

FRUIT CROPS

(A) TROPICAL AND SUB-TROPICAL FRUITS



Banana. *Banana (Musa paradisiaca L.)* occupies over 1,64,000 hectares, mainly in Tamil Nadu, West Bengal, Kerala, Maharashtra, Gujarat, Karnataka, Assam, Andhra Pradesh and Bihar. Though some inferior types of banana are found growing as far north as the Himalayas, its commercial importance is mainly limited to the more tropical conditions, such as those prevailing in central, southern and north-eastern India. It is a moisture- and heat-loving plant and cannot tolerate frost or arid conditions.

VARIETIES. Cultivated varieties are broadly divided into two groups : table and culinary. Among the former are 'Poovan' in Madras (also known as 'Karpura Chakkarekeli' in Andhra Pradesh); 'Mortaman', 'Champa' and 'Amrit Sagar' in West Bengal; 'Basrai', 'Safed Velchi', 'Lal Velchi' and 'Rajeli' in Maharashtra; 'Champa' and 'Mortaman' in Assam and Orissa; and 'Rastali', 'Sirumalai', 'Chakkarekeli', 'Ney Poovan', 'Kadali' and 'Pacha Nadan' in southern India. 'Basrai', which is known under different names, viz. 'Mauritius', 'Vamankeli', 'Cavendish', 'Governor', 'Harichal', is also grown in central and southern India. Recently, the 'Robusta' variety is gaining popularity in Tamil Nadu and Karnataka. The 'Virupakshi' variety (Hill banana) is the most predominant variety in the Palni Hills of Tamil Nadu. Among the culinary varieties, Nendran bananas, 'Monthan', 'Myndoli' and 'Pacha Montha Bathis' are the leading commercial varieties in southern India. 'Gros Michel' is a recent introduction into southern India; it is suitable for cultivation only under garden-land conditions and is generally fastidious in its cultural requirements. It is not, therefore, in favour with the cultivation.

PROPAGATION AND PLANTING. Propagation is by suckers or off-shoots which spring at the base of a banana-tree from underground rhizomes. Vigorous suckers, with stout base, tapering towards the top and possessing narrow leaves, are selected for plant. Each sucker should have a piece of underground stem with a few roots attached to it.

Banana suckers can be planted throughout the year in southern India, except during summer, whereas in the rest of the country, the rainy season is preferred. They are planted in small pits, each just enough to accommodate the base of a sucker. The planting-distance varies from 2m X 2m in the case of dwarf varieties to 4m X 4m in the case of very tall varieties.

MANURING. An application of 20 to 25 kg of farmyard manure, together with about 5 kg of wood-ashes per plant is given at planting time. In southern India, ammonium sulphate is applied one month, five months and nine months after planting 20 kg per hectare each time. In western India, a little over 2 kg of oilcake per stool is applied during the first three months after planting. A complete fertilizer mixture may be applied to supply 100 to 200 kg of N, 100 to 200 kg of P₂O₅ and 200 to 400 kg of K₂O per hectare. A green-manure crop is also considered beneficial. Trials at the Indian Institute of Horticultural Research have shown that for the 'Robusta' variety, a fertilizer mixture comprising 180 g of N + 108 g of P₂O₅ + 225 g of K₂O per plant is ideal.

AFTER-CARE. The removal of suckers, dry leaves and pseudostems, from which the fruits have been harvested, constitute the main after-care. Daughter-suckers should be removed promptly until the mother-plant flowers, when one daughter-sucker may be allowed to take its place. The removal of dry leaves and useless pseudostems requires to be done in time. After all the fruits are formed, the pendant portion of the remaining inflorescence along with the heart should be removed.

The propping of plants with bamboo poles, especially those which have thrown out bunches, is necessary wherever damage by wind is apprehended. Where the wind damage is recurring, dwarf varieties should be preferred.

IRRIGATION. The banana-plants require very heavy irrigation. Irrigation is given in most places once in seven to ten days. Stagnation of water in the soils is not very congenial to the proper growth of banana and, hence, the drainage of soil is also essential.

HARVESTING. Early varieties commence flowering in southern and western India about seven months after planting, and the fruits take about three months more to ripen. In the Andhra Pradesh delta areas, the fruits are ready for harvesting about seven to eight months after planting. The first crop of the 'Poovan' variety matures in 12 to 14 months and the second in 21 to 24 months after planting. In other parts of India, the first crop is usually gathered a year after planting, whereas the succeeding crop may be ready in six to ten months thereafter.

The bunch is harvested just before it attains the ripening stage. When the fruits have reached the full size, they become plump, and mature with a distinct change in colour. For long transport, the bunch may be harvested somewhat earlier. The bunch is cut, retaining about 15 cm of the stem above the first hand. The yield varies considerably from 26,000 to 55,000 kg per hectare.

CURING AND MARKETING. The ripening of banana is done in several ways, e.g. exposing the bunches to the sun, placing them over a hearth, wrapping them in closed godowns or smoking them in various ways. One of the common ways is to heap the fruits in a room and cover them with leaves, after which fire is lit in a corner and the room is closed and made as air-tight as possible. Ripening takes place usually in 30 to 48 hours. In a cool store, the bunches ripen well at about 15° to 20°C. The application of vaseline, a layer of clay or coal-tar to the cut-ends of the stalks prevents rotting during ripening and storage.



Wrapping up the fruits and packing them in crates help to reduce the damage during transport.

MANGO - *Mango (Mangifera indica L.)* occupies nearly half of the total area under fruits in the country. It is adaptable to a wide range of soil and climatic conditions and grows well right from Assam to the southern-most limits of the country and from the sea-level up to about 1,500 metres. It withstands both fairly dry conditions and heavy rainfall, provided severe and recurring frosts in winter do not endanger the young trees.

VARIETIES. The number of varieties is very large. Each variety has its own peculiar taste, flavour and consistently of pulp. Some of the important commercial varieties grown in different regions are : 'Bombay yellow', 'Alphonso', 'Gopal Bhog', 'Zafran' (all early), 'Langra', 'Desheri', 'Safeda Lucknow', 'Safeda Malihabad', 'Fajrizafarani' (all mid-late), 'Fajri', 'Same Bihisht', 'Chausa', 'Taimura' (all late). In Uttar Pradesh; 'Bombai', 'Alphonso', 'Hemsagar', 'Krishna Bhog', 'Aman Dasher', 'Gulab Khas' (all early), 'Langra', 'Aman Abbasi', 'Khasul-Khas' (all mid-late), 'Sinduri', 'Sukal', 'Taimuria' (all late) in Bihar; 'Bombai' or 'Maldah', 'Gopal Bhog', 'Hemsagar' (all early), 'Krishna Bhog', 'Zardalu' (both mid-late), 'Murshidabadi', 'Fazli Maldah' (both late) in West Bengal; 'Alphonso', 'Pairi', 'Cowsji Patel', 'Jamadar' in Bombay; 'Swarnarekha', 'Benishan', 'Cherukurasan', 'Panchadarkalasa', 'Desavathiyamamidi', 'Sannakulu', 'Nagulapalli', 'Irsala' in Circars; 'Rumani', 'Neelum Benishan', 'Bangalore', 'Alampur Benishan' in Rayalaseema; 'Murshidabadi', 'Mulgoa', 'Goabunder', 'Benishan', 'Neelum', 'Totapuri' or 'Bangalora' in Telengana; 'Alphonso', 'Peter', 'Rumani' in central districts; 'Mundappa', 'Neelum', 'Alphonso', 'Olour', 'Bennet Alphonso', 'Kalepad', 'Peter', 'Fernandin' in Coorg and Karnataka; and 'Padiri', 'Alphonso', 'Peter', 'Neelum', 'Bangalore', 'Rumani' in Tamil Nadu. In Goa, some excellent varieties like 'Alphonso', 'Fernandin', 'Mankurad' and 'Moussorate' are under cultivation. The new mango variety, 'Mallika' evolved at the Indian Agricultural Research Institute is now gaining popularity.

Other varieties, such as 'Jehangir' and 'Himayuddin', produce high-quality fruits, but are poor in yield and cropping tendencies. Attempts are being made to evolve hybrid progenies by crossing.

PROPOGATION AND PLANTING. Propogated vegetatively by inarching or budding *in situ* in the nursery, either by using Forkert or by using the T-method. The beginning of the monsoon in light-rainfall areas and the end of the monsoon in heavy-rainfall regions are the most suitable periods for inarching or budding. Recently, veneer-grafting has been found to be the best method of mango propagation. Grafted plant are ready for transplanting in the field after six to twelve months. Select straight-growing grafts and set them in pits filled with soil mixed with farmyard manure (45 kg) and a fertilizer mixture containing 0.225 kg of N, 0.45 kg of P and 0.225 kg of K per pit. The planting-distance is 7.5 to 9 metres in poor shallow soils and 15 to 17 metres in deep fertile soils. The beginning of the monsoon in low rainfall areas or the end of the monsoon in heavy rainfall tracts is the best time for planting. The graft-joint should be at least 15 cm above the ground.

PRUNING. No systematic pruning is done. The removal of dead-wood and the thinning of over-crowded and mis-shapen branches after about four years is all that is necessary; flowers that appear during the first three or four years should be removed.

CULTURE. Before planting, the field is ploughed, harrowed and levelled. Thereafter, it is ploughed and harrowed twice a year, once in the beginning of the monsoon and again at the close of the rainy season or in the cold-weather. It is green-manured once every two or three years. Short-season intercrops, like vegetables, may be taken during the first four to five years. Young plants require irrigation regularly. After five to six years, when they have established themselves, the trees are able to grow and fruit satisfactorily without irrigation in most parts of Peninsular India. In northern India, they have to be irrigated throughout their life. Irrigation is usually withheld during the cold weather before flowering, especially in deep retentive soils. Though the exact manurial requirement is not known, regular manuring is beneficial. The dose recommended for the bearing trees is 45 to 70 kg of farmyard manure, 0.5 to 0.7 kg of N, 0.7 kg to 1.0 kg of P and 1.2 to 1.5 kg of K per tree. Nitrogen and half of potash may be given before the monsoon, and farmyard manure, phosphate and half of potash in October or before flowering starts.

CROP IRREGULARITY. Grafted mango-trees bear fruits from the fourth or fifth year onwards and a full crop from the tenth or fifteenth year. The erratic bearing of mango is well known. It depends upon the variety, the weather and climatic conditions and cultural treatments. The selection of regular-bearing varieties, timely cultural practices and proper nutrition help to produce a regular crop. New growth in spring, on which flower-buds are produced during the next winter, can be encouraged by applying nitrogenous fertilizers (0.45 to 0.90 kg of N per tree). In the case of heavy late rains, an additional ploughing in winter helps to produce flower-buds in January-February. In the case of individual trees, ringing or girdling in August-September may also help to force flower-buds the following winter. The application of Ethrel (200 ppm) from September onwards has been found to induce flowering in mango in Karnataka by the Indian Institute of Horticultural Research.

IMPROVEMENT OF OLD AND SEEDLING-TREES. Mango-trees of inferior varieties, so also those raised from seedlings, can be converted into choice varieties by grafting them *in situ* either by crown or side-grafting. In crown-grafting, the trunk of the tree is cut down to about half a metre from the ground and one or more scions of the selected variety are inserted into it between the bark and the wood by splitting open the bark. The scion should be a dormant, terminal shoot, about 12.5 mm in diameter, with a whorl of plump swollen buds at the top. In side-grafting, the procedure is the same as in crown-grafting, except that the trunk of the stock tree above the grafting joint is cut down after the scions have sprouted and have established themselves properly. Old trees, having several branches, can be similarly improved (top-worked) by crown-grafting on each branch at a suitable height. Sometimes, the grafting is done by inarching, but the process is cumbersome, expensive and not very satisfactory.

HARVESTING AND MARKETING. The fruit takes five to six months to mature. Depending upon the onset of flowering, the mature fruits are ready for harvesting from April to May in western India, from May to June in the Deccan, from February to March in Malabar, from April to July in the coastal Andhra Pradesh, from May to August in Mysore and Rayalaseema, and from June to August in northern India. The mature fruits are harvested by severing the stalks to which they are attached, when they are still green and hard. The signs of maturity vary with different varieties. As a mango tree usually bears flowers in three or four distinct flushes lasting over a month, it is preferable to harvest the fruits as they mature. The fruits, so harvested, can be transported after packing them in baskets or wooden crates, properly padded with straw, wood-shavings or wool, to long distances. For overseas markets, they are packed in a single layer in specially designed wooden crates.

For ripening, the fruits are spread out on rice straw in a single layer. Two or three such layers are built one above another in a well-ventilated room. The mangoes are ready for disposal after they change colour.

Yield varies considerably with the variety, vigour of growth, flowering, etc. A grafted tree yields about 300 to 500 fruits in the tenth year, about 1,000 in the 15th year and 2,000 to 5,000 from the 20th year onwards.

CITRUS FRUITS

Citrus is grown in almost all the states of India. The total area covered is over 67,650 hectares, of which Madhya Pradesh, Madras and Maharashtra have the largest share. Citrus trees are grown in almost all kinds of soils, varying from heavy black soils to shallow open soils. Some of the varieties of citrus seem to adapt themselves to soil conditions better than others. They thrive in free-draining alluvial or medium black soil of loamy texture. A hard substratum or a sticky impervious layer is very injurious. Soils having a high water-table should be avoided. Though citrus trees on the whole do well in dry climate, with a rainfall between 75 and 125 cm, certain species, such as pummelo and certain mandarin oranges, thrive in heavy-rainfall areas of Konkan, Assam and Coorg.

Grapefruit. The name grapefruit (*Citrus paradisi* Macf.) has been derived from the habit of bearing the fruit in clusters like grapes. In India, its introduction is comparatively recent, and its cultivation is confined mostly to Punjab, the western parts of Uttar Pradesh and to places around Poona in Maharashtra.

CLIMATE AND SOIL. The climatic and soil requirements of the grapefruit are similar to those of the orange. High rainfall and humidity are harmful, as they encourage diseases.

VARIETIES. The popular varieties, which are all imported, are 'Marsh Seedless', pink-fleshed 'Foster' and yellow-fleshed 'Duncan'.

PROPOGATION AND PLANTING. Propagation is done by budding. However, owing to their polyembryonic nature, seedling trees have been frequently found to be quite satisfactory. The rootstock most successfully employed in the northern regions is *kharna khatta* (*Citrus karna* Raf.). In the south and Bombay-Deccan, 'Jamburi' is commonly employed, whereas in Assam grapefruit does well on Rabab tenga.

Planting, irrigation, manuring and interculture are the same as for the orange.

PRUNING. Grapefruit trees require less pruning than orange-trees.

HARVESTING AND MARKETING. The harvesting season is from January to March in the north and from September to November in the south. Picking, packing and other operations are the same as for the orange. Quality and flavour of the fruit is improved if it is stored before transporting.

Lemon (*Citrus limon* (L.) Burm.f) is not cultivated to any great extent in India, as it requires a comparatively cool climate for regular bearing. Its fruit is not so highly flavoured as that of sour lime.

Lime. The lime (*Citrus aurantiifolia* Swingle), both sour and sweet, known as *kaghzi nimboo* and *mitha* respectively, are more orized in India than lemon. Sour lime is propagated mainly from seed. Budding on rough lemon rootstock, layering and morcotting are also practiced to some extent. The tree is susceptible to frost. It flowers twice a year in February-March and again in August. The main crop is obtained in August from the first flowering. The second crop is ready in the following February.

The propagation of sweet lime is done from mature wood cuttings which root readily. It can also be propagated from seeds and the seedlings, usually come true to type. Planting of limes and their pruning, manuring, etc. are the same as for the sweet orange.

Mandarin orange.

CLIMATE AND SOIL. *Santra* or mandarin orange (*Citrus reticulata* Balanco) grows successfully in all tropical and subtropical parts of the country. It tolerates more humidity in summer and winter than the sweer orange. It is grown under rain-fed conditions in Coorg, Wynad tract, Palni Hills and the Nilgiris in the south between elevations of 600 and 1,500 metres. In Assam, the main centres of production are the Khasi, Jaintia and Lushai Hills. The region around Nagpur (elevation about 370 metres) produces a superior quality of mandarins. It is mainly grown under irrigation. In Punjab, its cultivation is confined mainly to the submontane districts up to about 600 metres. It can be grown successfully on a wide range of soils, but the ideal soil is medium or light loam with a slightly heavier subsoil. Heavy black soil, underlain with murrum and having good drainage, is also suitable. In the Khasi Hills of Assam, oranges are grown on sandy or gravelly soils.

VARIETIES. The important varieties cultivated on a commercial scale are the 'Nagpur' orange, the 'Khasi' orange, the 'Coorg' orange, 'Desi Emperor' and the 'Sikkim' orange.

PROPOGATION. The propagation of mandarin orange is largely through seed, except the 'Nagpur' and 'Emperor' varieties which are propagated by budding. Like other citrus species, the seed is polyembryonic. Therefore, while propagating by seed, the sexual seedlings which are usually stunted and poor are rogued out and the rest that are produced from the cells of the nucellus are allowed to grow. The seedlings, thus selected, are more or less uniform in growth and production. They are, however, late in bearing and remain tall and slender. Budded plants do not suffer from these defects. The *santra* orange is usually budded on rough lemon (jambhiri, Soh-myndong or *jatti khatti* rootstock. The variety 'Emperor' is budded on the *kharna khatta* rootstock. Studies at the Citrus Experiment Station, Coorg, of the Indian Institute of Horticultural research, has shown that trifoliate, Rangpur lime, Kodakthuli and Troyer citrage are good rootstocks for mandarin.

PLANTING. In the hills and humid regions, where plantings are generally done on steep slopes, the land is properly terraced. In the plains, where the trees have to be irrigated, the land should be levelled. The trees are usually transplanted during the monsoon. In heavy-rainfall areas, the plantings is generally done at the end of the heavy rains. They are planted 4.5 to 6 metres apart.

PRUNING. Prune young trees to build up a strong framework, as recommended for sweet orange. The bearing trees require little or no pruning. Undesirable growths, like water-shoots and crossing branches, should be removed once or twice a year.

In Bombay-Deccan, root exposure or resting treatment is given to *santra* trees to make them flower to order. The treatment is the same as for the sweet orange.

MANURING. Farmyard manure, 20 to 25 kg per tree, is applied at planting, together with about half a kilo of ammonium sulphate. A mixture supplying 0.09 kg each of N, P and K per tree may be applied in the first year after planting, and the dose is gradually increased to 0.45 kg of each N and P and to 0.90 kg of K per tree in the seventh year and kept constant thereafter. The dose of farmyard manure is increased to 50 kg per tree. It may be replaced by green manuring.

In northern India, manuring is generally done in winter, whereas in Bombay-Deccan it is done before the advent of the monsoon or at the time of root exposure.

IRRIGATION. When grown under irrigation, the method and frequency of application of water are the same as described under sweet orange.

HARVESTING. Seedling trees bear their first crop in the eighth year and the full crop from the tenth year onwards. Budded trees start bearing from the fourth year and full crop is had from the seventh year onwards. The harvesting periods differ in different parts of the country.

While picking the fruit, the stem-end should be cut close to the fruit without damaging rind. Packing is done by putting the fruits of different size grades in separate wooden crates.



SWEET ORANGE (*Citrus sinensis* (L.) Osbeck) is grown under both subtropical and tropical conditions. Dry and arid conditions, coupled with distinct summer and winter having low rainfall, are most favourable to the growth of the sweet orange. Rainfall seems to be unimportant if irrigation is provided, but atmospheric humidity exerts a great influence.

The sweet orange can be grown on a wide range of soils, from heavy clays to very light sands, with pH ranging from 6.0 to 8.0. The tree is particularly sensitive to high concentrations of salts and cannot stand water-logging.

VARIETIES. The important varieties of sweet orange grown in each region are 'Blood Red', 'Pineapple', 'Hamlin', 'Jaffa' and 'Valencia Late' in northern India, *mosambi* in Western India and 'Sathgudi' and 'Batavian' orange in southern India.

PROPOGATION AND PLANTING. Usually, propagated by budding. The most suitable rootstock is Jamberi or *jatti khatti*. For 'Pineapple', 'Hamlin', 'Jaffa' and 'Valencia Late' varieties, *kharna khatta* also provide a suitable rootstock. The trees are planted 6 to 7.5 metres apart each way in January or August-September in the north and in July-August in the south. The bud-union should be kept at least 15 cm above the ground while planting.

PRUNING. The pruning of citrus-trees begins in the nursery. All branches that start within a few centimetres of the union are removed, leaving about a half a metre of clean straight stem with a few well-placed branches. All unwanted branches are removed once a month during the first year after planting, and once in two to three months in subsequent years.

The bearing trees require little or no pruning. After the crop is picked, the branches touching the ground should be cut close to the laterals so that no stubs are formed. All diseased, injured and crossing branches, water-sprouts and dead wood should be removed periodically.

ROOT EXPOSURE In the Bombay-Deccan region, root exposure is given to the trees to bring them into flowering at a particular time of the year. Water is withheld for about two months in advance of the normal flowering season, and after about a month, the roots are exposed by removing about 10 cm of the soil in the case of light soils and about 20 cm in the case of heavy soils. After about 10 days, the soil is returned mixed with manure, and a light irrigation is given. After four or five days, a more copious watering is given, followed by 10 days later by the full dose of water. In the case of light soils, the withholding of water without root exposure is sufficient to check vegetative growth and force blossoming.

In southern India, no root exposure is given nor is it feasible. In the north, the root-exposure treatment is not necessary as the trees normally rest in winter and flower once a year. It should be mentioned that in most situations, the root exposure of citrus trees is a devitalizing process and should be resorted to only under expert advice and direction.

MANURING. Manuring may be followed as in the case of the *santra* orange.

IRRIGATION. After the first heavy irrigation given soon after planting a second light watering follows in four to five days. Thereafter, irrigation is given at regular intervals, depending upon the source of water and the nature of the soil. Under well irrigation, water is given after every eight days in hot months and about 12 to 15 days in cold months. Where irrigation is from canals, the usual interval is about 14 days. A light soil requires irrigation more often than a heavy soil. Excess watering should be avoided, especially in heavy soils.

When the trees are young, irrigation water is applied in basins of about one-metre radius. The basins are enlarged as the trees advance in age. In the ring method of irrigation a bund is formed about three-fourths of a metre away from the trunk to prevent water from touching it. The furrow method ensures a more even distribution of moisture in the soil.

HARVESTING. Trees begin to bear fruits from the fourth year onwards, but normal crops are borne from the seventh year. The main harvesting season in the north is December to February, whereas in the south, it is October to March. In the Bombay-Deccan region, there are two main seasons, November to January for *ambe bahar*, and March to May for *mrig bahar*

Picking may be done any time during the day, taking care that the stem is cut close to the fruit without damaging the rind. The fruits are washed, dried and graded for size and packed into wooden cases for disposal.



GRAPE (*Vitis vinifera* L.) is a subtropical fruit which grows well in dry climates having a short sharp winter and a long dry summer. The vines shed their leaves and rest in winter, put forth new growth in spring and mature in summer. Grape does not thrive in regions having humid summers. It tolerates frost during the resting period, but succumbs to it readily during its growing period. In India, however, it grows under varying climatic conditions. In Punjab, Uttar Pradesh and Himachal Pradesh, it grows and fruits once a year in summer, and rests during winter. In southern India, where it is cultivated mainly in Maharashtra, Hyderabad-Deccan, parts of Karnataka and Tamil Nadu, the vine grows throughout the year and bears two crops, the first in April and the second in August-September.

The grape grows best on light, friable loamy soils with free drainage. Heavy soils are unsuitable.

VARIETIES. Varieties suitable for different regions of the country are :

1. *Northern plains* : 'Black Prince', 'Bedana', 'Foster's seedling', 'Kandhari Dakh' and 'Muscat of Alexandria', 'Perlette'.
2. *Dry and temperate regions* : 'Thomson Seedless', 'Sultana' and 'Kishmish White'.
3. *Southern plains* : 'Bangalore Blue', 'Pachadraksha' and 'Anab-e-Shahi', 'Gulabi', 'Black Champa', 'Thompson Seedless'.
4. *Western plains* : 'Cheema Sahebi', 'Anab-e-Shahi', 'Thompson Seedless'.

PROPAGATION AND PLANTING. The vine is usually propagated by cuttings. In northern India, cuttings are made from one-year-old wood at the time of pruning in February, when the vines are dormant. The cuttings are tied in bundles and stored in moist sand for about a month for callusing. The callused cuttings start well in the nursery. Elsewhere in India, they are obtained from the prunings in October and planted in nursery for rooting. The cuttings are ready for transplanting in January. It is also possible to raise a plantation by planting cuttings *in situ* in the field.

PLANTING. The rooted cuttings are transplanted in northern India in January and February when they are dormant. The planting-distance varies according to the method of training involved. It is 2.5m X 3.0m, if vines are trained on the head system and 6m X 6m, for the overhead pergola. In western India, it is 25m X 1m for the avenue system. In Karnataka, it is 4.5m X 6m and in Tamil Nadu 4.5m X 7.5m for the overhead arbour system.

TRAINING AND PRUNING. The most popular systems of training are :

1. *Head system.* The vine is trained in the form of a dwarf bush. It is allowed to grow into an upright stem with the help of a support and the developing shoot is cut off at a height of 1 to 1.25 m in July. It is allowed to develop three to four lateral branches, each about 0.45 m long, arranged in the form of a vase or goblet. At the first dormant pruning in February, the lateral branches are shortened to spurs with one to two buds each. These spurs provide suitable arms for the framework during the succeeding summer. At the second dormant

pruning, eight to ten arms, with one to two spurs on each arm, are retained for cropping in the third year. This system is cheap, but yields are poor. It is practiced in northern India on varieties which fruit on the first few buds of the cane

2. *Cane system*. This system is suitable for training on a two-wire trellis. The trunk is headed back, as in the head system; four arms, two on each side of the trunk, are allowed to develop and are pruned to a 30-m length after a year. Fruit canes, each carrying 10 to 20 buds, develop on each arm which is tied to the trellis wire. A renewal spur is left on each arm just below the cane for the next year's crop.

3. *Cordon system*. After the vine has reached a height of 0.5 to 1 m, the stem is bent and is trained along the single-wire trellis. On each arm that develops from the trunk, short fruiting spurs, each carrying two to four buds, are allowed to remain at the time of pruning. The replacing spurs are also provided close to the base of the fruiting spurs.

4. *Pergola system*. In the pergola, arbour or bower system, the vine is allowed to develop into two or three branches, about 1 m from the ground. The branches are fastened to the horizontal wires of the pergola and allowed to grow and spread on the roof. The branches that grow on the arms are pruned each year according to the mode of bearing of the variety planted.

Pruning is usually done in northern India once a year in spring before the new growth starts. In Peninsular India, grapevine is pruned twice a year, once in summer and again in October, the exact period being decided by the distribution of rainfall.

Sometimes, the girdling or ringing of a cane is carried out to hasten maturity and to improve the size and quality of berries.

IRRIGATION. The grapevine should be regularly irrigated. It is necessary to regulate the water-supply carefully both when the vine is in flower and when the bunches are ripening. Too wet a soil during those periods is not desirable.

MANURING. In addition to the farmyard manure (25 to 30 kg), a dose supplying 0.07 to 0.09 kg of N, 0.54 to 0.57 kg of P and 0.135 to 0.18 kg of K per vine at pruning is recommended. Green-manuring may be done whenever feasible.

TIPS FOR SUCCESSFUL GRAPE-GROWING. (1) The cuttings for planting should be selected from one-year-old dormant wood from healthy bearing vines.

(2) Pruning of the vines should be regulated to suit the bearing habit of each variety. The timing of pruning should be so regulated as to avoid the vines coming into blossom when the days are characterized by dewfall.

(3) A portion of the berries at the tip of each bunch may be thinned to ensure more effective spraying against diseases.

HARVESTING AND MARKETING. The fruit is ready for picking after the berries near the tip have changed colour and have become sweet. The picked fruit should not be exposed to the sun and, if it is to be sent to a distant market, it should be packed in sawdust. Yields vary largely, depending upon the variety, the locality and upon a host of other factors. Yields even up to 40,000 kg per hectare have been obtained, though 15,000 kg may be considered an average. A single vine at Coimbatore has been known to yield more than 800 bunches in a single season.



Guava. (*Psidium guajava* L.). The total area under guava in the country is about 30,000 hectares, of which Uttar Pradesh has the largest area (9,840 hectares), followed closely by Bihar (4,800 hectares). It is a very hardy tree, withstanding heat and prolonged droughts, but is susceptible to frost. A cool winter induces heavy fruiting. It grows in all types of soils having pH ranging from 4.5 to 8.2. Its fruit is rich in vitamin C (35 to 100 mg per 100 g) content.

VARIETIES. 'Lucknow-49', 'Allahabad Safeda' and 'Seedless' are white-fleshed varieties. Several types having pink flesh and white flesh with bright red skin are also known.

PROPAGATION AND PLANTING. Guava is propagated through seed, and also vegetatively. Inarching, layering and air-layering are commonly practiced. Propagation through root suckers, root cuttings and budding is sometimes successful. Propagation is generally done during the rainy season. The new plants are ready to be set out after a year. The usual distance for planting is 5.5 to 6 metres.

CULTURE. The growing of a green-manure crop during the rainy season, and clean cultivation during the rest of the year are recommended. One or two irrigations between the end of the monsoon and the harvesting (winter) are given in northern India. In southern India irrigation throughout the year is necessary. In addition to bulky organic manures, the use of 45 to 60 kg of N, 77.5 kg to 90 kg of P and 100 kg to 110 kg of K per hectare is recommended.

PRUNING. Young trees require pruning several times a year to prevent the formation of long and slender branches. As the fruit is borne on new growth, heavy pruning of the bearing trees increases fruiting. All flowers should be removed until the framework becomes strong enough.

HARVESTING. Fruits must be plucked as they ripen. Plucking extends over several weeks. For long-distance marketing, it is necessary to harvest the fruit somewhat earlier. Yields of 22,000 kg per hectare have been reported.



Papaya. (*Carica papaya* L.). Papaya occupies a very small area, yet its cultivation is widespread in the country. It grows well almost everywhere, except at altitudes higher than 1,500 metres. It cannot tolerate low temperatures. A dry warm climate is necessary. Strong winds are highly detrimental to the trees as the hollow stems break easily. Even though the tree is adapted to a wide range of soils, it grows best in the loamy soil. Deep clayey soils that are prone to water-logging should be avoided. In heavy-rainfall areas, a prolonged stagnation of water near its stem is highly injurious.

VARIETIES. 'Washington', 'Honey Dew' (Madhubindu), 'Coorg Honey Dew', 'Singapore' and 'Ceylon' are important varieties. C.O.I., an improved strain of the Ranchi type has been evolved at Coimbatore. The varieties do not remain pure under the existing state of cultivation and give rise to varieties, both in tree and fruit characteristics.

SEX VARIATION. The papaya plant is normally unisexual. Some plants bear male flowers and some female. Occasionally, a plant with hermaphrodite flowers (having both male and female organs) may occur. The proportion of plants with male, female and hermaphrodite flowers varies with the variety. The proportion of fruit-bearing female plants of any variety varies from 40 to 60 per cent. The plants of 'Coorg Honey Dew' are either female or hermaphrodite and, hence, every plant yields fruits.

PROPAGATION AND PLANTING. Papaya is propagated through seeds. About 100 to 200 grammes of seed is required for an acre of plantation. Seeds obtained from mature large fruits, borne on female plants, are usually the best. The best time for raising seedlings is the monsoon period. The seedlings are ready for transplanting in four to six weeks, when they are 20 to 30 cm tall. They are lifted with a ball of earth around the roots; most of their leaves are clipped off, and they are planted in small holes made in the field 2.5 to 4 metres apart. Four seedlings may be planted in each hole about one-third metre apart from one another. After the plants have flowered, all male plants, except a few required for fertilizing the female plants, are pulled out. One male tree for every 10 to 20 female trees is sufficient. Transplanting is best done in the monsoon. The practice of planting four seedlings in one hole is not required for varieties, e.g. 'Coorg Honey Dew', which do not produce any male plants.

CULTURE. Papaya plants are irrigated once in every 10 to 12 days in winter and six to eight days in summer. To avoid stagnation of water near the trunks, the basin may be made to slope away from it. Nine kg of farmyard manure per pit is applied at the time of planting, followed by 35 to 45 kg of it every six months, once at the beginning of the monsoon and again in winter. A fertilizer mixture to supply 25 to 50 kg of N, 50 to 100 kg of P and 50 to 100 kg of K per hectare may be given in two equal doses every six months. The removal of weeds and a light or shallow ploughing or harrowing once or twice a year are necessary. Low-growing vegetables of short duration may be taken as intercrops. An occasional thinning of fruits is necessary to prevent overcrowding. Papaya may itself be grown as a 'filler' or in plantation of other crops where spacing is wide enough.

HARVESTING AND MARKETING. Papaya flowers in about four months after planting and fruits are ready for harvesting in another six months. Except during winter, the trees continue to flower and fruit all the time. Fruits are picked when they are still hard and green, but show a distinct change in the colour of the rind. Yield varies from 30 to 150 fruits per tree. The packing of fruits in baskets in several layers should be avoided. A soft padding, such as of wood-shavings, wool or straw is recommended.



Pineapple. Pineapple (*Ananas comusus* (L.) Merr.) occupies about 12,000 hectares and is grown mainly in Assam, West Bengal, Tripura, Uttar Pradesh, Andhra Pradesh, Kerala and Karnataka. It is a humid tropical plant and grows well, both in the plains and

also at elevations not exceeding 900 metres. It tolerates neither very high temperatures nor frost. It grows in almost any type of soil, provided it is free-draining.

VARIETIES. 'Kew', 'Queen' and 'Mauritius' are the three popular varieties. 'Kew' produces large fruits and is mostly used for canning. The other two have smaller fruits which are considered to be of superior quality. 'Kew' is a late-fruiting variety. 'Queen' is early, while 'Mauritius' is intermediate.

PROPAGATION AND PLANTING. Pineapple is commonly propagated from suckers or slips. Suckers arising from the underground parts of the plant are commonly used. Slips arise from the fruiting stem and from the crown on top of the fruit. After the fruit is harvested, stalks are cut into discs and used for propagation. Plants grown from suckers produce fruits in about 18 months, whereas those from slips and suckers propagated from disc cuttings take over two years.

Suckers or slips are first cured by stripping off the lower leaves, followed by drying in the sun, or in partial shade for three to four days before planting. They are planted either in flat beds, where there is no danger of water stagnation, or in shallow trenches which are filled as the suckers grow and develop. Care should be taken to see that the bud or 'heart' of the suckers does not get buried. A planting density of 43,500 plants per hectare can be followed, keeping a distance of 30 cm between plant and plant, 60 cm between rows and 90 cm between beds. The rainy season is the best time for planting.

CULTURE. The field is prepared by ploughing, harrowing, etc., before planting. In the hills, proper terracing is a necessity. In dry regions, the crop requires regular irrigation. Even when rain-fed, irrigation during the dry weather is necessary every week or ten days. Twenty-five to 50 tonnes of farmyard manure per hectare is applied in two doses in the 6th and 12th month after planting. Sixteen grammes of N and 2.5 g of K₂O per plant should be applied. Of these, part of the nitrogen can be applied as foliar application as 4% urea. Only two suckers are retained on each plant for the ratoon crop. After harvest, the plants are earthed up to stimulate the rooting of the ratoon suckers. The plantations is allowed to remain on the same site for four to five years after which it is renewed.

INDUCTION OF FLOWERING. Uniform flowering can be obtained by the application of NNA (Planofix), calcium carbide or Ethrel (100 ppm) at the 45-leaf stage.

HARVESTING AND MARKETING. Pineapple usually flowers from February to April and the fruits are ready from July to September. Sometimes, off-season flowers appear, and they produce fruits in September-December. The fruits are harvested when they just begin to yellow and the eyes become full and the bracts wither. The fruit is cut clean, retaining with it about 5 cm of the stalk.

The yield is 12 to 17 tonnes per hectare in the case of the two smaller varieties and 25 to 30 tonnes per hectare in the case of 'Kew' in the first year. With a high population density, even about 85 tonnes of fruit can be obtained. Fruiting decreased progressively in the case of the ratoon crops. For transport, the fruits are wrapped up in straw and packed in bamboo baskets or crates in one or two layers.



Sapota. *Sapota (Achras zapota L.)* known popularly as *chiku* in western and central India, is adaptable to a large variety of conditions of soil and climate. It flourishes in the heavy-rainfall areas of western and southern India and grows equally well in the drier parts of the Peninsular India. It is an evergreen, growing and flowering almost throughout the year. Rain or cloudy weather does not harm the setting of fruits. Young plants are easily injured by frost, but grown-up trees can withstand frost of a short duration. Its soil requirements are not very exacting, but it grows best in alluvial or sandy-loam

soilshaving good drainage.

VARIETIES. 'Cricket Ball' and 'Dwaropudi', both with round fruits, are common in Tamil Nadu, whereas 'Bangalora', 'Vavila Valasa' (both oval-fruited), 'Jonnavalasa' (round-fruited), 'Kirtabarati' and 'Pot' (dwarf trees) are recognized in Andhra Pradesh. In western India, 'Kalipatti' and 'Chatri' (both oval-fruited) are well-known varieties. The variety 'Cricket Ball' does very well in Karnataka.

PROPAGATION AND PLANTING. Propagated by layering, *gootes* (air-layering) or inarching. Side-grafting and budding are also possible. Rootstocks employed are rayan or manikara (*Manilkara hexandra* or mohwa (*Bassia latifolia* and *B. longifolia*). The second and third species are not recommended, as they are not compatible with the sapota scions. In northern India, the planting-distance is 4.5 to 6 metres, whereas in the south, it is 9 to 12 metres. In northern India, the young plant must be suitably protected against frost and hot winds after planting.

CULTURE. Before planting, the field is ploughed, harrowed and levelled. Irrigation is given every six to twelve days, except during the rainy season. The removal of weeds and the loosening of the soil by ploughing or harrowing are done once or twice a year. Manures and fertilizers are applied, as recommended for mango. For the bearing trees, half of the dose is applied in October-November and the other half in February-March or before the monsoon. Intercrops of vegetables may be taken for the first six to ten years. No pruning is necessary.

HARVESTING AND MARKETING. Substantial fruiting starts from the fourth or fifth year. The fruit takes four months to mature. Flowers appear throughout the year, but the crop is available for harvesting in two to three seasons, i.e. northern and central India, March-April and August-September; in southern India, February-June and September-October and in western India, January-February and May-June. The yield varies from 200 to 300 fruits in the fourth year, from 700 to 800 in the seventh year, from 1,500 to 2,000 between the tenth and 15th year, and from 2,500 to 3,000 from the 20th to 30th year. Mature fruits show a yellow streak, whereas the immature fruits show a green streak when scratched with the fingernail.

For distant markets, the fruits are packed in bamboo baskets immediately after picking, using straw as padding. Oval and round fruits may be separately packed.



Pomegranate. The largest area under pomegranate (*Punica granatum* L.) about 500 hectares, is in Maharashtra, but there are small plantings in almost all parts. Where winters are cold, the tree is deciduous, but in the plains, it is evergreen. A hot, dry summer produces the best fruits. The presence of many seeds and of tannin in the rind and membranes detracts from its attractiveness. The tree can stand considerable drought.

Climate

Pomegranate is sub-tropical fruit. It can adopt itself to a wide range of climatic conditions and can grow up to 1800 m above sea level. The fruit tree grows best in semi-arid climate where cool winter and hot and dry summer prevail. The tree requires hot and dry climate during the period of fruit development and ripening. The optimum temperature for fruit development is 38°C. The tree can not produce sweet fruits unless the temperature is high for a sufficient long period. Under tropical and sub-tropical climate, it behaves as an evergreen or partially deciduous. Under humid conditions, the sweetness of fruit is adversely affected. Therefore, it is considered that pomegranate is a hardy fruit and can thrive well under drought conditions, though yield is low. The plant bear well only under irrigation.

In areas of low temperature, the tree behaves as deciduous in nature and sheds its leaves during winter months. It is also rated as winter hardy fruit tree. Two years old shoots of hardy cultivars are not damaged even at 2°C. When temperature falls below -14°C, visible damage due to frost occurs. Aridity and frequent anomalies of the climate cause leaf shedding and fruit cracking.

Soils

It can be grown on diverse types of soil. The pomegranate is not very particular about its soil requirement. The deep loamy and alluvial soils are ideal for its cultivation. It can tolerate soils which are loamy and slightly alkaline. It can thrive well on comparatively poor soils where other fruits fail to grow. Pomegranate can also be grown in medium and black soils. It is rated as salt-hardy fruit plant.

Choice of Varieties :-

1. Ganesh : It is an improved variety known as GBG No. 1. Ganesh is a seedling selection by Dr. G.S. Cheema at Pune. It is a selection from Alandi and considered to be the best variety. The fruit is medium in size. It has soft seeds. Ganesh is a high yielding variety and is a good cropper. The flesh is pinkish and has juice with agreeable taste.

2. Alandi : Fruit medium in size, fleshy taste, blood red or deep pink with sweet slightly acidic juice. Seeds very hard. The variety is named after the name of village where it was grown extensively.

3. Dholka : Fruit large size, rind greenish white, fleshy taste, pinkish white or whitish with sweet juice. Seeds soft. Juice is acidic. It is medium cropper. It is an important variety of Gujarat.

4. Kandhari : It produces large fruits. The rind is deep red. The flesh is dark red or deep pink. The juice is slightly acidic. The seeds are hard. The variety is successfully grown in Himachal Pradesh.

5. Muskat : This variety is also largely grown. Fruits small to medium in size. Rind is somewhat thick. Fleshy taste, with moderately sweet juice. The seeds are rosy in colour. Fruits are tasty.

6. Nabha : Tree is medium in growth, fruit skin yellowish and smooth. Cracking medium. Juice is 65 per cent. The arils are light pink in colour. Seeds are medium in soft. Taste is good.

Propagation :

Pomegranate plants raised from seed vary widely and are undesirable. Thus, they must be raised vegetatively. Among the vegetative methods of propagation, cuttings are universally used for raising pomegranate plants on commercial basis.

Mature wood is used for making the cuttings and these are 8 to 10 cm long. The cuttings are planted in the

nursery fields in such a way that not more than one-third of the cutting is exposed. The best time of making the cuttings is December-January when the plants shed leaves. The cuttings made during September-October can also root satisfactorily. The cuttings in the nursery field are planted directly after making them from the plants. They need not to be kept for callusing.

Pomegranate may also be propagated by air-layering or gootee. Treatment with 10000 ppm Indole Butyric acid in lanolin as carrier was found to improve rooting. Ground layering is another method used for multiplying the pomegranate plants.

Planting Operation :

Land is prepared thoroughly and levelled prior to pit digging. The layout is done following square or hexagonal system. The size of the pit should be 60 * 60 * 60 cm. Pits should be filled with 22 - 25 kg of farmyard manure or compost, 1kg of superphosphate and good soil mixture.

The plants are planted at a distance of 6m * 6m apart in square system and it will accommodate 275 plants per hectare. In higher but deeper soil, the planting distance can be reduced to 5 * 5 m. Planting density is the most important yield contributing factor which can be manipulated to attain the maximum production per unit area. The optimum spacing is important for the maximum utilization of land and good income over a long period. At MPAU, Rahuri, it was observed that as the plant density was increased, yield per hectare also increased without affecting fruit quality. A density of 1000 plants per hectare gave 2-3 times higher yield and 2.44 times more profit as compared with normal plant population of 400 per hectare. It was also recommended that for higher yields for the first four to five years after planting, a distance of 5 * 2 m may be adopted and alternate plants may be removed afterwards maintaining a planting distance of 5 * 4 m. The best time of planting pomegranate in Northern India is dormant period, i.e. January to mid February and in South India during monsoon season.

Flowering and Fruiting :

In evergreen pomegranate cultivars, the flower buds of the spring flush are borne on nature wood of one-year old shoot, whereas the flowers which appears during July-August are borne on the current year's growth. In deciduous cultivars, the flowers are borne on the current year's growth between July and August. The flowers are found mostly in clusters, either terminally or in axils of the leaves. The inflorescence in cyme and due to heavy drops of secondary and tertiary buds they appear to be solitary in clusters. In Western India, three flowering seasons and in North India, two flowering seasons have been reported. The flowering period of different cultivars is also quite variable. Under Delhi condition, Dholka, Kandhari, Muskat and Patiala flowered only once in a year while Ganesh and Japanese Dwarf flowered twice.

Orchard Cultural Practices :-

Irrigation :

The newly set plants require regular irrigation so that the roots become well established and the plants can start growth. The plants may be individually watered daily or about a week after planting. In northern India where planting is done during the spring, regular watering may be given every 7 to 20 days till the start of the monsoon. In areas where planting is done during the monsoon, irrigation may be given whenever there is no rain for a prolonged period of time. After the plants are well established, in about 6 months, they can stand considerable amount of drought and irrigation may be given at intervals of 2 to 4 weeks depending upon the soil, climate, weather conditions and intercrops grown.

Regular irrigation is essential from flowering to ripening of fruits, as irregular moisture condition results in dropping of flowers and small fruits.

Intercropping :

Intercropping in pomegranate orchard is highly desirable because it takes about 6 - 7 years to come to commercial bearing. Vegetables viz. cabbage, cauliflower, tomato, radish, cucurbits, moong, peas, beans or green manure crops can easily be followed in pomegranate orchard. The growing of intercrops should be carried out for the first four years of the life of the plantation. It is usually advisable to allow the intercrops to grow throughout the year. Intercrops can be continued for another 3 to 4 years after the plants had started bearing. It is best to grow a green manure crop during the monsoon and burry, when it has completed its vegetative phase and started flowering.

Manuring and Fertilization :

In northern India, manures are applied during February, whereas in other areas, manuring may be done just before the start of monsoon in case of young plants. The one year old tree should be manured with about 10 kg of farmyard manure and 150 to 200 g of ammonium sulphate. The amount is increased by the same amount every year so that a five year old tree gets 50 kg of farmyard manure and one kg of ammonium sulphate. Experiment carried out at the MPAU indicate the following schedule :

At Mahatma Phule Krishi Vidyapeeth, Rahuri, an application of 500 g N, 125 g P₂O₅ and 125 g K₂O is recommended for 'Ganesh' variety. Under Udaipur conditions of Rajasthan, application of 240 g N, 160 g P₂O₅ and 60 g K₂O per plant is suggested for variety 'Jodhpur Red'. In Gujrat state pomegranate is applied with 50

kg farmyard manure, 500 g N, 250 g P₂O₅ and 500 g K₂O per plant per year. Application of fertilizers is done in December-January for **Ambe bahar**, in May-June of **Mrig bahar** and in October-November for **Hasth bahar**. In Andhra Pradesh, adult bearing trees are applied with 800 g N, 400 g P₂O₅ and 400 g K₂O per tree alongwith 100 kg FYM per tree. In Karnataka a dose of 200 kg N, 300 kg P₂O₅ and 100 g K₂O alongwith 12.5 tonnes per hectare farmyard manure is applied.

In Orissa, 45 kg N, 115 kg P₂O₅ per hectare along with 10 kg FYM + 100 g sterameal per tree are applied. In Tamil Nadu, 600 g N, 500 g P₂O₅ and 1200 g K₂O alongwith 30 kg FYM is incorporated per tree per year.

Training and Pruning :-

Training : Pomegranate may be trained as multi-stemmed tree or single stemmed tree.

(i) **Multi-stemmed tree** : In this method 3 - 4 stems are left at hill and remaining shoots are removed. In Maharashtra, the growers prefer multistem training by retaining all stems. But yield has not been found to be affected by number of stems per plant.

(ii) **Single-stemmed tree** : The single stem is left by removing all the side shoots at the time of planting. The main stem is headed back at a height of about one metre results in the formation of branches. Four or five well distributed branches on all sides above 60 - 70 cm from the ground level are allowed to grow. In the third year of planting one can maintain desired shape of the pomegranate. Single stemmed tree has tendency to produce less number of shoots.

Pruning : Pomegranate does not usually require pruning except for removal of suckers, dead and diseased branches and developing a sound framework of the tree. It is essential to remove the suckers as soon as they arise. The fruits are borne terminally on short spurs produced all along the slow growing mature wood. These bear fruits for 3 to 4 years. Therefore, only a limited pruning of bearing tree is required. Annual pruning in winter during dormant period should be confined to shortening of the previous season's growth to encourage fruiting.

For getting a good crop, a set of new shoots should be allowed to develop every year on all sides of the tree and gradual growth of new shoots should be encouraged by restricted cutting back of the bearing shoots.

Crop Regulation :

The pomegranate starts fruiting about 4 years after planting and continues for about 25 to 30 years. Economic yield is generally obtained after 10 years of planting.

To regulate flowering, water is withheld for about two months in advance of the normal flowering season. After two months, manures and fertilizers are applied and light irrigation is given. Three to four days later, heavier irrigations at normal interval are followed. The tree readily responds to this treatment by producing new growth and blooms and bears a good crop.

A full grown pomegranate has tendency to bear flowers and fruits throughtout the year. To obtain higher fruit yield during a particular period, plants are given a resting period by which the natural tendency of the tree is altered with artificial means. It is done by withholding of water for about 2 months in advance of normal flowering, root exposure and also use of chemicals. By adopting such methods flowering can be induced in June-July (**Mrig bahar**) coinciding with the break of monsoon, February-March (**Ambe bahar**) and September-October (**Hasth bahar**).

Mrig bahar is taken in Deccan areas where water is so scare during the hot weather. The flowering, therefore, is so forced that the maximum requirement of water falls during the rainy season. For this treatment, watering is withheld from December to April-May results in sufficient suppression of growth. In the month of March-April leaves are shed as plants go in dormant stage. The manures and fertilizers are applied and light irrigation is given which is followed by two heavy irrigations at 7 days interval before rain sets in. Within 15 days, trees will put on profuse growth along with the formation of flowers and fruits. The fruits ripen in October and continues upto December.

Ambe bahar is taken in the areas where enough water is available during hot weather. The fruits are available during June and July and no irrigation is given after the start of the rainy season. The trees shed their leaves by October-November, when a shallow hand digging or ploughing is done. During December-January, manures are applied. The first irrigation is given in January and the flowers appear within a month of this irrigation. In dry regions of western Maharashtra **Ambe bahar** has been found to be better treatment than **Mrig bahar**.

Hasth bahar is seldom taken. The trees have to be made dormant during August-September. This is rather uncertain because of the rains that occur during this period.

Pollination : Both self and cross pollination are recorded in pomegranate. Greater percentage of fruit set was observed by hand pollination and pollination under natural conditions i.e. **open pollination**.

Harvesting and Fruit Handling :

Pomegranate is a non-climacteric fruit. Its fruit become ready for harvesting in 5 - 7 months after the appearance of blossoms. Mature fruits become slightly yellowish and further pink to red. On tapping, the fruits give metallic sound and when pressed they give a 'Crunch' sound. The fruits are harvested with the help of secateurs.

The trees begin to bear fruit in the fourth year when a small crop of 20 - 25 fruits (4 - 5 kg) per tree may be harvested. In the 10th year, it rises to 100 - 150 fruits (20 - 25 kg). The average yield in well managed plantation may be as much as 200 - 250 fruits per tree.

After harvesting, sorting of fruits should be exercised to remove undesirable fruits. The healthy fruits are packed mostly in bamboo baskets and wooden crates containing 10 - 12 kg with a padding of paddy straw or dry grasses. The fruits can be transported to distant market without any loss. The fruits can be stored for about 5 - 6 months at 4.5°C and 80 - 85% relative humidity. The storage life of pomegranate fruits in sealed polythene bags (0.02 mm) at 10°C is extended upto 12 weeks.

Cracking or Splitting of Fruits :

This disorder is reported to be due to boron and calcium deficiency. There is further attack of insects or fungal attack on the cracked fruits. So fruits become unfit for marketing. The **Mrig bahar** crop is more susceptible to cracking than the crop of other bahars.

Main cause of this malady is the wide variation in moisture content of the soil as well as in the humidity of air due to monsoon. If there is sudden break in the rains during August, the growth of fruit is arrested. So as a result of the dry atmosphere that follows, the elasticity of the skin is lost; then there is rain again and growth restarts, results in cracking of fruit skin.

Thus cracking fruits is mostly due to irregular water supply to the trees. **Ambe bahar** crop is regularly irrigated, so it does not crack badly. The best treatment is to give regular irrigations to the **Ambe-bahar** crop taking care that at no stage there is a scarcity of water. In case of **Mrig-bahar** crop, the splitting of fruits cannot be controlled altogether as the variation in humidity cannot control cracking and can, however, be minimised if the plants are regularly irrigated whenever there is a break in rain. Cracking is correlated with rind thickness. Cultivars like Karkai, Guleshah, Bedana, Khog and Jalore Seedless are comparatively tolerant to fruit cracking.

For checking fruit splitting in pomegranate, supply soil moisture regularly through light irrigations. Plant windbreak around the pomegranate plantation. Spray borax @ of 0.1 per cent. In the month of June, give a spray application of GA₃ at 250 ppm. It is better to plant only those varieties which are less prone to fruit cracking.

Insect pests :-

1. Fruit borer or pomegranate butterfly (Virachola isocrates)

This is a serious pest found all over India. Infestation starts from flowering to button stage. The caterpillar bore inside the developing fruits. Such infested fruits are also invaded by bacteria and fungi and cause fruit to rot. Such affected fruits fall down.

Collect and destroy the affected fruits. Apply carbaryl 0.2 % @ 4 g/litre or phosphamidon @ 0.3 ml/litre of water at 10 - 15 days interval. Also, bag young fruits with coarse cloth or muslin cloth or polythene of 300 gauge thickness.

2. Bark eating caterpillar (Inderbela tetraonis)

This pest bore into the bark of pomegranate tree and feed inside. Trees become weak and do not bear fruits. Avoid over crowding of trees by removing unwanted twigs. Clean the affected portions by removing all web. Inject kerosene oil or petrol and plug the hole with cotton wool soaked in carbon bisulphide.

3. Stem borer (Aleurodes sp.)

The caterpillar of this pest makes a hole and bores through the main trunk or main branches. It comes out at night and feeds on bark.

Clean the hole by removing insect excreta with the help of a hooked wire. Plug the hole with cotton plug dipped in petrol, chloroform, carbon bisulphide or kerosene oil followed by sealing it with mud or painting with coal tar.

4. Sap sucking insects

These are mealy bugs, scale insects, thrips, aphids, mites cause shedding of buds, flowers and fruits at very young stage.

- (i) Spray 0.04 per cent Monocrotophous for the control of mealy bug and scale insects.
- (ii) Spray 0.04 per cent Dimethoate or phosphamidon for the control of white flies, aphids and thrips.
- (iii) Spray water soluble sulphur 1.25 g/litre for the control of red mites.

Diseases :-

1. Leaf spot : Xanthomonas punicae, Colletotrichum gloeosporioides

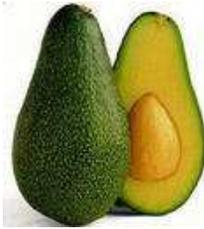
The former pathogen is bacterium and the latter is fungal. The bacterium pathogen causes irregular water-soaked spots on leaves. They are light brown to dark brown in appearance. The leaf spot caused by fungus, produce minute violet black or black spots on leaf.

For their control, collect fallen leaves and fruits and destroy them. Spray 0.2% Captan or Dithane M-45 at fortnightly interval.

2. Fruit rot : Phomopsis sp.

The flowers are affected and fail to set fruit. The young fruits may drop pre-maturely. Yellow or black spots appear all over the fruit. The disease spreads through the seeds of affected fruits. The incidence is wide spread during rainy season.

Remove all affected twigs, fruits and burn them. Spray Dithane Z-78 at 0.2 per cent at fortnightly interval.



Avocado. The avocado (*Persea* sp.) fruit is rich in protein and fat, both of which are deficient in the average Indian diet. It is neither sweet nor juicy, and is eaten fresh, either with bread or in salads. Of the three recognized races, the Mexican seems unsuited to India, the Guatemalan succeeds best at elevations above 1,000 metres, and the West Indian succeeds in the plains, except in the drier areas. Large parts of Maharashtra and southern India are quite suitable. A well-drained soil is required.

VARIETIES. About a dozen varieties are grown in different states. 'Pollock', 'Paradeniya Purple Hybrid' and 'Feurte' were introduced from Ceylon and have established themselves successfully at the foot of the Nilgiris.

PROPAGATION AND PLANTING. The easiest method of propagation commonly employed in India is through seeds. In Maharashtra and the Nilgiris, layering has met with success. The plants are set out 7 to 9 metres apart.

HARVESTING. The trees generally flower between February and April and the harvesting of the fruits is done in August-September.



Cashew. *Cashew(Anacardium occidentale L.)* is grown both for its fruit (cashew apple) as well as for its nuts, mainly for the latter. The crop is grown chiefly in Peninsular India, particularly along the coast. There are very few regular plantations of this crop. Cashew cannot tolerate the severe summers or winters of northern India. Even in the south, it does not grow satisfactorily at elevations higher than 300 metres. It is not very exacting in soil requirements, as it grows even in very gravelly soils. However, it needs a free-draining soil. It grows in areas having rainfall varying from 50 to 400 cm. Continued adequate soil moisture is, however, necessary for the success of cashew plantations.

VARIETIES. There are no distinct varieties of cashew and it exhibits a marked variation in fruit and nut characters when grown from seed. Some of the superior variants can be multiplied or perpetuated through vegetative propagation.

PROPAGATION AND PLANTING. Sowing the seeds *in situ* is the usual practice, but it is possible to transplant one-month-old seedlings after cutting them back by about one-third. This fruit can also be propagated by air-layering, inarching and side-grafting. The planting distance varies from 6 metres in lateritic and rocky soils to 12 metres in deep loamy soils.

AFTER-CARE. No attention is paid to cultivation, irrigation or manuring. An occasional clearing of undergrowth and the pruning of dead and diseased branches is necessary to maintain the trees in health and vigour.

HARVESTING. The fruits ripen from March to May but the season is prolonged during the years when heavy rainfall is experienced in November-December. The first bearing is normally secured in about three years after planting, though satisfactory crops can only be gathered after about eight years. The yield of nuts varies from 110 to 220 kg per hectare.

CURING AND PROCESSING. The nuts are separated from the cashew apples immediately after harvest. The dried nuts are roasted either in open pans over a furnace or in rotary cylinders and in oil-baths. Shelling is done by hand soon after roasting. The kernels, so obtained, are dried in the sun or in hot-air chambers. They are then kept in sweating chambers for some time. The nuts are then ready for grading and packing. For the export trade, the kernels are packed in tins under vacuum or in carbon dioxide. For internal markets, the kernels are sometimes packed in tins of different sizes and they may or may not be hermetically sealed.



Jackfruit. *Jackfruit (Artocarpus heterophyllus Lamk.)* is grown in southern India as stray trees in home gardens and coffee plantations where it flourishes in the humid climate on hill slopes. Warmer plains are suitable, provided there is adequate soil moisture. Cold and frost are harmful.

PROPAGATION AND PLANTING. Usually, seedlings are planted. Inarching is employed to propagate jack trees vegetatively. A spacing of about 12 metres is necessary for planting in the fields.

HARVESTING. The 'Singapore' variety produces fruits in 18 to 36 months after planting. Others take about eight years to come into bearings. The fruits are in season from March to June, the season extending up to September at higher elevations. Yields range from a few to 250 fruits per tree, each fruit weighing from 9 kg to even up to 20 kg.



Loquat. Loquat (*Eriobotrya japonica* Lindl.) is grown mainly in Punjab and Uttar Pradesh on about 800 hectares each, and to a small extent in Delhi, Assam, Maharashtra and in the hills of southern India. Whereas the tree can stand temperatures well below freezing, the flowers and young fruits, which are borne in winter, are severely injured by frost. It does not fruit well in areas with warm winter. It thrives on many different types of soils.

Climate

The loquat has been naturalized in India. It is grown nearly throughout the country upto an elevation of 1525 m above sea level. It can be grown throughout the tropics where there are elevations of a few thousand feet. The loquat succeeds well under subtropical climate. It can grow successfully in regions in which the temperature does not fall below the freezing point. In general, a mild climate with an average annual rainfall of 60 - 100 mm, well distributed throughout the year, is ideal for loquat cultivation. Since the tree bloom between November and late January at certain places, the crop may be destroyed by moderate winter frosts. The fruit of loquat is most susceptible to frost injury when it just starts colouration. Heavy damage is noticed in early ripening varieties.

In the areas where scorching hot winds begin to blow before the fruit ripens, the fruit either remain too small or do not ripen properly. Under such conditions, the pulp does not produce abundant required quantity of juice. Further, the fruit become sunburnt and unfit for marketing. Under cool and foggy weather at the time of ripening, the fruits lack in sweetness and flavour.

The loquat trees are, however, resistant to heat and drought. The thick, leathery leaves are well adapted to withstand seasons of neglect without serious injury.

Although an evergreen fruit, loquat is unique in tolerating cold weather conditions. However, warm and dry climate is essential at the time of fruit ripening. In arid and dry zones, the fruits are prone to sun burn injury. Consequently, loquat should be cultivated only in the submontane or other areas with mid climate or places free from severe hot weather condition.

Soil

The loquat can thrive in a wide variety of soils. In some places seems to do best on a light sandy loam; whereas at other places it has fared well on heavier soils. Good drainage is, however essential and the subsoil should be free from hard pan. Stagnation of water in the land, even for a short time may damage or kill even grown up trees and such soils should be discarded. According to the opinion of an expert from Israel, heavy soil of medium type should be preferred than a very light soil.

Choice of Varieties :-

Golden Yellow : It has medium sized, egg-shaped fruits with attractive golden yellow colour. Flesh is yellowish which tastes sour-sweet. Each fruit contain 4 - 5 dark brown, medium sized seeds.

Pale Yellow : It has large fruits, which are slightly conical to roundish in shape and pale yellow in colour. Flesh is white and tastes sour-sweet. Each fruit contains 2 or 3 medium-sized seeds.

California Advance : Fruit medium-sized, conical to round in shape, external colour yellow. Flesh creamy white, sour-sweet in taste. Fruit contains 2 or 3 medium-sized seeds.

Tanaka : Fruit medium, 4 - 5 cm long, 3 - 7 cm broad ovate in shape, smooth and moderately pubescent. Rind medium, firm. Pulp medium completely filled, sayal brown, coarse firm, juiciness abundant, taste pleasant subacid. Seeds 2 to 4 per fruit, medium in size.

Propagation and Rootstock :-

Raising of Rootstock : The loquat seeds germinate readily when it is sown immediately after extraction from the fruit. The seed should not be allowed to dry after extraction as exposure to heat and light tends to result in poor germination and stunted seedling growth. Fresh seed are sown during April-May in moist sand for germination. When the seedlings are 4 - 5 cm tall, they are transplanted in the nursery under the mother trees for inarching. If the mother plants are high headed, the seedlings are transplanted in the pots and brought in contact with the mother plants by raising platforms when they attain inarchable size. The seedlings grow rapidly and are fit for grafting in the following rainy season. Promising loquat varieties are generally grafted upon domestic loquat seedlings of the commercial varieties. Several other rootstocks such as pear, apple, quince (**Cydonia oblonga**) and **Mespilus** have also been used in certain occasions.

Propagation Techniques : The usual technique followed is to raise the plants through inarching. The best time for inarching is July-August. Air-layering can also be tried but success is much less. In air-layering 3 months old shoots are used. The use of 3 per cent indole butyric acid enhances the success in air-layering.

Planting Operation :

There are two planting seasons for loquat plants viz. February-March and August-September. The plants should preferably be planted during August-September when the weather has cooled down sufficiently. In general, loquat is planted at a distance of 6.5 m * 6.5 m in square system, thus accommodates 225 plants per hectare.

The pit should be made 1 * 1 * 1 m. While mixing add 3 - 4 baskets of farmyard manure and 200 g of single superphosphate per pit. Add 30 - 50 g BHC 10% dust to ward the attack of white ants.

Flowering and Fruiting :

In India, the flowering period of loquat is very long, lasting from mid July to January or sometimes even upto May. Three reproductive flushes under tropical conditions are noted, out of which the intermediate ones give the higher yield of better-sized fruits. In Saharanpur only one flesh continued flower from September to February. The number of inflorescence was higher in beginning but only a few of them bore fruits. The number of inflorescence continued to decrease with the advancement of season, but the percentage of fruit-bearing panicles gradually decreased. The fruit size seemed to be inversely proportional to the number of fruits per panicle. Earlier panicles gave best-sized fruit and size reduced afterward. In northern India only one continuous reproductive flush appears. No peak hour of anthesis was observed. The opening of flowers continued throughout the day. The dehiscence of anthers took place in longitudinal fashion. It took more than a day to complete dehiscence in all the varieties except improved 'Golden Yellow' and 'Pale Yellow' in which case it was completed only in one day. The time of dehiscence was found to have hastened with the increase in temperature.

In Punjab, the flowering period in loquat is very lengthy. The flowering starts sometimes in the first week of October and continues upto third week of December. The number of flowers per cluster may vary from 50 to 100 but in general, not more than 15 - 20 fruits per cluster are set. Some of the varieties are good pollinizers for others.

Loquat trees grow singly or in small groves, though produce perfect flowers, yield negligible or no crop. This is reported to be due to self-incompatibility in commercial loquat varieties.

The edible portion in loquat is entirely toral in nature, consisting of pith and cortical areas. The development of edible portion consists of rather uniform growth of receptacle tissue throughout the fruit. The toral cells of mature fruit are large, thin walled and very juicy.

Orchard Cultural Practices :-

Irrigation : The loquat is more drought resistant than any of the citrus fruits. However, the best results are obtained when the orchard is irrigated judiciously. There must be sufficient moisture in the soil in order to enable the shoots to develop and the mature terminal buds to fill out properly. As the trees blossom buds. During fruit growth to maturity three to four irrigations are generally advisable.

Interculture :

Through cultivation of loquat field should be given to check the weed growth. It prefer clean cultivation management practice. Mulching with brown, black, or transparent polythene film from November to June in loquat orchard was found effective. The cultivation of leguminous over crops is, however, considered beneficial. Winter cover crops may be planted before September, the purpose is that their sufficient growth to be turned under before the harvesting starts. The leguminous crops like gram, peas, mash, etc. should be preferred as intercrops.

Manuring and Fertilization :

Although little work has been done, it is generally recognized that loquat tends to exhaust the soil and that for good regular cropping it needs adequate nutrition. Given below is a broad nutritional schedule being recommended by the Panjab Agricultural University.

Age of tree (years)	Farmyard manure (kg/tree)	CAN(kg per tree)	Superphosphate (kg per tree)	Muriate of potash(kg per tree)
1-3	10-20	0.3-1.0	0.2-0.5	0.15-0.4
4-6	25-40	1.1-1.5	0.6-1.5	0.6-1.0
7-10	40-50	1.6-2.0	1.5-2.0	1.1-1.5
10 & above	60	2.0	2.0	1.5

The farmyard manure should be applied in September alongwith entire quantities of phosphorus and potash. However, one-half dose of nitrogenous fertilizer should be applied in October before flowering and remaining half in February-March i.e. **after the fruit-set**.

Training and Purning :

Loquat is generally trained according to Central leader or open centre system. During initial stages, stem up to height of 50 cm should be kept clean. Later on, purning is confined to removal of dead and diseased branches in the full grown tree. Harvesting of mature bunch is a kind of purning and it encourages new growth. The best time for purning is during summer after the crop has been harvested.

Top-working :

A large percentage of the loquat seedlings trees are unprofitable. Such healthy trees should be top-worked with some improved commercial varieties. The vegetative method of propagation such as inarching, T-budding and bark grafting could be employed. Grafting plants will start bearing superior quality of fruit after third years. Top-working of inferior loquat tree should be done during May. Good number of healthy shoots will emerge from the headed back plant during the rainy season. Only one or two healthy branches should be retained for grafting purpose.

Thinning of Fruits :

The loquat is a prolific bearer fruit plant. The tree has tendency to over bear. Thinning of fruit in the clusters or removing of some of the clusters may, therefore, be practised, for improving the size and quality of the remaining fruits. The thinning should be done when the fruits are less than 1.2 cm in diameter.

Harvesting and Handling of Fruits :-

Harvesting : The loquat tree starts bearing fruit after third year of planting. The yield goes on increasing as the trees grow older and maximum yield is obtained after fifteen years of age. The harvesting of immature and green fruits should be avoided. All fruits in a cluster usually mature uniformly, the entire cluster may be cut at once. But, in some cases where the fruit at the base ripens before that at the tip of the cluster, the pickers will have to clip the ripe fruits by hand. The fruits should never be pulled from the tree by hand, as the stem would separate from the flesh and cause decay to set in at once. The fruit should preferably be harvested with clipper.

The average yield of loquat tree is about 16 kg. Well maintained and healthy tree can yield fruit upto 40 kg.

Grading : The fruits should be suitably graded before packing into two grades. The large sized fruits tree from blemishes should be placed in one box while all the remaining marketable fruits should be packed separately. The undersized and mis-shapen fruits should be collected in a separate lot which can be sold for the preparation of jams, jelly or other products. All superfluous stem should be clipped off and badly bruised, shrivelled or scarred fruits should be discarded.

Packing : The fruit requires careful packing. Paper is placed at the bottom of each box. The large sized choice fruit should receive better handling and packing. The paper cuttings can be used for providing cushion. The wood boxes of 14 kg size should be used for sending fruits to nearby market. However, for distant markets, smaller packages are used to give considerable protection to the fruit.

Diseases :-

1. Shoot/fruit blight and Bark canker :

The disease is caused due to fungus **Phoma glomerata**. The cankers appear on the bud scars, wounds, twig stubs or in crotches. Small circular brown spots appear around a leaf scar. As the canker enlarges the centers become sunken with the edges raised above the surrounding healthy bark. The fungus perpetuates it self on the trees in bark cankers.

The canker should be removed and the dead bark decorticated alongwith 2 cm of healthy bark. The dead-wood and purnings should be destroyed. The wounds should be covered with a disinfectant solution and painted with Bordeaux mixture immediately afterward and also in March and June.

2. Crown rot :

It is caused due to fungus **Phytophthora sp.** The water loving fungus attacks the bark producing canker extending from the ground level up to the points where the main stem bifurcates. The rot girdles the trunk during the next 2 - 3 seasons. Flowering is very profuse on the affected trees, but fruiting is sparse and of low grade. Yellowish green foliage is characteristic of the crown rot disease. Often the half side of the tree affected by crown-rot may show symptoms. Some branches may be killed every year and ultimately the whole tree may succumb to the disease and dry up completely. The pathogen is soil borne and perpetuates itself in the dead cankers.

Remove the severely infested trees and use them as fire wood. Remove the diseased bark during the dry season by extending the cut an inch beyond the diseased zone on all sides. First treat the cut with a disinfectant solution and then apply Bordeaux paint after a week. Immediately after this, spray the tree with 2 : 2 : 250 Bordeaux mixture. Repeat the spray just before the mansoon, during the mansoon and thereafter, too, till October.

3. Root-rot - White-rot :

The disease is caused due to **Polyporus palustris**. The bark and the wood of the root including the root collar is affected. The decayed wood is pinkish to dull violet in colour whereas in the advanced stages, small, white, elongated pockets appear and they form a mass of spongy white fibres. The affected tree begins to

show symptoms of wilt, early leaf fall and increase in the fruit-set. The fruiting bodies conks (**gidder peehree**) which may grow up to 30 cm or more in diameter usually appear when the rot is fairly well advanced. They are either hidden by the litter or lie exposed on the surface of the soil.

Locate the affected trees in early stages by examining the roots and the root-collar region of the tree showing weakening signs. Digout decayed roots and cut them completely right from the collar region. Treat the cut end of the roots immediately with disinfectant solution. When dry, apply Bordeaux paste on these cut ends. Drench the soil from where the dead roots have been dug out with 2 : 2 : 250 Bordeaux mixture. Do not allow irrigation water to come into contact with the stem. Avoid deep hough and interculture to obviate injuries to the roots, through which fungus attacks.



this fruit.

Mangosteen. Though one of the most delicious among the tropical fruits, mangosteen (*Garcinia mangostana* L.) is the most difficult fruit-tree to grow on a commercial scale. At present, its cultivation is restricted to a few small pockets on the lower slopes of the Nilgiris at elevations of 300 to 1,000 m and in the Malabar and Tirunelveli districts. Excessive heat or cold, direct sun for long periods, dry atmosphere and desiccated soils are uncongenial to

No varieties are recognized. Propagation is mainly done from seed. It is also done by inarching or side-grafting on mangosteen seedlings or on seedlings of *Garcinia tinctoria*, *G. speciosa*, etc., but the grafts are difficult to establish in the field.

Timely irrigation is necessary to keep the soils moist. The removal of weeds and the replenishment of soil fertility through manuring are very necessary. Definite information on the manurial requirements of the fruit is lacking. As fruits are produced on the terminal portions of the primary and secondary laterals of the past season's growth, pruning is inadvisable.

The mangosteen matures (main crop) from august to October and another lighter crop from April to June. An individual tree may yield 2,000 fruits, but the average is far less.



Litchi. Litchi (*Litchi chinensis* Sonn) is grown extensively in northern Bihar, in the submontane districts of western Uttar Pradesh and in Punjab. Hot dry winds in summer, when the fruit is ripening, are very undesirable. It grows well in sandy and clayey loams containing large quantities of lime.

VARIETIES. In Bihar, the recommended varieties include the 'China', 'Purbi', 'Deshi', 'Bedana' and 'Dehra Rose'; in Uttar Pradesh, 'Rose-scented', 'Early Large Red', 'Kalkatia', 'Gulabi' and 'Late Seedless', and in West Bengal, 'China' and 'Muzaffarpur'.

PROPAGATION AND PLANTING. Air-layering is the commonest method. Inarching, budding and grafting are also possible. One-year-old layers are planted nine metres apart in pits during the rainy season.

PRUNING. As the fruit is borne on the growth of the previous year, the common practice of breaking off a metre or so of a branch along with the bunch of fruits is all the pruning that is necessary.

CULTURE. Protect young trees against frost with a thatch and against hot and dry winds by growing windbreaks. Remove weeds from time to time and irrigate from January onwards until the fruits mature. In addition to bulky organic manures, a complete fertilizer mixture should be given to supply N, P and K and Ca in the case of soils deficient in lime.

HARVESTING. Fruit bunches are broken from the tree by hand. A mature tree produces about 110 kg of fruit each year.