FRUITS

BANANA *(Musaspp.)*

Banana prefers tropical humid lowlands and is grown from the sea level to 1000 mabove MSL. It can also be grown at elevations up to 1200 m, but at higher elevations growth is poor. Optimum temperature is n°e. Soils with good fertility and assured supply of moisture are best suited.

Season

Rain fed crop: Irrigated crop:

April-May August-September

Adjust planting season depending upon 19cal conditions. A void periods of heavy monsoon and severe summer for planting. Adjust the time of planting so as to avoid high temperature and drought at the time of emergence of bunches (7-8 months after planting).

Va.rieties

Nendran (Clones): Nedunendran, Zanzibar, Chengalikodan .

Table varieties: Monsmarie, R:obusta, Giant Governor, Dwarf Cavendish, Chenkadali, Poovan, Palayankodan, Njalipoovan, Amritsagar, Grosmichael, Karpooravally, Poom-kalli,Koompillakannan; Chinali Dudhsagar), BRS-I and BRS-2

Culinary varieties: Monthan, Batheesa, Kanchekela, Nendrapadathy

Njalipoovan, Robusta, BRS-I and BRS-2 are particularly suitable for intercropping in coconut gardens both under rainfed and irrigated conditions Dudhsagar is highly resistant to major pests and diseases. The variety Boldles Altafort is recommended for high range region (ad hoc). .

Preparation of land

Prepare the field by ploughing or digging

and dig pits for planting. Size of pits depends upon soil type, water table and variety. In general, pit size of 50 x 50 x 50 cm is recommended. In low-lying areas, take mounds for planting suckers.

Selection of suckers

Select 3A month old disease free sword suckers from healthy clumps. In the case of . Nendran variety, cut 'back pseudostem to a length of 15-20 cm. from corm and remove old roots. The rhizomes. are to be smeared. with cowdung solution and ash and dried in the sun for about 3-4 days and stored in shade up to IS days before planting.

Spacing

Spacing may be provided as indicated be
low: .

Variety Poovan
Chenkadali Palayankodan Monthan Nendran Grosmichael Robusth, Monsmarie, Dwarf Cavandish

Spacing, m

2.1 x 2.1 2.1 x 2.1 2.1 x 2.1 2.1 x 2.1 2.0 x 2.0 2.4 x 2.4

uckerslha 2260 2260 2260 2260 2500 . 1730

2.4 x 1.8

2310

Planting

Plant. suckers upright in the centre of pits with 5 cm pseudostem remaining above soil level. Press soil around the sucker to avoid hollow air spaces.

Manuring

1. Apply compost, cattle manure or green leaves at the rate of 10 kg/plant at the time of planting.

2. Apply N:PZO5:KzO at the following dose (g/plant/year).

Nendran (irrigat_d): 190:115:300

Other varieties depending upon soil fertility level: 160-200: 160-200: 320-400
Palayankodan (rainfed): .1()0:200:400

Palayankodan Kuttanad) Plant crop: First ratoon: Second ratoon:

(reclaimed alluvial soils of

100:200:400 150:200:800 150:200:800

Plant crop followed by two ratoon crops gives maximum yield. Two suckers per clump should be retained for ratooning.

Apply the fertilizer 60-75 cm around the plant in two equal split doses; the first, two months after planting and the second, four months after planting. For ratoon crop, the entire fertilizers have to be applied in a single dose immediately after the harvest of the preceding crop. Irrigate immediately after manuring.

Note: For Nendran, apply the fertilizers in six split doses as- detailed below which will be beneficial to improve the finger size and bunch weight, provided the farmers can afford the cost of application.

I
i i I

Time of fertilizer application

N:P}O5:K}O
glpla/1t

40:65:60 30:50:60 30:00:60 30:00:60 30:00:60

One month after planting Two months after planting Three months after planting Four months after planting Five months after planting

Just after complete emergence of bunch

Total

30:00:00

190:115:300

169

For Palayankodan (rainfed), planting may be done in January and the suckers may be given pot irrigation @ nine litres of water once in 15 daysuntil April-May.

After planting banana, sow sunn hemp / daincha / cowpea adopting a seed rate of 50 kglha. Incorporate the crop into the soil 40 days after sowing. Repeat sowing of green manure crop and incorporate into soil 40 days after sowing.

Irrigation

1. During summer months, irrigate once in three days.

2. Ensure good drainage and prevent waterlogging.

3. About 6-10 irrigations per crop may be given depending upon soil conditions.

4. Banana var. Nendran (October planting) grown under deep water table conditions (below 2 m from ground level) needs 10 mm (40 l/plant) irrigation once in two days during summer season to ensure higher bunch yield and better water use efficiency.
Mulching the basin with 3.5 kg paddy straw. (waste quality) will considerably improve the bunch)1ield.

Weed **control**

During early stages, complete control of weeds could be obtained by raising cowpea in the interspaces. In gardens where this is not possible, pre-emergence application of diuron 1.5 kglha or oxyfluorfen 0.2 kglha is effective. Weeds emerging later could be controlled by the application of paraquat 0.4 kglha or glyphosate 0.4 kg/ha. If hand weeding is resorted to, give 4-5 surface diggings depending on weed growth. A void deep digging. Do not disturb soil after plants start producing bunches. If green manure crop is grown, weeding operations can be reduced to 1-2 diggings.

Desuckering

Remove side suckers produced till the emergence of bunch. Retain one or two suckers produced after the emergence of bunch.

Intercropping in Nendran variety

Cucumber and amaranth can be cultivated profitably with banana raised in SeptemberOctober without affecting the bunch weight. For vegetable purpose, cucumber may be harvested within 95 days and for seed purpose the duration may be about 130 days. Greater yam and elephant foot yam can be profitably intercropped with Nendran.

Tissue culture Nendran banana (Ad hoc recommendation)

Tissue culture offers a rapid method of multiplication of quality, uniform, pest and disease free pro<;luction of planting materials in large quantities in banana. The productivity of banana can be increased by cultivation of tissue culture plants of selected elite ecotypes of different varieties.

Spacing

Give spacing of 2 m x 2 m {2500 plantslha)

Tissue culture plants can also be used for high density plantiI1g in Nendran banana to achieve higher returns. The spacing recommended for high density planting is as follows:

(a) 2 m x 3 m with two plants / pit (3332 plants in 1666 pits per ha)

(b) 1.75 m x 1.75 m with one plant per pit (3265 plants / ha)

Pit size

50 cm x 50 cm x 50 cm Method of planting

Prepare pits 15 days in advance of planting.

Fill the pits with topsoil and FYM 15.20 kg per plant per pit. Plant the tissue culture plants on the top of the pit at ground level. Remove the polythene cover completely before planting without damaging the roots. Planting may be done preferably during evening hours. Provide partial shade to plants to protect against sun scorching for about two weeks. Irrigate the crop daily during initial days of establishment.

Plant Protection

Apply carbofuran 30 g/plant at planting, 15 g each at 60 and 90 days after planting.

Adopt integrated plant protection measures to control major pests and diseases.

Manures and Fertilizers

Apply FYM @ 15-20. kg per plant at the time of land preparation.

Apply lime 1 kg/plant with the organic manure at the time of land preparation.

Apply N:P2Os:K2O @ 300:115:450 g/plant in six split doses as shown below.

Time of application *N:P20j.K2O*
glplant 50:65:65 50:00:65 50:50:65 50:00:65 50:00:65 50:00: 125

1 month after planting
2 months after planting
3 months after planting 4 months after planting. 5 months after planting 7th month (i.e. after

bunch emergence)

Plant protection Pests

Banana pseudostem weevil (Odoiporus longicollis) (ad hoc recommendation)

The weevil resembling the rhizome weevil of banana is becoming a serious pest in re

ce.nt years. Adult female weevil punctures and inserts eggs into the pseudostem. Grubs emerging out feed extensively on the pseudostem and thereby the entire plant collapses.

Control

1. Field sanitation is the most important factor in the prophylactic and curative control ofthis pest.

2. Remove affected plants along with the rhizome in full and destroy them by burning the life stages of the insect using kerosene or by burying the material in deep pits in soil.

3. Destroy the parts of rhizome and pseudo stem of harvested plants in the field and destroy them as described above.

4. Remove the dry outer sheaths ofthe pseudostem of all infested and un-infested plants in the endemic areas and spray any of the recommended insecticides. Drenching all the leaf axils, rhizome and surrounding soil and all round the entire pseudo stem inserting the nozzle through the bore holes made by the larvae if any and also within the outer sheathes by slightly raising the same at different spots is also effective. Apply quinalphos 0.05% or chlorpyrifos 0.03% or carbaryl 0.2%. Repeat the treatment after 3 weeks if the infestation persists.

Banana rhizome weevil (Cosmopolites sordidus) (ad hoc recommendation)

The attack by this pest is reported to be serious in all localities where banana is cultivated. Female adults puncture healthy rhizomes and insert eggs through it. Grubs tunnel
. within and feed resulting in the stunting of rhizome development. If the infestation occurs on a mature rhizome, damage symptoms
appear through the reduction in leaf number, bunch size and the fruit number.

Control

1. Adopt strict field sanitation.

2. Select only healthy planting material.

3. Deep plough the land so as to expose the
inner soil layer to sun.

4. Cut and remove the outer layer of the rhizome and sundry for 3-4 days after smearing it with slurry of cowdung and ash.

5. Set traps using pseudostem of approximately *Y2* m length, which are split lengthwise and laid in the field. Adults attracted to it during nights may be collected and destroyed.

Aphid (Pentalonia nigronervosa)

These act as vector for the transmission of the dreadful bunchy top disease in banana.

Control

1. Apply 25 g phorate lOG or 20 g carbofuran 3G 20 days after planting around the rhizomes in soil.

2. Apply 12.5 g phorate lOG or 10 g carbofuran 3G per plant in the leaf axils or 25 g phorate or 20 g carbofuran per plant in the soil 75 days after planting. This may be repeated 165 days after planting.

3. For vaAety Chenkadali, apply 25 g phor

ate lOG *or* 20 g carbofuran 3G per plant as soil application, first at 20 days after planting and again at 95 and 165 days after planting.

Spindle leaf miner (Assuania sp.)

Spray dimethoate 0.05% or phosphamidon O._% on the spindle for controlling the leaf mIller.

Nematodes

Major species are burrowing nematode *(Radopholus* sp.), root knot nematode *(Meloidogyne incognita),* root lesion nematode *(Pratylenchus cojfeae)* and cyst nematode *(Heterodera oryzicola).*

In case of severe infestation there will be high reduction in the number of leaves, total bunch weight and the number of fruits.

Control

Pare the rhizomes and apply neem cake @ I kg/plant and carbofuran @ 0.5 g ai/plant at the time of the planting (ad hoc recommendation).

When granules are applied around the base of plants, there should be sufficient soil moisture; otherwise, the plants should be watered after broadcasting granular insecticides.

Diseases

Bunchy top disease

This is a virus disease transmitted by aphids. Control

l. Use insecticidal treatments recommended
for insect vector control.

2. Eradicate disease affected plants.

3. Use disease free suckers for planting. Karpoonivally, Kanchikela, Njalipoovan and Koompillakannan are *Jess* susceptible varieties.

Panama wilt (banana wilt) (Fusarium oxysporum f. *cubense)* .

I. Dip suckers of susceptible varieties in 0.1-0.2% carbendazim solution to prevent spread of the disease.

2. Drench the soil around affected clumps with 0.2% carbendazim solution to prevent spread of disease.

3. Remove and destroy affected clumps along with corms.

4. Apply lime @ 1 kg/pit and allow to weather. Varieties such as Palayankodan, Robusta and Nendran are resistant to the disease.

Sigatoka leaf spot (Mycosphaerella sp.)

I. Cut and bum all severely affected leaves.

2. Spray 1 % Bordeaux mixture soon after the appearance of the initial symptoms of the disease. The disease appears with the commencement of southwest monsoon. Five to six sprayings at fortnightly intervals are to be given depending upon the severity of the disease.

3. Power oil (mineral oil) I % emulsion is also effective in controlling the disease.

4. Spray carbendazim (0.1 %) or give alternate sprays of tridemorph (0.05%), mancozeb (0.2 %) and carbendazim (0.1 %) soon after the appearance of initial symptoms of the disease. Three to four sprayings at fortnightly intervals are to be given depending on the severity of disease.

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Kokkan disease (Banana bmct mosaic virus)

Kokkan disease was first reported from Thrissur district in the variety Nendran. Later on, the disease was found to affect other varieties like Palayankodan, Kodappanillakunnan, Monthan, Kanchikela, Poovan (Rasthali), Karpooravally and Chenkadali. Nendran is the highly susceptible variety.

During the young stage of Nendran banana plant (two months old), 'pinkish streaks can be seen on the pseudostem. All the kokkan affected plants need not show this symptom, but once this symptom is expressed there is no doubt that the particular plant is affected with kokkan disease. Necrotic streaks are another important symptom of the disease. The necrotic streaks are initially brown, which later turn black. It occurs on all aerial parts of the affected plant except on lamina, the length being a few mm to 10 cm. All the kdkkan-affected plants will exhibit the necrotic streaks from third month onwards at one stage or other. Some of the affected plants retain the necrotic streaks throughout the growth period. In certain

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cases it disappears with the senescence of the affected portion.

The affected plant produces only a sma1l bunch. The fingers are sma1l, curved and widely divergent with pale green to ashy green colour as compared to healthy. The abnormal colour and reduction in the size of the bunch depend upon the severity of the disease.

Suckers should not be taken from affected plants, which show necrotic streaks or abnormal colour of the pseudostem.

When the young plants show the symptom of pinkish streaks, they should be uprooted and destroyed.

Infectious chlorosis (Cucumber mosaic virus disease)

The disease is noticed in varieties such as Nendran, Palayankodan, Karpoorava1ly, Kosthabontha, Peykunnan, Bhimkhel, Mot
tapoovan, Dakshinsagar, Madhuraga (Rast hali) and *Musa ornata.*

The most characteristic symptoms are the

loss of leaf colour in patches; appearance of para1lel chlorotic streaks on the younger leaves, giving a striped appearance on the leaves. As the disease progresses, leaves emerge distorted, margins become irregularly wavy, often with blotches of necrotic tissues and the leaf lamina is reduced in width. In severe cases, rotted areas are found throughout the leaf sheath and pseudostem. The affected plants produce only small bunches.This is a virus disease transmitted by aphids.

1. Use disease free suckers for planting.

2. Eradicate disease affected plants.

3. Use insecticides recommended for insect vector control.

4. Avoid growing leguntinous and cucurbitaceous vegetables as intercrop in banana.

GUAVA *(Psidium guajava)*

Guava thrives we1l in places receiving medium rainfa1l not exceeding 100 em. In heavy rainfa1l areas, plants grow luxuriantly, but the quality of the fruits is found to be very poor and insipid. It grows well on any type of soil. Red sandy loam soil with good drainage is most ideal for commercial cultivation of guava.

Varieties

Allahabad Safeda, Sardar (Lucknow-49), Red Fleshed, Apple Coloured and Pear Shaped

Planting material

Seed propagation is not practised -because of high degree of variation among the progenies. Air layering is widely adopted for propagation of selected varieties. Layers

strike roots within 3-5 weeks. When the roots grow through the ba1l of moss, the stem may be severed below the girdled area in stages. The polythene film is removed from the fina1ly severed rooted stem, which is then potted and kept in the shade until new leaves appear. When the new flushes are produced, the plant can be hardened in fu1l sunlight preparatory to transplanting in the field.

Planting

Pits of one metre cube are made 6 m apart. Fi1l the pits with topsoil, sand and cowdung. Layers are planted in the centre of the pit. Staking of plants is also done, if necessary. After planting, mulching with dry leaves should be done to conserve moisture. JuneJuly is the ideal time for planting the layers and seedlings. Plants should be irrigated in

summer. Square system of planting facilitates easy orchard operations. Guava can be grown as an intercrop in coconut gardens.

Manuring

A fully grown-up bearing plant should be manured with about 80 kg of FYM, 200 g N, 80 g P2Os and 260 g K2O. These may be applied in two or three split doses .when there is sufficient moisture in the soil.

Yield

Guava starts bearing from 3-4 years after planting. About 500-800 fruits per year can be obtained from a 10 year old tree.

Plant protection *Fruit rot disease*

This is a serious disease of guava especially during rainy seasons. The symptoms are manifested as deve__pment of dark brown
circular spots at the blossom end of the immature green fruits. Application of zineb (0.2%) or aureofungin (10 ppm) as monthly sprays during June to October can control the disease.

Guava wilt

In affected trees, the branches wither and die one after another and in a few weeks or months the tree, which seemed entirely healthy will be dead. It is better to remove such trees as soon as the symptoms are identified to prevent the spread of the disease.

Fruit fly

This is a serious pest of guava. The insect affects the fruit when it matures. The infested fruits show depression with dark green punctures. As a precautionary measure, the crop should be sprayed just before fruit maturity with carbaryl (0.1 %) or dimethoate (0.1 %).

INDIAN GOOSEBERRY *(Phyllanthus emblica)*

Gooseberry (nelli) is quite hardy and can be grown with little care in all types of soil except very sandy type. It prefers a warm dry climate and is found in the dry deciduous forests of Kerala.

Varieties

Much genetic variability exists in this species. However, a high yielding larger fruited variety was located from the rain shadow region of the Western Ghats and popularized as "Chambakad Large". Other varieties are Banarasi, Krishna and Kanchan.

Cultivation

Nelli is usually propagated by seeds and vegetatively by wedge grafting. The seeds are enclosed in a hard seed coat, which renders the germination difficult. The seeds can be extracted by keeping fully ripe fruits

in the sun on a flat rock for about 2-3 days till they split open releasing the seeds. The seeds can be directly sown. Gooseberry can be vegetatively propagated through root suckers.

One year old seedlings can be planted in the field during rainy season at a spacing of 8 x 8 m. It can be planted as windbreak around the orchard.

No serious pests or diseases are generally found in this crop.

Harvesting

Planted seedlings will commence bearing from the 10th year. The vegetative growth of the tree continues from April to July. Along with the new growth in the spring, flowering also commences. Fruits will mature by January-February. Yield ranges between 30-50 kg per tree per year when full grown.

JACK *(Artocarpus heterophyllus)*

Jack comes up well in humid regions up to an elevation of 1000 m. Soil should be deep and well drained. Any rise in water table or poor aeration of the soil is detrimental to the crop.

Varieties / types

Jackfruit differs in size, shape and quality. The jackfruit may be classified into two groups: (i) soft fleshed and (ii) firm fleshed. The firm fleshed type is highly tasty, sweet and crisp. The two groups are further classified depending on the taste, size of fruit, odour of flesh, nature, shape and diversity of prickles on the rind.

Two distinct types with desirable qualities recommended for Kerala are:

I. Muttom varikka which is a firm fleshed, sweet scented variety.

2. Singapore or Srilanka jack which is an introduced variety from Srilanka. It bears fruits in 3 years after planting and is extremely precocious in habit. The fruits are more or less the same size as the common jackfruit. A tree may yield as many as. 250 fruits.

Planting materials

iY

Use seedlings or grafts for planting. For grafting, raise seedlings in polythene bags and when they are 9-12 months old do inarching. One month after grafting, behead the rootstock above the graft joint.

Epicotyl grafting can be undertaken successfully in jack. Three to four month old, 10 cm long scions are grafted on five-day old rootstocks in polythene bags by the cleft method during the month of June and kept under moist conditions. The scions should be pre cured 10 days before grafting by clipping the leaf blades and keeping the petioles intact on the twig. The graft union is complete by 80 days after grafting operations.

Season

Plant seedlings or one year old grafts at the onset of monsoon showers.

Planting

Prepare pits of size 60 x 60 x 60 cm at a spacing of 12-15 m. Refill pits with mixture of topsoil and 10 kg compost or FYM per pit to a level higher than the adjoining ground. Plant the grafts in the same depth as they were in the containers, preferably in the late evening. Deep planting results in .
poor growth of the graft. Ensure that the graft joint is above the soil level. Stake the plants to prevent snapping at the graft joints. Excellent drainage and adequate watering result in better performance. At no stage it should be exposed to drought or frost. It is useful to provide some protection, especially to young trees. Jack is rarely ma nured. Even without fertilizer application, the jack trees come up well under Kerala conditions.

Harvesting

The seedling plants generally bear after eight years and the grafted plants after three years of planting. The fruiting season lasts about four months from January-February to May-June. The average yield from one tree is about 50-100 fruits per year.

Plant protection

The important pests of jack are shoot borer caterpillar, mealy bug and jack scale.

1. To control shoot borer caterpillars spray with any contact insecticide.

2. To control jack scale apply contact insecticide.

3. To control mealy bug, spray contact insecticides like lime sulphur or dust sulphur.

The common diseases that attack the tree

are the pink disease, stem rot and fruit rot. Pruning of affected plants and protecting the cut-ends with Bordeaux paste are recommended against these diseases.

MANDARIN ORANGE *(Citrus reticulata)*

Mandarin orange is a subtropical fruit growing in the high ranges of Kerala. It requires deep soil rich in humus. The crop cannot withstand waterlogging. It is grown in regions having good drainage.

Preparation of land

Dig pits of size 70 x 60 x 70 cm at a spacing of 7-8 m at least on_ month in advance of planting.

Planting material

Use seedlings and budded plants for planting. For raising seedlings, extract seeds from selected fruits'by squeezing. Wash the seegs free of pulp and dry them. Make seedbeds 1.5 m long, I m wide and 15 cm high. Sow the seeds giving a spacing of 13 cm in a row and 3 cm between the row's. Thin the seedlings if necessary or plant selected seedlings in secondary nursery. For budding, use rough lemon (jamber) seedlings as rootstock. Raise the rootstock seedlings in a nursery and when they are 18-24 months old, budding may be done by the inverted "T" method. The best time for budding is from July to September. A month after insertion, lop off the vegetative growth of the seedling above the bud joint completely. The budded plants are ready for planting in 6-12 months.

Time and method for planting

Planting is done during July-August. Lift the plants carefully with a ball of earth around the roots and plant them carefully without disturbing the roots. While planting, remove the bandage around the bud joint and keep the bud joint at least 10-15 cm above soil surface. Remove the vegeta

tive growth arising below the bud union pe
riodically. .

Manuring

The manuring schedule recommended is given below.

Time after planting
1 st year

2nd year
3rd year 4th year 5th year 6th year 7th year onwards Apply organic manure in May and fertilizers in two equal split doses during June-July and in September-October. In addition to the above manures and fertilizers, spray micronutrients such as zinc sulphate: 500 g, copper sulphate: 500 g, manganese sulphate: 300 g and lime: 500 g in 100 litres of water per ha twice in a year during March and October-November.

FYM kg/plant	*N:P205:K2O g/plant/year*
2 4	40:20:25 80:35:50
.6	160:75:100 300: 100:150 600: 175:300 800:275:750 800:275:1000
8	
10 10 10	

Aftercultivation

Give a light digging or ploughing when the rains start.

Pruning

In the early stages, give some formative pruning to establish a strong framework. Remove all shoots arising from rootstock below the bud union. Remove dead branches and smear the cut ends with Bordeaux paste. Do not prune the roots.

Intercropping

Crops'like coffee, cardamom, banana, and pineapple can be planted as intercrops depending on soil fertility status.

Plant protection

For controlling citrus butterfly, hand picking of caterpillars and spraying with a contact insecticide are to be done.

To control stem borer incidence, chip off the affected new shoots and spray 0.2% carbaryl suspension once in three months. If borer tunnels have already been formed, inject 1 % dichlorvos into the tunnels. To control aphids apply dimethoate 0.05% or monocrotophos 0.05%.

Stem borers *(Chelidonium* sp., *Chloridolum* sp. and *Nupserha* sp.) cause withering of branches. Gum exudes from holes on stems and branches. Accumulation of wood dust on ground around the base is another symptom of borer damage.

Cutting and burning of the affected branches, injecting petrol or suspensions of carbaryl 1% using syringe and painting the stem with carbaryl 0.3% suspension during May are recommended again'st the borers.

Among diseases, die back, root and collar rot are important. Periodical removal of dried twigs and application of Bordeaux paste on cut ends and application of Bordeaux mixture can control dieback disease.

Against root and collar rot, removal of soil from the base of the trunk, scraping of the dead bark and application of lime-sulphur have to be done. As an alternative, smear Bordeaux paste over the treated roots and stem. Exposing the main roots to a depth of about 30 cm is also advised.

MANGO *(Mangifera indica)*

Mango is adaptable to a wide (aIlge of climate and soil conditions and grows well from sea level up to about 1500 m above mean sea level. It withstands both fairly dry conditions and heavy rainfall.

Varieties

Alphonso, Kalapady, Neelum, Mundappa, Pairi, Benishan, Alampur Benishan, Mulgoa, Suvarnarekha.

Hybrids

Hybrid No.45 (Bennet Alphonso x Himayuddin), Hybrid No.8? (Kalapady x Alampur Benishan), Hybrid No.151 (Kalapady x Neelum)

Season

Plant one year old grafts with the onset of monsoon showers so that they get estab

lished before the rains. If rainfall is heavy, planting should be done during AugustSeptember. .

Vegetative propagation

Stone grafting is successful in mango. August is ideal for the operation. Select four month old scion materials. Defoliation of
scion shoots 10 days prior to grafting is beneficial. Grafting of 8 cm long scion on rootstocks at a height of 6 to 8 cm is most successful. The dieback disease of grafts caused by *Colletotrichum* can be controlled by spraying 1 % Bordeaux mixture.

Planting

Select good grafts for planting. Planting can be done according to the square system or hexagonal system. Prepare pits of size 1 x I x 1 m at a spacing of 9 m one month before planting and allow to weather. Refill pits

with mixture of topsoil and 10 kg of compost or FYM per pit to a level higher than the adjoining ground. Plant the grafts at the same depths as they were in the containers, preferablY in the late evening. Deep planting results in poor growth of the plant. Ensure that the graft joint is above the soil level. Tie the plants to stakes to prevent snapping at the graft joints.

Manuring

Apply FYM/compost and fertilizers at the
rate indicated below:

Age Dlplant

N:P]Oj:K]O (g/plant/year)
20: 18:50 50:27:75

100:36:100 250: 172:200 400:144:400 500:360:750

1st year 2nd year 3-5 years 6-7 years 8-10 years Over 10 years

FYM
kg/plant/year
10 15 25 40 50 75

Green leaves (25 kg/plant) and wood ash (10-15 kg/plant) may be applied additionally. Apply organic manures in May-June with the onset of monsoon. Apply the fertilizers in one dose during May-June until bearing stage and thereafter in two equal split doses, the first during May-June and the second during August-September. Apply manures and fertilizers in trenches 30 cm deep taken at a distance of 2.5 to 3 m from the base of the tree.

After cultivation

Irrigate twice a. week during summer months till the plants are 4-5 years old. Grow vegetables, horse gram, black gram,
pineapple and banana as intercrops in young orchards. Carry out intercultural operations by ploughing or digging twice during the year in June and October. For reducing fruit drop and to improve productivity, NAA at 10-30 ppm concentration may be sprayed to the entire inflorescence at the pea stage in the second week after fruit set.

Plant protection

The important pests of mango are hoppers,
. stem borers, shoot midges, leaf feeding insects, fruit flies and psyllids. The common diseases. are the powdery mildew, anthracnose and dieback. To control mango hopper, spray carbaryl 0.1 % or malathion 0.1 % at the time of flowering. To control mango stem borer, apply paste made of crude carbolic acid (130 ml), soft soap (1 kg) and hot water (3.7 litres) to holes in the bark and plug the holes. Alternatively, inject aluminium phosphide tablets into the burrows after chiselling the opening and widening the burrows with an auger. To control fruit fly, spray malathion 0.) % emulsion / suspension containing 2% sugar. Collect and destroy attacked fruits that rot and drop down. Fruit flies can be effectively managed by keeping Ocimlim trap @ 4 / tree and a bait spray of 0.1% malathion with 2% sugar at monthly intervals from initial fruit set up to harvest. To control the leaf feeding insects, apply carbaryl 0.1 %. To control shoot midge, which causes the drying of tender shoots, apply carbaryl 0.1 % or dimethoate 0.05% or phosphamidon 0.03%. Apply wettable sulphur for the control of powdery mildew and anthracnose. To control dieback of twigs and branches, cut the affected twigs below the infected .region and apply Bordeaux paste to the cut ends.

PAPAYA *(Carica papaya)*

Papaya thrives well in tropical climate. . The occurrence of low temperature and frost limits its cultivation. The optimum temperature for the growth and development of

papaya is 22-26°C. In Kerala, the limiting factors for commercial cultivation are high rainfall and severe drought in summer. However, this is best suited as a homestead

fruit crop. The papaya prefers a rich, welldrained soil. It will not tolerate waterlogging around the trunk.

Varieties

Washington, Honey Dew, Coorg Honey Dew, Solo, Co-I, Co-2, Co-4, Pusa Nanha, Pusa Giant

Co-2 and Co-5 are suitable for papain extraction.

Propagation

Papaya is propagated. almost entirely by seeds. . The best time for raising papaya seedlings is from February to March. The seeds are sown in raised seedbeds of 2 x 1 m made 15 em above the ground level or in polythene bags. A mixture of sand, leaf
mould and dried FYM is spread over the seedbed. The seeds are sown 2-3 em deep at a distance of 5 em in rows 15 cm apart. To raise seedlings for plahting in a hectare, 250 g seeds are required. Seedbeds should be watered daily, if there is no rain.

Papaya seedlings raised in polythene bags can stand transplanting better than that raised in seedbeds. Polythene bags of :?O'x 15 em size and 150 gauge thickness are used as containers. They are filled with a mix- .
ture of FYM, soil and sand in equal proportions. Two seeds are sown in each bag and after germination, only one seedling is retained.

Vegetative propagation by mound layering is also possible.

Planting

Two month old seedlings are transplanted in the main field in May-June at a spacing of 2 x 2 m. Pits of size 50 x 50 x 50 em are taken and filled with topsoil. Male plants are removed as soon as they flower and the female and hermaphrodite plants are retained. In pure female plantations, one male plant is retained for every 10 female plants.

Seedlings are shaded to protect them from excessive sunlight until they establish. In hermaphrodite or monoecious types male plants may not be required.

Manuring '.

Organic manure may be applied at the rate
of 10 to 25 kg / plant / year at the onset of
southwest monsoon in basins around the plant. Each papaya plant should also be supplied with40 g N, 40 g P2Os, and 80 g K2O at every two month interval.

Intercultivation and intercropping

Keep the papaya plot free of weeds. Two hand-diggings, one in the beginning of the rainy season and another in JanuaryFebruary are necessary. When papaya is grown as the main crop, vegetables can be profitably cultivated as intercrop for about six months from planting of papaya seedlings.

Irrigation

The crop should be irrigated in summer. The ring system of irrigation is better for papaya than the basin system because the ring system prevents irrigation water coming into contact with the stem, thus prevent" ing collar rot.

Harvesting

The seedlings flower and set fruit within 3-5
months after transplanting. The number of fruits harvested per tree per year varies from 25 to 30. Fruits showing streaks of yellow colour are harvested. Although papaya trees bear flowers and fruits continuously for many years, it is not economical to retain the trees after 2.5 to 3 years.

Extraction of papain

Papain is an active enzyme present in the latex or milky secretion of papaya plants and

immature fruits. Half to three-fourth matured fruits (about 70 to 100 days from fruit set) are preferred for papain extraction. Tapping of fruits can be done early in the morning by giving longitudinal skin-depth incisions (0.3
cm) on the surface of the fruits from the stalk end to tip. Stainless steel blades or knives or bamboo splinters are used for incising papaya fruits. The milky latex is collected in arecanut spathes or aluminium or glass vessels. The incisions are repeated in two or three subsequent occasions at 3 to 4 days intervals. The latex collected in this way is dried in the sun or in an artificial drier at 50-55°C. A small quantity of potassium metabisulphite is added to the liquid latex to extend the storage We of papain. The dried latex can be stored in airtight polythene or glass containers for a period of six months. Tapped fruits are equally tasty as untapped fruits, although impaired in appearance.

Plant protection

D_mping off

It causes rotting of seedlings in the nursery.

This can be prevented by sterilizing the soil of the seedbed with 2.5% formaldehyde solution ahd covering it for 48 hours with newspapers or polythene sheets. This treatment is given 15 days before sowing.

Collar rot or stem rot

Waterlogging and bad drainage are the chief contributing factors. Application of Bordeaux paste on the stem and soil drenching with Bordeaux mixture are control measures.

Anthracnose

It causes premature fruit fall and leaf fall.
To control, spray Bordeaux mixture 1%.

Papaya mosaic and papaya leaf curl are two serious virus diseases of papaya. Remove the affected plants and bum them immediately.

PINEAPPLE *(Ananas comosus)*

Pineapple is mostly grown at low elevations in areas with a temperature range of 15 to 30°C. Pineapple is tolerant to drought because of the special water storage cells. They can be grown with a wide range of rainfall from600-2500 mm / annurl), the optimum being 1000-1500 mm. Pineapple can be grown in a wide range of soils, but does not tolerate waterlogging. It can be grown as a pure crop on plantation scale or as an intercrop in coconut gardens.

Season

The planting season is May-June. Planting
should be avoided during the periods of heavy rains.

Varieties

There are two varieties viz., Kew and Mauritius the cultivation practices of which are described separately.

1. KEW

Kew is a variety recommended for largescale commercial cultivation in Kerala. The

package of recommendations for its cultivation is detailed be"1ow.

Preparation of the land

Prepare the land for planting by ploughing or digging followed by levelling. Depending on the nature of land, prepare trenches of convenient length and about 90 cm width and 15-30 cm depth. The trenches are to be aligned at a distance of 165 cm from centre to centre.

Selection and treatment of suckers

Select healthy suckers of uniform size weighing 500-1000 g. Keep suckers in open space under shade in a single layer for about 7 days for drying. Strip off a few lower old dried leaves. Allow the suckers to dry and cure for another 7 days. Dip the cured suckers in 1 % Bordeaux mixture at the time of planting.

Planting

Rake the soil and plant the suckers in double

rows at spacing of 70 em between rows and 30 cm between plants. Limit the depth of planting to 7.5 to 10 em. Adopt triangular method of planting in each trench so that the plants in two adjacent rows are not opposite to each other (plant population 40400 / ha).

Manuring

Apply compost / cattle manure at 25 t/ha as basal dressing. Apply fertilizers at the following dosage:

Dose Per plant per year (g)	Per hectare per year (kg)
	N:P205:K2O
8:4:8	320:160:320

Apply full dose of P2O5 at the time of planting. Nitrogen and K2O may be applied in four splits, during May-June (at planting), August-September, November and May_ June (2nd year) .

Note: In places where rains are scanty during November, Nand K2O may be applied in three equal splits - two doses in 1st year (May-June and August-September) and the third in May-June of the second year. After application of fertilizers, cover with soil by scraping the sides of trenches.

Irrigation

During summer months, pineapple should be irrigated wherever possible at 0.6 IW/ CPE ratio (50 mm"depth of water). It requires five or six irrigations during dry months at an. interval of 22 days. Mulching the crop with dry leaves at 6 t/ha will help to conserve moisture.

Weed control

For effective and economic. weed control, use weedicides. Pre-emergent spray with diuron 3 kg or bromacil 2.5 kg in 600 litres of water per hectare completely controls all types of weeds in pineapple plantation. If there is subsequent growth of weeds, herbi

cide application may be repeated at half the above dose. Spraying should be done when there is adequate moisture in the soil. A void periods of heavy rainfall for spraymg.

Induction of flowering

For inducement of uniform flowering, apply 25 ppm ethephon (2-chloro ethyl phosphonic acid) in aqueous solution containing 2% urea and 0.04% calcium carbonate as follows:

The mixture (50 ml/plant) is to be applied pouring into the heart of 16-17 month old plants (39-4.2 leaf stage) during dry weather. For treating 1000 plants, 50 litres of the solution would be required. (The ingredients for preparing 50 litres of the aqueous solution are ethephon 1.25 ml, urea 1 kg and calcium carbonate 20 g, made up to 50 litres with water. The dosage has to be fixed depending on the availability of commercial formulation and the active ingredient contents)

Flowering will commence from 40th day after application and complete on the 70th day. .

Plant protection

No serious pests or diseases are noticed in the crop except for light incidence of leaf spot disease and of the mealy bugs.

For control of leaf spot, spray with anyone of the following fungicides when symptoms of the disease are noticed:
Bordeaux mixture 1 %, 225 litre / ha
Zineb 1 kg in _25 litre water / ha
Mancozeb1 kg in 225 litre water / ha
Ziram 1 kg in 225 litre water / ha

For control of mealy bugs, adopt the following measures: Apply quinalphos at 0.025%, fenitrothion 0.05% or fenthion 0.05%. Destroy grasses and. other monocot weeds, which serve as alternate h<;>sts for the pest.

2. MAURITIUS

Mauritius is recommended for commercial cultivation for table purposes and distant marketing, due to its shorter duration, better fruit quality, keeping quality and transportability .

Season

Main season of planting is April-May and August-September, but can also be planted in all months except during heavy rain of June-July. The best time for planting is August. For getting maximum price and better keeping quality, the best planting time is April-May. During summer months, if there are no summer showers after planting, irrigation should be given three weeks after planting for proper establishment.

Cropping system

Mauritius can be grown as a pure crop in garden land, reclaimed lowlands and wetlands- and as an intercrop in coconut and newly planted rubber plantations. In rubber plantation, it can be grown for the first 3-4 years only.

Land preparation

Pure crop: Prepare the land by digging the area to be planted at 90 em width in rows *I* strips, leaving the intetspaces undisturbed. However, ploughing can be adopted in level land. Planting is done in paired rows of 45 em distance between rows and 30 em between suckers. Suckers may be planted in triangular method in the paired rows. Interspace between the paired rows is kept at 150 em. Contour planting may be adopted in sloppy areas.

Intercropping in coconut garden: Land preparation, spacing and planting are the same as described above. There can be three-paired rows in between two rows of coconut.

Intercropping in rubber plantations: System of planting is in paired rows at 45 x 30 em. There will be only one paired row of pineapple in between two rows of rubber.

Wetlands / lowlands: Pineapple is highly sensitive to water stagnation and high moisture regimes. Hence it is important to provide good drainage, if grown in wetlands. In paddy lands, pineapple is planted in paired rows at 45 x 30 em spacing on ridges taken at 60-90 em height, depending on the water table and drainage requirement. The ridges are separated by drainage channels having 60 em width. The width of the ridges varies from 120-150 em. Wherever water stagnation and poor drainage are expected, a wider and deeper channel is given in between ridges. .

Selection of suckers

Suckers are selected from disease and pest free healthy plants. Suckers are to be graded into those having 500-750 g and 750-1000 g. The graded suckers are planted in different blocks or plots, to. get uniformity in growth and flowering. Bigger suckers give early yield. Dipping of suckers in 1 % Bordeaux mixture and 0,05% quinalphos will protect the suckers against diseases and pests.

Planting

After preliminary land preparations, planting is done in small pits of 10-15 em depth at a spacing of 45 em between rows and 30 em between plants in the rows. There is no need to plant the suckers in trenches.

Manuring

Apply compost / FYM at the rate of 25 tlha at the time of planting. Apply fertilizers at the rate of 8:4:8 g N:P2Os:K2O per plant per year. Full dose ofP2Os is applied as basal at the time of planting. Nitrogen and K2O are applied as four equal split doses after planting. First dose may be applied at 40-50

days after planting and thereafter at 60-70 days intervals.

Irrigation

Wherever irrigation facilities are available, providing irrigation in summer months at two weeks intervals results in 'good fruit size and high yield. If there is no irrigation facility, the crop should be scheduled for harvest before summer months (before March).

Weed control

Pre-emergence (within a few weeks after planting) spray of diuron @ 1 kg/ha in 600 litres of water can keep the field free of
weeds for about four months. For slibsequent weed control, herbicide application is repeated. For controlling, *Mikania micrantha* (vayara valli or American valli), spotapplication of diuron can be adopted. Spraying should be done in moist soil, but avoiding rainy periods.

Weeds in interspaces can be controlled by spraying glyphosate 0.8 kg/ha or a mixture of 2,4-D 0.5 kg/ha and paraquat 0.4 kg/ha. While spraying in interspaces, care should be taken that the weedicide shall not fall on pineapp1e plant.

Flower induction

For inducing uniform flowering, 25ppm ethephon is applied on physiologically mature plants having 39-42 leaves (7-8 months after planting). The solution for application in 1000 plants is prepared by adding 1.25 ml ofethephon (3.2 ml of 39% ethrel or 12.5 mt of 10% ethrel), 1 kg urea and 20 g calcium carbonate to 50 litres of water. Pour 50 ml of the prepared solution to the heart of the plant during dry weather conditions (when there is no rain during the time of application).

Flowering starts by 30 days and completes within 40 days of growth regulator application. Fruits will be ready _for harvest by 130-135 days after the application of growth

'regulator. Harvest over different months / seasons could be obtained by carefully phasing / planning the planting and gro:wth regulator application.

Plant protection

Sun burn: During summer months it is necessary to protect the' fruits from scorching sun by putting dried grasses, coconut or arecanut leaves.

Diseases

Root rot / heart rot / fruit rot caused by *Phyiophthora'sp.* is common in poor drainage conditions. Providing drainage is most essential. The water table should be at least 60 cm below the soil surface. Badly affected plants should be destroyed and the remaining plants should be drenched with 1 % Bordeaux mixture in the soil. Leaf spot can be controlled by spraying 1 % Bordeaux mixture or 0.2% zineb / mancozeb / ziram.

Pests

Mealy bugs *(Dysmicoccus brevi pes* / *Pseudococcus' bromeliae):* Spray quinalphos 0.025-0.05% or fenitrothion 0.05% or fenthion 0.05% or chlorpyriphos 0.05% or dimethoate 0.05% or monocrotophos 0.05%. Care should be taken that the spray shall reach the base and also the sides of the plant. The plot should, be kept weed free. For the control of mealy bugs, control of ants is a must. Hence apply carbaryl to control ants in its colonies in the farm. .

Scale insects *(Diaspus, bromeliae):* The spraying of chemicals for the control of mealy bugs, mentioned hbove, will be suffi
cient for the control of scale insects.

Ratoon cropping

The plant crop after harvest can b_, retained as ratoon crop for two more years. After the harvest of the plant crop, chopping the side leaves of the mother plitnt should be done

for easy cultural operations. The suckers retained should be limited to one or two per mother plant. Excess suckers if any should

be removed. Earthing up should be done. Other management practices are same as for the plant crop.

SAPOTA *(Manilkara zapota)*

Sapota requires a temperature range of 11 to 34°C and an annual precipitation of 225-375 cm. It can be grown in all types of soil but well drained soil is necessary for good growth.

Varieties

Cricket Ball, Oval, Co-I, Co-2, Badami, Baramasi, Calcutta Round, Pala and PKM-l

Propagation

It is propagated through layers and grafts. *Manilkara hexandra* (khrini) is the best

r?otstock for inarching sapota. .

Season

The season of planting is May-June. Plant
ing should be avoided during the periods of heavy-rains.

Planting

Planting is done in pits of 60 x 60 x 60 cm
at a square spacing 00-8 m.

Manuring

The recommended nutrient dosage for a full-grown sapota tree per year is:

FYM	55 kg
N:PzOs:KzO	500:360:750 g

Apply FYM in May-June with the onset of monsoon. Apply the fertilizers in two equal split doses, the first during May-June and the second during August-September.

Apply the manures and fertilizers in trenches 30 cm deep taken at a distance of I mJrom the base of the tree.

Irrigation

Irrigation may not be necessary except during the early stages and in the hot weather; but good crops can be obtained with irrigation.. .

Training and pruning

No pruning is necessary; but in old trees,
lower branches can be removed up to 1 m height.

Flowering and fruiting

The tree flowers continuously in several flushes at short intervals throughout the year. But there are two seasons when flowers will be produced profusely i.e., October to November and February to March. Grafted sapota begins to bear in the third year after planting. Fruit production increases with age up to 30 years followed by a decline. Fruits mature about 4 months after flowl(ring.

Harvesting

Mature fruits, which are dull brown in colour, are harvested and stored for about five days before they are fully ripened for consumption. Ripe fruits can be kept for about 5 to 7 days.

WEST INDIAN CHERRY *(Malph;g;a pun;cifolia)* . (Ad hoc recommendation)

West Indian cherry,.also known as Barbados cherry is the richest Source of vitamin C. It is a medium sized shrub, which thrives well

in tropical climate. It is best suited as a homestead fruit crop and prefers a rich well drained soil.

Varieties

Two distinct types are seen. *Pink flower type'*

Flowers are pink and are born in clusters in leaf axils. Fruits are large in size (about 6 g).

White flower type

Flowers are white and are born in clusters in leaf axils. Fruits are small (about 1 g) and orange coloured when fully ripe.

Planting materials

West Indian cherry is usually raised from seedlings. Seeds are sown in well-prepared beds and when the seedlings are about 2-4 months old, they are ready for planting. Vegetative propagation by means of hardwood cuttings along with leaves is feasible, though the percentage of rooting is very low. Air layering is highly successful when treated with IBA. Layers strike roots within 3-4 weeks. When the roots peep out though the ball of moss or coir pith, the stem may be severed in stages. The rooted shoot is potted after removing the polythene film and kept in shade till new flushes appear. Plants may be hardened in full sunlight prior to transplanting. Chip budding, shield budding, side grafting and veneer grafting are also successful to a limited extent.

Planting

For planting, pits of size 1 x 1 x 1 mare made, 6 m apart. Fill the pit with topsoil and 10 kg cowdung. After planting, mulching may be done with dry leaves to conserve moisture. July to December is considered to be the best time for planting. Irrigation once in four days during early stages of growth up to one year of planting and later on, once in 7-10 days is necessary.

Manuring

A fully-grown, bearing plant should be top dressed with fertilizers @ 100 g N, 160 g PzOs and 260 g KzO. These may be applied in two splits, in June-July and again in January, when there is sufficient moisture in the soil.

Pruning

Pruning is done once in a year to maintain regular shape. Pruning consists of removal of dried and diseased wood and also the drooping branches.

Flowering, fruiting and harvesting

The seedling plants come to flowering within two years of planting while rooted cuttings flower in six months. Flowering commences in the middle of May and extends up to August. The

harvest of fruits commences from August and continues up to November. Rarely, flowering is noticed in March and the crop comes to harvest in April/May.

Yield

The average yield during fourth year of the plant is 2 kg per plant.

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Processing'

The fruits may be consumed fresh or its pulp can be used for preparation of juice, jam, jelly, preserve, syrup etc. The juice or pulp may also be used to fortify ascorbic acid contents of various other products. Its juice can be used to blend with other fruit juice to give delicious mixed fruit cocktails and also to improve their nutritive value. As the richest natural source of vitamin C, the fruits have considerable scope to be developed on a commercial basis, for the production of vitamin C.

APPLE *(Malus sylvestris)*

Apple is an important temperate fruit suited for growing in the high ranges of Kerala. Sloping sites to allow free drainage are considered more suitable than level tops. The ideal soil viz., loam, sandy loam and silt loam with open porous and well-drained subsoil suites apple.

Preparation of land

The planting distance in India varies from 7 -10m, depending upon the vigour of plant. The pit should be of 1 m wide and 20 cm deep so that all roots may be accommodated in a well spread condition.

Planting material

Apples are ordinarily propagated by budding or grafting on seedlings of Crab apple, Yellow Newton or Golden Delicious. Winters are best for whip grafting. Shield budding is done in June with the season's bud. Both whip grafting and shield budding are widely practiced in India.

Time and method of planting

Apples are planted in the ground free of weeds, regularly irrigated for about two years in the beginning. Planting is done late in winter. For adequate root development a temperature of 7°C is considered ideal.

Pruning

The pruning and training are important in apple cultivation. One-year-old plants are cut back at about 80-100 cm above ground. Ifbranches are present at this time, only 4 to 5 of them ought to be retained and shortened in length. No shoot is retained below 50 cm
from ground. At the time of first donnant pruning, the main scaffold branches are cut back to about half a metre in length.

Secondary branches arise trom these main limbs. Some of the new shoots arising early in the second summer are rubbed off in order to develop only a few vigorous secondary branches. During the second donnant pruning, the crowded, misplaced or diseased secondary branches are removed and the extra vigorous ones headed back. This process is continued for 4 or 5

years, at the end of which there are 8 to 10 scaffold branches.

It is desirable to add 100-150 g of nitrogen as sulphate of ammonia. Similar quantities of phosphate and potash should be added when required. Five quintals of bone meal and 10 quintals of wood \ish per hectare are
given annually besides the fertilizers.. Fertilizers should be mixed with the soil at a radius of 1 m from the plant.

Thinning of fruit

Thinning of fruit is also practised in order to improve fruit colour and fruit size. It is desirable to retain one fruit for every 40 leaves. This spaces the fruit at about 15-20 cm apart and there will be only one fruit per spur.

Harvesting

Much of the success in apple production depends on proper picking, storage and disposal. When a fruit separates easily from the spur, firmness of flesh and taste are desirable. The harvested fruits may be stored for 120-150 days at 4-5°C, provided there is good circulation pf air.