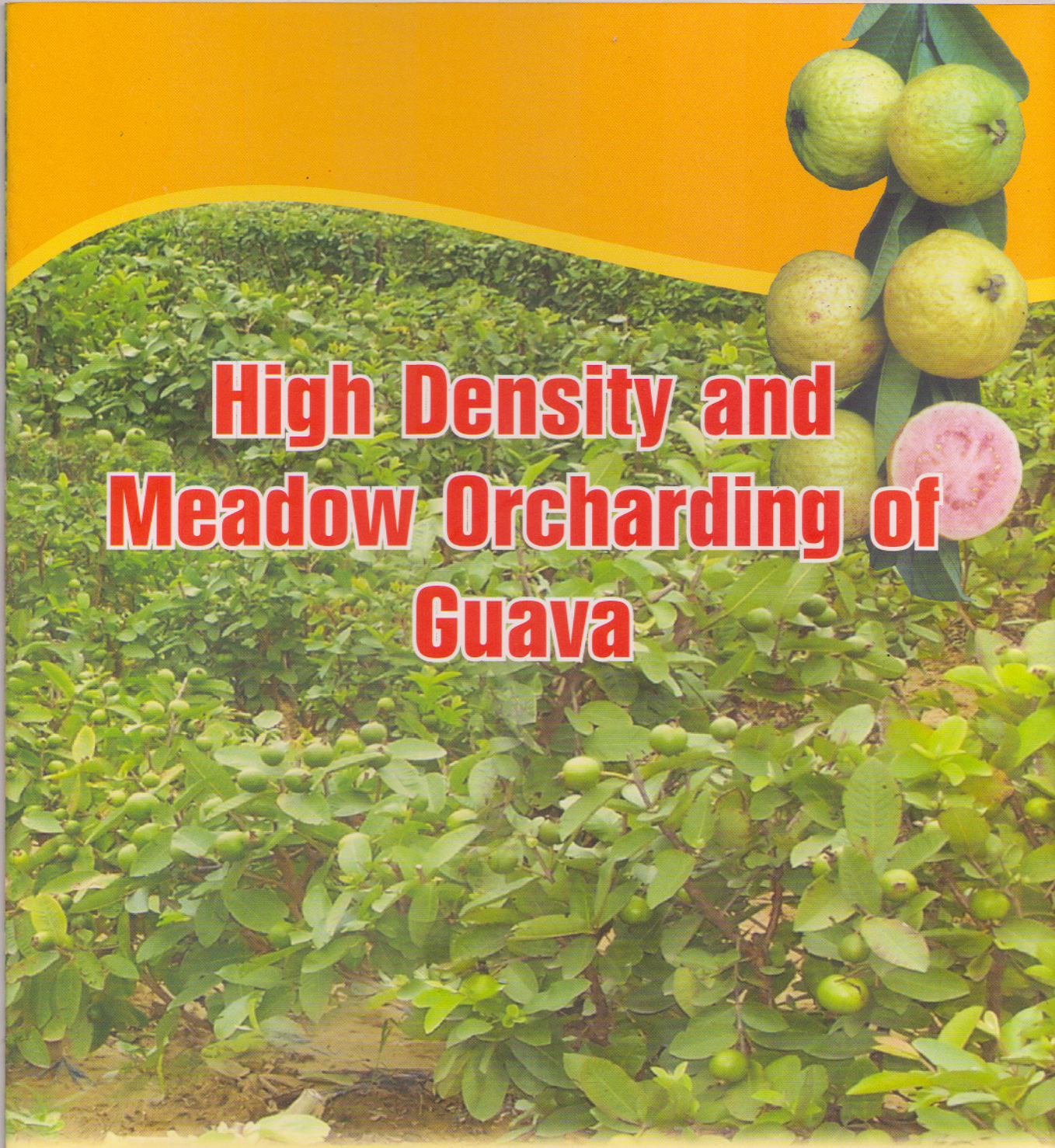

High Density and Meadow Orcharding of Guava

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ICAR

Central Institute for Subtropical Horticulture
Rehmankhera, P.O. Kakori
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Foreword

Fruits form the mainstay of human life. They are considerably important owing to their nutritional and medicinal values. In the yesteryears, fruits have become more important on account of awareness and improvement in the standard of living. Keeping in view the significance of fruits in human life, scientists have been extensively carrying out researches to improve the productivity and quality of fruits.

The Central Institute for Subtropical Horticulture, Rehmankhera, Lucknow under the aegis of the Indian Council of Agricultural Research, New Delhi has been one of the principal players in the horticultural development of the country. It has contributed significantly in improving the scientific production of fruit crops. The Institute is having more than 100 accessions of guava in its field gene bank apart from 7 guava species. Allahabad Safeda and Sardar are the main varieties cultivated throughout the country. The Institute has developed quality varieties of guava named Lalit and Shweta for commercialization.

The Institute has also developed high density and meadow orchard systems of guava to increase the production as well as productivity. Several trainings vis-à-vis demonstration trials on these technologies were organised across the country in general and Uttar Pradesh and Maharashtra in particular. These technologies have helped the orchardists to improve their economic condition. Farmers across the country have shown keen interest in both the technologies.

Taking into account the production and productivity statistics, these technologies are considerably better than the traditional one. If these technologies are adopted widely, there is no denying the fact that the production and productivity will increase. It will also add to the gross domestic product of the country. I hope this publication will be highly beneficial to one and all engaged in guava cultivation and research.

(B.M.C. Reddy)
Director

Contents

High Density and Meadow Orcharding of Guava

Guava is an important fruit crop in tropical and subtropical regions of the country due to the hardy nature of its tree and prolific bearing even in marginal lands. Its cultivation requires little care and inputs. But, of late, this crop has exhibited a paradigm shift in the production system, from subsistence farming to commercial production. The traditional system of cultivation has often posed problems in attaining desired levels of productivity due to large tree canopy. Hence, a need arose to improve the existing production system, besides increasing its productivity. Currently, there is a worldwide trend to plant fruit trees at higher density or meadow orcharding to control tree size and maintain desired architecture for better light interception and ease in operations such as pruning, pest control and harvesting. The high density or meadow orcharding facilitates enhance production and quality of fruits.

Present Scenario

The fruit is in demand in domestic as well as international markets and is traded in more than 60 countries. Major guava producing countries are India, Brazil, Mexico, South Africa, Jamaica, Kenya, Cuba, United States of America, Egypt, Thailand, Columbia and Pakistan. The international trade of guava is currently limited to processed products which are exported to United States, Japan and Europe. In India, guava is well adapted in almost all the states and principally produced in Maharashtra, Bihar, Uttar Pradesh, Andhra Pradesh, Madhya Pradesh, Rajasthan, Gujarat, Karnataka and Tamil Nadu.

Guava contributes 4 per cent of the total fruit production which is around 18.23 million tonnes from 182 thousand hectares. The productivity is around 9.9 MT ha^{-1}. Maharashtra is the leading guava producer both in area and production followed by Bihar and Uttar Pradesh. But its productivity is highest in Karnataka followed by Punjab, Bengal and Gujarat. However, overall productivity is far from its actual potential.

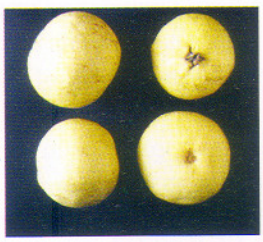
Commercial and Improved Varieties

Allahabad Safeda and Sardar (L-49) form the mainstay of Indian guava industry owing to their high yield, quality and wide market acceptability. Even Lalit, a variety suitable for both processing as well as table purpose, is also gaining popularity. The area under this variety has increased significantly in Maharashtra, Andhra Pradesh and Karnataka.

Some other improved guava varieties, viz. Shweta, Pant Prabhat, Dhareedar, Arka Mridula, Arka Amulya, Safed Jam, Kohir Safeda, Hisar Surkha, Hisar Safeda and Allahabad Surkha have been released by ICAR Institutes/SAUs in different states for commercial cultivation.

A brief description of important varieties is given below :

Allahabad Safeda



It is the most important variety of guava used for table as well as processing purposes. The tree is medium to tall in size, upright growth habit, heavy bearer, dense foliage and has a tendency to produce long shoots. Crown is broad and compact, often dome-shaped and rarely loose. Fruit is of medium size, round in shape with smooth skin and white flesh. The fruits are relatively soft with less seeds. Its keeping quality is good.

Sardar

Tree is vigorous, spreading and profuse bearer, heavy branching type with flat crown. Fruit is large, round to ovate in shape, primrose-yellow skin colour, white flesh and seeds are in plenty and harder than that of Allahabad Safeda.

Lalit

It is a high yielding pink fleshed guava variety released by Central Institute for Subtropical Horticulture, Lucknow for commercial cultivation in guava growing areas of the country. Fruits are of saffron yellow colour with red blush weighing 185-200 g $fruit^{-1}$. Its flesh is firm and pink with a good blend of sugar and acid. It is suitable for both table and processing purposes. The jelly made from this variety has better flavour and attractive appearance.

Shweta

The variety recently developed by Central Institute for Subtropical Horticulture, Lucknow is suitable for commercial cultivation. Tree is semi-vigorous with medium height and is a prolific bearer. It is a variety with medium size globose fruits, creamy white skin with red spots or blush and snow-white flesh. Fruits are attractive and have good nutritive value.

Allahabad Surkha

It is an outstanding variety of large uniform pink fruit with deep pink flesh. The plants produce up to 120 kg fruits in the sixth year of fruiting. Trees are vigorous, dome-shaped and compact. The fruit is sweet and strongly flavoured with a few seeds.

Advantages of Dwarf Tree

- Harvesting is easy and the cost of picking is reduced.
- The ratio of fruiting shoots to supporting ones is higher.
- Ease in spraying of chemicals for pest and disease control.
- Possible to plant more trees per unit area leading to higher income.

Concept of High Density and Meadow Orcharding

There is a shift in farmers' perception from production to productivity and profitability which can be achieved through high density planting. Recently, there is a trend to plant fruit trees at closer spacing leading to high density or meadow orchard. Higher and quality production is achieved from densely planted orchards through judicious canopy management and adoption of suitable tree training systems.

The **Meadow Orchard** is a modern method of fruit cultivation using s l or dwarf tree with modified canopy. Better light distribution within tree canopy increases the number of well illuminated leaves. It also promotes rate of photosynthesis that leads to high yield per unit area. This system of guava planting is going to revolutionize the guava industry by enhancing productivity coupled with reduction in production costs. The meadow orchard system of guava accommodates 5000 plants ha^{-1}, planted at 2.0 x 1.0 m spacing and managed with regular topping and hedging, especially during initial stages. Topping and hedging in guava are helpful in controlling tree size and extending fruit availability. A comparison between meadow orchard system and the traditional system of fruit growing is necessary to evaluate the potentiality of this technique.

Comparison between traditional and meadow orchard systems of guava growing

Attributes	Traditional system	Meadow system
Bearing	After two years	From first year
Production	Average yield is 12-20 t ha^{-1}	Average yield is 40-60 t ha^{-1}
Management	Difficult to manage due to large tree size	Easy to manage due to small tree size
Labour requirement	Requires more labour	Requires less labour
Production cost	Higher cost of production	Lower cost of production
Harvesting	Difficult	Easy
Quality	Large canopy, poor sunlight penetration and poor quality fruits	Small canopy, better air and sunlight penetration, minimum disease incidence and high quality fruits with good colour development

Establishing High Density Orchard

Orchard establishment is a long-term investment. Ploughing the area once or twice is suggested followed by two-three harrowings to pulverize and expose the soil completely. It can be best done during dry season. Rectangular system of planting/layout is preferred as it facilitates orchard operations. Planting can be done any time during the year provided irrigation facilities are available. However, planting in December-January should be avoided as frost may cause severe damage. The pits of about 75 x 75 x 75 cm or 50 x 50 x 50 cm or 40 x 40 x 40 cm are dug as per layout plan. After 7 to 10 days, each pit is filled with soil mixed with 10 to 15 kg organic manure and 500 g of single superphosphate.

Standard spacing for guava is 6 x 6 m, which accommodates 277 plants ha^{-1}. It is important to shape the tree after planting. Spacing of the plants in the system depends on fertility of the soil, availability of water, intensity of sunlight and wind exposure.

As guava responds very well to pruning, the following plant densities have been recommended by Central Institute for Subtropical Horticulture, Lucknow for early, higher and quality guava production:

A. 3.0 m (row to row) x 1.5 m (plant to plant) accommodating 2222 plants ha^{-1}

B. 3.0 m (row to row) x 3.0 m (plant to plant) accommodating 1111 plants ha^{-1}

C. 6.0 m (row to row) x 3.0 m (plant to plant) accommodating 555 plants ha^{-1}

High Density Planting in Guava

Canopy Management

Untrained or unpruned guava trees become huge and unmanageable after a couple years of growth. The bearing area is reduced and the interior of the plant becomes entirely devoid of fruiting. Trees are pruned to increase the yield of quality fruits by eliminating crowded and criss-cross branches. Pruning begins at an early stage of plant growth to develop single trunk trees with well-spaced scaffold branches to form the frame work. Apical growth is to be controlled within the first year of planting for better canopy architecture. Trees are topped to a uniform height of 60 - 70 cm from the ground level, two-three months after planting to induce the emergence of new growth

Early shoot management for better canopy and production

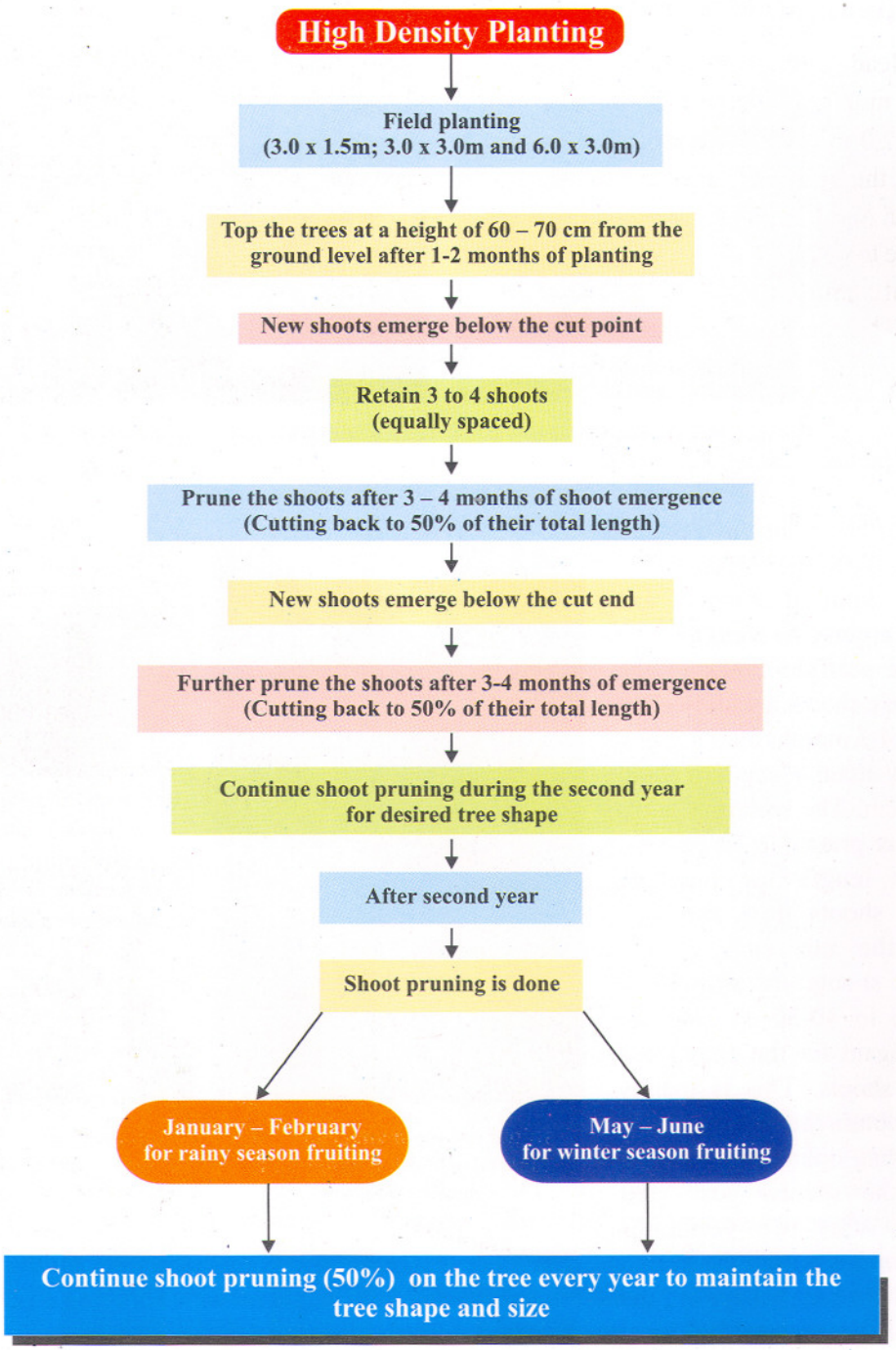
Enhancement of flowering through shoot pruning

below the cut point. As a result, new shoots emerge. Three to four equally spaced shoots are retained around the stem to form the main scaffold limbs of the tree. These shoots are allowed to grow for 4-5 months after topping until they attain a length of about 40 - 50 cm. The selected shoots are further pruned to 50 per cent of their length for inducing multiple shoots from the buds below the cut end. Newly emerged shoots are allowed to grow up to 40-50 cm and are pruned again for the emergence of new shoots. This is mainly done to obtain the desired shape. The pruning operations continue during the second year after planting. After two years, the short branches within the tree canopy produce a compact and strong structure. All the plants are confined to a hedge shape of 2 m inter row width and 2.5m height for which pruning is performed in January-February and May-June every year.

Initial canopy management to maximize fruiting under high density planting

Heavy fruiting after 7 years of planting

Confined growth of trees through pruning after 8 years of planting


High Density Planting
Field planting
(3.0 x 1.5m; 3.0 x 3.0m and 6.0 x 3.0m)
Top the trees at a height of 60 – 70 cm from the ground level after 1-2 months of planting
New shoots emerge below the cut point
Retain 3 to 4 shoots
(equally spaced)
Prune the shoots after 3 – 4 months of shoot emergence
(Cutting back to 50% of their total length)
New shoots emerge below the cut end
Further prune the shoots after 3-4 months of emergence
(Cutting back to 50% of their total length)
Continue shoot pruning during the second year
for desired tree shape
After second year
Shoot pruning is done
January – February
for rainy season fruiting
May – June
for winter season fruiting
Continue shoot pruning (50%) on the tree every year to maintain the tree shape and size

Establishing Meadow Orchard

Meadow Orchard System is a new concept of guava planting which has been developed for the first time in India at Central Institute for Subtropical Horticulture, Lucknow. The planting is done at 2.0 m (row to row) x 1.0 m (plant to plant), which gives a density of 5000 plants ha^{-1}. Initially, the trees are pruned and trained to allow maximum production of quality fruits during the first year. A single trunk tree with no interfering branches up to 30 - 40 cm from the ground level is desirable to make dwarf tree architecture. After a period of 1-2 months of planting, all the trees are topped at a uniform height of 30-40 cm from the ground level for initiation of new growth below the cut ends. No side shoot or branch should remain after topping. This is done to make a single trunk straight up to 40 cm height. After 15-20 days of topping, new shoots emerge. In general, 3-4 shoots are retained from below the cut point after topping. As shoots mature generally after a period of 3-4 months, they are reduced by 50 per cent of their total length so that new shoots emerge below the cut point. This is done to attain the desired tree canopy architecture and strong framework. The emerged shoots are allowed to grow for 3 - 4 months before they are again pruned by 50 per cent. After pruning, new shoots emerge on which flowering takes place.

Planting at a spacing of 2 x 1 m

Topping at a height of 30-40 cm from the ground level

Growth after topping

Growth after second pruning

Growth after third pruning

Flowering after third pruning

It is emphasized that shoot pruning is done thrice a year. This leads to desired canopy development. Though fruiting starts in the same year, one can not expect fruits on each and every shoot. Pruning is continued so that plants remain dwarf. After a year, pruning operation is done especially in May-June, September-October and January-February.

Initiation of new shoots and flowering after shoot pruning

Re-pruning (above the fruiting point) of shoots for initiation of new shoots

New shoots emerge after re-pruning and flowering takes place

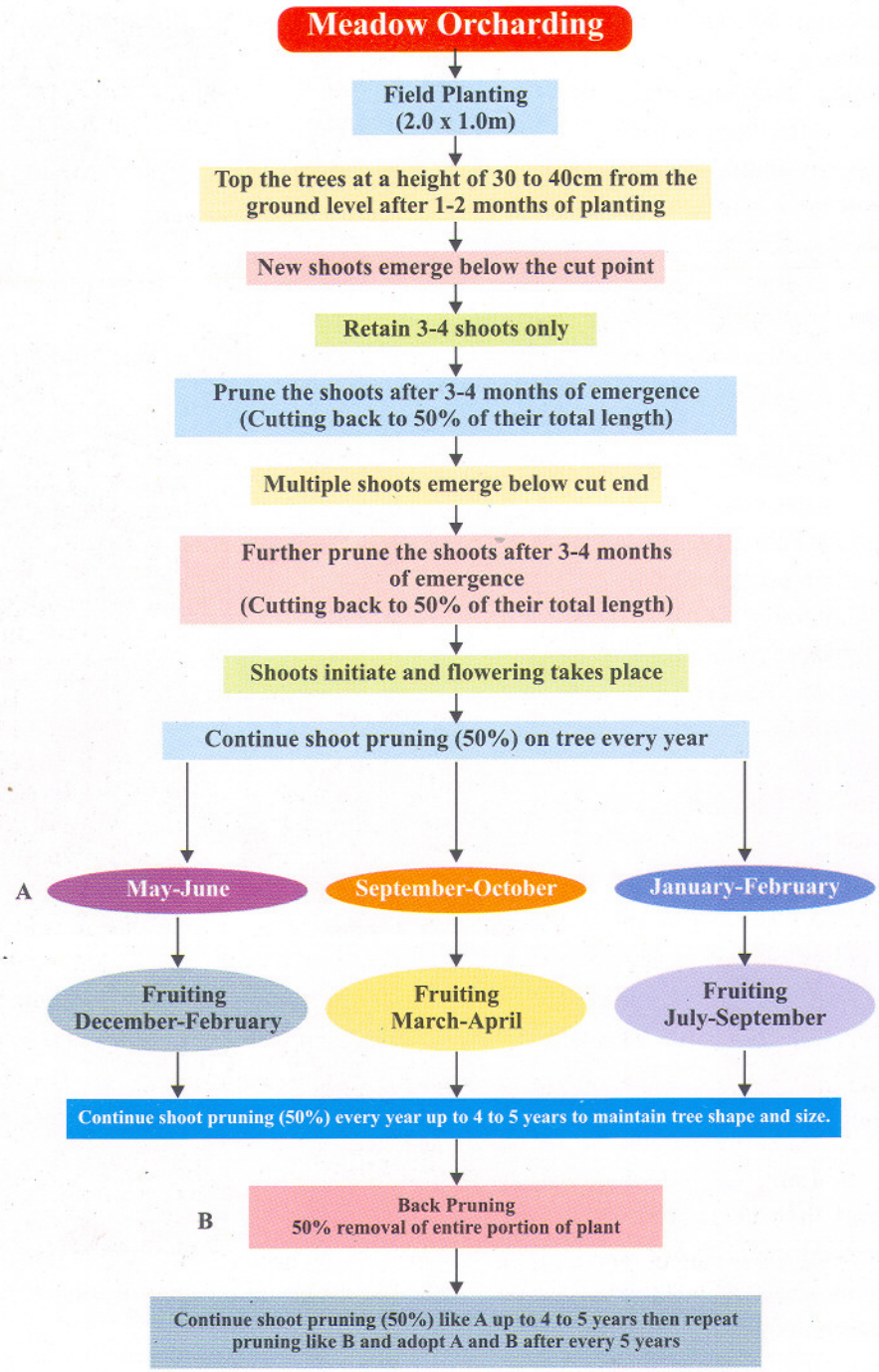
Pruned trees in flowering and fruting

Meadow orchard after 5 years of planting

Overview of meadow orchard

Harvesting of fruits is generally done in January-February from the May-June pruned shoots. After harvest, the pruning is done above fruiting points. New shoots emerge after pruning of shoots during January-February. On these shoots, flowering takes place and fruiting is obtained during July-September. Second time pruning is done in May-June. After pruning, once again shoots emerge and flowering take place, which yields fruits during December-February. These shoots are further pruned for the third time in September – October. It is done primarily for better canopy architecture. As a result of pruning in October, fruiting is obtained in March – April. This is the technique for maintaining a meadow orchard for optimum production and dwarf tree size. The height of plants is restricted to 1.0 m, while an average production of 10-12 kg fruits plant^{-1} is obtained every year. As harvesting is easy in a meadow orchard, no damage occurs to the fruits. Seven guava varieties, viz. Allahabad Safeda, Sardar, Shweta, Lalit, CISH-G-5, CISH-G-6 and hybrid (Lalit x Shweta) evaluated under meadow orchard system showed positive impact of the technology.

Overview of different guava varieties planted under meadow orchard


Meadow Orcharding
Field Planting (2.0 x 1.0m)
Top the trees at a height of 30 to 40cm from the ground level after 1-2 months of planting
New shoots emerge below the cut point
Retain 3-4 shoots only
Prune the shoots after 3-4 months of emergence (Cutting back to 50% of their total length)
Multiple shoots emerge below cut end
Further prune the shoots after 3-4 months of emergence (Cutting back to 50% of their total length)
Shoots initiate and flowering takes place
Continue shoot pruning (50%) on tree every year
A
May-June
September-October
January-February
Fruiting December-February
Fruiting March-April
Fruiting July-September
Continue shoot pruning (50%) every year up to 4 to 5 years to maintain tree shape and size.
B
Back Pruning 50% removal of entire portion of plant
Continue shoot pruning (50%) like A up to 4 to 5 years then repeat pruning like B and adopt A and B after every 5 years

Fertilization

The amount of fertilizers to be applied in high density /meadow orchard of guava depends on the age of tree, condition of plant and type of soil. For proper growth and higher yield, following fertilizer doses should be applied :

For spacing of 3.0 x 1.5m (2222 plants ha^{-1}); 3.0 x 3.0m (1111 plants ha^{-1}) and 6.0 x 3.0m (555 plants ha^{-1})

Year	Urea (g $plant^{-1}$)		SSP (g $plant^{-1}$)	MOP (g $plant^{-1}$)
	June	September	September	June
1st	182	78	375	100
2nd	364	156	750	200
3rd	546	234	1125	300
4th	728	312	1500	400
5th & above	910	390	1875	500

For spacing 2.0 x 1.0m (5000 plants ha^{-1})

Year	Urea (g $plant^{-1}$)		SSP (g $plant^{-1}$)	MOP (g $plant^{-1}$)
	June	September	September	June
1st	90	40	185	50
2nd	180	110	370	100
3rd	270	115	555	150
4th	360	150	740	200
5th & above	450	190	900	250

Irrigation

Newly planted plants should be watered at the time of planting, every second day during the first week and afterwards once or twice a week during the initial months. During long dry periods, newly planted young guava plants (first year) should be watered twice a week. Once the rainy season sets in, irrigation is done as per the requirement.

For the plants of 2 years or above, irrigation becomes beneficial for growth and fruiting during prolonged dry periods. Irrigation is required at intervals of 7-10 days in summers and at 25 days in winters.

Drip Irrigation

Drip irrigation is an essential input for increasing productivity and quality of fruits. Response to drip irrigation in relation to yield and water-use-efficiency has been found very effective. The basic concept underlying the drip irrigation method is to supply the amount of water needed by the plant within a limited volume of the soil rather than flooding, as often as needed.

Increase in yields up to 40 per cent along with saving in water to the tune of 40-50 per cent can be obtained. Adequate moisture is required during the vegetative growth for optimum flowering and fruit development. In high density planting, On-Line drip is preferred, while In-Line is suited in meadow orchard system. The maximum yield is obtained when irrigation is given at 60 per cent OPE replenishment. The following schedule of irrigation through drip is recommended for guava:

Drip irrigation coupled with polyethelene mulch

A. For spacing of 3.0 x 1.5m; 3.0 x 3.0 m and 6.0 x 3.0 m

Year	Drip irrigation (liters day^{-1} plant^{-1})
1st	4 to 6
2nd	8 to 12
3rd	15 to 20
4th	25 to 30
5th and above	35 to 40

B. For Meadow Orchard (2.0 x 1.0m)

Year	Drip irrigation (liters day^{-1} plant^{-1})
1st	2 to 3
2nd	4 to 5
3rd	6 to 8
4th	10 to 12
5th & above	14 to 16

Weed Control

It is crucial during the first 2-3 years of orchard establishment, after which trees give enough shade to arrest the growth of weeds. There are various methods to control weeds. Mulching at the base of trees can be done using 100 micron (400 gauge) black polyethylene sheet and organic residues such as straw, dried grass and banana leaves. Mulching with organic materials should be 12- 15 cm thick to arrest the weed growth and simultaneously permit rain water penetration to the root zone. Black polyethylene sheets prevent soil surface evaporation and conserve water, enhance growth, besides controlling weeds.


Mulch with Polyethylene


Mulch with banana leaf


Mulch with straw


Mulch with dried grass

Insect Pests

Number of insect pests affect guava crop. The symptoms and control measures of important pests are given below.

Fruit fly

Symptom and damage

Fruit fly, the most serious threat to guava production particularly during rainy season, lays eggs singly in ripened fruits just below the epicarp which eventually results in appearance of minute depressions with dark punctures. Maggots, after hatching, feed on pulp and make fruit unfit for consumption. They pupate in soil and takes about 12 to 18 days to complete its life cycle during July-August (main season).

Management

- Collection and destruction of infested fruits followed by ploughing around the tree basins to expose pupae to sun and natural enemies.
- Spraying of protein hydrolysate and Malathion (0.1-0.25% + 0.05%) on host trees for killing of adult flies.
- Hanging of wooden block traps soaked in ethanol, Methyl eugenol and Malathion (6:4:1) for 72 hrs on trees @ 10 traps ha^{-1} during fruiting period.

Bark eating caterpillar

Symptom and damage

The pest feeds on the bark of main trunk, stem and branches. Infestation is associated with the presence of irregular tunnels and patches covered with silken thread entangled with excreta and chewed particles on shoots, branches, stems and main trunk. Shelter holes are common at the joints of shoots and branches. In case of severe infestation, young infested shoots get dry and die above the point of girdling, giving die back like symptoms.

Management

- Orchard should be kept clean and healthy.
- Killing of caterpillars mechanically by inserting iron spoke in shelter holes at an early stage of infestation followed by inserting cotton wool soaked in Dichlorvos (0.25 – 0.5%) in the borer hole and plugging with the wet soil.
- Application of conidial suspension of Naturalis – L (0.40%) in the borer hole is also effective.

The Pomegranate butterfly

Symptom and damage

The insect attacks both rainy and winter season crops. Its incidence is at peak in the months of August (rainy season crop) and November-December (winter season crop).The violet brown female butterfly lays shiny white eggs singly on calyx of flowers and fruits. The larva bores the fruit and feed on the flesh and seeds, making the fruit hollow from inside.

Management

- Regular collection and destruction of infested fruits.
- Cultivation of pomegranate in vicinity of guava orchards should be discouraged.
- Carbaryl (0.2%) or Ethophenprox (0.05%) spray at the beginning of fruiting season and before ripening of fruits.

Castor capsule borer

Symptom and damage

It is a major pest of castor but attacks guava also and has been commonly recorded from the guava growing regions of North India, particularly in rainy season crop. The moth is of medium size, yellow with numerous black spots on the body. Larvae of this moth mainly bore fruits but it may also attack buds and tender shoots. Larvae feed on pulp and seeds of fruits resulting in rotting and premature drop of fruits. The affected fruits are generally deformed at the point of entry of larva. The pest completes its life cycle between 25-33 days. The borer is managed as per the management systems of the Pomegranate butterfly

Stem borer

Symptom and damage

Infestation of the pest is visible in the form of small holes (1-1.5 cm) found at the distance of 20-30 cm along with straw coloured pelleted faecal matter at the base of the plant. Severe

infestation results in leaf fall and drying of twigs and branches and finally leading to plant mortality. Eggs are laid in the bark by making an inverted U shaped punctures on the branches and main trunks. Grubs initially feed on the bark and later on enter into the wood, making zig-zag and single long tunnels. Its life cycle is annual.

Management

- Mechanical destruction of beetles.
- Removal of infested branches and its destruction by burning during December-February.
- U shaped markings and eggs should be destroyed with sharp knife during September-October.
- Injection of 5 ml Dichlorvos (0.1%) in case of severe infestation.

Diseases

Anthracnose

Symptom and damage

The plants begin to die backwards from top of the branch. Twigs, petiole and young leaves are also attacked resulting into leaf fall virtually leaving the twigs dried and naked. Fruit and leaf infections are generally seen in rainy season crop. Pin head spots are first seen on unripe fruits, which gradually enlarge. The infected areas on unripe fruits become corky and hardy, and often develop cracks in case of severe infection.

Management

- Sprays of Bordeaux mixture (3:3:50) or Copper oxychloride @ 0.3 per cent at 7-10 day intervals.
- Monthly spraying of Difolatan (0.3%) and Dithane Z-78 (0.2%).
- For post harvest treatment, dipping the fruits in 500 ppm Tetracycline solution for 20 minutes.

Canker

Symptom and damage

The appearance of canker on green fruits is evidenced in the form of minute, brown or rust coloured, unbroken, circular, necrotic areas, which later tears open the epidermis in a circinate manner. The canker remains confined to a shallow area and does not penetrate deep into the flesh of the fruit. In severe cases, large number of cankerous spots develop. Small rusty brown angular spots also appear on the leaves. During winter season, the cankerous spots are common but in rainy season minute red specks are formed.

Management

- Three to four sprays of one per cent Bordeaux mixture or lime sulphur at 15 days interval.

Phytophthora fruit rot

Symptom and damage

Disease appears at the stylar end of fallen fruits or the ones touching the ground and covered with foliage or stored in the form of whitish cottony growth which spreads very fast as the fruit ripens and covers the entire surface within 3-4 days during humid weather. Fruit skin below the whitish cottony growth becomes a little soft, turns light brown to dark brown and emits unpleasant smell. The diseased fruits generally retain their normal shape unless they are invaded by saprophytes which cause rotting. Immature fruits, if infected, shrink, turn dirty brown to dark brown, remain hard in texture, either remain intact as mummified fruit or drop.

Management

- Spraying of Diathane Z-78 (0.2 %) or Aureofungin (10 ppm) are found effective in controlling the disease.

Stylar end rot

Symptom and damage

The first symptom is the discoloration in the region lying just below and adjoining the persistant calyx which gradually increases in size, turn dark brown and becomes soft. Affected region becomes pulpy and light brown in colour in contrast to the bright white colour of the healthy ones. At an advanced stage fruit shrinking occurs and concentric wrinkles develop on the skin. Finally, the entire fruit is affected and covered with pycnidia.

Management

- Spray of Copper oxychloride (0.3%) at 15 days interval
- Two sprays of Carbendazim (0.1%) at 15 days interval in such a way that last spray falls 12-15 days prior to harvest.

Wilt

Symptom and damage

Yellow discolouration and curling of leaves of terminal branches appear initially. Later on plants show yellow to red discolouration of leaves. Subsequently, there is pre-mature shedding of leaves. Fruits of all the affected branches remain under developed, hard and stony. Later the entire plant defoliates and eventually dies.

Management

- Proper orchard sanitation and severe pruning of affected parts.
- Incorporation of FYM mixed with *Aspergillus niger* strain AN17 @5.0 kg pit^{-1}.

Guava rust

Symptom and damage

Foliage, young shoots and fruits of guava are commonly affected. Typical symptoms include the distortion, defoliation, growth reduction and eventually plant mortality.

Management

Sprays of Bordeaux mixture (1.0%) during active growth period followed by monthly intervals.

Production

The production of guava in high density planting (1.5 x 3 m.0 m) is 26 tonnes ha^{-1} in the third year. The yield goes up to 47 tonnes ha^{-1} in the fifth and 55 tonnes ha^{-1} in the seventh year of growth. In the density of 6.0 x 6.0m, the yield is 6 tonnes ha^{-1}. The meadow orchard system is more beneficial than any other system. In this system, the production starts in the first year itself giving an average yield of 13 tonnes ha^{-1} which doubles in the next year. In the 3rd and 5th year yield is approximately 40 and 60 tonnes ha^{-1}, respectively. This clearly shows that the meadow orchard system is better than other planting systems.

1st year

2nd year

3rd year

4th year

5th year

After 5 year

Growth pattern and fruiting under meadow orchard

Guava yield obtained under different densities (tonnes ha^{-1})

Densities	3rd year	4th year	5th year	6th year	7th year
1.5 x 3.0m	26.0	38.0	47.0	52.0	55.0
3.0 x 3.0m	18.0	26.0	30.0	35.0	38.0
6.0 x 3.0 m	11.0	17.0	24.0	28.0	31.0
6.0 x 6.0m	6.0	12.0	15.0	19.0	27.0

Yield under meadow orchard system (tonnes ha^{-1})

Density	1st year	2nd year	3rd year	4th year	5th year
2.0 x 1.0m	13.0	25.0	40.0	50.0	60.0

Cost and Returns from Meadow Orcharding and High Density Planting

The inital expenses right from land preparation and planting till crop comes to harvest is considered as the establishment cost of an orchard. The estimated operational cost for maintaining an orchard from 1st year (Meadow orchard) or the beginning of 3rd year (High density planting), when crop comes to the production, is given below :

Economic analysis of establishing, maintaining and returns from one hectare meadow orchard spaced at 2.0 x 1.0m (5000 plants ha^{-1})

Year	Estimated expenditure			Total expenditure (Rs.)	Production (tonnes)	Gross return (Rs.)	Net income (Rs.)	Cost benefit ratio
	Labour (Rs.)	Material (Rs.)	Contingencies (Rs.)					
1st	34000	112530	14653	161183	13	78000	0	0
2nd	18700	18310	3701	40711	25	150000	109289	2.68
3rd	24500	25215	4971	54686	40	240000	185314	3.38
4th	28500	32870	6137	67507	50	300000	232493	3.44
5th	30500	39450	6995	76945	60	360000	283055	3.67

Economic analysis of establishing, maintaining and returns from one hectare high density planting spaced at 3 x 1.5m (2222 plants ha^{-1})

Year	Estimated expenditure			Total expenditure (Rs.)	Production (tonnes)	Gross return (Rs.)	Net income (Rs.)	Cost benefit ratio
	Labour (Rs.)	Material (Rs.)	Contingencies (Rs.)					
1st	14140	54496	6864	75500	0	0	0	0.00
2nd	16500	15888	3239	35627	0	0	0	0.00
3rd	32500	22987	5549	61036	26	156000	94964	1.56
4th	45300	30818	7612	83730	38	228000	144270	1.72
5th	49100	37863	8696	95659	47	282000	186341	1.95
6th	51700	38163	8986	98849	52	312000	213151	2.16
7th	51700	38163	8986	98849	55	330000	231151	2.34

Economic analysis of establishing, maintaining and returns from one hectare high density planting spaced at 3 x 3m (1111 plants ha^{-1})

Year	Estimated expenditure			Total expenditure (Rs.)	Production (tonnes)	Gross return (Rs.)	Net income (Rs.)	Cost benefit ratio
	Labour (Rs.)	Material (Rs.)	Contingencies (Rs.)					
1	9898	27248	3715	40861	0	0	0	0
2	11550	7944	1949	21443	0	0	0	0
3	23750	11494	3524	38768	18	108000	69232	1.79
4	33710	15409	4912	54031	26	156000	101969	1.89
5	36370	18932	5530	60832	30	180000	119168	1.96
6	44190	19082	6327	69599	35	210000	140401	2.02
7	47190	19082	6627	72899	38	228000	155101	2.13

Economic analysis of establishing, maintaining and returns from one hectare high density planting spaced at 6.0 x 3.0m (555 plants ha^{-1})

Year	Estimated expenditure			Total expenditure (Rs.)	Production (tonnes)	Gross return (Rs.)	Net income (Rs.)	Cost benefit ratio
	Labour (Rs.)	Material (Rs.)	Contingencies (Rs.)					
1	9065	13612	2268	24944	0	0	0	0.00
2	10578	3968	1455	16001	0	0	0	0.00
3	21751	5742	2749	30242	11	66000	35758	1.18
4	29957	7698	3765	41420	17	102000	60580	1.46
5	36393	9457	4585	50435	24	144000	93565	1.86
6	43555	9532	5309	58396	28	168000	109604	1.88
7	45387	9532	5492	60411	31	186000	125589	2.02

Economic analysis of establishing, maintaining and returns from one hectare high density planting spaced at 6.0 x 6.0m (277 plants ha^{-1})

Year	Estimated expenditure			Total expenditure (Rs.)	Production (tonnes)	Gross return (Rs.)	Net income (Rs.)	Cost benefit ratio
	Labour (Rs.)	Material (Rs.)	Contingencies (Rs.)					
1	12166	6905	1907	20978	-	-	-	-
2	13000	3734	1673	18407	-	-	-	-
3	24500	4556	2905	31961	6.0	36000	4039	-
4	31000	4716	3572	39288	12.0	72000	32712	0.83
5	37250	8335	4559	50144	15.0	90000	39856	0.79
6	39180	8335	4752	52267	19.0	140000	87733	1.67
7	42175	8335	5051	55575	27.0	162000	106425	1.91

Sale of fruits @ 6.0 kg^{-1}

Demonstrations at Farmers' Field

Field demonstration of meadow orcharding system was taken up in various states of the country where farmers showed keen interest in the system. Demonstration trials were imparted in different areas of Maharashtra, Andhra Pradesh, Uttar Pradesh, Rajasthan, Karnataka, Jharkhand, etc. After the demonstration trials, the technology has gained immense popularity amongst the farmers across the country. In Ahmednagar district of Maharashtra, an average yield of 15 tonnes ha^{-1} was obtained during the first year. As a result, the demand of plant material for establishing meadow orchards has gone up considerably. The area under meadow orchard across the country is increasing day by day. Apart from meadow orcharding, demonstration on high density plantings (3.0 x 1.5 m; 3x3.0 m and 6.0 x 3.0 m) were also taken up in different states. After demonstration, the techniques of high density planting and canopy management gained popularity among the farmers.

Orchardists in discussion with scientist on meadow orchard at Bhilawadi and Malegaon in Maharashtra

Meadow orchard in farmers' field at Bhilawadi and Theur in Maharashtra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