recorded in the treatment Tuppamalli, unpruned bushes (7.64 t ha^{-1}).

The interaction between pruning date and pruning height on flower yield per ha was also found significant (Table and Fig. 4.17c). The highest flower yield was recorded in December'12 with pruning height at 50 cm (17.93 t ha^{-1}) followed by treatment December '12 with pruning height at 25 cm (15.92 t ha^{-1}) compared with rest of the treatments. The lowest flower yield was recorded in the treatment November'12, unpruned bushes (9.52 t ha^{-1}).

The interaction among genotype, pruning date and pruning height on flower yield per ha was also found significant (Table and Fig. 4.17d). The treatment Nityamalli, December'12 and pruning height at 50 cm recorded the highest flower yield (20.35 t ha^{-1}) followed by Nityamalli, December'12 with

Table 4.17a. Weight of flower buds per hectare (tonnes) of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

T X ST				
Pruning date (ST)				
Genotype (T)	**ST_1**	**ST_2**	**ST_3**	**Mean (T)**
T_1	14.49	18.24	15.94	**16.22**
T_2	8.46	11.02	9.32	**9.60**
T_3	14.26	16.15	14.92	**15.11**
Mean (ST)	**12.40**	**15.14**	**13.39**	
	T	**ST**	**T X ST**	
S.E m±	0.02	0.01	0.02	
C.D (P = 0.05)	0.07	0.04	0.07	

Table 4.17b Weight of flower buds per hectare (tones) of *Jasminum* as effected by genotype and pruning height during Nov. 2012 to June 2013.

T X SST					
Pruning height (SST)					
Genotype (T)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (T)**
T_1	17.52	18.86	16.10	12.41	**16.22**
T_2	10.05	11.53	9.18	7.64	**9.60**
T_3	15.08	17.81	14.33	13.22	**15.11**
Mean (SST)	**14.22**	**16.07**	**13.21**	**11.09**	
	T	**SST**	**T X SST**		
S.E m±	0.02	0.01	0.02		
C.D (P = 0.05)	0.07	0.04	0.07		

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10^{th} NOV ’12 ST_2**:**10^{th} DEC’12 ST_3**:**10^{th} JAN’ 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

Table 4.17c Weight of flower buds per hectare (tonnes) *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

ST X SST					
Pruning height (SST)					
Pruning date (ST)	**SST_1**	**SST_2**	**SST_3**	**SST_4**	**Mean (ST)**
ST_1	13.27	14.58	12.26	9.52	**12.40**
ST_2	15.92	17.93	14.56	12.13	**15.14**
ST_3	13.46	15.69	12.79	11.62	**13.39**
Mean (SST)	**14.22**	**16.07**	**13.21**	**11.09**	
	ST	**SST**	**ST X SST**		
S.E m±	0.01	0.01	0.02		
C.D (P = 0.05)	0.04	0.04	0.07		

Table 4.17d Weight of flower buds per hectare (tonnes) as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov. 2012 to June 2013.

Genotype (T)	Pruning date (ST)	T X ST X SST Pruning height (SST) SST_1	SST_2	SST_3	SST_4	Mean (T X ST)
T_1	ST_1	16.08	17.16	14.32	10.41	**14.49**
	ST_2	19.90	20.35	18.63	14.08	**18.24**
	ST_3	16.57	19.05	15.36	12.76	**15.93**
T_2	ST_1	9.21	9.82	8.92	5.89	**8.46**
	ST_2	11.78	13.90	9.87	8.55	**11.02**
	ST_3	9.17	10.89	8.76	8.47	**9.32**
T_3	ST_1	14.50	16.75	13.54	12.26	**14.26**
	ST_2	16.09	19.56	15.20	13.78	**16.15**
	ST_3	14.66	17.14	14.27	13.63	**14.92**
Mean (ST X SST)		**14.21**	**16.06**	**13.20**	**11.09**	**13.64 (X)**

Factors	T X ST X SST
S.E m±	0.04
C.D (P = 0.05)	0.13

Note

MAIN TREATMENTS- T_1: Nityamalli, T_2: Tuppamalli, T_3: Starmalli

SUB-TREATMENTS - ST_1**:**10th NOV '12 ST_2**:**10th DEC'12 ST_3**:**10th JAN' 13

SUB-SUB TREATMENTS- SST_1: 25 cm, SST_2: 50 cm, SST_3: 75 cm, SST_4: Control

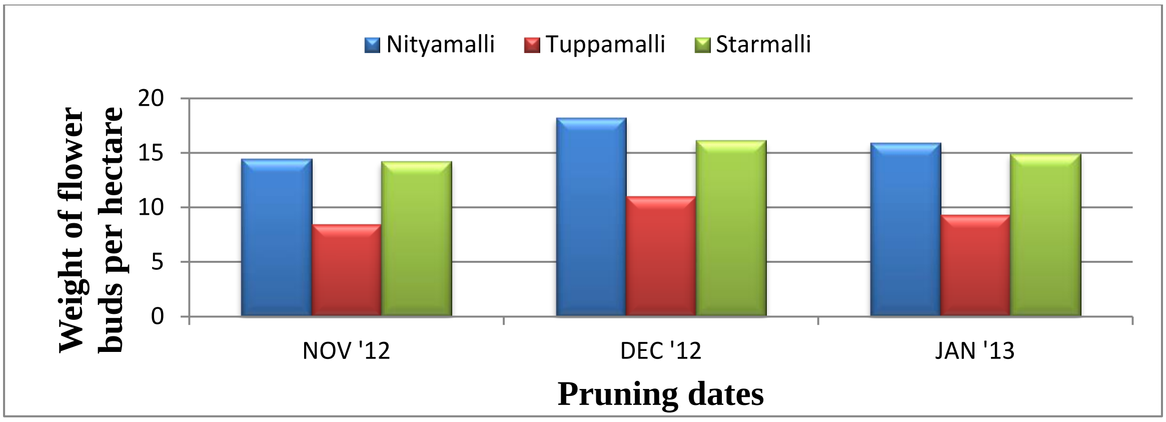


Fig.4.17a. Weight of flower buds per hectare (tonnes) of *Jasminum sambac* as effected by genotype and pruning date during Nov. 2012 to June 2013.

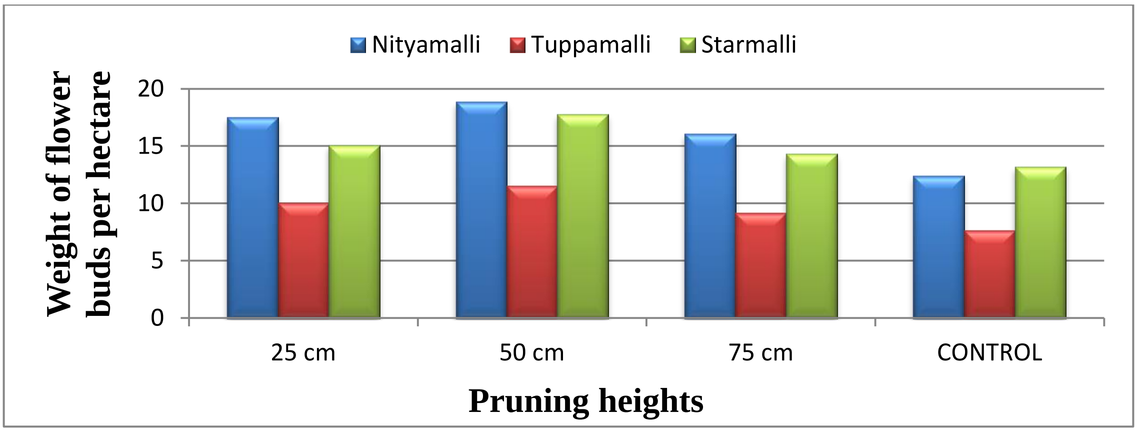


Fig.4.17b. Weight of flower buds per hectare (tones) of *Jasminum sambac* as effected by genotype and pruning height during Nov.2012 to June 2013.

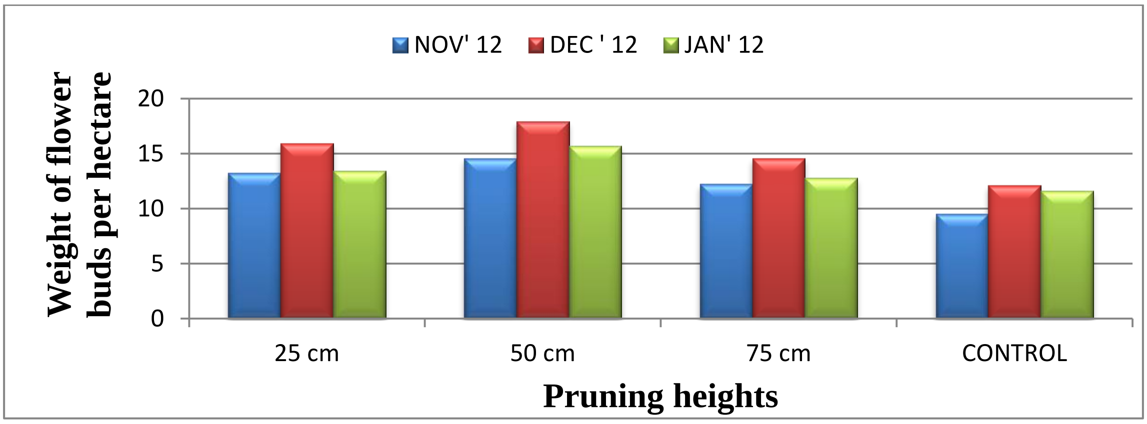


Fig.4.17c. Weight of flower buds per hectare (tonnes) *Jasminum sambac* as effected by pruning date and pruning height during Nov. 2012 to June 2013.

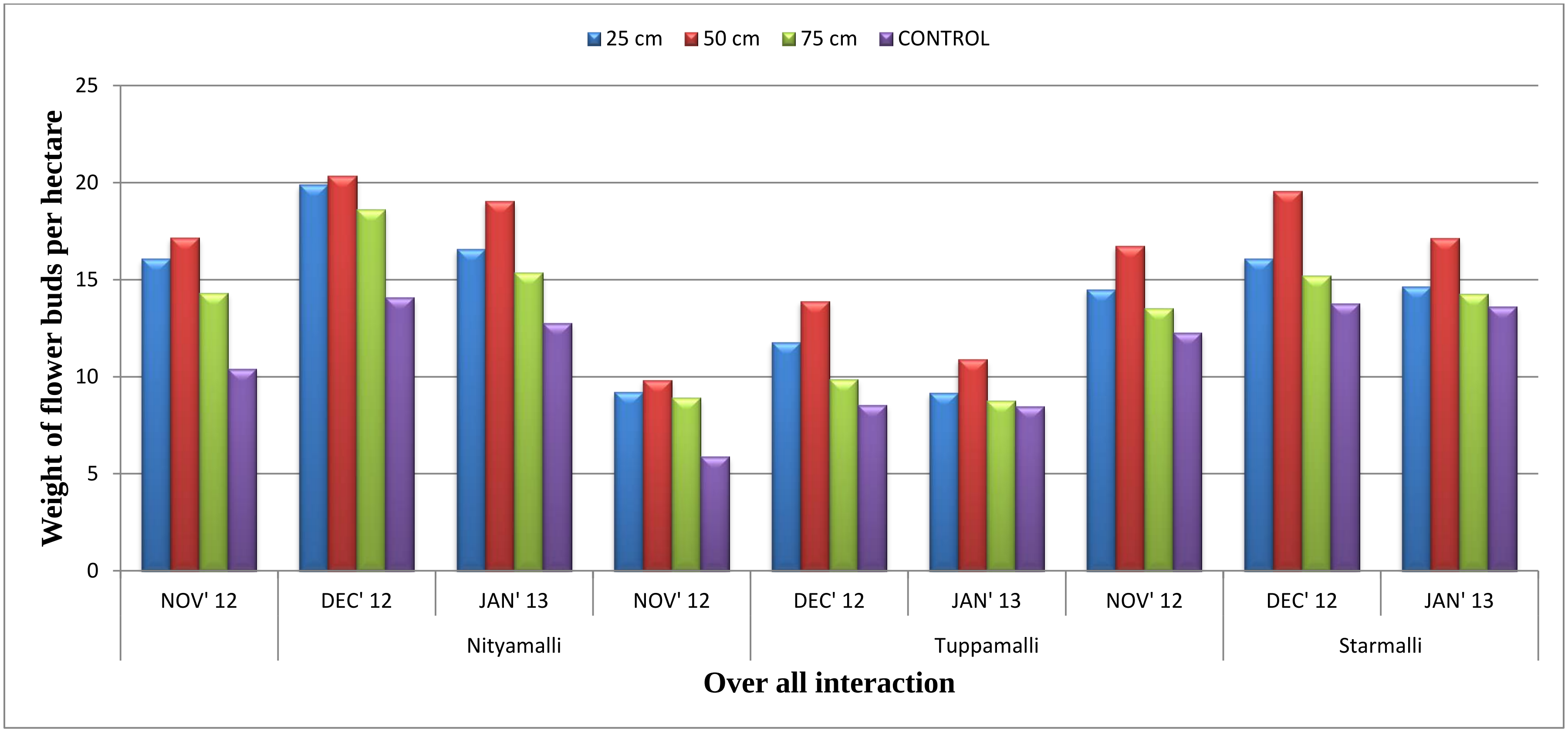


Fig.4.17d. Weight of flower buds per hectare (tonnes) as effected by genotype, pruning date and pruning height of *Jasminum sambac* during Nov.2012 to June 2013.

Pruning height at 25 cm

Pruning height at 50 cm

Pruning height at 75 cm

Un Pruned bushes

Plate 7: Nityamalli at Flowering stage pruning date November, 2012

Pruning Height at 25 cm

Pruning Height at 50 cm

Pruning Height at 75 cm

Un Pruned bushes

Plate 8: Nityamalli at Flowering stage pruning date December, 2012

Pruning height at 25 cm

Pruning height at 50 cm

Pruning height at 75 cm

Un Pruned bushes

Plate 9: Nityamalli at Flowering stage pruning date January, 2013

Pruning height at 25 cm

Pruning height at 50 cm

Pruning height at 75 cm

Un Pruned bushes

Plate 10: Tuppamalli at Flowering stage pruning date November, 2012

Pruning height at 25 cm

Pruning height at 50 cm

Pruning height at 75 cm

Un Pruned bushes

Plate 11: Tuppamalli at flowering stage pruning date December, 2012

Pruning height at 25 cm

Pruning height at 50 cm

Pruning height at 75 cm

Un Pruned bushes

Plate 12: Tuppamalli at flowering stage pruning date January, 2013

Pruning height at 25 cm

Pruning height at 50 cm

Pruning height at 75 cm

Un Pruned bushes

Plate 13: Starmalli at Flowering stage pruning date November, 2012

Pruning height at 25 cm

Pruning height at 50 cm

Pruning height at 75 cm

Un Pruned bushes

Plate14: Starmalli at flowering stage pruning date December, 2012

Pruning height at 25 cm

Pruning height at 50 cm

Pruning height at 75 cm

Un Pruned bushes

Plate15: Starmalli at flowering stage pruning date January, 2013

pruning height at 25 cm (19.90 t ha^{-1}) compared with the rest of treatment. The lowest flower bud weight was observed for the treatment Tuppamalli, November'12 and unpruned bushes (5.89 t ha^{-1}).

The data revealed that the genotype Nityamalli produced the highest flower yield per hectare (16.22 t ha^{-1}), which might be due inherent genetic factors that promote highest flower production. The pruning date December'12 recorded the highest flower yield (15.14 t ha^{-1}), which might be due to congenial weather conditions for growth and flower production *i.e.,* longer sunshine hours. The interaction effect between pruning date December'12 and Pruning height at 50cm produced the highest flower yield, which might be due to high potent vigour of the dormant buds and congenial climatic conditions. These results obtained were in accordance with the results of Sharma and Singh (1991), Nair *et al.* (2009).

4.1.18. Cost Benefit Ratio of Jasmine flower production

The price of Jasmine flowers was taken based on the average price of wholesale market @ Rs 50 per Kg. The cost of cultivation, gross income and net income were worked and shown in table 4.18 a & b. Since the Government of Andhra Pradesh was providing unregulated free electric power the cost of electric power was not considered.

Among the thirty six treatments involving three genotypes, three pruning dates and four pruning heights, the treatment Nityamalli, December'12 and Pruning height at 50cm ($T_1ST_2SST_2$) recorded the highest cost benefit ratio of (1:2.57) followed by Nityamalli, December'12 and Pruning height at 25 cm ($T_1ST_2SST_1$) (1:2.53) and Starmalli, December'12 and Pruning height at 50 cm ($T_3ST_2SST_2$) (1:2.49).

Table 4.18a: Economics of jasmine cultivation with different levels of pruning date and pruning intensity(Rs/ha).

ITEM	COST (Rs)
1. Land rent	50000
2. Interest on fixed capital	6000
3. Interest on working capital	36393
4. Plant material cost (10 Rs/ plant)	40000
5. Transportation cost	30000
6. FYM (30 t per ha)	14165
7. Fertilizers	40000
8. Plant protection	15500
9. Labour cost	
Land preparation	16350
Fertilizer application	18000
Planting	10600
Pruning	10800
Weeding	12860
Irrigation	11000
Insecticide and Fungicide sprays	14000
Harvesting	50000
10. Grading, packing and transportation cost	10000
11. storage (Establishment and maintenance cost)	10000
Total	395668

The expenditure for cost of cultivation was calculated by assuming interest rate @ 12% per annum, Planting material cost @ Rs 10/- per two year old bush (since jasmine has a productive life of 8-10 years the planting material cost was spread to five years), labour wages @ Rs 200/- per man per day, fertilizer price @ Rs 280/- for urea, single super phosphate @ Rs 350/-, muriate of potash @ Rs 950/- for 50 kg bag each. The expenditure on cost of cultivation varied due to labour cost for harvesting in different jasmine cultivars. The expenditure for establishment of pre cooling and cold storage has been spread over ten years.

Table 4.18b Cost of cultivation (Rs ha^{-1}), Gross Income (Rs ha^{-1}), Net Income (Rs ha^{-1}) & Cost Benefit ratio of jasmine cultivation with different levels of pruning date and pruning intensity during November, 2012-June 2013.

Treatments	flower yield (tons ha^{-1})	Cost of cultivation (Rs ha^{-1})	Gross returns (Lakh Rs ha^{-1})	Net returns (Rs ha^{-1})	C:B ratio
$T_1ST_1SST_1$	16.08	365050	804000	438950	1:2.20
$T_1ST_1SST_2$	17.16	377675	858000	480325	1:2.27
$T_1ST_1SST_3$	14.32	346262	716000	369738	1:2.07
$T_1ST_1SST_4$	10.41	306400	520500	214100	1:1.70
$T_1ST_2SST_1$	19.90	393675	995000	601325	1:2.53
$T_1ST_2SST_2$	20.35	395668	1017500	621832	1:2.57
$T_1ST_2SST_3$	18.63	380375	931500	551125	1:2.45
$T_1ST_2SST_4$	14.08	348800	704000	355200	1:2.02
$T_1ST_3SST_1$	16.57	366100	828500	462400	1:2.26
$T_1ST_3SST_2$	19.05	391050	952500	561450	1:2.44
$T_1ST_3SST_3$	15.36	359400	768000	408600	1:2.14
$T_1ST_3SST_4$	12.76	320650	638000	317350	1:1.99
$T_2ST_1SST_1$	9.21	302750	460500	157750	1:1.52
$T_2ST_1SST_2$	9.82	303900	491000	187100	1:1.62
$T_2ST_1SST_3$	8.92	298200	446000	147800	1:1.50
$T_2ST_1SST_4$	5.89	182500	294500	112000	1:1.61
$T_2ST_2SST_1$	11.78	319200	589000	269800	1:1.85
$T_2ST_2SST_2$	13.90	334250	695000	360750	1:2.08
$T_2ST_2SST_3$	9.87	302500	493500	191000	1:1.63
$T_2ST_2SST_4$	8.55	299250	427500	128250	1:1.43
$T_2ST_3SST_1$	9.17	301930	458500	156570	1:1.52
$T_2ST_3SST_2$	10.89	316625	544500	227875	1:1.72
$T_2ST_3SST_3$	8.76	300150	438000	137850	1:1.46
$T_2ST_3SST_4$	8.47	294225	423500	129275	1:1.44
$T_3ST_1SST_1$	14.50	348200	725000	376800	1:2.08
$T_3ST_1SST_2$	16.75	366000	837500	471500	1:2.29
$T_3ST_1SST_3$	13.54	339725	677000	337275	1:1.99

(Table 4.18b Cont.)

$T_3ST_1SST_4$	12.26	329100	613000	283900	1:1.86
$T_3ST_2SST_1$	16.09	362400	804500	442100	1:2.22
$T_3ST_2SST_2$	19.56	392641	978000	585359	1:2.49
$T_3ST_2SST_3$	15.20	359250	760000	400750	1:2.12
$T_3ST_2SST_4$	13.78	334150	689000	354850	1:2.06
$T_3ST_3SST_1$	14.66	347800	733000	385200	1:2.11
$T_3ST_3SST_2$	17.14	377600	857000	479400	1:2.27
$T_3ST_3SST_3$	14.27	346150	713500	367350	1:2.06
$T_3ST_3SST_4$	13.63	333762	681500	347738	1:2.04

Note: The average whole price of Jasmine was taken @ Rs. 50 / kg, but the price fluctuates between Rs 30-700/kg depending on market forces.

LEGEND:

MAIN TREATMENTS: Three local varieties/Strains of *Jasminum sambac*

T_1**:** Nityamalli, T2**:** Tuppamalli, T3**:** Starmalli

SUB -TREATMENTS: PRUNING DATES

ST_1**:**10th NOVEMBER, 2012 ST_2**:**10th DECEMBER, 2012 ST_3**:**10th JANUARY, 2012

SUB –SUB-TREATMENTS: PRUNING HEIGHT

SST_1 **:** 25 cm from ground level SST_2 **:**50 cm from ground level SST_3 **:** 75cm from ground level SST_4 **:** control without pruning

4.2 EFFECT OF DEFOLIATING CHEMICALS (CHEMICAL DEFOLIATION) ON GROWTH AND FLOWER YIELD OF *Jasminum sambac*

4.2.1. Weight of defoliated leaves per shrub

Significant difference was observed among the genotype and the concentration of defoliant chemical (Table 4.19). The maximum weight of defoliated leaves per shrub was recorded in Tuppamalli (21.72 g) followed by Nityamalli (18.48 g). The lowest weight of defoliated leaves was recorded in Starmalli (14.01 g).

Among the different concentrations among the interaction treatments defoliants, paraquat dichloride at 1000 ppm shown maximum weight of defoliated leaves (24.83 g) followed by paraquat dichloride at 500 ppm (23.19 g). The weight of defoliated leaves recorded in manual defoliation was 46.46g.

Significant differences were observed genotype and defoliant chemical concentration for weight of defoliated leaves (Table and Fig. 4.19). The genotype Tuppamalli sprayed with paraquat dichloride 1000 ppm concentration recorded maximum weight of defoliated leaves (27.45 g) followed by in Tuppamalli sprayed with paraquat dichloride 500 ppm concentration (26.20 g). Whereas, the minimum quantity of defoliated leaves was observed in genotype Starmalli sprayed with KNO_3 at 1 per cent (8.99 g). The weight of defoliated leaves recorded in manual defoliation of Tuppamalli was 71.23 g.

The highest defoliation was recorded in the genotype Tuppamalli, which might be due to the genetic character for the production of higher level of abscissic acid for the formation of abscission layer leads to quick leaf fall. Similar results were found in pomegranate (Chandra *et al.*, 2011). The defoliant paraquat dichloride @ 1000 ppm was found effective by defoliating relatively higher quantity of leaves, which might be due to optimum concentration of growth retardant substances for the formation of abscission layer. The higher quantity of defoliated leaves was observed in paraquat dichloride @ 1000 ppm.

Table 4.19 Weight of defoliated leaves (g) as effected by genotype and concentration of defoliant chemical during Rabi season2012-July'13

Genotype	Manual defoliation	PQ D 500 ppm	PQ D 1000 ppm	PQ D 1500 ppm	PQ D 2000 ppm	PQ D 2500 ppm	NaCl 1000 ppm	NaCl 2000 ppm	NaCl 3000 ppm	NaCl 4000 ppm	KNO_3 1%	KNO_3 2%	KNO_3 3%	KNO_3 4%	KNO_3 5%	WATER SPRAY (CONTROL)	Mean (G)
NITYAMALLI	36.66	24.77	26.85	22.13	21.48	20.68	16.59	17.48	18.49	19.54	12.68	13.76	14.18	14.81	15.69	0.00	**18.48**
TUPPAMALLI	71.23	26.20	27.45	24.08	22.28	21.62	18.26	19.00	19.18	20.18	13.39	14.96	15.61	16.65	17.51	0.00	**21.72**
STARMALLI	31.49	18.62	20.20	17.17	16.69	15.29	12.18	12.96	13.47	14.51	8.99	9.89	10.00	10.94	11.80	0.00	**14.01**
Mean (D C)	**46.46**	**23.19**	**24.83**	**21.12**	**20.15**	**19.20**	**15.67**	**16.48**	**17.04**	**18.07**	**11.68**	**12.87**	**13.26**	**14.13**	**15.00**	**0.00**	

FACTORS	**FACTOR (G)**	**FACTOR (DC)**	**G X DC**
C.D (P=0.05)	0.19	0.44	0.77
S.E m±	0.06	0.15	0.27

Note: G: GENOTYPE; DC: DEFOLIANT CHEMICAL; P QD:PARAQUAT DI-CHLORIDE; NaCl: SODIUM CHLORIDE; KNO_3: POTASSIUM NITRATE

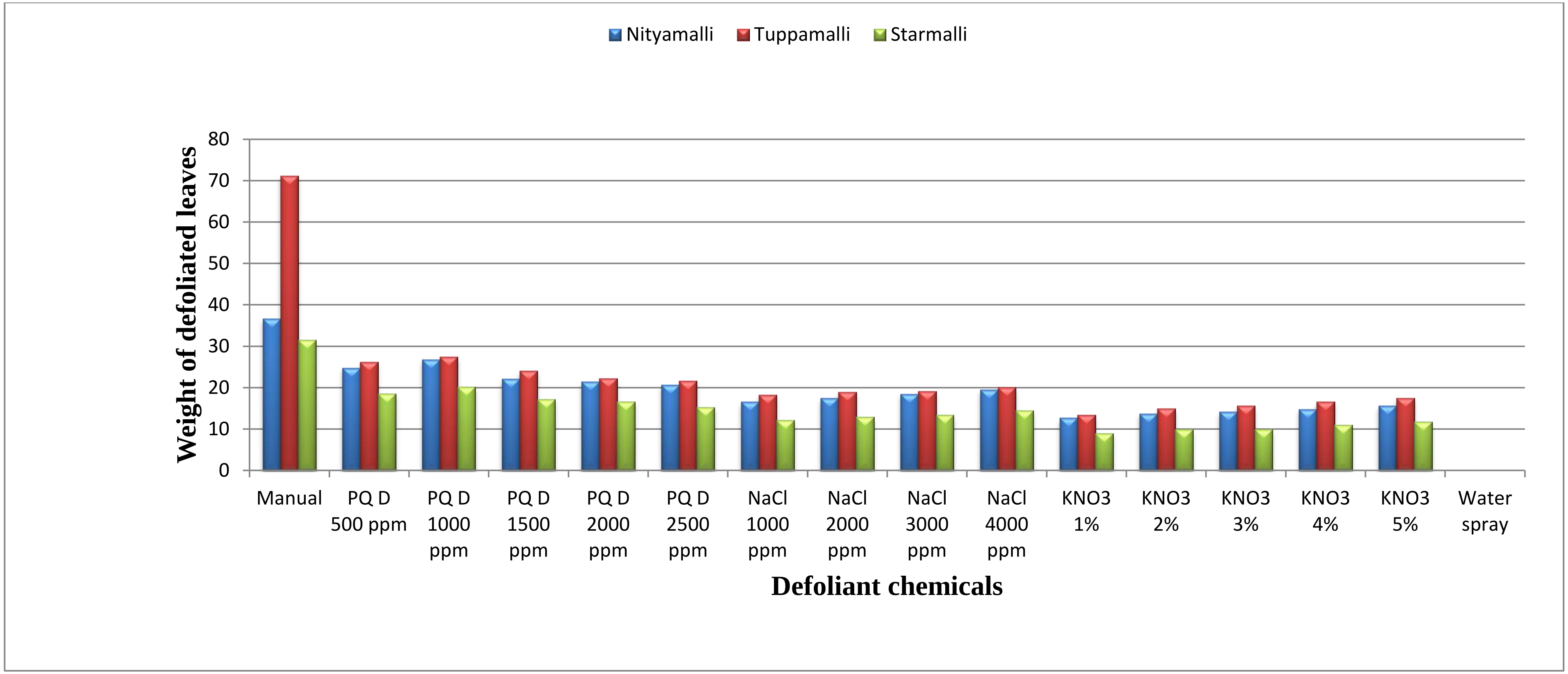


Fig 4.19 Weight of defoliated leaves (g) as effected by genotype and concentration of defoliant chemical during Rabi season 2012-July'13.

4.2.2. Days to complete defoliation

The differences among the genotype and concentration of defoliant chemicals on days to complete defoliation were found significant (Table 4.20). Minimum number of days to complete defoliation was recorded in Starmalli (9.69 days) followed by Nityamalli (9.94 days).

Among defoliant chemicals, paraquat dichloride at 2500 ppm recorded the minimum number of days for complete defoliation (1.67 days) followed by paraquat dichloride 2000 ppm (1.99 days). Maximum number of days for complete defoliation was recorded in Tuppamalli sprayed with KNO_3 @ 1per cent concentration (21.88 days).

The interaction between genotype and chemical defoliant concentration was found significant (Table and Fig. 4.20). Minimum number of days (1.23 days) was recorded in Starmalli sprayed with paraquat dichloride 2500 ppm followed by Starmalli sprayed with paraquat dichloride 2000 ppm (1.46 days). Maximum number of days for complete defoliation was recorded in Tuppamalli sprayed with KNO_3 @ 1per cent concentration (22.46 days).

The genotype Starmalli defoliated earlier than the other genotypes, which might be due to the genetic factors responsible for higher susceptibility to chemical defoliant through the formation of abscission layer. Similar results reported by Nanra *et al.* (2001) in Guava.

4.2.3 Days to new leaf emergence after defoliation (days)

The significant differences for this trait were observed among the genotypes and concentration of defoliant chemicals (Table 4.21). Nityamalli recorded minimum number of days (15.52) for new leaf emergence, which was on par with Tuppamalli (15.67). The genotype Starmalli took maximum number of days for new leaf emergence (16.69).

Among different defoliants chemical treatments, paraquat dichloride at 2500 ppm recorded minimum number of days (10.82) for new leaf emergence followed by paraquat dichloride at 2000 ppm (11.05). Whereas, the manual defoliation recorded 10.54 days for new leaf emergence after defoliation.

The interaction between genotype and defoliant concentration was found significant (Table and Fig. 4.21). Nityamalli sprayed with paraquat dichloride at

Table 4.20 Days to complete defoliation as effected by genotype and concentration of defoliant chemical during Rabi season 2012-July'13.

Genotype	Manual defoliation	PQ D 500 ppm	PQ D 1000 ppm	PQ D 1500 ppm	PQ D 2000 ppm	PQ D 2500 ppm	NaCl 1000 ppm	NaCl 2000 ppm	NaCl 3000 ppm	NaCl 4000 ppm	KNO_3 1%	KNO_3 2%	KNO_3 3%	KNO_3 4%	KNO_3 5%	WATER SPRAY (CONTROL)	Mean (G)
NITYAMALLI	1.00	3.16	2.63	2.43	2.30	2.00	12.63	11.30	10.46	10.43	21.50	21.16	20.26	19.50	18.43	0.00	**9.94**
TUPPAMALLI	1.00	3.00	2.36	2.46	2.23	1.8	12.36	12.23	11.53	11.23	22.46	21.63	21.26	20.03	19.36	0.00	**10.30**
STARMALLI	1.00	2.20	2.03	1.63	1.46	1.23	11.56	11.46	10.70	10.30	21.70	21.13	20.53	19.76	18.36	0.00	**9.69**
Mean (D C)	**1.00**	**2.78**	**2.34**	**2.17**	**1.99**	**1.67**	**12.18**	**11.66**	**10.89**	**10.65**	**21.88**	**21.30**	**21.68**	**19.76**	**18.71**	**0.00**	
FACTORS	**FACTOR (G)**						**FACTOR (DC)**						**G X DC**				
C.D (P=0.05)	0.04						0.10						0.18				
S.E m±	0.01						0.03						0.09				

Note: G: GENOTYPE; DC: DEFOLIANT CHEMICAL; P QD:PARAQUAT DI-CHLORIDE; NaCl:SODIUM CHLORIDE; KNO_3: POTASSIUM NITRATE

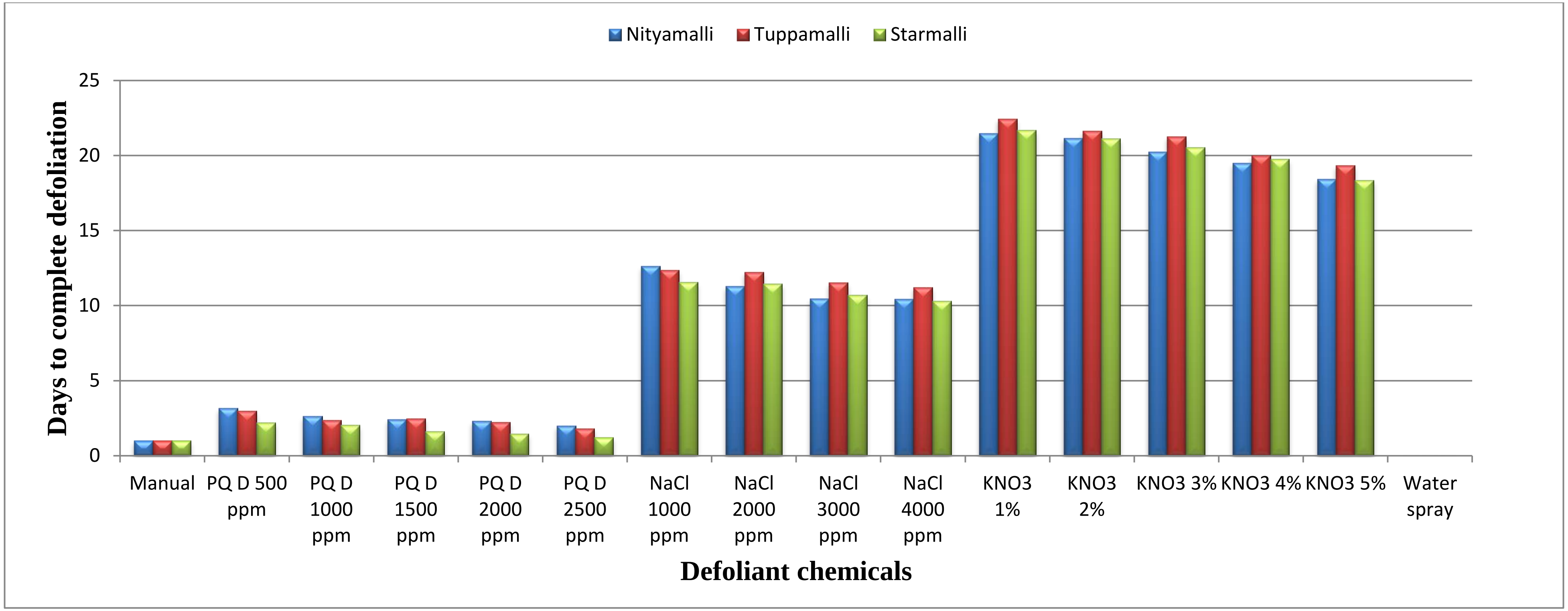


Fig 4.20 Days to complete defoliation as effected by genotype and concentration of defoliant chemical during Rabi season 2012 – July' 13.

Table.4.21 Days to new leaf emergence after defoliation as effected by genotype and concentration of defoliant chemical during Rabi season 2012-July'13.

Genotype	Manual defoliation	PQ D 500 ppm	PQ D 1000 ppm	PQ D 1500 ppm	PQ D 2000 ppm	PQ D 2500 ppm	NaCl 1000 ppm	NaCl 2000 ppm	NaCl 3000 ppm	NaCl 4000 ppm	KNO_3 1%	KNO_3 2%	KNO_3 3%	KNO_3 4%	KNO_3 5%	WATER SPRAY (CONTROL)	Mean (G)
NITYAMALLI	10.18	11.77	11.30	10.60	10.30	10.33	18.30	17.54	16.81	15.23	25.27	24.21	23.21	22.15	21.17	0.00	**15.52**
TUPPAMALLI	10.26	12.37	12.23	11.53	11.04	10.70	18.36	17.45	17.24	16.26	26.26	23.33	22.18	21.62	19.84	0.00	**15.67**
STARMALLI	11.19	13.50	12.63	12.33	11.83	11.45	19.40	18.44	17.13	16.26	28.23	26.23	24.15	23.18	21.19	0.00	**16.69**
Mean (D C)	**10.54**	**12.54**	**12.05**	**11.48**	**11.05**	**10.82**	**18.68**	**17.81**	**17.06**	**15.91**	**26.58**	**24.59**	**23.18**	**22.31**	**20.73**	**0**	

FACTORS	FACTOR (G)	FACTOR (DC)	G X DC
C.D (P=0.05)	0.50	0.11	0.20
S.E m±	0.01	0.04	0.07

Note: G: GENOTYPE; DC: DEFOLIANT CHEMICAL; P QD:PARAQUAT DI-CHLORIDE; NaCl:SODIUM CHLORIDE; KNO_3: POTASSIUM NITRATE

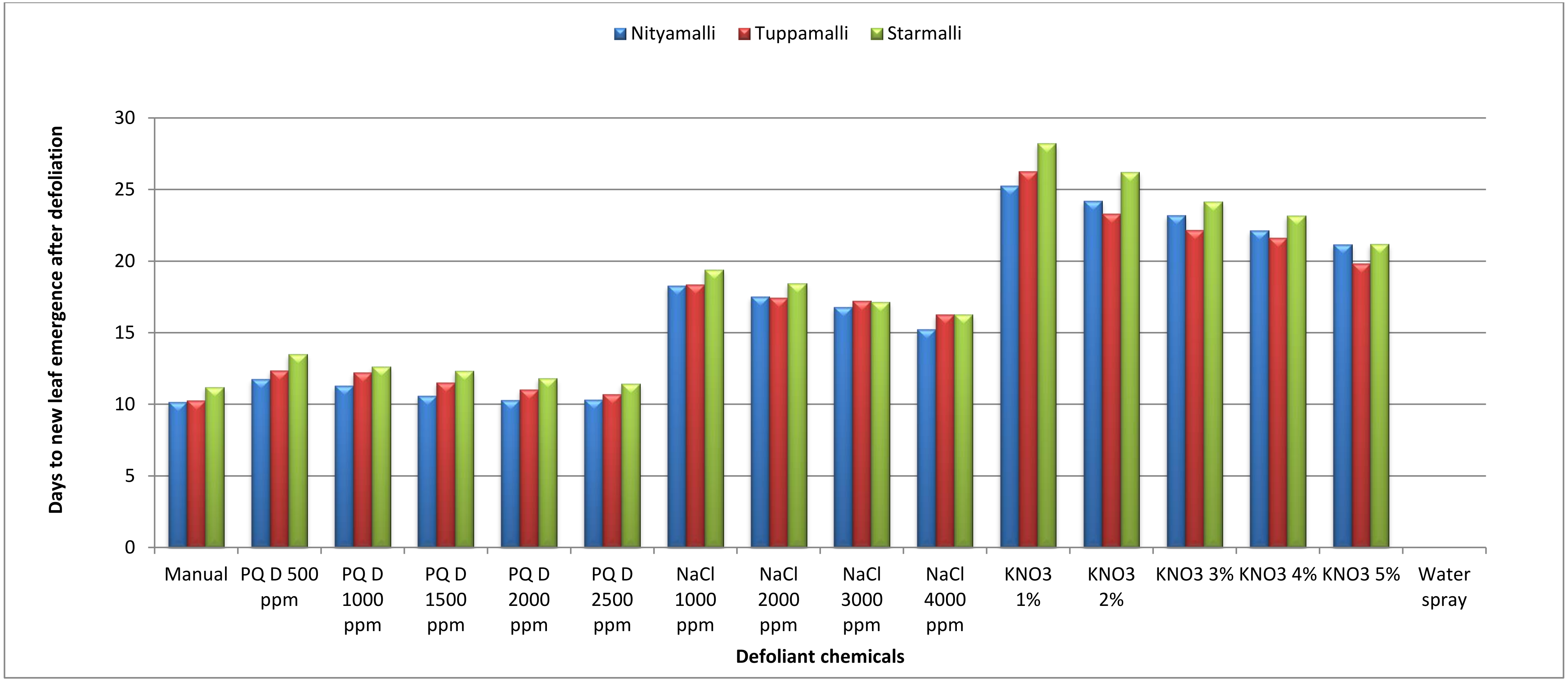


Fig.4.21 Days to new leaf emergence after defoliation as effected by genotype and concentration of defoliant chemical during Rabi Season 2012- July'13.

2000 ppm concentration took minimum number of days (10.30) for new leaf emergence, which was statistically on par with paraquat dichloride at 2500 ppm sprayed on Nityamalli (10.33). Maximum number of days to new leaf emergence was recorded in Starmalli sprayed with KNO_3 @ 1 per cent (28.23).

The genotype Starmalli took more number of days for new leaf emergence, which might be due to inherent genetic factors responsible for growth hormones create potassium deficiency accounting for leaf chlorosis, scorching, early leaf abscission, limb dieback particularly in the upper canopy (Lilleland, 1932; Lilleland and Brown, 1938; and Southwick, 1996). Potassium deficient leaves accumulate putrescine, a substance that has been used experimentally to induce K deficiency symptoms (Forshey and McKee, 1970). Putrescine toxicity might in part explain the development of the physical symptoms of chlorosis and browning observed when K deficiency and putrescine accumulation have been positively correlated (Evans *et al.*, 1977), Hossain *et al.* (2010) in Bougainvillea.

4.2.4 Total aerial biomass produced per plant per season (g)

Significant differences were observed among the genotype and concentration of defoliant chemical for the trait total aerial biomass production per plant per season (Table and Fig. 4.22). Among the genotypes, Tuppamalli recorded maximum aerial biomass per plant per season (130.82 g) followed by Nityamalli (116.95 g).

Among defoliant chemicals, paraquat dichloride at 1000 ppm recorded maximum quantity of aerial biomass per plant (155.30 g) followed by paraquat dichloride @ 500 ppm (138.71 g). The lowest biomass was produced in control *i.e.*, water spray (60.28 g).

The interaction between genotype and defoliant chemical concentration was found significant for this trait (Table and Fig. 4.22). The genotype Tuppamalli sprayed with paraquat dichloride @ 1000 ppm recorded highest aerial biomass (192.44 g) followed by Tuppamalli sprayed with paraquat dichloride @ 500 ppm (174.25 g). The lowest weight per plant per season was recorded in Starmalli sprayed with water (47.75 g).

The genotype Tuppamalli produced the highest biomass without roots per plant per season which might be due to inherent genetic factors responsible for

Table.4.22 Total aerial biomass production per plant in a season (g) effected by genotype and concentration of defoliant chemical during Rabi season 2012-July' 13.

Genotype	Manual defoliation	PQ D 500 ppm	PQ D 1000 ppm	PQ D 1500 ppm	PQ D 2000 ppm	PQ D 2500 ppm	NaCl 1000 ppm	NaCl 2000 ppm	NaCl 3000 ppm	NaCl 4000 ppm	KNO_3 1%	KNO_3 2%	KNO_3 3%	KNO_3 4%	KNO_3 5%	WATER SPRAY (CONTROL)	Mean (G)
NITYAMALLI	195.54	144.21	160.63	134.68	122.73	123.52	119.90	116.86	111.93	108.74	75.67	89.62	98.16	103	100.74	65.24	**116.95**
TUPPAMALLI	238.80	174.25	192.44	164.32	146.28	144.85	133.74	122.51	115.25	110.28	77.71	94.39	100.80	107.38	102.34	67.84	**130.82**
STARMALLI	118.69	97.66	112.82	84.97	76.07	75.14	70.90	67.02	64.36	62.29	50.66	53.01	54.99	60.70	58.09	47.75	**72.19**
Mean (D C)	**184.34**	**138.71**	**155.30**	**127.99**	**115.03**	**114.50**	**108.18**	**102.13**	**97.18**	**93.77**	**68.01**	**79.01**	**84.65**	**90.38**	**87.05**	**60.28**	
FACTORS	**FACTOR (G)**						**FACTOR (DC)**						**G X DC**				
C.D (P=0.05)	1.23						2.85						4.94				
S.E m±	0.44						1.01						1.76				

Note: G: GENOTYPE; DC: DEFOLIANT CHEMICAL; PQD: PARAQUAT DI-CHLORIDE; NaCl: SODIUM CHLORIDE; KNO_3: POTASSIUM NITRATE

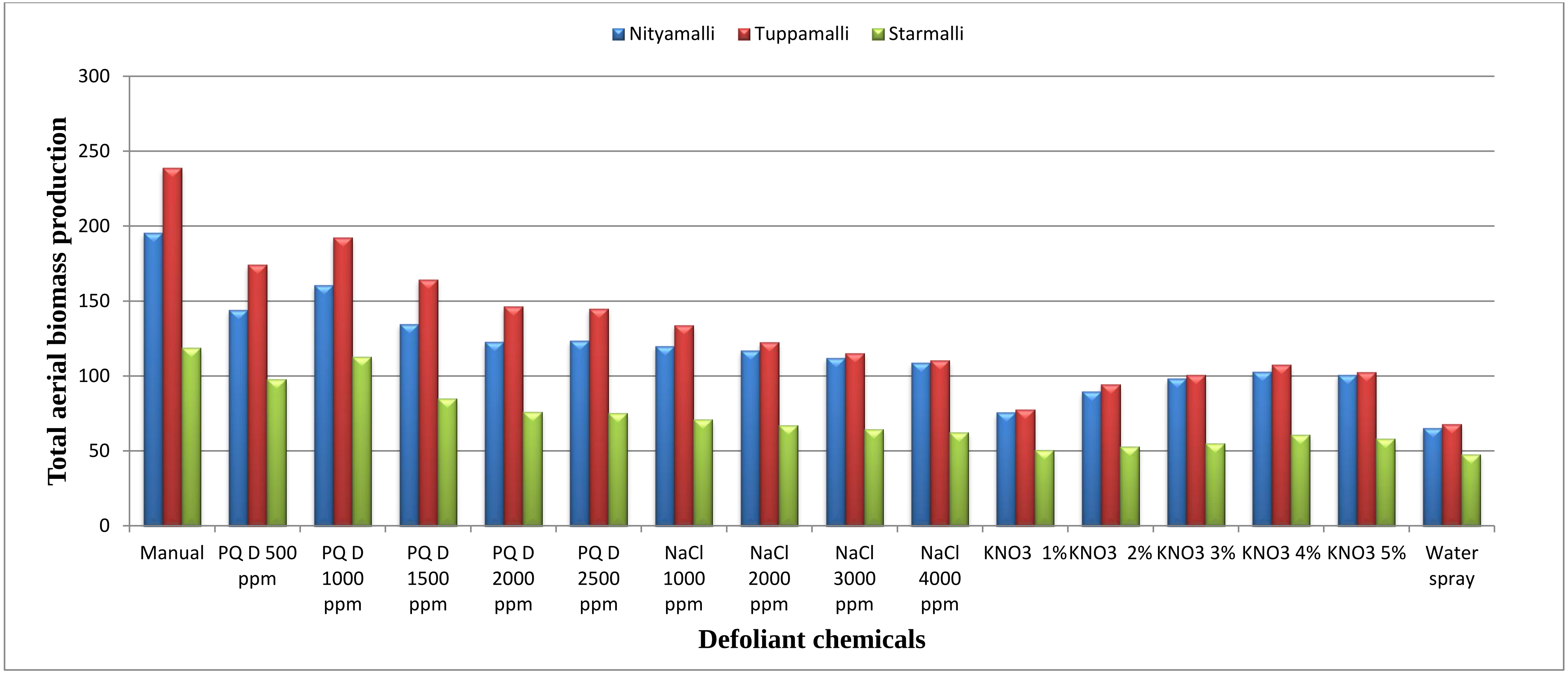
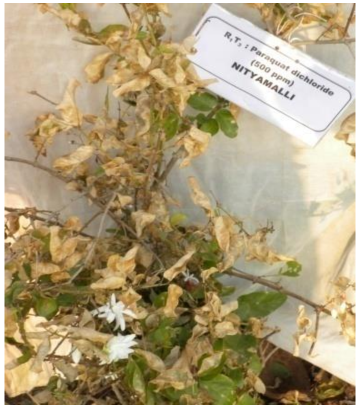
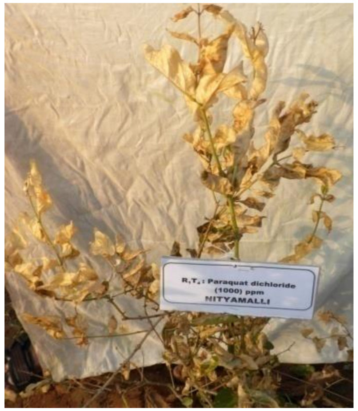


Fig.4.22 Total Aerial biomass production per plant in a season (g) effected by genotype and concentration of defoliant chemical during Rabi season 2012-July'13.



Paraquat dichloride @500 ppm



Paraquat dichloride @1000 ppm

Paraquat dichloride @1500 ppm

Paraquat dichloride @2000 ppm

Paraquat dichloride @2500 ppm

Paraquat dichloride @500 ppm

Paraquat dichloride @1000 ppm

Paraquat dichloride @1500 ppm

Paraquat dichloride @2000 ppm

Paraquat dichloride @2500 ppm

Plate 16: Response of Nityamalli to different concentrations of paraquat dichloride (Before and after application respectively)

Paraquat dichloride @500 ppm

Paraquat dichloride @1000 ppm

Paraquat dichloride @1500 ppm

Paraquat dichloride @2000 ppm

Paraquat dichloride @2500 ppm

Paraquat dichloride @500 ppm

Paraquat dichloride @1000 ppm

Paraquat dichloride @1500 ppm

Paraquat dichloride @2000 ppm

Paraquat dichloride @2500 ppm

Plate 17: Response of Tuppamalli to different concentrations of paraquat dichloride (Before and after application respectively)

Paraquat dichloride @ 500 ppm


Paraquat dichloride @1000 ppm

Paraquat dichloride @1500 ppm


Paraquatdichloride @ 2000 ppm


Paraquat dichloride @2500 ppm


Paraquat dichloride @ 500 ppm


Paraquat dichloride @ 1000 ppm


Paraquat dichloride @ 1500 ppm


Paraquat dichloride @ 2000 ppm

Paraquat dichloride @2500 ppm

Plate 18: Response of Starmalli to different concentrations of paraquat dichloride (Before and after application respectively)

hardiness and adoptability to the climate. A similar result was reported by Hossain *et al.* (2010) in Bougainvillea.

4.2.5 Flower yield per plant (g)

The differences among the genotype and concentration of defoliant chemical were found significant for flower yield per plant (Table and Fig. 4.23). Among the genotypes, Nityamalli recorded maximum flower yield per plant (217.27 g) followed by Starmalli (208.19 g). Lowest was recorded in Tuppamalli (158.66 g).

Among the defoliant chemicals paraquat dichloride at 1000 ppm recorded highest flower yield per plant (255.78g) followed by paraquat dichloride at 2000 ppm (253.26 g). Lowest flower yield per plant was recorded in water spray (108.04 g).

The interaction between genotype and defoliant chemical was found significant for this trait (table 4.23). Nityamalli sprayed with paraquat dichloride at 2000 ppm recorded maximum flower yield per plant (296.51 g) which was on par with paraquat dichloride @ 1000 ppm (293.97 g). Lowest flower yield per plant was recorded in Tuppamalli with water spray (93.88 g).

The data revealed that Nityamalli produced the highest flower yield per plant followed by Starmalli, which might be due to the inherent genetic factors promote photosynthetic capacity and biomass accumulation. Similar results reported by Huang *et al.* (2011).

4.2.6 Cost Benefit Ratio

The price of Jasmine flowers was taken based on the average price of wholesale market @ Rs50/- per Kg. The cost of cultivation, gross income and net income were worked and shown in table 4.24 a & b. Since the Government of Andhra Pradesh was providing unregulated free electric power, the cost of electric power was not considered.

Among the forty eight treatments involving three genotypes, sixteen chemical treatments, the treatment Nityamalli, Paraquat dichloride at 2000ppm recorded the highest cost benefit ratio of (1:1.56) followed by Nityamalli, Paraquat dichloride at 1000 ppm and 2500 ppm (1:1.55).

Table 4.23 Flower yield per plant (g) effected by genotype and concentration of defoliant chemical during Rabi season 2012-July'13.

Genotype	Manual defoliation	PQ D 500 ppm	PQ D 1000 ppm	PQ D 1500 ppm	PQ D 2000 ppm	PQ D 2500 ppm	NaCl 1000 ppm	NaCl 2000 ppm	NaCl 3000 ppm	NaCl 4000 ppm	KNO_3 1%	KNO_3 2%	KNO_3 3%	KNO_3 4%	KNO_3 5%	WATER SPRAY (CONTROL)	Mean (G)
NITYAMALLI	356.81	279.43	293.97	252.48	296.51	293.15	189.75	184.42	183.65	182.02	160.86	164.29	168.90	171.08	175.75.	122.51	**217.27**
TUPPAMALLI	206.79	173.81	189.87	176.56	185.10	179.32	158.53	154.62	152.37	150.25	138.37	140.95	143.16	149.03	146.02	93.88	**158.66**
STARMALLI	325.85	265.67	283.51	241.99	278.18	279.24	179.00	181.37	180.32	178.89	159.30	163.11	165.59	172.45	168.79	107.73	**208.19**
Mean (D C)	**296.49**	**239.64**	**255.78**	**223.68**	**253.26**	**250.57**	**175.76**	**173.47**	**172.11**	**170.39**	**152.84**	**156.11**	**159.22**	**165.74**	**161.96**	**108.04**	
FACTORS	**FACTOR (G)**						**FACTOR (DC)**						**G X DC**				
C .D (P=0.05)	1.27						2.95						5.11				
S.E m±	0.45						1.05						1.82				

Note: G: GENOTYPE; DC: DEFOLIANT CHEMICAL; P QD:PARAQUAT DI-CHLORIDE; NaCl:SODIUM CHLORIDE; KNO_3: POTASSIUM NITRATE

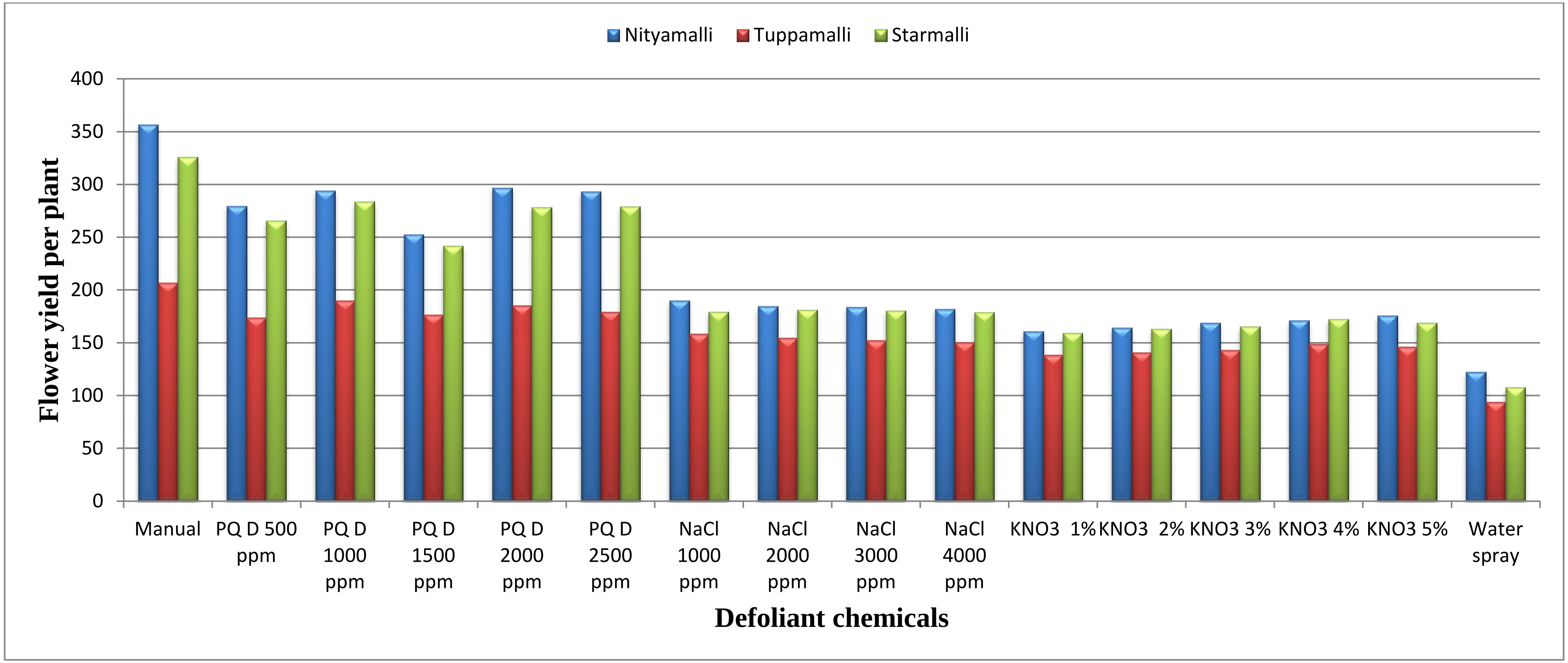


Fig 4.23 Flower yield per plant (g) effected by genotype and concentration of defoliant chemical during Rabi season 2012- July'13.

Table 4.24a: Economics of jasmine cultivation with chemical defoliation (Rs/ha)

ITEM	COST (Rs)
1. Land rent	50000
2. Interest on fixed capital	6000
3. Interest on working capital	34785
4. Plant material cost	40000
5. Transportation cost	30000
6. FYM (30 t per ha)	14165
7. Fertilizers	40000
8. Plant protection	15500
9. Labour cost	
Land preparation	16350
Fertilizer application	18000
Defoliants chemicals cost	
Paraquat dichloride 350 Rs/litre	
Sodium chloride 300rs/1kg	8000
Potassium nitrate 350rs/1kg	
Weeding	
Irrigation	12860
Insecticide and Fungicide sprays	11000
Harvesting	14000
	50000
Post harvest management/ processing cost	
10. Grading, packing and transportation cost	10000
11. storage (Establishment and maintenance cost)	10000
Total	380660

Table 4.24b: Cost of cultivation (Rs ha^{-1}), Gross Income (Rs ha^{-1}), Net Income (Rs ha^{-1}) & Cost Benefit ratio of jasmine cultivation with chemical defoliation during Rabi, 2012- July13.

Genotype	Treatments	flower yield (tons ha^{-1})	Cost of cultivation (Rs ha^{-1})	Gross returns (Lakh Rs ha^{-1})	Net returns (Rs ha^{-1})	C:B ratio
Nityamalli	Manual defoliation	14.27	500230	713620	213390	1:1.43
	PQ D 500 PPM	11.18	378710	558860	180150	1:1.48
	PQ D 1000 PPM	11.76	380080	587940	207860	1:1.55
	PQ D 1500 PPM	10.10	361650	504960	143310	1:1.40
	PQ D 2000 PPM	11.86	380660	593020	212360	1:1.56
	PQ D 2500 PPM	11.75	380050	587500	207450	1:1.55
	Nacl 1000 PPM	7.59	283492	379500	96008	1:1.34
	Nacl 2000 PPM	7.38	282940	368840	85900	1:1.30
	Nacl 3000 PPM	7.35	281000	367300	86300	1:1.31
	Nacl 4000 PPM	7.28	280250	364040	83790	1:1.30
	KNO_3 1%	6.43	249230	321720	72490	1:1.29
	KNO_3 2%	6.57	258230	328580	70350	1:1.27
	KNO_3 3%	6.76	267230	337800	70570	1:1.26
	KNO_3 4%	6.84	276230	342160	65930	1:1.24
	KNO_3 5%	7.03	280230	351500	71270	1:1.25
	WATER SPRAY (CONTROL)	4.90	200290	245020	44730	1:1.22

(Table 4.24b Cont.)

Tuppamalli	Manual defoliation	8.27	340230	413580	73350	1:1.22
	PQ D 500 PPM	6.95	260710	347620	86910	1:1.33
	PQ D 1000 PPM	7.59	276180	379740	103560	1:1.37
	PQ D 1500 PPM	7.06	271650	353120	81470	1:1.30
	PQ D 2000 PPM	7.40	273120	370200	97080	1:1.36
	PQ D 2500 PPM	7.17	282600	358640	76040	1:1.27
	Nacl 1000 PPM	6.34	268490	317060	48570	1:1.18
	Nacl 2000 PPM	6.18	265740	309240	43500	1:1.16
	Nacl 3000 PPM	6.09	264000	304740	40740	1:1.15
	Nacl 4000 PPM	6.01	260250	300500	40250	1:1.15
	KNO_3 1%	5.53	260230	276740	16510	1:1.06
	KNO_3 2%	5.64	260290	281900	21610	1:1.08
	KNO_3 3%	5.73	262230	286320	24090	1:1.09
	KNO_3 4%	5.96	267230	298060	30830	1:1.12
	KNO_3 5%	5.84	265230	292040	26810	1:1.10
	WATER SPRAY (CONTROL)	3.76	150230	187760	37530	1:1.25

(Table 4.24b Cont.)

Starmalli	Manual defoliation	13.03	470230	651700	181470	1:1.39
	PQ D 500 PPM	10.63	370710	531340	160630	1:1.43
	PQ D 1000 PPM	11.34	380280	567020	186740	1:1.49
	PQ D 1500 PPM	9.68	341655	483980	142325	1:1.42
	PQ D 2000 PPM	11.13	380020	556360	176340	1:1.46
	PQ D 2500 PPM	11.17	380600	558480	177880	1:1.47
	Nacl 1000 PPM	7.16	280490	358000	77510	1:1.28
	Nacl 2000 PPM	7.25	281740	362740	81000	1:1.29
	Nacl 3000 PPM	7.21	281000	360640	79640	1:1.28
	Nacl 4000 PPM	7.16	280650	357780	77130	1:1.27
	KNO_3 1%	6.37	275230	318600	43370	1:1.16
	KNO_3 2%	6.52	277230	326220	48990	1:1.18
	KNO_3 3%	6.62	278230	331180	52950	1:1.19
	KNO_3 4%	6.90	279230	344900	65670	1:1.24
	KNO_3 5%	6.75	278430	337580	59150	1:1.21
	WATER SPRAY (CONTROL)	4.31	190230	215460	25230	1:1.13

LEGEND:

P QD: PARAQUAT DI-CHLORIDE; NaCl: SODIUM CHLORIDE; KNO_3 : POTASSIUM NITRATE

Note: The average whole price of Jasmine was taken @ Rs. 50 / kg, but the price fluctuates between Rs 30-700/kg depending on market forces.

4.3 EFFECT OF IBA (AUXIN) CONCENTRATION AND SIZE OF CUTTING ON ROOTING AND PER CENT ESTABLISHMENT OF *Jasminum sambac* cv. "DOUBLE MOGRA"

The present study on influence of various concentrations of auxins *i.e.*, Indole Butyric Acid (IBA) and size of cuttings on growth parameters of shoot as well as rooting *Jasminum sambac* cv. Double Mogra results was presented and discussed here under.

4.3.1 Rooting percentage (%)

The rooting percentage of *Jasminum sambac* cv. Double Mogra stem cuttings was significantly affected by the various concentrations of IBA, number of nodes on stem cuttings and their interactions (Table 4.25).

Among various concentrations of IBA highest percentage of rooting was recorded at 2000 ppm (45 %) and at 3000ppm (45 %).

Among various sizes of cuttings, three node cuttings of Double Mogra recorded the highest percentage of rooting (49.58 %) and four node cuttings (47.91 %) rooting which were on par. The lowest rooting percentage was recorded in single node cuttings (5.83 %).

The interaction effect between various levels of IBA and sizes of cuttings was found significant (Table and Fig. 4.25). Among the interactions, three node cuttings treated with IBA @ 2000 ppm and @ 3000 ppm recorded highest rooting (61.66 %) and four node cuttings treated with IBA @ 2000 ppm and 3000 ppm recorded 58.33 % rooting which were on par. The lowest rooting percentage was recorded in untreated single node cuttings (3.33 %).

In the present study it was noted that by the treatment of IBA at 2000 ppm concentration, semi hardwood cuttings recorded the highest percentage of rooting (45.00) under shade-net condition. This might be due to the reduced loss of water by transpiration due to high humidity, which maintains the turgidity and creates favourable micro climate for increased percentage of rooting of cuttings. Similar results were reported by Sandhu and Zora (1986) in sweet lime. Application of auxins has been found to stimulate cambial activity thereby resulted in the mobilization of reserve food material to the site of root initiation (Gurumurthy *et al.,* 1984). The better effect of IBA might be due to its slow translocation property and stability (Singh, 2001). Root promoting chemicals stimulated the rooting and survival of Jasmine cuttings (Gowda *et al.*, 1989 and Zhang *et al.*, 1997). IBA was more beneficial in the production of higher percentage of rooting with root number and longer roots per cuttings in *Jasminum sambac* (Gowda *et al.*, 1989). Sreelatha *et al.* (1991) reported IBA had better effect on the rooting of the jasmines and greatest rooting percentage was found with 2000 ppm followed by 3000 ppm IBA. The reduction in the average number of sprouts per cutting at the higher concentration of IBA could be linked to its inhibitory or toxic effect (Nagaraja *et al.* 1991), might be due to ethylene production in cell which results in reduced levels of vegetative growth and little effect at low concentrations of auxin as reported by Salisburry and Ross (2007).

Three node cuttings of Double Mogra of Jasminum sambac produced the highest percentage of rooting. Among the interaction treatments three node cuttings treated with IBA concentration at 2000 ppm and 3000 ppm produced the highest rooting. It was found that semi hardwood cuttings having reserve food material when treated with IBA at 2000ppm recorded lowest number of days to sprouting and increase in number of sprouts under shade-net condition. This might be due to better utilization of stored carbohydrates; nitrogen in the semi hardwood with the auxin application enhanced the auxin concentration in the cell and increased the cell division which results on quick callus formation in the cutting as stated by Chandramouli (2001) in stevia. Similar results were reported by Patil *et al.* (2000) in grape and Chauhan and Reddy (1971) in plum, Deshmukh and Barad (2006), Swaroop and Singh (2005), Gupta *et al.* (2002), Asl *et al.* (2012) in Bougainvillea.

4.3.2 Root length (cm)

Different concentrations of IBA and number of nodes on cuttings and their interactions significantly affected the root length (Table 4.26).

Among the various concentrations of IBA, longest root length was recorded in 2000 ppm (4.56 cm) followed by IBA at 3000 ppm (3.98 cm) and shortest root length was observed in control (2.47 cm). Among various sizes of

Table 4.25: Percentage of rooting as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

IBA concentration	**Number of nodes**				
	1st node	**2nd node**	**3rd node**	**4th node**	**Mean (A)**
1000 ppm	5.00 (12.91)	33.33 (35.23)	43.33 (41.14)	41.66 (40.18)	**30.83 (32.37)**
2000 ppm	6.66 (14.75)	53.33 (46.89)	61.66 (51.73)	58.33 (49.78)	**45.00 (40.79)**
3000 ppm	8.33 (16.59)	51.66 (45.93)	61.66 (51.73)	58.33 (49.78)	**45.00 (41.01)**
Control	3.33 (8.61)	21.99 (27.69)	31.30 (34.21)	33.50 (35.23)	**22.50 (26.44)**
Mean (B)	**5.83 (13.21)**	**40.00 (38.94)**	**49.58 (44.70)**	**47.91 (43.74)**	

FACTORS	**SE m ±**	**C.D (P = 0.05)**
IBA CONC.(A)	0.78	2.26
NODE NUMBER (B)	0.78	2.26
Factor (A X B)	1.56	4.52

(Figures in Parenthesis are angular transformed values)

Table 4.26: Root length (cm) as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

IBA concentration	Number of nodes				
	1st node	2nd node	3rd node	4th node	Mean(A)
1000 ppm	1.22	1.84	5.68	5.34	**3.52**
2000 ppm	1.32	2.25	6.72	6.47	**4.56**
3000 ppm	1.42	3.65	6.27	6.08	**3.98**
Control	0.67	2.32	3.43	3.45	**2.47**
Mean (B)	**1.61**	**2.51**	**5.52**	**5.33**	

FACTORS	SE m ±	C.D (P = 0.05)
IBA CONC.(A)	0.04	0.13
NODE NUMBER (B)	0.04	0.13
Factor (A X B)	0.09	0.27

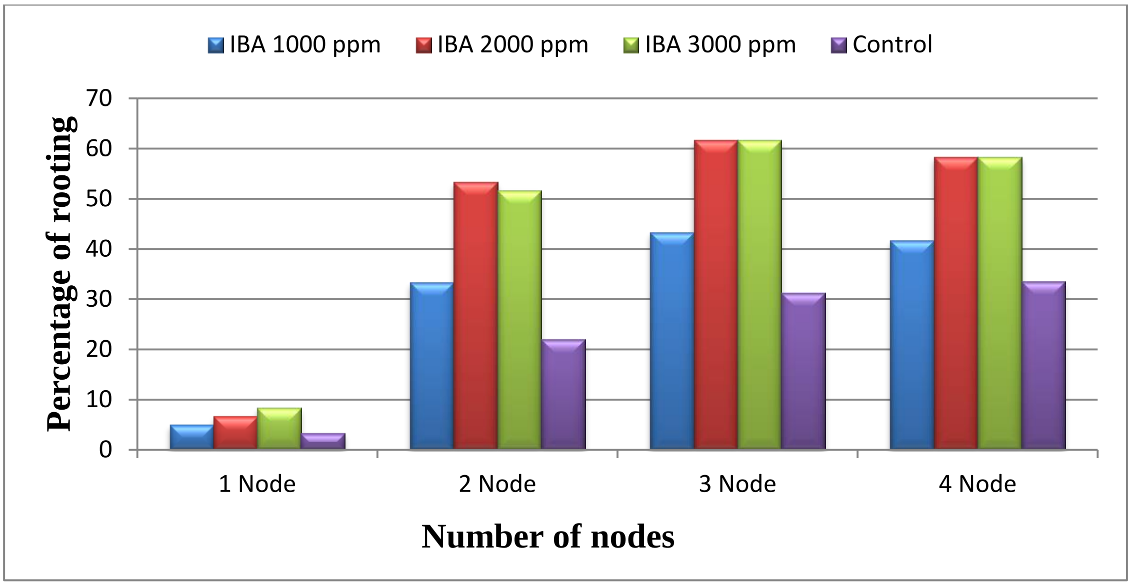


Fig 4.25 Percentage of rooting as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

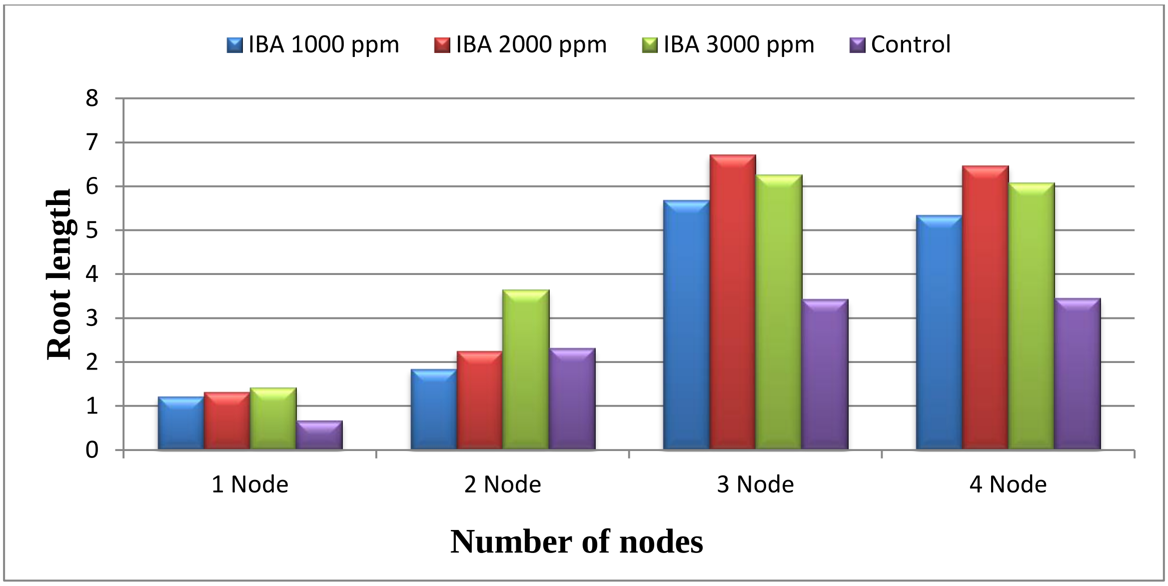


Fig 4.26 Root length (Cm) as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

1 node cutting @2000

2 node cutting @2000 ppm

3 node cutting @2000 ppm

4 node cutting @2000 ppm

Control

1 node cutting @3000 ppm

2node cutting @3000 ppm

3 node cutting @3000 ppm

4 node cutting @3000 ppm

Control

Plate 19: Size of Stem cuttings of *Jasminum sambac* cv. Double Mogra treated with IBA at 2000 ppm and 3000 ppm

cuttings, three node cuttings of Double Mogra recorded the highest root length (5.52 cm) followed by four node cuttings (5.33 cm). The lowest root length was recorded in single node cuttings (1.61 cm).

The interaction effect between concentrations of IBA and sizes of cuttings on root length per cutting was found significant (Table and Fig. 4.26). Among the interactions, three node cuttings treated with IBA @ 2000 ppm recorded the highest root length (6.72 cm) followed by 3node cuttings treated with IBA @ 3000 ppm (6.27 cm) compared with other interaction treatments. The lowest root length was recorded in untreated single node cuttings (0.67 cm).

The effect of auxin on the length of the longest root per rooted cutting observed in the semi hardwood cutting treated with IBA 2000 ppm concentration raised under shade net condition. Similar findings were observed by Jadhav (2007) in phalsa under mist condition and in grape reported by Patil *et al.* (2000). This might be attributed due to the action of auxin activity which might be caused hydrolysis and translocation of carbohydrates and nitrogenous substances in the cellular level at the base of cuttings and resulted in accelerated cell elongation and cell division under favourable environmental condition as reported by Singh *et al.* (2003). The highest root length in semi hardwood cutting was due to more starch and early sprouting on shoot which in turn brings about favourable condition for root initiation as well as increased root length. Similar results also reported by Singh and Harish kumar (1966) in phalsa, Purohit and Shekharappa (1985) in pomegranate, Sandhu *et al.* (1991) in pomegranate, Reddy *et al.* (2008) in fig and Ahmed *et al.* (2002) Singh *et al.(*2010) in Bougainvillea.

4.3.3 Root number

The data recorded on effect of concentration of IBA and sizes of cuttings on number of roots per cutting were found significant (Table 4.27).

Among the various concentrations of IBA highest number of roots per cutting was recorded in 2000 ppm (7.59) followed by IBA at 3000 ppm (7.21) and lowest number of roots per cutting was observed in control (3.33).

Different sizes of cuttings, three node cuttings of Double Mogra recorded the maximum number of roots per cutting (7.45) and four node cuttings (7.17) which were on par. Lowest number of roots per cutting was recorded in single node cuttings (3.78).

The interaction effect between concentrations of IBA and sizes of cuttings on root number was found significant (Table and Fig. 4.27). Among the interactions, three node cuttings treated with IBA concentration at 2000 ppm and 3000 ppm recorded more number of roots (9.21 and 9.16 respectively) and four node cuttings treated with IBA @ 2000 ppm (9.12) which were on par. The lowest number of roots per cutting was recorded in untreated single node cuttings (1.58).

The effect of auxins on the number of roots per cutting that were observed in the semi - hardwood cuttings treated with IBA 2000 ppm concentration performed better over other treatments under shade-net. Similar results were observed by Jadhav (2007) in phalsa under mist conditions. This might be due to enhanced hydrolysis of carbohydrates caused by auxin treatment Rajarama (1997) and Krishnamurthy (1981) opined that auxins would bring about various physiological changes, but the mechanism by which these changes were brought about was not fully understood except for the effect on cell elongation. The more number of roots per cutting under optimum concentration of IBA may be attributed to the increased rate of respiration, accumulation of higher level of amino acids at their bases in the auxin treated cuttings than untreated cuttings. Similarly, nitrogenous substances accumulating in the basal part of treated cuttings, apparently which were mobilized in the upper part and translocated as aspargine as reported by Strydom and Hartmann (1960) might caused the more number of roots under IBA treated cuttings. The semi hardwood cutting gave more number of roots. This might be due to fact that semi-hardwood cutting contained higher stored carbohydrate as stated by Hartman *et al.* (1990) resulted in more number of roots was confirmed with Camellia *et al.* (2009) in *Jatropha curcus*, Reddy *et al.* (2008) in fig and Ahmed *et al.* (2002), Singh *et al. (*2010), Swaroop and Raju (2008), Singh and Singh (2011) in Bougainvillea.

4.3.4 Root fresh weight (g)

Significant differences were observed among the concentration of IBA and sizes of cuttings on fresh weight of roots per cutting (Table 4.28).

Table 4.27 Root number as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

IBA concentration	Number of nodes				
	1st node	2nd node	3rd node	4th node	Mean(A)
1000 ppm	4.22	6.22	7.23	7.14	**6.20**
2000 ppm	4.77	7.25	9.21	9.12	**7.59**
3000 ppm	4.55	7.00	9.16	8.15	**7.21**
Control	1.58	3.25	4.22	4.27	**3.33**
Mean (B)	**3.78**	**5.93**	**7.45**	**7.17**	

FACTORS	SE m ±	C.D (P = 0.05)
IBA CONC.(A)	0.09	0.28
NODE NUMBER (B)	0.09	0.28
Factor (A X B)	0.19	0.57

Table 4.28 Root fresh weight (g) as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

IBA concentration	Number of nodes				
	1st node	2nd node	3rd node	4th node	Mean (A)
1000 ppm	0.37	0.93	1.16	1.11	**1.11**
2000 ppm	0.45	1.06	1.25	1.20	**1.20**
3000 ppm	0.41	0.99	1.21	1.14	**1.14**
Control	0.14	0.52	1.01	0.96	**0.96**
Mean(B)	**0.34**	**0.87**	**1.15**	**1.10**	

FACTORS	SE m ±	C.D (P = 0.05)
IBA CONC.(A)	0.01	0.03
NODE NUMBER (B)	0.01	0.03
Factor (A X B)	0.02	0.08

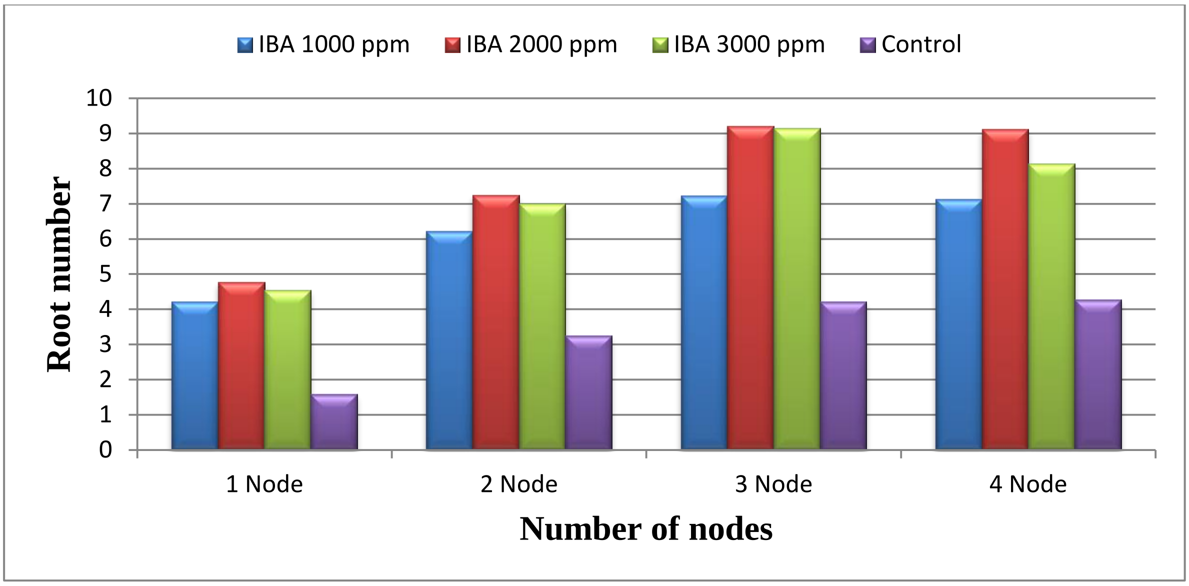


Fig.4.27 Root number as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

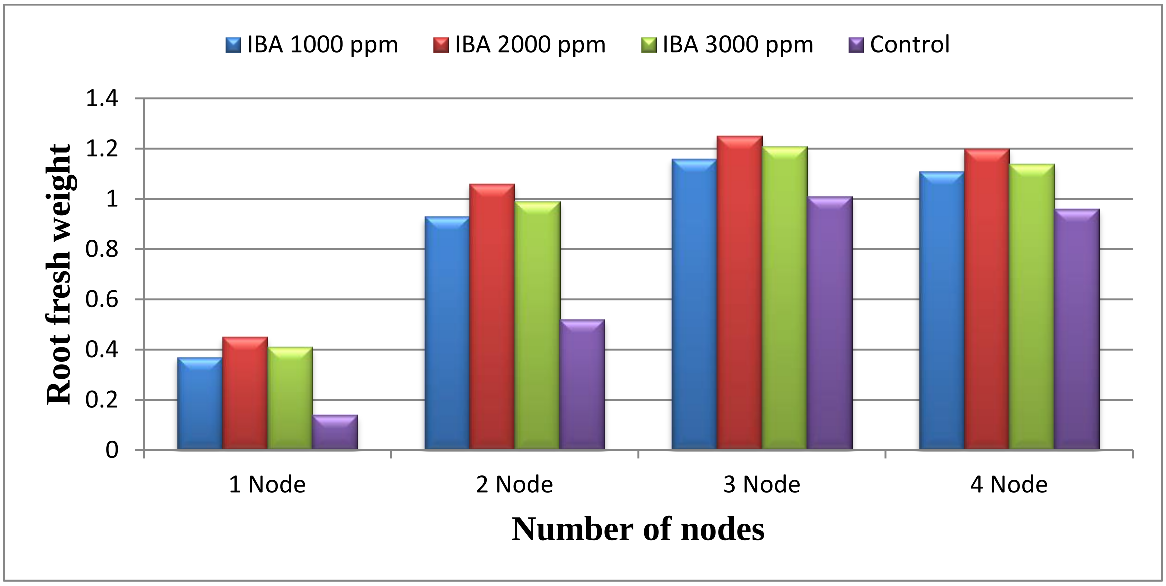


Fig.4.28 Root fresh weight (g) as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

Among the various concentrations of IBA maximum fresh weight of roots per cutting was recorded in IBA @ 2000 ppm (1.20 g) followed by IBA at 3000 ppm (1.14 g) and minimum weight of roots per cutting was observed in control (0.96 g).

Different sizes of cuttings, three node cuttings of Double Mogra recorded the maximum weight of roots per cutting (1.15 g) followed by four node cuttings (1.10 g) and minimum weight of roots per cutting was recorded in single node cuttings (0.34 g).

The interaction effect between concentrations of IBA and size of cuttings on root fresh weight was found significant (Table and Fig. 4.28). Among the interactions, three node cuttings treated with IBA @ 2000 ppm and 3000 ppm recorded highest weight of roots (1.25 g and 1.21 g respectively) and four node cuttings treated with IBA concentration at 2000ppm recorded more fresh weight of roots (1.20 g) which were on par. The lowest fresh weight of roots per cutting was recorded in untreated single node cuttings (0.14 g).

Natural and synthetic auxins when applied exogenously to the stem cuttings generally increase the development of pre-existing root primordial, increases the more number of cuttings which sprouts for their growth as reported by Haissing (1974).The semi-hardwood cuttings contain more starch content which in turn bring about favourable conditions for root initiation, presence of lower amount of starch might probably be one of the reasons for reduced rooting percentage in small size semi hardwood cuttings. Similar results were also reported by Purohith and Shekharappa (1985) in pomegranate and Reddy *et al.* (2008) in fig, and Parmar *et al.* (2010) in Bougainvillea.

The fresh weight of the root was directly proportional to number of roots in each cutting. The increase in number of roots per cutting might have directly influenced the fresh weight of the roots as reported by Milind (2008) in stevia.

4.3.5 Number of sprouts per cutting

The data recorded on the effect of concentration of IBA and size of cuttings on number of sprouts per cutting was found significant (Table 4.29).

Among the various concentrations of IBA more number of sprouts was recorded in IBA @ 2000ppm (1.37) and IBA at 3000 ppm (1.35) both treatments were on par and less number of sprouts was observed in control (0.90).

Different sizes of cuttings, four node cuttings of Double Mogra recorded the highest number of sprouts (1.60) followed by three node cuttings (1.55). Lowest number of sprouts was recorded in single node cuttings (0.78).

The interaction between concentrations of IBA and size of cuttings over number of sprouts per cutting was found significant (Table and Fig. 4.29). The treatment, four node cuttings and treated with IBA @ 2000 ppm recorded more number of sprouts (2.0) and 3node cutting with IBA @ 2000 ppm (1.91) which were on par. The lowest number of sprouts was recorded in untreated single node cuttings (0.27). Similar results were reported by Singh and Singh (2011) in Bougainvillea. There was reduction in the average number of sprouts per cutting at the higher concentration of IBA could be linked to its inhibitory or toxic effect (Nagaraja *et al.* 1991) and Ahmed *et al.* (2002), Singh *et al.(*2010), Parmar *et al.* (2010) in Bougainvillea.

4.3.6 Number of leaves per cutting

The data recorded on number of leaves per cutting of Jasminum sambac cv. Double Mogra was significantly affected by various concentrations of IBA and different number of nodes on cuttings and their interactions (Table 4.30).

Among various concentrations of IBA maximum number of leaves per cutting was recorded in IBA @ 2000ppm (5.75) and at 3000ppm (5.65) and @1000ppm (5.44) which were on par but significantly superior over control (4.61)

Among different sizes of cuttings, three node cuttings of Double Mogra recorded the highest number of leaves per cutting (7.26), followed by four node cuttings (6.94). The lowest number of leaves per cutting was observed in single node cuttings (1.06).

The interaction between concentrations of IBA and sizes of cuttings on number of leaves per cutting was found significant (Table and Fig. 4.30). Among the interactions, three node cuttings and IBA @ 3000ppm recorded maximum

Table 4.29 Number of sprouts per cutting as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

IBA concentration	Number of nodes				
	1st node	2nd node	3rd node	4th node	Mean(A)
1000 PPM	0.79	1.00	1.52	1.57	**1.22**
2000 PPM	1.03	1.11	1.91	2.00	**1.37**
3000 PPM	1.03	1.38	1.61	1.66	**1.35**
CONTROL	0.27	1.01	1.16	1.17	**0.90**
MEAN (B)	**0.78**	**1.13**	**1.55**	**1.60**	

FACTORS	SE m ±	C.D (P = 0.05)
IBA CONC.(A)	0.01	0.04
NODE NUMBER (B)	0.01	0.04
Factor (A X B)	0.03	0.09

Table 4.30 Number of leaves per cutting as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

IBA concentration	Number of nodes				
	1st node	2nd node	3rd node	4th node	Mean (A)
1000 ppm	1.12	5.94	7.35	7.23	**5.44**
2000 ppm	1.22	6.43	7.22	7.38	**5.75**
3000 ppm	1.24	7.15	7.74	7.37	**5.65**
Control	0.66	5.22	6.74	5.80	**4.61**
Mean (B)	**1.06**	**6.19**	**7.26**	**6.94**	

FACTORS	SE m ±	C.D (P = 0.05)
IBA CONC.(A)	0.10	0.29
NODE NUMBER (B)	0.10	0.29
Factor (A X B)	0.20	0.58

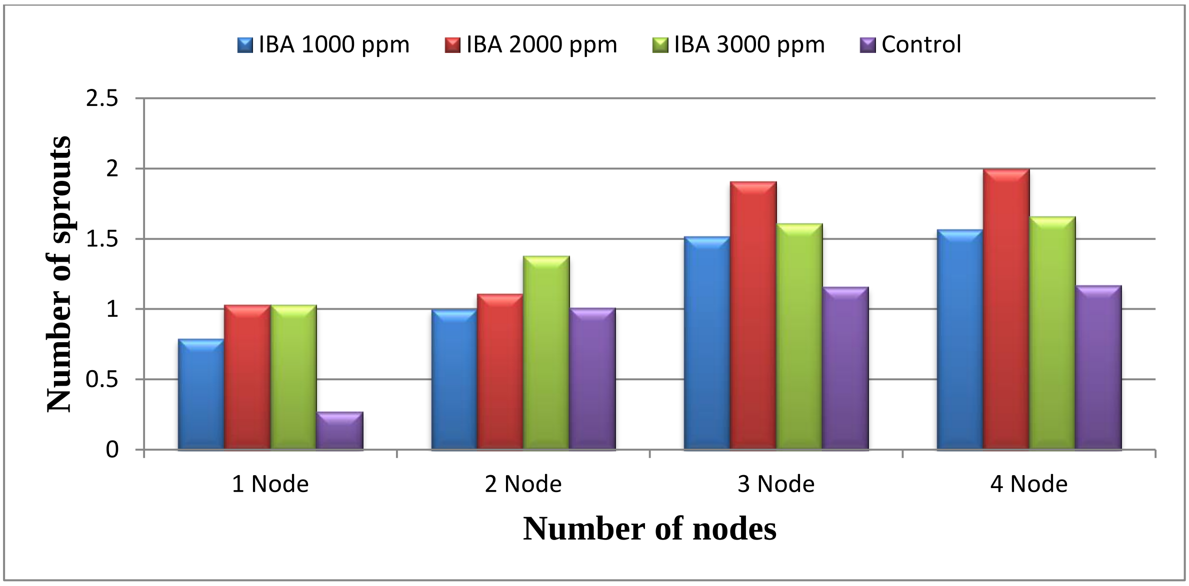


Fig 4.29 Number of sprouts per cutting as effected by size of cutting and IBA concentration. during Kharif season of 2012-13.

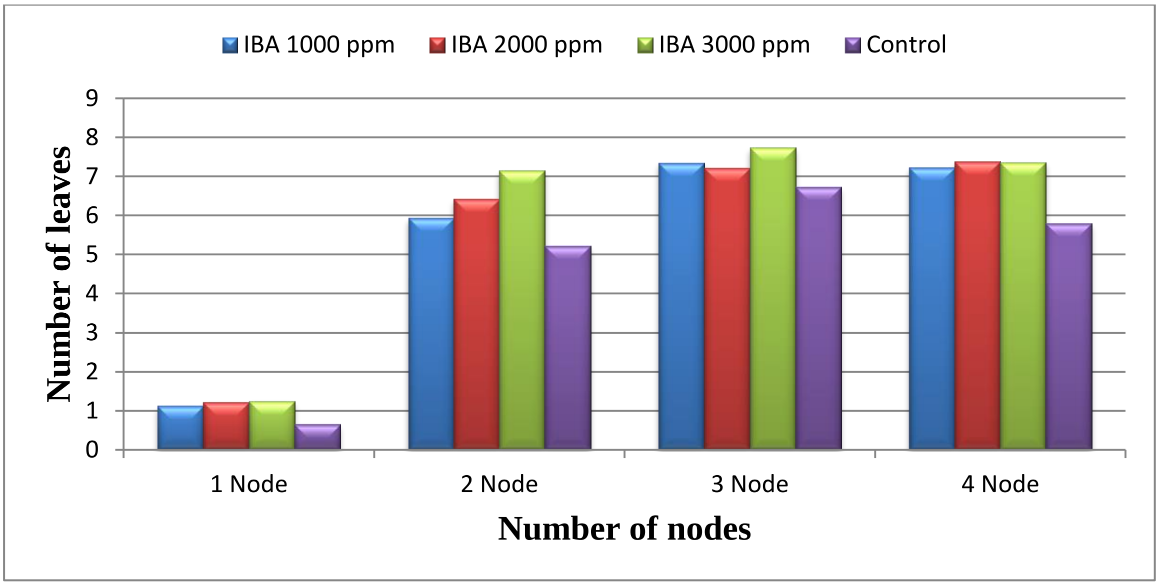


Fig 4.30 Number of leaves per cutting as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

number of leaves per cutting (7.74). The lowest number of leaves per cutting was recorded in untreated single node cuttings (0.66).

The relative humidity which was the important factor in the development of plant activities the shoot growth which probably increased the number of leaves. Similar results were observed by Chandramouli, (2001) in stevia and Panwar *et al.* (2001) in pomegranate. The semi hardwood cuttings having reserved food material when treated with IBA at 2000ppm concentration recorded maximum leaf area per cutting under shade net condition. The relative humidity and optimum light intensity which were the important factors in the development of leaf coupled with auxin content activated the synthesis of more carbohydrates in the leaves which might have resulted in elongation of leaves through cell elongation and cell division that resulted in more leaf area per cutting when compared to all other treatments. The results are in agreement with the findings of Baghel and Saraswat (1988) in pomegranate. Ahmed *et al.* (2002), Singh *et al. (*2010) in Bougainvillea.

4.3.7 Sprout diameter (mm)

The data recorded on the effect of concentration of IBA and sizes of cuttings on sprout diameter per cutting was found significant but interaction between them was not significant (Table 4.31).

Among the various concentrations of IBA maximum sprout diameter at the base of new growth was recorded in IBA @ 2000 ppm (1.74 mm) which was on par with IBA at 3000 ppm (1.64 mm) and minimum sprout diameter was observed in control (1.13 mm).

Among different sizes of cuttings, four node cuttings of Double Mogra recorded the maximum sprout diameter (1.84 mm) which was at par with three node cuttings (1.72 mm). The minimum diameter of sprout was recorded in single node cuttings (1.05 mm).

The semi hardwood cuttings having reserved food material when treated with IBA at 2000 ppm concentration recorded maximum sprout diameter per cutting under shade net condition. The relative humidity and optimum light intensity which were the important factors in the development of leaf coupled with auxin content activated the synthesis of more carbohydrates in the leaves

Table 4.31 Sprout diameter (mm) as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

IBA concentration	Number of nodes				
	1st node	2nd node	3rd node	4th node	Mean (A)
1000 ppm	1.09	1.40	1.78	1.87	**1.53**
2000 ppm	1.23	1.69	1.92	2.13	**1.74**
3000 ppm	1.21	1.55	1.84	1.98	**1.64**
CONTROL	0.66	1.13	1.34	1.39	**1.13**
Mean (B)	**1.05**	**1.44**	**1.72**	**1.84**	

FACTORS	SE m ±	C.D (P = 0.05)
IBA CONC.(A)	0.04	0.12
NODE NUMBER (B)	0.04	0.12
Factor (A X B)	0.08	NS

which might have resulted in elongation of leaves through cell elongation and cell division that resulted in more leaf area per cutting and sprout diameter at base when compared to all other treatments. Similar results were reported by Singh and Singh (2011) and Parmar *et al.* (2010) in Bougainvillea.

4.3.8 Number of days to sprouting

The data recorded on the effect of various concentrations of IBA and sizes of cuttings on number of days taken for sprouting was found significant (Table 4.32).

Among the various concentrations of IBA minimum number of days for sprouting was recorded in IBA @ 2000 ppm (14.92 days) and IBA at 3000 ppm (15.02 days), which were on par and maximum number of days for sprouting was observed in control (18.78 days).

Different sizes of cuttings, four node cuttings of Double Mogra recorded the minimum number of days for sprouting (14.52days) followed by three node cuttings (14.74days). Maximum number of days for sprouting was recorded in single node cuttings (20.58days).

The interaction between concentrations of IBA and sizes of cuttings was found significant (Table and Fig. 4.32). Among interactions, three node cuttings treated with IBA concentration at 2000 ppm recorded minimum number of days for sprouting (13.53 days) which was followed by three node cutting treated with 3000 ppm IBA (13.70 days). The maximum number of days for sprouting was recorded in untreated single node cuttings (24.44 days). Similar results were reported by Parmar *et al.* (2010).

4.3.9 Fresh weight of fully grown rooted cutting (g).

The data recorded on the effect of concentration of IBA and sizes of cuttings on fresh weight of plant at fully grown rooted cutting was found significant (Table 4.33).

Among the various concentrations of IBA maximum fresh weight of fully grown rooted cutting was recorded in IBA @ 2000ppm (2.81g) which was on par with IBA at 3000 ppm (2.80g) and minimum weight of fully grown rooted cutting was observed in control (2.10g).

Table 4.32 Days to sprouting as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

IBA concentration	Number of nodes				
	1st node	2nd node	3rd node	4th node	Mean (A)
1000 ppm	21.53	16.39	15.52	14.45	**16.97**
2000 ppm	18.16	14.26	13.53	13.74	**14.92**
3000 ppm	18.20	14.45	13.70	13.75	**15.02**
Control	24.44	18.34	16.22	16.15	**18.78**
Mean (B)	**20.58**	**15.81**	**14.74**	**14.52**	

FACTORS	SE m ±	C.D (P = 0.05)
IBA CONC.(A)	0.03	0.10
NODE NUMBER (B)	0.03	0.10
Factor (A X B)	0.07	0.21

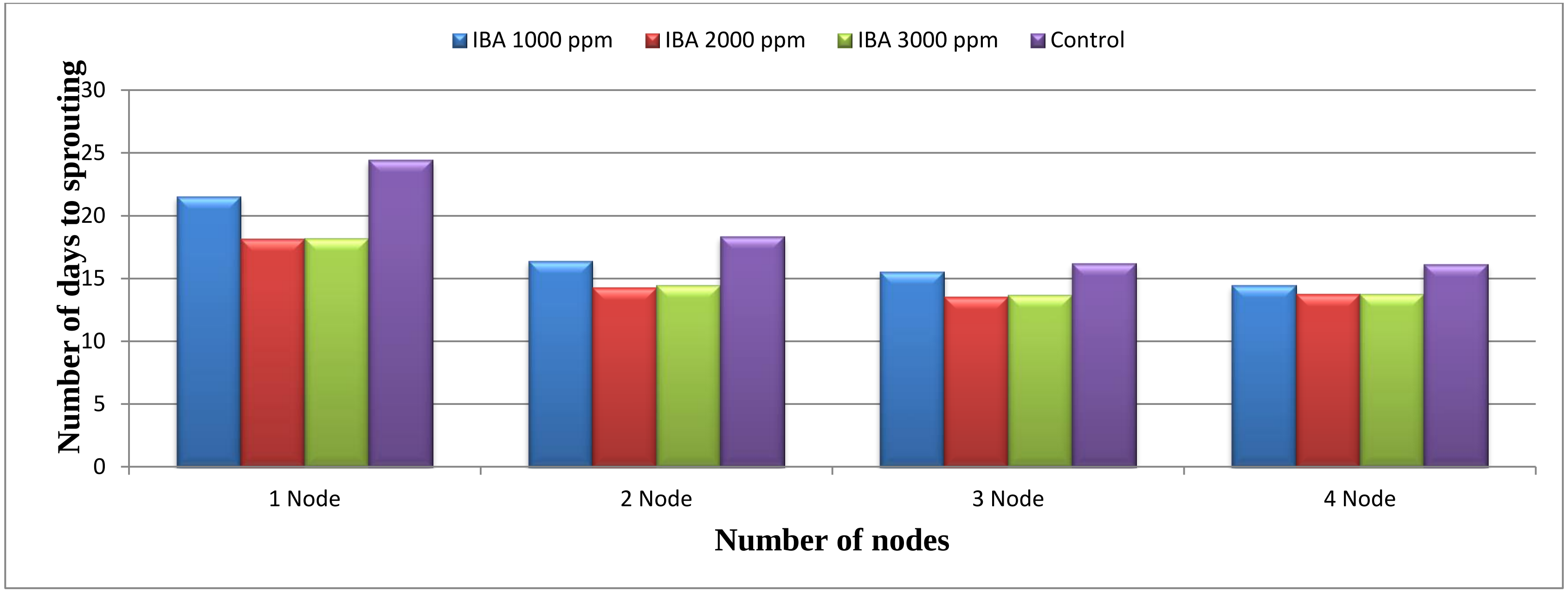


Fig 4.32 Days to sprouting as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

Different sizes of cuttings, four node cuttings of Double Mogra recorded the highest fresh weight of fully grown cutting (3.10 g) which was on par with three node cuttings (3.09 g). Lowest fresh weight of rooted cutting was observed in single node cuttings (1.66 g).

The interaction effect between concentrations of IBA and sizes of cuttings for this trait was found significant (Table and Fig. 4.33). Among the interactions, three node cuttings treated with IBA @ at 2000 ppm recorded highest fresh weight of fully grown rooted cutting (3.45 g) and four node cutting and IBA @ 2000 ppm (3.44g), 3 node cuttings treated with IBA @ at 3000 ppm (3.42 g) and four node cutting and IBA @ 3000 ppm (3.41g) which were on par. The lowest fresh weight of rooted cutting was recorded in untreated single node cuttings (1.17 g).

The better survival and invigorated shoot growth with auxin treatments might be synchronized due to higher length and more number of roots which could have facilitated more absorption of water and nutrients from the soil (Singh, 2001), Panwar *et al.* (1994) in Bougainvillea, Bhattacharjee and Balakrishna (1983) in Jasminum sambac.

The effect of auxins on fresh and dry weight of the shoot in the semi hardwood cuttings treated with IBA at 2000 ppm recorded maximum under shade net condition. This might be due to the fact that semi-hardwood cutting produced more number of sprouts, leaves, increased leaf area, leaf chlorophyll content, more starch, total sugar and C/N ratio which resulted in maximum fresh and dry weights of the shoot as stated by Purohit and Shekarappa (1985) in pomegranate. The similar results were also reported by Shukla and Bist (1994) in pear.

4.3.10 Dry weight of rooted cutting (g).

The data recorded on the effect of concentration of IBA and sizes of cuttings on dry weight of rooted cutting was found significant (Table 4.34).

Among the various concentrations of IBA maximum dry weight of rooted cutting was recorded in IBA @ 2000 ppm (1.10 g) followed by 3000ppm (1.06 g) and minimum weight of rooted cutting was observed in control (0.88 g).

Among different sizes of cuttings, three node cuttings of Double Mogra recorded the highest dry weight of rooted cutting (1.18 g) which was on par with

Table 4.33: Fresh weight of plant at fully grown rooted cutting (g) as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

IBA concentration	**Number of nodes**				
	1st node	**2nd node**	**3rd node**	**4th node**	**Mean(A)**
1000 ppm	1.73	2.13	3.07	3.12	**2.51**
2000 ppm	1.83	2.52	3.45	3.44	**2.81**
3000 ppm	1.91	2.48	3.42	3.41	**2.80**
Control	1.17	2.35	2.44	2.44	**2.10**
Mean (B)	**1.66**	**2.37**	**3.09**	**3.10**	

FACTORS	**SE m ±**	**C.D (P = 0.05)**
IBA CONC.(A)	0.01	0.03
NODE NUMBER (B)	0.01	0.03
Factor (A X B)	0.02	0.06

Table 4.34 Dry weight of rooted cutting (g) as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

IBA concentration	Number of nodes				
	1st node	2nd node	3rd node	4th node	Mean (A)
1000 ppm	0.52	0.96	1.10	1.06	**0.91**
2000 ppm	0.84	1.04	1.28	1.27	**1.10**
3000 ppm	0.71	1.03	1.25	1.24	**1.06**
Control	0.43	0.88	1.09	1.11	**0.88**
Mean (B)	**0.62**	**0.97**	**1.18**	**1.17**	

FACTORS	SE m ±	C.D (P = 0.05)
IBA CONC.(A)	0.005	0.01
NODE NUMBER (B)	0.005	0.01
Factor (A X B)	0.01	0.03

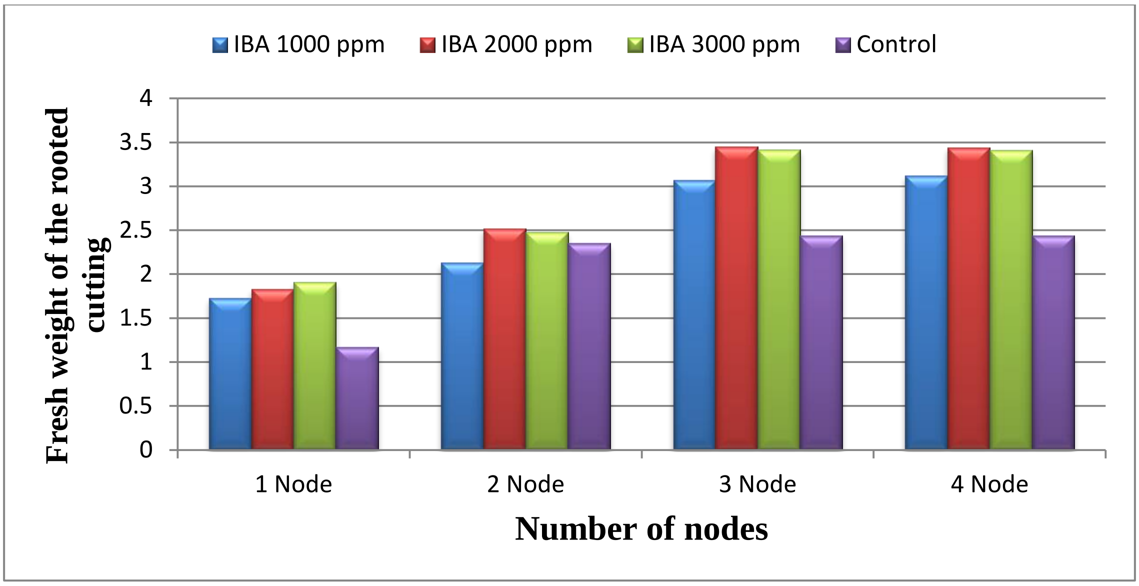


Fig 4.33 Fresh weight of plant at fully grown rooted cutting (g) as effected by size of cutting and IBA concentration during Kharif season of 2012-2013.

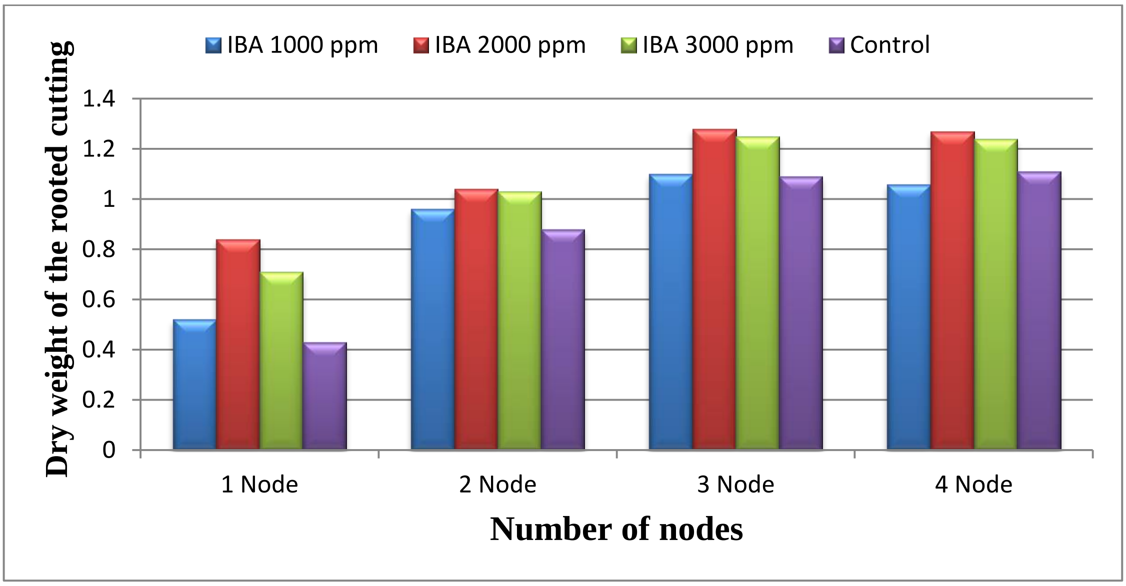


Fig 4.34 Dry weight of rooted cutting (g) as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

four node cuttings (1.17 g). Lowest dry weight of rooted cutting was recorded in single node cuttings (0.62 g).

The interaction between concentrations of IBA and sizes of cuttings for this trait was found significant (Table and Fig. 4.34). Among the interactions, three node cuttings treated with IBA @ 2000ppm (1.28 g), 4node, IBA @ 2000 ppm (1.27 g), 3 node, IBA @ 3000 ppm (1.25 g) and 4 node, IBA @ 3000 ppm (1.24 g) recorded highest dry weight of rooted cuttings which were on par. The lowest dry weight of rooted cutting was recorded in untreated single node cuttings (0.43 g). This might be due to increased length, maximum number of primary roots and early sprouting resulted in more thickness of the roots, perhaps the ability of regenerating further new fibrous roots from main roots, which probably absorb more nutrients and water from the soil under low transpirational losses in the shade net conditions resulted in maximum survival percentage of rooted cuttings will prevail. Similar results were also reported by Kathrotia and Singh (1995) in phalsa and Singh *et al.* (2003) in long pepper. The effect of auxins might be due to the slow translocation property or slow destruction of auxins by auxin destroying enzyme system as reported by Debnath and Maiti (1990) and also by the early formation of roots and more utilization of reserved food materials of the treated cuttings under shade net condition for its survival percentage in the nursery. The highest survival percentage in semi hardwood cuttings might be due to presence of high C/N ratio, carbohydrate reserves per cutting and higher amount of sugars in the cell tissue. Similar results were also reported by Purohit and Shekharappa (1985) in pomegranate, Reddy *et al.* (2008) in fig and Shukla and Bist (1994) in pear.

4.3.11 Duration of Propagation cycle (batch period) in days.

The data recorded on the effect of concentration of IBA and sizes of cuttings on propagation cycle (batch period) of *Jasminum sambac* cv. Double Mogra was found significant (Table 4.35).

Among various concentrations of IBA shortest duration of propagation cycle (batch period) was recorded in IBA @ 2000 ppm (67.98 days), IBA @ 3000 ppm (67.70 days) which were on par. The longest duration of propagation cycle (batch period) was observed in control (74.92 days).

Table 4.35 Propagation cycle (batch period) in days as effected by size of cutting and IBA concentration during Kharif season of 2012-13.

IBA concentration	Number of nodes				
	1st node	2nd node	3rd node	4th node	Mean(A)
1000 ppm	77.26	72.76	71.06	71.20	**73.07**
2000 ppm	73.40	68.10	65.23	65.20	**67.98**
3000 ppm	73.23	67.83	64.86	64.90	**67.70**
Control	80.55	74.30	73.10	71.76	**74.92**
Mean(B)	**76.11**	**70.75**	**68.56**	**68.26**	

FACTORS	SE m ±	C.D (P = 0.05)
IBA CONC.(A)	0.22	0.64
NODE NUMBER (B)	0.22	0.64
Factor (A X B)	0.44	NS

Four node cuttings of Double Mogra recorded the shortest batch period (68.26 days) which was on par with three node cuttings (68.56 days) among the various sizes of stem cuttings of *Jasminum sambac*.

The interaction between different concentration of IBA and sizes of cuttings on propagation cycle was found not significant (Table 4.35).Based on the results of the present investigation the duration of the jasmine propagation cycle can be reduced to a minimum of seven days by using growth hormones (IBA). After production of rooted cuttings, which need to be hardened to plant in the main field. The study on field establishment would be very much important with a view to know the continuity and performance of rooted cuttings in the soil. To find out the best combination of size of cutting and auxin concentration, the observations revealed that the semi hardwood cuttings treated with IBA 2000 ppm concentration raised under shade net conditions showed the higher percentage of establishment of the rooted cuttings. This might be due to the sprouting and rooting behavior of the cuttings which were raised under shade net and thereby better establishment of rooted cuttings in the main field. This might be due to highest length of the roots, number of roots, more number of leaves in the cuttings which help in absorption of water and nutrients from the soil in the main field and thereby increased the percentage of cutting establishment in the soil. Similar findings were reported by Sharma *et al.* (2009) in pomegranate.

4.3.12 Cost benefit ratio

The price of fully grown rotted jasmine cutting was taken based on the average price of wholesale market @ Rs 10. The cost of cultivation, gross income and net income were worked and shown in table 4.36a & b. Since the Government of Andhra Pradesh was providing unregulated free electric power to the farmers, the cost of electric power was not considered.

Among the sixteen treatments involving size of stem cuttings, four concentrations of IBA, the treatment 3node cuttings treated with 2000 ppm IBA and 3node cuttings treated with 3000 ppm IBA recorded the highest cost benefit ratio (1:1.89) followed by 4node cuttings treated with 2000 ppm and 3000 ppm of IBA (1:1.87).

Table 4.36a Economics of jasmine propagation per propagation cycle (Rs/4.2 lakh rooted cuttings)

ITEM	COST (Rs)
1. Land rent	20000
2. Interest on fixed capital	2400
3. Interest on working capital	242400
4. Plant material cost @0.1Rs/cutting @7 lakh cuttings	70000
5. Irrigation	15000
6. FYM ,Red soil,Sand	25000
7. Fertilizers (SSP)	3500
8. Plant protection	2500
9. Poly bags	35000
10. Growth regulators	5000
11. Labour cost Filling of polybags Rs.0.05/bag filling weeding watering plant protection chemical sprays Regular mali 4 @ 7000 for 3 man Miscellaneous	 35000 15000 20000 10000 84000 100000
Mist chamber cost and maintenance	300000
Mother plant maintenance	1300000
Total	2284800

Table 4.36b Cost of production (Rs), Gross Income (Rs), Net Income (Rs) & Cost Benefit ratio of jasmine propagation during Kharif, 2012-13.

Auxin (Conc.)	Treatments	Percentage of success	No. of successful cuttings	Cost of production (Rs)	Gross returns (Rs)	Net returns (Rs)	C:B ratio
1000ppm	1st node	5.00	35000	2056800	350000	-1706800	1:0.17
	2nd node	33.33	233310	2167300	2333100	165800	1:1.08
	3rd node	43.33	303310	2157800	3033100	875300	1:1.41
	4th node	41.66	291620	2168300	2916200	747900	1:1.34
2000ppm	1st node	6.66	46620	2076800	466200	-1610600	1:0.22
	2nd node	53.33	373310	2167800	3733100	1565300	1:1.72
	3rd node	61.66	431620	2284800	4316200	2031400	1:1.89
	4th node	58.33	408310	2178300	4083100	1904800	1:1.87
3000ppm	1st node	8.33	58310	2086800	583100	-1503700	1:0.28
	2nd node	51.66	361620	2017300	3616200	1598900	1:1.79
	3rd node	61.66	431620	2284800	4316200	2031400	1:1.89
	4th node	58.33	408310	2178300	4083100	1904800	1:1.87
Control	1st node	3.33	223310	2016800	233100	-1783700	1:0.12
	2nd node	21.99	253930	2147300	1539300	-608000	1:0.72
	3rd node	31.30	219100	2147800	2191000	43200	1:1.02
	4th node	33.50	234500	2148300	2345000	196700	1:1.09

Chapter V

SUMMARY AND CONCLUSIONS

The present investigation entitled **"Standardization of pruning and propagation technique in Arabian jasmine (*Jasminum sambac*)"** was undertaken during Nov. 2012 to June 2013, at HC&RI, Dr. Y.S.R.H.U, V.R. Gudem, West Godavari(Dist.) of A.P. The salient findings are concluded here.

5.1 Standardization of pruning technique.

The highest primary shoot length was observed in Tuppamalli (53.61cm), December'12 (52.47cm), pruning height at 50 cm (62.35 cm) from ground level. The longest primary shoot length among interaction treatments was observed with Tuppamalli shrubs pruned in December'12 (57.96 cm), Tuppamalli, pruning height at 50cm (70.30cm), December'12 and pruning height at 50cm (65.42cm) and Tuppamalli, December'12 and pruning height at 50cm recorded the longest primary shoot length (76 cm).

Tuppamalli (0.47cm), December'12 (0.46cm), pruning height at 50cm (0.51cm) recorded highest shoot thickness at base. Interaction treatments Tuppamalli December'12 (0.49cm), Tuppamalli, pruning height at 50cm (0.52cm), December'12 and pruning height at 50cm (0.54cm) and Tuppamalli Decmber'12 Pruning height at 50cm (0.56cm) recorded the highest shoot thickness at base.

Starmalli (3.60cm), January'13(3.71cm), Pruning height at 75 cm (3.35cm) recorded the shortest internodal length between 3rd and 4th inter node. Starmalli, January'13 (3.38cm); Starmalli, Pruning at 75cm (2.80cm); January'13 pruning height at 75cm (3.13cm) recorded the shortest inter nodal length among sub treatments.

Nityamalli (10.32), December'12 (9.82), pruning height at 50cm (11.41) recorded the highest the number of laterals per primary shoot. Nityamalli, December'12(11.01), Starmalli pruning height at 50cm (12.29), December'12 pruning height at 50cm (12.32) and Nityamalli December'12 pruning height at 50 cm (13.49) recorded the highest number of laterals per primary shoot.

Starmalli (124.34), December'12 (119.57), pruning height at 50cm (141.90) recorded the highest number of productive shoots per plant. Starmalli, December'12 (134.40), Nityamalli, Pruning height at 50cm (161.53); December'12, Pruning height at 50cm (156.70) and Nityamalli December'12 Pruning height at 50cm (181.26) observed highest number of productive shoots per plant.

The highest number of leaves per primary shoot per primary shoot was recorded in Nityamalli (65.74), December'12 (64.68), Pruning height at 50cm (80.71). Nityamalli, December'12 (74.65); Nityamalli, pruning height at 50cm (92.15), December'12, Pruning height at50cm (94.40) and Nityamalli, December'12, pruning height at 50cm (107.06) recorded the highest number of leaves per primary shoot.

Nityamalli (1871.27cm^2), December'12 (1699.23cm^2), pruning height at 50cm (2056.33cm^2) recorded the highest leaf area per shoot. Nityamalli, December'12 (2152.36cm^2); Nityamalli, pruning height at 50cm (2490.58cm^2), Dcember'12,pruning height at 50cm (2438.17cm^2) and Nityamalli, December'12, pruning height at 50 cm (2978.00cm^2) noted the highest leaf area per shoot.

Starmalli (43.59days), January'13 (42.83 days), pruning height at 75cm (41.78days) recorded the minimum number of days for flower bud initiation from pruning. The interaction treatments Starmalli, January'13(36.93days); Starmalli, pruning heightat 75cm (34.47days), and Starmalli, January'13, pruning height at 75cm (30.83 days) noted the minimum number of days for flower bud initiation from pruning date.

Days to flower bud development Starmalli (14.85days), January'13 (14.65 days), pruning height both at 50 and 75cm (14.82 days) recorded the shortest duration for flower bud development from flower bud initiation. Starmalli, January'13(14.46days); Nityamalli, pruning height at 50cm (14.65days); January'13, pruning height at 25 cm and 50cm (14.51 days) and Nityamalli, January'13, pruning height at 50cm (14.29 days)recorded lowest number of days for bud development from initiation.

Nityamalli (145.29 days), November’12(135.64days), Pruning height at 50cm (147.22days) recorded the longest duration of flowering. Nityamalli, November’12 (151.56days), Nityamalli, pruning height at 50cm (163.45 days); November’12, pruning height at 50cm (160.54 days) and Nityamalli, November’12, pruning height at 50cm (174.86days) recorded the longest duration of flowering. Flower bud Size - bud diameter: Nityamalli (1.0cm), January’13 (0.99cm), pruning height at 25cm (0.99cm) recorded the highest flower bud diameter. Tuppamalli, January’13 (1.03cm); Nityamalli, Pruning height at 25cm (1.04cm); January’13, Pruning height at 25cm (1.02cm) and Nityamalli, January’13 pruning height at 25cm (1.05cm) recorded the highest flower bud diameter among the other treatments. Flower bud length: Tuppamalli (4.03cm), December’12 (3.21cm), Pruning height at 25cm (3.60cm) recorded the longest flower bud length. Tuppamalli December’12 (4.01cm); Tuppamalli, Pruning at 25cm (4.12cm); December’12 pruning height at 25cm (3.52cm) and Tuppamalli, January’13, pruning height 25cm (4.20cm) recorded the highest flower bud length among the treatments.

The highest number of petals for flower was recorded in Nityamalli (23.21). There was no significant difference noticed for pruning date and pruning height on number of petals for flower.

Weight of fifty flower buds Tuppamalli (18.05g), December’12 (16.15g), pruning height at 75cm (16.21g) recorded the highest weight of fifty flower bud weight. Tuppamalli, December’12 (18.19g), Tuppamalli pruning height at 75cm (18.29g) and Tuppamalli, December’12, pruning height at 50 and 75cm (18.40 g) noted the highest weight of fifty flower buds over other treatments.

Nityamalli (1617.73), December’12 (1334.21), pruning height at 50cm (1560.51) recorded the highest number of flower buds per plant. Starmalli, December’12 (1736.24); Starmalli, pruning height at 50 cm(1926.18); December’12, pruning height at 50cm (1706.92) and Starmalli, December’12, Pruning height at 50cm (2187.83) recorded highest number of flower buds per plant among the treatments.

Nityamalli (466.99g), December’12 (425.38g), pruning height at 50cm (448.18g) recorded the highest weight of flower buds per plant. Nityamalli, December'12(513.89g); Nityamalli, pruning height at 50cm (533.00g); December'12, pruning height at 50cm (499.72g) and Nityamalli December'12 pruning height at 50cm (571.39g) recorded highest weight of flower buds per plant. Nityamalli (1.86kg/m^2), December'12 (1.69 kg/m^2), pruning height at 50cm (1.78 kg/m^2) recorded the highest number of flower buds per m^2 plot. Nityamalli, December'12 (2.05 kg/m^2); Nityamalli pruning height at 50cm (2.12 kg/m^2); December'12 pruning height at 50cm (1.99 kg/m^2) and Nityamalli, December'12, Pruning height at 50cm (2.28 kg/m^2) recorded highest weight of flower buds per m^2 plot among the other treatments. Nityamalli (16.22t ha^{-1}) December'12 (15.14t ha^{-1}), pruning height at 50cm (16.07t ha^{-1}), recorded the highest weight of flower buds per hectare. Nityamalli, December'12 (18.24t ha^{-1}) Nityamalli, pruning height at 50cm (18.86 t ha^{-1}), December'12, pruning height at 50cm (17.93 t ha^{-1}) and Nityamalli, December'12, Pruning height at 50cm (20.35 t ha^{-1}) recorded highest weight of flower buds per hectare from rest of the treatments.The treatment Nityamalli, December'12 and Pruning height at 50 cm recorded the highest cost benefit ratio (1:2.57).

5.2 Effect of chemical defoliation on growth and flower yield in jasmine.

Tuppamalli (21.72g) among the genotypes, paraquat dichloride at 1000 ppm (24.83g) and Tuppamalli sprayed with paraquat dichloride@1000ppm (27.45 g) recorded the highest weight of defoliated leaves per shrub. Among genotypes Starmalli (9.69days), paraquat dichloride at 2500 ppm (1.67days) and Starmalli sprayed with paraquat dichloride@2500 ppm (1.23days) recorded the minimum number of days for complete defoliation. Nityamalli (15.52days), paraquat dichloride at 2500ppm (10.82days) and Nityamalli sprayed with paraquat dichloride at 2000ppm (10.30days) recorded minimum number of days for new leaf emergence after defoliation. Tuppamalli (130.82g), Paraquat dichloride at 1000 ppm (155.30g) and Tuppamalli sprayed with Paraquat dichloride @1000 ppm (192.44g) recorded maximum aerial biomass per plant per season. Nityamalli (217.27 g), paraquat dichloride at 1000 ppm (255.78g), Nityamalli sprayed with paraquat dichloride at 2000 ppm (296.51 g) recorded maximum flower yield per plant. The treatment paraquat dichloride @2000ppm recorded the highest cost benefit ratio of 1:1.56 followed by paraquat dichloride

@1000ppm and paraquat dichloride @2500ppm (1:55) in Nityamalli. Hence, the treatment paraquat dichloride @2000ppm (1.56), paraquat dichloride @1000ppm (1:55) would be recommended to the farmers.

5.3 Propagation technique of *Jasminum sambac* Cv. Double Mogra

IBA@2000ppm recorded highest rooting per cent (45%), longest root length (4.56cm), highest number of roots per cutting (7.59), fresh weight of roots (1.2g), more number of sprouts (1.37), highest number of leaves (5.75), maximum sprout diameter (1.74mm) per cutting, minimum number of days to sprouting (14.92days), highest fresh weight of fully grown rooted cutting (2.81g), maximum dry weight of rooted cutting (1.10g) and shortest duration of propagation cycle (67.98days) over other concentrations of IBA.The size of cutting, three node stem cuttings of Double Mogra recorded highest rooting per cent (49.58%), highest root length (6.72cm), maximum number of roots per cutting (7.45cm), highest root fresh weight (1.15g), highest number of leaves (7.26), highest dry weight of rooted cutting (1.18g). Whereas four node cuttings recorded highest number of sprouts per cutting (1.60), sprout diameter (1.84mm), minimum number of days to sprouting (14.52days), highest fresh weight of fully grown cutting (3.10g) and shortest duration of propagation cycle (68.56days). Three node cuttings treated with IBA@2000ppm (61.66%) recorded highest rooting, highest root length (6.72cm), more number of roots (9.21), the highest fresh weight of roots (1.25g) per cutting and maximum sprout diameter at the base (1.74 mm), minimum number of days for sprouting (13.53days), highest fresh weight of fully grown rooted cutting (3.45g), highest dry weight of rooted cuttings (1.28g), shortest duration of propagation cycle (batch period) (67.98days) Whereas four node cuttings with IBA @ 2000ppm recorded (2.0) more number of sprouts. Three node cuttings and IBA@3000ppm recorded maximum number of leaves per cutting (7.74). Economics of propagation was calculated, the treatments 3node cuttings treated with IBA @2000ppm and 3node cuttings treated with IBA @3000ppm recorded the highest cost benefit ratio of 1:1.88. Hence, the treatment 3node cuttings treated with IBA @2000ppm would be recommended for commercial propagation as well as propagation at farmer’s level.

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* Original not seen.

The pattern of "Literature Cited" presented above is in accordance with the Guidelines for thesis presentation for Dr. Y.S.R. Horticultural University, Venkataramannagudem.

Appendix – A

Weekly meteorological data recorded at college farm, Horticultural College and Research Institute, V. R. Gudem, W. G. (Dist.) from 1-8-2012 to 23-06-2013.

S. No	Standard weeks	Temperature		Relative humidity (%)		Sunshine hours	Average wind speed (Km/hr)	Rainfall (mm)
		Maximum	Minimum	08:00 hrs	14:00 hrs			
*	Aug'12	31.96	24.90	80.03	66.29	21days	-	349.3
1	**36** (03-09-12 to 09-09-12)	30.78	26.27	54.31	37.9	12.07	0.10	73.40
2	**37** (10-09-12 to 16-09-12)	31.42	26.1	53.38	32.7	11.57	0.05	85.60
3	**38** (17-09-12 to 23-09-12)	31.42	25.85	45.27	32.18	12.00	0.00	24.60
4	**39** (24-09-120 to 30-09-12)	34.00	25.22	47.05	27.3	11.57	0.01	27.10
5	**40** (01-10-12 to 07-10-12)	30.97	25.1	57.28	40.18	11.71	0.10	69.90
6	**41** (08-10-12 to 14-10-12)	34.87	24.3	60.65	49.1	11.78	0.02	04.00
7	**42** (15-10-12 to 21-10-12)	32.92	23.75	45.47	40.15	11.50	0.01	01.60
8	**43** (22-10-12 to 28-10-12)	29.41	23.00	43.50	38.51	11.35	0.02	03.80
9	**44** (29-10-12 to 04-11-12)	29.42	23.94	44.00	41.72	10.71	0.00	65.40
10	**45** (05-11-12 to 11-11-12)	31.55	22.87	48.01	42.48	11.07	0.03	08.60
11	**46** (12-11-12 to 18-11-12)	18.17	31.35	42.00	37.11	11.00	0.05	01.80
12	**47** (19-11-12 to 25-11-12)	32.9	23.82	42.95	37.57	10.92	0.02	01.40
13	**48** (26-11-12 to 02-12-12)	32.37	20.87	43.35	36.82	11.14	0.03	0.20
14	**49** (03-12-12 to 09-12-12)	36.65	20.07	39.22	35.48	11.00	0.05	00.00
15	**50** (10-12-12 to 16-12-12)	32.61	19.48	40.25	35.37	10.92	0.04	0.60
16	**51** (17-12-12 to 23-12-12)	31.88	18.80	43.8	36.2	10.71	0.06	0.40
17	**52** (24-12-12 to 30-12-12)	30.71	19.01	42.47	37.4	10.78	0.04	0.40
18	**01** (31-12-12 to 06-12-13)	21.41	31.42	45.47	38.22	11.00	0.01	1.10
19	**02** (07-01-13 to 13-01-13)	32.17	19.92	44.21	38.35	11.00	0.30	0.20
20	**03** (14-01-13 to 20-01-13)	31.72	18.71	42.25	38.68	10.85	0.52	0.40
21	**04** (21-01-13 to 27-01-13)	31.00	20.32	43.11	39.18	11.00	0.22	0.20
22	**05** (28-01-13 to 03-02-13)	30.62	20.18	43.97	40.27	11.07	0.36	2.20
23	**06** (04-02-13 to 10-02-13)	31.2	20.12	43.18	39.92	11.00	0.56	0.40
24	**07** (11-02-13 to 17-02-13)	30.12	21.27	45.17	42.97	11.07	0.85	11.50
25	**08** (18-02-13 to 24-02-13)	31.14	22.71	45.20	41.70	11.57	0.61	4.60
26	**09** (25-02-13 to 03-03-13)	34.15	21.02	44.55	42.02	12.00	0.94	0.40
27	**10** (04-03-13 to 10-03-13)	32.92	22.15	45.57	43.00	11.92	0.52	0.20
28	**11** (11-03-13 to 17-03-13)	33.15	21.81	48.21	46.47	11.85	0.49	0.60

29	**12** (18-03-13 to 24-03-13)	32.78	23.17	50.65	48.12	11.92	0.41	0.00
30	**13** (25-03-13 to 31-03-13)	32.85	22.74	52.38	49.28	12.00	0.48	0.60
31	**14** (01-04-13 to 07-04-13)	33.84	23.60	56.67	56.67	12.21	0.61	0.00
32	**15** (08-04-13 to 14-04-13)	34.32	23.42	61.40	59.88	12.31	0.57	0.00
33	**16** (15-04-13 to 21-04-13)	35.95	23.02	61.98	59.34	12.50	0.93	3.50
34	**17** (22-04-13 to 28-04-13)	34.51	24.57	63.40	62.50	12.50	1.63	2.60
35	**18** (29-04-13 to 05-05-13)	33.61	28.14	63.15	61.90	12.42	0.53	0.00
36	**19** (06-05-13 to 12-05-13)	36.52	30.21	63.77	63.80	12.21	2.00	11.60
37	**20** (13-05-13 to 19-05-13)	37.32	32.61	57.65	54.62	13.00	2.16	0.00
38	**21** (20-05-13 to 26-05-13)	37.68	31.24	48.01	47.20	13.00	1.71	9.60
39	**22** (27-05-13 to 02-06-13)	38.41	32.22	46.65	50.00	12.35	1.63	23.20
40	**23** (03-06-13 to 09-06-13)	36.24	31.56	61.42	60.88	12.50	0.56	16.80
41	**24** (10-06-13 to 16-06-13)	36.78	30.25	60.44	58.78	12.71	0.52	0.00
42	**25** (17-06-13 to 23-06-13)	32.64	28.38	62.64	58.24	12.64	0.57	25.6

* Monthly average data of temperature, Rain fall, Relative humidity and Sun shine hours of August month was recorded.