STANDARDIZATION OF TIME FOR POLYBAG LAYERS IN GUAVA (Psidium guajava L.) UNDER AKOLA CONDITIONS

THESIS

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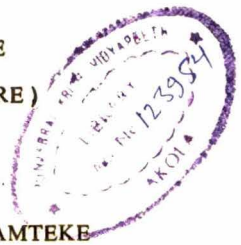

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DECLARATION OF STUDENT

I hereby declare that the experimental work and it's interpretation of the thesis entitled "STANDARDIZATION OF TIME FOR POLYBAG LAYERS IN GUAVA (*Psidium guajava* L.) UNDER AKOLA CONDITIONS" or part thereof has not been submitted for any other degree or diploma of any University, nor the data have been derived from any thesis/publication of any University or Scientific Organisation. The sources of materials used and all assistance received during the course of investigation have been duly acknowledged.

Date: 15.5.93

Place: Akola

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CERTIFICATE

This is to certify that the thesis entitled "STANDARDIZATION OF TIME FOR POLYBAG LAYERS IN GUAVA (*Psidium guajava* L.) UNDER AKOLA CONDITIONS" in partial fulfilment of the requirements for degree of MASTER OF SCIENCE IN AGRICULTURE (HORTICULTURE) of the Punjabrao Krishi Vidyapeeth, Akola, is a record of bonafide research work carried out by **Shri Narendra Haribhau Ramteke**, under my guidance and supervision. The subject of the thesis has been approved by the student's advisory committee.

15/5/93

(Dr.R.M. Verma)
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(N.H. Ramteke)

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Aug.	-	August
cm	-	Centimeter
C.D. at 5%	-	Critical difference at 5% level of significance
et al.	-	et alia (and others)
Eve.	-	Evening
Fig.	-	Figure
i.e.	-	that is
Max.	-	Maximum
Min.	-	Minimum
mm	-	Millimeter
Mor.	-	Morning
No.	-	Number
N.S.	-	Non-significant
Oct.	-	October
R.H.	-	Relative humidity
Sig.	-	Significant
S.E.(m) ±	-	Standard error of mean
Sept.	-	September
T	-	Treatment
Temp.	-	Temperature
Viz.	-	Namely
^{0}C	-	Degree(s) centigrade
%	-	Per cent
/	-	Per

CHAPTER I

INTRODUCTION

Guava (*Psidium guajava* Linn) is one of the most common fruits in India next to mango, banana and citrus. It belongs to the family "Myrtaceae". It is a native of tropical America and soon after the discovery of America by Columbus, probably Guava was introduced in India by Portuguese. Now, it has been spread as an important tropical and sub-tropical fruit crop in the country.

At present, Guava is grown throughout India from sea level to an elevation of about 3000 feet (Hayes, 1957). In India, tropical area under guava cultivation is 1,66,650 hectares with total production of about 10,42,550 tonnes, while Maharashtra State contributes about 7,460 hectares area under guava with total production of 1,49,200 tonnes. The average production per hectare of the Maharashtra State is almost double i.e. 20 tonnes/ha. to the production of the country as such (Annonymous, 1989).

It grows well on varied soil types and under different climatic zones of tropical and sub-tropical area due to it's hardiness and drought resistance behaviour both in India and abroad.

Some cultivars of wide reputation are grown in Uttar Pradesh in general, and Allahabad in particular. The

variety Sardar (Lucknow-49) is a selection from seedlings grown at the Ganeshkhind Fruit Experiment Station, Pune. It is a seedling selection of Safeda and has been recommended by Maharashtra State Department of Agriculture on account of it's relatively dwarf and spreading habit of growth, profuse bearing and excellent quality. Now, this variety is identified as Sardar (Cheema and Deshmukh, 1927).

Guava being a hardy fruit crop has got considerable importance on account of it's high food value from consumer's point of view and is highly profitable crop to the growers of Maharashtra State on account requirement of low investment and good returns.

In recent years, the economic condition of the cultivars growing rainfed crops in rainy season of the Maharashtra State is being depleted due to continuous erratic rainfall in monsoon season. On the other hand, the cultivators having irrigation potential are also facing the problem of availability of irrigation water during summer months in particular. Under such circumstances, it is a prime need of the day to grow fruit crops which are hardy and requiring only minimum water requirement. Government of Maharashtra has already initiated programme of fruit planting on a mass scale with a main object to uplift the economic condition of the growers and also simultaneously to upgrade

the dietic value per head per capita. The growers of the Maharashtra and Vidarbha region in particular are very much interested to grow hardy fruit crops like guava.

Generally, whatever the guava orchards are existing those are mainly from seedling plants and are differing to some extent in supplying fruits of good quality and production.

Asexual propagation method is most reliable supplying true to type plants. There are many methods of asexual propagation of which air, tongue and tip layering are popular ones. In all these methods, there is lot of mortality after detachment of layers from mother trees in nursery. The final percentage of survival depends mainly on the after care and the environmental conditions existing during summer months.

Recently, polybag method of layering has been introduced by Punjabrao Krishi Vidyapeeth, Akola in the year 1987 (Ulemale and Shelke, 1987) and it is being adopted for the multiplication by the nurserymen. In this method, the percentage success is higher than other methods.

Polybag method is beneficial to multiply the guava plants economically on large scale due to following advantages.

i) In polybag method, there is no need of transplanting the layers after detachment and hence the root system remains undisturbed.

ii) The layers obtained in this method are growing in a straight manner.

iii) Easy to water in polythene bags.

iv) This method does not require stone or pot or any additional arrangement to keep the shoot in position while root initiation and growth.

v) High percentage of survival after detachment in nursery stage during raring since, the root system produced by this method remain undisturbed.

In this way the polybag method of layerage is easy to perform and economical. This method will be useful to multiply the guava plants with more success and fulfill the growing demand of the farmers.

This method is being popularised with the nurserymen of Vidarbha region due to it's merits, but the scientific technology is yet to be developed and so, this fact inspired to carryout an experiment to standardize the

technology in respect of time of layering and after care while raring in nursery stage and to obtain high percentage of success of the layers. With these objects in view the, "Standardization of time for polybag layers in Guava under Akola conditions" were carried out in commercial fruit nursery, Punjabrao Krishi Vidyapeeth, Akola during the year 1992-93.

CHAPTER II

REVIEW OF LITERATURE

The present investigation "Standardization of time for polybag layers in Guava (*Psidium guajava* L.) under Akola conditions" was undertaken during the year June, 1992 to October, 1992 in commercial fruit nursery, Department of Horticulture, Punjabrao Krishi Vidyapeeth, Akola, and the available literature on the investigation is reviewed under appropriate headings.

2.1 Propagation Methods

Guava is propagated by seed as well as vegetative method. There is so much variation in fruit quality and yield from the plants grown by sexual method and it requires a long period for bearing. On the other hand, vegetative methods of propagation supply true to type plants bearing early crop of uniform quality. Therefore, the asexual method of propagation is of prime consideration.

The different methods of vegetative propagation techniques used for guava are mainly cuttings, budding and layering and the work done on these propagation methods by many research workers are summarised below.

2.1.1 Cutting

The multiplication of guava by cutting was carried out by many workers, but since guava is difficult to root under normal conditions, the success obtained was negligible.

Pennock and Maldonado (1963) did not obtain appreciable results in multiplication of guava cuttings even by use of intermittent mist propagation and different rooting media.

Singh and Gaur (1966) conducted an experiment on propagation on guava by hard wood, semi hard wood and soft wood cuttings, each with two pairs of leaves, failed to root either in full sunlight or in the partial shade of a lathhouse.

Hafeez et al. (1988) investigated multiplication of guava by hardwood cuttings under controlled conditions and failed to obtain any success even in case of paclobutrazol treated cuttings.

Mackowiak (1989) investigated propagation method in sweet cherries and failed to obtain roots in both semi hardwood and hardwood cuttings. Similarly Gutener and Bogoroditskii (1974) also reported poor results in propagation of walnut by softwood and hardwood cuttings.

2.1.2 Budding

The work done by many research workers in guava by budding are given below.

Chandra (1965) reviewed the research advances in clonal propagation of guava and reported that forkert method of budding was found to give consistently better results than shield or patch budding. He further reported that high percentage of success was obtained with air layering.

Singh et al. (1978) conducted an experiment on propagation of guava by budding and obtained higher shoot lengths with April or May budding. Patch budding gave 69% success as against only 24% with chip budding. Use of fresh buds gave better results than those from defoliated shoots.

Pandey et al. (1979) also obtained same trend of results. He further reported that use of swollen buds gave better results than dormant buds.

Nagabhushanam (1985) reviewed the work on vegetative propagation methods in cashewnut and reported air layering as significantly superior method of propagation than all other methods of grafting and budding.

2.1.3 Layering

Layering is one of the most successful method used widely for multiplication of guava. Lot of research work was

carried out by many workers and the same are presented below.

Tingwa and Abbadi (1968) investigated vegetative propagation methods of guava under tropical conditions of Sudan and reported air layering as superior method.

Manzo et al. (1974) conducted the trials on hazel by stooling and layering and obtained the greatest number of plants by layering.

Similarly, Nagabhushanam et al. (1979) reported air layering as the best method over all other methods tried for propagation of cashew.

Nagabhushanam (1985) concluded in his review on vegetative propagation of cashewnut that the air layers separated from mother tree and nursed in polybags for about 3 months gave 94 per cent survival after transplanting in field conditions.

In India, air layering is reported as one of the most successful layering method and it was reported as superior over the layerage methods used in soil.

Bhambota et al. (1968) in his investigation on propagation of litchi reported that layering in soil for a period of 2-3 months gave good results. However, he stated that aerial layering is more convenient. However, air

layering requires materials of sphagnum moss of superior quality, and it is not easily available. Under such circumstances, use of ground layers for multiplication of guava is the only convenient and cheap method of layerage. In Vidarbha region the soils are medium to heavy.

Fontanzza and Sallco (1968) reported that the branches with well developed shoots layered in July did not root until the following spring. In clay soil the root development was much poor than loam soil.

Ulemale and Bhelke (1987) introduced polybag method of layerage as ground layering. The polybags were filled with garden mixture and the operated shoots were inserted through rotting medium in polybags in July and the root growth was visible through transparent polybags and these rooted layers were detached, nursed in nursery till disposal. They obtained high percentage of success with this method. Further they have mentioned this method as most easy and economic.

2.2 Time of Layering

Time of layering plays an important role in inducing rooting, root growth and shoot growth. According to Bokovan (1974) an experiment on rooting of apple layers was continued throughout the growing season except during the

hottest months. Optimum rooting was occured at 18-24^{0}C temperature range associated with 65-75 per cent relative humidity and this was prevailing during June, July and August.

Roychoudhury (1957) achieved high percentage of success in July when rose apple was propagated by gooty under Bengal condition.

June was found to be the best month for guava layering (Anon, 1961) and Bokovan (1974).

Bhambota et al. (1968) obtained encouraging results when litchi was propagated by ground layering at the end of July under Punjab condition.

Similarly, Mishra and Agrawal (1975) reported the best period as July for air layering of Kagzi kalan under Shrinagar conditions. Same results were obtained by Patil and Chakrawar (1979) with seedless lemon under Parbhani conditions.

Patel and Singh (1982) investigated time of layering in mango by air layering and reported August as the best month for air layering.

Palaniswami et al. (1985) reported 40-50 per cent success in cashew by air layering on one year old shoot during July-September.

Valsalkumari et al. (1985) studied vegetative method of propagation in cashewnut and reported that the period between February to April gave maximum number of rooted layers.

Nagabhushanam (1985) reported that air layering in cashew was significantly superior to other methods from March to May under South Indian condition.

Kanwar and Kahlon (1986) conducted propagation studies in litchi of ten years old. In his studies, one year old shoots were air layered on several dates from July to November and obtained highest success when carried out between mid July and early October under Punjab conditions. He got best rooting on North-East and North-West side of the tree.

Tewari (1986) reported that grape shoots of one year old when air layered in late August with growth regulators treatments gave best rooting from 83.33 to 94.44 per cent and survival percentage of 59.50 per cent.

Ulemale and Shelke (1987) suggested July to August as suitable period for polybag method of layering in guava under Akola conditions.

Nagone (1989) conducted propagation studied on pomegranate by air layering and reported July is the best month of layering under Akola conditions.

Suriyapananont (1990) studied propagation of apple by air and soil layering under Thiland conditions and reported 100 per cent rooting in soil layering as against 77 per cent in air layering. The best period for starting the layering process was from April and June. While the percentage of rooting was dropped down to 30 per cent when layered from October to December.

Navaneetha et al. (1991) etiolated tamarind branches for one month and studied rooting by air layers with and without growth regulators treatments at biomonthly intervals from May, 1989 to March, 1990 and observed 75 per cent rooting, in case of layers treated with 1000 ppm of IBA and performed in the month of May. No rooting was observed in January to March.

2.3 Preparation of layerage

For preparation of layerage, the selection of proper shoot for layering depends upon it's age, size, length and condition of shoot during layering. The research on above aspects carried out by the workers are reviewed here.

2.3.1 Juvenile phase of shoot

Shoots in juvenile condition and of one year old are best suited for layering. The age of the mother plant shoot can be an overriding factor in root formation. The

layering done on juvenile shoots required less time for rooting than adult shoots.

In air layering, the one year old shoot of mother plant should be selected for better root formation and higher survival of layers (Roychoudhury, 1957); Patil and Chakrawar, (1979) and Palaniswami et al., (1985).

As the age of shoot of mother plant increases, the rooting percentage decreases. The scientific reason is that phenolic levels decreases as increases the age of the plant than juvenile condition. The phenolic levels acts as auxin and it helps for initiation of rooting. In juvenile condition, shoot contains more phenolic level than mature one. While second reason is that the rooting inhibitors produced are more in adult shoots with increasing in age and hence, juvenile condition of shoot should be considered for better rooting (Hartmann and Kester, 1989). Therefore, progressive increase in age of shoot results in decreasing the rooting percentage in apple layers in the same order (Andrew, 1979).

Kuzin (1973) studied the rooting and water content of apple layers of different maturity and reported that the availability of free and bound water in juvenile and mature shoot was almost equal but roots on juvenile shoot appeared 20 days earlier than on mature layers and the root system

developed in juvenile layers was also better. While in Jack fruit air layering root appeared 30 days sooner in juvenile layers than mature shoot (Lingarajppa, 1982).

Desai and Patil (1984) carried out studies on air layering on 16 year old (adult) and 6 year old (juvenile) trees and observed best rooting in layers in juvenile trees than that of adult trees.

2.3.2 Diameter, thickness and length of shoot

In layering, selection of shoot from mother plant plays an important role in rooting of layers. The shoots of different diameter and thickness have definite vital role in rooting and survival of layers. Many research workers carried out work on these aspects which are summarised below.

In air layering of guava, the shoot having 1/2 inch diameter gave good results (Ruehle, 1948). Similarly, in mound layering of guava, the shoot having 1.5 cm diameter proved to be the best (Sharma et al., 1978) while Roychoudhury (1957) obtained good results in case of rose-apple gooty with shoots having thickness of little more than that of ordinary pencil.

Tankersley and Emino (1981) reported that, the stems of grandientalum having more than 0.5 cm diameter established more successfully than thinner stems.

In plum layers, the shoots having more than 1.3 cm diameter rooted best while thin and medium shoots gave only 11 to 22 per cent and 32.8-54.5 per cent rooting respectively (Grzyb, 1982).

In polybag method of layering in guava var. Sardar, branches or shoots of pencil thickness with 4 to 5 leaves rooted best (Ulemale and Shelke, 1987).

2.4 Vegetative Growth of Layers

The vegetative growth of layers included number of shoots, length of shoots, height of layers and number of leaves. The research work carried on these aspects by research workers are summarised below.

Dikshit (1956) stated that the most vigorous shoots were developed on the cuttings of palm when prepared in rainy season.

Wankar (1975) noted number of leaves as 9.77 in guava shoots of 0.51 cm diameter.

Patil and Chakrawar (1979) recorded the shoot length of 40.74 cm and number of mean leaves of 36.03 per layer in seedless lemon by air layering.

Huchche (1983) observed number of shoots as 4.70 in guava.

Purohit and Shekarappa (1985) reported that cutting of pomegranate gave highest number of shoots when prepared in rainy season.

Tewari (1986) found that the treatment of dates of layering (15th July, 30th July, 15th August) were equally effective in producing vigorous plants with more or less equal number of leaves in grape layers however the more number of leaves were in treatment of 15th July.

Nagone (1989) carried out work in air layering of pomegranate and reported that, there was continuous increase in the number of shoots after 90 days from detachment of layers. The layers prepared June produced maximum shoots of 8.91 and there was significant reduction in number of shoots in case of layers prepared in July onwards. The length of shoot was also increased after 90 days from time of detachment. The shoots layered in the month of June gave larger shoots of 15.84 cm followed by subsequent dates of layering whereas the lowest value was noted in layers of October (12.02 cm).

Raut (1992) noted the observations of number of leaes as 11.4, diameter of stem as 0.93 cm and mean height of layers as 42.15 cm in guava layers.

2.4.1 Vegetative growth as influenced by environmental factors

Environmental factors such as temperature, relative humidity and rainfall plays an important role in vegetative growth. The available literature are summarised below.

Lyon (1938) stated that in general the rate of production of leaves was increased when temperature rose after a sharp fall.

Cooper (1959) reported that, leaves were produced at constant rate of 2.6 leaves per week between March and August.

According to William (1959) leaf production varied with day length and temperature in Respberry. Went (1952) stated that the temperature alongwith light, humidity at optimum range encourage growth of plant to a maximum extents temperature of $25^{0}C$ as optimum was best to run physiological processes at normal rate.

Krishnamurthy et al. (1960) had postulated that, no shoot growth of citrus species took place below $13.6^{0}C$ and maximum shoot was observed with temperature range of $18.0^{0}C$ to $24.1^{0}C$.

Krishnamurthy et al. (1961) studied growth habit in mango and found better growth with optimum temperature of 24.0 to $28.8^{0}C$.

2.5 Rooting of Layers

Rooting of layers depends on number of factors like use of rooting media, relative position of the shoot on the parent plant and season. The work done by research workers on the above aspects are summarised below.

2.5.1 Rooting media

The rooting in the layers is influenced by the medium in which it is growing. Some of the references available are presented below.

Bhambota et al. (1968) burried the litchi layers in soil for 2 or more months. During this period, the cambium layer of a shoot was exposed in rooting medium to induce profuse root system before detachment.

The rooting medium plays an important role in root formation. It holds the layers in place during the rooting period. Also, it provides moisture for layers and permit penetration of air to the base of the layers as available oxygen in the rooting medium which is essential for root production. Hence, Hartmann and Kester (1989) suggested the use of an ideal rooting media which should be well drained and free from harmful pathogen.

Fontanazza and Salleo (1968) conducted layering experiments on hazel propagation and reported that root development in clay soil was poorer than in loam.

Salontai et al. (1986) used zeolitic volcanic tufa as a mixed ingredient in soil and reported that layering in polythene bags containing rooting medium of soil and zeolitic volcanic tuff in the ratio of 1:3 was found to be best and most profitable.

Ulemale and Shelke (1987) suggested use of rooting medium consisting of soil, FYM and Sand in the ratio of 1:1:1 for filling the polythene bags to obtain vigorous root system.

2.5.2 Relative position of the shoot on the mother plant

The mother plant consists of numerous shoots located in all directions. They also differ in their maturity according to the age. The research workers studied all these aspects and their finding are reviewed below.

Grzyb (1980) obtained maximum shoots by girdings and pruning of mother plants of plum and carried horizontal layering and obtained best rooting on two or three shoots located nearest to the trunk of mother tree.

Ulemale and Shelke (1987) suggested to select the basal/lower branches of guava var. Sardar possessing natural

bending habit for production of more number of roots in less time and more survival percentage.

Mackowiak (1989) propagated root stocks of cherries by using vertical and horizontal shoots for layering and obtained more successful rooted layer with horizontal shoots than the vertical shoots.

Hartmann and Kester (1989) stated that the basal branches of mother tree produced more number of roots because of more carbohydrate accumulation at the base of the shoot.

2.5.3 Rooting as influenced by season

In all there are three main seasons and all these seasons vary from each other in respect of humidity, day and night temperatures, day length, light intensity and so on. Therefore, season plays an important role in rooting of layers and hence better rooting obtained in rainy season from June to September.

Shrivastava (1961) obtained profuse rooting in pomegranate air layers after third week of July. Anon (1961) obtained good rooting in guava layers in June. Sen *et al.* (1961) reported that mango layers produced good rooting in the middle of June.

Ahmed (1964) reported higher percentage of rooting in guava air layers when done in rainy season than in spring.

Bokovan (1974) carried continuous layering in apple and stated that rooting of layers were obtained throughout the year except during hottest part of the summer.

Misnra and Agrawal (1975) reported best rooting in Kagzi kalan air layers in the month of July under Shrinagar conditions.

Dimova (1975) reported best rooting in berry tip layering in the month of early July.

Pandey and Phogat (1978) reported that the first week of June was found to be the best month of rooting in air layers of olive.

Patil and Chakrawar (1979) obtained higher percentage of rooting in seedless lemon in the month of July under Parbhani conditions.

Nazeem et al. (1984) obtained best rooting (81-90%) in Jack by air layering in rainy season under Kerala condition.

Kanwar and Kahlon (1986) reported that litchi layering done in mid July gave highest rooting.

Tewari (1986) stated that grape shoots air layered in late August gave maximum rooting. While Ulemale and Shelke (1987) suggested that the period of rainy season from July to

August was most successful/suitable for layering in guava by polybag method.

Nagone (1989) stated that pomegranate shoots air layered in July gave maximum rooting under Akola conditions.

Suriyapananont (1990) obtained best rooting in apple when layered in June and it was poor in layers performed in the month of October to December.

Navaneetha et al. (1991) exceptionally obtained higher percentage of rooting with tamarind air layers performed in the month of May.

2.5.4 Average number and length of roots

Bhange (1973) reported mean number of primary roots as 3.00, mean length as 7.66 cm and mean number secondary roots as 17.33 in guava air layer. Mishra and Agrawal (1975) noted 48.08 mean number of roots and mean length as 3.04 cm in kagzi kalan air layer.

Patil and Chakrawar (1979) obtained mean number of roots of 49.76 per layer in seedless lemon air layering. Rao (1983) noted mean root number of 12.66 and mean length of main shoot of 5.97 cm in seedless lemon.

Desai and Patil (1984) noted 35.29 roots per air layer and highest length of roots as 38.86 mm in Jack fruit.

Tewari (1986) recorded mean number of roots as 7.0 and mean length of roots as 1.80 cm in grape air layer.

Nagone (1989) obtained mean number of roots of 7.40 per layer in pomegranate air layer prepared in the month of July under Akola conditions.

Sharma et al. (1990) reported that the China, a variety of litchi produced 39.40 roots per layer having highest length of roots as 8.9 cm than other variety Shahi.

Navaneetha et al. (1991) noted the observations on primary and secondary roots in tamarind air layers and those were 3.86 and 3.52 only, respectively. The roots obtained in tamarind layers were very less. Further, he noted highest length of roots as 3.84 cm.

Raut (1992) noted the observations on number of primary and secondary roots in guava air layer and those were 7.18 and 25.20 respectively. The mean length of primary roots obtained was 4.17 cm.

3.6 Mode of detachment of layers

The layers produce abundant root system of thick roots of dull white colour after two to three months period. These roots do not have habit of absorption of nutrient and water. In due course of time these roots turn to brown

colour. The thickness of the roots become thin and such roots are more active and useful for establishment of layers. These change of function of roots from inactive to active stage can be brought by giving cuts below the roots on the branch with giving a gap of one week between each cut. This process helps in hardening of roots and successful establishment of layers.

Ruehle (1948) reported in guava air layers that the root began to form in 3-5 weeks. Further, he added that, the layers after detachment should be kept in shade until new leaves appeared and grow upto 6"-8" in length and then these rooted layers could be shifted in full sunlight for hardening.

Malik and Maqbool (1977) detached the litchi layers from mother plants after 3 or 4 months by giving a half cut through the thickness of the branch. 15 days prior to detachment but he did not find much difference between the detachment methods.

Ulemale and Shelke (1987) suggested to give three cuts before detachment of layers of guava var. Sardar from mother plant. Three cuts should be given with interval of 10 days for each cut. The first cut of 1/3rd depth was given on a rooted branch just below the root zone then it was extended to 2/3rd after a gap of 10 days from first cut. The complete

layer should be removed from mother plant after a gap of 10 days from 2nd cut.

3.6.1 Raring after detachment in partial shade and full sunshine

Immediately after detachment, the foliage of layer is reduced and initially kept under partial shade till the new functional leaves are formed. This process helps in reduction of mortality of layer after detachment. After functional leaves are formed they are shifted to full sunlight till they are used for planting in fields. So, the rooted layers are first kept in shade for initial establishment and then shifted to full sunlight for final establishment.

Ruehle (1948) reported to keep rooted layers in shade until new leaves appear and they grow upto 6-8 inches long. At this stage, he suggested to shift the layers to full sunlight for further hardening.

2.7 Final Survival Percentage of Layers

Initially, the roots are formed to the layers and such rooted layers on detachment do not survive cent per cent. Some of them die during raring in partial shade and on exposure to sunlight for their final establishment.

Ahmed (1964) obtained higher percentage of success in air layering of guava in rainy season from June to August.

Mishra and Agrawal (1975) reported higher survival percentage of 69.99 in kagzi kalan air layer in July.

Patil and Chakrawar (1979) obtained highest percentage success as 96.67 in seedless lemon layers in the month of July. Similarly, Palaniswami et al. (1985) achieved the final survival percentage of 40 to 50 per cent in cashew air layering. Tewari (1986) obtained the final survival percentage of 59.50 in grape air layer. Also Kanwar and Kahlon (1986) noted maximum survival percentage of 76.8 in litchi when layered in the month of July. Nagone (1989) achieved the final survival percentage of 48.52 in pomegranate air layering when prepared in the month of July under Akola conditions.

Ulemale and Shelke (1987) suggested maximum survival percentage of polybag layers in guava when the layers were processed from July to August.

CHAPTER III

MATERIALS AND METHODS

The present investigation "Standardization of time for polybag layers in Guava (Psidium guajava L.) under Akola conditions" was undertaken during the year 1992 i.e. from June, 1992 to October, 1992 at the Nagarjun Garden, Department of Horticulture, Punjabrao Krishi Vidyapeeth, Akola (M.S.).

Akola is situated at 282.5 meters attitude, $20^{0}42'$ N latitude and $77^{0}02'$ E longitude with sub-tropical climate. Some important meteorological observations recorded during the course of study in the observatory at the University Campus in Agronomy Department, Akola are presented in Appendix-I.

3.1 The details of guava mother plants selected for layering and other information like number of shoots, their diameter and length are presented in Table 1.

Table 1: Details of guava mother plant and plant material used

Sr.No.	Particulars	Details
1.	Age of the guava mother tree(s) var. Sardar	6 years
2.	Number of plants of uniform size selected	15 plants
3.	Number of shoots selected for layering on each tree	14 shoots
4.	Length of shoots	50-60 cm
5.	Girth of shoots	3-4 cm

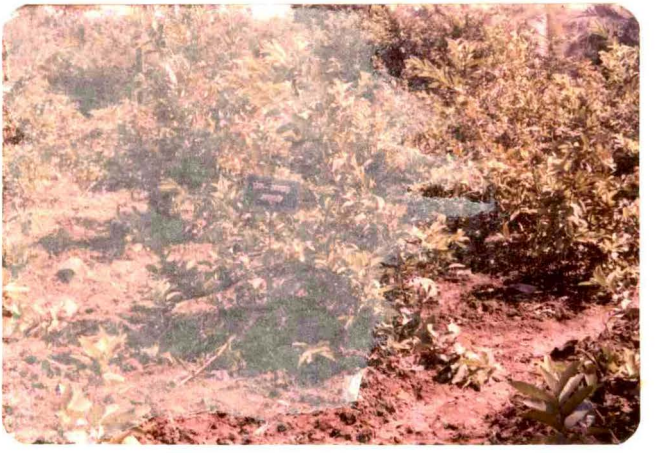


Fig. 1: Guava mother tree var. Sardar.

3.2 Experimental details viz. design employed, number of treatments, number of replications and number of shoots per treatment are presented in Table 2.

Table 2: Experimental details

Sr.No.	Item	Details
1.	Design of Experiment	: Randomised Block Design
2.	Replications	: Three
3.	Treatments	: Ten
	Details of treatments :-	
	No.of layering operations: Ten	
	June-Twice, July-Twice, August-Twice, September-Twice, October-Twice (Forthnightly)	
		T_1 - 8th June, 1992
		T_2 - 23rd June, 1992
		T_3 - 8th July, 1992
		T_4 - 23rd July, 1992
		T_5 - 8th August, 1992
		T_6 - 23rd August, 1992
		T_7 - 8th September, 1992
		T_8 - 23rd September, 1992
		T_9 - 8th October, 1992
		T_{10} - 23rd October, 1992
4.	Number of layers in each treatment and replication	: 7
5.	Total number of shoots selected for layering	: 210

PLAN OF LAYOUT

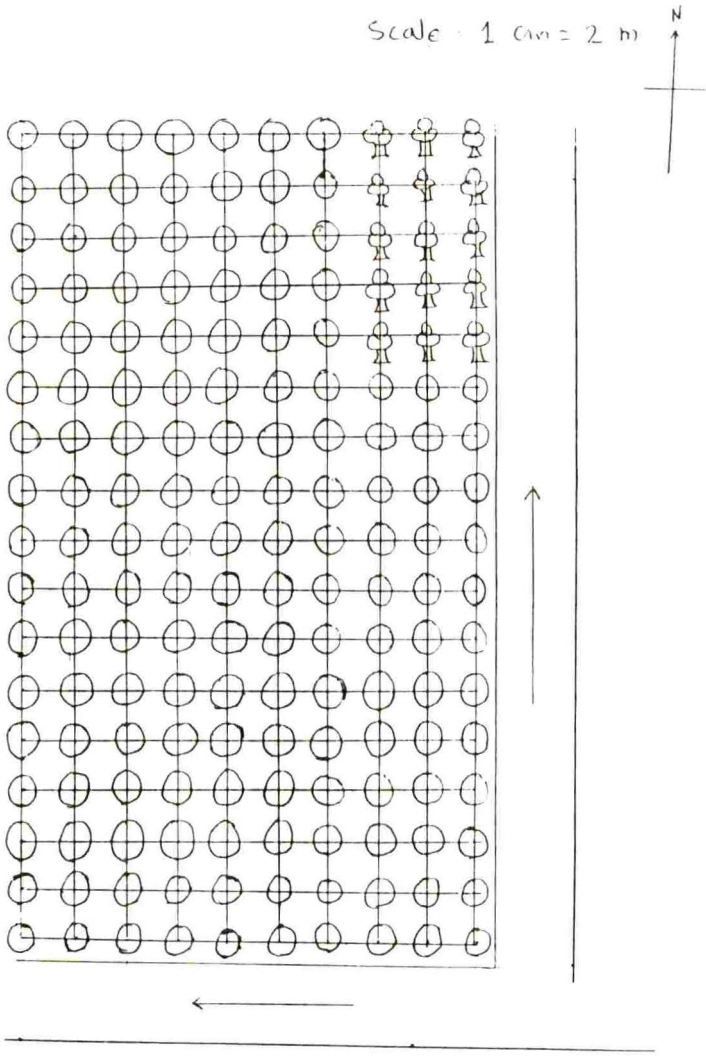


Fig. 2 Mother Orchard of guava Var. Sardar

INDEX :

O ... Non-layering trees

... layering trees

3.3 Methodology

3.3.1 Selection of plant material :

Six year old guava mother trees of uniform size of Sardar variety were selected for preparation layers by polybag method.

3.3.2 Selection of shoots

Twenty one shoots of uniform growth and size (50-60 cm in length and of pencil thickness) were selected on each plant and such fifteen mother trees were selected to prepare the layers by polybag method.

3.3.3 Selection of polybags

Polythene bags of uniform size (25 cm in height and 10 cm wide of 250 guage) were used.

3.3.4 Preparation of rooting medium

The well decomposed Farm Yard Manure, soil and sand were mixed in ratio of 1:2:1 respectively and used for filling the bags after preparation of layers.

3.3.5 Preparation of layers

The vigorous shoots of above specification and easily touching centrally to the ground were selected only 3-

Fig. 3: Photograph on polybag layering operation in guava var. Sardar.

4 leaves at apex (tip) were retained and the leaves located centrally on the branch were removed. The shoot tip was inserted from outside the bag through a hole and taken out of the bag through the hole of 2.5 cm in diameter prepared on one side of the bag just 10 cm above from closed end of bag. The slanting cut of 3-5 cm in length below the node was prepared by giving a deep cut on a selected shoot, then going half way through the thickness of a branch towards the tip just below the node. A small stick was inserted in between the tongue shaped cuts. This operated part was moved centrally in a bag and the the bag was filled with garden mixture, pressed and burried in soil leaving only 1/4 th portion outside the soil.

3.3.6 Application of water

The first watering was done immediately after operation was performed and being monsoon it was applied as and when there was break in rains.

3.3.7 Removal of layers

Initially, the root growth was seen through transplant polyethylene bag. When the roots were visible, the first cut of 1/3rd depth was given on a rooted branch just outside the bag then it was extended to 2/3rd after a gap of 10 days from the first cut. Again a gap of 10 days was

given after 2nd cut and later on the complete rooted layer was detached from the mother tree.

3.4 Observations

The layering operations were carried out twice in a month with an interval of a fortnight from June, 1992 to October, 1992. The various observations on number of days required for visible growth of roots, number of primary and secondary roots, length of primary and secondary roots, number of leaves, thickness of layers, height of layers and success percentage were recorded for each of the treatment under each replication by using two detached layers from mother trees. The above observation were recorded after detachment (90 days), before shifting from partial shade to open sunshine i.e. raring in shade (135 days) and finally after 180 days from time of layering.

3.4.1 Visual observation of rooting

Days required for appearance of roots outside the polybag were recorded by visual observation through transparent polythene bag. The layers which did not produce roots at all were considered as failure.

3.4.2 Average number of primary roots

The number of primary roots were recorded by counting after 90, 135 and 180 days from time of layering.

3.4.3 Average number of secondary roots

The treatmentwise number of secondary roots were recorded from sample layers by counting and the mean was calculated for each treatment.

3.4.4 Mean length of primary roots

The length of each primary root from each sample was measured by measuring scale and the mean length was calculated for each of the treatment.

3.4.5 Mean length of secondary roots

The length of each secondary root from each sample was measured by measuring scale and the mean length was calculated for each of the treatment.

3.4.6 Mean number of leaves

The number of leaves from rooted sample layer were counted and the mean number of leaves were calculated for each treatment.

3.4.7 Mean girth of stem of layers

The stem girth of each rooted sample layer was measured by measuring scale and the mean girth was calculated for each treatment.

3.4.8 Mean height of layers

The height of each sample rooted layer was measured by measuring scale and the mean height was calculated for each of treatment.

3.4.9 Percentage success

Success percentage was recorded on the basis of total number of layers survived in each treatment and replication after every 90, 135 and 180 days interval from time of layering.

3.5 Statistical Techniques Used

This was done by the standard method of analysis of variance as given by Panse and Sukhatme (1967). The significance was denoted by 'F' test, S.E. and C.D. values.

CHAPTER IV

EXPERIMENTAL FINDINGS

The present investigation was carried out to study the "Standardization of time of polybag layers in Guava (Psidium guajava L.) under Akola conditions" in Commercial Fruit Nursery, Nagarjun, Department of Horticulture, Punjabrao Krishi Vidyapeeth, Akola with a view to find out suitable time of polybag layering in guava var. Sardar. The observations on number of days required for visual root growth, number of primary and secondary roots, length of primary and secondary roots, number of leaves, stem girth, height of layer and survival percentage of layers were recorded from time to time and the respective observations are presented in this chapter under appropriate headings.

4.1 Days Required For Visible Root Growth

The number of days required for visual observation of root growth through transparent film of polybag in each date of layering were noted and those are presented in Table 3 and illustrated in Fig. 5.

4.1.1 Visual root growth as affected by time of layering

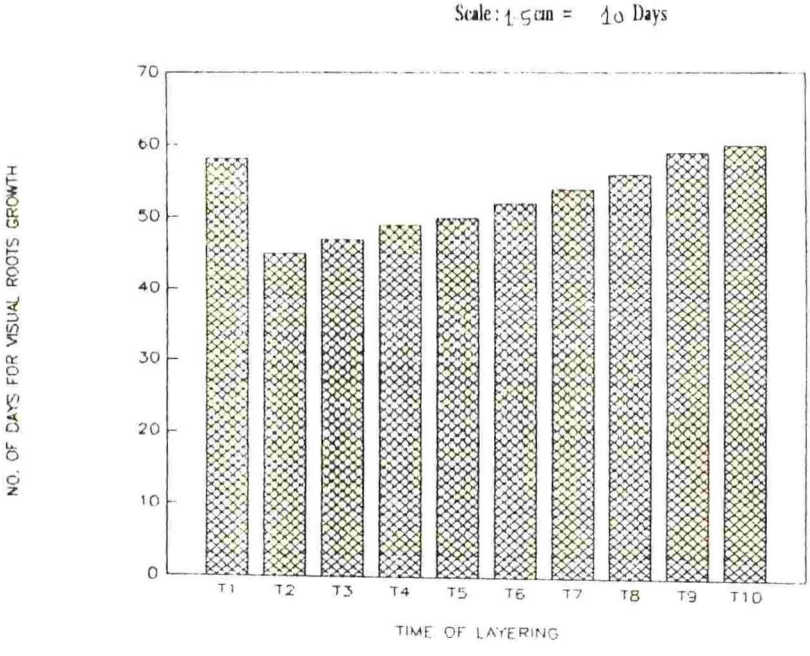
From Table 3, it reveals that visual root growth in case of operated root layers on different date of layering was definitely influenced and the results obtained showed significant differences.

Table 3: Mean number of days required for visible root growth in different time of layering by polybag method in guava

Treatments	No. of days required for visual root growth in polybag
T_1 (8th June)	58.20
T_2 (23rd June)	45.00
T_3 (8th July)	47.00
T_4 (23rd July)	49.00
T_5 (8th August)	50.00
T_6 (23rd August)	52.00
T_7 (8th September)	54.00
T_8 (23rd September)	56.00
T_9 (8th October)	59.00
T_{10} (23rd October)	60.00
'F' test	Sig.
S.E.(m) $\pm$	0.67
C.D. at 5%	2.01

The date of layering of 23rd June (T_2) was found to be significantly superior in recording the maximum visual root growth over all dates of layering except T_3. The period of 45 days was required as minimum for recording earlier visible rooting in T_2 as against period of 60 days required

Fig. 4: Photograph showing layers of different dates.



T1	-	8th June 92	T6	-	23rd Aug. 92
T2	-	23rd June 92	T7	-	8th Sept. 92
T3	-	8th July 92	T8	-	23rd Sept. 92
T4	-	23rd July 92	T9	-	8th Oct. 92
T5	-	8th Aug. 92	T10	-	23rd Oct. 92

Fig. 5: Number of days required for visual root growth as affected by time of layering

in case of (T_{10}) delayed layering. The response of T_2 was at par with T_3. Similarly, no significant differences were observed in visual observations of root growth initiated by T_{10}, T_9 and T_1 treatments. All the treatments of date of layering of T_2 followed by T_3, T_4, T_5, T_6, T_7 and T_8 significantly required the less period of 45 to 56 days for initiating visual root growth as against maximum period 58.20 to 60 days required in treatments of T_{10}, T_9 and T_1. The number of days required for visual observation of root growth was minimum of 45 days in treatment T_2 and it was progressively increased with advanced period from 23rd June to 23rd October, 1992. The period of 45 to 50 days was required for visual growth of root in case of treatments of T_2 to T_5 i.e. from 23rd June to 8th August while it was from 51 to 56 in case of treatments of T_6 to T_8 i.e. from 23rd August to 23rd September.

4.2 Mean Number of Primary Roots per Layer

During the course of present investigation, the mean number of primary roots per layer obtained in different dates of layering in guava are presented in Table 4 and illustrated in Fig. 7.

4.2.1 Effect of time of layering

The data presented in Table 4 clearly indicate that the time of layering significantly influenced the average

number of primary roots per layers at various stages of growth.

Table 4: Mean number of primary roots as influenced by time of layering

Treatments	Mean number of primary roots		
	90 days	135 days	180 days
T_1 (8th June)	4.0	5.0	6.67
T_2 (23rd June)	6.8	8.3	10.0
T_3 (8th July)	6.5	8.0	9.30
T_4 (23rd July)	6.0	7.8	8.70
T_5 (8th August)	5.73	7.4	8.30
T_6 (23rd August)	5.20	7.0	8.00
T_7 (8th September)	5.0	6.5	7.20
T_8 (23rd September)	4.70	5.9	6.70
T_9 (8th October)	3.50	4.8	6.00
T_{10} (23rd October)	3.0	4.0	5.00
'F' test	Sig.	Sig.	Sig.
S.E.(m) $\pm$	0.228	0.23	0.30
C.D. at 5%	0.679	0.68	0.91

4.2.1.1 <u>After detachment (90 days)</u>

The average number of primary roots per layers were influenced to maximum extent by treatment T_2 (6.8) and it was

Fig. 6: Photograph showing number of roots per layer as affected by time of layering.

significantly superior than the treatments of T_5 to T_{10} and T_1. The treatments T_2 and T_3 were at par. The number of roots were found to be reduced progressively when layers prepared after July onwards.

4.2.1.2 In partial shade (135 days)

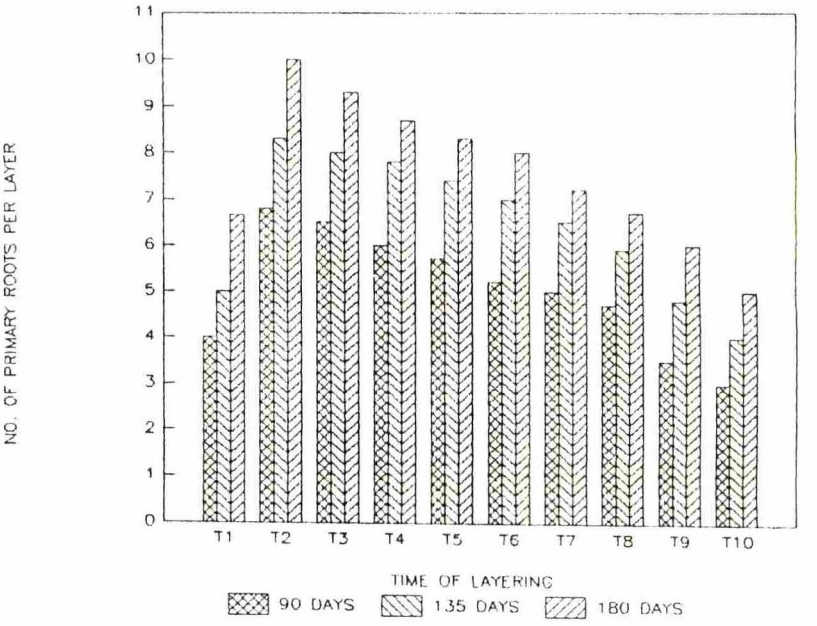
From the data presented in Table 4 and illustrated in Fig.2, it is revealed that the number of primary roots obtained in various treatments in partial shade showed significant differences.

The mean number of primary roots per layer recorded as 8.3 in treatment of T_2 (23rd June) were significantly higher than all other treatments. The treatments of T_2, followed by T_3 and T_4 significantly increased the number of primary roots per layer over the treatments of T_7, T_8, T_9, T_{10} and T_1. However, the response obtained in treatments of T_2 to T_5 was at par. The treatments of T_6 to T_8 also significantly increased the number of primary roots per layer over the treatments of T_1, T_9 and T_{10} treatments. The production of primary roots in treatments of T_1 and T_9 were at par but showed significant response over treatment of T_{10}.

4.2.1.3 In open sunshine (180 days)

The data in respect of number of primary roots obtained under each treatment in open space after 180 days

Scale 1 cm = 1 root



T1	-	8th June 92	T6	-	23rd Aug. 92
T2	-	23rd June 92	T7	-	8th Sept. 92
T3	-	8th July 92	T8	-	23rd Sept. 92
T4	-	23rd July 92	T9	-	8th Oct. 92
T5	-	8th Aug. 92	T10	-	23rd Oct. 92

Fig. 7: Mean number of primary roots per layer as affected by time of layering at various growth stages.

from the date of layering are presented in Table 4 and in Fig. 2. The various dates of layerage showed significant differences in producing the number of primary roots.

The treatments T_2 followed by T_3 to T_6 gave significantly higher number of primary roots per layer over treatments of T_7 to T_{10} and T_1. The response noted in treatments T_2 followed by T_3 showed highest response on production of maximum number of primary roots over the treatments of T_5 to T_{10} and T_1. The response noted in T_2 and T_3 was at par. Similarly, the treatments of T_7, T_1, T_8 and T_9 also significantly increased more number of primary roots per layer as compared to the treatment of T_{10}.

4.3 Mean Number of Secondary Roots

During the course of present investigation an mean number of secondary roots per layer recorded with different dates of layering at various stages are presented in Table 5 and illlustrated in Fig. 8.

4.3.1 Effect of time of layering

The observation on mean number of secondary roots per layer recorded under each date of layering at 90, 135 and 180 days showed significant differences.

4.3.1.1 After detachment (90 days)

All dates of layering from 8th June to 8th October significantly increased the number of secondary roots per layer over the layering date of 23rd October. The mean number of secondary roots per layer were maximum in treatment of T_2 followed by T_3, T_4, T_5, T_6 and T_7. All these treatments in asending order were significantly superior over the immediate treatment. Whereas treatment T_8 and T_1 were at par but significantly increased the secondary roots in comparison with the treatments of T_9 and T_{10}.

4.3.1.2 In partial shade (135 days)

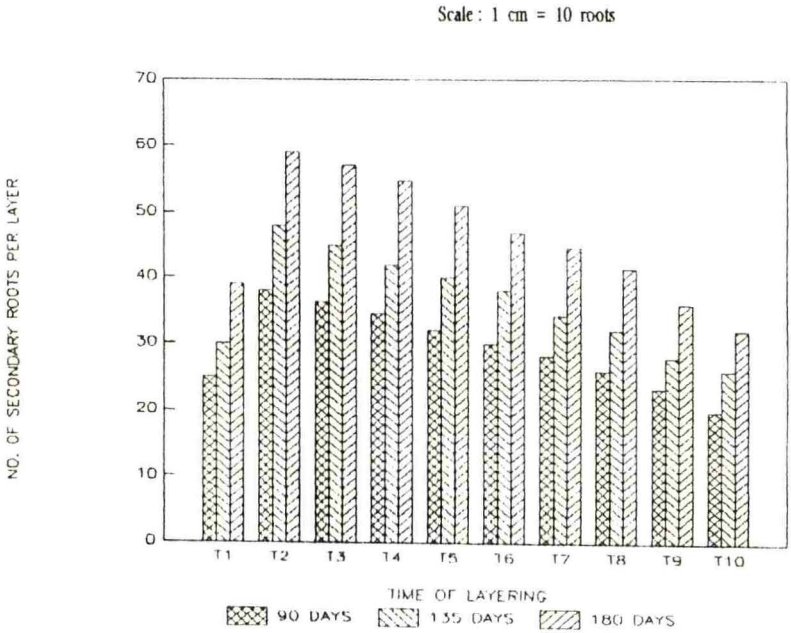
All the treatments progressively increased the mean number of secondary roots per layer upto 135 days and trend of increase in each treatment was similar to that of obtained in earlier data presented at 90 days.

4.3.1.3 In open sunshine (180 days)

From Table 5, it is clearly seen that the time of layering significantly influenced the average number of secondary roots in open sunshine (180 days).

Table 5: Mean number of secondary roots as influenced by time of layering at various stages

Treatments	Mean number of secondary roots		
	90 days	135 days	180 days
T_1 (8th June)	25.0	30.0	39.0
T_2 (23rd June)	38.0	48.0	59.0
T_3 (8th July)	36.2	45.0	57.0
T_4 (23rd July)	34.5	42.0	54.67
T_5 (8th August)	32.11	40.0	51.0
T_6 (23rd August)	30.0	38.0	47.0
T_7 (8th September)	28.2	34.2	44.67
T_8 (23rd September)	26.0	32.1	41.33
T_9 (8th October)	23.3	28.0	36.00
T_{10} (23rd October)	20.0	26.0	32.00
'F' test	Sig.	Sig.	Sig.
S.E.(m) $\pm$	0.368	0.346	0.37
C.D. at 5%	1.094	1.029	1.109



T1	-	8th June 92	T6	-	23rd Aug. 92
T2	-	23rd June 92	T7	-	8th Sept. 92
T3	-	8th July 92	T8	-	23rd Sept. 92
T4	-	23rd July 92	T9	-	8th Oct. 92
T5	-	8th Aug. 92	T10	-	23rd OOct. 92

Fig. 8: Mean number of secondary roots per layer as affected by time of layering at various growth stages.

The influence obtained for each date of layering from 8th June to 23rd October was similar to that of obtained after 135 days. The mean number of secondary roots of 59.0, 57.0, 54.07, 51.00, 47.00, 44.67, 41.33, 39.00, 36.00 and 32.00 were recorded under the treatments of T_2, T_3, T_4, T_5, T_6, T_7, T_8, T_1, T_9 and T_{10} respectively. The number of secondary roots obtained in treatment of T_{10} (23rd October) was lowest and significantly less as compared to all remaining treatments. The highest response was obtained in T_2 (23rd June) followed by T_3 (8th July), T_4 (23rd July), T_5 (8th August) and the values of secondary roots were ranged from 51 to 59.

4.4 Mean Length of Primary Roots

The data in respect of mean length of primary root are presented in Table 6 and illustrated in Fig. 9.

4.4.1 Effect of time of layering

The data presented in Table 6 reveal that the mean length of roots per layer recorded under each date of layering at 90, 135 and 180 days showed significant response consistently.

Table 6: Average length of primary roots as influenced by time of layering at various stages of growth

Treatments	Average length of primary roots		
	90 days	135 days	180 days
T_1 (8th June)	6.00	8.0	10.00
T_2 (23rd June)	12.00	16.0	19.43
T_3 (8th July)	10.60	14.43	18.50
T_4 (23rd July)	9.80	12.60	17.10
T_5 (8th August)	9.00	11.30	16.20
T_6 (23rd August)	8.10	11.00	15.30
T_7 (8th September)	7.00	10.20	13.67
T_8 (23rd September)	6.50	9.00	11.00
T_9 (8th October)	5.60	7.00	9.09
T_{10} (23rd October)	5.00	6.30	8.00
'F' test	Sig.	Sig.	Sig.
S.E.(m) $\pm$	0.31	0.30	0.37
C.D. at 5%	0.92	0.90	1.11

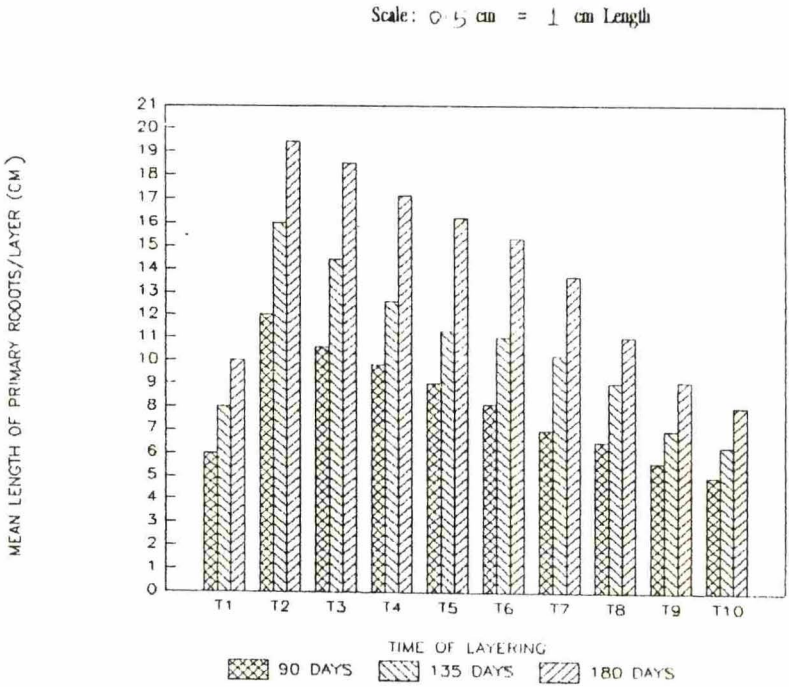
4.4.1.1 After detachment (90 days)

The response of primary root length obtained in T_2 (23rd June) treatment was significantly highest as compared

to all other treatments. The treatment of T_3 and T_4 were at par but these treatments showed significant response in increasing the length of primary roots per layer over the treatments T_5, T_6, T_7, T_8, T_1, T_9 and T_{10}. The treatments of T_5 and T_6 did not show any significant differences but these treatments significantly increased the length of primary roots/layer over the treatments T_7, T_8, T_1, T_9 and T_{10}. The length of primary roots obtained in treatment T_8 were at par with the treatments T_7 and T_1. However, the treatments T_7, T_8 and T_1 gave significantly more length of primary root as compared to the treatment T_{10} which was at par with T_9.

4.4.1.2 In partial shade (135 days)

The observations recorded at 135 days in Table 6 indicate that the response of T_2 was significantly higher in producing maximum length of primary root as compared to all other treatments. The treatments of T_3 and T_4 were found significant in increasing the length of primary root as compared to the treatment T_5 to T_{10} and T_1. The treatment T_6 did not show any significant differences in length of primary root obtained in the treatments of T_5 and T_7. However, the response was significantly more as compared to the treatments of T_8, T_1, T_9 and T_{10}. The treatment effect recorded with treatment T_9 and T_{10} was at par.



T1	-	8th June 92	T6	-	23rd Aug. 92
T2	-	23rd June 92	T7	-	8th Sept. 92
T3	-	8th July 92	T8	-	23rd Sept. 92
T4	-	23rd July 92	T9	-	8th Oct. 92
T5	-	8th Aug. 92	T10	-	23rd OOct. 92

Fig. 9: Mean length of primary roots per layer as affected by time of layering at various growth stages.

4.4.1.3 In open sunshine (180 days)

The data presented in respect of mean length of primary root recorded after 180 days in Table 6, show that all the dates of layering from 8th June to 23rd September at fortnightly interval significantly gave more length of primary root as compared to the layering on 23rd October. No significant differences were obtained between the dates of layering on 8th October and 23rd October. The maximum primary root length of 19.43 cm and 18.5 cm were obtained with T_2 and T_3 respectively and both these treatments were found to be significantly superior over remaining treatments. The length of primary root of 16.2 obtained with T_5 treatment was at par with 17.1 and 15.3 noted in treatments of T_4 and T_6 respectively. However, the response recorded by these treatments was significantly more over the treatments from T_7 to T_{10} and T_1. The lowest value of 8.00 cm per mean primary root length was obtained in treatment T_{10} which was at par with treatment T_9 having mean primary root length of 9.09 cm. Both T_1 and T_9 were also at par.

4.5 Mean Length of Secondary Roots

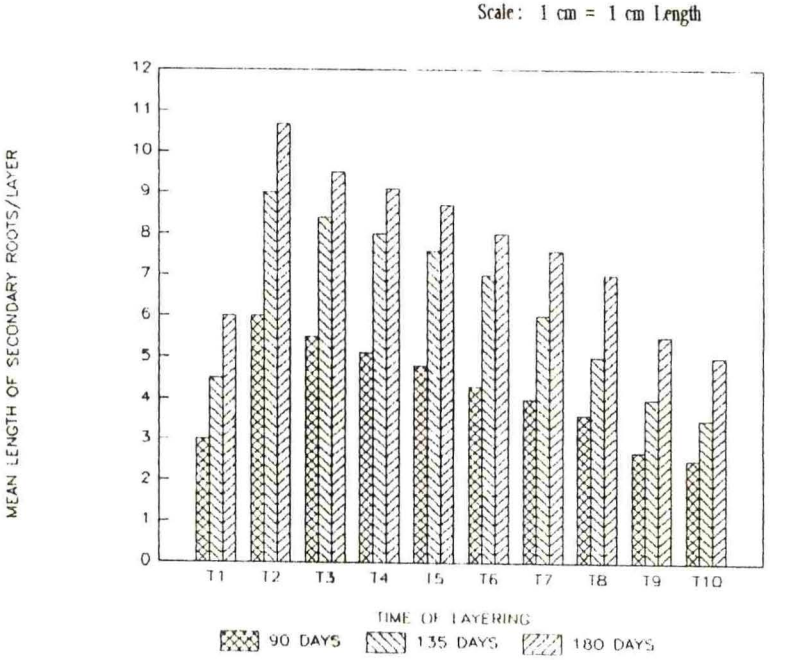
The data on mean length of secondary roots per layer as affected by different dates of layering at various stages are presented in Table 7 and illustrated in Fig. 10.

Table 7: Mean length of secondary roots as influenced by time of layering at various stages of growth

Treatments	Mean length of secondary roots		
	90 days	135 days	180 days
T_1 (8th June)	3.0	4.5	6.00
T_2 (23rd June)	6.0	9.0	10.67
T_3 (8th July)	5.5	8.4	9.50
T_4 (23rd July)	5.1	8.0	9.09
T_5 (8th August)	4.8	7.6	8.70
T_6 (23rd August)	4.3	7.0	8.00
T_7 (8th September)	4.0	6.0	7.60
T_8 (23rd September)	3.6	5.0	7.00
T_9 (8th October)	2.7	4.0	5.50
T_{10} (23rd October)	2.5	3.5	5.00
'F' test	Sig.	Sig.	Sig.
S.E.(m) ±	0.24	0.26	0.50
C.D. at 5%	0.70	0.77	1.48

4.5.1 Effect of time of layering

From Table 7, it appears that the dates of layering had significant response on mean length of secondary roots at all stages of growth i.e. at 90, 135 and 180 days from date of layering.



T1	-	8th June 92	T6	-	23rd Aug. 92
T2	-	23rd June 92	T7	-	8th Sept. 92
T3	-	8th July 92	T8	-	23rd Sept. 92
T4	-	23rd July 92	T9	-	8th Oct. 92
T5	-	8th Aug. 92	T10	-	23rd Oct. 92

Fig. 10: Mean length of secondary roots per layer as affected by time of layering at various growth stages.

4.5.1.1 After detachment (90 days)

The data recorded at 90 days in Table 7 clearly indicate that the treatments of T_2 (6.00 cm) followed by T_3 (5.5 cm) gave significantly maximum response on mean length of secondary roots per layer over all other treatments. The next best treatments of T_4 and T_5 also significantly increased the length of secondary roots as compared to the treatments of T_7 to T_{10} and T_1. The treatments of T_1, T_9 and T_{10} were found equally effective and recorded the mean values of secondary roots per layer as 3.00, 2.7 and 2.3 cm respectively.

4.5.1.2 In partial shade (135 days)

The mean secondary roots per layer recorded after 135 days were as 9.0 and 8.4 cm in treatments of T_2 and T_3 respectively and these values were significantly higher over the treatments of T_5 to T_{10} and T_1 treatments. The response of T_3 treatment was at par with T_4. The next best treatments of T_5 and T_6 also showed significant response on mean length of secondary roots over the treatments of T_7 to T_{10} and T_1. The mean length of secondary roots obtained in T_7 and T_8 were also significantly more as compared to the treatments of T_9 and T_{10}. The treatments T_9 was observed to be equally effective in increasing the length of secondary roots when

compared with the response obtained in the treatments of T_1 and T_{10}.

4.5.1.3 In open sunshine (180 days)

The data on mean length of secondary roots recorded after 180 days showed that the treatments of T_2 (10.67 cm) followed by T_3 (9.50 cm), T_4 (9.09 cm) and T_5 (8.70 cm) significantly gave higher mean length of secondary roots over the treatments T_7 and T_{10} and T_1. However, the highest response was obtained with T_2 treatment. The treatments of T_4 and T_5 showed equally good response but did not show any significant differences with T_3 and T_6. The mean length of 7.6 cm of secondary roots in treatment T_7 was found to be more than treatments of T_1, T_9 and T_{10}. The response obtained in treatments of T_8 followed by T_1 was also significantly more than treatment T_{10}. The treatments T_8, T_9 and T_1 were observed at par.

4.6 Mean Number of Leaves

The data on mean number of leaves per layer obtained in different dates of layering at various stages are presented in Table 8 and illustrated in Fig. 11.

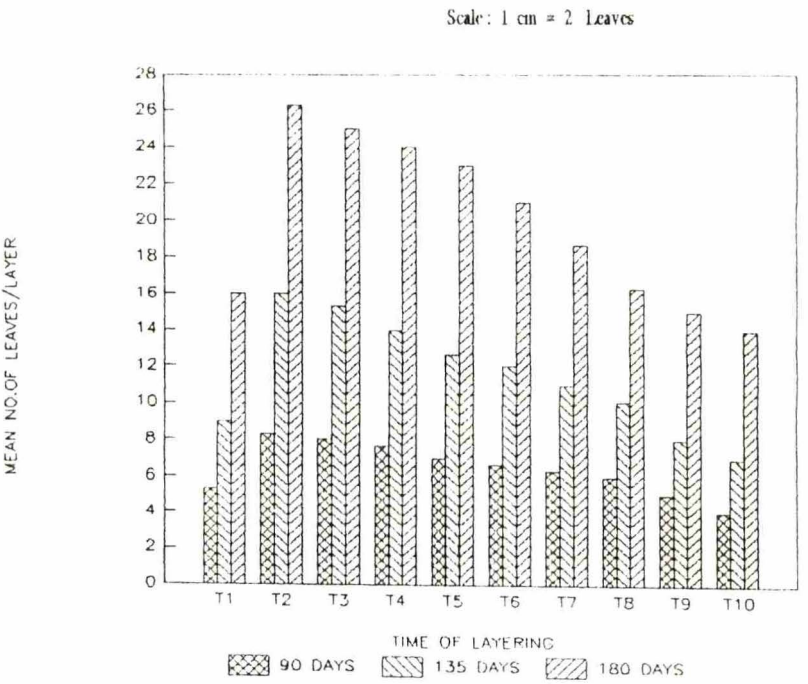
4.6.1 Effect of time of layering

From the data given in Table 8, it is seen that the treatments of different dates of layering gave significant

response on number of leaves per layer at all stages i.e. at 90, 135 and 180 days from the date of layering.

Table 8: Mean number of leaves per layer as influenced by time of layering at various stages

Treatments	Mean number of leaves per layer		
	90 days	135 days	180 days
T_1 (8th June)	5.33	9.00	16.00
T_2 (23rd June)	8.33	16.00	26.27
T_3 (8th July)	8.00	15.33	25.00
T_4 (23rd July)	7.67	14.00	24.00
T_5 (8th August)	7.00	12.67	23.00
T_6 (23rd August)	6.67	12.00	21.00
T_7 (8th September)	6.33	11.00	18.67
T_8 (23rd September)	6.00	10.10	16.33
T_9 (8th October)	5.00	8.00	15.00
T_{10} (23rd October)	4.00	7.00	14.00
'F' test	Sig.	Sig.	Sig.
S.E.(m) $\pm$	0.48	0.31	0.62
C.D. at 5%	1.43	0.93	1.84



T1	-	8th June 92	T6	-	23rd Aug. 92
T2	-	23rd June 92	T7	-	8th Sept. 92
T3	-	8th July 92	T8	-	23rd Sept. 92
T4	-	23rd July 92	T9	-	8th Oct. 92
T5	-	8th Aug. 92	T10	-	23rd Oct. 92

Fig. 11: Mean number of leaves per layer as affected by time of layering at various growth stages.

4.6.1.1 After detachment (90 days)

The number of leaves per layer was significantly higher in treatments T_2 and T_3 as compared to all other treatments. The treatment T_4 was at par with T_5 but significantly increased the number of leaves over the treatments T_6 to T_{10} and T_1. The response of treatment of T_5 was significantly better than the treatments of T_1, T_9 and T_{10}. The treatment of T_6, T_7 and T_8 also significantly increased the number of leaves as compared to the treatments of T_9 and T_{10}. The influence of treatment T_1, T_9 and T_{10} was more or less same. The number of leaves produced in treatment T_1 (5.33) were observed to be at par with treatments of T_7 (6.33) and T_8 (6.00). The minimum of 4 number of leaves followed 5 were obtained in treatments T_{10} and T_9 respectively.

4.6.1.2 In partial shade (135 days)

The number of leaves of 16.00 and 15.33 were obtained respectively in T_2 and T_3 treatments and these values were significantly higher than remaining treatments. The treatment of T_4 showed significantly more leaves as compared to the treatments of T_5 to T_{10} and T_1. The number of leaves produced in treatment of T_5 and T_6 were significantly more than the treatments of T_7 to T_{10} and T_1.

The number of leaves obtained in treatments T_7, T_8, T_1 and T_9 were significantly more than the treatment T_{10}.

4.6.1.3 In open sunshine (180 days)

The values of 26.67, 25 and 24 as number of leaves per layer were recorded respectively in the treatments of T_2, T_3 and T_4 and the response obtained was significantly superior over all remaining treatments. The response observed in treatments of T_5 and T_6 was significantly better than the treatments T_7 to T_{10} and T_1. The number of leaves of 18.67 recorded in treatment T_7 was significantly more than the treatments T_8 to T_{10} and T_1. Although the treatments of T_8 and T_1 gave significant response over the treatment of T_{10}, these treatments were observed to be at par with T_9. No significant differences were seen on number of leaves produced by the treatments T_9 and T_{10}. The minimum value of 14 as number leaves was recorded in treatment T_{10}.

4.7 Mean Girth of Layers

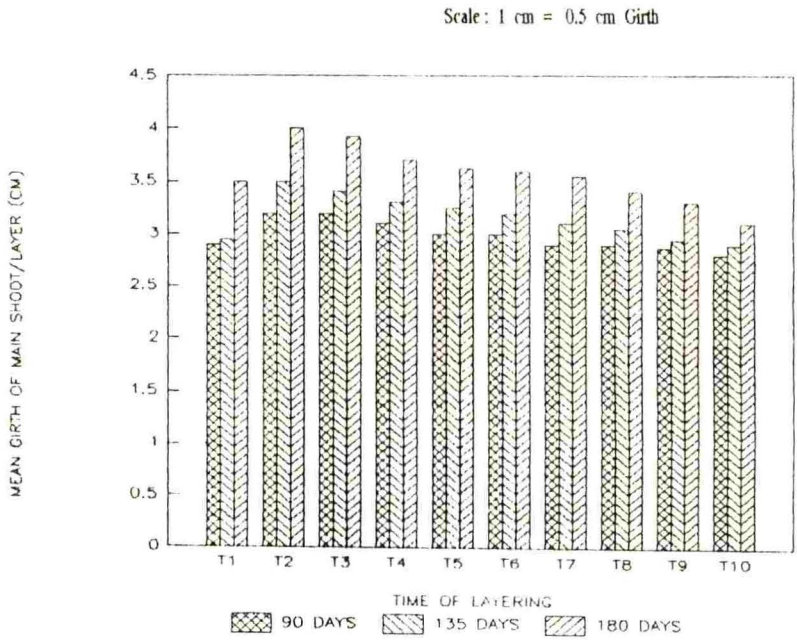
The data recorded in respect of mean girth of layers is presented in Table 9 and illustrated in Fig. 12.

Table 9: Mean girth of main shoot as influenced by time of layering

Treatments	Mean girth of main shoot (in cm)		
	90 days	135 days	180 days
T_1 (8th June)	2.90	2.95	3.50
T_2 (23rd June)	3.20	3.50	4.00
T_3 (8th July)	3.20	3.40	3.93
T_4 (23rd July)	3.10	3.30	3.70
T_5 (8th August)	3.00	3.25	3.63
T_6 (23rd August)	3.00	3.20	3.60
T_7 (8th September)	2.90	3.10	3.55
T_8 (23rd September)	2.90	3.05	3.40
T_9 (8th October)	2.87	2.95	3.30
T_{10} (23rd October)	2.80	2.90	3.10
'F' test	Sig.	Sig.	Sig.
S.E.(m) ±	0.10	0.04	0.05
C.D. at 5%	-	0.12	0.15

4.7.1 Effect of time of layering

From the data given in Table 9, it is seen that the treatments of different dates of layering gave significant response on mean girth of main shoot layer at all stages of growth i.e. at 90, 135 and 180 days from the date of layering.



T1	-	8th June 92	T6	-	23rd Aug. 92
T2	-	23rd June 92	T7	-	8th Sept. 92
T3	-	8th July 92	T8	-	23rd Sept. 92
T4	-	23rd July 92	T9	-	8th Oct. 92
T5	-	8th Aug. 92	T10	-	23rd Oct. 92

Fig. 12: Mean girth of main shoot of layer as affected by time of layering at various growth stages.

4.7.1.1 After detachment (90 days)

From Table 9, it reveals that the mean girth of main shoot of layer obtained in different treatments was found to be non-significant.

4.7.1.2 In partial shade (135 days)

From Table 9, it is seen that the mean girth of main shoot of layer were significantly influenced by date of layering. The mean girth of main shoot of layers of 3.50 cm and 3.40 cm were obtained respectively in T_2 (23rd June) and T_3 (8th July) respectively and these values were significantly higher than remaining treatments. The treatment of T_4 showed significantly more girth as compared to the treatments of T_5 to T_{10} and T_1. The girth of main shoot of layers in treatment T_5 and T_6 were significantly more than the treatments of T_7 to T_{10} and T_1. The girth of main shoot obtained in treatments T_7, T_8, T_1 and T_9 were significantly more than the treatment T_{10} (23rd October).

4.7.1.3 In open sunshine (180 days)

The values of 4.0 cm and 3.93 cm as girth were recorded respectively in the treatments of T_2 and T_3 (23rd June and 8th July) and the response obtained was significantly superior over all remaining treatments. The response observed in treatments of T_4, T_5, T_6 and T_7 was significantly better than the treatments T_8 to T_{10} and T_1. The girth of shoot of 3.50 (8th June) was significantly more

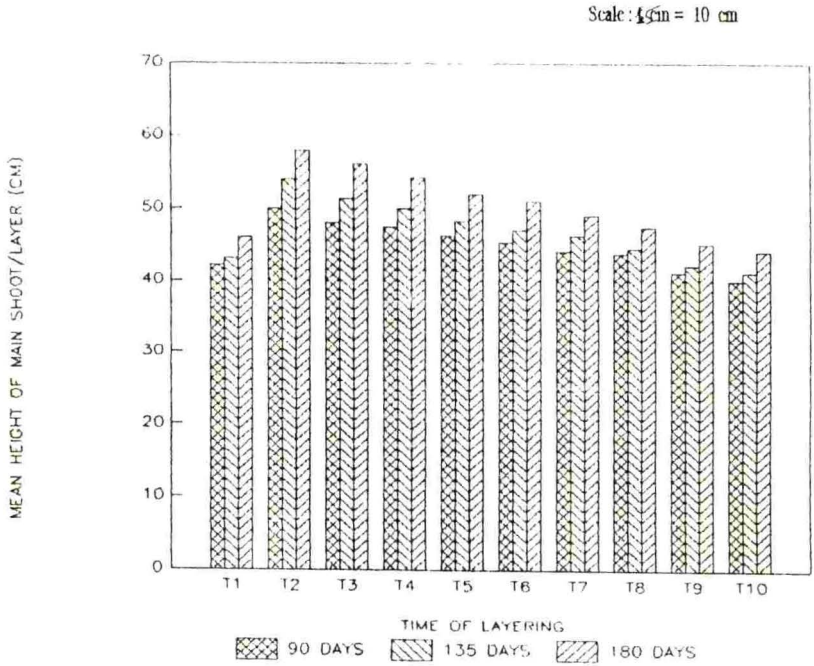
than the treatments of T_8 to T_{10} (23rd September to 23rd October respectively). Although the treatment of T_8 was at par with T_1 and T_9 but it was superior than T_{10} (23rd October). The minimum girth of 3.10 cm was observed in layers prepared on 23rd October (T_{10}).

4.8 Mean Height of Layers

The data on mean height of layers obtained in different dates of layering at various stages are presented in Table 10 and illustrated in Fig. 13.

Table 10: Mean height of main shoot as influenced by time of layering at various stages

Treatments	Mean height of main shoot (in cm)		
	90 days	135 days	180 days
T_1 (8th June)	42.17	43.00	46.00
T_2 (23rd June)	50.00	54.00	58.00
T_3 (8th July)	48.00	51.33	56.10
T_4 (23rd July)	47.33	50.00	54.30
T_5 (8th August)	46.20	48.20	52.00
T_6 (23rd August)	45.30	47.00	51.00
T_7 (8th September)	44.00	46.30	49.00
T_8 (23rd September)	43.67	44.33	47.30
T_9 (8th October)	41.00	42.00	45.00
T_{10} (23rd October)	40.00	41.00	44.00
'F' test	Sig.	Sig.	Sig.
S.E.(m) ±	0.50	0.42	0.38
C.D. at 5%	1.48	1.26	1.12



T1	-	8th June 92	T6	-	23rd Aug. 92
T2	-	23rd June 92	T7	-	8th Sept. 92
T3	-	8th July 92	T8	-	23rd Sept. 92
T4	-	23rd July 92	T9	-	8th Oct. 92
T5	-	8th Aug. 92	T10	-	23rd Oct. 92

Fig. 13: Mean height of main shoot in guava as affected by time of layering at various growth stages.

4.8.1 Effect of time of layering

It is seen from Table 10 that the mean height of layers obtained in each date of layering was found to be significant in increasing the height of layer at all stages of growth i.e. 90, 135 and 180 days after layering.

4.8.1.1 After detachment (90 days)

The mean height of layer was significantly higher in case of treatments of T_2 and T_3 over all remaining treatments. The treatments T_4 followed T_5 also significantly increased more height of layer than the treatments T_5 and T_6 was at par. Similarly, the treatments of T_7, T_8 and T_1 showed significant response over the treatments T_{10}. No significant differences were observed in between the treatments of T_9 and T_{10}.

4.8.1.2 In partial shade (135 days)

The treatments of T_2 followed by T_3 and T_4 showed significantly highest response on mean height of layers over all remaining treatments. The next best treatments of T_4 followed by T_5 also significantly increased the mean length of layers as compared to the treatments of T_7 to T_{10} and T_1.

The treatments of T_5 and T_6 were observed to be equally effective. The treatment of T_7 produced significantly more height of layer as compared to the treatments of T_1, T_9 and T_{10}. No significant differences were noticed in between the treatments of T_1, and T_{10} with T_9. The response of treatment T_8 was significantly more than that of T_9 and T_{10}.

4.8.1.3 In open sunshine (180 days)

The maximum height of 58.00 cm was obtained with treatment T_2 and it was significantly higher than all remaining treatments. The influence of treatments of T_3 (56.10 cm) followed by T_4 (54.30 cm) and T_5 (52.00 cm) was significantly more than the treatments of T_2 to T_{10} and T_1. The treatments of T_7 followed by T_8 and T_1 also significantly increased more height of layer as compared to the treatment T_{10}. There were no significant differences in height of layer affected by treatment T_9 and T_{10}.

4.9 Survival Percentage

The data in respect of survival percentage are recorded in Table 11 and illustrated from Fig. 14.

4.9.1 Effect of time of layering

From Table 11, it appears that the dates of layering had significant response on mean survival percentage

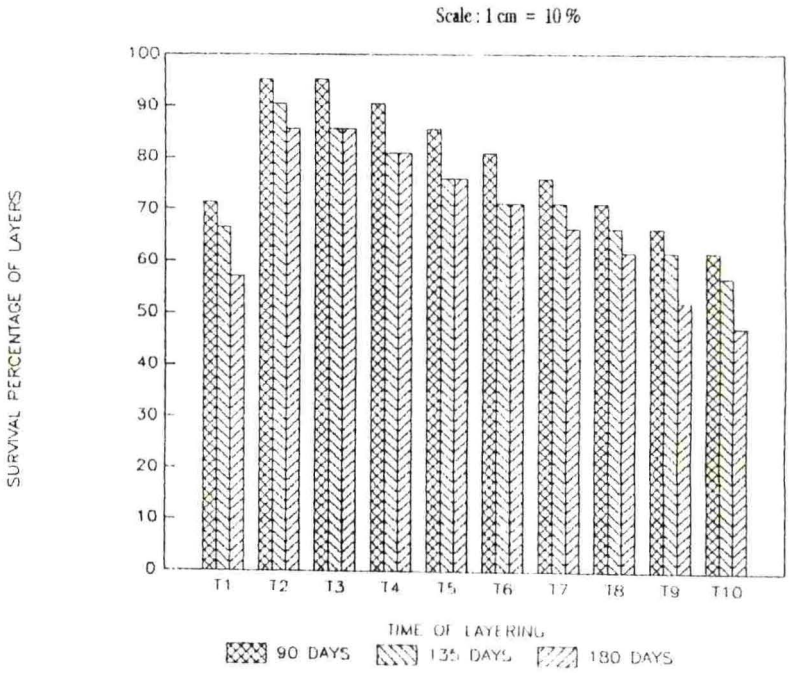
at all stages of growth i.e. at 90, 135 and 180 days from date of layering.

Table 11: Survival percentage of layers as influenced by time of layering

Treatments	Survival percentage of layers		
	90 days	135 days	180 days
T_1 (8th June)	71.43	66.67	57.14
T_2 (23rd June)	95.24	90.47	85.71
T_3 (8th July)	95.24	85.71	85.71
T_4 (23rd July)	90.47	80.95	80.95
T_5 (8th August)	85.71	76.19	76.19
T_6 (23rd August)	80.95	71.43	71.42
T_7 (8th September)	76.19	71.43	66.67
T_8 (23rd September)	71.43	66.67	61.90
T_9 (8th October)	66.67	61.90	52.38
T_{10} (23rd October)	61.90	57.14	47.62
'F' test	Sig.	Sig.	Sig.
S.E.(m) ±	4.68	3.58	4.26
C.D. at 5%	13.91	10.65	12.65

4.9.1.1 After detachment (90 days)

The data recorded at 90 days in Table 11 clearly indicate that the treatments of T_2 (95.24%) T_3 (95.24%)



T1	-	8th June 92	T6	-	23rd Aug. 92
T2	-	23rd June 92	T7	-	8th Sept. 92
T3	-	8th July 92	T8	-	23rd Sept. 92
T4	-	23rd July 92	T9	-	8th Oct. 92
T5	-	8th Aug. 92	T10	-	23rd Oct. 92

Fig. 14: Survival percentage of layers as affected by time of layering at various growth stages.

followed by T_4 (90.42%) gave significantly maximum response on mean survival percentage over all other treatments. Statistically, treatment T_2 was at par with T_3 and T_4. The next best treatments of T_5 and T_6 (8th August & 23rd August) gave significantly more survival percentage than T_7 to T_{10} and T_1. While T_1 (8th June) had more survival percentage of 71.43 and was observed more superior than T_9 and T_{10}. The treatment T_{10} (23rd October) had lowest survival of 61.90 per cent.

4.9.1.2 In partial shade (135 days)

From the data in Table 11, it reveals that the mean survival percentage recorded after 135 days were as 90.47, 85.71, 80.95 in treatments of T_2, T_3 and T_4 respectively and these values were significantly higher over that treatments of T_5 to T_{10} and T_1. The treatments of T_2 was at par with T_3 and T_4. The response of T_5 treatment was at par with T_6, T_7, T_8 and T_1 treatments. While the treatment T_1 gave more survival percentage than T_9 (8th October) and T_{10} (23rd October). The T_9 and T_{10} were found to be at par. Hence, the observations of reduction in survival percentage was observed proportionately with delaying in layering. Therefore, lowest survival percentage of 57.14 per cent was observed in treatment T_{10} (23rd October).

4.9.1.3 In open sunshine (180 days)

The data on final survival percentage recorded after 180 days show that the treatments of T_2 (85.71%) and T_3 (85.71%) significantly gave maximum survival percentage than all other treatments and both were at par. The next best treatment was T_4 (80.95%) and was found to be superior than T_5 to T_{10} and T_1 treatments. The survival percentage obtained in treatment T_5 (76.19%) and T_6 (71.42%) were higher than T_7 to T_{10} and T_1. However, T_1 (57.14%) treatment significantly gave more survival percentage than T_9 and T_{10} treatments. The treatment of T_9 was superior than T_{10}. The minimum final survival percentage of 47.62 was observed in treatment T_{10} (23rd October).

CHAPTER V

DISCUSSION

The present investigation on "standardization of time for polybag layers in Guava (Psidium guajava L.) under Akola conditions" was conducted at commercial fruit nursery, Punjabrao Krishi Vidyapeeth, Akola during the period from June, 1992 to February, 1993. The layering operations were carried out with ten dates of layering commencing from 8th June with fortnightly interval upto 23rd October with a object to find out best suitable time of layering. The results obtained in respect of various parameters of root growth as well as shoot growth alongwith their survival percentage have been discussed in this chapter.

5.1 Visual Growth of Roots

The observations of roots visible through the transparent film of polybag were recorded as and when visible and the number of days required for this purpose were noted for each date of layering.

In the present studies, the layers prepared on 23rd June (T_2) took 45 days as minimum period and this treatment was significantly superior over all remaining treatments except treatment T_3 (8th July). Treatment T_3 produced the visible roots at 47th day and it was at par with treatment

T_2. The period of 49 and 50 days was required for visual root growth in case of treatments of T_4 (23rd July) and T_5 (8th August) and the number of days required were much less than treatments of T_6 to T_{10} and T_1. The treatments of T_6, T_7 and T_8 produced the visible roots at 52nd and 54th and 56th day respectively as compared to the treatments of T_1 (58.20), T_9 (59.00) and T_{10} 60 days respectively which were at par and took longer period for root growth.

The visible root growth obtained within the layers operated on 23rd June, 8th July, 23rd July and 8th August required the period of 45 to 50 days and the requirement of lesser number of days for visible roots might be due to prevailing of favourable environmental conditions existing during rainy season from June to September and to some extent in October too. During this period the total rainfall of 888.2 mm was received in 40 days with maximum intensity in August. The mean maximum temperature was ranged between 29.7 to 39.3 and the minimum between 21.3 to 25.9^{0}C. The maximum and minimum relative humidity recorded in morning and evening hours were respectively as 62 to 89 and 37 to 72 per cent. These favourable conditions might have accelerated the process of callusing, formation root primordia and root growth too. The minimum period of 45 to 50 days required to record visible root growth in treatments of T_2, T_3, T_4 and T_5 might be due to early initiation encouraged by favourable

environmental conditions existing from 23rd June to September end.

The layering operations carried out in October took maximum period of 60 days for visual root growth and perhaps this might be due to less humidity, low temperatures etc.

The results of minimum and maximum days required for visible root growth are in close confirmity from the work carried out by some workers. The findings of profuse rooting in pomegranate air layers was reported after third week of July by Srivastava (1961). Best rooting was obtained in Kagzi kalan air layers in the month of July under Shrinagar conditions by Mishra and Agrawal (1975). Patil and Chakrawar (1979) reported higher percentage of rooting in seedless lemon in July under Parbhani conditions. Suriyapananont (1990) obtained best rooting in apple when layered in June but reported poor performance in the month of October to December.

5.2 Number of roots as affected by time of layering

In the present investigation, the various dates (treatments) caused a marked increase in number of primary and secondary roots per layers. Among the various dates, 23rd June (T_2) followed by 8th July (T_3) were found to be significantly best period over all remaining dates of

layering by polybag method in guava var. Sardar. The layers under treatment T_2 produced maximum number of primary roots as 6.8, 8.3 and 10.0 and secondary roots as 38.0, 49.0 and 59.0 respectively at 90th, 135th and 180th day from time of layering when compared with other treatments (layering dates).

Similarly, the results noted in respect of primary and secondary roots in case of T_3 and T_4, the response of both the treatments was found to be equally effective in respect of production of secondary roots. However T_3 and T_4 were observed to be next best treatments.

The maximum number of primary and secondary roots obtained in layers performed on 23rd June, 8th July and 23rd July might be due to favourable environmental conditions encouraging more number of primary and secondary roots. The results obtained are more or less in agreement with the number of roots of 49.76 per cent layer obtained in seedless lemon by air layering by Patil and Chakrawar (1979). Also Desai and Patil (1984) reported as 35.29 roots per layer in air layering of jackfruit while Sharma et al. (1990) reported number of roots as 39.40 per layer by air layering in litchi.

On comparing the results obtained in earlier and later dates of layering, T_2, T_3 and T_4 produced maximum

number of primary and secondary roots over the treatments T_1, T_9 and T_{10}.

In T_1 treatment the layering was performed on 8th June. The climatic conditions existing in earlier three weeks in June were abnormal. There were adequate rains till third week of June and the maximum temperature were from 42^0C to 44^0C and the relative humidity was 18 to 26 per cent (Eve.) Probably, this might have resulted in low number of roots. Similarly, from September to October the number of roots were decreased. The decrease in number of roots might be due to comparatively low temperatures and fall in humidity percentage. Therefore callus production is less and ultimately root produced in less number. Some workers reported low number of roots in layering in month of October. Nagone (1989) obtained low mean number of root as 4.60 in air layering of pomegranate when prepared in October. Suriyapananont (1990) obtained very low roots in apples air layering in the month of October to December.

5.3 Length of Root as Affected by Time of Layering

The length of primary roots of 12.0 cm, 16.0 cm, 19.43 cm and secondary roots of 6.0, 9.0, 10.67 cm were obtained in treatment T_2 (23rd June) at 90th, 135th and 180th day from time of layering and were found to be significantly higher than all remaining dates of layering.

The treatment T_3 (8th July), T_4 (23rd July) and T_5 (8th August) were observed to be next best dates of layering and significantly increased the length of both primary and secondary root as compared to the treatments of T_6 and T_{10} and T_1 at all stages. The final values of primary roots of 18.50 cm, 17.10 cm and 16.20 cm and secondary roots of 9.50 cm, 9.09 cm and 8.70 cm were obtained respectively in T_3, T_4 and T_5 and all these values were significantly higher than the values of primary and secondary roots obtained in the treatments of T_7 to T_{10} and T_1.

The lower values of primary roots of 10.0 cm, 9.09, 8.00 and secondary roots of 6.00 cm 5.50 cm and 5.0 cm were obtained in the treatments of earlier date of layering T_1 (8th June) and late dates of T_9 (8th October) and T_{10} (23rd October) respectively.

The best results in respects of length of primary and secondary roots were obtained on different dates of layering of 23rd June followed by 8th July, 23rd July, and 8th August. The response was highest with 23rd June and gradually it was decreased with the dates following one after another. The maximum growth of primary and secondary roots obtained might be due to favourable conditions existing in rainy season enhancing the process of rooting. Some what the results obtained in the present investigation are in close

confirmation with the results of profuse rooting in pomegranate air layer in third week of July obtained by Srivastava (1961). Ahmed (1964) obtained best rooting in rainy season. Rao (1983) obtained the length of 7.66 cm in pomegranate air layering. Desai and Patil (1984) obtained the length of 38.86 mm in jack fruit while Nagone (1989) obtained the length of 6.80 an in pomegranate air layering when performed in June to July. While Sharma et al. (1990) reported the length of root as 8.9 cm in litchi air layering.

In general, the layering performed in the month of October gave significantly lowest values of both primary and secondary root length. Probably, there was gradual decrease both in temperature and humidity percentage which might have affected poor development of root process resulting in reduction in length of roots. Moreover, the layering operations done in late August and September gave comparatively more root length as compared to the late dates. The stage of shoot available during this period might be some what of more maturity which might be one of the reason. This statement is in close confirmation with Kuzin (1973). He reported that the availability of free and bound water in juvenile and mature shoot was almost equal but the time required for rooting was less in juvenile shoot as compared to matured shoot. The delayed rooting might have affected root length.

5.4 Mean Stem Girth of Layers

In present investigation, the layering dates or period did not show any marked difference at 90th day from layering but later on showed positive response over the girth of layers obtained from different dates i.e. from 8th June to 23rd October. Eventhough the results obtained at 90th day were non-significant yet, the girth of shoot was significantly influenced by different dates of layering in advance period at 135th day and 180th day from layering. The mean thickness of main shoot of 4.00 cm followed by 3.93 cm were obtained in the treatments of layering dates of 23rd June and 8th July and the results observed were significantly higher than all remaining treatments except T_4 (23rd July). The next best dates of layering observed were 23rd, July and 8th August. The significantly lowest values of 3.10 cm as thickness of main shoot was recorded from the layering date of 23rd of October.

So, the girth of main shoots recorded initially was more or less of equal thickness upto 90 days. By this time the process of rooting was completed and fresh growth was started at nursery stage which might have influenced the thickness of main shoots of significant differences under different dates of layering at 135th day from layering. Finally, the marked differences were observed at 180th day

from layering. In present investigation the marked differences of girth of main shoot were noted in dates of layering of 23rd June followed by 8th July, 23rd July and 8th August. Whereas the layering operation done in September and October progressively decreased the mean girth of shoot to a greater extent.

The marked girth noted was governed by dates of layering performed from 23rd June to 8th August and perhaps it was due to effective foliage and root growth observed. The girth of shoot is directly related with production of shoots and the new foliage growth obtained in present investigation was in confirmation with the formation of functional leaves on rooted shoots when rared in partial shade by Ruehle (1948).

5.5 Mean Height of Main Shoot and Mean Number of Leaves per Layer

Growth of vegetatively propagated fruit plant is primarily depend upon the amount of roots produced by the plant in the nursery. It was not uncommon to say that the layers having good amount of root grow very vigorously and produce good growth. In the present studies, the same principles hold good irrespective of time of layering. The layers with extensive root system produced vigorous growth while the layers with lesser proportion of roots gave proportionately less vegetative growth.

A significantly highest height of main shoot was recorded on 23rd June followed by 8th July. Similarly, the response of mean number of leaves obtained on 23rd July and 8th August was significantly higher than the succeeding dates and earlier one (8th June) at all stages of growth period.

Finally at 180th day, the more number of leaves of 26.67, 25.0 and 23.0 were obtained respectively in the treatments of T_2, T_3, T_4 and T_5 as against the lowest values of 14.0 and 15.0 layer obtained in the treatments of T_9 and T_{10} (8th and 23rd October).

The higher growth obtained under each date of layering from 23rd June to 8th August in the present investigation was directly related with more root growth produced by the same dates of layering. This indicated that there was a reciprocal relationship between the root and shout development. This was because of prevailing of favourable climatic conditions during June, July and early August.

Low number of leaves obtained in decreasing order with later dates of layering from September to October was associated with the decreasing the suitability of conditions with reduction in relative humidity associated with low rainfall and temperatures in September and October. Reproduction of low amount of roots in later dates of

layering had influenced directly in less number of leaves due to deterioration in favourable conditions of multiplication of plants. The number of leaves obtained with 23rd July to 8th August are in close agreement to some extent with number of leaves reported by Patil and Chakrawar (1979). They noted mean number of leaves as 36.03 per layer in seedless lemon air layering when layering prepared in the month of July while Raut (1992) recorded 11.4 as the mean number of leaves per layer in air layering of guava.

5.6 Survival Percentage of Layers

The survival percentage of rooted layers recorded at various dates at fortnightly interval commencing from 8th June to 23rd October showed significant differences at all stages.

The layers operated on 23rd of June (T_2) followed by 8th July (T_3) significantly increased maximum survival percentage over all remaining dates at various stages of growth.

The maximum survival percentage of 95.24 was obtained initially at 90th day immediately after detachment of rooted layers of dated 23rd June and 23rd July and these layers were nursed in partial shade for about one and half month. Both the treatments T_2 followed by T_3 showed some mortality in partial shade and the percentage success noted at 135th day was as 90.47 and 85.71 in respect of T_2 and T_3

treatments. Later on these layers were shifted from partial shade to open place for hardening. After shifting of layers, the mortality was observed in some of the treatments and the final count of percentage survival was noted at 180th day under each treatment. The treatment T_2 followed by T_3 recorded maximum survival percentage of 85.71 in both the treatments and it was significantly higher than the survival percentage of 61.90, 57.14, 52.38 and 47.62 obtained under the respective treatments of T_8 (23rd September), T_1 (8th June), T_9 (8th October) and T_{10} (23rd October). The survival percentage recorded finally at 180th day in each date of layering at fortnightly interval from 23rd June to 8th August were observed at par. The higher survival percentage obtained finally from 23rd June to 8th August might be due to optimum favourable environmental conditions existing during this period. Most of the workers obtained higher percentage of rooting in rainy season particularly from late June to August and this is in close confirmation with the findings obtained by Ahmed (1964). He obtained higher percentage of success in air layering of guava in rainy season from June to August.

Mishra and Agrawal (1975) reported higher final survival percentage in air layering of Kagzi kalan in the month of July. Patil and Chakrawal (1979) obtained highest percentage success as 60.0 in seedless lemon layers in the month of July. Similarly, Rao (1983) had obtained same

results (60.0%) in seedless lemon air layering. Palaniswami et al. (1985) achieved the final survival percentage of 40 to 50 per cent in cashew air layering. Also, Kanwar and Kahlon (1986) noted maximum survival percentage of 76.8 in litchi when layered in the month of July. Similarly, Nagone (1989) obtained highest percentage success of 48.52 in pomegranate air layers in the month of July.

The low performance of operations carried out on 8th June the foremost date might be due late on set of monsoon i.e. from third week and prevailing of long period with higher temperatures beyond $40^{O}C$ associated with low humidity. Similarly, the low percentage survival obtained in case of dates of 23rd September, 8th October and 23rd October might be again due to onset of somewhat abnormal environmental conditions which were not much favourable for rooting processes initially and for their growth in winter season. Due to prevailing of low temperature the growth process were affected resulting in poor performance and this is in close confirmation with the findings obtained by Patil and Chakrawar (1979). They reported less survival percentage in the layers prepared on 15th August as compared to 15th and 30th July in seedless lemon by air layering. Similarly, Nagone (1989) obtained very low survival percentage of 38.20 in pomegranate air layers when prepared in the month of October.

CHAPTER VI

SUMMARY AND CONCLUSION

The present investigation on "Standardization of time for polybag layers in Guava (Psidium guajava L.) under Akola condition" was carried out in the Commercial Fruit Nursery, Nagarjun, Department of Horticulture, Punjabrao Krishi Vidyapeeth, Akola during the period June, 1992 to October, 1992.

The design of experiment was Randomised Block Design (RBD) with ten treatments and three replications. The treatments of Time or Dates of layering are given below.

Treatments (Dates of layering)

T_1 - 8th June, 1992

T_2 - 23rd June, 1992

T_3 - 8th July, 1992

T_4 - 23rd July, 1992

T_5 - 8th August, 1992

T_6 - 23rd August, 1992

T_7 - 8th September, 1992

T_8 - 23rd September, 1992

T_9 - 8th October, 1992

T_{10} - 23rd October, 1992

The result obtained during the course of present studies in respect of days required for visible root growth,

number of roots, length of roots, vegetative growth of layers i.e. number of leaves, girth of main shoot and height of layers and survival percentage of layers are summarised below.

As regard the days required for visible root growth and standardization of time, the layers prepared on 23rd June started early initiation and profound growth of roots as compared to other treatments.

The number of primary and secondary roots, length of primary and secondary roots were found to be reduced with delay in time of layering. Date of 23rd June was found to be superior to later dates of layering.

The growth in respect of number of leaves, girth of main shoot and height of main shoot were observed to be maximum with date of layering of 23rd June and these were progressively decreased with delay in time of layering. The response noted with 23rd June was highest and the dates of layering of 8th July, 23rd July and 8th of August had also gave more number of leaves, girth of main shoot and height of main shoot as compared to other dates of layering. The lowest response was noted with 23rd of October.

The survival percentage of polybag layers of guava was decreased progressively with delay in time of layering

from 23rd June to 23rd of October and the maximum survival was obtained in layers prepared in the fourth week of June (23rd June) as against lowest percentage of survival in October layering (23rd October).

CONCLUSION

In the present studies layers prepared by polybag method in guava in fourth week of June (23rd June) proved to be superior in respect of early root initiation and maximum root growth in respect of more number of primary and secondary roots and length of roots. Similarly, the maximum vegetative growth in respect of number of leaves, girth of main shoot, height of layer and survival percentage were positively encouraged with date of layering of 23rd June.

However, the performance was better with 23rd of June to 8th of August and further delay in layering decreased the root initiation, root growth, shoot growth and survival of layers with successive delay in layering of guava.

The earlier date of 8th June showed comparatively negative performance as compared to the dates of layering from 23rd July to 8th of August. Perhaps this might be due to unfavourable weather condition existing in first three weeks of June and probably, it may give better response if favourable weather conditions exist during 1st to 3rd week of June.

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* Original not seen.

APPENDIX-I

Weekly weather data for the year June 1992 to December 1992 recorded at Agril. Meteorological Observatory, P.K.V., Akola

Week No.	Date	Temp ^{O}C		R.H. %		Rainfall in mm
		Max.	Min.	Mor.	Eve.	
22	28-3 June	43.5	27.8	43	14	0.00
23	4-10	44.6	28.4	45	18	0.0
24	11-17	42.7	26.1	58	26	43.0
25	18-24	32.0	23.6	84	75	175.0
26	25-1 July	35.6	25.1	73	38	0.5
27	2-8	37.5	26.1	66	34	00.0
28	9-15	36.8	25.3	79	46	4.6
29	16-22	34.4	25.0	76	57	30.4
30	23-29	32.0	24.0	79	62	26.0
31	30-5 August	30.5	23.2	87	65	59.5
32	6-12	31.6	23.1	89	66	170.3
33	13-19	29.4	23.2	92	79	72.3
34	20-26	27.6	22.3	87	74	82.5
35	27-2 Sept.	30.4	23.5	87	71	117.4
36	3-9	30.4	22.8	88	71	57.0
37	10-16	11.0	21.6	82	49	00.0
38	17-23	33.4	19.8	83	37	00.0
39	24-30	34.8	20.4	81	36	4.0
40	1-7 Oct.	35.0	20.5	86	35	13.9

41	8-14	32.0	21.1	88	60	31.8
42	15-21	33.4	18.7	87	34	00.0
43	22-28	33.7	17.6	75	30	00.0
44	29-4 Nov.	32.8	12.9	80	25	00.0
45	5-11	32.6	11.3	79	22	00.0
46	12-18	30.8	14.5	81	42	1.6
47	19-25	29.5	16.5	82	42	00.0
48	26-2 Dec.	30.0	8.1	77	25	00.0
49	3-9	30.4	10.9	72	25	00.0
50	10-16	29.0	7.2	78	23	00.0
51	17-23	29.8	8.0	65	22	00.0
52	24-31	30.1	6.1	76	19	00.0

VITA

Narendra Haribhau Ramteke, a native of Siroli, District Bhandara born on 15th March, 1968. He completed his primary education from Primary School, Siroli, Distt. Bhandara. He passed S.S.C. with distinction and secured first place from Centre Arjuni (Morgaon) from Shyama Prasad Vidyalaya, Mahagaon, District Bhandara and passed H.S.S.C. from Nevajabai Hitkarini College, Bramhapuri, District Chandrapur. He completed his graduation from College of Agriculture, Nagpur and obtained B.Sc. (Agri.) degree of Punjabrao Krishi Vidyapeeth, Akola in June 1991. Thereafter he joined the Post Graduate Institute, Punjabrao Krishi Vidyapeeth, Akola for his post graduate education leading to M.Sc. (Agri.) degree in the subject of Horticulture.

THESIS ABSTRACT

a)	Title of the thesis	:	"STANDARDIZATION OF TIME FOR POLYBAG LAYERS IN GUAVA (Psidium guajava L.) UNDER AKOLA CONDITIONS"
b)	Full name of the student	:	Narendra Haribhau Ramteke
c)	Name and Address of Major Advisor	:	Dr. R.M. Verma, Asso. Prof. of Horticulture, Univ. Deptt. of Horticulture, P.K.V., Akola
d)	Degree to be awarded	:	M.Sc. (Agri.)
e)	Year of award of degree	:	1993
f)	Major subject	:	Horticulture
g)	Total number of pages in thesis	:	86
h)	Number of words in thesis abstract	:	195
i)	Signature of student	:	NR Felce
j)	Signature, Name and Address of forwarding authority	:	Head, Department of Horticulture, P.K.V., Akola

ABSTRACT

The investigation on "Standardization of time for polybag layers in guava (Psidium guajava L.) under Akola conditions" was undertaken during the year 1992-93. The

experiment was laid out in simple Randomised Block Design with ten treatments of dates of layering and three replications.

Among the various dates of layering studied, the date of 23rd June was found to be superior over all other dates of layering in respect of producing layers of more root growth, shoot growth and final survival.

As regards dates of polybag layering in guava, the date of 23rd June was observed to be significantly superior in producing guava layers with early visible root growth, better root growth, better shoot growth and high survival percentage of layers over all other dates of layering. However, the treatments of 8th July, 23rd July and 8th August also showed significant response over the successive time of layering and earlier date of layering. The lowest response was noted with the date of 23rd October.

The best time of 23rd of June followed by 8th July, 23rd July and 8th August were observed to be best suited for successful production of guava layers by polybag method.