MEDICINAL AND AROMATIC PLANTS

EUCALYPTUS (*Eucalyptus citriodora*)

Eucalyptus thrives both in the tropics and subtropics. High humidity and plenty of rainfall are conducive to its luxuriant growth. It can be grown in varied types of soils. The essential oil is used in the preparation of cosmetics, hair oil and soap.

Preparation of land

Clear the land of jungle growth. Take pits of size 45 cm x 45 cm x 45 cm at a spacing 2 m x 2 m at least one month prior to planting and allow to weather. Fill up the pits with soil completely so as to prevent water stagnation.

Planting

Nursery is raised and 4-5 months old seedlings are planted with the commencement of southwest monsoon. After planting, press the soil around the seedling and form mound to prevent stagnation of water.

Manuring

Manuring is not usually done. However, application of 400 g ammonium sulphate, 60 g superphosphate and 25 g muriate of potash per plant per year during August from third year onwards is found to be useful in increasing leaf yield.

After cultivation

During first year, cultivate the rows in both directions to prevent weed growth. Hand weeding is done around the seedlings. Fire belts are to be provided all around.

Intercropping

Eucalyptus can be grown along with coffee, lemongrass and palmarosa. In the first four years, intercropping with pineapple, yam and vegetables can be done.

Harvest and curing

Pruning of side branches may be started from second year onwards. Lopping at a height of 2 m is done during third or fourth year and thereafter lopping is resorted to at half-yearly intervals leaving only one branch. For extracting oil, steam distillation is resorted to. Optimum time for distillation is two hours and the average recovery of oil is 1.5 – 1.8 per cent of the net weight of leaves. Wilting of the cut leaves under shade for 24 hours before distillation will increase the oil recovery percentage.

KACHOLAM (*Kaempferia galanga*)

An attractive medicinal plant used in various medicines. The aromatic essential oil of the rhizome is widely used in perfumery, as a condiment and as a folk medicine. Asians employ the rhizomes and leaves as a perfume in cosmetics, hair washes and powders. Rhizomes are used to protect the clothing against insects and are chewed with betel nut.

Kacholam is a plant adapted for tropical climate. Fertile loamy soil having good drainage is ideal for the crop. Laterite soil with heavy organic manure application is also well suited.

Preparation of land

Prepare the land to a good tilth during March by ploughing or digging. On receipt of

pre-monsoon showers in April, prepare beds of 1 m width 25 cm height and of convenient length with spacing of 40 cm between beds.

Seed materials

Whole or split rhizome with at least one healthy sprout is the planting material in kacholam. Select well developed healthy and disease free rhizomes. Rhizomes can be stored in cool dry place or pits dug under shade, plastered with mud or cowdung. Two weeks before planting of the new crop, smoking the rhizomes by spreading it on *Glycosmis pentaphylla* (panal) leaves is practised in certain localities.

Varieties

Rajani and Kasthuri are high yielding varieties with an yield potential of more than 2 tonnes dry rhizomes per ha and have good aroma and flavour. Local types are also under cultivation.

Season and method of planting

Planting is done during the month of May with the receipt of pre-monsoon showers. Take small pits in the beds in rows with a spacing of 20 cm x 15 cm and at a depth of 4-5 cm and plant rhizomes with at least one viable healthy bud facing upwards. Adopt seed rate of 700-800 kg ha^{-1}.

Manuring

Apply FYM or compost as basal dose @ 20 t ha^{-1}, either by broadcasting and ploughing or by covering the rhizome in pits after planting. Apply N, P_2O_5 and K_2O @ 50, 50 and 50 kg ha^{-1} at the time of the first and second weeding.

Mulching

After planting, mulch the beds with dry or green leaves @ 15 t ha^{-1}.

After cultivation

Remove weeds as and when necessary. Apply fertilizers and earth up the crop during the first and second weeding (45 and 90 days after planting). Avoid water stagnation in the beds. Further weeding is not necessary as the spreading leaves smother the soil surface.

Plant protection

During heavy rains, leaf rot disease occurs in certain localities. For controlling this disease, drench the beds with 1 per cent Bordeaux mixture or thiram 0.2 per cent.

For controlling nematodes *(Meloidogyne incognita* and *Radopholus similis)* associated with Kacholam, rhizome treatment with *Pseudomonas fluorescense* @ 3 per cent weight by weight of seed material or by green leaf mulching with neem and glyricidia @ 5kg/ m^2 at 30 DAP can be recommended.

Harvesting and curing

The crop can be harvested seven months after planting. Drying of the leaves is the indication of crop maturity for harvest. Harvest the crop carefully without damaging the rhizomes, remove dried leaves and roots, wash the rhizome in water and dry. With sharp knife, chop the rhizomes into circular pieces of uniform size except the end portion, which has to be cut separately. Spread the cut rhizomes uniformly on clean floor and allow drying for four days. On fourth day, heap the rhizomes and keep it overnight. On the next day it is again spread and dried. Clean the dried produce, bag and store in cool dry place or market it. Prolonged storage can cause insect and fungus attack.

LEMONGRASS (*Cymbopogon flexuosus*)

Lemongrass prefers warm climate with a well-distributed rainfall and well-drained soil. Usually it is grown on poor, gravelly soils. Lemongrass is a perennial grass mainly cultivated on hill slopes as a rainfed crop. The crop provides maximum yield from the second to fourth year of planting and economic yield up to the sixth year. Thereafter, the yield declines considerably. The leaves yield an aromatic oil, containing 70-90 per cent citral. The oil is used in soaps, cosmetics and disinfectants and is a raw material for manufacturing ionones and vitamin A.

Seeds and sowing

The crop is propagated mostly through seeds. It can also be propagated vegetatively through planting of slips.

Sugandhi is the improved variety of lemongrass recommended for cultivation.

Seeds can be sown directly in the field or seedlings are raised in a nursery and then transplanted. Transplanted crop is found superior to direct-sown crop in respect of grass yield, oil content and citral content in oil. Seeds are sown in well prepared nursery beds during April-May with the onset of pre-monsoon rains and covered with thin layer of soil. The seed rate is 3 to 4 kg ha^{-1}. Seeds collected in the season should be sown latest by August of the same year. The seedlings will be ready for transplanting in 2 to 2.5 months.

Preparation of land

The land is prepared by digging. Raised beds of 75-80 cm width and of convenient length are formed with a spacing of 30-35 cm between beds. On sloppy terrain, the beds are formed along the contours. At the early southwest monsoon (June-July), two or three seedlings or slips per hill are transplanted on the beds at a spacing of 15-20 cm in 4-5 rows. Before planting, the top leafy portion of the seedling is cut off leaving the plant stalk about 15-20 cm length.

Manuring

Application of compost made of spent lemongrass (refuse obtained after distillation) and wood ash @ 2500 kg ha^{-1} and 1875 kg ha^{-1} respectively is found beneficial. Application of nitrogenous fertilizers @ 100 kg ha^{-1} in four splits (each after 1^{st} to 4^{th} harvest) has been found to increase oil yield considerably.

After cultivation

Regular weeding depending on weed growth and earthing up at least once in a year along with manuring is recommended. Serious pests or diseases do not generally infest the crop.

Harvesting

Harvesting is done by cutting the grass 10 cm above ground level. During the first year of planting, three cuttings are obtained and subsequently five to six cuttings per year are taken subject to weather conditions. The harvesting season begins in May and continues till the end of January. The first harvest is taken about 90 days after planting and subsequent harvests at intervals of 40-50 days. The optimum interval between harvests to obtain maximum quantity of oil is 40-45 days for local types of lemon grass. For Sugandhi, the optimum interval was found to be 60-65 days when grown in hill tops and 45-55 days in valleys and lower areas.

Seed collection

The crop for seed production is left without cutting to get maximum seeds. The

crop flowers during November-December and the seeds are collected during January-February. The whole panicle is cut and dried for one or two days and then threshed and sieved to collect the seeds.

Distillation

Essential oil from lemon grass leaves is extracted by hydro-steam distillation. Time required for distillation is two hours including the time required for charging and discharging. A light yellow, lemon scented volatile oil is obtained. When crop area is large enough, steam method is found to be more economical. Coal is used as fuel.

The cut grass is chopped into smaller pieces before feeding to the distillation unit. It can be stored up to 3 days under shade without any adverse effect on yield or quality of oil.

Storage of oil

Lemongrass oil can be stored up to 3 years without affecting the quality of oil, if kept in aluminium containers sealed air-tight using wax. The containers are to be kept in darkness.

Yield

The grass yield during the first year will be about 10 t ha^{-1}, which gives about 28 kg of oil. From the second year onwards, the grass yield will be about 25 t ha^{-1} giving about 75 kg of oil. The average recovery of oil is 0.30-0.35 per cent with 70 per cent citral for local types of lemongrass while OD-19 variety gives 0.40-0.45 per cent oil recovery and 85-90 per cent citral content.

PALMAROSA (*Cymbopogon martinii* var. *motia*)

Palmarosa (rosha grass) is adapted to marginal areas and poor soils. The flowering tops and foliage contain sweet smelling oil emitting a rose like odour and is widely used in soaps, cosmetics and perfumery industries. The oil is also used as a raw material for producing geraniol, which is extensively used in the perfumery industry.

Propagation

The crop can be propagated by seeds and slips. Seedlings establish quicker and are better than slips. So seedlings are preferred as planting materials under Kerala conditions. Prepare the seedbed in well pulverized soil after 15th April. Seed rate is 4-5 kg ha^{-1}. Seeds collected in January-February must be sown latest by August.

Planting

Prepare the main field for planting, form beds and plant the seedling, two on a hill, at a spacing of 30 cm x 20 cm. Apply organic manures like compost made of spent grass and wood ash @ 6 t ha^{-1} and 2.5 t ha^{-1} respectively at the time of formation of beds.

Harvesting

By about 3.5 to 4 months, the plants attain a height of 150-200 cm and they start producing inflorescence. The grass is cut one week after flowering. Generally two cuttings are made during the first year of planting. From second year onwards 3 to 5 cuttings are possible.

Distillation

As in the case of lemongrass, extraction of palmarosa oil is done by the hydro-steam method. It takes two hours to complete one distillation. The average recovery of oil from ODP-1(Amaravathy type) is 0.40 to 0.45 per cent. Allowing the cut grass to wilt in shade for 24 hours during monsoon season and 48 hours during the post-monsoon will increase the oil recovery.

Plant protection

Pink globular root aphids *(Tetraneura)* occur on the roots and cause withering of the crop in patches due to desapping. Dig out and burn the affected patches and irrigate with water charged with fish oil soap or emulsion spray oil to control the aphids.

VETIVER (*Chrysopogon zizanioides*)

Vetiver is a perennial grass, commonly known as 'khus' and mainly cultivated on hill slopes as a rainfed crop. The essential oil is extracted from the roots and known as 'khus khus oil'.

It prefers a warm climate and grows in areas up to 600 m elevation. Even though vetiver grows almost in all soils, a rich and fairly well drained sandy loam is the best. An annual rainfall of about 100 to 200 cm, temperature ranging from 25 to 40ºC and moderate humidity are ideal for its growth.

Its root contains fragrant oil, which is a perfume by itself. The dry aromatic roots are made into curtains, mats, fans, etc. to emit scented cool aroma when moistened. The oil is used as a valuable fixative for blending perfumes and cosmetics.

Varieties

Two types of vetiver namely, South Indian and North Indian (khus) are generally under cultivation. South Indian types produce higher root and oil yield, but North Indian types have superior oil quality. Among the South Indian types, the Nilambur type (ODV-3) on an average produces 5 t ha^{-1} of root, yielding 20-30 kg oil ha^{-1}.

Planting

The crop is propagated through slips. June-July is the optimum period for planting. Two to three ploughing are given so that the soil is well loosened and ridges or beds of convenient length are made. Slips are planted in two rows on 1 m wide beds.

Manuring

Usually 5 t ha^{-1} of FYM or compost is applied at the time of bed preparation. Application of 22.5 kg each of P_2O_5 and K_2O per ha is found to be beneficial for increasing root and oil yield.

Harvesting and distillation

The optimum period of harvest of roots to get the maximum oil yield is 18 months. Harvesting is done with the digging forks. The roots are washed gently to remove the earth and are chopped into bits of 4-5 cm length. The oil is extracted by hydro-distillation.

Vetiver as a soil binder

Vetiver has a deep, dense and strong fibrous root system. The perennial and sterile characteristics of the crop with its hardiness and unpalatability to livestock make

it an excellent soil-conserving crop. It may be planted as a contour hedge on sloppy lands or can be used to protect the banks of major irrigation canals.

CHETHIKODUVELI [CITRAKA] (*Plumbago rosea*)

This is an attractive erect rambling shrub with long tuberous roots and bright red flowers in long terminal spikes. The root tubers are the medicinally important parts. This is an esteemed remedy for leucoderma and other skin diseases. The synonyms of fire like 'agni', 'analah' etc. are attributed to this drug to indicate the caustic action of roots causing blisters on the skin. The drug is used only after adequate curing and purification. Roots contain plumbagin, which is responsible for the therapeutic action of the drug.

Varieties: Mridhula and Agni.

Planting materials

Propagated by single, double or three node semi-hard wood stem cuttings. Cuttings are planted in nursery beds of convenient length and 1 m width for rooting.

Land preparation

Prepare the land to a good tilth by ploughing two or three times. Make ridges of about 30 cm height and 50 cm apart for planting rooted cuttings. Two to three month old rooted cuttings can be planted on the ridges at a spacing of 15 cm in June-July.

Manuring

Cattle manure or compost @ 10 t ha^{-1} may be applied as basal dose at the time of land preparation. The fertilizer dose for chethikoduveli is $N:P_2O_5:K_2O$ 50:50:50 kg ha^{-1}. Entire P_2O_5 has to be applied as basal dose and N and K_2O in two split doses, 2 months and 4 months after planting.

After cultivation

Weeding has to be done two or three times depending on weed growth. Earthing up may be done two times along with topdressing of fertilizers.

For controlling nematodes *(Meloidogyne incognita* and *Radopholus similis)* associated with Chethikoduveli, apply *Pseudomonas fluorescens* @ 10g/plant at the time of transplanting rooted cuttings.

Harvesting

The crop can be harvested in about 12-18 months after planting. After digging out, the root tubers are cleaned by washing in water and marketed.

NEELA AMARI [NILI] (*Indigofera tinctoria*)

Nili is a reputed drug for the promotion of hair growth. Due to antitoxic property it is also a good remedy for poisons. This plant, which is the original source of natural indigo, is an erect shrub with imparipinnate leaves. Leaves are important in medicine and form a major ingredient of preparations like 'Nilibhringadi'.

Land preparation

Prepare the soil to fine tilth by ploughing two or three times.

Seeds and sowing

Seeds are very small and the seed rate is 3 kg ha^{-1}. Seeds require pretreatment for good germination, as the seed coat is hard. Seeds are mixed with sand and ground gently to break the seed coat. An alternate method for enhancing germination is dipping the seeds in boiling water for a second. After pre-treatment seeds are broadcasted. Broadcast the seeds preferably mixed with sand 2-3 times its volume to ensure uniform coverage. Seeds germinate within a week. Alternatively, 1 to 1.5 months old seedlings raised on beds or in polybags can be transplanted at a spacing of 45 cm x 30 cm.

Seasons

The best time for sowing is September-October.

Manuring

Apply cattle manure @ 10 t ha^{-1} as basal dressing and incorporate into soil along with last ploughing.

After cultivation

Weeding has to be done twice, three weeks and six weeks after sowing.

Harvesting

Plants start flowering 2-3 months after sowing. Harvesting is done by cutting the plants at this time, at a height of about 20 cm from ground level. Irrigate plants after harvest. Subsequent harvests can be made at 1.5 – 2 months interval. Four to five cuttings can be taken in a year depending on the growth.

Seed collection

A few plants per plot are left without cutting to set seeds. Ripe pods are to be harvested in the early morning to prevent loss of seeds by shattering during harvest.

Pests

The psyllid *Arytaina puctipennis* infest top shoot causing curling up and drooping of leaves and shoots and wilting of plants.

CHENGAZHINIRKIZHANGU (*Kaempferia rotunda*)

Indian crocus, also known as bhucampaka in Sanskrit, abhuyicampa in Hindi and chengazhinirkizhangu in Malayalam is a medicinal herb with aromatic rhizome. The rhizomes are used for the treatment of tumours, swellings and wounds. It helps to remove blood clots and other purulent matters in body. It is used in many ayurvedic formulations including 'Chyavanaprasam' for improving complexion and curing burning sensation, gastric complaints, mental disorders and insomnia.

Climate and soil

The plant is distributed in the tropics and subtropics of Asia and Africa. It grows wild in wet, humid or shaded forest ecosystems of South India. It is also cultivated as an intercrop with other commercial crops. Moist loamy soil is ideal for the crop. Laterite soil with heavy organic manure application is also well suited.

Propagation

It is propagated through rhizomes.

Varieties

At present, only local types are available for cultivation.

Season

The optimum time of planting is with the receipt of pre-monsoon showers in May-June.

Land preparation

Plough the field to good tilth. Incorporate organic manure at 10-15 t ha^{-1}. Prepare raised seed beds of 1 m breadth and of convenient length.

Seed rate

Use rhizome bits of size 10-15 g for planting. About 2500-3000 kg rhizomes are required for planting one hectare. Smoking the rhizomes for 2-3 weeks is good for the development of healthy sprouts. At times, rhizomes are stored in *Glycosmis pentaphylla* leaves in underground pits covered with coconut fronds.

Planting

Pits are made at 20 cm spacing on the seed bed. Whole or split rhizomes with at least one healthy sprout is planted 5 cm deep with the sprout facing upwards and covering the pit with FYM.

Mulching

Mulch the beds thickly with green leaves or straw @ 15 t ha^{-1} immediately after planting and again after two months along with weeding and topdressing. Mulching is absolutely essential for good growth.

Fertilizer application

Fertilizer application can be skipped in fertile soils. In poor and marginal soils a moderate dose of 50:50:50 N:P_2O_5:K_2O kg ha^{-1} may be applied; P_2O_5 as basal and N and K_2O in two or three split doses.

After cultivation

Remove weeds, apply manure and fertilizers and earth up two and four months after planting, followed by mulching.

Plant protection

During rainy months, rhizome rot is noticed which can be prevented by drenching 1 per cent Bordeaux mixture.

Harvesting and yield

The crop matures in 7-8 months. Drying up of the leaves is the indication of maturity. Dig out the rhizomes carefully, remove leaves and clean. The rhizomes with attached tubers are usually marketed afresh. Prolonged storage may cause insect and fungus attack. The average yield is 12-15 t ha^{-1}.

KASTHURIMANJAL (*Curcuma aromatica*)

Curcuma aromatica known as vanharidra in Sanskrit and kasthurimanjal in Malayalam is a rhizomatous herbaceous medicinal plant. The rhizome is an odoriferous ingredient of the cosmetics used for the cure of chronic skin diseases caused by impure blood. It is used as appetizer and tonic to women after childbirth. It is also useful against high fever and worm infestation.

Climate and soil

It is distributed in Southeast Asia. The plant grows wild in the eastern Himalayas and in moist deciduous forests of Kerala and Karnataka. It is grown as a subsistence crop in backyard, kitchen garden and interspaces of other crops in areas with good rainfall. Well-drained rich loamy soils are ideal for the crop.

Propagation

It is propagated vegetatively by rhizomes.

Varieties

At present, only local types are available for cultivation.

Land preparation

Clear the area, remove all the pebbles and stones and plough the field to good tilth. Incorporate FYM or organic manure @ 10-15 t ha^{-1}. Prepare raised seedbeds of 1.2 m breadth and of convenient length.

Seed rate

A healthy disease free mother rhizome with at least one germinated sprout is the planting material. It is required @ 1500 kg ha^{-1}.

Planting

Take small pits at 60 cm x 40 cm spacing on the seedbed and plant seed rhizomes with the germinating sprout facing upwards. Cover the rhizome with FYM and mulch the bed with leaves or straw.

Fertilizer application

Apply fertilizers @ 100:50:50 N:P_2O_5:K_2O kg ha^{-1}; entire P_2O_5 as basal and N and K_2O in two equal splits at planting and two months after planting.

After cultivation

Carry out gap filling if necessary within one month. Remove weeds two months after planting followed by topdressing, earthing up and mulching.

Plant protection

No serious pests and diseases are encountered in the crop.

Harvesting and yield

The crop matures in 7 months. Drying up of leaves is the indication of maturity. Dig out the rhizomes without causing damage. Remove the dry leaves and roots. The cleaned rhizomes are either marketed or dried and stored. The average yield of fresh rhizome is 28 t ha^{-1} which on drying gives 27 per cent recovery.

Processing

The rhizome is thinly sliced and steam distilled for 3-4 hours for extracting the essential oil and the yield is 90 litres per ha. Oil recovery is 0.33 per cent on fresh weight basis and 1.05 per cent on dry weight basis.

CHITTARATHA (*Alpinia calcarata*)

Alpinia calcarata is also known as rasna in Sanskrit, kulainjan in Hindi and chittaratha in Malayalam. It is a perennial herb with non-tuberous pungent rootstock. It grows to a height of 1.5 m and produces around 24 suckers per clump per year. The economic part is rhizome, which is a major constituent of many formulations of indigenous system of medicine for relieving throat inflammation, stimulating digestion, purifying blood and improving voice.

Climate and soil

Alpinia comes up well in tropical climate. It grows on a wide range of climate and soil.

Well-drained hilly areas and places up to 1400 m altitude are good for its cultivation. Fertile red loams to forests soils are suitable.

Propagation

It is propagated vegetatively by rhizomes.

Varieties

At present, only local types are available for cultivation.

Season

Rainfed crop is planted with the onset of monsoon in May-June. Irrigated crop can be planted at any time.

Land preparation

Plough the field to good tilth. Remove all pebbles and stones. Incorporate FYM or organic manure at 10-15 t ha^{-1}. Prepare raised beds of convenient length and breadth to facilitate drainage.

Seed rate

Fresh healthy disease-free rhizome bits with at least one shoot is the planting material, which is required @ 1000-1500 kg ha^{-1}.

Planting

Take small pits on the seedbed and plant 5 cm long rhizome bits. Cover rhizome with FYM and mulch the seedbed with leaves or straw. The optimum spacing is 40 cm x 30 cm under good fertility and 30 cm x 20 cm under poor fertility conditions.

Fertilizer application

Apply fertilizers @ 100:50:50 N:P_2O_5:K_2O kg ha^{-1} per year in two or three split doses. Application of biofertilizer *Azospirillum* @ 10 kg ha^{-1} and *in situ* green manuring with cowpea are beneficial for the crop.

After cultivation

Carry out gap filling, if required, within one month; remove weeds two months after planting followed by topdressing, earthing up and mulching. Thereafter no weeding is required as the crop smothers the weeds.

Plant protection

Usually pests and diseases are not serious enough to take up any control measures. Occasionally shoot borers and leaf eating caterpillars are observed. Blight disease can be controlled by spraying 1 per cent Bordeaux mixture.

Harvesting and yield

Though the crop can be harvested after 18 months, the optimum stage of harvest for obtaining maximum rhizome and oil yield is 36-42 months after planting. Cut and remove the shoot portion and carefully dig out the rhizomes and roots. Harvesting is very arduous due to strong and extensive root ramification. Separate the roots, clean the rhizomes and cut into 5 cm long pieces, which are dried in the sun for 3-5 days to 10 per cent moisture for marketing. The average yield of rhizomes is about 23 t ha^{-1}, which on drying gives 25 per cent recovery.

Processing

The fresh rhizomes on steam distillation for 3-5 hours give 0.22 per cent essential oil. The oil recovery on dry weight basis is 0.93 per cent.

NILAPPANA (*Curculigo orchioides*)

Black musli or Nilappana, one of the ayurvedic dasapushpas, is a small geophilous herbaceous plant with cylindrical rhizome. Rhizome is the economic part. It is a rejuvenating and aphrodiasic drug. It improves complexion and is useful in general debility, deafness, cough, asthma, piles, skin diseases, impotency, jaundice, urinary disorders etc. It is an ingredient of ayurvedic formulations like Vidaryadighrita, Vidaryati lehya, Murma gulika, Musalyadi churna, etc.

Climate and soil

The plant is found through out India from near sea level to 2300 m altitude, particularly in rock crevices and laterite soil. It grows well in moist humus – rich soils especially in shady forest areas and rubber plantations. It is a shade loving plant and its growth, yield and quality are optimum under 25 percent shade. It can be grown as an under story crop or intercrop in plantations.

Propagation

The plant is propagated through rhizome. New propagules also emerge from leaf tips in contact with soil during monsoon.

Varieties

At present only local types are available for cultivation.

Season

Rain fed crop is planted with the onset of monsoon in May-June. Irrigated crop can be planted any time.

Land preparation

Plough the field to good tilth. Remove all pebbles and stones. Incorporate well decomposed poultry manure at 2.7 t ha^{-1} or FYM 20 t ha^{-1}. Prepare raised beds of convenient length and breadth to facilitate drainage.

Seed rate

Fresh healthy disease free rhizome with at least one shoot is the planting material, which is required at 750 kg ha^{-1}.

Planting

Fresh rhizome bits of 1.5-2 cm are planted at a spacing of 10 cm x 10 cm. 25 per cent shade is required for proper growth.

Fertilizer application

Apply fertilizers at 10:8:5 kg N, P_20_5 and K_2O ha^{-1} for maximizing nutrient use efficiency and realizing highest yield of quality rhizome.

After cultivation

Carry out gap filling, if any, within one month. Soil should be sufficiently moist to get maximum rhizome development. Two to three weedings are essential to control weeds. As the rhizome development is upward regular earthing up is required for high yield.

Plant Protection

Seedling rot is found during rainy season and spraying 1 per cent Bordeaux mixture can control it. Rhizomes are found eaten by rodents and hence proper measures are to be taken for their control.

Harvesting and Yield

Production of secondary rhizomes starts from fourth month. The plant grows actively upto 7 months, after which it could be

harvested for rhizome. During summer, the above ground portion dries up. Harvesting is done by digging out the rhizomes. The shoot portion and the roots are removed and the separated rhizomes are cleaned. Fresh rhizome yield is 3-4 t ha^{-1}. Rhizomes are sliced to 1cm size, dried in sun and marketed or stored in gunny bags. The dried rhizome yield is 1-1.5 t ha^{-1} (35-45 per cent driage). Higher yield is obtained if harvested during second year.

JEEVAKOM *(Seidenfia rheedii* Sw. Szkch)

Jeevakom is a medicinal orchid widely used in Ayurveda. It is available in the market in two forms. 'Jeevakom' and "Edavakom'. Jeevakom belongs to the 'astavarga' group of drugs mentioned in Ayurveda. It is a short-stemmed fibrous rooted lithophytic herb with 5-7 leaves. Stem is swollen at the base forming a conical pseudo balbil which is the part used in medicine. Jeevakom is a rejuvenating drug and an ingredient of many Ayurvedic formulations viz. *Chavanaprash, Dhanwantharam kashayam, Dhanwantharam kuzhambu* and *Ashtavargam kashayam*.

Climate and soil

The plant is present in select pockets of India, mainly in the forests. In Kerala it occurs at altitudes ranging from 650 to 1000 m above MSL. In the forests jeevakom colonizes on decomposed organic matter on wet rocks amidst moss and grass. It is a shade loving plant and prefers 50%-75% shade for better growth, yield and quality. The crop can be grown under natural as well as artificial shade provided by shade net.

Propagation

The plant is propagated through pseudo- bulbils. Mother bulbils cut into single node bits can also be used.

Varieties

Only local cultivars (ecotypes) are available for cultivation.

Season

Crop is raised as rainfed. Best time for planting is after the receipt of summer showers (May-June).

Land preparation

Select an area receiving 50-75 percent shade (natural or artificial shade provided by shade net). Plough the field to good tilth. Incorporate dried FYM at the rate of 20t/ha^{-1}. Prepare raised beds of convenient length and breadth to facilitate drainage.

Seed rate

Stored pseudobulbils of previous year are used as planting material. Small side bulbils weighing 1 g or mother bulbils cut into 2g bits having single node can be used. Seed rate is 250 kg/ha^{-1}.

Planting

Bulbils are planted at a spacing of 10x10 cm. Bulbils are placed horizontally over the beds, they are just pressed gently into the soil. Beds are mulched heavily after planting with green or partially decomposed dry leaves.

Manuring

Crop responds well to organic manures. Powdered FYM/leaf compost/vermicompost is applied @ 100g/m^2, 60 days and 90 days after planting.

After cultivation

Carry out gap filling if any within 30 days. Remove the weeds as and when they come

up. The crop performs well under moist condition. Cover the soil with mulch for the first 4-5 months, keep the soil moist always. Crop flowers 1-2 months after planting. Side bulbils start emerging from 4th month onwards.

Harvesting and yield

After six months of planting, aerial parts start yellowing. Leaves turn yellow and ultimately dry up. Bulbils are gathered from the beds manually. Bulbils covered with the leaf sheaths are separated, roots removed. Mother and daughter bulbils are separated. Since the part used as drug and the propagule are one and the same, the mother bulbils are used as drug and the side bulbils can be used as planting material for next season.Total yield from a bed is 6.0 kg/3m^2. The bulbils which are succulent in mature can be stored in earthern containers in a cool room for a period of 4-5 months without loosing viability.

ADAPATHIYAN *(Holostemma adakodien)*

Holostemma or Adapathiyan is a large, glabrous, laticiferous twining shrub, much branched, with shining stem and large conspicuous flowers. Root is the economic part. It is useful in ophthalmopathy, orchitis, cough, burning sensation, stomachalgia constipation, fever and tridoshas. It is used in preparations of Vidaryadi ganam, Dhanwandharam thaila, Manasa mithra vatakam, Balarishta and Anuthaila. It is also useful in eye diseases and it imparts resistance to diseases.

It grows on a wide range of climate and soil. Well-drained hilly areas with an underlying hard pan is good for its cultivation. Fertile red loams to forest soils are suitable.

Propagation

The plant is propagated vegetatively by stem cuttings and by seeds. The seeds are collected from the plant in November-December before being dispersed. Seeds are cleaned, dried and stored for sowing. The stored seeds after soaking in water for 4-5 hours are sown on seedbeds. About one month old seedlings are planted in polybags, which are kept in shade and irrigated. About 1–1.5 month old seedlings are ready for transplanting.

Varieties

Jeeva is a high yielding variety. It has purple colored stem with a yield of 4.5 t ha^{-1} of fresh tubers.

At present, only local varieties are available for cultivation.

Seasons

Rainfed crop is planted with the onset of monsoon in May-June. Irrigated crop can be planted any time.

Land preparation

Plough the field to good tilth. Remove all pebbles and stones. Incorporate FYM or organic manure at 20 t ha^{-1}.

Planting

Pits of 30 cm^3 size are taken at a spacing of 60 cm x30 cm distance and filled with 10 kg dried cowdung and top soil and formed into a mound. Seedlings are transplanted on to the mounds from the polybags carefully.

Fertilizer application

Application of NPK @ 100:50:50 kg ha^{-1} is beneficial.

After cultivation

Carry out gap filling, if any, within one month; remove weeds two months after planting followed by top dressing, earthing up and mulching. Thereafter no weeding is required as the crop smothers the weeds. Since the crop is twining in nature, pandal or stakes are to be provided to aid trailing. Regular irrigation is to be given till flowering.

Plant protection

Aphid infestation is seen in the crop, which can be controlled by spraying 0.05 per cent quinalphos.

Harvesting and yield

Flowering and fruiting occurs in November-December. Harvesting can be done one and half to two years after planting and it is better to harvest in January – February. The tubers are cut into pieces of 10 cm length and dried in sun before sale. Yield of dry tubers is about 1. 5 t ha^{-1}.

ASOKA *(Saraca asoca)*

Asoka or Asokam is a medium sized beautiful evergreen tree growing upto 9 m in height with numerous spreading and drooping glabrous branches. The bark is useful in dyspepsia, fever, burning sensation, visceromegaly, colic, ulcers, menorrhagia, metropathy, leucorrhoea and pimples. The well-known Ayurvedic preparations are Ashokarishta and Ashokaghrita.

Climate and soil

Asoka grows well in areas with well-distributed rainfall and in slightly shady areas. The tree is grown throughout India except in northwestern part of the country upto an elevation of about 750 m. It grows on a wide range of soils.

Propagation

The plant is seed propagated. Seeds are formed usually during February-April. Seeds are collected when they are ripe and fall down. They are sown after soaking in water for 12 hours on the prepared beds. Seeds germinate within 20 days. The seeds are then planted in polybags. 2 month old seedlingsfrom the polybags are used for transplanting. Air layering in Asoka is found successful. Coir pith compost is the best rooting media. June-July is the ideal time for air layering.

Varieties

Aswani-1 is an improved variety that give high bark yield. Local varieties are also cultivated.

Season

The crop is planted with the onset of monsoon in May-June.

Planting

Square shaped pits of 60 cm depth are taken at 3 m spacing and filled with topsoil, sand and dried cow dung. 2 months old seedlings are then transplanted.

After cultivation

The base of the trees is to be cleared of weeds and FYM at 2 kg/tree/year may be applied twice; first in May-June and again in October-November. The dose is to be increased gradually to 10 kg from 5th year onwards. Chemical fertilizers are not usually applied. However its application during the initial years will help in better establishment of the plant. NPK at 90:45:45 g/ tree/year is recommended.

Plant protection

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

Harvesting and yield

Asoka can be cut after 20 years for collection of bark, the medicinally useful part. It is cut at a height of 15 cm from soil level. If irrigation and fertilizers are given the stump will produce new shoots and it can be harvested again after 5 years. Alternatively, the bark can be collected without cutting down the tree. The bark is peeled off first, vertically from one side of the main trunk. The excised area is renewed with fresh bark in 1-2 years. Then, the bark on the other side can be peeled off. The process can be continued over years.

KANJIRAM *(Strychnos nux-vomica)*

Strychnos or kanjiram is a large deciduous tree with a fairly straight and cylindrical bole having dark grey or yellowish grey bark and minute tubercles. Strychnos is highly toxic to man and animals producing stiffness of muscles and convulsions, ultimately leading to death. In small doses it can serve as efficacious cure for paralysis and other nervous disorders. Root and root bark is used in fever and dysentery.

Climate and soil

The plant is distributed throughout India in deciduous forests up to 1200 m. It prefers tropical and subtropical climate. It is grown in different soil types such as laterite, sandy and alluvial.

Propagation

It is propagated through seeds. Germination can be substantially increased by treating the seeds with hot water (50^0 C) for a period of six to twelve hours prior to sowing.

Season

Seedlings can be planted in main field with the onset of South-West monsoon in May – June.

Planting

Seeds are sown in poly bags. The saplings are later transplanted to the main field on to pits of about 1m x 1m taken at a spacing of 6m x 6m, filled with top soil and organic manure.

After cultivation

The basins of the trees are cleared of weeds and after application of manures and fertilizers covered with soil. FYM at 2 kg per tree is to be applied during early stages and the dose is gradually increased to 20kg from 5th year onwards.

Plant protection

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

Harvesting and yield

Flowering is during March-April and fruiting during May-December. Fruits take about 8-9 months to mature. Mature pods are collected and seeds are extracted, washed, dried and stored for later use. The yield is 50-75 kg dry seed per tree per year.

THIPPALI *(Piper longum)*

Thippali is one of the important medicinal plants used in many of the Ayurvedic drugs. Fruits as well as roots of the plant are attributed with numerous medicinal properties and are used for diseases of respiratory tract, carminative and as a general tonic for maintaining health, vigour and vitality.

It is a slender aromatic climber with perennial woody roots. It is a dioecious plant with female and male spikes seen in different plants. Male spikes are long and slender with green colour during immature stage and yellowish during mature mage. Female spikes are short and thicker and greenish in immature stage and deep black in mature stages. Dried mature female spikes are commercially marketed.

Preparation of land

Thippali is highly adapted for warm humid tropical climate. Fertile, loamy soil having good drainage is ideal for this crop. Sandy soil with high organic content is also well suited. It is a shade loving plant and can be cultivated in middle aged coconut gardens and also in similarly shaded plantations.

Seed materials

3-5 noded rooted cuttings are used for planting in the field.

Varieties

Variety 'Viswam' is recommended for higher spike yield both in irrigated open and shaded conditions. It recorded 800 to 850 kg dry spikes per hectare in open condition and 350 to 400 kg in coconut gardens during second year of planting.

Season, method of planting and manuring

In a well ploughed land, beds of 1m width and of convenient length may be taken and pits are taken at a spacing of 60 cm x 30 cm. FYM @ 20 t ha^{-1} is needed for one hectare. Between the beds channel of about 30 cm depth have to be provided for easy drainage of water. Two rooted cuttings per pit have to be planted during the month of May-June after the receipt of 4-5 pre-monsoon showers.

Irrigation

If it is a sole crop irrigation may be provided once in a week and as an intercrop in irrigated gardens, irrigation for the main crop will be sufficient for this crop also. If irrigation is not possible during summer months mulching using dried leaves is recommended.

Weeding

During the first year the field should be free from weeds and second year onwards the whole field will be covered by the growth of vines.

Plant protection

For controlling nematodes *(Meloidogyne incognita* and *Radopholus similis)* apply

Pseudomonas fluorescens @ 10 g plant^{-1} is recommended.

Harvesting and curing

Mature female spikes can be harvested seven months after planting. Black matured female spikes can be harvested at weekly intervals.The spikes are to be dried under shaded conditions for two weeks. The dry spike yield will be 1/5th of the fresh weight of the spike.

NEEM *(Azadirachta indica)*

Neem is known as Aryavepu in Malayalam, Neem in Hindi and Nimba in Sanskrit. All parts of the plant viz. stem, bark, leaves and root bark are useful. The bark gives bitter tonic and is an astringent and is useful for fevers and skin diseases. It is also having insecticidal property.

Climate and soil

The tree is well distributed throughout the tropics and subtropics. It is also grown in homesteads of Kerala, Tamil Nadu, Karnataka etc. Well drained loamy soils are suitable for its cultivation.

Propagation

It is propagated through seeds. Seeds are to be extracted from fresh fruits after pulping and sown without delay.

Cultivation

Plough the field and pits of size 60 cm x 60 cm x 45 cm are taken at a distance of 4 m. The pit is covered with FYM @1 kg/pit and top soil. The seedlings are planted in the centre of pit. Irrigate the crop regularly. Mulching the crop in the early stages is found to be good.

PATHIMUGHAM *(Caesalpinia sappan)*

The Heart wood is the economic part used for medicinal purpose. Natural dye extracted from the heart wood of the tree is used for coloring textiles, liquors etc. on a commercial scale.

Cultivation

It can be grown in any type of soil but cannot tolerate waterlogging. Seeds are used for propagation. The seeds are dipped in water for 12 hours before sowing in the nursery. Six months old seedlings can be transplanted to the field by the onset of South West monsoon.

Plough the field and pits of size 60 cm x 60 cm x 45 cm are taken at a distance of 2.5-3 m. It is best grown as a fence crop.

Management

Prune the side branches from 1st year onwards and allow one or two branches to grow.

Harvesting

The harvesting can be done from 7-8 years after planting. About 20kg heart wood is obtained on an average from a single plant. The stump regenerates and a ratoon crop is also obtained.

CHITTADALOTAKAM *(Adathoda beddomei)*

Chittadalotakam is known as 'vasa' in Sanskrit. It is used in many ayurvedic preparations against cough, rheumatic complaints, bronchitis etc. The whole plant, leaves and roots are the economic parts.

Varieties

Ajagandhi and Vasika.

Propagation

It is propagated by soft woodcuttings. Well-drained loamy soils are best suited for cultivation. It can tolerate shade and can be grown as inter crop in coconut and rubber gardens. It can be planted on mounds or ridges in levelled field. In sloppy areas pits can be taken for planting. The soft wood cuttings are planted in poly bags and when they attain 4-5 leaves in 2 months, they aretransplanted in the main field. FYM @ 10 t ha^{-1} is applied at the time of planting. Cuttings are planted at a spacing of 60 cm x 30 cm. Irrigate the crop at an interval of 4 days. The crop can be harvested 2 years after planting.

Harvesting

The leaves can be collected one year after planting. The roots are harvested two years after planting and it is better to harvest in December- January. After the harvest the roots are washed in water, dried and can be stored in air tight steel containers upto five months without quality deterioration.

KOOVALAM *(Aegle marmelos)*

In Sanskrit it is known as vilwam and it is one of the ingredients of "Dasamoola". The drug comprises of ripe or half ripe fruits of the tree. The fruit is very useful in chronic diarhoea and dysentery. The unripe or half ripe fruits improve appetite and digestion. The leaves and roots are effective against stomach complaints and diabetes. There are 2 types of Koovalam, North Indian type and South Indian type, of which North Indian type is suitable for cultivation. The fruits of these are edible.

Propagation

The fruits mature by December-January. The seeds are extracted from the fruit and dried under sun. The seeds are dipped in water for 6 hours and are sown in furrows. Mulch the furrows with dried leaves. The seeds will germinate within 15 - 20 days after planting and they are transplanted to poly bags at 5 - 6 leaf stage. 2 months old seedlings are used for field planting.

Land preparation and planting

Plough the field, and pits of size 60 cm x 60 cm x 45 cm are taken at a distance of 4 m. The pit is covered with FYM @1 kg/pit and top soil. The seedlings are planted at the centre of pit. Irrigate the crop regularly.

THULASI *(Ocimum tenuiflorum)*

Indians are having age-old practice of growing thulasi in their homes. The whole plant of thulasi is used for medicinal purpose. It is used for extraction of oil and as an antibiotic and astringent. It is effective against cough complaints.

Cultivation

It is grown in well-drained soil and cannot tolerate waterlogging. The propagation is by seeds. The seeds are sown in nursery beds two months before planting. Apply FYM /compost @ 2 kg/bed and mix well with soil. The seeds are sown at a depth of 1-2 cm and cover with soil or FYM. Irrigate using sprinkle hose. Since the seeds are very small, mix with sand @ 4 times the quantity of seeds for sowing and the seed rate is 500 g ha^{-1}. The seeds germinate by 8 – 12 days and are ready for transplanting by 6 weeks after planting.

The field is ploughed to a fine tilth and ridges are taken at a distance 40 cm. Apply FYM or compost @ 10t ha^{-1}. The 2 months old seedlings are transplanted at a spacing of 30 cm. Irrigate the crop in alternate days up to 2 weeks after planting. After 2 weeks, irrigate the crop @ 2 irrigations/week. Remove the weeds 2 or 3 times. Earth up the field at 2 months after planting.

Harvesting can be done 90–95 days after planting. The above ground portion is cut at a height of 15-20 cm from the ground level. Harvest the crop in a sunny day to increase the oil content of the plant. Keep the harvested produce in the field for 4-5 hrs to reduce the water content and weight of the produce.

KARINOCHI *(Vitex negundo)*

In Sanskrit it is known as Nurgundi. The flush as well as the stem portion are used for medicinal purpose. It is effective against rheumatic and cough complaints and used in several ayurvedic preparations.

Propagation and planting

Propagated by rooted cuttings. Plough the field and pits of size 45 cm^3 are taken at a distance of 3 m. From second year onwards up to 10^{th} year after planting the leaves can be harvested at regular intervals.

KATTARVAZHA *(Aloe vera)*

Kattarvazha is known as kumari in Sanskrit. The leaves are used for medicinal purpose. It is grown well in open areas receiving good amount of sunlight. The suckers are used for propagation. The field is ploughed to a fine tilth and the suckers are planted at a spacing of 45 cm x30 cm. Apply FYM or compost @ 5t ha^{-1} at the time of land preparation. The mature leaves can be harvested from the bottom of the plants. After each harvest apply FYM along with earthing up. The harvesting of leaves can be done up to 3 years at 2 months interval. The side suckers can be used as planting material.

ARROW ROOT *(Maranta arundinacea)*

Rhizomes are used for the production of starch. Starch grains are small and easily digestible. Hence it can be used as food for infants. It has also medicinal value against dysentry.

Propagation

It is propagated vegetatively by rhizomes. Healthy disease free rhizomes with at least one germinated sprout is the planting material. Small pits at 50 cm x 30 cm spacing on the seed bed are taken and plant seed rhizome with germinated sprout facing upwards. Cover the rhizome with FYM and mulch the bed with leaves or straw. Weeding is done 2 or 3 times along with earthing up and mulching.

The crop matures in 7 months. Drying of leaves is the indication of maturity. Dig out rhizomes without damage. Remove the dry leaves and roots. The cleaned rhizomes are either marketed or dried and stored.

DANTAPPALA *(Wrightia tinctoria)*

Dantappala, known as Vettuppala in Tamil and Ivory wood in English has much importance in both Ayurveda and Siddha medicines. It is very effective medicine for the dreadful skin disease psoriasis.

Climate and Soil

The tree is well distributed in Western Ghats, Deccan, parts of Gujarat and Konkan areas. Well drained forest soil and laterite loamy soils are suitable.

Propagation

It is propagated through seeds. The seeds can be collected from the trees during August-September. The seedlings can be raised in polybags containing potting mixture and will be ready to transplant after three months of growing. The seedlings are transplanted at a spacing of 5m x 5m in pits of size of 60 cm x 60 cm x 45cm covered with farm yard manure @ 2kg/pit and top soil. Irrigate the plants regularly till it establishes. Mulching the plant in early stages is found to be good.

Dantappala oil

Dantappala oil prepared from the leaves of this plant is used for curing psoriasis. Mature leaves plucked from the trees will be crushed immediately and exposed to sunlight in fresh coconut oil in the ratio of 1kg dantappala leaves and 1kg coconut oil for psoriasis and 500g dantappala leaves and 1kg coconut oil for dandruff and pre-mature greying. The exposure of leaves to sunlight may be repeated for three days consecutively till the coconut oil will turn into deep violet colour. It is filtered and stored.

BRAHMI (*Bacopa monnieri*)

Brahmi is used as a memory booster and nerve tonic. It is a safe cardiac stimulant. Brahmi is used in ayurvedic preparations like Brahmigritham, Saraswatarishtam, Brahma thailam etc.

It grows in moist and marshy areas. It comes up well on borders of water channels, wells and irrigated fields. It is propagated vegetatively through stem cuttings.

The field is prepared by ploughing and

shallow beds of about 5 cm deep are prepared to maintain the moist condition during the crop growth. Two-three nodded healthy disease free vine cuttings are planted at a spacing of 20 cm x10 cm in the field. Apply farmyard manure @10 t ha^{-1} at the time of field preparation. During crop growth period wet condition should be maintained by providing irrigation. Weeding is done two times along with slight raking of soil during the first weeding. The optimum stage for harvesting is five months after planting. Harvesting is done by uprooting the whole plant and by cutting the plants. When harvested by cutting regrowth takes place from nodes above soil. Apply farmyard manure after each harvest. Subsequent harvests can be done at three months interval. Three cuttings can be taken in a year depending on growth and can be continued up to two years after which it is replanted. The marketing is done in fresh form as well as after drying depending on the fluctuation of price in the market. The fresh form is marketed immediately after harvest. The harvested produce is washed and dried under shade. The dried material can be stored up to 6 months without damage in air tight containers. The weight of herbage is reduced to $1/4^{th}$ of the fresh weight after drying.

KURUMTHOTTI (*Sida alnifolia*)

Sida prefers open condition for maximum yield and quality. The best time for planting Sida is before the onset of monsoon.

Optimum spacing : 50 x 25 cm.

Optimum stage of harvest is 8 months after planting.

MEDICINAL PLANTS AS INTERCROPS IN HOMESTEADS

Neelamari is recommended as intercrop in homesteads of coconut based intercropping situation with 20 to 40 per cent shade intensity.

Thulasi, Panikoorka and Kiriyath are recommended as intercrop in homesteads of coconut and coconut + arecanut based intercropping situation with 20 to 60 per cent shade intensity.

Kasthurimanjal is recommended for cultivation under intensive homestead system with Coconut + Arecanut + Pepper based intercropping situation.