

ANTHURIUM (*Anthurium* spp.) (Ad hoc recommendation)

Anthurium is one of the important economic flowers of export potential. There are more than 500 species and several varieties. Few of them are commercially important.

Anthurium andreanum, *A. veitchii* and *A. scherzerianum* are the economically viable species. Many of them are partially epiphytic in growth habit. Plants prefer to grow under shade. The tolerable level of light in the tropical region during summer is 20-30 per cent. Excess light causes yellowing and scorching of leaves. Very low light intensity causes excessive vegetative growth and low flowering. It is preferable to grow anthurium in the open, under artificial shade structures for better growth and yield. Plant prefers to grow under a relative humidity of not less than 60 per cent and a temperature of not more than 30°C.

Propagation

Anthurium is multiplied by seed and vegetatively by stem cuttings or by separation of basal sprouts. Propagation by seed is not recommended as a commercial propagation method as it results in high variability. Plants can be multiplied in large number by micro-propagation techniques from the tender leaf bits.

Varieties

The economic varieties suitable for Kerala condition are Lima White, Cuba, Agnihotri, Liver Red, Can Can, Tropical, Nitta, Sunburst, Linda-de-Mol, Tinora, Acropolis, Gino Orange and Midori.

Seed propagation

Seeds are produced by hand pollination. Selfing or crossing can be made. Seeds become mature within a period of 4-6 months after pollination. Mature seeds will have a pulpy coating. The pulp is carefully removed without injuring the soft seed. Seeds are sown immediately after extraction. Sowing is done on a medium of clean fine sand or on a moist cotton pad. Sprouted seeds on cotton pad are shifted to a sand medium for further growth. Seedlings will take two years for flowering.

Vegetable propagation

Plants are propagated vegetatively by cutting the thick main stem into 3-4 cm long discs. If the stem is very thick, the discs can be cut vertically. Each bit should have minimum two lateral buds. Cut-pieces are treated with a fungicide solution and planted on a medium of clean river sand. Cuttings will take 1-2 months for sprouting. Suckers from flowering plants can also be separated as and when available and planted in the medium.

Seedlings and sprouted cuttings of 5-10 cm height are transferred to the main field or pots. Planting in pots is preferred in the plains. Cultivation in beds is good at higher altitudes (about 1000 m above MSL). A base medium above the ground is suitable for anthurium. Old and chopped coconut husk (3 cm size) mixed with brick pieces and charcoal are filled in narrow trenches 10 cm below and above ground level. Pots can also be filled with the same mixture. An ideal pot should be 30 cm diameter at top with 3 large holes at the bottom on sides. One seedling can be planted in a pot. On ground, the spacing is 45 to 60 cm depending up on the variety. Fresh cowdung or neem cake mixed with 10-15 times of water, kept for 4-5 days, can be sprayed on the plants after filtering. Cow's urine can be sprayed or drenched after mixing with 25 times of water. Complex fertilizer (N:P₂O₅: K₂O 20:20:20) 2.5 to 5.0 g/l of water is applied in the medium once a week. Slow release fertilizers, if used, need be given only once in 2-3 months.

Pruning of older leaves, removal of suckers at young stage, cleaning of crown before rains etc.

are other operations to be carried out in order to have a better growth and flowering.

Plant Protection

The two major diseases are bacterial blight and anthracnose. Blackening of the stem and decay of leaf axils are the symptoms of bacterial blight. Tiny circular black spots appear on leaf and spadix in case of anthracnose. Spraying mancozeb 0.3% or carbendazim 0.1 % can control the disease. Root rot caused by *Pythium* and *Phytophthora* can be controlled by the application of potassium phosphonate 0.3%.

The major pests are scales and bugs, which are controlled by spraying malathion @ 2 ml per litre of water. Snails also cause damage to young roots. Use of metaldehyde can prevent the attack of snails.

Harvesting

The flowers are harvested with its long stem when 1/4th to 3/4th flowers on the spadix are open, indicated by the change of colour. Colour change varies with the varieties.

ORCHIDS

(Ad hoc recommendation)

Orchids are noted for their bewitchingly beautiful, long-lasting flowers, widely differing in shape, size and colour. They belong to the family Orchidaceae, reported to comprise over 600 genera, 30000 species and a lakh man-made hybrids. They have varying habitats but epiphytic orchids dominate the trade. They are also classed as monopodials (stems having a vertical growth, non-branching, with aerial roots) and sympodials (steps having a horizontal growth, producing pseudobulbs in clusters, no aerial roots).

The ideal location for orchid growing is in the open conditions, under appropriate level of shade nets. In Kerala it is also grown under the shade of coconut trees above 10 years old.

Most attractive orchids belong to the group of epiphytes, which require free moving air at all times. The orchid plants produce aerial roots, which absorb water and nutrients from the atmosphere. Both terrestrial and epiphytes grow under varying levels of shade. Plants grown under deep shade will have good vegetative growth and poor flowering. Hence shade and light regulations are very important operations for better flowering. This requirement varies with the species and varieties. Some species grow in open sunlight. A humid and warm atmosphere is congenial for the growth of most of the tropical orchids. Better results are obtained when the atmospheric humidity is 50 to 80%. Orchids require proper temperature for good growth and flowering. Accordingly there are tropical, subtropical and temperate orchids.

Genera/ varieties

The popular genera of orchids that are suitable for growing in Kerala are *Arachnis*, *Aranthera*, *Vanda*, *Phalaenopsis* (monopodials); *Aranda*, *Mokara* (inter-generic monopodials); *Dendrobium*, *Cattleya*, *Oncidium* (sympodials).

Dendrobium is the most popular genus of Kerala. Some of the important varieties belonging to this genus are given below, grouped according to colour.

Purple and white: Sonia 17, Sonia 28, Sonia Born Jo, Earsakul

Purple: Renappa, New Wanee, Sabine Red, Jurie Red

White: Emma White, Fairy White, Kasem White, Snow White

Pink: Sakura Pink, New Pink

Yellow: Sherifa Fatimah, Kasem Gold, Tongchai Gold

Propagation and planting

The conventional method of propagation is by vegetative means. Monopodial orchids are propagated by stem cuttings. Terminal cuttings with one or two healthy aerial roots are ideal as planting material. Basal cuttings of 30 cm length with a few roots and leaves are also good. But they take longer time to sprout and grow. Sympodial orchids are propagated by separation of pseudobulbs. A plant with minimum two or three pseudobulbs with the basal root is ideal for planting. Some of the sympodial varieties produce sprouts at the top of pseudobulb called as keikis. Keikis when fully grown can be separated and planted. Besides, backbulbs or spent canes (shoots that have ceased to produce flowers) before they shrivelled can be severed from the mother plant and placed horizontally over the medium to stimulate sprouting of new shoots.

Seed propagation is possible only under aseptic conditions. Seedlings produced by embryo culture will take 2-5 years for flowering, depending on the genus.

Meristem culture is very effective in large scale propagation of orchids.

Terminal cuttings of monopodial orchids are planted loosely on old coconut husks at a spacing of 30 cm between plants and 45 cm between rows in long beds. There can be two or three rows in a bed. Basal cuttings will sprout within a period of two months.

Partial shade up to 50% is required for sprouting. Basal cuttings are planted close to each other in nursery beds for sprouting. After sprouting they are planted at the recommended spacing. Monopodial orchids can be grown on ground above soil level. A thick bed of 15-20 cm height is loosely arranged. Well-dried coconut husks are better than fresh husks. Sympodial orchids are grown on benches above ground level or suspended from above. Slotted wooden baskets filled with small pieces of dried coconut husk or partially burnt charcoal is good for plant growth. Planting is done above the medium with a support for proper anchorage.

Planting can also be done in pots or other containers. Mud pots of 10-20 cm diameter with several large holes on the side and bottom, filled with tile bits, chopped coconut husk or charcoal are used for planting. Both monopodial and sympodial orchids are to be supported properly since the planting is done above the medium. A clear solution of fresh cowdung can be used for irrigation for a few days. Dipping in fresh cow dung solution before planting also gives good results.

Manuring

Monopodial orchids grown on ground can be given cowdung slurry once in a month. One kg fresh cow dung mixed in 5 litres of water is sufficient for one square metre. Two to three applications can be given in a year. Sympodial orchids are sprayed with the supernatant liquid of cow dung slurry.

Nutrition of plants from the natural sources is not sufficient to support the plants for economic production. Hence additional feeding is required.

Foliar feeding is very effective in orchids. Fertilizer mixture of N:P₂O₅:K₂O 3:1:1 can be applied during vegetative period and 1:2:2 can be applied during flowering period. The usual dose of such mixture is 2-3 g per litre of water, applied twice a week.

Plant protection

Diseases

The important fungal diseases are:

Leaf spot (*Colletotrichum* and *Gloeosporium*)

Leaf blight (*Pythium*)

Collar blotch (*Penicillium thimmi*)

Collar rot (*Sclerotium*) Orchid wilt (*Sclerotium rolfsii*)

These can be controlled by application of mancozeb, carbendazim etc. at the recommended dose. Spraying should be done prior to the commencement of monsoon and at fortnightly intervals during heavy monsoon. Important virus diseases are mosaic and ring spot. Destroying the affected plants can control spread of these diseases.

Pests

The common pests attacking orchids are thrips, aphids, spider mite, soft scale, mealy bugs, orchid weevil, ants etc. Insecticides at suitable concentration can control all the insects. Other very serious pests of orchids are snails and slugs. They feed on the tender young shoots, roots and buds. Hand-picking is effective, if the number of plants is less. They move out during late night and hide before early morning. Damage is caused during this period. All the pests can be controlled by application of contact and systemic insecticides at appropriate concentration.

Harvesting

The spikes are harvested when all the buds of the spike except two or three are open.

JASMINE (*Jasminum* sp.p.)

Jasmine is an important flower crop that could be grown on a commercial scale in Kerala. *Jasminum sambac* is the most ideal species for cultivation in Kerala. The flowers are used for preparing garlands. The jasmine oil has great export potential in addition to its use for medicinal purpose.

Important cultivars

There are trailing, climbing, and erect growing species and cultivars. Three important species and their varieties are given below:

1. *Jasminum sambac*: Gundumalli, Motia, Virupakshi, Sujimalli, Madanabanam, Rama banam.
2. *Jasminum grandiflorum*: Co-1 Pitchi, Co-2 Pitchi, Thimmapuram, Lucknow.
3. *Jasminum auriculatum*: Co-1 Mulla, Co-2 Mulla, Long Point, Long Round, Short Point, Short Round.

Soil and climate

Jasmine can be planted on a wide range of soils. Well-drained sandy loams and red loams are ideal for its cultivation. In clayey soils, there is increased vegetative growth and reduced flowering. They give good yield in low rainfall conditions.

Propagation

Layering and cutting are the main propagation methods. Better rooting of cuttings can be obtained by planting in coarse sand and also by using any of the rooting hormones like IBA (5000 ppm), IAA (1000 ppm) and NAA (5000 ppm). Simple and compound layering methods are followed during June-July to October-November. Layers will be ready for planting within 90-

120 days.

Planting

After ploughing the land, pits of about 40 x 40 x 40 cm size are taken and filled with topsoil and 15 kg well-rotten FYM.

Planting distance depends on the species and also on soil and environmental conditions.

Species	Planting distance
<i>J. sambac</i>	1.2 x 1.2 m
<i>J. auriculatum</i>	1.8 x 1.8 m
<i>J. grandiflorum</i>	2.0 x 1.5 m

Planting is usually done during June-August.

Manuring

Each plant requires a fertilizer dose of 120 g N, 240 g P₂O₅ and 240 g K₂O. The fertilizers are mixed together and applied in two split doses during January and July. This has to be supplemented with organic manures like neem cake, groundnut oil cake etc. at the rate of 100 g per plant per month.

Pruning

Pruning is essential and is done at a height of 45 cm from the ground level during mid December-January.

Weed control

Manual weeding is effective but expensive. Use of weedicides like paraquat is also practised. Mulching also reduces weed population.

Irrigation

Constant and adequate water supply during peak flowering season (March-October) is essential for high yield of flowers. After flowering is over, the water supply can be cut off. During summer, irrigate twice a week.

Pests

Jasmine is comparatively a hardy plant. Major pests are bud and shoot borers and blossom midge, which can be controlled by spraying 0.15-0.20% carbaryl.

Diseases

Leaf blight: Can be controlled by spraying 0.2% mancozeb or 0.1 % benomyl

Fusarium wilt: Drench the soil with 1 % Bordeaux mixture.

Rust: Controlled by spraying 0.2% zineb.

Yield

Yield of flowers and jasmine oil vary according to the species and management practices.

Species	Flower yield (t/ha)	Oil yield (kg/ha)
<i>J. sambac</i>	5	15.44
<i>J. auriculatum</i>	5	28.00
<i>J. grandiflorum</i>	6	29.00

GLADIOLUS (*Gladiolus* spp.)

Gladiolus is grown for its attractive flower spike having florets of huge form, dazzling colour and varying sizes, with long vase life.

Varieties

There are a number of varieties in gladiolus. Friendship, Spic and Span, Mansoer Red, Dr. Fleming, Peter Pears and White Friendship are some of the common varieties. Varieties evolved in India are Sapna, Poonam, Nazrana, Apsara, Agnirekha, Mayur, Suchithra, Manrnohan, Manohar, Muktha, Archana, Arun and Shobha.

Soil

It can be grown in a wide range of soils, light sandy to clay loam. Deep well-drained acidic soils with a pH of 5.5-6.5 are the best for cultivation.

Propagation

Gladiolus is propagated by corms and cormels. Size of the corm markedly influences the growth and flowering of gladiolus. Medium and large sized corms are preferred for planting, as small corms produce only small flower spikes.

Planting

The land is ploughed two or three times and FYM @ 25 t/ha is applied and mixed well with the soil. Ridges are made 20 cm apart. Fertilizer application is made @ 50:60:60 kg N:P₂O₅:K₂O per ha. The corms are planted at a distance of 30 cm and at 5 cm depth. Topdress the crop with 50 kg N, 45 days after planting and earth up. Best season for planting is September-November.

Irrigation

The crop has to be irrigated once in two or three days depending upon soil and weather conditions.

Plaid protection

Gladiolus is attacked by many insect pests.

Several species of aphids like green peach aphid, potato aphid and melon aphid damage developing foliage and flowers. They can be controlled by using dimethoate or endosulfan. Thrips and caterpillars can be controlled with monocrotophos or phosphamidon.

Brown and *Fusarium* wilts are the major diseases. Spraying the crop with 30 g copper oxychloride dissolved in 10 litres of water or drenching carbendazim 0.1% is recommended when diseases are noticed.

Harvesting and yield

The plant starts flowering in 2-3 months after planting based on the variety. The entire spikes

along with two leaves are cut, when the basal flower bud starts opening. Nearly 2 lakh flower spikes can be obtained from one hectare.

After harvest of flowers, the plants are left undisturbed in the field. When they start yellowing, the plants are uprooted for harvest of conus and connels.

TUBEROSE (*Poliantha tuberosa*)

Tuberose occupies a very special position among the ornamental bulbous plants because of its prettiness, elegance and fragrance. It has good economic potential for loose/cut flower trade and essential oil industry.

Cultivars

There are four groups of cultivars as given below:

1. *Single*: Flower is pure white and has only a single row of corolla segments. Cultivars are Sringer, Culcutta Single, Mexican Single and Suvarna Rekha.

2. *Double*: Flowers are white, tinged with pinkish red. Petals are in several whorls.

Cultivars are Suvasini, Culcutta Double and Pearl.

3. *Semi-double*: Similar to double but with only 2 to 3 rows of corolla segments.

4. *Variegated*: This has variegated leaves with yellow margins.

Soil

Porous, well-drained sandy loam soils are the best suited for tuberose cultivation.

Propagation

Propagation is by bulbs. Boat shaped bulbs of size 2 to 3 cm are preferred for planting.

About 1.25 to 1.50 lakh bulbs (800 to 900 kg) are required for planting one hectare.

Cultural practices

Land is prepared well by ploughing *two* or three times. FYM @ 30 t/ha is mixed well with soil. Best time for planting is May-July. The bulbs preferably these of size 2-5 cm or above are *to*' be planted at a depth of 7-10 cm, with a spacing of 20 x 25 cm. A fertilizer dosage of 100:50:50 kg/ha N:P₂O₅ :K₂O is recommended. Of these, half N, complete P₂O₅ and K₂O are applied at the time of planting. Remaining N is applied when the flower spikes start *to* appear. A heavy irrigation once in 5-10 days is necessary depending upon the weather conditions. The peak flowering is between June and October.

Ratoon crop

After the harvest of the main crop, the flower stalks are headed back and the plat is manured and irrigated. Three or four ratoon crops can be taken from single planting. If the bulbs are *not* uprooted and replanted after three or four ratoons, the spikes tend *to* become smaller and unattractive.

Plant protection

Slugs and grass hoppers, which feed on the leaves, and thrips which damage and cause distortion of the spikes are the major pests. Malathion and carbaryl are effective against these

pests. Wherever nematode problems occur, application of carbofuran is recommended. No major disease is noticed. *Sclerotium* fungus, which attacks the leaves and flower stalks at ground level causes defoliation and toppling of spikes. This can be controlled by drenching of soil around the plant with fungicides.

Harvest and yield

Tuberose is harvested by cutting the spikes from the base for table decoration or the individual flower is picked from the spike for making garlands and other floral ornaments. The average yield of flower is as follows.

Plant crop:	5-10 t/ha
First ratoon:	9-12 t/ha
Second ratoon:	4-6 t/ha

CROSSANDRA (*Crossandra infundibuliformis*)

Crossandra flowers are very popular for their bright color, light-weight and keeping quality. Deep orange colored flowers are of great demand for garlands and hair adornments.

Cultivars

Yellow Orange, Lutea Yellow and Delhi (triploid) are the important varieties.

Soil

Crossandra could be cultivated in a wide range of soils. Fertile, red loamy soils with pH range of 6 to 7.5 are ideal for its cultivation.

Propagation

Propagation is by seeds or stem cuttings. Seedlings are ready for transplanting when they have four or five pairs of leaves. In the case of triploid varieties like Delhi, cuttings are used. Cuttings should be transplanted when sufficient roots are developed.

Cultural hints

The land has to be ploughed three or four times. FYM @ 25 t/ha is incorporated and mixed well in the soil. Ridges are prepared 60 cm apart. A fertilizer dose of 33.3: 60: 60 kg/ha N:P₂O₅:K₂O is applied as basal. The seedlings or cuttings are transplanted at a spacing of 30 cm.

The crop is topdressed twice with 33.3 kg N per ha each time, the first at 3 months after transplanting and the second 8-9 months after transplanting. The application of fertilizers is to be necessarily followed by irrigation. Weeding, application of fertilizer and earthing up are combined together for easy maintenance of the crop.

Plant protection

Scales, plant bugs and white flies are the important insect pests, which can be controlled by phosalone (0.07%), or methyl parathion (0.01 %).

Wilt caused by, *Fusarium solani* will result in yellowing of leaves and death of the plants. The incidence of the disease is found to be more in the presence of root lesion nematode, which can be controlled by application of phorate @ 1 g per plant.

Harvest and yield

Crossandra flowers within two to three months after planting and continues to bear flowers

throughout the year with a lean production season during rainy months. Flowers are to be picked early in the morning by pulling the corolla out of the calyx. Harvesting of flowers is to be done on alternate days. The yield of flowers is about 5 t/ha.

MARI GOLD (*Tagetes* spp.)

Marigold is a popular annual flower that could be grown on a commercial scale. It has gained popularity on account of its easy cultivation and wide adaptability. Free flowering habit, short duration to produce marketable flowers, wide spectrum of colour, shape, size and good keeping quality make marigold an acceptable commercial crop.

Cultivars

There are two species of marigold, namely, African marigold (*Tagetes erecta*) and French marigold (*Tagetes patula*). Interspecific hybrids between these two species also have been evolved, which are known as Red and Gold hybrids. Varieties under this group are Nugget, Show Boat and Red Seven Star.

African marigold varieties

Apricot, Primrose, Sun Giant, Guinea Gold, Fiesta, Golden Yellow, Hawaii, Crown of Gold, Honey Comb, Cupid, Pus a Narangi Gaintha and Pusa Basanti Gaintha.

French marigold varieties

Rusty Red, Naughty, Marietta, Flame, Star of India and Harmony.

Soil

A wide range of soils with good drainage is suitable for cultivation of marigold. Sandy loam soil with pH 5.6 to 6.5 is ideal for its cultivation.

Propagation

Seeds are used for raising the crop.

Cultural practices

Seedlings are prepared by sowing the seeds in the nursery beds as follows: Prepare nursery beds of 6 m length, 1.2 m width and 10-20 cm height. Apply 30 kg FYM along with 0.5 kg of 15:15:15 fertilizer mixture and mix them well in the soil. Sow the seeds in rows 7.5 cm apart. Cover the seeds with fine FYM and irrigate. The seedlings will be ready for transplanting within one month.

For the main-field, the land should be ploughed well and FYM @ 20 t/ha should be incorporated to the soil. Apply a basal dose of fertilizers @ 112.5 kg N, 60 kg P₂O₅, and 60 kg K₂O per ha. Transplant the seedlings at a spacing of 30 x 30 cm in case of French marigold and 45 x 45 cm in case of African marigold on one side of the ridge and irrigate. Topdress the crop with 112.5 kg N per ha at the time of pinching (30-45 days after transplanting) and earth up. Pinching is done to increase the total yield. It consists of removing terminal portion of the plant 30-45 days after transplanting.

Irrigate once in 4-6 days depending upon soil moisture and weather conditions. Weeds have to be removed at monthly intervals.

Plant protection

Marigold is not attacked by many pests. However, flower beetles, leaf hoppers, stalk borers, mites etc. cause occasional problems. These plants are rarely attacked by diseases. In poorly drained soils, foot rot caused by *Phytophthora* may occur. Stem rot caused by *Sclerotinia sclerotiorum* is also reported. Drenching with copper oxychloride is helpful in checking foot rot,

while stem rot is controlled by soil drenching with fungicides.

Harvest and yield

Marigold flowers will be ready for harvest in about 2 ¹/₂ months time from the date of transplanting. The plant continues to bear flowers for another 2-2¹/₂ months from the date of first harvest. The flowers are harvested when they have attained full size. Harvest the flowers in the evening along with a portion of stalk. Yield of French marigold will be 8-12 t/ha and that of African marigold 11-18 t/ha.

CHINA ASTER (*Callistephus chinensis*)

China Aster is a free blooming, colourful annual flower. It is grown on a commercial scale in many parts of India. Bright coloured flowers of China aster are in much demand for the preparation of bouquets and flower arrangements.

Varieties

Ostrich Plume, Comet, Poomima, Kamini, Sasank, Violet cushion etc. are some of the commercial varieties.

Soil

Though it could be cultivated on a wide range of soils, well-drained red loamy soil is ideal.

Propagation

Commercially propagated by seeds.

Cultural practices

Seedlings are to be raised in nursery beds of size 7.5 m long, 1.2 m wide and 10 cm high for preparing planting materials for an area of one hectare. The seeds are sown thinly and covered with fine FYM. The seedbeds are irrigated immediately after sowing. The seedlings will be ready for transplanting in about four weeks.

For transplanting, prepare the main field by ploughing land three or four times. FYM is applied @ 10-15 t/ha and mixed well with the soil. Chemical fertilizers @ 90 kg N, 120 kg P₂O₅ and 60 kg K₂O per ha are required as basal dose. Seedlings of 4 weeks are transplanted in 30 cm rows at 30 cm apart. The crop has to be topdressed with 50 kg N at 40 days of transplanting. The crop has to be irrigated once in 4-5 days depending upon the soil and weather conditions. Earthing up has to be done twice at 30 days intervals.

Harvest and yield

China aster blossoms will be ready for harvest within 10-12 weeks of transplanting. Generally the entire plant is harvested when most of the flowers in the plant are opened and made into bundles of 10-12 each. The yield will be 10-12 t/ha.