

PACKAGE OF PRACTICES FOR FRUIT CROPS



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Contributors

Fruit Science

1. Dr Parshant Bakshi, Senior Scientist ACHR
2. Dr Mahital Jamwal, Deputy Director Research
3. Dr Amit Jasrotia, Associate Professor
4. Dr Arti Sharma, Assistant Professor
5. Dr Kiran Kour, Assistant Professor
6. Dr Deep Ji Bhat, Assistant Professor
7. Dr Rajesh Kumar, Junior Scientist RARS
8. Dr Akash Sharma, Junior Scientist ACHR
9. Dr Rakesh Kumar, Junior Scientist RRSS
10. Dr Nirmal Sharma, Junior Scientist RHRSS

Entomology

1. Dr Hafeez Ahmad Professor & Head
2. Dr Uma Shankar Associate Professor

Plant Pathology

1. Dr S.K.Singh Associate Professor
2. Dr R.S.Sodhi Associate Professor

Compiled by:

1. Dr A.K. Sharma, Associate Director Extension
2. Dr Rakesh Sharma, Senior Scientist, Agril. Extension Edu.
3. Dr Pawan K. Sharma, Scientist, Agril. Economics

FOREWORD

Cultivation of fruits assumes an eminent place in the agrarian setup in terms of efficient land use, creation of eco-friendly environment, generation of higher economic returns and provision of better employment opportunities. Seasonal fruits provide nutritional security to poor sections of the society. The scientific cultivation of fruits offers valuable option in farm diversification. Besides, it provides ample scope for sustaining agro-industries. India is the second largest producer of fruits in the world with first rank in the production of Banana, Mango, Lime & Lemon and Papaya. In India, the fruit crops are grown over an area of around 66.5 lakh hectares (ha) with total production of 98,579.27 thousand metric tonnes (MT). The average productivity of fruits at national level is 14.8 MT per hectare.



Prof. J.P. Sharma
Vice Chancellor
SKUAST-Jammu

The agro-climatic situations prevailing in the Union Territory (UT) of Jammu and Kashmir (J&K) offer opportunity for cultivation of wide varieties of fruit crops. The area under fruit crops in UT of J&K is around 3.45 lakh ha, including 1.185 lakh ha in Jammu division. The total production in J&K is around 2564.27 thousand MT, including 253.68 thousand MT from Jammu region with average productivity of 7.4 MT/ha and 2.14 MT/ha, respectively.

The productivity of fruits in Jammu region is much less compared to state and national averages. The adoption of scientific practices in fruit cultivations can lead to sustainable development and doubling of farmers' income, as envisaged by the Prime Minister of India. Therefore, there is a vast potential for improving the productivity of existing orchards through scientific package of practices, including plantation of improved varieties with budding/grafting on proper rootstock.

Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu is dedicated to bring positive change in the lives of farmers of Jammu region. To this endeavor, the University has updated and published the "**Package of Practices for Fruit Crops**". I congratulate Directorate of Extension and Division of Fruit Science for updating the publication for the benefit of orchardists, field functionaries and researchers.

Date
Place: Jammu


(J.P. Sharma)
Vice Chancellor

PREFACE

One of the mandates of the Directorate of Extension is to publish the package of practice for fruit crops on regular basis for updating the knowledge of fruit growers and field functionaries. In this context, “**Package of Practices for Fruit Crops-2020**” has been published for use as reference book by the fruit growers, field functionaries, young entrepreneurs, students and researchers interested in adopting and promoting horticulture.

Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu through Division of Fruit Science, Research Stations and Krishi Vigyan Kendras is playing an important role in popularization of zone specific new cultivars of different fruit crops for enhancing the cultivation of commercial fruit crops in Jammu region.

The package of practice for fruit crops includes the agronomic and management practices of various crops namely mango, guava, ber, aonla, litchi etc. that are grown in sub-tropical areas, pear, plum, peach etc in intermediate (low hills) areas and almond, peach, walnut, apple etc. in temperate zones of Jammu division in a very simple and easy to understand language.

I would like to take this opportunity to acknowledge my indebtedness to the scientists of Division of fruit science, plant pathology and entomology who helped the Directorate of Extension in the compilation of this publication.



(S.K. Gupta)
Director Extension

CONTENTS

	Chapters	Page (s)
1.	Introduction	1
2.	Raising of Fruit Nursery	5
3.	Mango	10
4.	Citrus Fruits	21
5.	Litchi	28
6.	Guava	33
7.	Grapes	41
8.	Aonla	46
9.	Ber	50
10.	Phalsa	54
11.	Jamun	56
12.	Pomegranate	59
13.	Custard Apple	62
14.	Lasoda	64
15.	Karonda	66
16.	Bael	68
17.	Jackfruit	71
18.	Olive	73
19.	Pecan	76
20.	Apple	79
21.	Pear	93
22.	Peach	102
23.	Plum	108
24.	Apricot	112
25.	Almond	115
26.	Walnut	122
27.	Strawberry	127
28.	Persimmon	131
29.	Kiwifruit	133

Introduction

Jammu division with three agro-climatic zones viz., sub-tropical, intermediate (low hills) and temperate (Fig 1.1) has vast potential for horticultural industry by way of improving the productivity of existing orchards and using vast tracts of underutilized wastelands, kandi areas of sub-tropical zone and hilly areas of intermediate and temperate zones for fruit production. For this, there is need for plantation of suitable varieties, budded/grafted on proper rootstock and following of improved orchard management practices namely training and pruning, nutrient and water management and pest and disease control. In Jammu division, fruits occupy an area of 118542ha with the production of 253684 Metric Tonnes (MT) and productivity of 2.14 MT/ha in.

Sub-tropical zone

This zone is characterized by hot summers and relatively dry but pronounced winters. The land is suitable for cultivation of mango, citrus crops (sweet orange, mandarin particularly kinnow, lime, lemon, guava, litchi, ber, papaya and other minor fruits). Some low chill varieties of temperate fruits like peach, pear and strawberry have been found suitable for cultivation in Jammu sub-tropics. The peach cultivars Shan-e-Punjab, Flordasun and Flordared and pear cultivars Patharnakh and LeConte have shown better yield and fruit quality. Besides, strawberry cultivars namely Chandler, Gorella, Fern and Belrubi have also been found better on the basis of yield and fruit quality parameters. For rainfed areas, hardy fruits like aonla, ber, guava, lasoda, karonda and custard apple are more suitable with aonla and ber being commercially more viable.

Intermediate (low hills) zone

This area lies in between sub-tropical zone and high hills with altitude ranging between 1000- 1500 m above mean sea level. It includes parts of Billawar and Basohli tehsils of Kathua district as well as several localities of Rajouri, Poonch, Reasi, Udhampur, Doda, Ramban and Kishtwar districts. Annual precipitation is nearly 1500 mm. Winters are sub-humid and colder, whereas summers are less severe but more humid. This zone is more suited for peaches, plums, apricots and citrus. This area abounds in wild pomegranate and wild olive trees. In recent times, several known olive cultivars have been introduced, however, improved orchard management practices are needed to improve their yield and quality.

Temperate (high hills) zone

The altitude in this zone varies between 1500-2500 m and above mean sea level. This zone has severe moist cold winters and experiences snow fall at higher reaches and includes bulk area of Doda, Poonch, Ramban, Kishtwar and Rajouri and some areas of Udhampur and Kathua districts. Walnut, apple, pear, peach and plum are successfully grown in this zone.

Orchard management practices/General considerations in fruit cultivation Cultivars

The choice of cultivars depends upon its climatic requirement, soil conditions and moisture availability. In case of temperate fruits, it is necessary to see whether the cultivars to be planted will get necessary chilling hours in winter.

Providing windbreaks

An effective windbreak of tall trees alternating with relatively small but spreading trees must be established on the windward side of orchard, well before the orchard is planted to protect trees from hot winds of summer which damage the trees resulting in fruit splitting and fruit-drop. *Eucalyptus*, jamun, seedling mango, mulberry, jackfruit etc. are some of the trees which can make good windbreaks under sub-tropical conditions.

Digging and filling of pits

Preparation of pits and planting should always be done with the help of planting board. The guide pegs are planted at both ends. One metre deep pit of 1 metre diameter should be dug. Top 30 cm soil should be kept on one side and is used for refilling the pits as fertile soil. Bottom 70 cm soil should be kept on other side. The pits should be exposed for few days before planting. The pits should be filled with mixture of top soil, 2-3 baskets of silt as well as well rotten farm yard manure (FYM). The refilled pits should be watered properly before planting the tree. In each pit, 0.05% solution of chlorpyrifos can be added against white ants.



Fig. 1.1: Agro-climatic zones of Jammu Division

Nutrition

Fruit trees remove large amount of nutrients from soil than other field crops. An orchard can be maintained in commercial bearing using adequate manuring. However, the nutrient requirements of fruit trees are governed by many factors like fruit kind, fruit cultivars, climatic conditions and cultural practices followed. For proper fertilizer programme, there is need of soil and leaf analysis for particular fruit growing area. In the following pages, the fertilizer schedule is given for the respective crops for general guidance. Organic manures should be applied 3 months ahead of spring season so that nutrients are converted into available form by the onset of spring season. The fertilizers should be placed in bands or trenches around the tree in basins. The size of basin should be increased with the increasing age and canopy of the tree.

Irrigation

For obtaining a good yield, it is necessary to have optimum soil moisture at certain critical stages of growth, flowering, fruit set and fruit development. The aim of irrigating a tree is to wet the entire rooting zone. Depending upon the availability of water, different irrigation systems, like furrow, basin, sprinkler and drip can be utilized. In rainfed areas, water-harvesting techniques during rains should be practiced.

Protection against adverse weather conditions

The fruit plants like mango, citrus and litchi are damaged by high summer temperatures. The fruit trees, especially young plants need more attention and adequate protection against heat during summer and frost during winter.

- (i) **White washing:** This is the most practical method for saving the trunk of fruit trees from sun-injury. The bare trunk portion should be white washed in the month of March. White washing may again be repeated if it gets washed by rains. The effective whitewash material can be prepared by adding unhydrated lime (25 kg) and copper sulphate (2 kg) to 450 litres of water and mixing them. Copper sulphate is also effective against fungal diseases.
- (ii) **Providing shelters:** Young fruit plants of tender type can be protected by erecting thatches made of paddy straw.
- (iii) **Wind breaks:** The windbreaks should be planted before fruit tree plantation. Trees selected should be fast growing, tall, hardy and drought resistant.
- (iv) **Irrigation:** Frequency of irrigation should be increased during summers.

Protection against cold

- (i) Covering young plants with thatches made of farm waste.
- (ii) Wrapping of exposed tree portion with old gunny cloth to avoid damage to bark by cold injury.

- (iii) Dry leaves should be burnt as smoke raises atmospheric temperature by few degrees and save fruit trees from frost.
- (iv) By irrigating the orchards during winter, it is possible to raise the temperature by 1-2°C.
- (v) Planting windbreaks on the North-Western sides of the orchard, provide protection from the cold waves during winter season.

Raising of Fruit Nursery

Nursery management is the backbone of fruit industry. It provides continuous supply of healthy and certified planting material. So, one should give utmost attention while raising fruit plants. The important steps taken in the multiplication of quality planting material are as under:

A. Seed extraction

Most of the fruit species are propagated through vegetative methods but some fruits namely jamun, papaya and phalsa are still propagated by seeds. Besides this, seed is also the main source for raising rootstock on which the plants are budded or grafted. The rootstock has a profound effect on the vigour, precocity, fruit yield, quality and longevity of scion. Proper care should be taken in selection of seed source. An ideal rootstock should have the following characteristics:

1. Easy to propagate by seeds or by cuttings.
2. High degree of polyembryony in some fruits like citrus, mango etc.
3. Compatible with scion cultivar.
4. Dwarf, precocious with high yielding impact on scion.
5. Vigorous in early age with well anchored roots and free from suckering.
6. Adaptable to problematic soils (moist, drought, saline, calcareous etc.)
7. Adaptable to unfavourable weather conditions.
8. Resistant to pests and diseases.

The seed should always be extracted from fully ripened fruits collected from healthy, vigorous and high yielding trees.

B. Handling of seeds

After extraction, the seeds should be washed properly with water and dried in shade. The seeds of sub-tropical fruits should preferably be sown immediately after shade drying. Seeds can also be stored in cool and dry places in air tight containers for certain duration as given in Table 1.

Table 1: The storage longevity of seeds of different fruits

Fruit	Longevity (Years)
Almond	5
Apple	2-3
Apricot	5
Cherry	1-3
Citrus	Immediate
Mango	30 days
Peach	5
Pear	3
Pecan	1-3
Plum	4-6
Walnut	1-3

C. Pre-sowing treatment

The seeds which are having very hard seed coat require scarification prior to sowing which can be done by breaking, scratching, altering or softening the seed coverings. The seeds of ber, peach and walnut can be scarified by cracking of seeds with hammer. The scarification can also be done by giving hot water treatment (77°-100°C) for few seconds followed by cold water treatment for 12-24 hours. The scarification of guava seeds can also be done by giving 0.25% HNO₃ treatment for 3 minutes. The use of concentrated H₂SO₄ for 5-10 minutes and 500 ppm GA₃ for overnight as seed treatment is very useful to enhance the seed germination of ber and aonla, respectively. The seed should be thoroughly washed after acid treatment.

Prior to sowing, seeds of temperate fruits need some period of rest under moist chilling conditions (stratification) for germination as given in Table 2.

Table 2: Duration of seed stratification (at 1-5°C) in moist sand medium

Fruit	Stratification duration
Apple	50-70 days
Pear	30-50 days
Peach	60-70 days
Plum	60-70 days
Apricot	45-50 days
Almond	45-50 days
Walnut	95-120 days
Pecan	70-75 days
Persimmon	90-100 days

The seed germination can be improved by treating the seeds with 5000 ppm thiourea for 15-20 hours (peach and grapes), 100 to 500 ppm GA₃ for 12 hours (for apple, cherry, peach and hazelnut), 5000 ppm ethrel (for guava) and 10-20 ppm benzyladenine (for apple). When controlled temperature conditions for stratification are not available, sowing of seed is done directly in nursery in the month of November-December in cool areas.

D. Preparation of seed bed/container

The growing media to be used must be sufficiently firm to provide anchorage to seeds or cuttings, well decomposed with high C:N ratio, free from weeds and harmful pathogens, cheaper and readily available, and should have slightly acidic pH and good water holding capacity with sufficient porosity to drain excess water. For raising seedlings, the bed of 2-3 m (L) x 60-100 cm (W) x 15-20 cm (H) should be prepared by mixing 2 parts loamy soil + 3 parts leaf mould + 5 parts sand. This soil media must be sterilized either by covering with white transparent plastic polyethylene sheet for 4-6 weeks during the hottest part of the year or with 2% formalin solution (300 g/cubic metre of media). This media should be mixed with 2.5 kg of base fertilizer mixture of (1.8 kg CAN or

Ammonium sulphate + 2.5 kg Super phosphate + 1.0 kg Muriate of potash) per cubic metre of root media. This media with the base fertilizer can also be filled in the containers, earthen pots, polyethylene bags etc. for raising seedlings. The seeds of deep-rooted fruits (ber, jackfruit, walnut etc.) can be sown directly in the pit called *in situ* planting.

E. Seed sowing

The seeds of sub-tropical fruits should be sown immediately after extraction from the fruit, while the seeds of temperate fruits should be sown after their stratification. Since, the seeds of citrus are available in winter months, covering the seed bed with alkathene sheet enhances germination. Covering the growing seedlings with poly-tunnels helps in better growth.

The seeds should be sown at a depth of 3 times the thickness of seed. The seeding distance of some fruit species is given in Table 3.

Table 3: Seeding distance of some fruit crops

Fruit	Distance
Citrus and guava	10 cm x 2 cm
Mango	45 cm x 15-20 cm
Jamun	25-30 cm x 15 cm
Apple, pear, peach, plum	30 cm x 10-15 cm
Phalsa	10-15 cm x 15 cm
Ber	30 cm x 15 cm

The germination period of seeds varies with the crop and is given in Table 4.

Table 4: Seed germination period after sowing

Fruit	Germination period (in days)
Apple	75-100*
Apricot	20-25*
Citrus	21
Guava	25-30
Ber	40-50
Mango	25-30
Peach	45*
Pear	45*
Plum	30*
Cherry	20*
Walnut	30*

*After stratification

F. After care of seedlings

After sowing, the bed should be covered with thin layer of pulverized soil or some other materials like wood ash plus well rotten FYM. If there is a need of irrigation, water should be given with very fine nozzle. The frequency of irrigation in seedbed depends upon the weather and soil conditions. Hand

weeding should be done to check the population of weeds. The nursery bed should be protected from summer heat by thatching with paddy straw and sugarcane leaves, sowing of arhar around the bed, irrigation etc. The protection from very low winter temperature injury and frost is achieved by thatching, irrigation, smoking, polyethylene tents etc. In areas, where rapid death and collapse of seedlings occur in nursery, drenching of nursery beds with copper oxychloride @ 300gm in 100 litre of water should be done.

G. Transplanting

After attaining the age of transplanting (Table 5), the seedlings should be transplanted in properly leveled and well drained beds having optimum moisture level which have been liberally supplied with well rotten FYM/organic manures. The seedlings should be planted in twin rows at 30 cm x 15 cm distance. The distance between twin rows should be kept 50-60 cm for performing other nursery operations. Raising of rootstocks in open nursery beds lifting of plants for supply with earth ball in sandy soils is practically difficult. To avoid damage during handling and transportation, the rootstocks should be raised in polythene bags. Generally, polythene bags of 16''x6'' with perforations in the bottom and sides are used for raising the rootstocks.

Table 5: Transplanting age of seedlings

Fruit	Age
Mango	2-3 weeks
Jackfruit	1-2 years
Bael	1 year
Ber	2 months
Phalsa	8-10 months
Jamun	10 months
Citrus	4-5 months
Guava	4 months
Loquat	4-5 months
Temperate fruits	8-10 months

Proper care (irrigation, weeding, nutrition, plant protection measures etc.) of these seedlings should be taken in transplanting bed.

H. Selection of mother plants

The trees selected for mother plants should have the following characteristics:

1. It should be true-to-type.
2. Consistently high performance and maximum yield over 3-5 years with good quality fruit.
3. Plant should have attained full bearing age.
4. Free from pests and diseases.

I. Preparation of rootstock

Select healthy seedlings for budding/grafting which have attained the pencil (10 mm) diameter. Remove thorns/leaves from the rootstock at budding/grafting height. The budding or grafting operations should be performed at a height of 20 cm from ground level.

J. Preparation of scion

Select round wood scion and it should be prepared according to the method of budding/grafting to be performed as mentioned for every fruit crop in this package of practices.

K. After care of grafted/budded plants

Proper care should be taken of these plants. Do not allow any sucker to grow from the rootstock below budding/grafting union.

L. Use of root trainers

The ideal budded or grafted plant should have strong uncoiled tap root system with sufficient lateral roots. In containers or under sized polybags, if the plant is kept for longer time, the tap root is coiled up and plant show poor performance after planting out. In order to overcome these problems, root trainers can be used which facilitate strong fibrous root system in plants.

Mango

Mango (*Mangifera indica* L.) is one of the choicest and most ancient fruits known to mankind. It occupies a pre-eminent place amongst the sub-tropical fruits grown in Jammu region. It occupies an area of 13,037 ha with annual production of 30,478 M.T. It is extensively grown in Jammu district and also in the sub-tropical areas of Udhampur, Reasi, Kathua and Rajouri districts of Jammu region.

Climate and Soil

Mango thrives well up to 600 m above mean sea provided locality is frost free and there is no high humidity or rains during flowering. The favourable temperature is 24°C to 27°C. However, it can tolerate temperature as high as 48°C provided that trees are getting regular irrigation.

Mango grows well on a wide range of soils. However, deep and well-drained sandy loam soils are most suitable for its cultivation. Heavy black cotton, saline and alkaline soils should be avoided. The ideal range of soil pH for mango cultivation is 5.5 to 7.5.

Cultivars

Bombay Green (Malda)

This is one of the earliest varieties of North India. Fruits are medium sized having strong and pleasant flavour and harvested by the end of June. The pulp is deep yellow, firm and fibreless.

Dashehari

This is the mid season mango variety ripens in first half of July and is most popular in North India. Fruits are medium sized with pleasant flavour, sweet and fibrous pulp. Its keeping quality is good.

Langra

This is also a mid season cultivar and ripens in 2nd half of July. Fruits are medium to large in size, flesh is firm, fibreless, lemon yellow and strongly flavoured. This is an important variety of North India with biennial bearing habits.

Samar BahishtChausa

This is a late maturing variety of North India ripening in first fortnight of August. Fruits are large with light yellow colour having soft and sweet pulp. It is shy bearing.

Jammu Mango (Selection-5)

This is a mid season sucking type of mango selection released by SKUAST-J. It is suitable for rainfed/kandi area of Jammu sub-tropics and yields more than 120 kg per plant at spacing of 10x10m apart. It has total soluble solids of 18.9° Brix and 14.68 percent of total sugars. It is tolerant to drought during

fruit set and fruit development which results in large fruit size and higher yield. Fruit skin is smooth, thin and easily separated from the pulp. The flesh is yellow, very tender and melting with a very delicate aromatic flavor. The fruit get matured and ready for pickle making in the month of May and harvesting is over before the onset of monsoon. It is moderately resistant to mango malformation.

Other promising cultivars

Pusa Arunima, Pusa Surya, Pusa Pratibha, PusaShreshth, PusaPeetamber, PusaLalima, Ambika, Arunika, Pant Sinduri, Pant Chandra.

Propagation and Rootstock

Rootstock used for grafting is grown from stones of seedling mango trees. The stones are sown soon after they are removed from the ripe fruit as they lose their viability very soon. Before sowing, stones should be immersed in water and only those stones are sown which sink in water as these are considered to be viable. The stones are sown in July-August in well-prepared beds. In the beds, the seed are sown in lines which are 45 cm apart and at a distance of 60 cm is left after every two rows to facilitate the cultural practices and grafting of seedlings. The stones after sowing are covered with the mixture of sand and farmyard manure. The seedling assumes graftable size in next July-August but some of the well-cared seedlings become fit for grafting even in March-April.

Grafting Methods

Mangoes can be propagated by several methods but it has been observed that veneer and side grafting are efficient as well as cheaper than inarching method. The following points should be kept in view, while selecting and preparing scion wood for grafting.

- i. The scion sticks should have equal thickness to rootstock.
- ii. The scion sticks should be selected from terminal non-flowered shoot, which is of about 3 to 4 months of age.
- iii. The scion stick should be defoliated leaving a portion of petiole 7-10 days before their detachment from the mother plant.

Grafting time

Grafting can be done from March to April and from mid July to September.

Planting

The pits are dug during summer and filled with 20-25 kg well rotten FYM and garden soil. The distance of planting varies with cultivars. However, 8-10 m distance in both ways is advocated. For establishing high density orchards of mango, planting should be done at 4.5 m x 4.5 m spacing (row to row and plant to plant) to accommodate 495 plants/ha whereas at 4.0x3.0m (row to row x plant to plant) to accommodate 833 plants/ha. During planting, earth ball should remain intact and graft union should be above the ground level. The following points should be kept in consideration while selecting plant materials:

- i. Plants should be obtained from reliable nursery and should be of known pedigree.
- ii. The graft union should be smooth and about 25 cm above from ground level.
- iii. The plants should be vigorous and straight growing and free from various insect-pests/diseases.
- iv. The plant should be taken out with good sized earth ball to keep maximum part of root system intact.
- v. The plant should be handled carefully during transit to keep the graft union as well as the earth ball in sound condition.

After care of young Plants

- i. Provide irrigation to the newly planted young fruit plants. Avoid heavy watering and stagnation of water in their basins.
- ii. Remove/pinch off stock sprouts whenever they appear.
- iii. Remove tying material at the bud/graft union, otherwise it may cause constriction.
- iv. Provide support to the plants for their upright growth.

Protection from frost and hot weather

It is necessary to protect the young plants for at least 3-4 years against frost and low temperature injury by covering them with suitable thatching material. Irrigation can also be useful to ward off ill effects of frost.

Protection of plants/trees against hot weather by white washing the lower basal portion of stem is also desirable. Other measures, like wrapping the stem/trunks of plants/trees with old gunny bags or providing thatches to young plants may also be carried out.

Training and Pruning

Training of the tree for well spaced branches is essential in early years. The main branches should grow in different directions at least 30 cm apart and with good crotch angles. As mango bears terminally, so annual pruning is not done except removing over crowded, diseased and dead branches.

Top-working of inferior mango trees

The old unproductive and inferior seedling trees, can be rejuvenated and improved by top-working.

The selected scaffold limbs of inferior or unproductive trees, desired to be top worked are headed back in December-January. The cut ends are treated with copper oxychloride paste. Many shoots emerge within a short time below the stubs. Out of these, 2-3 vigorous shoots per branch or limb are selected and remaining are removed. These shoots make fast growth and become suitable for grafting by August-September of the same year.

Rejuvenation of old/senile/unproductive mango trees

The mango tree which attained more than 40-50 years of age and have completed their productive life can be rejuvenated by following technique:

Calendar of activities for rejuvenation of old/unproductive mango orchard

December - January:

- Marking of trees and their desired branches for pruning. Pruning marked branches in December.
- Pruning to be followed in alternate row.
- Pruning to be initiated from lower surface of the branch and alter from upper surface to avoid cracking and bark splitting.
- Application of copper oxychloride paste or biodynamic tree paste on the trunk, branches as well as surfaces to check microbial infection.
- Cleaning of the dust on the polythene band, applied in the month of December to prevent ascent of nymphs of mealy bug.
- Ploughing and weeding of orchards in January.
- Preparation of basins and irrigation channels.

February - March

- Application of recommended full dose of SSP (3kg tree⁻¹ and half dose of urea (1.25 kg tree⁻¹) in basins by the end of February
- Careful observation for infestation of stem borer, insect pest in pruned trees and other pests like mango hoppers and mealy bugs.
- Upon identification of infestation, placing cotton wick soaked with kerosene oil or inject water emulsion of 0.05% or chlorpyrifos 20EC @ 0.05 %.
- Spray wetablesulphur 200-250 g 100⁻¹ liter of water. Spraying of Oxydemeton methyl 25 EC @ 1-2 ml/litre of water or dimethoate 30 EC @ 1.5-2 ml/litre of water against mango hoppers.

April - May

- Irrigation as per requirement
- Mulching in basins around the trees
- Hoeing and weeding in basins.
- Care for new emerging shoots.
- Observation for incidence of stem-borer, mango hoppers, mealy bugs and their management.

June - July

- Thinning out of undesired shoots while retaining about 8-12 outwardly growing healthy shoots per pruned branch during June followed by spray of copper oxychloride 3g/litre.
- Irrigation at an interval of 10-15 days.

- Application of remaining half dose of urea i.e 1.25 kg per tree during June.
- Application of FYM (120 kg per tree) in basins during July.
- Management of stem borer as described earlier.
- Spray of copper oxychloride (3g per litre of water) twice at an interval of 15days if there is infestation of anthracnose and other leaf spot diseases on new leaves.
- If there is serious incidence of leaf cutting weevil, two sprays of acetamiprid 20 SP @ 0.2 g/litre of water at an interval of 15 days may be done.
- Sowing of green manuring crops or rainy season intercrops.

August - September

- Thinning out of undesired shoots.
- Observations of incidence of stem borer insect pest and anthracnose and other leaf spot diseases and their management.
- If attack of mango leaf webber is noticed, spraying the infested bunch thoroughly with dimethoate 30EC@ 2ml/litre of water or oxydemeton methyl 25 EC @ 1-2 ml/litre of water.
- Repeat the spray for control of scale insects, leaf, shoot borers and leaf cuttings weevils as suggested in previous month.
- Ploughing of green manuring crops.
- If required, repeat the spray for control of scale insects, leaf, shoot borers and leaf cutting weevils.
- Ploughing, cleaning and removal of weeds to be done.

October - November

- Cultural operations of ploughing, hoeing, weeding etc.
- Removal of dried and diseased twigs.
- Management of insect pests and diseases.
- Foliar spray of 2 % urea during October for healthy vegetative growth.
- Marking of trees for pruning.
- Spray 200ppm naphthalene acetic acid in the 2nd fortnight may be done to overcome the mango malformation.
- Mixing of 75-100 kg well decomposed FYM in the basins of each plant.
- To control die back disease, cut the affected twigs and burn.
- Spray 0.3% copper oxychloride and the spraying may be repeated after 15 days.

Manure and Fertilizers

Age of tree (Year)	FYM (Kg/tree)	Fertilizer requirement (g/tree)		
		Urea	Diammonium Phosphate (DAP)	Muriate of Potash (MOP)
1	5	95	50	35
2	5	190	105	65
3	10	285	155	100
4	15	380	205	135
5	20	475	260	165
6	25	570	310	200
7	30	715	360	235
8	35	865	415	265
9	40	1010	465	300
10	45	1155	515	335
11	50	1305	570	365
12	60	1450	620	400
13	70	1600	670	435
14	80	1745	720	465
15 th year and above	100	1945	770	500

Note: Apply full nitrogenous fertilizers alongwith half of phosphorous and half of potash after harvesting of fruit. Remaining quantities of two fertilizers should be applied during October with last irrigation. Apply at this time organic manure also, as they are released slowly.

Irrigation

The very first irrigation is needed just after planting in the absence of rains. Subsequent irrigations are needed as per need of the plantation up to 2-3 years or so. The interval between subsequent irrigation may be of 3-4 days in summer to once a fortnight in winter depending upon type of soil and climatic conditions. Bearing mango trees respond well to irrigation and they produce more yields by increasing fruit setting and fruit retention. Such trees should be irrigated at 10-15 days interval during the fruit development period. Bearing trees should not be irrigated during flowering stage, rather it is advantageous to withhold irrigation that will induce more flowering otherwise it will result in more vegetative growth.

Interculture and Intercropping

Young mango orchards should be kept completely free of any weeds. At least one shallow cultivation should be done at quarterly interval (once in 3 months). Bearing mango orchards are shallow cultivated in the beginning of the monsoon and again cleaned in post monsoon season. In the interspace of the mango orchard, certain vegetables can be intercropped namely onion, tomato, radish, carrot, cowpea, cluster bean, french bean, okra, cauliflower, cabbage, peas, colocasia, turmeric, methi and palak. Besides, fruit crops *viz.* phalsa and strawberry can also be grown for initial 4-5 years.

Harvesting and yield

During first 3-4 years, any flowering on trees should be removed to develop a good frame work of tree. It is common practice to harvest mango fruits when they start falling from the tree naturally (Tapka stage). Fruits should be harvested by using bamboo hand tool called mango picker.

The yield of the mango fruit varies due to several factors viz., age of the tree, variety grown, climatic conditions, soil type, type of tree (seedling or grafted one), on and off year and management practices followed. However, from a well grown mango tree (10 year onwards) the yield varies from 40 to 100 kg and may go up to 3-5 quintals per tree per season upto the age of 40 years.

Grading and packing

Sorting and grading are desirable pre-requisite for successful marketing. The fruits of mango can be graded according to their weight as follows:

1st grade: Fruit weight 320 g or more

2nd grade: Fruit weight 270-320 g

3rd grade: Fruit weight 200-270 g

The common practice is to pack the fruits in bamboo baskets which usually are not of any standard size. Now the wooden boxes are used for packing mangoes. The lining material (newspaper, paddy straw) may be used in boxes.

Special problems

Fruit drop in mango	Management
The natural fruit drop of mango is rather severe amounting to about 99% at various stages of growth.	i) Regular irrigation during the fruit setting and development period can reduce fruit drop considerably. ii) Application of plant bio-regulators like NAA (40 ppm) or 2,4-D (20 ppm) about 6 weeks after fruit set, reduce fruit drop considerably. iii) Spray of 0.8% zinc sulphate or 4.0% potassium nitrate at bloom stage are very effective in increasing the fruit retention, yield quality and shelf life of mango cv. Dashehari.
Biennial bearing This is one of the most burning problems since it renders mango cultivation less remunerative to the growers. Biennial bearing is also known as alternate bearing. It indicates yield variations in alternate years i.e. a year of optimum or heavy fruiting followed by a year of little or no fruiting. The problem of biennial bearing is a varietal character governed by genetic makeup, and this tendency starts exhibiting in mango plant even at the second year of fruiting and become	i) Proper upkeep and after care of orchards, adequate manuring and proper irrigation after fruit set can help in reducing irregular/erratic bearing in mango. ii) Application of paclobutrazol (PBZ) through soil drench in alternate bearing varieties of mango @ 2.5 ml/m ² of tree area (PBZ 28% SC) or 1.25 ml per year of tree age (PBZ 28% SC) and finally the volume raised to 20 liters with water is effective in mitigating the problem of alternate bearing, which results in early and profuse flowering.

<p>more serious as the age advances.</p>	<p>iii) Age of mango tree should not be less than 10 years. iv) Apply the treatment during 15 September to 15 October. v) Add 25% more fertilizers in comparison to recommended dose of fertilizer.</p>
<p>Mango malformation Mango malformation is of two types viz., vegetative and floral. The vegetative malformation generally affects seedlings of young plants in which there is a swelling of buds and formation of small shoots with short internodes at the apical portion giving witches broom like symptoms. In floral malformation, panicles become deformed, axis become short and rachis thick, due to this inflorescence look like a cluster. Malformed panicles have bigger flowers than the normal flowers and are mostly male.</p>	<p>Following measures can lower the malformed panicles significantly:</p> <p>i) Deblossoming once at bud burst stage. ii) Single spray of 200 ppm NAA in October.iii). Cutting the malformed twigs along with approximate 15 cm healthy portion after complete fruit set in May.</p>
<p>Leaf scorch Mango leaves particularly old one show scorching at the tip and margins. Affected leaves fall down and the tree vigour and yield are reduced. The main cause of this malady is due to an excess of chloride ions which render potash unavailable.</p>	<p>i. Collect and destroy leaves. ii. Apply potassium sulphate. iii. Avoid brackish water for irrigation.</p>
<p>Black Tip The cause of black tip in mango is attributed to coal fumes and gases of brick kilns. The disorder is characterized by depressed spot of yellowish tissue at distal end of fruit which increases in size becoming brown and finally black. Dashehari variety has been found very susceptible.</p>	<p>I. Spraying of 0.6 percent borax three times i.e before flowering, during flowering and after fruit setting is necessary.</p>

Plant Protection

Insect Pest Management

Insect-pest and Symptoms	Management practices
<p>Mango Hopper (<i>Amritodusatkinsoni</i>, <i>Idioconusclypealus</i>)</p> <p>This pest is active from February to May. Damage is caused by both nymphs and adults by sucking sap from tender leaves, shoot in inflorescences. As a result, fruit setting is affected and quality is reduced. Nymphs while feeding secrete honey dew which falls on leaves and encourages the growth of sooty mould fungus.</p>	<p>i) Avoid overcrowding of the trees and water logging.</p> <p>ii) Overcrowded trees and intermingling branches should be pruned for free air circulation and penetration of sunlight to discourage the breeding of mango hopper.</p> <p>iii) Orchards may be sprayed thrice as given below:</p> <p>1st Spray: End of February use chlorpyrifos 20 EC 2ml/litre of or 480 ml in 240 litre of water/acre or acetamiprid 20 SP @ 0.2 ml/litre of water or 48g in 240 litre of water/acre.</p> <p>2nd Spray: End of March after fruit set, use: Dimethoate 30 EC@ 2ml/litre of water or 480 ml in 240 litre of water/acre or methyl demeton 25 EC @ 1ml/litre of water or 240 ml in 240 litre of water/acre</p> <p>3rd Spray: May be given in April or four weeks after 2nd spray. Use same insecticide as given for 2nd spray.</p>
<p>Mango Mealy Bug (<i>Drosichamangiferae</i>)</p> <p>Damage is rendered by nymphs and adult females by sucking sap from young shoots and inflorescence, panicles as a result fruit setting is reduced and fruits remain undersize and some even fall to the ground.</p>	<p>i) Prune the affected parts and burn the same in the initial stage of infestation.</p> <p>ii) Soil in the mango orchard should be turned over in June-July with a furrow turning plough to expose the egg masses and their destruction by summer heat.</p> <p>iii) Treat the basins of the trees and area around the mango tree in January-February with cartap hydrochloride 4G @ 8kg/acre or carbofuron 3G @ 12 kg/acre.</p> <p>iv) Apply insecticide treated mud plaster around the tree trunk to smoothen the gaps over trunk and then fastened the alkathene bands 30 cm wide (400 gauge) about ½ m above ground in the month of December to prevent the ascending of nymphs. The upper and lower portion of sheet should be lined with thick paste of grease.</p> <p>v) The nymphs which have ascended and settled on the growing points can be checked by sprays recommended against mango hopper (systematic insecticides like dimethoate or methyl demeton).</p>
<p>Mango Shoot Borer (<i>Bactoceraspp.</i>)</p> <p>Larvae of this pest after hatching from the egg bores into the young shoot from top</p>	<p>i) Remove all the dried shoots and destroy them.</p> <p>ii) Spray the new growth once or twice in August-September with dimethoate 30 EC@ 2ml/litre</p>

<p>to downwards and makes small gallery and feeds on the soft tissues. The attacked shoots show drooping and leaves dry up and turn black.</p>	<p>of water or 480 ml in 240 litre of water/acre or methyl demeton 25 EC @ 1ml/litre of water or 240 ml in 240 litre of water/acre</p>
<p>Bark Eating Caterpillars (<i>Indrabelasp.</i>) The larvae feed on the bark of stem and branches. Such trees are seen with ribbon-like webbings mixed with excretal pellets and chips and chewed wood under which the caterpillar moves and feeds. The affected trees show loss of vitality and vigour and may slowly die.</p>	<ul style="list-style-type: none"> i) Keep the orchard clean ii) Avoid growing susceptible varieties. iii) Remove the silken webbings and treat the affected branches with quinalphos 25 EC 2 ml in 1 litre of water. iv) Insert in holes, where the caterpillars rest when not feeding, cotton soaked in petrol or quinalphos 25 EC @ 2 ml in 1 litre of water. v) and seal the holes with mud plaster.
<p>Leaf webber (<i>Orthogaeuadrusalis</i>) This is the emerging and serious pest of mango in Jammu region. Its infestation starts from July and remains active up to December.</p>	<p>Suggested earlier</p>
<p>Mango fruit fly (<i>Bactrocera dorsalis</i>) The genera <i>Bactrocera</i> cause significant loss to many fruit crops as they are the polyphagous pests. The rainfed crops production is seriously infested with fruit flies especially <i>Bactrocera zonata</i> (Saunders) and <i>Bactrocera dorsalis</i> (Hendel) and causing heavy quantitative and qualitative loss. Besides Mango, guava, citrus, papaya, jamun, peach, apricot, loquat and plum are seriously affected by this dreaded pest.</p>	<ul style="list-style-type: none"> i) After Harvesting, collect infested and dropped fruits and destroy them. ii) Secondly, go for deep ploughing of orchard immediately after harvest to expose eggs and pupae of fruit flies for predation. iii) Poison Baits are effective for monitoring fruit fly population iv) Fruits should be harvested earlier and put in 5 per cent brine solution for an hour to deactivated the egg mass of fruit fly. v) Treat harvested mango fruits with hot water (48°C) for 1 hour. vi) Low cost methyl eugenol traps with used water bottles: Mix ethyl alcohol (60ml)+ methyl eugenol (40ml) + malathion (20ml) (Ratio of 6:4:2) for preparation of lures @ 6-10/acre vii) Traps and lures can also be procured readymade from the markets

Diseases and their Management

Symptoms	Management
<p>Powdery Mildew (<i>Oidium mangiferae</i>) Whitish or greyish powdery mass appears on young foliage and inflorescence. The affected panicles bear very little or no fruit due to pre-mature withering of inflorescence. Fruit drop may also take place.</p>	<p>Spray tridemorph (100 ml/100litre of water), Fosetyl-AL (300g/100litre of water) or wettable sulphur (3g/litre of water) when disease appears. Give 2-3 subsequent sprays at an interval of 10-15 days as per disease severity.</p>
<p>Anthracnose (<i>Colletotrichum gloeosporioides</i>) The disease appears on young, leaves, shoots inflorescence and fruits. Round or irregular brown spots appear on leaves and young shoots. Spots on leaves enlarge with cracked centre. Spots on shoots enlarge longitudinally giving a blighted appearance. In severe attack, the shoots may die. Minute black dots appear on inflorescence and fruit skin. Affected fruit becomes sunken.</p>	<p>i). Prune off the diseased/dead shoots and apply bordeaux paste or copper oxychloride paste to cut ends during December-January. ii). Spray the trees with copper oxychloride (300g/100litre water) or chlorothalonil (200g/100 litre of water). Give one spray each before and after flowering and 2-3 subsequent sprays at fortnightly intervals as the monsoon sets in.</p>
<p>Twig Die Back and Leaf Blight (<i>Macrophoma mangifera</i>) Minute, yellow spots turning brown appear on leaves and twigs. The spots increase gradually and cover a large leaf surface. The spots have dark purple margins. Dark brown lesions appear on young and ripening fruits.</p>	<p>i) Clip off the diseased twigs from 15 cm below the infection site and destroy by burning. ii) Apply Bordeaux paste/paint or copper oxychloride paste to the cut ends. iii) Spray with copper oxychloride (300g/100 litre of water). Repeat 2-3 sprays at 15 days interval.</p>
<p>Red Rust (<i>Cephaleuros virescens</i>) Rusty red, circular spots appear usually on old leaves and rarely on petioles and young leaves.</p>	<p>i) Avoid close plantation. ii) Spray with bordeaux mixture (1:1:100) or copper oxychloride (300g/100 litre of water) during July-August. Give 2-3 subsequent sprays at 15 days interval.</p>
<p>Bacterial Canker (<i>Xanthomonas campestris</i> pv. <i>Mangiferae</i>) Minute, dark green, water-soaked areas appear on leaves and fruits. Later, these spots become raised. The disease spread is rapid during rains and becomes severe in July-August.</p>	<p>Give two sprays with copper oxychloride (300g/100litre water) or streptomycin sulphate (50g/100litre of water) as soon as disease appears on leaves. Give subsequent sprays at 10-12 days interval.</p>

Citrus Fruits

Citrus (*Citrus* spp.) is one of the most important fruits grown in sub-tropical and foot hill regions of Jammu province (Kathua, Hiranagar, Samba, Jammu, Akhnoor, Parts of Basohli, Nowshera, Ramnagar, Ramban and Udhampur) upto an elevation of 800 m amsl. The most important commercial citrus fruits in Jammu region are kinnow mandarin, sweet orange, grapefruit, lemon and lime. The area under citrus fruits in Jammu division is 13913 ha with an annual production of 32223 M.T.

Climate and soil

Citrus plants being sub-tropical cannot with stand prolonged cold period. Temperature 3°C and 40°C are injurious to the citrus. Hot winds and excessive heat during flowering and fruit set cause fruit drop and sun burning. These are the light loving crops.

Citrus fruits thrive well in deep, loose, well aerated soils with the pH of 5.5 to 6.2 devoid of any hard pan layers of calcium carbonate in the rooting zone up to 150 cm. High water table and poor drainage system are quite unsuitable for citrus fruits which cause drying of roots and nutritional imbalance, respectively.

Cultivars

Fruit	Cultivar	Characteristics
Mandarin (<i>C. reticulata</i>)	Kinnow	Fruit medium in size, globose to oblate, golden orange colour when fully ripe, strong aroma, moderately acidic, tight skinned and ripens in December.
	Local Santra	Fruit medium to small size, oblate to sub-globose, loose skin, fair flavour, juicy, slightly acidic and ripens in January.
Sweet orange (<i>C. sinensis</i>)	Mosambi	Fruit medium in size, sub-globose shape, rough skin with longitudinal furrows, apex marked with a typical circular ring, flesh pale-yellow or whitish with low acid content, and ripens in November.
	Pineapple	Fruit medium to large, round to slightly oblate, smooth skin with deep orange colour, juicy with excellent flavour and ripens in December.
	Jaffa	Medium to large fruit, round to oblate, golden yellow to orange red skin, juicy with rich flavour and ripens in December.
	Malta Blood Red	Medium to large fruit, roundish to slightly oblong with thin skin, orange yellow to deep orange colour, fully red flesh when ripens, rich in flavour and ripens in January.

	Valencia	Medium to large fruit, slightly oval, golden yellow in colour, juicy sub-acidic in taste and ripens in February.
Grapefruit (<i>C. paradisi</i>)	Marsh Seedless	Fruit medium to large, roundish oblate, light yellow colour with smooth skin and ripens in January.
	Duncan	Fruit large, oblate, light yellow or orange in colour, fruits quite acidic and sweet but bitter and ripens in January.
	Foster	Medium to large fruit, oblate in shape, pale yellow with pink flesh, well blended with acidity and sweetness along with well marked bitterness, and ripens in November-December.
Lemon (<i>C. limon</i>)	Eureka	Fruits medium in size, oblong with a nipped apex, yellow skin, juicy, acidic with excellent flavour and ripens in August-September.
	Baramasi	Bear fruits in 3-4 flushes throughout the year, fruits round and yellow with a round apex, smooth and thin skin, juicy and almost seedless.
	Galgal	Large oval, yellow at maturity and suitable for making pickles, squash and candy.
Acid lime (Nimboo) (<i>C. aurantifolia</i>) Sweet lime (<i>C. limetoides</i>)	Kaghzi	Fruits small, round and thin skinned, greenish white, juicy and highly acidic.
	Local	Fruits medium to large, pale yellow with smooth skin and typical aroma, juicy and ripens in September.

Other promising cultivars**Citrus (lemon):**Kagzi Kalan, Pant Lemon-I**Citrus (Sweet Orange):**Pusa Round, Pusa Sharad**Citrus (Mandarin):** PAU Kinnow-1, Daisy, W. Murcott**Citrus (Sweet Orange):** Pusa Round, Pusa Sharad**Citrus (Grape fruit):** Flame Seedless, Blood Red**Citrus (Lime):** Pramalini, Vikram, Jai Devi, Sai Sharbati, Phule Sharbati, Rasraj (IIHR Hybrid), Seedless Lime**Propagation and Rootstock**

Most of the citrus fruits are generally propagated through T-budding. Jatti Khatti (*Citrus jambhiri*) is the common rootstock for most of the citrus fruits but Jatti Khatti and Rangpur lime for kinnow, Rangpur lime and cleopatra mandarin for Blood Red, Jatti Khatti and Cleopatra mandarin for Jaffa are promising. The fresh seeds of rootstocks are sown in beds at 2 cm x 10 cm distance and 1.0 cm deep which germinate 3 weeks after sowing. After attaining the 15 cm height, the seedlings should be transplanted in nursery where budding operations are to

be performed. Citrus plants can be budded either during March-April or August-September. Lime and lemons are propagated through air layering in rainy season.

Planting

a) **Planting Time:** July-August
February-March

b) **Planting distance:**

Lemon & lime	5-6 m
Grapefruit	6-7 m
Mandarin & sweet orange	6-9 m

Citrus plants are planted in pits of 50 cm x 50 cm x 50 cm or 75 cm x 75 cm x 75 cm sizes and irrigated thereafter. The young plants should be protected from cold weather during winter season.

Training and Pruning

Thinning out of branches in young nursery plants should be done at least once a month during the year following planting and once in two to three months during the first three years just for avoiding very low headed trees. Training should be done to develop mechanically strong trees with well spaced scaffold limbs at the early years before fruiting. In bearing trees, ground touching, diseased or dead branches should be removed after harvesting of fruits.

Manure and Fertilizers

Following schedule should be followed for fertilizing citrus trees.

Age of tree (Year)	FYM (Kg/tree)	Fertilizer requirement (g/tree)		
		Urea	DAP	MOP
1	5	160	35	25
2	10	320	70	50
3	15	480	105	75
4	20	640	140	100
5	25	800	170	120
6	30	960	205	150
7	35	1120	240	175
8	40	1280	275	200
9	45	1445	310	225
10 Year and above	50	1600	345	250

Note: 1) The full amount of FYM and phosphatic fertilizer should be applied in January. Whole potash and ½ nitrogenous fertilizers should be applied 15 days before flowering, whereas remaining ½ of the nitrogenous fertilizer should be given after fruit set.

2) Foliar spray of nutrient mixture (400 g CuSO₄ + 200 g FeSO₄ + 200 g borax + 1.04 kg lime + 100 litre of water) on new emerging growth flushes is beneficial for improving yield and quality of fruits.

Irrigation

Citrus trees should be irrigated at 10 days and 30 days interval during summer and winter, respectively. Irrigation water should not come in direct contact with tree trunk. The young plants (up to 3-4 years) should be irrigated at weekly intervals.

Intercropping

Intercropping in citrus orchards up to age of 3-4 years is desirable, for which shallow rooted, short duration, less exhaustive having good canopy cover and helpful in adding nutrients through nitrogen fixing crops (pea, cowpea, gram, beans etc.) are considered safe and profitable. In addition to that, some other crops like tomato, okra etc. can also be grown as the intercrops in non-bearing citrus orchards.

Flowering and fruit thinning

In mandarin, sweet orange and grapefruits, flowering takes place in spring, while lemon and lime flower almost round the year. Generally, citrus fruits are self-pollinated, but cross pollination is not uncommon. Honey bees are known to act as the pollinating agent in citrus. Fruit thinning is essential in overbearing trees of citrus fruits (like kinnow) after fruit set in May in order to maintain fruit size and tree health and to ensure regular cropping.

Harvesting & yield

Citrus fruits should be harvested when they attain full size, ground colour and recommended TSS/acid ratio. Citrus fruits are harvested generally between December and February. The fruits should be clipped from the tree retaining a non-protruding short fruit stalk but not by pulling from the branches. Average yield in terms of number of fruits for different citrus fruits is given as under:

Sweet orange	-	400 – 500 fruits/tree/year
Mandarin	-	1000 – 1500 fruits/tree/year
Kinnow	-	300 – 500 fruits/tree/year
Grape fruit	-	150 – 300 fruits/tree/year
Lime	-	800 – 1000 fruits/tree/year
Lemon	-	500 fruits /tree/year

Plant Protection

Insect pest and their Management

Insect-pest and Symptoms	Management Practices
<p>Citrus Leaf Miner (<i>Phyllocnistiscitrella</i>) Young larvae mine into the epidermal layer of young tender leaves by making silvery white zigzag galleries and suck sap. Infested leaves curl and their photosynthetic activity is reduced. Attacked trees bear poor quality fruit.</p>	<p>Prune the heavily affected parts during winter and burn the same. The peak period of these pests is March to September when maximum damage is rendered, therefore, a spray schedule comprising of 4 to 5 sprays will control these pests. 1st spray during February-March before flowering with dimethoate 30 EC 250 ml or methyl demeton 25 EC 250 ml in 200 litres of water/ acre. 2nd Spray end of March or four weeks after 1st spray (after fruit set) imidacloprid @ 75 ml in 200 litres of water/acre. 3rd Spray 3 weeks after 2nd spray in end of April or may use same insecticides as recommended for 2nd spray. 4th Spray in July-August use same insecticides as recommended for 2nd spray. 5th Spray in August-September use anyone of the insecticides mentioned for 1st spray.</p>
<p>Citrus Psylla (<i>Diaphorinacitri</i>) Small wedge shaped grey insects seen sitting in a typical symmetry on the underside of the leaves and suck the sap, as a result, the leaves curl and distorted, the quality of fruits is lowered.</p>	<p>Same as Citrus Leaf Miner. Spraying of wild tobacco extract prepared in cow urine @ 2.5 %.</p>
<p>Lemon Butterfly (<i>Papiliodemolus</i>) The caterpillars of this butterfly feed on the eaves from margin inside and defoliate the branches. Both nursery and grown up plants are attacked and their vitality is reduced.</p>	<p>Hand picking and destruction of various stages of the pest. Spraying of cypermethrin 10EC @ 1 ml/litre of water at evening hours.</p>
<p>Bark Eating Caterpillars (<i>Indarbelaquadrinorata</i>)</p>	<p>Same as given under mango.</p>
<p>Fruit sucking moth (<i>Eudocinafullonia and Achaea janata</i>) This is an emerging pest of citrus at the time of fruit maturity. This pest remains active from July to October. The adult moth is attracted at dusk to the ripening fruits and punctures the rind of fruit. The infested fruits drop off prematurely perhaps due to some toxin injected by the moths. A circular spot appears at the site of feeding which gives frothy jet of juice when squeezed.</p>	<p>Disposal of fallen and decaying fruits. Creating smoke in the orchards after sunset may be beneficial in warding off moths attack Use of poison baits Mix 20 ml malathion 50EC + 500 g molasses or gur in 2 liter of water for poison bating or 20 liter of water for bait spray</p>
<p>Fruit flies (<i>Bactrocera spp.</i>)</p>	<p>Same as given under mango.</p>

Special Problems
Diseases and their Management

Diseases and Symptoms	Management practices
<p>Citrus Canker <i>(Xanthomonas campestris pv. citri)</i> Dark brown, rough, raised, pimple-like corky spots appear on leaves, twigs, branches, petioles, fruit stalks, fruits and thorns. On leaves, spots first appear on lower surface and then on upper surface, spots are surrounded by a yellow halo. Lesions on twigs are elongated. On fruits, the lesions are confined to rind only.</p>	<p>i) Prune off the affected twigs before monsoon and destroy by burning. ii) Spray the tree and nursery plants with copper oxychloride (300 g/100 litre of water) + streptomycin sulphate (50g/100 litre of water) or streptocycline (100g/100litre of water) at 15 days interval, give 5-7 sprays.</p>
<p>Gummosis or Foot Rot <i>(Phytophthora spp.)</i> Bark on the tree trunk at the soil level turns brown, develops longitudinal cracks and starts gumming. The affected trees become weak, exhibit sickly appearance, usually blossom heavily and die before the fruit matures due to girdling effect.</p>	<p>i) Select plants from disease free nursery. ii) While planting, keep bud union above the soil. iii) Scrap the disease portion along with some healthy part with sharp knife. Disinfect the wound with mercuric chloride (1g/litre of water) and apply bordeaux paste (2:3:30) or copper oxychloride paste. iv) Maintain good water drainage in the orchard. Avoid excessive irrigation, stagnation of water and injury to root or base of the tree trunk.</p>
<p>Melanose (<i>Phomopsis citri</i>) Minute, brown, circular spots with yellow margins appear on young leaves which late become raised and turn dark brown. Similar lesions also appear on twigs. The affected fruits show small and tough pustules confined to rind only.</p>	<p>Prune off and burn the diseased twigs. Spray with copper oxychloride (300g/100 litre of water) or chlorothalonil (200g/100 litre of water) twice during March to April at 15-20 day interval. Repeat 2-3 sprays at fortnightly interval starting immediately after first monsoon shower.</p>
<p>Wither tip/Anthracnose <i>(Colletotrichum gloeosporioides)</i> Wither tip is characterized by shedding of leaves and die back of twigs. In severe infection, branches show die back symptoms and the tree dies in a few years. On leaves, necrotic spots are found in concentric rings.</p>	<p>i) Maintain tree vigour by proper irrigation, manuring and cultural practices. ii) Prune off dead twigs during February and destroy by burning. Protect the cut ends with bordeaux paste or copper oxychloride paste. iii) Spray with copper oxychloride (300g/litre of water) during March, July and September. Repeat sprays at 15 days interval as per disease severity.</p>

<p>Citrus decline (<i>A syndrome involving infection by fungi, nematodes, viruses, phytoplasma and nutritional disorders.</i>) The trees show decline in health and fruit yield, growth is stunted and the trees may ultimately die.</p>	<ul style="list-style-type: none"> i) Adopt cultural practices like hoeing, proper fertilization and irrigation. ii) Control aphids and citrus psylla by spraying insecticides like dimethoate, phosphomidon or monocrotophos to check the disease. iii) Spray copper oxychloride (300g/100litre of water water) for controlling fungal diseases. iv) Spray zinc sulphate + lime (600 g + 300g/100 litre of water) at tender foliage stage. v) Use disease free bud-wood planting material for new plantation. vi) Adopt integrated control measures with budwood certification, use of resistant rootstocks and fungicides/insecticides where the problem is acute.
<p>Damping off and Wilt in Nurseries (<i>Pythium sp., Phytophthora sp. Fusarium sp., Rhizoctonia sp.</i>) Water-soaked spots appear on the stem at collar region. Young seedlings fall and die immediately. In old seedlings, spots increase and ultimately the seedlings die.</p>	<ul style="list-style-type: none"> i) Select well-drained soil for raising seedlings and use raised beds. ii) Avoid over-crowding of seedlings, improper irrigation and infested/sick soil. iii) Use well rotten FYM compost. iv) Treat the seed bed, before sowing with 40% formaldehyde (40 ml/litre of water with 5L solution per sq. metre area) and cover with polythene sheet. Remove polythene sheet after 48h and plant after two weeks. v) Treat seed with copper oxychloride (3g/kg seed) before sowing. vi) Burning of trash (10-12 cm thick) over the well worked soil and rotation of nursery beds help in avoiding the disease. vii) Drench the standing nursery with chlorothalonil (200g/100 litre of water) or copper oxychloride (100g/100 litre of water).

Litchi

The litchi (*Litchi chinensis*) is a delicious juicy fruit of excellent quality. It is liked very much as table fruit. Presently, litchi occupies 938 ha area in Jammu region with an annual production of 1964 MT.

Climate and Soil

Litchi being a sub-tropical fruit thrives best under warm humid sub-tropical climate. However, frost in winter and hot winds in summer limits its growth and production. Hot winds result in cracking of fruits before reaching maturity while excessive rainfall at the time of flowering interferes with pollination. The prolonged dry spell after fruit set reduces the crop considerably.

Litchi flourishes well on deep, well drained loamy soil, rich in organic matter and free from hard substrata.

Cultivars

- a) **Early** : Muzaffarpur, Early Seedless (Early Bedana)
- b) **Mid-Early** : Dehradun, Rose Scented
- c) **Late** : Calcuttia, Late Seedless

Propagation

- a) **Method:** Litchi is commercially propagated by air-layering (gootee). Non-flowering mature branches may be used for air layering.
- b) **Time:** Air-layering of litchi can be done in spring or early summer, however, the period from mid of July to August is considered best for air-layering.

The litchi layers treated with IBA 500ppm in the first week of August and planted in polythene bags of size 22x10x8 cm filled with the soil of litchi orchard resulted into 98.29 percent rooting with survival of 91.45 percent within 210 days of planting litchi layers.

Planting:

- a) **Pit Size:** Before planting, pits of dimension 1m x 1m x 1m should be dug at the desired place a few weeks before the actual planting. The pit should be filled with a mixture of top soil, FYM, which should be mixed with a basket full of soil from a litchi orchard. It is helpful in establishment and quick growth of newly planted plants.
- b) **Planting Time:** Planting of litchi should be done when the weather is neither too wet nor too dry. The best planting time is August-September, as the temperature remains moderate at that time.
- c) **Planting Distance:** Under favourable conditions, litchi is planted at a distance of 10 metre apart both ways i.e., in rows and between plants. Young plants of litchi are very sensitive to heat and frost. They should be protected for first 4-5 years of their orchard life from cold and hot weather.

Thatching in winter, frequent irrigations and partial shading in summer can be done to protect the plants from adverse weather conditions.

Training and Pruning

Training of young plants for making a good frame work is necessary. Once desired shape and frame work is achieved, pruning is not required as it happens naturally at the time of fruit harvesting.

Floor Management

- a) **Weed control:** Weeds in litchi orchard reduce plant growth and vigour by competing with trees for light, moisture and nutrient. Application of paraquat and glyphosate is beneficial in controlling weeds.
- b) **Mulching:** Use of mulch is very beneficial in reducing the soil moisture loss and development of better root system of young plants. Suitable fibrous mulches are wheat or barley straw, peanut shells.

Manure and Fertilizers

FYM, DAP and MOP should be applied in December, half of urea should be applied in the middle of February and other half in the middle of April after fruit set. The doses of FYM and fertilizers according to the age of tree are given in fertilizer schedule as under:

Age of tree (Year)	FYM	Fertilizer requirement (g/tree)		
	(Kg/tree)	Urea	DAP	MOP
1	5	95	50	25
2	10	190	105	50
3	15	285	155	75
4	20	380	205	100
5	25	475	260	125
6	30	650	310	145
7	35	830	360	175
8	40	1010	415	200
9	45	1185	465	225
10 th year and onwards	50	1490	645	335

Irrigation

Litchi should be carefully irrigated at all stages of development. The irrigation needs are more in summer. The young plants need irrigation twice a week during April-June. In bearing trees, irrigation need is critical during flesh development which occurs from the second week of May to the end of June. Irrigation of litchi trees twice a week during this period reduces cracking of fruits to a great extent and help in proper size development.

Flowering and Fruit set

a) Time of flowering

Litchi trees from air layers may come to flower at the age of 3-5 years, while seedlings take 8-12 years to flower.

b) Fruit set

Though the litchi tree flowers profusely, only a small percentage of the flowers develop into fruits. Several factors such as moisture stress, higher and lower temperatures and strong winds enhance flower drop and reduce fruit set.

Harvesting and Yield

a) Maturity Indices

The maturity of the fruit is determined by the flatness of tubercles and smoothness of epicarp, besides the changes in fruit colour.

b) Method of harvesting

The fruits are harvested in bunches from the tree. While harvesting, the panicles should be cut from the tree with secateurs.

c) Yield

A well cared and fully grown up tree yields 0.8-1.5 q of fruit.

Special Problems

Problem	Management Practice
Fruit Drop The premature drop of fruit is thought to be due to failure of fertilization, hormonal imbalance and external factors like high temperature, low humidity and strong winds.	1. Treatment with growth regulators like NAA @ 20-30 ppm or GA3 @ 20-50 ppm will minimize fruit drop. 2. Foliar spray of boron (200 ppm) at the start of anthesis is the most effective treatment in increasing fruit set, yield and quality of Dehradun litchi under sub-tropical agroclimatic conditions of Jammu.
Fruit cracking Sun burning and skin-cracking of developing fruits are serious problems in litchi and are promoted by high temperature, low humidity and low soil moisture.	Frequent irrigations during critical period of aril growth, spraying of zinc sulphate (1.5%) at weekly intervals, starting from pea size stage of fruit growth to harvest or spraying of GA3 @ 40 ppm.

Plant Protection

Insect Pest Management

Insect-pest and Symptoms	Management Practices
<p>Litchi fruit borer (<i>Conopomorphasinensis</i>)</p> <p>Fruit borers are the important insect pests of litchi causing extensive loss in developing fruits (when fruit size is about 18-20 mm length) and the second, at colour breaking stage or 15-20 days before harvest and rendering the fruits unfit for consumption. They are responsible for fruit drop in early stage also.</p>	<p>Spraying of cypermethrin 10 EC @ 1ml/litre of water is effective in controlling the fruit infestation at early stage and repeat this at colour breaking stage or 15-20 days before harvesting the fruits</p>
<p>Bark eating caterpillar</p>	<p>Unattended orchards are attacked by bark eating caterpillar, for which control measures can be recommended as under mango for the same insect</p>
<p>Litchi mites (<i>Aceria litchi</i>)</p> <p>Although this pest is not prevalent in Jammu region but its infestation is recorded as serious nature in adjoining state Himachal Pradesh. Mite damage the leaves, inflorescence and developing fruits through sucking the cell sap. The symptoms occur as velvety brown-chocolate growth on the lower leaf surface resulting in reduction in photosynthetic area.</p>	<p>Proper sanitation of orchard is maintained. Pruning and removal of infested twigs/shoots just after harvesting of the fruits Before emergence of new flush, 2 spray of propargite 57 EC (3ml/litre of water) at 15 days interval during July may be promising in reducing the damage</p>
<p>Birds damage</p> <p>Many birds fauna like parrots, Bulbul, barbets and Koel are responsible for damaging the fruits.</p>	<p>Use bird scare Use reflecting ribbons to keep ward off birds fauna Locally made (Empty tin container filled with stones) sound devices are better to keep ward off birds at ripening stage</p>

Diseases and their management

Symptoms	Management
<p>Leaf Spots</p> <p>i) Pestalotia Leaf Spot (<i>Pestalotiapauciseta</i>) Light, discoloured spots on both sides of the leaf appear, having 0.5-2 cm x 0.2 x 2 cm size. Later, the spots coalesce to form bigger lesions, colour of the spot changes from brown to russet.</p>	<p>Spray copper oxychloride (300 g/100L water) or chlorothalonil (200g/100 litre of water) on the appearance of spots and repeat at 10-15 days interval as per disease severity.</p>
<p>ii) Colletotrichum leaf spot (<i>Colletotrichum gloeosporioides</i>) Spots usually start from the tip of the leaf and extend towards the base, irregular in outline, black to brown in colour with a margin encircling them.</p>	<p>Spray copper oxychloride (300g/100litre of water) on the appearance of spots and repeat at 10-15 days interval as per disease severity.</p>
<p>iii) Botrydiplodia leaf spot (<i>Botryodiplodiatheobromae</i>) Spots usually start from the tip or margin of the leaf lamina, deep chocolate in colour, margin of the spots with irregular outline and brown in colour. Black pycnidial mass appears on both leaf surfaces.</p>	<p>Spray copper oxychloride (300g/100 litre of water), or bayleton (100 g/100 litre of water) on the appearance of spots and repeat at 10-15 days interval as per disease severity.</p>
<p>iv) Microdiplodia leaf spot (<i>Microdiplodia litchi</i>) Margins of the diseased leaves turn yellowish brown to brick red in colour, the coloured area later becomes light brown and exhibits black dotted pycnidia. Coloured area later becomes light brown and exhibits black dotted pycnidia.</p>	<p>Spray copper oxychloride (300 g/100 litre of water) or chlorthalonil (200g/100L of water) on the appearance of spots and repeat at 10-15 days interval as per disease severity.</p>
<p>v) Red Rust (<i>Cephaleuros virescens</i>) Orange yellow to pink, velvety coating of round shape is formed, generally on the lower surface of the leaves. The affected leaves turn dark brown in colour. The whole terminal gets bronzed, velvety and the inflorescence does not emerge from such terminals. The affected leaves become leathery and turn brown.</p>	<p>i) Prune off the affected branches during autumn and rainy season and destroy them by burning. ii) Give three sprays of copper oxychloride (300 g/100 litre of water) during spring season: first spray during last week of March before buds open, second and third sprays at 10-15 days interval before flowers open. iii) Repeat three sprays during rainy season.</p>

Guava

Guava (*Psidium guajava*), the apple of tropics, is one of the most common fruits in India. It is the fourth most important fruit in area and production after mango, banana and citrus. Being hardy, it gives assured crop even with little care, and is good for rain-fed areas also. This fruit is popularly being grown in sub-tropical regions of Jammu on 2340 ha with annual production of 7943 MT.

Climate and Soil

Guava is successfully grown under tropical and sub-tropical climate. In areas with distinct winter season, the yield tends to increase and quality improves. It can be grown upto an altitude of 1000 m above msl. Older plants can tolerate drought. High temperature at the time of fruit development can cause fruit drop.

Guava trees are very hardy and can thrive on all types of soils, but are sensitive to water logging. The best soils are deep, loamy and well drained. Being shallow rooted, plant requires rich top soil.

Cultivars

Allahabad Safeda

The fruits of this cultivar are large in size, round in shape, smooth skinned and yellowish white in colour. The flesh is white, firm, soft having pleasant flavour, TSS is 9.5° B and vitamin C content of 140 mg/100g pulp. It can withstand drought conditions.

Lucknow-49 (also known as Sardar Guava)

Its fruits are large weighing 90-140g, roundish, ovate in shape, skin primrose-yellow and whitish pulp, very sweet and tasty. The total soluble solids (9.5° B) and vitamin C content of 130 mg/100g pulp. Plant is vigorous.

ArkaAmulya

- It is a progeny from the cross Allahabad Safeda x Triploid.
- Plants are medium in vigor and spreading type.
- Fruits are round in shape.
- Skin is smooth and yellow in colour.
- Fruits on an average weigh about 180 - 200 g, flesh is white in colour and firm.
- TSS IS 12.5° B and seeds are few and soft.

Hisar Surkha

Trees are spreading and medium in size, fruit round in shape, skin light yellow in colour, flesh pink. TSS is 13.6° B and 140 mg/100g vitamin C.

Hisar Safeda

Trees grow upright with compact crown, are tall and vigorous, fruit round

in shape, skin smooth shining and yellowish white, pulp creamy white with few soft seeds. TSS is 13° B and vitamin C content of 200 mg/100g.

Shweta

- Selection from half-sib population of apple colour.
- Tree is semi-vigorous, medium height and prolific bearer.
- Fruits medium, globose, each weighing on an average 225g: few soft seeds.
- Creamy white epicarp with red spots or blush; snow-white pulp.
- Good keeping quality.

Please put in para form as for other cultivars.

Propagation and Rootstock

Plants grown directly from seed give poor fruit yield and quality, and come into bearing late. Seeds should be used for raising rootstock. In recent times, stooling has been found cheapest and easiest method of propagation. As seeds lose viability after extraction, they should be sown immediately. Soaking of seeds in water for 12 hours gives about 90 per cent germination. Time of propagation is February-March and July-August. Guava can also be successfully propagated by air layering.

Wedge grafting with poly-tubes can also be carried out in winter season (15th December) by covering the grafts with poly-tube for 3 weeks.

Planting

The planting should be done in pits of 1m x 1m x 1m size filled with mixture of FYM and soil during rainy season (July-August) or in spring (February-March) at a distance of 6 m x 6 m. For high density orcharding in guava, planting should be done at 6.0 m x 3.0 m spacing (row to row and plant to plant) accommodating 555 plants/ha, another at 3.0 x 1.5m (rows x plants) accommodate 2222 plants/ha and 3.0 x 3.0m (rows x plants) accommodate 1111 plants/hectare. The recommended varieties for high density in guava are Shweta, L-49 and Lalit.

Calendar of operations for establishing High density plantation of Guava

May

- Ensure the soil suitability by digging a profile pit of 90 cm depth.
- Observe the soil for presence of any calcareous nodules or sheet rock. If the lime nodules or sheet rock is present avoid such soils for taking up plantations.
- Avoid water logging or ill drained soils.
- Based on soil test report, even if the soil pH is up to 8.2 it is considered as suitable for guava plantation.

June

- Take up summer ploughing with mould board plough twice and level the land.

- During layout, care should be taken that row to row spacing should be facing east-west direction.
- Alignment and peg marking for pit digging.
- Pit size to be followed is 75x75x75cm/50x50x50cm/40x40x40cm.
- Pit digging – Precaution - keep the dug-out top soil (up to 30cm depth) to the right side of the pit and bottom (remaining portion) to the left side of the pit.
- Spray with chloropyriphos 20EC @ 2.5-5 ml/litre of water or imidacloprid 17.8 SL @ 0.5 ml/litre of water for termite control in the dug pit.
- Allow the pit for exposure to sun at least for two weeks before filling the pits to control soil born pest and diseases.
- Make arrangements for procurement of plant material from reliable nurseries preferably from Government nurseries or from nurseries recommended by National Horticulture Board.
- High yielding varieties like Lucknow-49 (Sardar guava)/Shweta may be selected.

July

- Pit filling-fill the pits firstly with top soil and then mix the bottom soil with 20 kg of FYM+100g Single Super Phosphate + 300 g Muriate of Potash and 100 gm Neem Cake.
- Fill the pits with the soil at least 6'' above the ground level so that when the soil settles it will be at the ground level at planting.
- Ensure thorn fencing or with any thick growing live fence to control cattle trespassing.

August

- Budded/layered guava plants should be planted by keeping the plants in the centre of the pit without disturbing the ball of earth around the root system.
- Water the plant immediately after planting.
- Irrigate the plants at every 4 to 5 days interval during the first month and later at 7 to 10 days interval if there are no rains during the initial two years.

September

- Staking of the plants should be done for its upright growth.
- Weeding should be done at least in a fortnight during monsoon season to control weeds. Simultaneously the area around the plant should be made to retain water during dry spells.
- To avoid Evapo-transpiration losses, mulch the basins with paddy husk or paddy straw or ground nut shells. Mulching also help to control the weeds in the basins.
- If heavy rains persist leading to ill-drained conditions, provide drainage channels to avoid water stagnation. Ill-drained condition leads to yellowing of leaves and wilting of plants.

October

- Trees planted during July –August should be topped to a uniform height of 60-70cm/50-60cm/40-45cm from the ground level to induce the emergence of new growth below the cut point.
- Three to four equally spaced shoots should be retained around the stem to form the main scaffold limbs of the tree and allowed to grow for 4-5 months till they are 40-50 cm in length.
- If micro nutrients like zinc and magnesium deficiencies are noticed, correct it by spraying 2 g of zinc sulphate + 2 g of magnesium sulphate + 5 g of lime in 1 litre of water at 15 days interval.
- Work out the soils in the basin to keep weed free and improve aeration.

November

- Prune the side shoots which appear from time to time to 50 per cent of their length to encourage lateral branches preferably in the east -west direction for better sunlight exposure.
- If inter crop during June-July is not cultivated, farmers can sow inter crops for *rabi* season during this month.

December

- Newly emerged shoots are allowed to grow up to 40 -50 cm and are pruned again to 50 per cent for emergence of new shoots.
- Ensure regular irrigations at 7-10 days interval.
- If white fly incidence is noticed on matured leaves curling and reddening of leaves will be observed. Control by spraying 5ml of neem oil in 1litre of water.

January

- Ensure regular irrigations at 7-10 days interval.
- Reddening of leaves due to phosphorous deficiency may be observed. It may occur due to immobilization of phosphorus due to low soil temperatures in winter season. Correct it by spraying 0.5% DAP solution and frequently irrigating in the basins.

February

- Gap filling - If any gaps are noticed due to death of plants, it should be replaced by taking up gap filling.
- Weeding and soil working to improve aeration and weed control

March

- For 3 x 3 m and 3 x 1.5 m spacing, all the plants are confined to a hedge shape of 2 m inter row width and 2.5 m and 1.0 m height for which pruning is performed in February and shoot tip pruning (10-15cm tip) August every year.
- Remove the side shoots/stock sprouts which appear from the base of the plant.
- Irrigate the plants at 5-7 days interval regularly.

April

- Ensure regular irrigation through drip or at least once in 5-7 days interval through basins irrigation.
- The tender shoots will be infected with mealy bugs or white flies. Control them by spraying of chlorpyrifos 50 + cypermethrin 5 w/w @ 2ml/litre of water or acephate 75 SP @ 1gm/litre of water.
- White Fly incidence will also be severe during this month. Trap the white flies by keeping yellow cards or metal boxes applied with grease or any sticky substance.

Training and pruning

The plant should be trained to a low headed system of open centre or delayed open centre keeping scaffold limbs having wide crotch angles. Pruning is not generally required every year however, terminal shoots may be headed back to stop overcrowding of trees.

Manure and Fertilizers

Although, guava is grown without application of any manure and fertilizer, it responds well in their application by giving higher yield and better quality fruit. For fully matured eight year guava tree, the fertilizer requirement of NPK is 572:207:265 g tree⁻¹ where application of poultry manure @ 19 kg tree⁻¹ in combination with urea @ 620 g tree⁻¹ and *Azotobacter* @ 200 g tree⁻¹ or well rotten FYM @ 29 kg tree⁻¹ integrated with urea @ 933 g tree⁻¹ and *Azotobacter* @ 200 g tree⁻¹ can replace the application of nitrogen by 50 % and 25 % respectively.

Age of tree (Year)	FYM	Fertilizer requirement (g / tree)		
	(Kg/tree)	Urea	DAP	MOP
1	5	55	35	15
2	10	115	70	35
3	15	170	105	50
4	20	225	140	65
5	25	345	170	85
6	30	415	205	100
7	35	565	240	115
8 & onwards	40	700	275	135

Note: 1) The fertilizer should be applied in two split doses i.e. 1st week of May for rainy season crop and 1st week of July for winter season crop.

2) For augmenting *Azotobacter* in the soil: The *Azotobacter* @ 200 g plant⁻¹ mixed in 10% jaggery solution should be applied to roots after 20 days from the application of inorganic fertilizers

Irrigation

Guava is mostly grown under rainfed conditions and irrigation is generally not practiced but wherever the irrigation is available, it should be given in summer and October/November as it enhances the yield of guava tree by increasing fruit set.

Intercropping

Guava orchards may be intercropped with short growing leguminous crops like mash, moong, guar and vegetables during pre-bearing period.

Aftercare

Pre-harvest spray of calcium nitrate (2%) two weeks before harvest improves quality at the time of harvest of guava, whereas, the spray of 150 ppm silver nitrate at 5 weeks before harvest and another spray at three weeks after first spray increases the shelf life of guava satisfactorily upto 6 days at room temperature. GA₃ 90 ppm, sprayed 30 days before harvest improves the fruit quality at harvest and also increases the shelf life of guava.

Harvesting and Yield

Grafted plants come into bearing at the age of 3 years and peak harvesting periods are August-September for rainy season crop and January-February for winter season crop. Guava develops best flavour and aroma only when they ripe on tree. The fruits produced in the rainy season are not of high quality because of poor shelf life. Spray 10 per cent urea or 600 ppm NAA during April-May when maximum flowers have opened. This eliminates rainy season crop so that winter crop is heavy and of superior quality. A ten years old guava tree gives a yield, up to 100 kg of fruit. Alternatively, guava crop regulation can be achieved involving one pair pruning of leaves in the month of April thereby encourage winter season guava crop.

Plant Protection

Insect pest and their Management

Insect-pest and their Symptoms	Management Practice
<p>Fruit Fly (<i>Bactrocera dorsalis</i>) Fruit flies deposit eggs in soft skin of ripening fruits. After hatching the maggots feed on the soft pulp as a result fruits start rotting and fall on the ground.</p>	<p>i) Harvest fruits when they are still hard. ii) Collect and destroy all fallen fruits. iii) Plough around tree during winter to expose and kill the pupae. iv) Apply bait sprays in July-August at 10-15 days intervals (malathion 50 EC 200 ml and gur 1 kg in 100 litre of water). v) Poison bating: Mix 20 ml malathion 50EC with 500 g molasses or gur. To this add 2 liters of water for poison bating or 20 liters of water for bait spray. vi) Control measures should be undertaken as cooperative campaign in large areas.</p>
<p>Fruit Borers (<i>Viracholaisocrates</i>) (<i>Dichochrosispunctiferalis</i>) Larvae of <i>V. isocrates</i> bore into the fruit and feed on the pulp of the fruit which leads to mummified fruits which can be seen on plants after harvest</p>	<p>i) Remove and destroy all affected fruits. ii) Bagging of fruits is also effective. iii) Spray dimethoate 30 EC @ 1 ml/litre of water at marble stage of the fruit followed by 2nd spray at 4 weeks interval.</p>
Bark eating caterpillar	Same as in mango
Birds damage There are several birds such as parrots, Bulbul, Koel, grey barbet are damaging the fruits of guava	Same as in Litchi

Diseases and their Management

Diseases & Symptoms	Management Practices
<p>Fruit Rot (<i>Phytophthoranicotianae</i>) The disease starts at the styler end. Whitish cottony mass develops very fast as the fruit starts ripening and covers the entire fruit surface in few days. Humid weather favours the disease. The diseased fruit drops from the tree.</p>	<p>Spray the tree with metalaxyl (100 g/100 litre of water) as soon as the disease is observed, repeat sprays at 15 days interval.</p>
<p>Anthracnose/Die Back (<i>Colletotrichum psidii</i>) Symptoms appear on the leaves, twigs, flowers and fruits. Necrotic grey lesions are</p>	<p>i) Prune dead twigs, remove mummified fruits hanging on the trees and burn. ii) Spray copper oxychloride</p>

<p>formed on the leaves twigs start drying from downwards. Floral infection may lead to mummification or symptoms appear on ripe fruits as circular, slightly sunken lesions with raised margins. Spots coalesce to form corky and hard lesions developing cracks in them. Symptoms on mature fruits appear as pinkish spots with sticky spore mass in the centre.</p>	<p>(300g/100 litre of water) or chlorothalonil (200g/100 litre of water) soon after pruning, repeat spray at 15 days interval after fruit set.</p> <p>iii) Bury deep in soil the diseased/rotten unmarketable fruits fallen on the ground.</p>
<p>Wilt (<i>Fusarium oxysporum</i>f.sp.<i>psidii</i>) Browning and wilting of leaves, stem discolouration accompanied by death of the branches on one side. The whole plant, sometimes shows wilting symptoms and finally dies.</p>	<p>i) Prune/uproot the wilted plants and burn.</p> <p>ii) Treat the soil with gypsum (2 kg/tree) to prevent further spread.</p> <p>iii) Severe pruning of diseased branches followed by soil drenching with copper oxychloride (300g/100 litre of water), metalaxyl (200g/100litre of water) at an interval of three months.</p>
<p>Twig Blight and Canker(<i>Cytosporachrysosperma</i>) The diseased plants show sick look, less foliage and blighted appearance. Canker appears on bud scars, wounds, twigs or in crotches. Embossed, globose and cankerous pimples appear on diseased twigs. Bark becomes loose with amber yellow exudates becoming horny on drying. The symptoms are quite pronounced under wet conditions. Stromatic fungal masses appear on the surface of diseased twigs.</p>	<p>i) Scrap the dead bark along with some healthy portion. Burn the pruned dead twigs and disinfect the wound with Bordeaux paste or copper oxychloride paste.</p> <p>ii) Spray the treated trees with copper oxychloride (300g/100 litre of water) or chlorothalonil (200g/100 litre of water). Repeat sprays in March and June.</p> <p>iii) Remove severely infested trees and burn.</p>
<p>Collar Rot (<i>Phytophthora</i>sp.,<i>Sclerotium</i>sp.,<i>Diplodia</i> sp.) Bark of the plant at collar region turns brown, cracks and sometimes peels off.</p>	<p>i) Scrap the infected portion along with some healthy area and apply Bordeaux paste or copper oxychloride paste.</p> <p>ii) Drench soil with metalaxyl (200g/100 litre of water).</p>
<p>Wither tip (<i>Colletotrichum gloeosporioides</i>) The disease causes shedding of leaves and withering of tips of branches. On leaves, light green spots appear which later turn brown. Spots usually develop on the tips or margins of leaves. Black dots develop on leave and twigs with pinkish ooze of spore mass.</p>	<p>i) Prune off the diseased twigs and treat the cut ends with bordeaux paste or copper oxychloride paste.</p> <p>ii) Give 1-2 follow up sprays with copper oxychloride (300g/100litre of water)</p>

Grapes

Grape (*Vitis vinifera* Michx.) is the most important fruit crop of the world. In recent times, it has become an important fruit crop in sub-tropical and tropical areas of India. Jammu division has an area of 102 ha under grapes with an annual production of 269 M.T.

Climate and Soil

Grape is a temperate fruit but can also be successfully grown in sub-tropical and tropical areas. However, areas with high humidity and high rainfall are not suitable. Soil with good drainage and good water holding capacity having pH range of 6.5-7.5 is ideally suitable for grapes.

Cultivars

The important cultivars of grapes are Perlette, Beauty Seedless, Thompson Seedless, Pusa Seedless, Punjab purple, Bangalore Blue, Anab-e-Shahi. However, for sub-tropical regions of Jammu, Perlette cultivar has been found to be the most suitable.

Propagation and Rootstock

Grape is propagated by hard-wood cuttings with at least 4 nodes taken after pruning in December-January. Cuttings are prepared from middle parts of canes and stored by burying in trenches or keeping in a cool place in moist sand or saw dust for about a month and planted in early spring. Nursery planting of cuttings is done in flat beds at a distance of about 30 cm. After about a year, rooted cutting becomes fit for transplanting.

The rooting can be increased by giving a quick dip for 10 seconds in 2000 ppm Indole-butyric-acid (IBA). The rooting media should have 30-40% well decomposed FYM to retain moisture and similar proportion of sand for good drainage. The rooting media should be treated with chlorpyrifos 20EC to prevent termite attack. Light and frequent irrigations are to be given to the cuttings.

Planting

- a) **Planting distance:** Under Head, Kniffin and Telephone systems of training, the planting distance 3 m x 3 m and under Bower system of training it is 5m x 3m.
- b) **Planting time:** Rooted cuttings should be planted in January-February, when they are still dormant. The rooted cutting should be properly staked so that it grows upright.

Training and Pruning

The following system of training and intensity of pruning is recommended:-

Varieties	System of training	No. of canes to be left on each vine	No. of buds per cane
Perlette,	Head	20-30	4-6
Beauty Seedless	Kniffin, Head	30-40	3-4

Vigorous varieties can be trained to bower system while less vigorous varieties can be trained to Head or Kniffin system. Vines should be pruned every year in December-January as they bear only on one year old shoots (canes). Some canes should be pruned to 1-2 bud for next year fruiting.

Manure and Fertilizers

A grape vine removes good amount of nutrients from soil both in terms of wood and fruit. As such, adding nutrient every year is advised for good quality crop.

Age of tree (Year)	FYM (Kg/tree)	Fertilizer requirement (g/tree)	
		Urea	DAP
1	90	100	50
2	150	200	100
3	350	300	150
4 & onwards	750	500	200

Note: 20-25 kg of FYM per vine should be applied every year in dormancy. Fertilizers should also be applied in February-March.

Irrigation

Time

After pruning
 First week of March
 After fruit set in April till harvest
 November to January

Frequency

One irrigation
 One irrigation
 Weekly
 One irrigation

Improvement of berry quality

Varieties like Perlette tend to bear very compact bunches and require considerable thinning of berries. It is recommended that the removal of distal end of bunch be carried out for uniform ripening of berries. Application of 10 ppm of GA₃ at full bloom followed by dipping of bunches in 75 ppm of GA₃ solution at fruit set stage help to increase the bunch and berry size. Girdling of main trunk improves yield and bunch size. Two foliar sprays of potassium sulphate @ 1.5% first one week after fruit set and second at colour break stage, improve the quality and colour of perlette grapes.

Harvesting and Yield

Grapes are harvested when fully ripe since they do not ripen after harvesting. Grapes should be harvested during cool time of the day. When the lower most berry of a bunch becomes soft and sweet, the bunch is harvested. The average

yield of seedless cultivars is 20 tonnes per hectare. Harvested grapes are trimmed, graded and packed properly.

Aftercare

Trunk girdling (1 week) before bloom + 40 ppm GA₃ (bunch dipping for 15 seconds) is effective in increasing the yield, quality and shelf life of grape cv. Perlette under agro climatic conditions of Jammu area.

The spray of 40 ppm GA₃ at full bloom is effective in bunch loosening and quality improvement of Perlette grape.

Treatment of 0.75% Na₂CO₃ at pre-bloom and 60 ppm GA₃ fifteen days after full bloom has been found to increase the yield and quality of grapes.

Special Problems

Problem and Symptoms	Management
<p>Uneven ripening The presence of green berries in a bunch of coloured branches demarcates the attribute of uneven ripening, a varietal character.</p>	Flower thinning, girdling and ethephon spray (250 ppm) at colour break is recommended.
<p>Flower-bud and Flower drop When panicles are fully expanded, the flower buds drop before the fruit set. This is common in North India. Reason not known.</p>	Stem girdling 10 days prior to bloom can reduce the problem.

Plant Protection

Insect Pest Management (Temperate Area)

Insect pest and their Symptoms	Management Practices
<p>Mites The mites suck sap from leaves resulting in blister formation on the upper side of leaves and yellow cavities below the blister on the lower surface. The leaf size is reduced and turns yellowish which fall prematurely.</p>	i. Spray dicofol 40EC @ 2.5 ml or propargite 57EC @ 1.5-2 ml/litre of water to keep grape mites under check.
<p>Chaffer Beetles Adult beetle feed on leaves, buds, blossom and fruitlets. Eaten away leaves are perforated. The grubs feed on roots and may cause wilting of the plant.</p>	i. Apply cartap hydrochloride 4G @ 8-10 kg/acre in the soil against the grubs of chaffer beetles. ii. Spray acetamiprid @ 0.2g/litre of water as soon as adult chaffer beetles start emerging on grapes.

Insect Pest Management (Sub-Tropical Area)

Insect pest and Symptoms	Management
<p>Leaf Defoliating Beetles They damage the vines during and after rain, leaves are seen with numerous irregular holes in the leaf lamina bitten away by beetles.</p>	One or two sprays with acetamiprid @ 0.2 g /litre of water will control these insects.
<p>Leaf Roller The slender green larvae with pink head are very active and roll the leaves with the webbings secreted by them and feeding inside on the rolled leaves.</p>	When the attack of this pest coincides with the attack of beetles, then spray with acetamiprid @ 0.2 g /litre of water will control these insects.
<p>Caterpillar of Hawk Moth Caterpillars are heavy leaf defoliators and feed on leaves, and may defoliate the whole vines in few days. The attack is occasionally seen.</p>	When the attack of this pest coincides with the attack of beetles, then the above treatment will also control it. Or Spray the crop with cypermethrin 10 EC @ 1ml/litre of water
<p>Yellow and Red wasps They are active flying insects common during summer. They puncture the ripening berries and feed by sucking juice. Such berries start rotting and even whole bunch is spoiled.</p>	Locate the nests of these wasps in the vicinity and destroy them or apply cypermethrin 10EC @ 1 ml/litre of water and close, the entrance holes.
<p>Termites They are soil-inhabiting insects, they attack all parts of the plants, especially the roots and destroy them by feeding upon them as a result the trees are killed.</p>	Apply chlorpyrifos 20EC @ 2.5 ml/litre of water in the pits at the time of planting.

Diseases and their Management

Diseases and their Symptoms	Management Practices
<p>Grape Anthracnose (<i>Gloeosporiumem-pelophagum</i>) Light brown, elliptical and slightly sunken lesions appear on shoots and tendrils. On leaves, these spots are brown with dark margin. Spots with grey centre lined by reddish brown border (bird's eye spot) occur on berries.</p>	<p>i) Prune off diseased plant parts (twigs) and destroy them by burning, especially at the time of annual pruning.</p> <p>ii) Spray the vine with copper oxychloride (300g/100litre of water) after pruning at emergence of new shoots, fruit set, and 10-15 days after fruit set depending upon the disease severity.</p>
<p>Powdery Mildew (<i>Uncinulanecator</i>) White, powdery patches appear on young leaves and shoots as well as on flowers and young berries. Affected leaves and shoots</p>	<p>i) Spray azoxystrobin (100ml/100litre of water) or wettable sulphur (250g/100litre of water).</p> <p>ii) Start spraying as soon as the disease</p>

<p>turn black, shedding of blossoms and berries causes great losses to the crop.</p>	<p>appears and at an interval of 8-10 days until the disease is checked. (Do not spray wettable sulphur at field temperature of 30°C and above).</p>
<p>Downy Mildew (<i>Plasmopara viticola</i>) The disease appears mainly on leaves. Yellowish, irregular spots, mostly on upper surface appear with downy white growth on the lower surface. Malformation and necrosis are noticed. Infected leaves and shoots turn brown and curl up. Brown spots are produced on inflorescence which dries up, berries drop off, growing points of the vine show curling and twisting.</p>	<ul style="list-style-type: none"> i) Infected plants and pruned material should be removed and burnt before bud sprout. ii) Remove excess vegetation to improve aeration and sunlight penetration and avoid excessive humidity. iii) Do not irrigate the orchard during cloudy/rainy weather. iv) Spray of metalaxyl (200g/100 litre of water) or copper oxychloride (300g/100 litre of water) at the appearance of disease. Give subsequent sprays at an interval of 10-15 days as per requirement.
<p>Short Berries or Hen and Chicken Disease (Boron deficiency) Drying of floral cluster, poor fruit-set and large number of short berries are the characteristic symptoms of the disease. Berries do not develop properly. Growing points of the vine show curling and twisting.</p>	<p>Give a soil application of 20-50 g of borax per vine during December or spray grape vine with borax solution (220g boric acid + 110g lime + 100 litre of water)</p>

Aonla

Aonla (*Emblica officinalis* syn. *Phyllanthus emblica*) is one of the most important minor fruit of Jammu division of Jammu and Kashmir which is grown over an area of 1701 ha with annual production 3780 MT. Its importance lies in its high content of vitamin C. Owing to its hardy nature, it is suitable for sub-tropical waste lands.

Climate and Soil

Aonla is a sub-tropical fruit, and is grown up to 1800 m altitude. The tree is not much influenced either by hot wind or frost. However, young plants should be protected from desiccating wind in summer and frost in winter, at least up to the age of 3-4 years.

Aonla can be grown in light as well as heavy soils except in very sandy ones. The plants have capacity for adaptation to rain-fed areas, and can also grow in moderately alkaline soils. However, its production is high in deep and fertile loamy soils.

Cultivars

Some of the Aonla cultivars are:

- i) **NA7:** A seedling selection from Francis. It is precocious, prolific and regular bearer. This is an ideal variety for processing.
- ii) **Banarasi:** Tree has upright growing habit and is a shy bearer. Flesh is moderately fibrous and nearly fibreless.
- iii) **Francis:** The branches have drooping habit and moderate in bearing. Flesh is soft and nearly fibreless.
- iv) **Chakaiya:** The tree has spreading habit and bears profusely. Flesh is fibrous and hard.
- v) **NA4 (Krishna):** The cultivar bears moderately. Flesh is fibreless, hard and semi-transparent.
- vi) **NA6:** A seedling selection from Chakaiya. It is prolific and heavy bearer. It is ideal for preserve and candy, owing to low fibre content.

Propagation and Rootstock

Aonla has long been raised from seeds but the plants do not come true to type and produces small sized fruits of inferior quality. Seedlings are raised from seeds and used as rootstock. Seedlings can be raised in seedbeds or polythene bags, which take about four months to attain buddable size.

Of the various methods of asexual propagation, shield budding and patch budding in the month of August are most common.

Planting

Grafts or budded plants of Aonla are best planted in the beginning of monsoon i.e. in the month of July-August. Since trees grow to a huge size, a

distance of 8-10 m both ways (row to row and plant to plant) is recommended. In areas with irrigation facilities, planting can be done in spring (February – March). Immediately after planting, a light irrigation should be given to each plant. NA7 and Chakaiya have been recommended for cultivation in rain fed areas of Jammu.

Training and Pruning

Aonla plant should be encouraged to develop a medium-headed tree. Aonla tree does not require regular pruning. However, pruning in early years for giving proper shape and development of strong framework may be necessary for which tree should be trained to single stem up to the height of about 1 m and then primary branches can be allowed at regular space all around the trunk.

The pruning of bearing plants can be done after the termination of the crop each year. While pruning, dead, diseased, broken, weak and crossing branches and suckers appearing from root-stock should be removed.

Manure and Fertilizers

15 to 20 kg of FYM is given to young trees, while matured trees should be given 30 to 40 kg of FYM. Every mature tree (10 years old) should be given 1.8 kg urea, 1.1 kg DAP and 1.7 kg MOP. Full dose of FYM and DAP along with half of urea and MOP should be given in tree basin during January and remaining half should be applied in August. In sodic soils, 100-150g of boron and ZnSO₄ should also be incorporate alongwith fertilizers as per tree age and vigour.

Irrigation

Aonla trees are hardy and stand very well against drought and hardly any irrigation is practiced. However, the crop shall be benefitted by giving 2-3 irrigations at the time of full bloom and fruit set. During summers, when the tree is dormant, there may not be any benefit to irrigate trees. However, the young plants require watering during summer season at fortnightly interval, particularly till they are fully established.

Intercropping

Aonla being a deep rooted deciduous tree with sparse foliage, is an ideal plant for 2 or 3 tier cropping system. Some models are: aonla + ber (2-tier); aonla + guava (2-tier); aonla+ber+phalsa (3-tier); aonla + dhaincha + wheat or barley (3-tier). On cost /return basis results showed that yield increase with turmeric, bottle gourd and okra which resulted in B:C ratio of 1:3 during *kharif* season. In *rabi* season crops, peas, onion, beetroot and broccoli increased B:C ratio more than 4.0. Besides, it reduces runoff by 10 percent and nutrient loss by 40 percent compared to plots with cultivation along slope. Hence, it is advised to the farmers of rainfed areas to adopt intercropping of vegetables particularly broccoli and beetroot during summers and bottlegourd, turmeric and okra during winters in their established aonla orchards to increase their farm income.

Harvesting and Yield

Aonla plants come into bearing quite late. Generally, vegetatively propagated trees start bearing commercial crop after 3-4 years of planting, while seedling trees may take 8-10 years to come into bearing. Productive life of trees is estimated to be 50-60 years under good management conditions. Change in seed colour from creamy-white to brown is an indication of fruit maturity.

Generally, aonla fruits are ready for harvest in November-December. The fruits are light green at first, but when they mature, the colour becomes dull greenish yellow or rarely brick red. Maximum vitamin C content is observed in mature fruits, while immature fruits are acid and low in vitamin C content and minerals.

Yield of aonla crop varies from cultivar to cultivar. As far as yield is concerned, the production varies from cultivar to cultivar. Banarasi cultivar is poor yielder as compared to Chakaiya and NA7. On an average, a grown up tree should yield 150 to 200 kg fruits per annum.

Plant Protection

Insect pests and their Management

Insect pests and their Symptoms	Management Practices
Aonla fruit borer (<i>Deudorixisocrates</i>)	Same as in Guava
Aonla aphids	Spraying of dimethoate 30 EC 2 ml/litre of water or oxydemeton methyl 25 EC @ 1ml/litre of water
Aonla gall maker (<i>Betousastylophora</i>)	Overcrowding of branches should be discouraged or pruned. Spray chlorpyrifos 20 EC @ 2ml/litre of water in the beginning of the season
Aonla leaf roller (<i>Garcillariaacidula</i>)	Spray the infested plants with chlorpyrifos 20 EC @ 1-2 ml/litre of water or acetamiprid @ 0.2 g/litre of water.
Bark-eating caterpillar (<i>Indarbelaquadrinata</i>)	Same as in Mango, Guava and Litchi

Diseases and their Management

Diseases and their Symptoms	Management Practices
Rust (<i>Raveneliaemblicae</i>) Black pustules appear which later form a ring, join together covering a larger area. Pustules rupture exposing black spore mass. Pinkish pustules develop on leaves which may be isolated or in groups.	Give 3-4 of sprays of propiconazole (100g/100L water), metalaxyl (200g/100litre of water) at an interval of 15 days depending upon disease incidence.

<p>Anthracnose (<i>Colletotrichum</i> spp.) Minute, circular, greyish spots with yellow margins appear on leaflets, central area remaining grayish with dot-like fruit bodies. Lesions on fruits are depressed, turn dark in the centre, acervuli formed are arranged in rings. Lesions may vary in size and shape. Spore mass appear on fruiting bodies at high humidity. Infected fruits become shriveled and rot.</p>	<p>Spray copper oxychloride (300g/100litre of water) at 15 days interval, repeat sprays as per disease severity.</p>
<p>Fruit rot (<i>Phomaspp.</i>, <i>Phomopsis phyllanthi</i>, <i>Nigrosporasphaerica</i>, <i>Cladosporium tenuissimum</i>, <i>Pestalotia creenta</i>, <i>Alternaria alternate</i>, <i>Cytosporaspp.</i>) The disease appears as small, pinkish brown necrotic spots. Smoke brown to black round lesions, black ring spots or colourless soft areas appear resulting in partial or complete rotting of fruit.</p>	<p>Give post-harvest treatment to fruit with difolatan (150g/100litre of water)</p>
<p>Blue mold rot (<i>Penicillium islandicum</i>) It causes brown patches with water-soaked areas on fruit. With the progress of the disease, three different colours viz., bright yellow, purple brown and bluish green develop. Yellowish drops of liquid exude from the disease patches, fruit emits a bad smell, finally giving a bluish grey or beaded look.</p>	<ol style="list-style-type: none"> i) Handle fruit carefully to avoid wounds. ii) Manage good sanitary conditions in storage. iii) Treat fruits with borax (5kg/100 litre of water).

Ber

Ber (*Zizyphus mauritiana* Lamk.) is one of the ancient and common fruits, indigenous to India. It is growing in wild, semi wild and cultivated forms all over the country in sub-tropical and tropical areas. Area under ber in Jammu is 4759 ha with annual production of 10254 M.T.

Climate and Soil

Ber plant is hardy and can grow successfully even under poor soil and unfavourable climatic conditions, where most other fruit trees fail to grow. It prefers a hot and dry climate for its successful cultivation, but needs adequate water during its first fruiting season. It can be grown up to the elevation of 1000 metres above msl. Excessive atmospheric humidity seems to be a limiting factor in its successful fruiting.

The ber tree develops a deep tap root system within a short period of its growth and as such adopts itself to wide variety of soils. However, deep sandy-loam soils appear to be better for its plantations. It is well known in its ability to thrive under adverse conditions of salinity, drought and water logging.

Cultivars

- i) Sanaur-2 - Mid-season variety, ripening during 2nd fortnight of March and fairly resistant to powdery mildew.
- ii) ZG-2 - Less susceptible to powdery mildew.
- iii) Nazuk - Less susceptible to powdery mildew.
- iv) Sanaur-5 - Mid season variety

Propagation and Rootstock

Till recently, the most common method of multiplying the ber plants has been through seeds. For vegetative propagation, the seedling of ber has to be raised for root stock purpose. Generally, seeds of Katha ber (*Zizyphus mauritiana*) are sown 30 cm x 15 cm apart during March-April (after fresh extraction). The treated seeds (GA₃ @ 500 ppm) germinate in 7 to 10 days after sowing. The germination of freshly harvested seeds can be improved by soaking in concentrated sulphuric acid for six minutes and washing them thoroughly with water immediately. One year old seeds stored at room temperature germinate better than that of freshly extracted seeds. Some of the seedlings are fit for T/Shield budding in August-September, while remaining can be budded during March-June.

Top working of wild trees

The wild ber trees (up to 5 years age) are headed back for top working at the height of about one metre from ground level. In case of older trees, limbs should be headed back at about 30 cm from the branch leaving central limb intact, to avoid the risk of drying of the whole tree (this central limbs be cut off

when the top worked limbs get established). The heading back operations may be done from January to April. Bordeaux paste (1 kg of copper sulphate + 1 ½ kg of quick lime into 7 ½ litre of water) should be applied to the cut surface to safeguard against diseases/pathogens. The headed back trees produce a number of shoots below the cut end during June-July. Of these, 2-3 well spaced and healthy shoots should be retained and other removed. When these retained shoots become 1.5 cm to 2.0 cm thick, they should be “T” budded with any of the improved cultivar, during June to September. In order to avoid breakage of the budded shoots due to wind hazards, they may be stacked in case of young trees and tied with central limbs in older trees. Within a year, the top worked trees develop a sufficient growth to bear a small crop and in 2nd and 3rd years, these trees start good bearing.

Planting

There are two planting seasons for ber crop *viz.* February-March and July-September. The area is laid out and pits of size 1 m x 1 m x 1 m are dug, one month before planting. Pits should be filled up to about 15 cm higher than the ground level by mixing about 20 kg well rotten farm yard manure, 1 kg super phosphate and 100 g urea with soil in each pit. These pits should be flooded with water thereafter, to settle the loose soil. A plant should be set in the centre of a pit, maintaining same level of soil at which it had stood in the nursery. The budding union should remain about 15-20 cm high from the ground level. The plants should be immediately watered after fixing them in the pits. The plants should be irrigated after four to five days at least during the first two months and then once a week for another three to four months or till plant get fully established. It is very important that all the shoots emerging from below the budded point should be immediately removed.

Training and Pruning

In order to develop strong framework of the ber tree, training becomes essential from first year of planting. While training, care should be taken that there should not be any branch below one metre height of the main stem. The total number of main branches may be 4-6. This will enable the tree to grow in good and balanced shape.

Pruning is highly desirable in ber to maintain tree vigour and productivity as well as to improve fruit size and quality of fruit. The fruits are borne in the axil of leaves on the young shoots of current season. Therefore, annual pruning is necessary to induce healthy shoots, which will provide maximum fruit bearing area on the tree. The best time of pruning is the hot and dry season when plants shed their leaves and go to rest or become dormant. Light pruning *i.e.* heading back of about one fourth old growth is desirable for getting higher yield of good quality of fruit. Some thinning out of the branches of ber trees is also necessary to avoid too much crowding so as to admit adequate sunlight and facilitate proper aeration.

Manure and Fertilizers

Age of tree (Year)	FYM (Kg/tree)	Fertilizer requirement (g/tree)		
		Urea	DAP	MOP
1	10	215	-	-
2	20	435	-	-
3	30	650	-	-
4	40	870	-	-
5 & onwards	50	1085	20	100

Note: It will be desirable to apply total quantity of fertilizers and manures with monsoons in rainfed areas. However, fertilizer application can be split into two doses in irrigated belts, first half in July and second half in October.

Irrigation

Ber is grown successfully in arid climate; however budded trees do need irrigation for better yield. Bearing trees may be irrigated at monthly intervals during the fruiting season i.e. September–October to February-March. When the fruits are about to mature, irrigation may be avoided, otherwise fruits may become too soft and insipid. After the fruit has been harvested, one or two irrigation may be enough, if there is no rainfall.

Control of fruit drop

Application of 20-30 ppm naphthalene acetic acid (NAA), once in the second week of October and again in the second week of November checks fruit drop to the extent of 10 percent.

Harvesting and yield

The peak season of harvest is from mid-March to mid April, though it could differ somewhat depending upon location, altitude, cultivar etc. As all the fruits do not ripen simultaneously, 3-5 pickings may be required. The average yield of different cultivars at their prime age of bearing varies from 80 to 200 kg fruit per tree. In dry areas, the yield is relatively lower i.e., 50 to 80 kg per tree.

Plant Protection

Insect Pest and their Management

Insect pest and their Symptoms	Management Practices
<p>Fruit Fly (<i>Carpomyiavesubiana</i>) Fruit flies damage ripe fruits of Ber. Maggots feed in the fruit pulp, causing rotting.</p>	<p>i) Harvest fruits when they are still hard. ii) Collect and destroy all fallen fruits. Apply bait sprays in July-August at 10-15 days intervals. iii) Mix 20 ml malathion 50EC + 500 g molasses or gur in 2 litre of water for poison baiting or 20 liter of water for bait spray.</p>

Diseases and their Management

Diseases and their Symptoms	Management Practices
<p>Powdery mildew The disease attacks emerging leaves and fruit at tender stage. Symptoms start in form of white powdery mass on leaves or in patches on fruit surface. Spots later turn in to light brown to dark brown discolouration. The infected leaves curl, fruits shrivel and drop down.</p>	<p>Spray tree with sulfex (200g/100litre of water) or azoxystrobin+ tebuconazole (200ml/100litre of water) and repeat sprays at 15-20 days interval.</p>
<p>Leaf Spots Spots of various sizes and shapes appear on the foliage. Severe attack may lead to shedding of leaves.</p>	<p>Spray with copper oxychloride (300g/100litre of water) or chlorothalonil (200g/100litre of water), repeat sprays at 15 days interval as per disease severity.</p>

Phalsa

Phalsa (*Grewiaasiatica*L.) is one of the hardiest, drought resistant and quick growing fruit crop. Different parts of the plant are used for curing variety of ailments. The ripe phalsa fruits are consumed fresh, in desserts or processed into refreshing fruit and soft drinks enjoyed during hot summers.

Climate and Soil

Phalsa prefers dry conditions and can therefore withstand drought. It flourishes well under variable climatic conditions, and requires protection from the freezing cold temperature. Also, adequate sunlight and warm or hot temperature is required for fruit ripening, development of appropriate fruit colour and good eating quality. Kandi areas are, therefore, quite suitable for its cultivation. It can also be grown under irrigated conditions. Phalsa plant grows vigorously under wide range of soils including fine sand, clay or even limestone. However, best results are obtained in well-drained, loamy soils.

Cultivars

There is no distinct cultivar available in phalsa. Some types which have umbrella like plants are called Chhatri as compared to those which are bushy in appearance. The plants of some types are found to be tall and some are found to be dwarf. A type, Sharbati is known in north India, which is believed to be of better quality.

Propagation

It is commercially propagated by seeds. The seeds should be sown in well prepared nursery beds at 4-5 cm apart in rows spaced at 25-30 cm in July-August with the onset of monsoon. However, seeds lose their viability within 3 months when stored at ambient temperature and hence, fresh seeds from fully ripened fruits should only be sown.

Cuttings

Phalsa cuttings treated with IBA 300 ppm and planted in last week of July results in 71 per cent survival and takes only 14 days for sprouting.

Planting

Phalsa can be planted either during July-August or February-March when the plants shed their leaves. Eight to twelve month old seedlings are better for planting in the field. Usually, planting is done 2.5-3.0 metre apart both ways, thus accommodating about 1,100-1,500 plants per hectare.

Training and Pruning

Phalsa is allowed to develop a bush, so no training is needed. The most important operation in phalsa cultivation is pruning. Pruning is essential for securing high yield of better grade fruits as it bears fruit on current season's growth. Annual pruning to a height of about 0.5 metres encourages fruiting.

Manure and Fertilizers

Being a hardy crop, fertilization is hardly practiced. But since the bearing is on new growth, it would definitely respond to good fertilization. The application of 10-15 kg FYM after pruning followed by 250g urea per plant after sprouting is optimum for higher yield. The plant is very sensitive to iron deficiency. Therefore, spraying of FeSO₄ (0.4%) will be beneficial to the plants.

Irrigation

Phalsa is regarded as a drought resistant plant but occasional irrigation during fruiting season and in dry periods is profitable for growers. The first irrigation is required in the second or third week of February after the application of fertilizer. During March and April, irrigation after every 20-25 days seems to be beneficial. However, during May, irrigation after every 15-20 days is desirable.

Flowering

Flowering in phalsa starts from February-March and continues till May. Flowers are borne in the axil of leaves.

Harvesting and Yield

Phalsa bushes start bearing in the second year. They yield a good commercial crop in the third year after planting. The fruit starts ripening by the end of May and its harvesting continues through June. Harvesting is done by picking. Ripe berries may be picked on alternate days. The average yield from a mature plant ranges from 2-2.5 kg.

Plant Protection

Insect pests and their Management

Phalsa borer: It attacks the fruits in early stage which can be controlled by spraying with chlorpyrifos 20 EC @ 2ml/litre or cypermethrin 10 EC @ 1ml/litre.

Diseases and their Management

Diseases and their Symptoms	Management Practices
Leaf Spots (<i>Alternaria</i> sp., <i>Cercosporasp.</i> , <i>Phyllostictasp.</i>) Spots brown to dark brown or with white crust, irregular, small to medium in size, may coalesce to form big, blighted patches on leaves. Some spots are circular, 3-9 mm in diameter with ashy centre.	Spray chlorothalonil (200g/100litre of water) or copper oxychloride (300g/100 litre of water) at 10-15 days interval.
Rust (<i>Dasturellagrewiae</i>) Yellow to light brown pustules with uredospores appear on the leaves. Severe infections lead to drying of leaves resulting in defoliation.	Give 2-3 sprays with azoxstrobin (100ml/100litre of water) or propiconazole (100ml/100litre of water) at 15 days interval.

Jamun

Jamun (*Syzygiumcumini*Skeels) is an indigenous fruit grown in tropical and sub-tropical parts of India. It is a tall, and evergreen tree planted in homelands, public compounds, along avenues, in forests and as wind break on roads. It also has some medicinal properties.

Climate and Soil

Jamun is successfully grown under tropical and sub-tropical climate. It is one of the most hardy fruit crop and can easily be grown in neglected and marshy areas where other fruits cannot grow successfully. It requires dry weather at the time of flowering and fruit setting. Early rains are beneficial for ripening of fruit and proper development of fruit size, taste and colour.

It requires deep well drained loamy soil for optimum growth and good fruiting. Its cultivation should be avoided in very heavy and light textured soils.

Cultivars

No standard variety of this fruit is cultivated on commercial scale. The common cultivars grown under North Indian conditions are:

Ra-Jamun: It produces big sized fruit. The colour of ripe fruit is purple pink. The fruit is juicy and sweet.

Small sized Jamun: It is a late maturing cultivar. The fruit is slightly round, deep purple or blackish at ripe stage. Sweetness of the pulp is less than Ra-Jamun. Stone is very large.

Propagation and Rootstock

The most common method of Jamun propagation is by seed. For improved and selected true to type plants, vegetative methods of propagation like inarching and air layering can be done. Seeds can be sown in beds or polybags. The seedlings are planted in rainy season next year. One or two year old seedlings are then inarched in June-July.

Planting

The jamun is planted at a distance of 10-12 metres in square system. Jamun can be transplanted into field during spring (February-March) or during monsoon (August-September). The plants should be transplanted with earth ball into 1 m x 1 m x 1 m pit and are given irrigation till they are well established.

Training and Pruning

Jamun plants should be trained according to the modified leader system. Regular pruning is not required in jamun plants. In later years, dried and crossed branches are removed.

Manure and Fertilizers

In pre-bearing period, 20-25 kg well rotten FYM or compost per plant/year

should be applied. This dose is increased upto 50-60 kg/tree/year. The ideal time for giving organic manure is before flowering. Grown up tree should be applied with 500g N, 600g P₂O₅ and 300g K₂O per plant/year. This should be spread over the tree basin along the canopy line of the plant and mixed in soil by hoeing.

Irrigation

Irrigation should be given just after manuring. Young plants require 8-10 irrigations for better growth. In bearing trees, irrigation should be given from September-October for better bud formation and from May-June for better fruit development. Total 6-8 irrigations are given.

Pollination and Fruit setting

Its flowering starts in the 1st week of March and continues upto mid-April. Its flowers are hermaphrodite, light yellow in colour. The jamun is a cross-pollinated crop and the pollinating agents are honey bees, house flies and wind.

Orchard Floor Management

To supplement the income from pre-bearing period of jamun, inter-cropping can be practiced. Inter-cropping also improves fertility of soil. Fruit crops like peach, plum, guava, kinnow, kagzi lime, phalsa and papaya can be grown as filler trees. Such filler trees can be uprooted when jamun starts bearing commercially. The leguminous crops like gram, peas, moong can also be grown successfully.

Harvesting and Yield

The grafted jamun starts bearing after 6-7 years, while the seedling one after 8-10 years of planting. The fruit ripens in June-July. The fruit takes 63-65 days for ripening after fruit set. Being non-climacteric in nature, jamun should be picked when it is ripe. The fruits are generally harvested daily and sent to market on the same day. The average yield of a jamun plant should be 80 to 100 kg/plant/year.

Special problems

Problems and their Symptoms	Management Practices
<p>Flower and Fruit drop In jamun, the flower and fruit drop starts just after opening of flowers and continue upto maturity. Only 12-13 per cent flowers reach maturity. The flower and fruit drop occurs in three stages.</p>	<p>The extent of flower and fruit drop in jamun can be reduced by two sprays of 60 ppm GA₃, once at full bloom and other 15 days after initial setting of fruit.</p>

Plant Protection

Diseases and their Management

Diseases and their Symptoms	Management Practices
<p>Anthracnose(<i>Glomerellacingulata</i>) Small spots scattered throughout the leaf lamina appear which later enlarge and become circular, oval to elongate or irregular and turn light brown or reddish brown. Black, raised pinhead-like fruiting bodies develop on these spots which may coalesce to give a patchy appearance. The disease also attacks fruit. Lesions vary in size and shape. The infection leads to rotting and shriveling of fruits.</p>	<p>Spray copper oxychloride (300g/100 litre of water) repeat spray at 10-15 days interval or chlorothalonil (200g/100L water) on the appearance of the disease. Give subsequent sprays at 15 days interval.</p>

Pomegranate

Pomegranate (*Punicagranatum* L.) is very much liked for its refreshing juice. The hardy nature, low maintenance, high yield, better keeping quality and survival without irrigation have made it popular in many parts of India. In Jammu division, wild pomegranate growing in intermediate zones is being exploited for *anardana* production.

Climate and Soil

Pomegranate can be grown successfully upto an elevation of about 1500 metres above msl. The area should be free from spring frost. It requires dry and hot summers for producing good quality fruits. A well distributed rainfall of 50-60 cm is considered optimum. High yields of pomegranate are obtained from deep loam soils which are slightly alkaline. In India, it is considered a crop of arid and semi-arid regions because it withstands different soils and climatic stresses. It grows under wide variety of soils and can tolerate even alkalinity and salinity. It can also tolerate drought to some extent.

Cultivars

The important pomegranate cultivars are Kandhari, Ganesh, Dholka, Bedana, Bhagwa, G-137 and Jalore Seedless. Wild pomegranate is too acidic and is used as souring agent.

Propagation and Rootstock

It can be propagated easily through cuttings. The semi-hard wood cuttings from the previous season's growth are taken in December-January. The wood younger than 6 months and older than 18 months is not good for rooting. Cuttings 20-30 cm long and 6-12 mm thick can also be taken from suckers, which arise from base of the stem. Cutting dipped in 50 ppm indole butyric acid (IBA) for 18 hours improves rooting.

Planting

The recommended planting season of pomegranate is December-January. While planting, roots should be intact and properly spread in their natural position before covering with soil. The plants with bare roots should be disinfected against collar rot by dipping them in solutions containing copper fungicides. The planting should be done in the pits of 60 cm x 60 cm x 60 cm size, dug at 4-5 m distance.

Training and Pruning

The pomegranate trees should be trained on multi-stem system. The main trunk should be kept clean upto the height of 20 cm from ground. The training should preferably be done on six-stem system which gives better yield. During bearing period, such plants do not require heavy pruning and it should be limited to the occasional removal of diseased, dead and crossing branches and ground

suckers. However, a little thinning and pruning of old spurs will encourage growth of new spurs. As flowers are born on terminal buds of shoot, so its pruning lower flowers.

Manure and Fertilizers

Pomegranate is hardy fruit plant, growing successfully in low fertile soil. However, productivity is greatly increased by application of manures and fertilizers. Application of 10 kg of FYM and 75 g ammonium sulphate to a 5 years old plant is sufficient. In general, 1304 to 1522g urea, 2500 to 3120g DAP and 330 to 420g MOP per plant per year is recommended for mature tree. In case of bearing trees, the manures and fertilizers should be applied in the basin 1 metre away from the trunk at the time of bahar in split doses.

Irrigation

In order to get good growth of trees and a bumper crop, proper irrigation is essential. In orchards with high density plantation, flood irrigation should be adopted. It requires frequent irrigation especially during summer to avoid fruit cracking.

Harvesting and Yield

The fruits are harvested when the rind attains the proper colour. Owing to the cracking of the fruits, pomegranates are often harvested at immature stage. The fruits are clipped off with a sharp scissors from its stalk. Harvesting is generally done at weekly intervals.

Yield - 30-50 fruits/plant

Post harvest management of wild pomegranate (*Anardana*)

- Sun dried *anardana* from mature and ripened fruit remained fresh in polybags even after 3 months of storage at room temperature; whereas in dried seeds of immature fruits some larvae were found which deteriorate the quality of *anardana*.
- Instead of gunny bags for drying on rooftops, use muslin cloth for hygienic drying.
- Small poly tent structures should also be used for septic drying of *anardana*.
- Gloves should be used for separating seeds from septa so as to overcome blackening or tanning of hands.
- Sun drying for 38 hours was found to be best followed by poly tent house sun drying. However, the seeds dried at room temperature showed some fungal growth.

Plant Protection

Insect-pest and their Management

Insect-pest and their Symptoms	Management Practices
Fruit Borer Anar butterfly <i>(Deudrixisocrates)</i> Newly hatched caterpillars bore in to the fruits and feed on developing seeds.	i) Collect all fallen and infested fruit and destroy. ii) Bag fruits after single spray of dimethoate 30 EC @ 1 ml/litre of water with muslin cloth or butter paper bags are effective. iii) If possible, release of <i>Trichogrammaembryophagum</i> @ 1.5 lacs adults parasites six times and teleonomuscyrus for egg parasitization on hilly area iv) Harvest fruits when they are still hard.
Aphids and thrips	Spraying of dimethoate 30EC@ 2ml/litre or methyl demeton 25 EC @ 1ml/litre of water.

Diseases and their Management

Diseases and their Symptoms	Management Practices
Leaf Spots (<i>Colletotrichum gloeosporioides</i> , <i>Fusarium fusarioides</i> , <i>Phomopsis aucubicola</i> , <i>Coleophomaempetri</i>) Leaf spots of varying colours and sizes usually appear during rainy months of July-August. Spots from small specks and dots of larger sizes, may be necrotic. Infected leaves, sometimes turn pale and drop.	Spray copper oxychloride (300g/100litre of water) as soon as spots appear. Repeat sprays at 15 days interval, if required.
Fruit spots or rots (<i>Beltaraniellahumicola</i> , <i>Drechslerarostrata</i> , <i>Phytophthora nicotianae</i> , <i>Cladosporium oxysporum</i> , <i>Colephomaempetri</i> , <i>Pestalotiopsis versicolor</i> , <i>Aspergillus</i> spp.) Fruit rots usually occur in rainy months, high humidity aggravates the rot. Fruits at all stages are attacked. Spots are usually dark brown to black and of varying sizes. Some rots emit foul smell.	Spray azoxystrobin (100ml/100litre of water) or copper oxychloride (300g/100litre of water) or chlorothalonil (200g/100litre of water) on the appearance of the disease. Give subsequent sprays at 15 days interval.
Canker (<i>Ceuthosporaphyllosticta</i>) Elliptical black spots appear on the twigs, the affected portion becomes flattened and depressed with raised edges. Twigs beyond the lesions dry off and in severe cases the whole tree may die.	i) Scrap cankerous wounds and apply Bordeaux paste or copper oxychloride paste. ii) Spray with copper oxychloride (300g/100litre of water)

Custard Apple

Custard apple (*Annona squamosa* L.) is one of the most delicious fruits mainly consumed fresh. It is hardy, tolerant to drought, salinity and saline irrigation water to certain extent. It grows very well even on a shallow soil. It also sheds off leaves during stress period to evade moisture loss from plant tissues through transpiration and thus a most appropriate fruit crop for rain-fed region. This crop is known by varied name like sitaphal, sugar apple and shariffa. The edible portion or pulp is creamy or custard like, granular with a good blend of sweetness and acidity which varies with the species. It is also used in ice-creams and other milk products and in making preserves as jam, jelly and other products.

Climate and Soil

It is a tropical plant but can be grown in mild sub-tropics also. It is sensitive to frost. It prefers dry climate during flowering but fruit set is aided by high humidity which begins with the onset of monsoons. Annual rainfall of 50 to 75 cm is optimum though it can withstand higher rainfall or drought. Generally, shallow and poor classes of soils are preferred for custard apple cultivation. It is tolerant to many soil conditions except alkalinity.

Cultivars

Propagation of this fruit is generally done by seeds and therefore, there are no standard cultivars. Only two distinct groups are known like red fruited and green fruited in which large variables are reported. Important ones are as follows:

- | | |
|-----------------|---------------|
| i) Washington | ii) Mammoth |
| iii) Barbados | iv) Balanagar |
| v) Red Sitaphal | |

Propagation and Rootstock

Propagation of custard apple is generally done through seeds. For rainfed conditions, seedlings can be raised in polythene bags filled with garden soil and planted in the field at the onset of monsoon when they attain height of about 20-25 cm. Seeds can also be sown directly in the field in well prepared pits in the beginning of monsoon and at the appropriate height and girth, they can be soft wood grafted when new growth emerges after one year. Propagation by budding (chip and shield) and whip grafting has been found successful for improving the yield and quality. Budding is done in spring when sap starts flowing.

Planting

Pits of 60 cm x 60 cm x 60 cm size are made in summer, refilled with soil and FYM (1:1). Planting distance is kept at 4.5 m x 4.5 m to 5.0 m x 5.0 m. Planting is done in the beginning of monsoon to avail the advantage of available rain water.

Training and Pruning

Generally training and pruning are not practiced in annonaceous fruits, but leaf shedding in winter season and production of floral buds on new shoots indicate the necessity of some amount of training and pruning. Only few scaffold limbs are allowed to develop and other branches are removed. Subsequently, very old and weak branches are thinned out from time to time for giving place for new and young branches. Pruning should, however, be carried out when the plant is to put forth new growth in early spring after dormancy.

Manure and Fertilizers

Custard apple trees are not generally manured or fertilized however, fertilization improves vigour, yield and fruit quality.

Age of tree (Year)	FYM (Kg/tree)	Fertilizer requirement (g/tree)		
		Urea	DAP	MOP
1-2	25	120	109	84
3-5	35	240	217	167
Above 5 year	50	542	271	209

Note: The above fertilizer doses should be applied in the beginning of rains.

Irrigation

Custard apple does not require irrigation to produce fairly good crop provided effective water harvesting is affected by developing micro-catchments in rainy season. However, in absence of water harvesting in post monsoon period, 2 to 3 irrigations help in better quality of fruits and higher production.

Flowering

It takes about three years for plants to come into bearing and five or more years to develop full canopy. An average plant bears about 2000 flowers and the fruit set is about 2-3 per cent. Fruit set is better where humidity is high.

Harvesting and Yield

Custard apple produces single crop in a year during September -November in North India. It comes into bearing from the age of 4-5 years. It is a climacteric fruit and should be harvested when fully matured and firm. A five years old tree would yield about 50-100 fruits per year.

Plant Protection

Diseases and their Management

Diseases and their Symptoms	Management Practices
Fruit Rot (<i>Glomerellacingulata</i>) Dry, blackish-brown spots at the blossom end of the fruit which spread slowly in all directions and usually cover the whole fruit. The fruit becomes a shriveled mass. The diseased fruit may drop down.	The disease can be effectively controlled by foliar sprays with copper oxychloride (300g/100 litre of water), give 2-3 repeat sprays at 15 days interval.

Lasoda

Lasoda (*Cordia myxa* Roxb.) is a medium-sized broad leaved deciduous fruit tree grown all over India except high hills. It has a great capacity to tolerate drought once established, and therefore, quite wide spread in semi-arid and rainfed regions of North India.

Climate and Soil

It thrives under tropics as well as sub-tropics upto an elevation of 5000 feet. It needs warmer climate and is sensitive to frost and can withstand drought to a very greater extent but is sensitive to frost. Under tropics, flowering can be regulated through moisture availability, while in sub-tropics temperature is the determining factor. Lasoda is not very exacting in soil requirement and has great capacity to grow in stress due to water or salinity.

Cultivars

Since it has been propagated through seeds, there are no well defined cultivars. However, great variation exists in the size of fruits and pulp content.

Propagation

It is generally propagated by seeds. Seeds from freshly harvested ripe fruits are extracted and sown in the months of April to May. Plants are ready for planting in July to August. Budding can be successfully done on seedlings during July to September on one year old seedlings.

Planting

Under rainfed conditions, appropriate time for planting is the beginning of rainy season for which pits of 60 cm x 60 cm size are made 6 m x 6 m apart during summer. These pits are refilled with soil and farm yard manure (1:1) at least a month before planting. It would be advisable to create small catchment around each plant to harvest run off during rainy season.

Training and Pruning

Young plants are trained initially to erect position. Pruning is not required but diseased and dead branches needs to be pruned off.

Manure and Fertilizers

For good and regular production, fertilization shall be beneficial. Each tree can be given 25 kg FYM and about 600 g of urea in the beginning of monsoon.

Irrigation

In the event of failure of monsoon in the year of planting, irrigation is required for young saplings for establishment. Once this is achieved, irrigation is not required for this plant.

Flowering

A grafted/budded plant comes into bearing in fourth year and flowering takes place in March to April. The fruit ripens in May to June.

Harvesting and Yield

Fruit is mostly used for pickling, therefore, it should be harvested at green mature stage. Whole bunch of fruit is harvested and marketed. If fruit is required for processing, harvesting can be prolonged till the fruit attains pinkness. Each grown up tree can yield 100 to 125 kg fruit per season.

Plant Protection

Insect pest and their Management

1. **Lasoda fruit weevil:** It is the important insect pests of lasoda which infested the serious and economic damage. It can be minimized by spraying acetamiprid 20 SP @ 0.2 g/litre of water at pea size stage.

Karonda

Karonda (*Carissa carandas* L.) is an evergreen spiny shrub or small tree. It is very popular as a protective hedge plant of 3-6 m height. Its fruits are very nutritious, especially as a rich source of iron. It makes use of natural moisture availability period and therefore highly suitable for rainfed region.

Climate and Soil

Karonda is a very hardy shrub and can be successfully grown in tropical and sub-tropical climatic conditions. However, heavy rainfall and waterlogged conditions are harmful. Soil is not a limiting factor for its cultivation. It can be grown in any soil except very sodic or alkaline soils but for better production, fertile sandy loam soil is better.

Cultivars

Although there is no known variety of karonda, but based on the colour of the fruits, three types are commonly grown:

- i) Green fruited
- ii) White fruited
- iii) Pink fruited

The differences are not much in shape and size of fruits in all the three cultivars. However, there is tremendous scope for improvement using selection and vegetative methods of propagation.

Propagation

Karonda is commonly propagated by seeds and vegetative methods like stem cuttings, inarching and air-layering. The fresh seeds are sown in nursery in the month of August or September, where under good management, seedlings become ready for transplanting after one year. Air-layering and inarching is also successful when tried during the beginning of monsoon.

Planting

The pits of 45 cm x 45 cm x 45 cm size are prepared and filled with organic manure and soil in the ratio of 1:1. The distance of planting in regular planting is 1.5 -2.0 m both ways. The best time for planting is the beginning of monsoon.

Training and pruning

At the time of planting, plants are supported with the help of wooden stakes so that plants can grow erect. Pruning of all the unwanted laterals is advised to give the desired shape to the plant. Bearing trees usually do not require pruning. Diseased, dead wood and suckers arising from ground are removed.

Manure and Fertilizers

Karonda plants grown as protective hedge are hardly manured or fertilized. Manuring, however is beneficial, otherwise its plants slowly get exhausted after taking two crops and show symptoms of dieback. Therefore, 10-15 kg well

rotten FYM or compost per plant should be applied before flowering. In most cases, it is advisable to supplement the fertilizer applications with micro-nutrients spray.

Irrigation

Karonda is a slow growing plant, once established will not require much of irrigation. However, efforts should be made to collect run off during rainy season.

Harvesting and Yield

The plant starts bearing in the month of August. However, unripe fruits are available from May onwards. Both unripe and ripe fruits are harvested. Complete harvesting for all fruits may not be done. It is done in two to three pickings. Colour change is a good indicator of maturity. About 4-5 kg of fruit can be obtained from a matured plant.

Plant Protection

Diseases and their Management

Diseases and their Symptoms	Management Practices
<p>Bacterial canker(<i>Xanthomonas carissa</i>) Spots appear on the surface of leaves. Spots are small, round, water soaked, translucent dots, gradually expanding and turning dark brown. Yellow hole may surround the spots. On mid vein, spots cause browning and necrosis of the affected area. Closely formed spots causes browning and necrosis of the affected area, central portion of the spots finally collapses and forms a depression. Twigs show similar symptoms.</p>	<p>i) Prune off the diseased twigs and remove infected leaves. ii) Spray with streptomycin sulphate/agrimycin (20g/100litre of water) or copper oxychloride + streptomycin sulphate (0.3%), repeat sprays at 10-15 days interval.</p>

Bael

Bael (*Aegle marmelos*) is one of the oldest fruits cultivated in India. The trifoliolate leaves of this tree are traditionally used as sacred offering to Lord Shiva. It is growing wild in Jammu District and also in sub-tropical parts of Udhampur, Rajouri and Kathua districts. It is a hardy fruit crop tolerant to adverse soil and weather conditions. The importance of this fruit lies in its curative properties, which make the tree one of the most useful medicinal plant.

Climate and Soil

The bael trees grow successfully and produce higher yields in sub-tropical climate where summer is hot and dry and winter is mild. Further, bael tree is reported to be hardy and can be grown up to an altitude of 1,219 m and is not damaged by temperature as low as -7°C. It can thrive well in swampy, alkaline and stony soils. However, well drained sandy loam soil is the best.

Cultivars

Named varieties are not available though different types are being grown in different places with great variations in size and shape of fruit, bearing habits, quality of pulp, colour, texture, sugar percentage. However, some varieties like Mirzapuri, Kagzi Gond and KagziBanarasi are popular in certain localities of India.

Propagation

Generallybael is propagated by seed. However, to get true-to-type plants or cultivars, patch budding is the ideal method when done in June or July. The seeds do not have dormancy and are sown in June in well prepared beds mixed with FYM and sand. The seeds germinate within 3 weeks and seedling is ready for budding in a year.

Planting

The pit of 50 cubic cm are dug and filled with top soil mixed with 10 to 15 kg of FYM. Planting distance is 10 m x 10 m to 12 m x 12 m and planting can be done in spring and rainy seasons. However, for rainfed conditions, planting should be carried out with the onset of monsoon.

Training and pruning

Young plants are trained with the help of stakes, so that they grow erect. In order to provide good framework to the individual tree, the main stem should be given a cut at a height of 1 m and 4-6 well spaced branches should be selected from the stem. Yearly pruning is only done to remove the diseased and criss-crossed branches.

Manure and Fertilizers

Age of tree (Year)	FYM (Kg/tree)	Fertilizer requirement (g/tree)		
		Urea (g)	DAP (g)	MOP (g)
1	10	90	55	85
2	20	180	110	170
3	30	270	165	255
4	40	360	220	340
5	50	450	275	425
6	60	540	320	510
7	70	630	375	595
8	80	720	440	680
9	90	810	495	765
10	100	900	550	850

Note: FYM should be given in the beginning of May. Half dose of N, full dose of P and half dose of K should be given just before flowering. Remaining half dose of N and K should be given in the last week of August. Manures and fertilizers should be spread under whole tree canopy and given immediate irrigation.

Irrigation

Young plants need to be irrigated time to time in the first few year of planting and when plants establish well, usually irrigation is not required except after manuring and fertilization.

Harvesting and Yield

Bearing starts in budded plants after 5 years and the yield is 200 to 300 fruits per tree after 10th year. For preserve making, bael fruits are harvested 8 months after fruit set when their colour changes from deep green to light green and the pulp from light yellow to deep yellow. Ripe fruits are used for beverage making and are harvested tree ripe.

Special Problems

Fruit drop and cracking before ripening:

Growth regulators 2,4-D and 2,4,5-T with various concentrations can check fruit drop to a great extent, while cracking can be checked by maintaining proper moisture during maturity of fruits.

Plant Protection

Insect-pest and their Management

1. **Citrus Butterfly (*Papiliodemoleus* and *P. polytus*):** See citrus for management

Disease and their Management

Diseases and their Symptoms	Management Practices
Bacterial shot hole and fruit canker (<i>Xanthomonas bilvae</i>) Round, water-soaked spots (0.5 mm) surrounded by clear hollow appear which gradually increase in size (3-5 mm) and form brown lesions with saucer-like depression in the centre.	i. Prune off gummy twigs/branches and burn them. ii. Spray with streptomycin sulphate (20g/100 litre of water) + copper oxychloride (0.3%) or copper oxychloride (300g/100litre of water), repeat sprays at 10-15 days interval.

Jackfruit

Jackfruit (*Artocarpusheterophyllus*L.) is a medium sized tree, 8 to 10 m tall, having a dense irregular globose crown. The sap is milky white and the leaves are dark green, alternate, petioled, ovate-oblong or obovate. Tender jack fruit appears in the market in spring and continues until summer as a popular vegetable. Ripe fruit has high nutritive value. It is an important source of pectin and contains about 1.9 per cent protein on fresh weight basis. This fruit is locally known by the name kat-hal.

Climate and Soil

Jackfruit thrives best in warm and humid climate and its fruit quality deteriorates at higher altitude. It requires deep well drained and rich alluvial soils.

Cultivars

- Khaza
- Katahari
- Local

Propagation

Jackfruit is cross-pollinated and mostly seed propagated. Seeds must be sown immediately after extraction since they lose viability in storage prior to sowing. Seeds should be soaked in GA₃, (500 ppm) solution for 48 hrs to improve germination. It can also be successfully propagated by air layering (2500 ppm IBA treatment) and chip/patch budding. The air layering should be done in the month of June-July.

Planting

It should be planted in July-August at a distance of 12 m x 12 m in 1 cubic metre pits in which 30 kg FYM + 500 g superphosphate is mixed with soil.

Training and pruning

Being a vigorous tree, it should be trained properly to a desired shape. Diseased, undesirable branches should be removed from time to time to enhance the productivity.

Manure and Fertilizers

One year old plant requires 10 kg FYM + 500 g Ammonium sulphate + 2 kg bone meal + 5 kg wood ash per year. These doses should be increased up to 10 years and remain constant thereafter. In addition to that, 1% foliar spray of borax should be applied in alternate years in the month of March-April.

Irrigation

Young plants should be irrigated weekly during summers; however, established trees require 3-4 irrigations throughout the period of summer.

Intercropping

In irrigated areas, peas, lobia, moong, urdbean, soyabean, okra and brinjal can be grown till regular bearing of tree starts.

Flowering

Being a monoecious tree, the male and female flowers develop separately on the same tree. Making of small wounds on stems and main branches 1-2 months prior to flowering may enhance the proportion of female flowers. Poor pollination leads to the drop of female flowers.

Harvesting and Yield

Time of harvesting -June-July

Yield -100-400 kg/tree

Seedling originated plants start bearing from 7-8 year onwards, while budded ones start bearing from 3rd year of planting.

Plant Protection

Diseases and their Management

Diseases and their Symptoms	Management practices
<p>Leaf Spots (<i>Botryodiplodiatheobromae</i>, <i>Coletotrichum Lagenarium</i>, <i>Carcosporamehran</i>) Light coloured to grayish-brown or brown spots, irregular or circular to oval with pink or brown margin appear on leaves.</p>	<p>Spray with copper oxychloride (300 g/100 litre of water) at 10-15 days interval, repeat sprays at fortnightly interval.</p>
<p>Blossom and Fruit Blight (<i>Botrytis cineria</i>) Flowers give blighted appearance, fruit may also be affected causing premature fall of young fruits.</p>	<p>Spray copper oxychloride (300g/100 litre of water) as soon as the disease appears, repeat spray at 10-15 days interval.</p>
<p>Soft Rot (<i>Rhizopus atrocarpi</i>) Male inflorescence and young fruits are attacked. Female flowers and mature fruits are usually not attacked. The fungus starts growing near the stem-end or any other part of immature fruits or male inflorescence causing soft rot. Greyish growth with abundant mycelium appears which gradually become denser and black in colour or entire inflorescence rots and falls off.</p>	<p>Spray with copper oxychloride (300g/100 litre of water).</p>

Olive

Olive (*Olea europea*) is an evergreen plant but requires chilling for fruiting. Fruits are mainly used for oil extraction and pickling.

Climate and Soil

The olive varieties differ in their chilling requirements, which range between 400-2000 hrs. It gets injured when temperature falls below minus 12°C. For their optimum production, the annual mean temperature should be 15-20°C with 100-120 cm annual rainfall. The localities should be free from early fall and late spring frost. Its cultivation can be undertaken in areas ranging from 650-2300 m above msl. Best olive orchards are found on well drained, clay soils underlain with a hard pan. On deep fertile land, olive tree produces excessive vegetative growth and medium crop. The most desirable pH range for olive is from 6.5-8.0.

Cultivars

Its varieties can be divided into 2 categories. They are as under:

Oil type	Pickle type
Carolea	Ascolano
Coratina	Mission
Pendolino	Grosseune
Frontoio	Picholine
Canino	Cornicobra
Ascolanaterena	Coratina
Aglandeau	

Pollinizers

Yield improves when sufficient pollinizers are planted alongwith the main cultivars. Pollinizer variety should be 20-25% of the whole plantation and 2-3 cultivars having synchronized flowering period should be planted. Frontoio, Coratina, Ascotirana and Ascolano are good pollinizers.

Propagation

The most economical method of olive propagation is through semi-hard wood cuttings or terminal cuttings. The cutting should be treated with IBA and kept under controlled temperature and humid conditions in the mist chamber. Olive is also propagated on wild seedlings by shield and patch budding in July-August.

Planting

a) Pit Size

Pits may be dug two months prior to planting. The size of the pits should be 1 m x 1 m x 1 m.

b) Planting Time

The planting of olive should be done in July-August, however if irrigation facility is available planting can be done in December-January. The graft union should be kept 15 cm above the ground level to avoid collar rot.

c) Planting Distance

The recommended planting distance is 8 m x 8 m but under rainfed areas where soil is poor, the spacing could be reduced to 6 m x 6 m.

Training and Pruning

Olives are generally trained on modified leader system. The bearing olive trees require minimum pruning comprising of water sprouts, dead and interfering branches. Weak and old shoots should be thinned out. It is ideal to prune ¼ of old wood every year and keep the centre of tree open. Pruning done on 15th January with 25% pruning intensity improved the fruit production of olive cv. Frontoio.

Manure and Fertilizers

Age of tree (Year)	FYM (Kg/tree)	Fertilizer requirement (g/tree)		
		Urea	DAP	MOP
1	10	120	108	80
2	15	240	216	160
3	20	360	324	240
4	25	480	432	320
5	30	600	540	400
6	35	720	648	480
7	40	840	756	560
8	45	960	864	640
9	50	1080	972	720
10 and above	50	1200	1080	800

Note:

- Nitrogenous fertilizer should be applied in three split doses, viz., immediately after harvest, onset of spring season and in the beginning of rainy season.
- Apply 200 g borax per tree in alternate years.
- In drought prone areas, two foliar spray of urea (1.0%) and boric acid (0.4%) should be applied during pre bloom and post bloom, respectively.
- Foliar application of 0.5% zinc sulphate in combination with 0.5% boric acid and 1000ppm paclobutrazol in the first week of March and repeatedly done again after 30 days, improved the fruit production of olive cv. Frontoio.

Irrigation

Mature olive trees require 950 mm water during March-September. It is important to apply this water during critical periods for growth and productivity of trees. In autumn, apply two irrigations immediately after harvest, at an interval of 20 days. It is necessary to apply one irrigation four weeks prior to expected time of flowering which ensures adequate development of flowers and

lower down the flower bud abscission. The tree should be irrigated after two weeks of the peak bloom period as it improves fruit set.

One irrigation should be given a month after fruit set to stimulate development of fruit and reduce fruit drop

Mulching

Mulching is very effective to conserve moisture and to lower moisture losses. Hay, white polythene film or tree leaves can be used for mulching. The mulch should be applied during late winter before the drought period set in.

Harvesting and Yield

The harvesting of olive is being done by the following methods:

a) Hand picking

The ripened fruit is picked up manually from the tree. Since the olive fruits do not ripe at one time, such harvesting operations are time consuming and uneconomical.

b) Manual shaking

A cloth or paper is spread below the tree and its limbs are vigorously shaken by bamboo pole having hook at its distal end and hold the tree limbs at the time of shaking.

c) Allow natural fruit drop

With this method, only a little amount of fruit is received everyday and grower finds it difficult to market them.

Depending upon the cultivar, soil fertility, moisture conditions and weather, the yield varies from 30-40 kg/tree to over kg in a mature tree.

Plant Protection

Insect Pest and their Management

Insect Pest and their Symptoms	Management Practices
Olive psylla (<i>Euphyllurapakistanica</i>) Nymph and adult feed on the growing parts of the plant as a result of which leaves and shoots get deformed	Spray dimethoate 30EC @ 1ml/litre of water or metasystox 30EC 1ml/litre of water.
Olive tinged bug	Follow olive psylla management
Olive scales	Follow olive psylla management

Disease and their Management

Diseases and their Symptoms	Management Practices
Anthraxnose/Twig die-back (<i>Colletotrichum gloeosporioides</i>) Dark brown spots appear on leaves and brown circular spots on fruits which develop concentric black circles oozing pink spore mass under humid conditions. Twigs start drying from tip downwards.	Give 4-5 sprays at fortnightly interval with copper oxychloride (300g/100litre of water) during rainy season.

Pecan

Pecan (*Caryaillinoensis*) is a highly nutritive and energy giving nut fruit. It has nutty flavour and superb tree characteristics. Pecan is mainly cultivated in Rajouri and Poonch areas of Jammu with an area of 493 ha having annual production of 72M.T.

Climate and Soil

Pecan need warm temperate climate and extremely temperate and sub-tropical climates are undesirable. It needs adequate chilling hours ranging from 400-600 hours below 7.2°C for different cultivars. Mean monthly temperature ranging from 24.0 to 29.5°C, with little diurnal variation during growing period is best for growth and fruiting. High humidity prevents pollination, increases the incidence of diseases and premature splitting of nuts.

Although, pecan nuts are grown in varied soil conditions, but sandy loam soils (pH 5.0-8.0) which are deep, fertile and rich in organic matter are best for its growth and fruiting. Symbiotic mycorrhiza and fibrous roots permeate the top 1 metre of soil.

Cultivars

The choice of cultivars should be based on the climate, incidence of diseases, chilling hours and number of days required by the different cultivar to mature.

Important commercial cultivars:

- i. Western Schley: It is recommended for high density planting. It is precocious, very prolific bearer and self pollinated.
- ii. Desirable: Tree comes into bearing early, a regular and prolific bearer and resistant to scab. Good for high density planting.
- iii. Stuart: It gives good yield and comes into bearing late. It should be grown with protandrous cultivar Desirable.
- iv. Wichita: It is very prolific bearer and most precocious. Susceptible to scab and has high zinc requirement. The cultivar is protogynous and should be grown with cv. Western Shelley for pollination.

Propagation and Rootstock

The seeds of any available cultivar of pecan are used as rootstock. Stratification of seed at 1-5°C for 70-75 days gives highest germination. Patch budding in August and whip grafting in dormant season have given best results for propagation. High mortality is experienced at transplanting.

Planting

Pecan trees are very large and are planted at a distance of 16-20 m, depending upon cultivar and soil. For precocious cultivars, spacing of 10.7 m x 10.7 m is recommended. Deep ploughing and leveling is done before planting in

late winter or early spring. Because of slow growth of fibrous root system, a considerable mortality is experienced at transplanting which can be minimized by removal of top 50% of plant and keeping 50 cm tap root at planting time. In situ grafting of rootstock also gives good results.

Training and Pruning

Training begins with planting when one third to one half of the top is removed. From second year, the plant is trained to central leader system and branches are allowed to emerge as high as 1.5 m to 2.0 m from ground. No narrow angled branch is retained. Yearly pruning of big tree is difficult, however, possible crowded branches should be removed. Since pecan is a terminal bearer, it requires light pruning.

Manure and Fertilizers

Fully grownup pecan trees should be applied with 100kg FYM every year in December. In addition, apply 500g NPK mixture (15:15:15) per year depending upon the age of the tree and 8 kg mixture to the full bearing trees of sixteen years age and above. The fertilizer should be applied in early spring. Pecan are prone to zinc and manganese deficiency which can be prevented with foliar application of 0.5% zinc sulphate and manganese sulphate.

Irrigation

Water requirement of pecans is higher than other nut fruits. Supplemental water treatments significantly increase kernel yield, nut weight and diameter. The common methods of applying water are flooding, furrows, sprinklers or drip irrigation.

Flowering and pollination

After budding or grafting, the pecan trees begin fruit production in a period of 4 to 6 years depending upon the cultivars and vegetative growth. The staminate and pistillate flowers are borne separately on the same tree.

The pecan nut is mostly cross pollinated, and self pollination is very rare. The planting of 5 % pollinizers have been recommended to ensure good fruiting.

Alternate bearing

Alternate bearing is more pronounced in pecan than other nut fruits. A good orchard management involving better nutrition, water management and pest & disease control considerably reduce degree of alternate bearing.

Harvesting and Yield

The indication of colour markings as dots and streaks on the shell is an indication of nut maturity. Generally, the nuts are thrashed down from the trees with bamboo poles or allowed to fall naturally to the ground where from these nuts are gathered manually. Harvesting should be done in dry weather conditions. The commercial production begins from 9th to 10th year and yield ranges from 20 to 100kg tree⁻¹ from a fully grown tree depending upon cultivar and growth of a tree.

Drying and storage

When pecan lies on wet soil for few days, they discolour and are infected with mould which deteriorates kernel quality. So, they are dried after harvest to bring moisture content to 4.5%. The nuts should be dried at room temperature by constant circulation of low moisture air for about three days.

Plant Protection

Diseases and their Management

Diseases and their Symptoms	Management Practices
Leaf Blotch (<i>Gnomoniacaryae</i>) Leaves become brownish giving a blotching effect. Circular dead spots appear on nuts. Cankerous symptoms appear on twigs.	Spray with copper oxychloride (300 g/100 litre of water) or chlorothalonil (200 g/100 litre of water) at weekly interval until leaves have fully expanded.

Apple

Apple (*Malus x domestica* Borkh.) is a premium fruit of the world. It is a typical temperate fruit and main fruit crop of Jammu and Kashmir. The area under this fruit in Jammu and Kashmir is 162971 ha with an annual production of 1726834 M.T. Apple is being grown in upper areas of Doda, Kishtwar, Ramban, Poonch, Udhampur, Reasi, Kathua and Rajouri districts of Jammu division. The acreage under this fruit crop in Jammu division is 18415 ha with annual production of 30595 M.T.

Climate and soil

Apple is a typical temperate fruit crop requiring 1000-1600 hours of rest period below 7°C. The average temperature during growing season should be 21°C to 24°C. Sunshine is essential for colour development of the fruit. In general, a cool climate with low winter temperature and little rainfall in summer is most suitable for apple cultivation.

Apple is grown on a wide range of soils. However, a well drained slightly acidic (about 6.5-6.7 pH) loam soil with good depth (more than 45 cm) is ideal for apple cultivation. Apple can't tolerate wet field, and water logging may cause collar rot and death of trees.

Cultivars

Most suitable cultivars are those which have commercial value and are also effective for cross pollination. Some of the important cultivars grown in the J&K state are:

Early season cultivars: Mollies Delicious, Starkrimson, Red June, Irish Peach, Benoni and Tydeman's Early Worcester (P*)

Mid-season cultivars: American Mother, Razakwar Jonathan (P*), Cox's Orange Pippin (P*), Red Gold, Queen's Apple. Rome Beauty and Scarlet Siberian.

Late season cultivars: American Apirouge, Ambri, King of Pippins, Lal Ambri, Sunahari, Chamure, Red Delicious, Golden Delicious (P*), Baldwin, Yellow Newton (P*) and White Dotted Red.

*P – These varieties can be used as pollinizers also.

Scab resistant cultivars: Firdous and Shireen have been released for commercial cultivation in J&K State.

Low chilling Cultivars: Vered, Michael, Anna, Tamma, Neomi (less than 800 hours chilling needed). Tropical Beauty and Parlin's Beauty are suitable for processing.

Other promising cultivars

Super Chief Sandidgue, Red Chief Campspur, Red Velox, Oregon Spur,

Silver Spur, Starkrimson, Gala RedLum, Gala Buckey, Gala Brook Field, Fuji Zehn Aztec, Fuji Kiku, Golden Delicious Reindeers, Golden Delicious Clone B

Propagation and Rootstock

The apple plantations are raised on seedling rootstock. Seeds of Crab apple, White Dotted Red, Yellow Newton, Golden Delicious and Northern spy have good seed viability, germinability and seedling growth. The treated seeds (as mentioned in the raising of nursery chapter) are placed between 2-3 cm thick layer of moist sand in wooden boxes or polythene bags in December. These boxes or bags are kept in cool places having 1-5°C temperature for 50 to 70 days. However, the stratification requirement of seeds is also met in areas of very cool winters by direct sowing of seeds in nursery beds during November-December.

Clonal rootstocks

The size controlling clonal rootstock of Malling (M) and Malling Merton (MM) can be used in deep and fertile soils having assured irrigation facilities. Use of dwarfing rootstocks will result in early bearing and increase productivity per unit area of land.

Clonal rootstock for apple

Category	Root Stock	Characteristics
Dwarfing	M9, M26	Short Juvenile phase, weak anchorage suitable for high density plantation in irrigated areas.
Semi-dwarf	M4, M7, MM106	Susceptible to collar rot, suitable for high density plantation and well drained soil.
Semi-Vigorous	M2, MM 111	Tree size 70% of standard, drought tolerant, MM111 is resistant to wooly aphids

MM106 and MM111 are the most suitable apple rootstocks for temperate areas of Jammu Division. The common method of propagation of clonal rootstocks is by mound layering (stooling). The desired cultivars can be grafted or budded on seedling or clonal rootstocks.

Methods of grafting and budding

Method of grafting	:	Tongue grafting
Time of grafting	:	February-March
Method of budding	:	T-budding
Time of budding	:	July-August

The bud sticks should be taken from trees which are healthy, producing excellent fruits of superb quality and prolific and regular bearers. The bud sticks collected prior to grafting should be kept slightly moist with moist saw dust or moss and stored at low temperature to prevent bud break. The bud sticks may also be stored at 5-6°C in wrapped bundles till the time of grafting.

Planting

- a) Planting System :Square
- b) Planting Distance :6 m-7.5 m
- c) Planting Time :March

In high density plantation on clonal rootstocks, the number of plants per hectare can vary from 500-1666 plants per hectare with a planting distance of 5 m x 4 m and 3 m x 2 m, respectively.

The grafted/budded plants should be planted in December in the previously dug pits of 1 m x 1 m x 1 m size. During planting, the prime consideration should be the planting of sufficient pollinizers to ensure effective pollination.

Pollination

Most of the apple cultivars require adequate cross-pollination for optimal yields. For delicious group of apple, 20-25% pollinizers are adequate for getting a commercial yield, however, their proportion can be increased to 30-50% if the plantations are affected by adverse climatic conditions. Early, mid and late season pollinizers provide assured cross-pollination to main cultivar. At some places pollinizers like Golden Delicious and Red Gold show biennial bearing tendency and lead to crop failure during off year, hence new pollinizers like Summer Queen, Tydeman's Early Worcester, Lord Lambourne, Granny Smith, Spartan, Glauster and Red McIntosh need to be diversified as pollinizer group. The placement of 6-8 bee hives/ha is highly beneficial to increase fruit yield in apple.

Training

Training in apple trees is done for giving desired shape to a tree during early years. The apples are trained to a modified leader system. The plant is cut to 90 cm above the ground immediately after planting. In subsequent years, 3-4 scaffold limbs around the main trunk are developed in different directions. It is not necessary to have all scaffold limbs in first year only, they can be developed in subsequent years. Weak branches and branches with narrow crotch angles should be cut back. Rope and pegs can be used to make crotch angles wider, to induce early flowering.

Pruning

a) Pruning of non-bearing trees

After 3-4 scaffold limbs are developed, very light and corrective pruning is done. Thinning is done to space laterals, narrow angled and criss-crossed branches are removed.

b) Pruning of bearing trees

Apples bear mostly on spurs. Pruning should be done to maintain balance between vegetative growth and spur development. For this, light to moderate pruning should be done in bearing trees. Moderate thinning and heading back should also be done. Overcrowding branches should be removed. Cut should be

made close to branches leaving no stubs. Pruning should start from top of tree to down wards. Upward growing branches should be cut back to strong laterals. Remove dead and diseased wood. Competing branches should be thinned out. Large cuts should be covered with bordeaux paste.

Manure and Fertilizers

Age of tree (Year)	FYM (Kg)	Fertilizer requirement (g/tree)		
		Urea	DAP	MOP
1	5	35	20	50
2	10	70	45	100
3	15	105	65	150
4	20	140	85	200
5	25	175	110	250
6	30	245	150	350
7	35	315	195	450
8	40	385	235	530
9	45	455	280	630
10	50	525	325	730
11	60	630	385	900
12	70	735	450	1050
13	80	840	515	1190
14	90	940	580	1345
15 th year & onwards	100	1050	645	1500

Note: In matured trees, di-ammonium phosphate and muriate of potash should be applied in December. Urea should be applied in 2 split doses. 1st dose should be applied in first fortnight before expected bloom. Second dose may be applied about 3 weeks after fruit set. Apply FYM in the month of February-March.

Besides, the following schedule of nutrients is recommended for correcting their deficiencies.

Element	Formulation	Concentration (%)	Time of spray
Nitrogen (N)	Urea	0.5	After petal fall
		5.0	Pre-fall in Oct.-Nov.
Calcium (Ca)	CaCl ₂	0.5	30-45 days before harvest
Zinc (Zn)	ZnSO ₄	0.5	After petal fall
Manganese (Mn)	MnSO ₄	0.5	After petal fall
Boron (B)	H ₃ BO ₃	0.1	At pink bud and after petal fall

Irrigation

In case there is a prolonged dry weather, 2-3 irrigations should be given in June, July and August. Areas with excessive rainfall or low lying should be provided with drainage channels to drain out excess of water.

In rainfed areas, mulching with 15 cm layer of FYM/straw/cut grass can conserve moisture and improve soil conditions.

Orchard soil management

Dry grass mulching (10 cm thick) with prior application of glyphosate (800 ml/h) is effective for weed control and moisture conservation. Three grasses viz., clover, fescue and orchard grass can be grown in the orchard to increase soil fertility and for the use as a nutritional fodder for milch animals.

Flowering and fruiting

Application of 3 % dormex (hydrogen cyanamide) 40 days before bud break enhances flowering and improves fruit set. Promalin (GA₃ + BA) @ 30-60 ppm sprayed at king bloom stage is effective in improving oblong shape of delicious apples which is a desirable characteristic for better marketing.

Fruit thinning

Heavy bearing in apple not only results in small sized poor quality fruits but also sets in alternate bearing cycle. The judicious thinning (30-40 leaves/fruit) suitably used at the proper stage of fruit development can regulate cropping and improve fruit size and quality. Ethephon @ 200 ppm sprayed 2-3 weeks after full bloom is effective for fruit thinning.

Harvesting and yield

The apple should be harvested at proper picking maturity. Some of the maturity indices are:

- i. When apples attain proper size peculiar to variety.
- ii. The fruit should attain intense skin colour.
- iii. In most apple cultivars seed colour should be brown.
- iv. The calendar dates for harvesting a particular cultivar in a particular locality may vary from 5-10 days over a period of year.
- v. Bloom days: Each cultivar requires specific number of days from full bloom to maturity. They may vary slightly due to weather conditions.

The farmers should rely on their experience for picking and also keeping above indices in view. But before starting harvesting, orchard ladders, trained persons, packing material etc. should be kept ready. For removing field heat, the fruit should be precooled (hydrocooled or air cooled) before placing in cold storage. The yield of apple varies with rootstocks, cultivars, soil fertility, weather conditions and orchard management practices. However, on an average, an apple tree yields 30 to 50 kg fruit per year.

Special problems

Problem and their Symptoms	Management Practices
<p>June drop June drop caused by moisture stress and hostile environment</p>	It can be reduced by maintaining soil moisture through irrigation and mulching.
<p>Pre-harvest drop Most serious economic loss caused by reduction of auxin level and increase in ethylene level.</p>	The pre-harvest drop can be checked by application of 10 ppm Naphthalene acetic acid (NAA) before the expected fruit drop or 20-25 days before harvest.
<p>Irregular bearing: The apple cultivars Red Delicious, Royal Delicious and Golden Delicious and some other cultivars have tendency to bear a heavy crop in one year followed by a poor crop next year.</p>	<p>The alternate bearing habit can be checked to some extent by</p> <ol style="list-style-type: none"> i. Thinning of flowers in one year with 10-15ppm NAA at full bloom. ii. Nitrogen application. iii. Judicious spur pruning in winter to decrease crop load. iv. Application of growth retardants like paclobutrazol @ 500-1000 ppm in June-July.
<p>Bitter pit A physiological storage disorder caused by calcium deficiency is characterized by breakdown of cells under skin causing slight depressions generally concentrated at the calyx end of the fruit. Affected tissues become dry and spongy with bitter taste. Large fruits and light crop, excessive nitrogen use and fluctuating soil moisture may result in bitter pit.</p>	Fruit dipping in 4.0 % CaCl ₂ for 30 seconds before storage.
<p>Water core Affected fruits become spongy and having dull skin, water soaked areas in the flesh and fermented taste.</p>	Spray calcium chloride @ 3g litre ⁻¹ during first week of July and replaced after 21 days.
<p>Cork spot Affected fruits have small blushed areas on skin and brown spots may be anywhere in the cortex. Affected fruits have harder tissues than normal fruits.</p>	<ol style="list-style-type: none"> 1. Spray the tree with boric acid at bud swell stage @ 1.5g litre⁻¹ of water and repeat spray at petal fall. 2. Avoid excessive use of nitrogenous fertilizers.

Plant Protection

Insect Pest and their Management

Insect Pest and their Symptoms	Management Practices
<p>San Jose Scale (<i>Quadraspidiotus perniciosus</i>)</p> <p>All parts above ground are attacked. Heavily infested trees lack vigour, its foliage turn thin and yellow speckled. In the beginning only growth is checked but as the infestation increases, the attacked trees die due to devitalization. More often certain limbs become infested and die before the whole tree is affected. Even after successful control of scale on heavily infested trees/limbs, the branches and buds may be so weakened that no fruit is borne for one or two seasons. Often bark around scale is reddened. On fruits the insects appear as grey patches surrounded by inflamed red area.</p>	<p>Spray orchard during dormancy with 3% tree spray oil or diesel oil emulsion prepared locally with fish oil soap at 6.33% i.e., stock solution and water in 1:5 ratio. The dormant spraying should be done after leaf fall in clear weather and temperature is about 4°C. Spray with high volume sprayer to cover the plant surface thoroughly.</p> <p>Where spraying during dormancy has missed it may be done at late dormant stage (upto ½” green tip stage) and in that event the diesel oil emulsion may be diluted 10-15 times and tree spray oil 2-2.5% depending upon the stage of foliage development.</p> <p>In case of late dormancy, spraying the tree spray oil may be impregnated with either chlorpyrifos 20EC @ 2ml/ litre of water, or methyl demeton 25EC @ 1ml/litre of water to help in suppression of Sanjose Scale and reduction in population of European red mite, aphids, thrips and other infestation in early spraying.</p> <p>The spray should be applied thoroughly to all parts of the tree. In case of rains washing the spraying of oil emulsion, spray should be repeated. The normal orchard practice of dormant spraying, but heavy encrustation often requires additional applications to control crawlers. At 80% of petal fall of Red Delicious variety (as indicator variety) spray the trees with any of the insecticides, chlorpyrifos 20 EC @ 2ml/litre of water, quinalphos 25EC @ 2ml/litre of water, methyl demeton 25 EC @ 1ml/litre of water against adult male of San Jose Scales. The time of application is most important to control the heavy scale infestations. The treatment of petal fall will also suppress the population of aphids, mites, leaf miners, tortricid moths and other pests.</p> <p>The spraying may be repeated in the first week of June against crawlers of first generation. If needed third spraying may be</p>

	<p>done in the last week of August when the crawlers of second generation start emerging.</p> <p>Care should be taken to repeat insecticides during summer control programme. If the crop is ready for harvest the trees may be sprayed with dichlorvos (0.05%). The fruit should not be harvested before waiting period.</p>
<p>Apple Aphid Feeding on plant results in severe distortion of leaves which may turn yellow or brown resulting in premature fall. Infested trees become sick and have stunted growth.</p>	<p>Dormant spray as for San Jose Scale gives adequate control. However, spray with methyl demeton 25 EC @ 1ml/litre of water, chlorpyrifos 20 EC @ 2ml/litre of water, dimethoate 30 EC @ 2ml/litre of water, malathion 50EC @ 2ml/litre of water in late May or early June on young trees.</p>
<p>Woolly Aphid (<i>Eriosomalanigerum</i>) Woolly aphids suck the sap of branches, twigs and roots. Galls are often formed at the point where aphids feed. Infested plants become sickly and stunted in growth.</p>	<p>In addition to dormant sprays for San Jose Scale, application of methyl demeton 25 EC @ 1ml/ litre of water, dimethoate 30 EC @ 2ml/litre of water, malathion 50 EC @ 2ml/litre of water between petal fall and June will prevent infestation during summer. Infestation on non bearing young trees (1-4 years old) can be reduced by placing carbofuran 3G @50 g granules at 5 cm depth in the root zone in April-May when there is sufficient moisture in soil. In case no moisture is available give light irrigation.</p>
<p>Tortricid Moth/Bud caterpillar (<i>Cacoeciasarcostega</i>) Larvae often feed on leaves buds and small fruits. They often spin a light web around several leaves which they roll or draw together often enclosing cluster of apples. They may eat cavities in centre or sides of the fruits.</p>	<p>Same as in San Jose Scale. Spray chlorpyrifos 20EC @ 2ml/litre of water after petal fall.</p>
<p>Apple Leaf Miner (<i>Gracilariachrysa</i>) Larvae mine the leaves. Tissue surrounding the mines become discoloured. If several mines are present, infested leaves may eventually shrivel, die and all.</p>	<p>Spray at green tip stage with tree spray oil against San Jose Scale will give effective control. Application of methyl demeton 25EC @1ml/litre of water, dimethoate 30 EC @ 2ml/litre of water after petal fall will suppress the pest.</p>
<p>Hairy Caterpillar (<i>Euproctis sp.</i>) Caterpillars feed on leaves. In heavy infestation, trees are completely defoliated. Repeated defoliation may</p>	<p>Hairy caterpillar may be managed by:</p> <ol style="list-style-type: none"> i) Collection and destruction of egg masses. ii) Stapling burlap skirts around tree

<p>weaken and kill most of the trees.</p>	<p>trunks infested with caterpillar and collection and destruction of larvae/pupae from May to the end of June.</p> <p>iii) Spraying after petal fall chlorpyrifos 20 EC @ 2 ml/litre of water or quinalphos 25EC @ 2ml/litre of water</p>
<p>Shot/Pin Hole Borer (<i>Scolytoplatypus raja</i>) Adult and grubs tunnel into the sapwood and hardwood of the plant making galleries and pin holes. Surface of infested branches get perforated followed by yellowing and wilting of leaves. A serious infestation may kill the whole trees. Holes are some times indicated on the bark.</p>	<p>Shot/pin-hole borer may be controlled by:</p> <p>i) Pruning and destruction of borer infested branches.</p> <p>ii) Up-keep the vigor of trees by application of balanced dose of fertilizers will help in reducing the attack of shot hole borer/stem borer.</p> <p>iii) Balanced use of fertilizers.</p> <p>iv) Leave scattered, fallen tree trunks and branches in the orchard for trapping egg laying of scolytids during the month of June or first week of July.</p> <p>v) Swabbing infested branches and trunks with 1.5% chlorpyrifos dust and soil in the ratio of 1:6 mixed with rice wheat straw.</p>
<p>Stem Borer (<i>Aprionacineria</i>) The beetles damage the stem and branches drilling big holes in the trunk. Saw dust is seen coming out from holes.</p>	<p>To avoid serious damage by stem borer, clean the hole and plug it with cotton soaked in petrol/quinalphos @ 4-5 ml after inserting naphthalene balls.</p> <p>Swabbing as in Shot/Pin hole borer.</p>
<p>Chaffer Beetles (<i>Adoretus spp.</i>) Adult beetles feed onleaves, buds, blossom and fruit/lets. Eaten away leaves are perforated. Thegrubs feed on roots andmay cause wilting of the plant.</p>	<p>i) Spray acetamiprid 20 SP @ 0.2 g/litre during May-June at dusk.</p> <p>ii) Shaking of young non-bearing trees at dusk and collecting and destroying the beetles is useful.</p> <p>iii) Apply carbofuran 3G (10-12 kg/acre) in soil against grubs.</p>
<p>European Red Mite (<i>Panonychusulmi</i>) Two spotted spider mite(<i>Tetranychusurticae</i>) The mites puncture the tissues of the leaves and feed on plant juice. If the infestation is light the foliage becomes speckled heavily infested leaves become yellowish or bronzed. Severe infestation will result in early dropping of leaves, retarded growth, weakened fruit buds and reduced size of fruits.</p>	<p>Dormant oil emulsion spray or delayed dormant spraying with mixture of tree spray oil and organophorous compounds will provide adequate control of European red mite. If 5-8 mites/leaf are observed during June spray of propagate 57 EC@ 2ml/litre of water or dicofol 18.5 EC @ 2.5-3 ml/litre of water. Certain fungicides like wettablesulphur also reduce the mite population.</p>

<p>Bud & flower thrips (<i>Thrips spp.</i>) Thrips feeding within the buds may cause weeping of sap from injured areas. Later brownish patches are produced at the bases of stamens and styles and on petal of infested blossom. Attacked leaf tissue also becomes distorted. Injury may led to distortion of petals, resetting of fruits and reduction of fruits set.</p>	<p>Control measures recommended for San Jose Scale shall also take care of blossom thrips.</p>
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Diseases and their Management

Diseases and their Symptoms	Management Practices
<p>Apple scab (<i>Venturia inaequalis</i>) The disease symptoms are most conspicuous on leaves and fruits. Minute, lesions develop on the lower surface of freshly emerged leaves. These lesions are olivaceous velvety and turn brown to black with age and do not have definite margin. On young leaves these lesions have a radiating appearance with feathery edges. Lesions on older leaves form a convex surface on the opposite side. In heavy infection leaf blades may be curled, dwarfed and distorted. On young fruits, the lesions are small and dark in colour which soon turn almost black. Small, superficial or large patches develop on the fruit surface. Severe early attack leads to formation of mis-shapen fruits that may cause shriveling and cracking. Lesions on twigs are small, 3-5 cm long and slightly raised which become blistered and cause bursting of bark.</p>	<p>i) Spray apple trees with urea (5kg/100 litre of water) at pre-leaf fall. ii) Give one chemical spray before initiation of leaf fall with tebuconazole (40 g/100 litre of water) iii) Clean cultivation: Collect and destroy the fallen leaves and pruned, material by burning. Plough the orchard to bury plant debris harbouring the pathogen. iv) Adopt the following spray schedule.</p> <p>1st Spray: Silver tip to green tip stage (mid-March to mid April): dodine (100g/100 litre of water), chlorothalonil (400g/100litre of water) or dithianon (75 g/100 litre of water)</p> <p>2nd Spray: Pink bud stage (1st week of April to end April): hexaconazole (30ml/100 litre of water) or dodine (60g/100 litre of water)</p> <p>3rd Spray: Petal fall stage (last week of April to end of May): hexaconazole (30ml/100 litre of water) or tebuconazole (40g/100 litre of water).</p> <p>4th Spray: Fruitlet stage: pea size fruit (mid-May to mid-June) dithianon (75g/100 litre of water), dodine (100g/100 litre of water), bitertanol (50g/100 litre of water)</p> <p>5th Spray: Fruit development stage: Walnut size fruit: 15-21 days after 4th spray (1st week of June to 1st week of July) diathianon (50g/100 litre</p>

	<p>of water), dodine (100g/100 litre of water) or difenoconazole (30ml/100 litre of water) or myclobutanil (70g/100 litre of water),</p> <p>6th Spray: Fruit development stage: 40 days before harvest (mid-August) spray of bitertanol (50g/100 litre of water) or chlorothalonil (150g/100 litre of water)</p> <p>7th Spray: Pre-harvest spray (20-25 days before harvest) ziram (200g/100 litre of water)</p>
<p>Powdery Mildew (<i>Podosphaera leucotricha</i>) Small, grayish or white powdery patches appear on young leaves. The infected leaves crinkle and curl up. The grayish white powdery coating covers the entire leaf. Infected foliage becomes hard and brittle. The disease rapidly spreads from one leaf to another. The powdery mass on twigs disappears and brown felt-like covering with dark brown fruiting bodies are seen. The diseased twigs are stunted or get killed and dried up. Floral parts, when affected shrivel and are blighted. Young infected fruits show russetting.</p>	<p>i) Prune infected dormant shoots, tips and shriveled areas to avoid infection in the next season.</p> <p>ii) Spraying the trees at green tip, petal fall and 20 and 40 days after fruitlet stage tridemorph (100g/100 litre of water), carboxin (100g/100 litre of water)</p>
<p>Sooty Blotch and Fly Speck (Sooty Blotch: <i>Gloeodespomisena</i>: Fly speck: <i>Microthyriellarubi</i>) The twin diseases appear superficially on the skin of apple fruit together and are mistaken as a single disease. The disease becomes severe in late summer with the onset of rains. Sooty blotch is characterized by dull-black to grey spots with indefinite outline. Fly speck lesions are definite, circular, black and often glistening spots resembling sooty blotch in size and colour. These are not deep seated on the fruit skin, but their presence reduces the market value of the fruit. These diseases may express themselves during transit/storage.</p>	<p>i) The best way to control these diseases is to carry on pre-harvest sprays. Give 1st spray 40 days before harvest and the second spray 15-20 days before harvest with copper oxychloride (300g/100 litre of water).</p> <p>ii) Dip the harvested fruit for 1 minute in stable bleaching powder (5kg/100 litre of water) or sodium chlorate (3kg/100 litre of water) before packing.</p> <p>iii) Pruning for aeration and sunlight.</p>
<p>Collar Rot (<i>Phytophthora cactorum</i>) The disease appears mostly near the graft</p>	<p>i) Clean the infected collar area with the sharp knife and apply bordeaux paste</p>

<p>union or on the lower trunk or at pruning wounds. The bark of the diseased tree at soil level becomes cankered, soft and spongy. The necrotic tissue turns dark brown and wood beneath the bark is stained dark brown. Bark above ground dries out and splits from the wood. Leaves become purple red in late summer and fall. The affected tree shows little or no shoot growth and girdling leads to death of the tree.</p>	<p>or chaubatia paste or copper oxychloride paste.</p> <ul style="list-style-type: none"> ii) Raise the bud/graft union height to 40-70 cm from soil level. iii) Adopt cultural practices like removal of crop residue and fallen fruits, avoid injury to stem, removal of weeds and long grasses from the tree basin.
<p>White Root Rot (<i>Dematophoranecatrix</i>) The disease attacks roots of the plant which gives reflection of symptoms on the foliage. Rotting of fine roots is observed which extends to secondary and tertiary roots and ultimately to tree trunk. In advanced stages, roots are completely eaten up by the fungus and seedling/tree is easily uprooted. The symptoms on the foliage are premature yellowing, leaves and fruits remain small in size and cessation of shoot growth. White fungal growth is seen entangled in the root system. In advanced stage when root system is shattered, the tree dies.</p>	<ul style="list-style-type: none"> i) Pits in the known infested soil be treated with formaldehyde (50g/litre of water) before new plantation. ii) Rotten roots should be cut and the cut ends painted with disinfectant paste (bordeaux paste or chaubatia paste). iii) Infested soil of basins be replaced or treated separately with formaldehyde (50g/ litre of water) during dormancy iv) Central drainage system should be followed. v) Apply metalaxyl (100g/100 litre of water), fosetyl-AL (100ml/100litre of water) in deep holes made in the tree basin 20-40 cm apart with a crowbar. Repeat the treatment 3-4 times every year during rainy season or simply drench the seedlings.
<p>Black Rot and Canker (<i>Physalospora obtuse</i>) The disease occurs in three phases viz. leaf spots (frog eye spot), fruit rot (black rot) and canker. The most serious is the development of cankers on limbs, trunks and branches. On large limbs, cankers usually develop on upper surface as reddish brown, sunken lesions which are initially smaller, but slowly increase in size. These turn smoky and show concentric rings. The bark beneath the rough exterior becomes dry, hard and tough. Cankers develop lengthwise more rapidly and become elliptical on limbs and branches and may extend to more than one metre in length and may</p>	<ul style="list-style-type: none"> i) Avoid mechanical injury. Apply wound dresser on the wounded areas (bordeaux paste). ii) Remove girdled limbs, cankers must be cleaned with sharp knife and covered with Bordeaux paste or chaubatia paste or copper oxychloride paste. iii) Remove mummified fruits, dead and pruned twigs from the orchard and burn.

<p>completely girdle the affected part. Sometimes, a canker represents a superficial roughening of bark. As the infection advances deep into wood, it cracks and falls away exposing the slit wood which is stained reddish brown.</p>	
<p>Stem Brown: (<i>Botryosphaeria ribis</i>) Cankers and fruit rot are two phases of the disease. The cankers usually appear in summer months as brown, depressed lesions starting from pruned surface or around the insect holes. Sometimes, blisters appear on the bark which exudes watery liquid spreading over the surface of the lesions. Up to the following spring, a few pimple like eruptions develop on the smooth bark of the lesion as a result of production of fruiting bodies underneath the bark. The small cankered lesion show die-back and become wrinkled. The bark is loosened. It becomes brown and papery. Wood below the bark is stained dark brown. It turns slimy and develops cracks. An alcoholic smell is emitted. Large limbs may be girdled by fusion of cankers. The symptoms on fruits are irregular, light green spots encircled with brown halo on the yellow skin of the young fruits. Spots later become margins. Some of these spots produce a series of concentric rings as well. Infection on the mature fruit may develop rapidly under warm conditions and the entire fruit is decayed.</p>	<p>The disease can be effectively controlled by adopting judicious pruning of all dead wood and proper management. Normal fungicidal spray schedule, as recommended for apple scab, if properly followed, takes care of the disease. Spray any of the fungicide recommended in that schedule at 10-15 days interval as per severity of the disease.</p>
<p>Apple Mosaic (<i>Apple mosaic virus</i>) Plants show variable symptoms in the field. Creamy white or yellow patches appear on the leaf lamina. A part or the whole leaf turns yellow due to numerous spots. Leaves become necrotic and wither away. Plant loses vigour gradually and yield is reduced considerably. The virus is transmitted through bud-wood by natural root-grafting and budding.</p>	<ul style="list-style-type: none"> i) The bud wood and grafted seedlings can be rendered virus free by keeping at 36°C for 4 weeks. ii) Keep the infected bud wood at 50°C for 8 minutes before budding. iii) Maintain seedlings at 37°C for 27 days or at 40°C for 20 days to inactivate the virus. iv) Virus free mother plants be indexed for graft and bud-wood material.

Pre Mature Leaf Fall <i>(Marsoninnamali)</i> Dark Brown spots of 5-10 mm appear on mature leaves in spring or early summer which turn yellow and drop within few weeks. Small dot like structures appear on such lesions.	i) Collect and burn fallen leaves in autumn. ii) Spray tree with dithianon (50g/100 litre of water) or dodine (75g/100 litre of water). Give 4-5 sprays at 20 days interval from fruit set up to harvesting.
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Pear

Pear (*Pyrus* spp.) is also another potential fruit crop of temperate region owing to its tolerance to wide range of soil and climatic conditions, it is grown both in sub-tropical and temperate conditions. In J&K, it is cultivated over an area of 14532 hectare with an annual production of 88329 M.T. In Jammu Division, pear is being grown on 7633 ha land area having 24843 M.T. productions annually. The pear is grown in Doda, Kishtwar, Ramban, Poonch, Rajouri, Udhampur, Reasi and Kathua districts of Jammu division.

Climate and Soil

Pear is adapted to wide range of climatic conditions. Most of the commercial cultivars require 900-1000 hours of chilling below 7°C to break the dormancy. Though pear is a temperate fruit crop; however, it can be grown successfully in sub-tropical regions of Jammu. There are several low chilling cultivars, which are well adapted for cultivation under sub-tropical conditions. Pears are grown successfully over a wide range of soils provided they have sufficient moisture. Compared to apples, they are less tolerant to drought and rather more tolerant to impeded drainage. Deep, well drained and fertile soil is ideal for pear cultivation.

Cultivars

(A) For temperate region

- (a) **Early season cultivars:** Mature from last week of June to third week of July.
 - i) China pear (China Tang)
 - ii) Beurre-de-Amanalis (Zirhami Tang)
- (b) **Mid-season cultivars:** Matures in third week of July to third week of August.
 - i) Citron-des-Carmes (Goshbugh)
 - ii) Clapp's Favourite
 - iii) Doyenne Bossoch (Surajbali Tang)
 - iv) Fertility (Misri Tang)
 - v) Williams' Bon Chretien or Bartlett (Awal Number)
 - vi) Starkrimson
- (c) **Late season cultivars:** Matures from last week of August to second week of September.
 - i) Beurre Hardy (Kharpaddur)

(B) For sub-tropical region

- i) **Patharnakh:** Tree spreading and vigorous, fruit medium round, green, flesh gritty, crispy and juicy, good keeping quality, stands transportation well. Ripens in last week of July. Average yield is 150 kg/tree.

- ii) **LeConte:** Tree medium in vigour and spreading. Fruit small to medium in size and pyriform in shape with alternate greenish yellow colour. Flesh whitish, juicy and sweet. Ripens in August and yields about 60-80 kg/tree.

Some other cultivars recommended for sub-tropical areas are: Kieffer, Punjab Beauty, Punjab Gold, Punjab Nectar etc. Smith is also a good pollinizer for LeConte.

Other promising cultivars

Green Anjou, Red Anjou, Beurre Bosc, Corella, Forelle, Red Sensation, Winter Nellis

Pollination

Most pears fail to set a good crop with their own pollen and crop better with cross pollination. So, plant two or more cultivars whose flowering overlaps for a good crop. For adequate pear pollination, 5-6 honey bee colonies/ha are optimum at 100-150 m distance. For optimum fruit set and yield in pear, bee hives should be placed at 30-50% flowering, and should be replaced by fresh ones after 3-4 days to increase the number of foraging bees.

Propagation and Rootstocks

The choice of rootstocks lies between pear and quince. Plants grown on quince rootstock can be planted in soils with higher water table and with the objective of having dwarf pear trees. However, seedlings of commercial cultivars can also serve the purpose of a good rootstock.

Plants are raised on wild pear (*Pyrus pashia*) stock locally known as Kainth and also on quince seedling. Seedlings of kainth or quinces are raised after stratification of seeds for 30-50 days at 1-5°C.

The stratification can also be met by sowing the seeds in open nursery in November. Seedlings are tongue or splice grafted before the bud break. In temperate areas 'T' budding is commonly practiced in July-August.

Planting

Planting distance depends upon the site, soil, rootstock and cultivars. Generally, the pear trees are planted at the distance of 6-8 m in square system of planting. The planting is done in winter upto middle of February. Generally, one-year-old plants are planted but older plants of 2-3 years age can also be planted with good success. The older plants should preferably be planted by the end of December.

Training and Pruning

- a) Pear trees are trained to "modified central leader system". In this, 4-5 well spaced branches are developed in first 3 to 4 years and then leader is headed back to a strong lateral.
- b) Pruning of young plants differs considerably from that of bearing ones. In case of young plants, unbranched plants should be headed back at 60-90 cm

above the ground level at planting time. Pear bears on spurs arising on two year old shoot. In case of old bearing trees, pruning of dead woods and non-bearing spurs should be practiced. Old trees often require spur shortening to maintain size and quality of fruit and vigour of trees. The thinning out and heading back of the laterals may also be done to encourage the fruiting spur formation.

Manure and Fertilizers

Age of tree (Year)	FYM (Kg)	Fertilizer basis (g/tree)		
		Urea	DAP	MoP
1	5	35	20	50
2	10	70	45	100
3	15	105	65	150
4	20	140	85	200
5	25	175	110	250
6	30	245	150	350
7	35	315	195	450
8	40	385	235	530
9	45	455	280	630
10	50	525	325	730
11	60	630	385	900
12	70	735	450	1050
13	80	840	515	1190
14	90	940	580	1345
15 th year & onwards	100	1050	645	1500

Note: FYM should be applied in the month of February-March. DAP and MOP should be applied as single dose in December, half of urea should be applied 2-3 weeks before expected bloom and another half of urea 3 weeks after fruit set.

Irrigation

Irrigation becomes necessary when there is not enough moisture in soil and there are no summer rains. Excessive irrigation should be avoided.

Orchard floor management

(a) Weed control:

Weeds can efficiently be controlled by spraying the herbicides namely paraquat @ 0.6 % or hexuron or glycel or gramaxone.

(b) Mulching:

Under rainfed conditions, mulching is used to conserve moisture, which also helps in controlling weeds, erosion and temperature fluctuation. Straw mulching is considered better.

Harvesting and Yield

Fully mature pear fruits are harvested while, firm and green for canning and distant market, and for local consumption they are picked at slightly latter stage because fruits remaining on a tree make a considerable gain in size, weight and overall quality. Pear fruits are picked individually by giving slight twist rather

than pulling directly. Two to three pickings at an interval of 3-4 days are better than single picking.

The yield of fruit varies greatly with the cultivars, age of the plant, orchard management and climatic conditions. A well managed orchard gives about 30-40 tonnes of fruits/hectare.

Special problems

Physiological disorders	Management
Mis-shapen fruits and corking	They are caused by boron deficiency. To overcome it, 25-40 kg borax should be applied through soil at the time of first dose of fertilizer application after every three years.
Fruit drop	Apply 20 ppm NAA after fruit set for checking early fruit drop. To control pre-harvest drop, application of 10 ppm NAA three weeks before harvest is beneficial.

Plant Protection

Insect Pest Management

Insect-pest and their Symptoms	Management Practices
<p>Sanjose Scale(<i>Quadraspidiotus perniciosus</i>) All parts above ground are attacked, heavily infested trees lack vigour, its foliage turn thin and yellow speckled. In the beginning, only growth is checked but as the infestation increase, the attacked trees die due to devitalization. More often certain limbs become infested and die before the whole tree is affected. Even after successful control of scale on heavily infested trees/limbs the branches and buds may be so weakened that no fruit is borne for one or two seasons. Often bark around scale is reddened. On fruits, the insects appear as grey patches surrounded by inflamed red area.</p>	<p>Spray orchard during dormancy with 3% tree spray oil or diesel oil emulsion prepared locally with fish oil soap (potash base) at 6.33% i.e., stock solution and water in 1:5 ratio. The dormant spraying should be done after leaf fall in clear weather and temperature is about 4°C. Spray with high volume sprayer to cover thoroughly the plant surface.</p> <p>Where spraying during dormancy has missed, it may be done at late dormant stage (upto ½” green tip stage) and in that event, the diesel oil emulsion may diluted 10-15 times and spray oil 2-2.5% depending upon the stage of foliage development.</p> <p>In case of late dormancy, spraying the tree spray oil may be impregnated with either chlorpyrifos 20 EC @ 2ml/litre of water or methyl demeton 25 EC @ 1ml/litre of helps controlling Sanjose Scale and in suppressing the population of European red mite, aphids, thrips and other infestation in early spraying.</p> <p>The spray should be applied thoroughly to all parts of the tree. In case of rains washing the sprarying of oil emulsion spray should be repeated. The light infestations may be controlled by the normal orchard practice of dormant</p>

	<p>spraying, but heavy encrustation often requires additional applications to control crawlers. At 80 % of petal fall of Red Delicious variety (as indicator variety) spray the trees with any of the insecticides, chlorpyrifos 20EC (0.02%) quinalphos 25EC @ 2ml/litre of water against adult male of San Jose Scales. The time of application is most important to control the heavy scale infestations. The treatment at petal fall will also suppress the population of aphids, mites, leaf miners, tortricid moths and other pests.</p> <p>The spraying may be repeated in the first week of June against crawlers of first generation. If needed third spraying may be done in the last week of August when the crawlers of second generation start emerging.</p> <p>Care should be taken in repetition of insecticides during summer control programme. If the crop is ready for harvest, the trees may be sprayed with quinalphos 25EC @ 1ml/litre of water. The fruit should not be harvested before waiting period.</p>
<p>Apple Aphid Feeding on plant results in severe distortion of leaves which may turn yellow or brown resulting in premature fall. Infested trees become sickly and stunted in growth.</p>	<p>Dormant spray as for San Jose Scale gives adequate control. However, spray with methyl demeton 25EC @ 1ml/litre of water, chlorpyrifos 20 EC @ 2ml/ litre of water, dimethoate 30 EC @ 2ml/ litre of water, malathion 50 EC @ 2ml/ litre of water in late May or early June on young trees.</p>
<p>Woolly Aphid (<i>Eriosomalaniigerum</i>) Woolly aphids suck the sap of branches, twigs and roots. Galls are often formed at the point where aphids feed. Infested plants become sickly and stunted in growth.</p>	<p>i) In addition to dormant sprays for San Jose Scale, application of methyl demeton 25 EC @ 1ml/litre of water, diemthoate 30 EC @ 2ml/litre of water, malathion 50 EC @ 2ml/litre of water between petal fall and June will prevent infestation during summer.</p> <p>ii) Infestation on non bearing young trees (1-4 years old) can be reduced by placing carbofuran 3G @ 50g granules at 5 cm. Depth in the root zone in April-May when there is sufficient moisture in soil. In case no moisture is available give light irrigation.</p>
<p>Totricid Moths Larvae often feed on leaves buds and small fruits. They often spin a light web around several leaves</p>	<p>Same as in Sanjose Scale.</p>

<p>which they roll or draw together often enclosing a cluster of apples. They may eat cavities on centre or sides of the fruits.</p>	
<p>Apple Leaf Miner (<i>Gracilariachrysa</i>) Larvae mine the leaves. Tissue surrounding the mines becomes discoloured. If several mines are present on infested leaf may eventually shrivel, die and fall.</p>	<p>Spraying at green tip stage with spray oil against San Jose Scale will give effective control. Application of methyl demeton 25 EC @ 1ml/litre of water, dimethoate 30EC @2ml/litre of water after petal fall will suppress the pest.</p>
<p>Hairy Caterpillar (<i>Euproctisspp.</i>) Caterpillars feed leaves. In heavy infestation trees completely defoliated. Repeated defoliation may weaken and kill most of the trees.</p>	<ul style="list-style-type: none"> i) Collection and destruction of egg masses. ii) Stapping burlap skirts around tree trunks infested with caterpillars and collection and destruction of larva/pupae from May to the end of June. iii) Spraying after petal fall chlorpyriphos 20 EC @ 2ml/litre of water or quinalphos 25EC @ 2ml/litre of water
<p>Shot/ Pin Hole Borer (<i>Scotyusamygda</i>) Adult and grubs tunnel into the sapwood and hardwood of the plant making galleries and pin holes. Surface of infested branches get perforated followed by yellowing and wilting of leaves. A serious infestation may kill the whole trees. Holes are sometimes indicated on the bark.</p>	<ul style="list-style-type: none"> i) Pruning and destruction of borer infested branches. ii) Up-keep the vigor of trees by application of balanced dose of fertilizers will help in reducing the attack of shot hole borer/stem borer. iii) Leave scattered fallen tree trunks, and branches in the orchard for trapping egg laying scolytids during the month of June or first week of July. iv) Swabbing infested branches and trunks with 1.5% chlorpyriphos dust and soil in the ration of 1:6 mixed with rice wheat straw.
<p>Stem Borer (<i>Aprionacinerea</i>) The beetles damage the stem branches drilling big holes in the trunk. Saw dust is seen coming out from holes.</p>	<ul style="list-style-type: none"> i) To avoid serious damage by stem borer: ii) Clean the hole and plug it with cotton soaked in petrol/quinalphos after inserting naphthalene balls. iii) Swabbing as in Shot/Pin hole borer.
<p>Chaffer Beetles (<i>Adoretus spp.</i>) Adult beetle feed on leaves, buds, blossom and fruit-lets. Eaten away leaves are perforated. The grubs feed on roots and may cause wilting of the plant.</p>	<ul style="list-style-type: none"> i) Spray acetamiprid 20 SP @ 0.2 g/litre of water during May-June at dusk. ii) Shaking of young non-bearing trees at dusk and collecting and destroying the beetles is useful. iii) Apply carbofuran 3G @ 10-12kg /acre in soil against grubs.

<p>Mites European Red Mite <i>(Panonychusulmi)</i> Two spotted spider mite <i>(Tetranychusurticae)</i> The mites puncture the tissues of the leaves and feed on plant juice. If the infestation is light the foliage becomes speckled heavily infested leaves become yellowish or bronzed. Severe infestation will result in early dropping of leaves, retarded growth, weakened fruit buds and reduced size of fruits.</p>	<p>Dormant oil emulsion spray or delayed dormant spraying with mixture of tree spray oil and organophosphorous compounds will provide adequate control of European red mite. Application of chlorpyriphos 20 EC @ 2ml/ litre of water, or quinalphos 25 EC @ 2ml/ litre of water in the last week of July or August applied against second brood of San Jose Scale may also provide effective control of mite pest complex. Spraying of dicofol 18.5 EC @ 2.5-3 ml/litre of water may also prove effective. Wettable sulphur, can also reduce the mite population.</p>
<p>Blossom Thrips (<i>Thrips spp.</i>) Thrips feeding within the buds may cause weeping of sap from injured areas. Later brownish patches are produced at the bases of stamens and styles and on petal of infested blossom. Attacked leaf tissue also becomes distorted. Injury may lead to distortion of petals, resetting of fruits and reduction of fruit set.</p>	<p>Control measures recommended for Sanjose Scale shall also take care of blossom thrips.</p>
<p>Pear Psylla (<i>Psylla pyricola</i>) Heavy infestation leads to the development of small mishaped fruits and premature leaf fall or fruit drop. Blossom attacked by first generation nymphs turn later in the season may affect the following seasons pear crop by weakening or killing the development of fruit buds. The succulent tissues at the tips of new shoots are particularly liable to attack and tree growth may be checked. Sooty mould grows profusely on honey dew secreted by nymphs often coating the shoots, foliage and fruits in an unsightly and unpleasant black layer.</p>	<p>Light infestation may be controlled by spraying about 3 weeks after petal fall with chlorpyriphos 20 EC @ 2ml/litre of water, methyl demeton 25 EC @ 1ml/litre of water, dimethoate 30 EC @ 2ml/litre of water. Heavy infestation may require two sprays, one at petal fall and other three weeks later.</p>

Diseases and their Management

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<p>Seedling Blight (<i>Sclerotium rolfsii</i>) Infected seedlings are killed and small mustard seed like sclerotia bodies appear at the collar region during monsoon.</p>	<p>i) Uproot and burn the affected seedlings. ii) Drench the nursery soil with chlorathalonil (100g/100 litre of water) at 15 days interval before transplantation.</p>
<p>Hairy Root (<i>Agrobacterium rhizogens</i>) Excessive growth of fibrous roots develops from one point and gives broom like appearance.</p>	<p>i) Avoid collar/root injury. ii) Dip healthy grafted plants in 1% copper sulphate solution for 90 min. iii) Change the nursery site. iv) Rogue out infected plants.</p>
<p>Crown Gall (<i>Agrobacterium tumefaciens</i>) Globular, elongated or irregular tumors formed at or near the graft union, usually in the nursery plants.</p>	<p>Same as in Hairy Root.</p>
<p>White Root Rot (<i>Dematophoranecatrix</i>) Affected seedlings/trees show scanty foliage, slow growth, bronzing and yellowing of leaves. Such plants ultimately die. Roots turn brown and remain covered with white cottony mycelial mat of the fungus during rainy season.</p>	<p>i) Improve orchard drainage. ii) Remove infected roots and apply chaubatia paint (red lead, copper carbonate and linseed oil 4:4:5) on the cut ends and healthy parts of the roots during November-December. iii) Uproot and burn dead plants and treat the soil pit with mercuric chloride solution (1%). iv) For curing the infected trees, give three drenching of chlorathalonil (100g/100 litre of water) at 15 days interval during monsoon. Drenching application should be made in 6-9 inch deep holes at a distance of 30 cm each throughout the canopy of the tree.</p>
<p>Collar Rot (<i>Phytophthora cactorum</i>) Collar region of the tree near the ground level turns brown, soft and spongy and on being girdled, completely kills the tree. The disease spread is highest in poorly drained soils.</p>	<p>i) Remove soil around the collar region in November-December, expose the affected portion to sunlight. Remove the affected bark and apply copper oxychloride paint on healthy portion. ii) Irrigate around the tree trunk in 30 cm radius with metalaxyl (200g/100litre of water) iii) Keep the graft union 20-25 cm above the soil level. iv) Use M4 and M9 rootstocks as these are resistant to collar rot disease. v) Avoid water-logging conditions in the</p>

	orchard by staking pebbles or sand in the tree basin.
<p>Canker and Die-Back (Pink Canker: <i>Botryobasidium salmonicolor</i>, European canker: <i>Nectriagalligena</i>, Black rot or Smoky blight: <i>Botryosphaeria quercum</i>, Nail head Canker: <i>Numularia discrete</i>, Stem black <i>Coniotheciumchomatosporum</i>, Silver leaf: <i>Chondrostereum purpureum</i>, Stem brown or stem bark canker: <i>Botryosphaeria dothidea</i> and other cankers caused by various fungi.</p>	<p>i) Cut and burn the badly cankered portions of the tree. ii) Scrap the cankered portions along with some healthy portion and cover the wounds with Chaubatia paint or copper oxychloride paint or white lead paint. iii) Spray copper oxychloride (300 g/100 litre of water) after harvest and bud swell stage. iv) Spray schedule adopted for apple/ pear scab also helps in reducing the incidence of these cankers.</p>
<p>Pear Scab (<i>Venturia pirina</i>) The symptoms resemble those of apple scab. The disease is more pronounced on Kashmiri Nakh. The symptoms are more conspicuous on fruit than on leaves. On fruits, the spots are smaller and darker which soon turn almost black.</p>	Same as in Apple.
<p>Leaf Spots (<i>Mycosphaerella spp.</i>, <i>Alternaria mali</i>, <i>A. alternata</i>, <i>Coniothyriumpyrinium</i>, <i>Phyllosticia spp.</i> and <i>Botryosphaeria quercum</i>) Leaf spots of different colour, sizes and shapes are of common occurrence during late summer and rainy season. Severely affected leaves turn yellow and fall prematurely.</p>	<p>i) Spray schedule adopted for pear scab also provides effective control of these diseases. During rainy season, spray 2-3 times with chlorathalonil (100g/100 litre of water) at 15 days interval</p>
<p>Sooty Blotch and Fly speck (<i>Gloeodespomigena</i> and <i>Schizothyrium pomi</i>) Both the diseases appear under high atmospheric humidity in rainy season on the external surface of the fruits and reduce their market value. Dull black or grey spots of sooty blotch and black circular flyspecks appear.</p>	Same as in Apple.
<p>Powdery mildew (<i>Podosphaera leucotricha</i>) Symptoms resemble those in apple. The disease affects the growth of buds, new shoots and leaves, and produces white powdery patches.</p>	Same as in Apple.

Peach

Peach (*Prunus persica*(L.) Batsch.) is a highly popular fruit crop grown in temperate regions of the world. In India, peach cultivation is confined to mid hill zone of Himalayas extending from J&K U.T. to Khasi Hill at an altitude of 1500 to 2000 metres above msl. Low chilling cultivars are also grown in sub mountainous zones of Punjab, Haryana, Delhi and U.P. and also gaining popularity in sub-tropical areas of Jammu. Peach crop in J&K U.T. covers an area of 2615 ha with 1703 ha falling in Jammu Division. Total production of peach in J&K U.T is 6221 M.T, out of which 2512 M.T. is being contributed by Jammu Division. Main peach growing areas in Jammu region are hilly areas of Poonch, Doda, Kishtwar, Ramban Udhampur, Reasi, Rajouri and Kathua districts. Recently, the new orchards of low chill peaches are also being planted in Jammu, Samba and Kathua districts.

Climate and Soil

Peach does well in wet and cool climate with cold winter and dry summer. It likes mild climate. The limiting factors in peach cultivation are the minimum winter temperature, chilling hours, spring frost, hail storms, high humidity and desiccating winds during summer. In sub-tropical areas of North, the low chilling cultivars require 50-300 hours of chilling during the winter for proper flowering and fruiting.

The peach thrives well on light textured soil. Deep, fertile, loam or sandy loam with good drainage is considered ideal for successful peach cultivation. Poorly drained soil should be rejected for peach cultivation.

Cultivars

a) Sub-tropical areas

Early season (Maturing in last week of April):Florda Sun and Florda Prince and Partap

Mid season (Maturing in 1st to 2nd week of May):Shan-e-Punjab and Early Grand

Late season (Maturing in mid June):Florda Red and Sharbati

b) Temperate areas

Early Season (Maturing in third week of June): Saharanpuri (Saharanpuri No. 1) and World's Earliest (Saharanpuri No. 2)

Mid Season (Maturing in 1st to 2nd week of July):Peshawari and July Elberta (Amba-Chanun No. 1)

Late Season (Maturing in last week of July to 1st week of August):Elberta (Amba Chanun No. 2) and Quetta

Rootstock

Rootstocks used for peach are wild peach, apricot, plum and peach. Plum stocks can be used when peaches are to be planted in a slightly heavier soil. Rootstock in sub-tropical areas are generally grown from the seeds of desi peach tree or some commercial cultivars like Sharbati and Khurmani. Seed should be extracted from ripe fruit only, which ensures better germination. Peach seed needs stratification for germination which can be done by placing them under moist condition at about 1-5°C for 60-70 days, however, this period varies with cultivars. Seeds can also be directly sown in the open ground in the month of November for stratification under natural conditions. Pre-soaking of peach seed in GA3 at 100 ppm for 24 hours before placing them under stratification improves germination and reduces time for germination.

Propagation

Peach seeds become buddable by June to July when they attain pencil thickness. Peaches are propagated commercially by tongue (when stock and scion are of same size) or cleft grafting (when stock is thicker than scion) and T-budding or ring budding. In hills, tongue grafting during January-February and T-budding during June to September are performed. However, in plains grafting is performed during November-January and budding during April-June and September.

Planting

Planting should be done 6 metres apart in pits of 1m x 1m x 1m dug few months in advance of plantation. After planting, the young peach plants need staking with bamboo or wooden sticks so that they can grow upright and straight. The young plants should be watered at 15 days interval. If there is any indication of white ant attack, chlorpyrifos @1ml per litre of water should be applied.

After care

The peach is highly susceptible to scorching sun heat injury in sub-tropical areas, hence the open stem need to be whitewashed during summer. The problem of stem bark cracking can also be reduced by keeping plants low headed.

Training and Pruning

The peaches are trained to open centre or central modified leader system. For sub-tropical conditions where the sunshine is plenty and there are strong winds during summers, open centre system is not suitable in view of weak framework. Plants should be headed back to a height of 90-100 cm at the time of planting in the fields. All the branches in the plant are cut back to two buds. Within some weeks, the plants develop branches and 3-5 branches are retained well spaced around the trunk and selected as main branch. The lowest branch should be about 50 cm above from the ground level. In the second year, very little pruning is done and only overcrowded and interfering branches are

removed. No lateral is allowed to outgrow the other. In the third year, the main leader is suppressed by cutting it back to the nearest lateral.

Pruning in young and old trees

Peaches bear mostly on one year old growth. Pruning should be done annually so as to produce 50-100 cm of growth in young trees and 30-70 cm of growth in old trees. The heading back is accompanied by thinning out so that adequate sunlight enters into the tree. Pruning should be carried out in early January. About 40 percent of one year old branches should be thinned out to ensure proper growth.

Manure and Fertilizers

The peaches have high requirement for nitrogen and potassium as compared to phosphorous.

Age of tree (Year)	Fertilizer doses (g/tree)			
	FYM(Kg)	Urea	DAP	MOP
1	10	55	20	65
2	15	115	40	130
3	20	170	65	200
4	25	225	85	265
5	25	280	110	330
6	25	395	150	585
7	25	510	195	750
8	25	620	240	915
9	25	735	280	1080

Note: Apply FYM alongwith full dose of Muriate of potash and diammonium phosphate should be applied as single dose in December. Urea should be given in two split doses, one 2-3 weeks before normal bloom, while rest half of urea be applied 3 weeks after fruit set.

Irrigation

Peach tree should be irrigated 2-3 times in a month during summer for obtaining optimum yield and quality fruit. The orchard should be provided with proper drainage system and water should not be allowed to stagnate.

In sub-tropical region, there is more frequent need of irrigation as weather becomes warmer from 2nd fortnight of March. Irrigation may be given in sub-tropical areas at 8-10 days interval in the month of March-May. After harvesting, the irrigation can be given at longer intervals.

Orchard floor management

The shallow cultivation of orchard will help in better soil aeration, destruction of weeds, increasing nitrification and destruction of hibernating insects. The tree should be white-washed regularly to protect from sunburn.

Harvesting and Yield

For harvesting peach crop the peculiar brown colour of the variety and 5% pit browning should be taken into consideration alongwith the experience of

orchardist. For local market, the fruit should be picked at the full maturity, while for distant market the fruit should be harvested when slightly immature. All the peach fruit do not mature simultaneously and 3-4 pickings are required at 4-5 days interval. The yield may vary from 50 to 125 kg per tree depending upon the cultivars and orchard management practices. The peak harvesting period of peach in sub-tropical plains is from last week of April to mid of June.

Post-Harvest Management

The peaches stored in polythene bags of 1006mm holes per m² improved the quality of fruit. However, intermittent warming coupled with modified atmospheric storage is effective in preventing chilling injury and prolonging storage life of peach.

Plant Protection

Insect pest and their management

Insect pest and their Symptoms	Management Practices
<p>Peach Leaf Curl Aphid (<i>Myzuspersicae</i>) Nymphs and adults suck the sap from the leaves, petiole, blossom and fruits causing leaf curl and distortion. Blossoms wither and fruit do not develop and drop if formed.</p>	<p>1. Keep the trees as free as possible from mechanical wounds, winter injury, crotch separation and cankers.</p>
<p>Peach Tree Borer Larvae feed in irregular tunnels in the bark and outer wood of the trunk and main root near the ground surface. The injured area produces a great deal of gum usually containing casting from the borer.</p>	<p>2. Destroy dead and dying fruit trees and branches to avoid borer infestation.</p>
<p>Peach Twig Borer Larvas tunnel the buds and terminal shoots in early summer. The injured trees wilt and die. Larvae also infect the fruits from the stem and may bear into the fruit.</p>	<p>3. Prune and destroy the scale and borer infested branches.</p>
<p>Plum Aphid The aphids suck the sap and weaken the trees, some species cause marked curling of leaves. Sooty fungus grows on honey dew exuded by aphids and thereby reducing the market value of fruit.</p>	<p>4. Maintain vigour of the tree to keep away shot hole/pin hole borer, bark beetles and other pest infestation.</p>
<p>Green Peach aphid Aphids feed on leaves, blossom and fruitlets resulting in fruit drop and sometimes leaf curling.</p>	<p>5. Spray 6.33 diesel oil emulsion or 3% tree spray oil during dormancy when the temperature is above 4°C to control scales, aphids and mites etc.</p>
	<p>6. Spray at bud burst stage any of the insecticides, if heavy infestation of mites, aphids, scales etc. is observed with chlorpyrifos 20 EC @ 2ml/litre of water, methyl demeton 25 EC @ 1ml/litre of water or dimethoate 30EC @ 2ml/litre of water.</p>
	<p>7. Spray 7-10 days after petal fall any of the insecticides if curling of</p>

<p>Lecanium Scale The insect pierce the tissue and suck the sap and if abundant for 2-3 years, the infested branches may get killed. Mould develops on the exude of this pest.</p>	
<p>Sanjose Scale All parts above ground are attacked heavily infested trees lack vigour its foliage turn thin and yellow speckled. Often bark around scale is reddened. On fruits the insect appear as grey patches surrounded by inflamed red area.</p>	
<p>Flat Headed Borer Adults feed on foliage. Young grubs feed below the bark which gets loosened and splits. Full grown grubs bore into wood. Gum oozes out from the holes. Leaves pale and growth of the tree is arrested.</p>	
<p>Short Hole Borer/Pin Hole Borer Adults and grubs tunnel into the sapwood and hardwood of the plant making galleries and pin holes. Surface of infested branches get perforated followed by yellowing and wilting of leaves. A serious infestation may kill the whole tree. Holes are sometimes indicated by boring on the bark.</p>	<p>leaves is noticed, chlorpyrifos 20 EC @ 2ml/litre of water, dimethoate 30EC @ 2ml/litre of water, malathion 50 EC @ 2ml/litre of water or methy demeton 25EC @ 1ml/litre of water to control scales aphids, mites twig borer and other pests. Repeat after 2-3 weeks, if necessary. Insecticides applied at bud burst stage should not be repeated.</p>
<p>Hairy Caterpillar Caterpillars feed on leaves. In heavy infestation trees may be completely defoliated. Repeat defoliation may weaken and kill most of the trees.</p>	<p>8. Fruit fly can be controlled by spraying the tree with dimethoate 30 EC @ 2ml/ litre of water, chlorpyrifos 20EC @ 2ml/ litre of water or malathion 50EC @ 2ml/litre of water about 10 days after petal fall. Repeat with quinalphos 25 EC @ 2ml/litre of water if necessary after sweet varieties begin to develop colour.</p>
<p>Chaffer beetles Adult beetle feeds on leaves, buds, blossom and fruitlets. Eaten away leaves are perforated. The grubs feed on roots and may cause wilting of the plant.</p>	<p>9. Swabing infested branches and trunk with 1.5% D chlorpyrifos dust and soil in the ration of 1:6 mixed with rice or wheat straw will help in reducing damage by shot hole borer and other insect borers.</p>
<p>Stem Borer The beetles damage the stem branches drilling big holes in the trunk. Saw dust is seen coming out from holes.</p>	<p>10. Apply Chlorpyrifos 1.5% D @ 8-10 Kg/ acre in the soil against the grubs of chaffer beetles.</p> <p>11. To avoid serious damage of stem borers, clean the holes and plug them with cotton soaked in petrol after inserting naphthalene balls in the holes. Swab the affected area with 1.5% lindane dust and soil in the ratio of 1:6.</p> <p>12. Pre-bloom spraying against aphids and mites will also provide control</p>

<p>Apricot Chalcid The grubs bore into the kernels and feed in the inner contents leaving the papery coat intact. As a result fruit development is arrested and the fruit fall prematurely with grubs still feeding within the fruits.</p>	<p>against the apricot chalcid. However, all fallen fruits which may contain the grub be collected and burnt. Pre-bloom spraying against aphids may also provide some degree of control against peach twig borer. However, additional application of any insecticide listed at 6 may provide satisfactory control in case of heavy infestation.</p> <p>13. Spray 10 days after petal fall and three weeks later methyl demeton 25 EC @ 1ml/litre of water, dimethoate 30EC @ 2ml/litre of water) or chlorpyrifos 20EC@ 2ml/ litre of water against peach tree borer. Spraying of acetamiprid 20 SP @ 0.2 g/ litreof water.</p>
<p>Peach fruit fly (<i>Bactrocerazonatus</i>)</p>	<p>Same as in mango and Guava</p>

Diseases and their Management

Diseases and their Symptoms	Management Practices
<p>Leaf Curl(<i>Taphrina deformans</i>) Symptoms develop on leaves, twigs, flowers and fruits. The leaf blade becomes thickened and puckered along with midrib leaf curls and turns yellowish. Later, the upper leaf surface gives a silvery appearance and becomes brittle. Finally, the affected leaves dry and drop. Infected twigs become swollen and may exude a gum like substance. The affected twigs usually die. Flowers and fruits, when infected, drop prematurely.</p>	<p>Spray the trees at leaf fall, bud swell, petal fall and fruit-let stage with: copper oxychloride (300g/100 litre of water) or chlorthalonil (100g/100 litre of water).</p>
<p>Coryneum Blight and Shot Hole(<i>Stigminacarpophyla</i>) Twigs, blossoms, leaves, fruits and unopened buds are blighted. Small, circular, deep purple spots appear on the fruit. The spots are raised and rough. On leaves, dark brown, scattered lesions enlarge rapidly. Abscission of the diseased areas of the leaves results in shot holes. The diseased buds become darker in colour. Small purplish, raised spots develop on twigs which expand into necrotic cankers.</p>	<p>Spray the leaves at leaf fall, before bud-burst, fruit set and 15-20 days after fruit set stage with: copper oxychloride (300g/100 litre of water).</p>

Plum

Plum (*Prunus salicina* Lindl.) is a temperate fruit and grows on commercial scale in J&K, HP and Uttaranchal. In J&K, plum cultivation is spread over 4038 ha with total yield of 10112 M.T. In Jammu Division, plum is being grown in temperate areas of Poonch, Rajouri, Doda and Kathua districts covering an area of 2656 hectares with an annual production of 4150 metric tonnes.

Climate and Soil

Plum exhibit considerable varietal differences in their climatic requirements because of their wide variability between different species. The Japanese plums do very well in the low and mid hill regions ranging between 650 to 1650 metres above msl. Some varieties can be grown successfully in the warmer regions of plains.

For good growth and longer life of plants, well drained medium to deep soils are most suitable. Plums propagated on peach root stocks grow better on sandy loam soil, while for heavier soils apricot rootstock or Kabul green gage root stocks of plum can be used.

Cultivars

Temperate areas

Sharp's Early, Formosa	(Early season)
Wickson, Satsuma, Burbank, Santa Rosa	(Mid season)
Blue Impeatrice, Prune-D-Agen, Grand Duke	(Late season)

Sub-tropical areas

Titron, Kala Amritsari, Kataruchak and Alubukhara

Propagation and Rootstock

Wild plum stones can be used for rootstock, where a desired cultivar is T-budded on it in July-September. The seeds of plum need stratification for germination.

Planting should be done in dormant season, when danger of winter injury is over. Planting distance of 6 m x 6 m is recommended in a square system of layout. Pits 1 m x 1 m x 1 m are dug about a month before planting and are filled with fertile top soil mixed with 40 kg of well rotten farmyard manure per pit.

Training and Pruning

The tree should be trained to modified leader system. The plant is headed back to the height of 90 cm from ground level. After planting in the field, two years old tree have a number of laterals, and 4 or 5 of which are selected to make a proper frame work. Pruning in 3rd and 4th year is done to keep a balance between main scaffold limbs and secondary branches. During 5th year, leader should be headed back at a point where a suitable out growing lateral is present to check the height of the plants.

Pollination and fruit setting

The Japanese plum cultivars require cross-pollination to set satisfactory crop. However, Santa Rosa, and Kala Amritsari are self-fruitful grown in temperate and sub-tropical areas, respectively. But in both varieties yield can be improved if cross compatible variety is also planted in the orchard.

Manure and Fertilizers

Age of tree (Year)	FYM (Kg)	Fertilizer doses (g/tree)		
		Urea	DAP	MoP
1	10	55	20	65
2	15	115	40	130
3	20	170	65	200
4	25	225	85	265
5	30	280	110	330
6	35	395	150	585
7	40	510	195	750
8	45	620	240	915
9	50	735	280	1080

Note: FYM alongwith full dose of Muriate of potash and diammonium phosphate should be applied in December and half dose of urea should be given 2-3 weeks before normal bloom, while rest half of urea be applied 3 weeks after fruit set.

Irrigation

The irrigation should be avoided during flowering and fruit-setting stage. During hot months, frequent irrigation should be given for the development of fruit size and quality. Irrigation should be stopped at colour break stage to avoid heavy fruit drop. Orchard should have proper drainage system.

Harvesting and Yield

For harvesting plum crop, following maturity guide should be adopted:-

1. **Ground colour:-** Ground colour changes with maturity depending upon varieties.
2. **Pit browning:-** In case of free stone cultivars, pit-browning upto 5% of the pit area is a good index of maturity.

Plum starts yield within 3 years of planting and in general fruit ripe stage is reached 12 weeks after fruit set. In sub-tropical areas, peak harvesting time is 2nd fortnight of May. In temperate zone, the fruit ripen within 92 to 136 days after fruit set depending upon the cultivars and average daily temperature. The grown up tree of plum yields about 30-50 kg of fruit per tree.

Effective preservation of fresh fruits in condition is mainly governed by harvesting of fruits at right stage of maturity and post-harvest treatments.

Plant Protection

Insect Pest and their Management

Insect Pest and their Symptoms	Management Practices
<p>Peach Leaf Curl Aphid Nymphs and adults suck the sap from the leaves, petiole, blossom and fruits causing leaf curl and distortion. Blossoms wither and fruit do not develop and drop if formed.</p>	<p>1. Keep the trees as free as possible from mechanical wounds, winter injury, crotch separation and cankers.</p> <p>2. Destroy dead and dying fruit trees and branches to avoid borer infestation.</p> <p>3. Prune and destroy the scale and borer infested branches.</p>
<p>Peach Tree Borer Larvae feed in irregular tunnels in the bark and outer wood of the trunk and main root near the ground surface. The injured area produces a great deal of gum usually containing casting from the borer.</p>	<p>4. Maintain vigour of the tree to keep away shot hole/pin hole borer, bark beetles and other pest infestation.</p> <p>5. Spray 6.33% diesel oil emulsion or 3% tree spray oil during dormancy when the temperature is above 4 C to control scales, aphids and mites etc.</p>
<p>Peach Twig Borer Larvas tunnel the buds and terminal shoots in early summer. The injured trees wilt and die. Larvae also infect the fruits from the stem and may bore into the fruit.</p>	<p>6. Spray at bud burst stage any of the insecticides, if heavy infestation of mites, aphids, scales etc. is observed, with chlorpyrifos 20 EC @ 2ml/litre of water, methyl demeton 25 EC @ 1ml/litre of water and dimethoate 30 EC @ 2ml/ litre of water.</p>
<p>Plum Aphid The aphids suck the sap and weaken the trees, some species cause marked curling of leaves. Sooty fungus grows on honey dew exuded by aphids and thereby reducing the market value of fruit.</p>	<p>7. Spray 7-10 days after petal fall any of the insecticides if curling of leaves is noticed, chlorpyrifos 20 EC @ 2ml/litre of water, dimethoate 30 EC @ 2ml/litre of water, malathion 50 EC @ 2ml/litre of water, methyl demeton 25 EC @ 1ml/litre of water to control scales aphids, mites twig borer and other pests.</p>
<p>Green Peach Aphid Aphids feed on leaves, blossom and fruitlets resulting in fruit drop and some times leaf curling.</p>	<p>Repeat after 2-3 weeks, if necessary. Insecticides applied at bud burst stage should not be repeated.</p>
<p>Lecanium Scale The insect pierce the tissue and suck the sap and if abundant for 2-3 years, the infested branches may get killed. Mould develops on the exude of this pest.</p>	<p>8. Fruit fly can be controlled by spraying the tree with dimethoate 30 EC @ 2ml/litre of water, chlorpyrifos 20 EC @ 2ml/litre of water or malathion 50 EC @ 2ml/litre of water about 10 days after</p>
<p>Sanjose Scale All parts above ground are attacked heavily infested trees lack vigour its foliage turn thin and yellow speckled. Often bark around scale is reddened. On fruits the insect appear as grey patches surrounded by inflamed red area.</p>	

<p>Flat Headed Borer Adults feed on foliage. Young grubs feed below the bark which gets loosened and splits. Full grown grubs bore into wood. Gum oozes out from the holes. Leaves pale and growth of the tree is arrested.</p>	<p>petal fall. Repeat with quinalphos 25 EC @ 1ml/litre of water if necessary after sweet varieties begin to develop colour.</p>
<p>Short Hole Borer/Pin Hole Borer Adults and grubs tunnel into the sapwood and hardwood of the plant making galleries and pin holes. Surface of infested branches get perforated followed by yellowing and wilting of leaves. A serious infestation may kill the whole tree. Holes are sometimes indicated by boring on the bark.</p>	<p>9. Swabbing infested branches and trunk with 1.5% chlorpyrifos dust and soil in the ratio of 1:6 mixed with rice or wheat straw will help in reducing damage by shot hole borer and other insect borers.</p>
<p>Hairy Caterpillar Caterpillars feed on leaves. In heavy infestation trees may be completely defoliated. Repeat defoliation may weaken and kill most of the trees.</p>	<p>10. Apply 1.5% chlorpyrifos dust at 8 kg/acre or carbofuran 3G @ 10-12 kg/acre in the soil against the grubs of chaffer beetles.</p>
<p>Chaffer Beetles Adult beetle feeds on leaves, buds, blossom and fruitlets. Eaten away leaves are perforated. The grubs feed on roots and may cause wilting of the plant.</p>	<p>11. To avoid serious damage of stem borers, clean the holes and plug them with cotton soaked in petrol after inserting naphthelen balls in the holes. Swab the affected area with 1.5% chlorpyrifos dust and soil in the ratio of 1:6.</p>
<p>Stem Borer The beetles damage the stem branches drilling big holes in the trunk. Saw dust is seen coming out from holes.</p>	<p>12. Pre-bloom spraying against aphids and mites will also provide control against the apricot chalcid. However, all fallen fruits which may contain the grub be collected and burnt. Pre-bloom spraying against aphids may also provide some degree of control against peach twig borer. However, additional application of any insecticide listed at 6 may provide satisfactory control in case of heavy infestation.</p>
<p>Apricot Chalcid The grubs bore into the kernels and feed in the inner contents leaving the papery coat in tact. As a result fruit development is arrested and the fruit fall prematurely with grubs still feeding within the fruits.</p>	<p>13. Spray 10 days after petal fall and three weeks later methyl demeton @ 1ml/ litre of water, dimethoate 30 EC @ 2ml/litre of water or chlopyrifos 20 EC @ 2ml/litre of water against peach tree borer.</p>

Diseases and their Management

Diseases and their Symptoms	Management Practices
<p>Shot Hole/Corynium Blight (<i>Stigminacarpophylla</i>) Same as in peach</p>	<p>Same as in peach</p>

Apricot

Apricot (*Prunus armeniaca*L.) is an important fruit crop of mid hills and dry temperate regions of the country. The ripe fruit of apricot is an excellent dessert fruit. The fruit is candied, canned, frozen and dried. It is also used for making jam, nectar, papad and squash. The total area under apricot in J&K U.T. is 6123 ha with an annual production of 13598 M.T. In Jammu Division, apricot cultivation is confined to Doda, Udhampur, Poonch and Rajouri districts with 2987 ha under apricot giving 4300 M.T. of yield per year.

Climate and Soil

Apricot is grown successfully at an altitude of 900 to 2000 metres above msl, however, some cultivars can be grown upto 3000 m. The minimum temperature required for peak flowering is 5-6°C and for fruit ripening varies between 15-19°C. The long cold winter, frost free and warm spring are favourable for fruiting. Apricot is hardy and can be grown in most of the soils which are deep, well drained and should be about 3 m deep.

Cultivars

Early Season	(Maturity period: second week of June) Charmagz (Mithacher) Kaisha (Kaisa) New Castle
Mid Season	(Maturity period: 3 rd week of June to last week of July) Frogmore Early (Khaircher) Gilgati Sweet (Bota cher) Harcot Bebco
Late Season	(Maturity period: 1 st week of August) Amba

Propagation

Raising of rootstocks

Rootstocks are propagated through seeds. Apricot seeds require stratification for a period of 72 days at 4°C. The stratification medium should have proper moisture retaining capacity, good aeration but no toxic substances. Germination of apricot seeds is hastened by removal of kernel from shell, scarification and gibberllic acid/ kinetin treatment.

Sowing of seeds

Few seeds begin to germinate at the end of stratification period. These are then ready for sowing in well-prepared planting beds which should be free from

weeds and pebbles and supplied with a good amount of compost. The seeds should be sown carefully 30 cm apart in rows. Ample moisture in the nursery bed ensures good germination and seedling growth. It can be achieved by frequent watering and mulching. Application of terbacil @ 2-3 kg/ha before weed emergence helps in weed control in the nursery.

Vegetative propagation

T-budding and tongue grafting are generally adopted for apricot multiplication. Apricots are generally propagated on wild apricot (*Zaradalu*), apricot and plum seedlings. The apricot seedlings are suitable for sandy soils and dry conditions while, plum rootstocks are good for heavy soils and wet situations. The seedlings which attain pencil thickness in the month of May-June are budded and other seedlings are utilized for fall budding in September. The rootstock should be more than 0.6 cm in diameter with a bark separating readily from the wood. The stock may be budded at a height of about 10-25 cm above the ground level in a smooth bark surface. Some of the May-June budded plants become ready for planting in the dormant season while fall budded plants can only be utilized grafted in the following dormant season by tongue grafting. In apricot, both budding and grafting gives higher percentage of success.

Planting

Planting is done according to square, rectangular and triangle system but on hill slopes contour system is generally practiced. Pits of 1 m x 1 m x 1m should be dug 1-2 months in advance before planting. The plants are generally planted at a distance of 6 x 6 m in square system. Apply 10 kg of well rotten FYM at the time of planting.

Manure and Fertilizers

Age of tree (Year)	FYM (Kg)	Fertilizer doses (g/tree)		
		Urea	DAP	MoP
1	10	55	22	65
2	10	115	45	130
3	10	170	65	190
4	20	225	85	265
5	20	280	110	330
6	30	395	150	585
7	30	510	195	750
8	40	620	240	915
9	40	735	280	1080
10 th year and above	50	850	325	1250

Note: Apply FYM alongwith full dose of Diammonium phosphate and muriate of potash in December. Half of urea should be applied 2 weeks before normal bloom whereas rest half of urea should be applied three weeks after fruit set.

Training and Pruning

Apricot should be trained to modify central leader system. At the time of planting, 1 year whip should be headed back at 70-80 cm above the ground and 3-5 main branches should be encouraged to grow spirally around the main stem. For first 3-5 years, the pruning should be only corrective so that the frame work of the trees should be maintained. As apricot bears mainly on spurs and to some extent on one year old shoots, the yearly pruning should not be heavy. The old trees require heavy pruning to encourage new shoots.

Irrigation

During fruit growth and development, 2 to 3 irrigations should be given. Mulching with hay and black polythene helps in conservation of moisture.

Harvesting and Yield

Harvesting of tree ripe fruits is done in last week of May – August depending upon variety and location. However, for distant market, the fruit is harvested before skin develops typical apricot colour. The fruit should be harvested in morning hours as it is highly perishable in nature. The fruiting starts at the age of 5 years. The average yield is 50-80 kg fruit per tree.

Plant Protection

Insect Pest and their Management: Same as in Peach and Plum

Diseases and their Management

Diseases and their Symptoms	Management Practices
Leaf Curl (<i>Taphrina deformans</i>)	Same as in peach
Coryneum blight and shot hole (<i>Stigminacarpophylla</i>)	Same as in peach

Almond

The almond (*Prunus amygdalus*Batsch) is one of the major and oldest tree-nut crops in the world. Its kernel is a very high energy source due to its high oil content. Production of almonds is very much limited in India, however, its cultivation has been in progress to some extent in the hilly areas of J&K and H.P. Almond plantation covers an area of 7107 ha in J&K U.T. with annual production of 6360 M.T, with Jammu Division accounting for 117 ha area and 5.0 M.T. of yield.

Climate and Soil

Elevation of prominent almond growing areas ranges from above 700-2500 metres above mean sea level. Temperature is the most important climatic factor and almond requires a mild winter for regular bud sprouting in spring. Chilling requirement for normal bud opening depends on the cultivar and varies from 100 to 700 hours below 7.2°C. The limiting factor in almond cultivation is the spring frost especially during full bloom or immediately after fruit set and sensitiveness of early varieties to climatic conditions and lack of ideal late blooming varieties in the state and its cultivation under rainfed conditions. Almonds when grafted on almond seedling can tolerate high summer temperature and very low humidity better than any other temperate fruit crop. For successful growing and cropping of almonds tree, 65 cm or more annual rainfall is needed.

The site for almond cultivation should have proper soil and air drainage. Almonds grow on a wide variety of soils varying from finest clay soils to rocky soils of foot hills. However, they grow and produce best crops in well-drained soil of light medium texture. In heavy and poorly drained soils, the almonds do not thrive well and may collapse within a short period of time. It is better to go for leaf and soil analysis to correct any deficiencies of nutrition before planting is done.

Cultivars

Most of the almond cultivation in Kashmir valley is of seedling origin. The plantation of budded plants of known cultivars of good quality, mostly thin-shelled and medium shelled is now being encouraged.

Some of the promising cultivars are:

- i) Afghanistan Seedling
- ii) IXL
- iii) Jordanolo
- iv) Merced
- v) Non-Pareil
- vi) Texas

Propagation

Rootstocks

The most commonly used rootstocks for almond are seedlings, raised from sweet, bitter almond, wild peach and Marianna plum. However, keeping in view the shorter life of peach, it is preferable to use sweet or bitter almond seedling rootstocks.

Raising of seedlings

The almond nuts are harvested from July to September and are stored in cool and dry place till December. The nuts are stratified in the end of December in boxes by putting 3 cm thick, alternate layers of sand and nuts. By the middle of February, the hard shell of the seed breaks open by absorbing moisture and the kernels which begin to show signs of germination are exposed partly or wholly. When the shells have split partly, the nuts are taken out from the stratification box and sown in beds.

Seeds are sown 3-4 cm deep on well-cultivated and manured beds 30 cm apart between lines and 10 cm within lines. A distance of 60 cm is left every two rows which will facilitate the budding process and cultural operation in the nursery beds. Germination starts in 2-3 weeks.

Budding and Grafting

When the seedlings are of pencil thickness and have attained a height of 30 cm, they are T-budded in the month of July/August. The seedlings which do not make sufficient growth so as to become fit for T-budding are grafted by tongue or cleft method in January/February. Tongue grafting is employed when stock and scion are of equal thickness.

Planting

The land should be thoroughly prepared for almond plantation. Pits of 1 x 1 x 1 m size should be dug at least 15 days before actual planting. Depending upon nature and fertility of soil, almonds can be planted 6-7 m apart. The planting should be done in the autumn. More than one variety of almond should be planted in an orchard as most of the varieties are self-unfruitful.

The best method of planting the different varieties together is to put 3 rows of the main variety and one row of pollinizer variety. The recommended pollinizers are Non-Pareil, IXL and Jordanolo. It is also useful to have 3-4 colonies of bees per hectares of orchard.

Training and Pruning

Pruning is carried out at three different stages in the life of the almond tree:-

- i) During early years: The early pruning is practiced to shape the tree. Immediately after planting, head back the tree to 100 cm. Allow first branch at 0.6 m from the ground. The plants should be trained to modify central leader system by retaining 3-4 branches, 15-20 cm apart spirally in order to produce a well-balanced tree. The crotch angles of the scaffolding

limbs should be 45° to 60°. In case of weak crotches, the branches should be tied to the ground by strong thread or thin nylon thread with pegs.

- ii) During cropping: When the tree is cropping, regular pruning should be carried out every year to ensure high yield. Almond flowers are usually located on spurs which live for about 5 years, and in order to renew them, about one fifth of fruiting wood is replaced every year. Amount of pruning depends on the previous crops, efficiency of pollination, kind of fertilization, cultivars, tree vigour and climate. The success of pruning programme can be judged in part by the length of new shoot growth over the entire each year. In growing trees with age less than 10-12 years, a 22.5-25 cm of new growth is optimum whereas for older trees new shoot growth of 15 cm each year is desirable.
- iii) To reinvigorate old plants: Reinvigorating pruning is carried out only when trees are old and unproductive but healthy. The main branches can be cut back and many new shoots will grow out to replace them in the spring. Thin these shoots to prevent overcrowding. Use the remaining shoots to replace old, unproductive wood and to establish a new top on the tree.

Manure and Fertilizers

Almond is a heavy feeder and requires proper fertilization. For maximum production, the soil and foliar analysis must be conducted. However, the following recommendations may be adopted in absence of the analysis:

Age of tree (Year)	FYM (Kg)	Fertilizer doses (g/tree)		
		Urea	DAP	MoP
1	15	55	20	65
2	15	115	45	130
3	20	170	65	200
4	20	225	85	265
5	25	285	110	330
6	25	395	150	585
7	30	510	195	750
8	40	620	235	915
9	50	735	280	1085
10 th year and above	60	850	325	1250

Note: Apply FYM alongwith full dose of diammonium phosphate and muriate of potash in December. Nitrogen may be split to 2-3 doses. First dose (half the quantity) should be applied a fortnight before expected bloom, second dose (1/4th of the total requirement) may be applied 3 weeks after fruit set and third dose (1/4th of the total requirement) should be applied in June/July.

Irrigation

Irrigation is the most important practice to improve the growth and yield of almond, because summer rainfall is insufficient in the areas where they are

grown. Frequently, dry summer irrigation is good for proper development of nuts and prevention of fruit drop besides laying foundation for the next year's crop.

In case of established plants of almond, a 10-day interval of irrigation in summer and 20-25 days during winter is sufficient. In the event of rainfall, irrigation may be suitably delayed and adjusted.

Harvesting and Yield

Harvesting time varies yearly depending on location. Almonds are ready for harvest when the hull colour changes from green to yellowish which cracks or splits at suture starting from pedicel end.

Under premature harvest conditions, the hulls remain as stick-tight and it requires more energy to dislodge the nuts, resulting in damage to limbs in the form of wounds.

For full recovery of nuts, orchard floor should be cleaned and tarpaulin or polyethylene sheets may be spread beneath the trees prior to knocking of the nuts. Nuts should be placed at a shady place for drying and removing of hulls.

The average yield is 3-6 kg per tree, however, improved cultivars, soil management and good weather can result in yield of 10-12 kg nuts per tree.

Plant Protection

Insect Pest and their Management

Insect Pest and their Symptoms	Management Practices
<p>Mealy Bugs Presence of insects covered with white cottony mass below the collar of the plant. Wilting and drying of nursery plants. Old and weak plantations are more susceptible to attack and exhibit nutrient deficiency symptoms and sickly appearance which result in poor yield.</p>	<ol style="list-style-type: none"> 1. Avoid planting of scale, aphid and borer infested saplings. 2. Removal of dead and drying trees to avoid borer infestation. 3. Pruning and destruction the scale and borer infested branches. 4. Collection and destruction of egg masses of hairy caterpillar. 5. Up-keep of the vigour of trees by application of balanced dose of fertilizers will help reduce attack of shotholes bark beetles and other pest infestation. 6. During dormancy when temperature is 4°C, spray diesel oil emulsion 6.33% or tree spray oil 3% if infestation of scale is noticed. 7. Spray at bud burst stage any of the insecticides chlorpyrifos 20 EC @ 2ml/litre of water, methyl demeton 25 EC @ 1ml/litre of water and dimethoate 30EC @ 2ml/litre of water to control aphids,
<p>Walnut weevils (<i>Alcidodusporrectirostis</i>) Eggs are laid in the pits excavated on the fruits. The grubs bore into the fruits and feed on kernel. The adult bite circular hole.</p>	
<p>Leaf Curling Aphid Nymphs and adults suck the sap from the leaves, petiole, blossom and fruits causing leaf curl and distortion. Blossoms wither and fruit do not develop and drop, if formed.</p>	

<p>Green Peach Aphid Aphids feed on leaves, blossom and fruitlets resulting in fruit drop and sometimes leaf curling.</p>	<p>mites, scale insects, thrips and other pests.</p> <p>8. If necessary, repeat the spray after 10 days of petal fall with chlorpyrifos 20 EC @ 2ml/litre of water, methyl demeton 25 EC @ 1ml/L and dimethoate 30EC @ 2ml/litre of water, malathion 50EC @ 2ml/litre of water to control scales, aphids mites, twig borer and other pests.</p> <p>9. Whenever infestation of mealy bugs is noticed, slippery bands of alkathane sheets 25-30 cm on a coal tar coating 0.5 to 1.0 m above ground be applied during April.</p> <p>10. During the last week of March or beginning of April the soil may be treated with 150-200 g chlorpyrifos 1.5 % D t around collar region will reduce the population in the soil.</p> <p>11. Swabing infested branches and trunk with 1.5% D chlorpyrifos dust and soil in the ratio of 1:6 mixed with rice or wheat straw will help in reducing damage by shot hole borer and other insect borers.</p> <p>12. To avoid serious damage of stem borers, clean the holes and plug them with cotton soaked in petrol after inserting naphthalene balls in the holes. Swab the affected area with 1.5% D chlorpyrifos and soil in the ratio of 1:6.</p> <p>13. During May / June, the application of chlorpyrifos 20EC @ 2ml/litre of water, quinalphos 25EC @ 2ml/litre of water will help in reducing the damage by defoliating beetles and other pests.</p> <p>Collection and destruction of fallen nuts during May-June.</p> <p>Proper sanitation should be maintained. Smaller and medium plants can be sprayed with chlorpyrifos 20EC @ 2ml/litre of water, quinalphos 25EC @ 2ml/litre of water during the month of April-May.</p>
<p>Lecanium Scale The insects pierce the tissue and suck the sap and if abundant for 2-3 years, the infested branches may get killed. Mould develops on the exude of this pest.</p>	
<p>Sanjose Scale All parts above ground are attacked heavily infested trees lack vigour its foliage turn thin and yellow speckled. Often bark around scale is reddened. On fruits the insect appear as grey patches surrounded by inflamed red area.</p>	
<p>Hairy Caterpillar Caterpillars feed on leaves. In heavy infestation trees may be completely defoliated. Repeat defoliation may weaken and kill most of the trees.</p>	
<p>Chaffer beetles Adult beetle feeds on leaves, buds, blossom and fruitlets. Eaten leaves are perforated. The grubs feed on roots and may cause wilting of the plant.</p>	
<p>Stem Borer The beetles damage the stem branches drilling big holes in the trunk. Saw dust is seen coming out from holes.</p>	
<p>Shot Hole /Pin Hole Borer Adults and grubs tunnel into the sapwood and hardwood of the plant making galleries and pin holes. Surface of infested branches get perforated followed by yellowing and wilting of leaves. A serious infestation may kill the whole tree. Holes are sometimes indicated by boring on the bark.</p>	

Diseases and their Management

Diseases of dry fruits

Diseases and their Symptoms	Management Practices
<p>Canker More than one fungus is associated with the disease. Leaves twigs and fruits develop small, round to irregular, light brown to dark brown lesions. The necrotic spots on leaves when slough-off, form shot holes. Early infected fruits exude gum from the infected sites. In early spring, lateral buds carrying bunch of leaves, flowers and fruits may get blighted and killed under wet and rainy weather conditions. Severe premature leaf fall often occurs, leading to complete defoliation by August-September. The disease results in heavy loss of vegetative and productive life span of almond trees</p>	<p>I. Cultural practices</p> <ol style="list-style-type: none"> i) Prune cankerous twigs and burn, clip-off the emerging diseased shoots and bury or burn. ii) Suitably thin closely spaced trees during dormancy to control leaf spot disease. iii) Peach plants susceptible to leaf curl disease should not be planted. Orchard management practices like clean cultivation, ploughing and balanced fertilization should be adopted to maintain the vigour of the tree. <p>II. Chemical management Spray the trees at bud burst, petal fall, fruitlet stages and 15-20 days before harvest of fruit with copper oxychloride (300g/100litre of water) or prune out the infected spurs and branches.</p>

Disease and their Management

Diseases and their Symptoms	Management Practices
<p>Leaf Spot / Shot Hole (<i>Stigminacarrpophyla</i>, <i>Cladosporium sp.</i>, <i>Cercospora sp.</i>) More than one fungus is associated with the disease. Leaves, twigs and fruits develop small, round to irregular, light brown lesions. The necrotic spots on leaves, when slough off, form shot holes, early infected fruits exude gum from the infected sites. In early spring lateral buds carrying bunches of leaves, flowers and fruits may get blighted and killed under wet and rainy weather conditions, severe premature leaf fall often occurs leading to complete defoliation by August-September. The disease results in heavy loss of vegetative and productive life span of almond trees.</p>	<p>I. Cultural Practices</p> <ol style="list-style-type: none"> i) Prune cankerous twigs and burn. Clip off emerging diseased shoots and destroy. ii) Suitably thin closely spaced trees during dormancy to control leaf spot diseases. iii) Raise disease-free plants. iv) Orchard management practices like clean cultivation, ploughing and balanced fertilization should be adopted to maintain the vigour of the tree. <p>II. Chemical Management Spray the trees at bud burst, petal-fall, and 10-15 days before harvesting of fruit with copper oxychloride (300g/100litre of</p>

<p>Leaf Curl (<i>Taphrina deformans</i>) Symptoms develop on leaves, twigs, flowers and fruits. The leaf blade becomes thickened and puckered alongwith midrib, leaves curl and turn yellowish. Later, the upper leaf surface gives a silvery appearance and becomes brittle. Finally, the affected leaves become swollen and may exude a gum like substance. The affected twigs and fruits usually die. Flowers and fruits, when infected drop prematurely.</p>	<p>water), or chlorthalonil (100g/100litre of water)</p>
<p>Almond Blight (<i>Cryptosporiopsis sp.</i>) It generally attacks current season shoots by early entry through leaf blade, leaf petiole and ultimately into the bark and wood forming dead, blighted, brown lesions on young bark and wood. The early shoot infection forms a girdle and leads to wilting and death of the shoot. The disease usually starts in mid-summer and intensifies during August-September. The lesions on twigs are whitish grey from their central portion and are often studded with small, black bodies. The disease spread is quite rapid and within few years whole of the tree may completely decline.</p>	<p>Spray copper oxychloride (300g/100 litre of water) or chlorthalonil (100g/100 litre of water) at the appearance of the disease and follow up spray at 10 days interval. Spray copper oxychloride (300g/100 litre of water) at bud swell and subsequent sprays at 10-15 days interval.</p>
<p>Leaf Blotch (<i>Polystigmina rubra</i>) Yellow, irregular blotches appear on both sides of leaves which become brick red and finally die, forming dark brown patches. Diseased leaves prematurely wither away. The disease is confined to leaves only and appears in mid-summer reaching its highest intensity during August-September.</p>	<p>Spray copper oxychloride (300g/100 litre of water) at the appearance of the disease and follow up spray at 10 days interval.</p>

Walnut

Walnuts (*Juglans regia* L.) are found in the northern parts of the country in temperate belts. They are grown in the length and breadth of the valley in Jammu and Kashmir and hilly areas of Jammu. Total area under walnut cultivation in Jammu & Kashmir is 38653 ha with an annual production of about 84356 M.T. In Jammu Division, walnut plantation is on 38,318 ha with an annual production of 92227 M.T. The walnut is very rich in proteins, fats and minerals and is a concentrated source of energy.

Climate and Soil

Walnuts are found growing in all parts of the Himalayan region from 1200 to 2100m above msl. Walnuts are sensitive to both low and high temperature. Climate should be free from frost in spring and from extreme heat in summer. They grow well in areas where rainfall is about 75 cm or more and is well distributed. Temperature of 29-32°C near harvesting time results in well-filled kernels. Walnuts do best in soils where roots can penetrate deep evenly. In addition to good top soil, sub-soil must be free of rock, impervious clay or layers of gravel. Most suitable soil is well drained silt loam with abundant organic matter. Alkaline soil and sandy soils should be avoided for walnut growing. A soil with 2-3 metres depth and pH range of 6-7 gives best results.

Cultivars

Most of the trees are of seedling origin and no standard cultivar is grown at present. Usually walnuts are grouped into 2 broad categories.

- i) Thin shelled (Burzal)
- ii) Medium shelled (Kagzi)

The following introductions have been found promising

- i) Lake English
- ii) OpexCulchery

Propagation

Walnuts can be propagated either by seed or vegetative methods.

The walnuts should be collected from vigorous and high yielding trees. The selected walnuts should be of big size, bright brown colour and good cracking quality of the shell, bright yellow colour, good taste and flavour of the kernel. The nuts are stratified by placing in alternate layers with suitable medium and subjected to cold treatment 3-4°C for a period of 2-3 months.

Walnuts are stratified till December and are then sown immediately at 8-10 cm depth in well prepared beds of 30 cm in row to row and 10 cm seed to seed. The germination starts in the beginning of March. The planting of large nuts at 7 cm depth in soil in vertical position gives better germination and seedling growth.

Vegetative propagation

Walnut can be propagated vegetatively by grafting and budding. *Juglans regia* is the most easily available rootstock for walnut in India and is the only one used whenever walnut trees are raised by budding or grafting. This rootstock has better compatibility and is practically suitable for light soils however it is unsuitable for waterlogged, saline and nematode infected soils. The most common method of grafting practiced in this nut is cleft grafting. Better survival of grafts is obtained when grafting operation is carried out in the middle of January. Patch budding is common among the budding methods which gives 30-35% success. Mid June is found to be an optimum time for budding.

Planting

Walnuts should be planted by square or hexagonal systems in plains and contour system is recommended for undulating areas. Pits of size 1 m x 1 m x 1 m are dug and then filled with well rotten FYM and soil in 1:2 proportion. Planting is done in early spring. Budded/grafted plants should be planted 10.5 m apart.

Training and Pruning

Walnut trees are trained according to modified leader system. Pruning of walnut tree is determined by the bearing habit. In the terminal bearing cultivars, pruning consists of heading back of selected framework branches and thinning out of competing limbs. The lateral bearing cultivars are both thinned and headed back heavily in order to encourage shoot growth which get suppressed due to early fruit production. The pruning operations are carried out in the dormant season.

Irrigation

Watering is very essential for the establishment of grafts and young plants. The water requirement, however, decreases with the development of roots. The frequency of irrigation depends upon the age of the tree, type of soil, rainfall, mulching and soil management system. The choice of an irrigation system depends upon water supply, ground level, and above all cost benefit ratio.

Flowering and fruit sets

Walnut seedlings take about eight to ten years to come into bearing, but grafted plants begin fruiting early in about four to five years.

Harvesting and Yield

Walnut is mostly harvested in the months of September and October. Some nuts fall on the ground after splitting of the hulling natural ways, while others are forced to drop down by beating with long poles. The total harvest is done in two or three times at few days interval. Pre-harvest treatment of walnut trees with ethrel @ 200-300 ppm at packing tissue turned brown (PTB) stage proved better to induce early and uniform hull dehiscence (dehulling) in walnuts. Moreover, it makes harvest of entire crop possible at one time and advances dehulling by about 12 days. The average yield of walnut is 40 kg per tree but a larger tree of about 40 year age can produce as much as 175 kg nuts per tree.

Manure and Fertilizers

For achieving higher yields of quality crop, following recommendation of fertilizers should be applied to walnut trees.

Age of tree (Year)	FYM (Kg)	Fertilizer doses (g/tree)		
		Urea	DAP	MoP
1-3	10	20-40	60-65	30-50
4-6	20	60-135	65	65-125
7-10	30	190-490	65-130	165-415
11-15	40	585-1565	160-435	500-995
16-19	50	1960-3415	540-975	1245-2155
15 th year and above	60	3915	1085	2490

Note: Apply FYM in the month of February-March. Full dose of DAP & MOP and ½ dose of urea should be applied two weeks before expected bloom. Rest half quantity of urea should be split into two equal doses which should be applied 3 weeks after fruit set and during early July.

Plant Protection

Insect Pest Management

Insect Pest and their Management	Management Practices
<p>Mealy Bugs Presence of insects covered with white cottony mass below the collar of the plant. Wilting and drying of nursery plants. Old and weak plantations are more susceptible to attack and exhibit nutrient deficiency symptoms and sickly appearance which result in poor yield.</p>	<ol style="list-style-type: none"> 1. Avoid planting of insect infested saplings. Remove dead drying trees. 2. Pruning & destruction of borer infested branches. 3. Collection & destruction of egg masses of hairy caterpillar. 4. Keep up vigour of trees by application of balanced doses of fertilizers, this will help to reduce the attack of borers & other pests. 5. Stapling burlap skirts around tree trunks infected with hairy caterpillars and collection of larvae pupae from May to end of June and their destruction will help in suppressing the pest population. 6. Wherever possible spray the trees with chlorpyrifos 20EC (0.02%) in the month of May to reduce the population of aphids, mites, hairy caterpillars, walnut
<p>Leaf Curl Aphid Nymphs and adults suck the sap from the leaves, petiole, blossom and fruits causing leaf curl and distortion. Blossoms wither and fruit do not develop and drop, if formed.</p>	
<p>Green Peach Aphid Aphids feed on leaves, blossom and fruitlets resulting in fruit drop and sometimes leaf curling.</p>	
<p>Lecanium Scale The insects pierce the tissue and suck the sap and if abundant for 2-3 years, the infested branches may get killed. Mould develops on the exude of this pest.</p>	
<p>Sanjose Scale All parts above ground are attacked, heavily infested trees lack vigour its foliage turn thin and yellow speckled. Often bark around scale is reddened. On fruits the insect appear as grey patches surrounded by inflamed red area.</p>	

<p>Hairy Caterpillar Caterpillars feed on leaves. In heavy infestation trees may be completely defoliated. Repeated defoliation may weaken and kill most of the trees.</p>	<p>weevil and other pests. Repeat the spray after 3-8 weeks, if required.</p>
<p>Chaffer Beetles Adult beetles feed on leaves, buds, blossoms and fruitlets. Eaten away leaves are perforated. The grubs feed on roots and may cause wilting of plant.</p>	<p>7. Collect and destroy the fallen walnut leaves. The leaf size is reduced and turns yellowish which fall prematurely.</p>
<p>Stem Borer The beetles damage the stem, branches by drilling big holes in the trunk. Saw dust is seen coming out from holes.</p>	
<p>Shot Hole /Pin Hole Borer Adults & grubs tunnel into the sapwood and hardwood of the plant making galleries and pin holes. Surface of infested branches get perforated followed by yellowing and wilting of leaves. A serious infestation may kill the whole tree. Holes are sometimes indicated by boring on the bark.</p>	
<p>Walnut Aphids The insects suck the sap from leaves which results in drying, wilting and yellowing of foliage. The infested leaves fall prematurely.</p>	
<p>Grey Weevil The weevil nibbles walnut leaves. Nursery plants are more affected; continued feeding may defoliate a nursery plant.</p>	
<p>Walnut weevils (<i>Alcidodusporrectirostis</i>) Eggs are laid in the pits excavated on the fruits. The grubs bore into the fruits and feed on kernel. The adult bite circular hole.</p>	<p>Collection and destruction of fallen nuts during May-June. Proper sanitation should be maintained. Smaller and medium plants can be sprayed with chlorpyrifos 20EC @ 2ml/ litre of water or acetamiprid 20 SP @ 0.2 g/ litre of water of water during the month of April-May.</p>

Diseases and their Management

Diseases and their Symptoms	Management Practices
<p>Leaf Blotch(<i>Marssoninajuglans</i>) The affected leaves show small, circular, light brown spots which later develop into large blotches having irregular outline and often involve the entire lamina. The pathogen survives mainly on the infected portions of dead, fallen and over wintered leaves.</p>	<p>i) Collect and burn fallen leaves in autumn. ii) Spray the tree with dodine (75g/100litre of water) or chlorthalonil (100g/100litre of water) in late spring. Repeat 2-3 sprays at 15-20 days interval.</p>
<p>Mistletoe(<i>Visum album</i>) The phanerogamic parasite forms witches broom on the tree and feeds on walnut plant reducing its yield.</p>	<p>The parasitic plant should be removed from the tree along with haustoria. In case of severe infestation, the entire branch or twig should be removed and burnt.</p>

Strawberry

Strawberry (*Fragaria xananassa*Duch.) is a temperate fruit crop, but some cultivars have been screened for sub-tropical areas of Jammu, where it has shown promising results.

Climate and Soil

Strawberry can be grown in a variety of agro-climatic conditions but cooler places free from spring frost and hail storm having the proper irrigation facility, are considered best for its successful cultivation. Strawberry on northern slopes ripens later than those on southern slopes but the yield on northern slopes may be higher. A rich friable loam well drained with a sub-soil retentive of moisture with 5.8 to 6.5 pH is best for growing strawberries. Gentle slopes are better for its cultivation.

Cultivars

Chandler, Belrubi, Confitura, Gorella, Fern, Brighton, Oso Grand.

Propagation

Strawberry is propagated through runners. The runner producing capacity in sub-tropical areas can be significantly improved by growing strawberry under 50 % shading conditions with sufficient irrigation during summer. The foliar spray of BAP (45 ppm) + urea (1.5 %) in the month of June has been found effective for its regeneration under Jammu conditions. The mulch materials should be removed after fruit harvesting for propagating this crop. Strawberry runners can also be multiplied on commercial scale using tissue culture technique for which protocol has been standardized by SKUAST-Jammu.

Planting

Planting can be done in August-September (on hills) and October-November (in plains) on raised beds in twin rows at 30 cm x 45 cm. In extreme colour areas, the planting can also be done in early spring.

Manure and Fertilizers

Strawberry requires FYM in bulk amount (250-300 q/ha). For getting commercial yield, strawberry requires 163-217 kg urea, 500-750 kg SSP and 84 to 105 kg MOP per ha.

Apply full amount of FYM and half dose of nitrogen, phosphorus and potash and mix them into soil prior to planting. Remaining doses of phosphorus and potash alongwith one fourth of nitrogen should be applied in the month of December, while remaining one fourth amount of nitrogenous fertilizer should be applied before flowering.

The application of well decomposed FYM @ 72 tonnes/ha or poultry manure @ 18 tonnes /ha can substitute the amount of inorganic fertilizers for getting commercial yield.

Irrigation

Strawberry requires frequent irrigation but less water. Strawberry should be irrigated at an interval of 8-10 days during winter and 3-4 days during summer depending upon the nature of soil. First irrigation should be given just after planting of runners.

Mulching

Mulching of strawberry is a beneficial operation in minimizing winter freezing injury to plants, suppressing early spring growth, thereby reducing fruit bud frost injury, smothering of weeds, keeping berries clean, reducing berry disease and conserving soil moisture.

Time of mulching- Winter season (mulch the whole bed)

Spring season (mulch around the individual plant)

Mulching materials - Polythylene sheets, dry grasses, paddy straw, pine needles and wood shavings etc can be used as mulch however, Black polythene mulch reduces weed population more effectively and also increase plant growth, yield and quality.

Flowering and Fruiting

Time of flowering - January – February (in plains)

March – April (on hills)

Chief pollinator - Honeybees

- Placement of two-bee hives/ha in strawberry field is beneficial for ensuring good fruit set and size of berries. For improving the quality and shelf-life of strawberry cv. Chandler, foliar application of 0.6 % FeSO₄ sprayed 30 days and 80 days after planting results in maximum vegetative growth whereas 0.6 % ZnSO₄ application improves quality of Chandler cv. Strawberry. For enhancing the shelf-life upto 60 hours of Chandler cv. of strawberry, apply CaCl₂ 0.6 per cent twice i.e. 30 and 80 days after planting.

Growing early and late strawberries in sub-tropical areas

In Jammu, the strawberry production coincides during 2nd week of March to last week of March, which creates glut in the market and growers face serious economic losses. The use of black polythene mulch and white polythene row covers can advance fruit ripening at least 15-20 days besides protecting fruits from rain or hail damage. This system requires drip irrigation to be provided under the polythene sheet. For extending the availability of strawberry fruit till May, it needs to be grown with paddy straw mulch and sprinkler irrigation.

Harvesting and Yield

Time of harvesting-February-April (on plains)

April-June (on hills)

The berry ripening can be advanced by 15-20 days by growing strawberry crop under white transparent polyethylene row covers and using polythene mulch.

Yield - 250-300 q /ha

Plant Protection

Diseases and their Management

Diseases and their Symptoms	Management practices
<p>Leaf Spots i) White-centered Purple Leaf Spot <i>(Mycosphaerellafragariae)</i> Small, round, purple spots appear scattered on upper surface of the leaves but may also appear on petioles, fruits and stems. Centre of the spot becomes white and a dark purple zone surrounds the central area.</p>	<p>i) Plant in well-drained weed free soil. ii) Give 2-3 sprays at 10-15 days interval with copper oxychloride (300g/100 litre of water) or chlorthalonil (100g/100 litre of water)</p>
<p>ii) Yellow Leaf Spot <i>(Dendrophomaobscurans)</i> Minute, purplish spots appear scattered on the upper surface of leaf during July to September. The spots soon attain a characteristic halo with yellow brown center surrounded by a purplish zone. Spots later become oblong or irregular blotches. The affected area dies up, becomes puckered or makes shot holes.</p>	<p>Spray with copper oxychloride (300 g/100litre of water) or chlorthalonil (100g/100litre of water)</p>
<p>Pestalotiopsis Leaf Spot <i>(Pestalotiopsisdisseminata)</i> The spots are circular with chocolate center and reddish brown or yellowish margin. The spots coalesce to give a patchy appearance. The infected area becomes brittle and detaches from the healthy area. Heavily infected leaves get defoliated.</p>	<p>Give 2-3 sprays at 10-15 days interval with copper oxychloride (300 g/100 litre of water)</p>
<p>Colletotrichum Leaf Spot <i>(Colletotrichum gloeosporioides)</i> Minute, dull, violet-black or black spots appear on leaf surrounded by yellow region. Spots coalesce forming bigger spots causing defoliation.</p>	<p>Plant in well-drained, weed-free soil. Spray at 10-15 days interval with copper oxychloride (300g/100 litre of water) or chlorthalonil (100g/100 litre of water) repeat 2-3 sprays.</p>
<p>Leaf Scorch <i>(Maroniafragariae)</i> Numerous irregular, oval or angular, purple spots appear scattered on the upper surface of leaves in April or May surrounded by reddish brown or pinkish halo. Elongated, reddish brown or purple streaks appear on petioles of leaves and peduncles of flowers. Such symptoms also appear on runners</p>	<p>Spray the crop with copper oxychloride (300g/100 litre of water), give subsequent 2-3 sprays.</p>

<p>which become girdled and discoloured at the affected parts.</p>	
<p>Leaf Blight and Dry Stalk (<i>Rhizoctonia bataticola</i>) Circular spots with ashy grey centre and purplish margins appear on leaves. Later, these spots become oval or irregular. Leaf puckering, curling and defoliation are observed. Runners and stalks turn dark brown or black with irregular lesions.</p>	<ul style="list-style-type: none"> i) Use certified disease-free planting material. ii) Avoid plantation in water-logged soil. iii) Do not plant in known sick soil. iv) Spray copper oxychloride (300 g/100 litre of water) or chlorthalonil (100g/100 litre of water) at the disease appearance, 2-3 sprays at 15 days interval as per disease severity.
<p>Black Root Rot Complex (<i>Leptosphaeria coniothyrum, Peziza lythri, Ramularia spp., Fusarium orthoceras, Corticumvagum, Pachybasidiumcandidum, Pythium spp.</i>) Plant gives uneven, patchy appearance due to dwarfing and death of affected plants. Roots develop brown and small, fibrous rootlets are killed. Lesions extend and the entire root is blackened. Leaves remain small with short petioles and turn yellowish, old leaves wither. Berries, if formed, remain small or wither before ripening.</p>	<ul style="list-style-type: none"> i) Avoid plantation in areas where the crop has recently been grown. ii) Use disease-free planting material. iii) Do not plant in water-logged soil. Treat the soil before sowing with 40 % formaldehyde (40 ml/litre of water) using 5 L solution/sq. metre area and covering with polythene sheet. Remove polythene sheet after 48 hours and rake the soil before transplanting.

Persimmon

Climate and Soil

Most cultivars of persimmon (*Diospyrus kaki*) require 500-800 chilling hours and can be successfully grown in those areas where peach and Japanese plums are grown, however, cool summers tends to delay the fruit ripening. High humidity is intolerable to the fruit. It is highly prone to spring frost injury. Non-astringent cultivars require warmer conditions for fruit maturation than the astringent type. Persimmon thrives best in deep (1 m) well drained sandy loam soils with 5.5 to 6.5 pH.

Cultivars

Non-astringent Fuyu, Twentieth Century and Jiro

Astringent Hachiya and Triumph

The cultivars may be monoecious or dioecious. Some varieties like Hachiya bear only female flowers and develop fruits parthenocarpically and do not require any pollination. In other varieties, pollination takes place through wind or honey bees.

Propagation and Rootstock

Persimmon is grafted (tongue) on the seedling (*Diospyrus lotus*) rootstock before bud break. Prior to sowing, seeds are stratified at a temperature (1-5°C) for 90 days and sown in the nursery in March-April. After one year, seedling attains the graftable size. It can also be propagated by shield budding in the month of August.

Planting

Time of planting - December-January

Planting Distance - 5-7 m

Training and Pruning

It is trained in modified central leader system and trees are kept low headed. After giving proper shape to the tree, practically no pruning is needed except that the dead, broken and interfering branches are to be removed every year.

Manure and Fertilizers

In the bearing orchards, 20 tonne FYM/ha should be applied in alternate years in addition to 75kg N, 60 kg P₂O₅ and 60kg K₂O/ha. In absence of organic manure, the doses of N, P₂O₅ and K₂O may be increased to be doubled.

Irrigation

After fruit set 7-10 irrigations are required during growth and fruiting period. There is no need to irrigate during rainy and winter season.

Harvesting and Yield

Fruits are harvested in the month of September-October when their ground colour changes to deep orange. The fruits are then kept for 10-15 days at room temperature for softening and removing of astringency from fruits. The average yield of persimmon tree is 25 - 30 kg of fruit per tree.

Special Problems

Problem	Management
Fruit Size	For getting fruits of good size, thinning should be practiced with spray of NAA 25 ppm at full bloom stage.
Control of Fruit drop	Excess drop of fruit can be controlled by application of GA ₃ (100 ppm) at full bloom stage.

Kiwifruit

Kiwifruit (*Actinidia deliciosa*) originated in China, is a vigorous, climbing deciduous fruit vine. Ripe fruits have refreshing, delicate flavour, pleasant aroma and high nutritive and medicinal values. It is mostly used as fresh or combined with other fruits in salad and desserts.

Climate and Soil

The kiwifruit thrives well from 900-1800 m amsl where the climate is warm and humid. The satisfactory plant growth of kiwi vine takes place in areas which experience well distributed moderate to high rainfall or assured irrigation. Kiwifruit requires 600-800 chilling hours for successful fruiting. It requires sites free from spring frost with a well-drained sandy loam and well exposed to sunlight.

Varieties

It is a dioecious plant, and requires essentially planting of both male and female varieties in a single block.

Female varieties : Allison, Abbott, Hayward, Monty and Bruno

Male varieties : Tomuri, Matua and Allison

Propagation

Seeds extracted from well ripened fruits are stratified at 3-4°C for 40 days. The seeds are then sown in a growing media. The seedlings are used as rootstock and tongue grafted in the month of February. It can also be propagated through hardwood cuttings to be taken in the month of January-February, after treating with 4000 ppm IBA solution for 2-3 minutes. The percentage of rooting can be enhanced by maintaining high humidity (80-90 %) in the nearby area.

Planting

The plants should be planted during late winter to early spring in a pit of 1 m x 1 m x 1 m dimensions at 6 m x 4 m distance. Before planting, 40 kg FYM and 45 g DAP should be mixed into the soil per pit. Kiwifruit orchard rows should be oriented in north-south direction for maximum light distribution.

Training and Pruning

Training of kiwi vine is very important, requiring constant attention. The main aim of training is to establish and maintain a well formed framework of main branches and fruiting arms. Training also facilitates soil management, spraying and harvesting properly. The supporting branches should be erected even before planting the vines or thereafter as early as possible. Three types of supporting structure (fences) are constructed.

A single wire fence is commonly adopted though another wire is sometimes provided by some growers and then structure takes the form of

kniffin system. One 2.5 mm thick tensile wire is strung on the top of pillars which are 1.8- 2.0 m high above the ground. The pillars are made of wood, concrete or iron and are erected at a distance of 6 m from each other in a row. The wire tension at installation should not be over- strained otherwise wire can break at knot due to crop load.

A cross arm (1.5 m) on the pole also carries two outrigger wires. This training is known as T-bar or overload trellis/ telephone system. The laterals arising from the main branch are trained on canopy of three wires.

A flat topped network or crisscross wires is prepared to train vines on pergola or bower system. The system is costly and difficult to manage but gives higher yield.

T-bar

A strongly growing shoot is selected as a main trunk to carry the vine up to the wire. The trunk is staked to provide support and tied at frequent intervals, so that it does not twist around and grows straight. When the vine attains a height of 2 m and reaches near the wire, one permanent leader can be allowed to grow out in each direction along with centre wire. To achieve this, the leader can be trained one way along the wire and suitable placed shoot can be trained in opposite direction as the second leader. Alternately, the initial shoot can be cut just below the wire to force the production of two leader growths which can be trained as leaders along the wire.

From the permanent leaders, a system of temporary fruiting arms 25- 40 cm apart is developed, at right angle along both sides of each leader. These arms are tied down to the outrigger wires to hold them in position taking care not to break them out at their bases.

The leader should not be allowed to twist tightly around the wire or a restriction or sap flow in future years could result and weaken the vine beyond constriction. Using substantial shoots for training as leader hasten full development of fruiting arms and the time of full production. Growth may be relatively slow during first season but within 3-4 years the fence should be furnished with strong leaders and fruiting arms in each direction.

Pergola

Training of vines over pergola is similar to that of T-bar fence. The vines are grown as straight, single trunk until they reach a height of two meter near the top of the structure. A single, strong, permanent leader is then allowed to grow in each direction along the main wire.

To form the canopy of the pergola, a system of fruiting arm is developed from the leaders at right angle to the wire. Fruiting arms can be retained longer on pergolas and may be more permanent than on T-bar. On more permanent fruiting arms, temporary fruiting laterals are allowed to develop. It usually takes up to seven years for a pergola to become fully furnished with vine growth.

Pruning

The vine should grow 2-4 m every year which may become overcrowded and unmanageable if not controlled by both summer and winter pruning. The fruits develop only on current season's growth, arising from the buds developed in the previous year. Only basal 3-6 buds of the current season's growth are productive. The shoots developed on older wood by heading back do not fruit normally in the first season. Good quality fruits develop on the exposed vines. A shoot dies gradually if it is pruned just beyond the fruiting bud.

Thus pruning in kiwi should be carried out in such a way that the fruiting areas are available every year requiring the wood to be young. This is achieved by following a 3-4 year lateral replacement system which becomes a pruning cycle. In the beginning, a lateral arising from main rod is cut back in winter provide enough space for 4-5 fruiting shoots at 4-5 bud intervals between two such shoots. The strong uprights or the shoots arising at undesirable points are pruned in spring when they have not grown too long. This is more applicable to Hayward variety, in which the shoots of only medium vigour bear fruits. In others, vigorous shoots can be pulled back to horizontal position to convert them into fruiting wood. Thus the summer pruning constitutes in shortening back of fruiting arms, thinning out of crisscross and shading shoots. The secret of successful summer pruning is in the selection and encouragement of correct laterals to bear fruits in the next year and expose and vine to the sun.

In dormant pruning, the fruiting lateral is cut back to two vegetative buds beyond the last fruit. In the second year, these vegetative buds produce the fruiting shoots which are pruned again. The arms on the lateral shoot and allowed to fruit during third or fourth year. After this, the laterals are removed from the main branch and other laterals are selected and pruned accordingly so that the balance between vegetative and reproductive growth is maintained for the continuity in fruit production.

The fruiting laterals which have lost vigour or become over crowded are remove to encourage the development of new laterals. Since the fruiting arm is removed after the third year it implies that about one third of the total fruiting arms are cut away from the vine each year. These are cut back to permanent leaders. Dormant pruning must be completed by mid February each year.

Irrigation

After fruit set 7-10 irrigations are required during growth and fruiting period. There is no need to irrigate during rainy and winter season.

Pollination

Male and female plants should be planted in the ratio of 1:9 for adequate pollination. Placement of 9 beehives/ha in small groups of 3-4 colonies, after opening of 10-20 % flowers is sufficient for getting good crop.

Manure and Fertilizers

Age of vine (Years)	FYM (Kg/vine)	Urea (g/vine)	DAP (g/vine)	MOP(g/vine)
1	20	200	220	266
2	25	400	440	532
3	30	600	660	798
4	35	800	880	1064
5 and above	40	1000	1100	1330

Full dose of FYM, DAP, MOP and half dose of urea should be applied during January-February and remaining half dose of urea should be applied in the month of May.

Fruit Thinning

All cultivars bear heavily except Hayward. So, thinning should be done to 4-6 fruits/cane after attaining the size of wild pear fruit.

Harvesting and Yield

Generally fruit harvesting is done during November. The fruit when contain about 6.2°Brix TSS is considered ready for harvesting. Being a climacteric fruit, it takes 10-15 days to be ripened at room temperature after harvesting.

The yield of a kiwi vine varies from 50-100 kg fruit/year.