

**ARULMIGU PALANI ANDAVAR ARTS COLLEGE FOR WOMEN,  
PALANI**

**PG DEPARTMENT OF BOTANY**



**LEARNING RESOURCES**

**GARDENING AND NURSERY MANAGEMENT**

## GARDENING AND NURSERY MANAGEMENT

### GARDEN FEATURES

In order to break the monotony and to enhance the beauty, any garden should contain components of varying nature. Following are certain important features:

#### Avenue

An avenue is the row of trees grown on both sides of roads. Shade and beauty are the sole criteria to be considered while selecting avenue trees. The trees should also be selected according to the length and breadth of the road.

#### AVENUE PLANTING



#### Topiary

It is the art of developing the plant or training the plant into different forms or shapes like animals, birds, arches, *etc.* The plant should be amenable for repeated pruning and also flexible with more vegetative growth.

(eg) Hills – *Cupressus macrocarpa*, *Pinus patula*

Plains – *Casuarina sp.*, *Caesalpinia coriari*, *Bougainvillea sp.*, *Jaminum sp.*

## **TOPIARY**



## **Lawn**

It enhances the beauty of a garden whether it is small or large. It finds the most important component of a garden giving a view of a green carpet.

## **LAWN WITH SHADE GRASS**



## **Trophy**

It is the arrangement of colourful potted plants in different tiers around a central object which may be a tree trunk, lamp post or a pillar.

## TROPHY



### **Carpetbeds**

The art of growing ground cover plants closely and trimming them to a design or alphabetical letters is called a carpet bed. Colourful foliage as edge plants is found to be more suitable for this purpose. (eg.) *Alternanthera*.

### **Shrubs and Shrubbery**

Growing of shrubs in a group is called shrubbery. It is of two types (i) Pure shrubbery (ii) Mixed shrubbery. Pure shrubbery refers to planting of entire selected area with a single species and the opposite holds good for mixed shrubbery.

Shrubs for showy or attractive flowers (e.g.) *Hibiscus*, *Ixora*, *Mussaenda*, Night queen, Euphorbia etc., Shrubs for fragrance (e.g.) Jasmine, Rose, Nandiyavattai (*Tabernaemontana*), Pavalamalli (*Nyctanthes*) etc. Shrubs for foliage (e.g.) *Crotons*, *Polycias*, *Eranthemum*, *graptophyllum*, etc.

### **Arboretum**

Growing of different species of trees in one place is called 'Arboretum'. The trees form the main frame work of the garden. Group of trees in one place will help to give depth to the garden. Trees are very fascinating because of their graceful appearance and the abundance of bloom. They are grown for their economic importance or aesthetic value or both.

### **Flower beds and Borders**

Annuals and herbaceous perennials are grown in flower beds to provide massing effect of different colours. Borders are continuous beds of more length than width containing plants of one kind only.

#### **Flower bed**



#### **Ground cover**

When a dicot plant is of straggling nature is used to cover the ground surface is called ground cover (eg.) *Wedalia*, *Verbena*, *Ipomea*, *Acalypha*, *Portulaca*.

#### **Climbers and creepers**

A group of ornamental plants used to grow over walls, trellis, arches, pergolas, arbours, pillars, bowers, *etc.* These are grouped as light or heavy according to the amount of wood it produces.



Annual climbers (e.g.) *Clitoriaternatea*, sweet pea, morning glory (*Ipomoea rubrocaerulea*)

***Clitoriaternatea***



Climbers for screening (e.g.) *Antigononleptopus*, *Passiflora*, *Porana Ipomoea*, *Clerodendronsplendens*, *Thunbergia* etc.

***Clerodendronsplendens***



Climbers for low walls or trellis for this purpose only light climbers are selected. (e.g.) *Lonicera japonica*, *Solanumseaforthianum*, *Tristellatiaaustralis*, *Tecomajasminoides*, *Jacquemontiaviolacea*.

Climbers for pergola usually heavy climbers are grown. (e.g.) *Quisqualisindica*, *Petreavolubilis*, *Adenocalymmaallicea*, *Allamandacathartica*, etc.

*Quisqualisindica*



*Allamandacathartica*



Climbers for porches (e.g.) *Pyrostegia venusta*, *Petreavolubilis*, *Clerodendron splendens*, *Bougainvillea*, *Jasminum sp.* etc.

Flowering climbers in partial shade (e.g.) *Passiflora*, *Aristolochia*, *Quisqualisindica*, *Clerodendron splendens*, *Jacquemontia violaceae*. Foliage climbers (e.g.) *Scindapsus aureus*, *Philodendron sp.*, *Monstera deliciosa*.

***Scindapsusaureus***



***Philodendron***



Climbers for pot culture (e.g.) *Tristellatiasutralis*, *Adenocalymmaallicea*, *Clitouraternatea*, *Bignonia purpurea* etc.

**Flowering**

**annuals**

Antirrhinum, stocks, dwarf sweet pea, pansy, dahlia, chrysanthemum, marigold, sweet alyssum, phlox, pinks (*Dianthus*) and verbena.

**Dahlia**



**Herbaceous perennials**

*Pelargoniums*, *Michaelmas daisy*, *Cenna*, *Mirabilis jalapa*, *Portulaca*, *Solidago Canadensis*, *Vincarosea*, and *Perennial verbena*.



## Portulaca



### Trees

One or two dwarf trees such *Plumeria* sp. *Callistemon lanceolatus* and *Gliricidamaculata* can be grown as specimen plants. Some large to medium trees such as *Araucaria cookii*, *Mimusopselengi*, *Brassaiaactinophylla*, etc., can also be grown till they are young.

### *Callistemon lanceolatus*



### Bulbs

A variety of bulbous plants of annual or perennial nature can be grown.

### Water plants

Water lillies and other water plants can be grown in the lily pool, if any or in cement tubs.

## Water lily



## Hedges

With the help of plants, live hedges can be formed and used as a fence or a green wall. It serves to screen a particular site or building or hiding of unwanted places. They help to partition the garden into several parts. It provides a natural background to a garden, like a frame to a picture. The characteristics of a good hedge are that it should be thick and dense; it should have foliage from the bottom to top; it should be trim and neat; if it is a flowering hedge its bloom should not clash with the general colour scheme.

Some of the most common foliage hedges are *Acalypha* with its copper-red leaves, it is suitable for a medium hedge; *Clerodendron inerme* an evergreen drought-resistant plant used frequently by the roadside, is not eaten by cattle or goats, and is suitable for a low to medium hedge; *Duranta* is also an evergreen drought-resistant fast-growing plant with very neat habit and bright green foliage, suitable as a medium hedge; *Dodonea viscosa* with its evergreen narrow shining leaves suitable as a medium hedge; *Pithecalobium dulce* (*Inga dulce*) with its thorough stems and small feathery leaves making an impregnable medium to tall hedge; *Lawsonia alba* (Maruthani) with its pretty small bright green leaves is suitable as a low to medium hedge; *Murraya exotica* with its small dark green leaves is suitable for any size of hedge. There is a large variety of flowering plants which can be used as hedges. The most prominent of these is the Bougainvillea. A variety like 'Thimma' or 'Dr. Rao', or 'Louise Wathena variegated' gives pretty blooms as well as beautiful variegated leaves.

## **Acalypha**



The other common flowering hedges are *Beloperoneamhersita* with its perpetual rust-colored bracts overlapping small white flower, *Buddleia aisatica* with gray green foliage and conical fragrant clusters of off-white flowers; *Hamelia patens* with red-veined leaves like *Fuchsia* and attractive orange-colored flowers in the rainy season; *Hibiscus* with its trumpet like bright flowers of orange, pink, white, red, purple, etc. with dark green bright foliage; *Jatropha* with its star-like rose-crimson flowers; *Lantana* with its compact dark-green foliage and round cluster of flowers; *Lonicera japonica* (honeysuckle) with beautiful fragrant white flowers and small dark-green leaves; *Plumbago* with pearl blue flowers; *Pomegranate* with tiny leaves and bright scarlet flowers; *Tabernaemontanacoronaria* with star-like pure-white flowers, decorating dark-green shining leaves; and *Tecomastans* with bright yellow trumpet-like flowers.

## ***Tecomastans***



## Edges

These are perennial herbs often used as a short border for lawn or ground cover or dividing beds from roads, walks or paths. These herbs often stand frequent trimming. They consist of live material like the dwarf plants or inert material like bricks, stone slabs or corrugated iron sheets. The common evergreen edges used for edging are Eupatorium and Alternanthera. Justicea is capable of standing rainfed or drought conditions. Pilea, dwarf marigold and dwarf Coleus are also used as edges in rockeries.

### Dwarf marigold



### Suitable plants as informal edgings

*Achilleatomentosa* and *A. tonbellata*

*Alyssum saxatile*

*Bellisperennis* varieties

*Campanula*, all dwarf species

*Dianthus deltoids*, *D. squarrosus*, etc.

*Geranium farreri* and *G. sanguineum*

*Gypsophila repens*

*Hypericumolympicum*

*Iberissampervirens*

*Linumsalsoloides*

*Phlox subulata* varieties

*Polyanthus* varieties

*Priumulapulgaris* varieties

### **Conservatory or summer house**

It is made of wood and iron to the size of the glass house. It can be located in a cool shady place. Shade loving plants are mainly grown in pots which are highly priced for the ornamental foliage. It is also called as green house and glass house. It helps to create a special environ with cool, airy, humid and marshy soil for shade loving, moisture loving and water loving plants. The root of such structure is made of wooden reapers, angle irons and concrete poles and covered with mesh or natural creepers. A tank or water trough is constructed at the center to increase humidity and few benches are provided for the display of plants. Such structures can be erected under a partial shade preferably.

### **Sunken garden**

It is formed by taking the advantage of a natural depression. The depression is made into different tiers over which ground covers, edges, flower beds and small herbs may be grown. At the center of depression, a pond or pool is formed to grow water plants.

### **Rock garden**

A rock garden is the arrangement of rocks with plants grown in the crevices. Its bold ruggedness is a pleasant contrast to the softness of the flowers. The stones help the plants in retaining their moisture and keeping their roots cool. In plains, on the sunny side some of the cacti & succulents; *Lantana*, *Setcreasea*, *Verbena*, etc can be grown successfully. Ferns and some indoor plants also look natural on the rockery slopes in shade.

### **Lantana camera**



## **Water garden**

It may have a water course, a water pond and a water fountain or any one or more of these features, harbouring water loving and marsh plants. Water gardens, no matter, how tiny, are extremely effective in beautifying the landscape. Water lilies (*Nymphaea*) are the most popular water plants. Another aspect to be considered is the depth of water. The large tank is around 3-5 m deep at the deepest point. A reflecting garden pool is preferably shallow with a depth of 25-30 cm. If hydrophytic plants are to be grown, varying depths have to be provided in the same pond, which may range from 15 to 90 cm, the deepest portion allotted to lotus and water lilies. In shallow pockets and galleries, swamp plants such as *Typha* and *Cyperus* are accommodated. *Salvinia*, *Pista* and other floating plants may be conveniently added to this grouping. Provision is necessary to prevent rain water and through it silt entering into the pool. A slightly raised rim to a height of 10 cm will be helpful in this regard. Provision to drain the pool by providing an outlet at its floor level will help to clean it, as often as is necessary.

## **Water garden**



## **Two level garden / Formal garden**

This is also called as an "Italian style" or 'scroll' garden. It is symmetric with two tiers, the down tier is grown with flower beds, edges, *etc.* and a small pond at the centre. The upper tier is decorated with flowering shrubs, hedges, *etc.*

## **Japanese garden**

Japanese garden is mainly divided into three types namely

1. Mountain garden
2. Island garden
3. Tea garden

The paths and roads in these gardens are narrow and bushy plants are grown along the path to provide concealment. Islands are interconnected by bridges made up of stones or bamboo or stems of palms. The mountains are the source of water located at one side of the garden.

River stones, water plants, bamboo, dwarf trees, stone lanterns are the components in these gardens. Bamboos, cycads are the commonly found ornamental plants in this garden.

### **Garden adornments**

There are several garden adornments and accessories such as fountains, statues, garden seats, ornamental posts and pillars, arches and pergolas, trellises, hanging baskets, tubs, vases and urns with plants which make the garden more enjoyable. Playing of a fountain is an interesting feature in a garden and the water in the cistern should be kept clean. Garden seats made up of stones, concrete or metal are placed under the tree. Handsome tubs, vessels and urns are utilized to display plants in conspicuous places. Arbours, arches, pergolas and trellises serve as support to several beautiful plants and to dispel monotony in garden.

Arbours are usually open in all sides. Very often a long wall or the end of a pergola leads to an arbour. Arches are generally erected over walks, usually at the entrance and are usually two meters in height. Pergolas are series of arches connected over a walk.

### **Garden**

A garden is a planned space, usually outdoors, set aside for the display, cultivation, or enjoyment of plants and other forms of nature. The garden can incorporate both natural and man-made materials. Gardens may exhibit structural enhancements including statuary, follies, pergolas, trellises, stumperies, dry creek beds and water features such as fountains, ponds (with or without fish), waterfalls or creeks. Gardening is the activity of growing and maintaining the garden. This work is done by an amateur or professional gardener. A gardener might also work in a non-garden setting, such as a park, a roadside embankment, or other public space. Types of garden: Ornamental Garden Ornamental gardening can be simply defined as planting various plants on a piece of ground from and for an artistic point of view. ... An ornamental garden therefore is one that is planted purely for aesthetic

value. The cultivation of ornamental plants is called floriculture, which forms a major branch of horticulture.

Garden plants Commonly, ornamental [garden] plants are grown for the display of aesthetic features including: flowers, leaves, scent, overall foliage texture, fruit, stem and bark, and aesthetic form. In some cases, unusual features may be considered to be of interest, such as the prominent thorns of *Rosa sericea* and cacti. In all cases, their purpose is for the enjoyment of gardeners, visitors, and the public institutions. Trees Similarly certain trees may be called ornamental trees. This term is used when they are used as part of a garden, park, or landscape setting, for instance for their flowers, their texture, form, size and shape, and other aesthetic characteristics. In some countries trees in 'utilitarian' landscape use such as screening, and roadside plantings are called amenity trees.

### **Grasses**

Ornamental grasses are grasses grown as ornamental plants. Many ornamental grasses are true grasses (Poaceae), however several other families of grass-like plants are typically marketed as ornamental grasses. These include the sedges (Cyperaceae), rushes (Juncaceae), restios (Restionaceae), and cat-tails (Typhaceae). All are monocotyledons, typically with narrow leaves and parallel veins. Most are herbaceous perennials, though many are evergreen and some develop woody tissues. Ornamental grasses are popular in many countries. They bring striking linear form, texture, color, motion, and sound to the garden, throughout the year. Ornamental grasses are popular in many colder hardiness zones for their resilience to cold temperatures and aesthetic value throughout fall and winter seasons. Cultivation For plants to be considered ornamental, they require specific work and pruning by a gardener. For instance, many plants cultivated for topiary and bonsai would only be considered to be ornamental by virtue of the regular pruning carried out on them by the gardener, and they may rapidly cease to be ornamental if the work was abandoned. Ornamental plants and trees are distinguished from utilitarian and crop plants, such as those used for agriculture and vegetable crops, and for forestry or as fruit trees. This does not preclude any particular type of plant being grown both for ornamental qualities in the garden, and for utilitarian purposes in other settings. Thus lavender is typically grown as an ornamental plant in gardens, but may also be grown as a crop plant for the production of lavender oil.



## **KITCHEN GARDEN**

Kitchen garden is the growing of fruits and vegetables at the backyard of house by using kitchen waste water. Otherwise called as Home garden or Nutrition garden or Kitchen gardening or Vegetable gardening

### **Advantages of Kitchen garden**

- Supply fresh fruits and vegetables high in nutritive value.
- Supply fruits and vegetables free from toxic chemicals.
- Help to save expenditure on purchase of vegetables.
- Vegetables harvested from home garden taste better than those purchased from market.
- Effective utilization of kitchen waste water and kitchen waste materials.
- Exercise to the body and mind.

### **Site selection**

- Backyard of house
- Preferably open areas with plenty of sunlight near the water source

Size and shape of vegetable garden depends on

- Availability of land
- Number of persons in family and Spare time available for its care
- Nearly five cents of land (200 m<sup>2</sup>) is sufficient to provide vegetables throughout year for a family consisting of five members
- A rectangular garden is preferred than a square plot or a long strip of land.

### **Layout of Kitchen garden**

- Fence – Barbed wire fence or live fence with agathi
- Perennial crops (Mango, Sapota, Acid lime, Amla, Morniga) should be planted at the peripheral areas of kitchen garden (avoid shading)
- One or two compost pits may be provided on one corner
- Fences on all sides should be trained with Cucurbitaceous vegetables (Bottle gourd, Bitter gourd and Snake gourd)
- Some vegetables are direct sown – (Amaranthus, Bottle gourd, Bitter gourd and Snake gourd)
- Some vegetables are nursery transplanted (Tomato, Brinjal, Chillies, Onion)
- Divide the area into equal sized plots for raising annual vegetable crops
- As intensive and continuous cropping is done in a kitchen garden.
- Fertility and texture of soil may be maintained by applying adequate quantities of organic manures frequently.
- Ridges and furrows are formed in each plots.
- Season of planting: June – July, September – October
- Bee-hive may be provided for ensuring adequate pollination of crops besides obtaining

honey. • However, in order to harvest good crop, chemical fertilizers are also essential. • Pick and destroy the larvae found on fruits and vegetables and then spray Neem oil @ 4 ml/liter of water or Neem Seed Kernel Extract @ 3 %. • Avoid spraying of toxic chemicals.

### **Maintenance of Kitchen garden**

- Grow the plants on the fence by training
- Dump all the kitchen waste in the manure pits and maintain in wet condition

### **Irrigation**

- As and when necessary

### **Manures and Fertilizers**

- Apply the decomposed kitchen waste to all the crops • Complex fertilizers @ 5 gram/plant at 30, 60 and 90 day of planting

### **Weeding**

- As and when necessary

### **Harvest**

- When there is a colour change from green to yellow or orange

### **Plat Protection**

- Pick and destroy the larvae found on fruits and vegetables and then spray • Avoid spraying of toxic chemicals.

### **Organic method of plant protection**

- Neem oil •Neem seed kernel extract •Panchakavya

Implements used in kitchen garden

- Spade • Pick Axe • Hoe • Hand sprayer • Rode can • Rose • Secature

### **Herbal garden**

An herb garden is basically a garden that is being used solely to grow herbs. A better description of what an herb garden might be is a beautiful and relaxing place where you can

find plants that are not only useful but beneficial to the enjoyment of life. An herb garden can be any size or shape and can contain many different types of herbs or just a few. An herb garden may take up an entire yard or may simply be planted in a small windowbox container. Herb gardens can be kept indoors on a sunny windowsill or outdoors in the open breeze. An herb garden design can also be incorporated into a vegetable garden, with landscape shrubbery, or mixed in with your flowers.

Types of Herb Gardens There are many different types of herb gardens and many ways for using herb gardens, each with their own character and charisma.

### **Kitchen Herb Garden**

A culinary, or kitchen, herb garden will consist of only herbs used for flavorings in cooking. Most are grown in containers, though they can be grown in the garden too, nearest the kitchen.

It might contain:

1. Parsley
2. Basil
3. Chives
4. Oregano
5. Rosemary
6. Thyme

### **Fragrant Herb Garden or Herbal Tea Garden**

An herbal tea garden will consist of herbs such as chamomile, anise, hyssop, and assorted mints that can be brewed into delicious teas. Medicinal Herb Garden A medicinal herb garden will consist of herbs used for soothing and comfort, where you might find aloe and feverfew. A word of caution on using herb gardens for medicinal purposes: while some herbs have been found to be helpful, other herbs can be harmful if ingested or used improperly. Always check with a doctor before starting any herbal remedy.

### **Ornamental Herb Garden**

Ornamental herb gardens are prized for their beautiful flowers and unusual foliage. An ornamental herb garden might contain southernwood, sage, and germander.

### **Botanical Gardens in India**

Botanical garden, also called a botanic garden, is a garden that contains a wide variety of plant species, usually labelled with their scientific names. A botanical garden is typically devoted to research, cultivation, preservation, and display of plants.

As one of the world's mega-biodiversity countries, India has a wide variety of plant species. India has one of the richest floras in the world, thanks to its sheer size, range of latitudes and altitudes, rainfall, and climatic and geographical conditions.

There are about 200,000 living plants recorded in the accessions of these gardens.

Acharya Jagadish Chandra Bose Botanic Garden in Kolkata is the first botanical garden established in India and also in South Asia.

### **History**

The first botanical garden of India was founded in 1787 by an army officer of the East India Company, named Colonel Robert Kyd. The primary purpose of establishing the garden was to identify new plant species, such as teak, which had great economic value and grow them on a commercial scale for trade.

It was then named Royal Botanic Garden, Calcutta. Later, the name was changed to Calcutta Botanical Garden and then to Indian Botanic Garden. On 25th June 2009, the name was finally changed to Acharya Jagadish Chandra Bose Botanic Garden in honour of Acharya Jagadish Chandra Bose, a Bengali botanist-physicist and an early writer of science fiction.

Over 12,000 specimens of rare plants are housed in the garden, which cover 109 hectares. Under the Ministry of Environment and Forests of India, the Botanical Survey of India (BSI) manages the centre.

### **Importance of Botanical Gardens**

As botanical gardens house a wide variety of plant species, it is an open, outdoor laboratory for a large number of students and botanists. Such a garden is important because:

- It is a place where a variety of endangered flora are conserved.
- It helps in taxonomic study and research.
- It provides the public with information about local and exotic species of plants.
- Rare species and genetic diversity are conserved and propagated in a botanical garden.

## **Botanical Gardens of India**

There are about 122 botanical gardens recorded in India. Below is the list of the famous botanical gardens in India:

- Assam State Zoo-cum-Botanical Garden– Guwahati, Assam
- Botanical Garden Sarangpur – Chandigarh
- Sanjay Gandhi JaivikUdyan – Patna, Bihar
- Botanical Garden Waghai – Gujarat
- Gujarat Technological University – Ahmedabad, Gujarat
- R. B. Botanical Garden and Amusement Park – Gujarat
- The GarçaBrancaAyurvedic Botanical Garden – Loutolim, Goa
- National Cactus and Succulent Botanical Garden and Research Centre – Haryana
- Lalbagh – Bangalore, Karnataka
- Curzon Park – Mysore, Karnataka
- Mysore Zoo – Mysore, Karnataka
- Pilikula Arboretum, PilikulaNisargadhama – Mangalore, Karnataka
- Regional Museum of Natural History Mysore – Mysore, Karnataka
- University of Mysore Botanic Garden – Mysore, Karnataka
- Prof. Nagaraj Botanical Garden – Kalaburgi, Karnataka
- Malabar Botanical Garden and Institute of Plant Sciences – Kozhikode, Kerala
- Malampuzha Garden – Palakkad, Kerala
- Jawaharlal Nehru Tropical Botanic Garden and Research Institute – Trivandrum, Kerala
- Vellayani Agricultural College – Trivandrum, Kerala
- Empress Garden – Pune, Maharashtra
- Odisha State Botanical Garden – Nandankanan, Bhubaneswar, Odisha
- Botanical Garden Guru Nanak Dev University – Amritsar, Punjab
- Botanical Garden Punjabi University – Patiala, Punjab
- Auroville Botanical Gardens – Auroville, Tamil Nadu
- Tamil Nadu Agricultural University – Coimbatore, Tamil Nadu
- The Institute of Forest Genetics and Tree Breeding – Coimbatore, Tamil Nadu
- Government Botanical Gardens, Ootacamund – Nilgiris, Tamil Nadu
- SemmozhiPoonga – Chennai, Tamil Nadu
- Botanical Garden, Hyderabad – Telangana

- NTR Garden – Hyderabad, Telangana
- Botanical Garden of India Republic – Noida, Uttar Pradesh.
- Jhansi Botanical Garden – Jhansi, Uttar Pradesh
- Saharanpur Botanical Garden – Uttar Pradesh
- Acharya Jagadish Chandra Bose Indian Botanic Garden – Shibpur, Kolkata, West Bengal
- Agri Horticultural Society of India – Alipore, Kolkata, West Bengal
- Garden of Medicinal Plants, North Bengal University – West Bengal
- Lloyd’s Botanical Garden – Darjeeling, West Bengal
- Narendra Narayan Park – Cooch Behar, West Bengal

### **Interesting Facts about Botanical Gardens in India**

Some interesting facts about the famous botanical gardens in India:

1. Largest and first botanical garden in India – Acharya Jagadish Chandra Bose Indian Botanic Garden
2. Oldest botanical garden in India – Acharya Jagadish Chandra Bose Indian Botanic Garden
3. Kohli Memorial Himalayan Garden – operated as the world’s smallest botanical garden for 20 years from 1990
4. Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Trivandrum, Kerala, conserves the largest number of plant species in Asia.
5. An amazing collection of roses can be found at the Government Botanical Garden in Udamangalam in Tamil Nadu.
6. National Cactus and Succulent Botanical Garden and Research Centre – one of the largest cactus and succulent botanical gardens in India
7. The largest collection of aquatic plant species in India – Malabar Botanical Garden and Institute of Plant Sciences.

### **Indoor Gardening**

8. Indoor gardening relates to the act of growing a selection of plants inside that you would typically grow outside. Because you can more easily control temperatures and other conditions, you can access things like veggies, fruit, herbs, or tropical plant species year-round, unlike in many outdoor gardens when the temperature determines the growing season.

## **Plants for Indoor Gardening**

Certain plants are known for being well-suited to being grown indoors. These include:

- **Veggies.** Some veggies grow particularly well indoors. These include carrots, hot peppers, lettuce, and tomatoes.
- **Herbs.** Basil, chives, mint, parsley, and thyme are just a few herbs that do well in a sunny position indoors.
- **Low-Light plants.** If you want to create a low-maintenance tropical jungle in a shady area in your home, opt for low-light species like spider plants, snake plants, and certain ferns.
- **Humidity-loving plants.** Consider things like begonias, ferns, and peace lilies if you want plants for a terrarium or to grow in a bathroom.

## **Common Types of Indoor Gardening Systems**

The indoor gardening system you select depends on the type of plants you want to grow, your budget, available space, and your preferred aesthetic. Below are some of the common types of indoor garden systems.

### **Soil-Based Systems**

Allows you to grow your plants in containers with potting mixes. It is the closest to traditional, straightforward outdoor gardening and is an economical option, often used for cultivating a herb garden or displaying a selection of tropical plants.

### **Hydroponic Systems**

Hydroponic gardens allow plants to be grown in water rather than soil. The water contains essential nutrients, and some include substrates like perlite, vermiculite, or coconut coir. It's a bit pricier than traditional soil-based setups, but it maximizes space, conserves water, and produces fast-growing, healthy, and high edible plant yields.

### **Aquaponic Systems**

Aquaponics is similar to hydroponics and shares many of the same benefits, but it is less widely used. These systems involve keeping live fish in the water. Their waste is full of nutrients that help the plants flourish. If this doesn't gross you out too much, be prepared for a

more pricey initial setup and ensure the plants you pick are happy in this wet environment (leafy greens are a popular go-to).

### **Aeroponic Systems**

This advanced hydroponic-style system sprays nutrient-infused water on suspended plant roots rather than fully submerging them in water. This method allows plants to absorb the maximum nutrient levels promoting fast-growing, large yields. However, it is challenging and costly to set up.

### **Terrariums**

Try a glass terrarium if you want to grow a selection of humidity-loving plants without taking up much space. You can select plants that are low-maintenance while still visually appealing. Terrariums come in a wide range of sizes and prices, so there should be something to suit every enthusiast.

### **Living Walls**

If you have limited floor or shelf space or want to liven up a bare wall in your home, creating a vertical living plant wall could be the way to go. Select plants with similar care requirements as you will water them all together.

### **Tip**

A wide range of plug-in-and-go indoor gardening systems is available from major retailers. These typically include handy features such as built-in auto-timers, grow lights, and self-watering capabilities. You can save money not having to buy all the elements separately, and the kits are easy to assemble.

### **Indoor Garden Plant Care**

The conditions your plants require vary depending on the type of indoor garden you want to cultivate and the individual species you select. Here are some general tips to consider when it comes to their care.



## **Light**

Where you position your indoor garden depends on the plants' light requirements. Plants grown indoors will never have access to the same direct bright sunlight they could get outdoors; even sunlight streaming through a window is less intense than it is outdoors. You may need grow lights to help create the right conditions for major sun-loving plants indoors or if you don't have any natural light in an apartment. Conversely, if you have true shade-loving plants, keeping them away from windows will be necessary.

## **Soil**

If you aren't opting for a hydroponic setup or collecting air plants, your indoor garden will generally be best grown in a loose, well-drained potting mix. The mix can be tailored depending on what you grow, but it is often composed of peat moss, vermiculite, and perlite. This combination absorbs moisture quickly and doesn't become easily compacted. However, it will dry out quickly, so it won't work for moisture-loving plants like basil.

## **Water**

Of course, every plant grown indoors will have differing requirements in terms of watering. However, one of the biggest common problems for indoor gardens is overwatering. Many indoor plants die as a result of root rot.

Always research what the plant species you are growing needs. Watering your plants with room temperature water is also a good idea. Cold tap water can shock your plants.

## **Fertilizer**

Ensuring your indoor garden plants receive enough nutrients is important for long-term success. Although some potting soils have nutrient enhancements, the plants will use them up after a couple of months. Slow-release fertilizers are popular as they can last several months before another application is required.

## **Temperature and Humidity**

Being able to control the temperature and humidity in an indoor environment is one of the key benefits of indoor gardening. The ideal humidity level for many indoor plants ranges from around 40 to 60 percent humidity.

If you have moisture-loving plants that need high humidity or your living space is particularly dry during the winter months when the heating is on, you could invest in a humidifier or set up the garden in your bathroom. You can also use indoor greenhouses or terrariums.

## **Repotting**

Repotting your indoor garden plants in soil-based systems annually, or when they are becoming root bound, is vital for long-term growth and health. Make sure the pot is big enough for future growth.

## **The need for modern nursery**

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1. Success of any orchard mainly depends upon the availability of right type of planting material.
2. Initial planting material is the basic requirement on which the final crop depends both in quality and quantity.
3. In case, any mistake made during initial years, cannot be rectified in subsequent years and will cause everlasting damage to productivity and income of the orchardists.
4. Non-availability of genuine seeds and elite planting material is one of the major constraints in obtaining expected productivity in fruits.
5. The planting material must be sourced from consistently high yielding mother plants raised in scientific way and free from major pests and diseases.

## **Shortcomings in nurseries**

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- Invariably scion shoot are collected from diseased and infected trees (vegetative malformation in mango, viruses in citrus and temperate fruits)
- Scion shoots are often taken from juvenile trees.

- Invariably scion shoots are taken from the mother plants without knowing its history.
- Enough rotation is not practiced in the nursery and same bed is used repeatedly year after year
- In general, plants are multiplied in the bed. Hence every time, 4-6 kg soil is transported as earth ball.
- Distant transport of plants along with earth ball is tedious, expensive and less efficient.
- Often, number of diseases and pests (root rot, collar rot, wilt, nematodes) are carried along with earth ball.
- Production of less number of plants per unit area.
- In most cases provision of source for rootstock is lacking.

### **Basic characteristics of mother plant**

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- Consistent high performance and maximum yield over 3-5 years.
- High quality fruits.
- Free from incidence of pest and diseases.
- The plants should attain full bearing age before taking scion stick.

### **Maintenance of mother plants**

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- Initial propagation from elite clones which are planted at closer distance (4-6m).
- Application of manures and fertilizers.
- Irrigation.
- Weeding and inter-culture operations.
- Training and pruning.
- Appropriate plant protection measures

### ***Seed***

- Suitable for propagation of papaya, phalsa, kagzilime and karonda.
- Seeds should be obtained from mature fruits.
- Rootstocks of most of fruits are propagated by seed for vegetative propagation.

- Plants propagated by seeds are variable in growth and have long juvenility hence commercial propagation of mango, aonla, bael etc. should be discouraged.

### ***Inarching (Approach grafting)***

- It takes almost two years.
- Cumbersome and tedious and be discouraged
- Limited scion shoots are available on the mother plant.
- Root stock is to be brought in close proximity of scion shoot
- It is a source for spread of malformation in mango.

### ***Veneer grafting***

- Rootstocks of 1 year age (0.50 to 0.75 cm diameter) are used
- A slanting downward and inward 30-40 mm long cut is made in the smooth area of the stock at a height of about 20 cm from bottom
- At the base of the cut, a smaller and shorter cut is made to intersect the first so as to remove the wood and bark
- Scion of similar thickness is selected having a length of 2.5 to 10 cm and 4-5 months old.
- It should preferably be a terminal and non-flowering shoot.
- Selected scions are defoliated on the mother plant 7-10 days prior to detachment.
- Base of the scion is given a long cut on side and short cut on the opposite side to match the cuts on the rootstock.
- The scion is inserted into the cut portion and graft union is tied with transparent polythene strip and kept in polyhouse.
- This method can be adapted from March to September under field conditions.
- Practiced in mango, aonla, cashew nut, custard apple, walnut etc.

### ***Soft wood grafting***

- Newly emerged stock shoots of 1 year old rootstock, seedlings having bronze coloured leaves (especially in case of mango) are selected for cleft grafting.
- Scion wood to be used is defoliated 7-10 days prior to grafting.
- Thickness of stock shoot and scion stick should be the same.

- After grafting, it is firmly tightened with 1.5 cm wide, 4.5cm long and 200 gauge polythene strips.
- This can be performed in open field or containers.
- With use of poly and net house, grafting operation can be continued almost year round.
- Practiced in Mango, Cashew, Guava, Aonla, Bael, Jack fruit etc.

### ***Patch Budding***

- Prepare the rootstock seedlings by removing side shoots frequently.
- Select seedlings having straight growth and thickness of 0.8 to 1.25 cm in diameter. Usually such thickness is attained after 5-7 months of growth.
- For high success in budding, temperature (30-32<sup>0</sup>C) and humidity (80-90%) is ideal.
- Select 6-9 months old determinate shoots as scion sticks from mother plant.
- Remove the leaf blades but not the petioles from the scion sticks; wrap them in polythene and store in cool place.
- Remove rectangular bark patch of 1 cm x 3 cm size from selected rootstock seedlings (having 0.8 to 1.2 cm thickness), and 15-20 cm above from root media in the poly bag, by a sharp budding knife.
- A patch of 1 cm x 3 cm size from scion sticks is also taken out. Scion stick having fully developed and swollen buds but not sprouted should be taken.
- The scion patch is placed carefully on the removed portion of the bark of rootstock.
- Tie with polystrip, keeping the bud naked and without leaving any air pocket
- Shift the budded plants in the poly house for taking advantage of optimum temperature and humidity for higher bud burst.
- Bud starts sprouting after 15-20 days. Cut the rootstock 20 cm above the bud union.
- Again after 15 days when sprouted bud has grown up to 3.0 cm, cut the rootstock 5 cm above the bud union.
- Only sprouted bud is to be allowed to grow, remove all other shoots regularly.
- Shift the budded plants in the open area for a few days before these are shifted to Post Propagation and Maintenance and Sale Nurseries (PPMS).
- Practiced in aonla, guava, bael, jack fruit, tamarind etc.

### ***Softwood cutting***

- Suitable for the propagation of grapes, guava, lemon, pomegranate, fig and mulberry.
- In guava, cuttings (8-10cm) are made from current herbaceous growth.
- After treating with suitable concentration of rooting hormone, planted in suitable rooting media.
- Intermittent misting required for better root initiation.
- Root Initiation takes place after one and a half months.
- After root initiation, plants are shifted to plastic containers for establishment and kept in mist chamber for few days.
- After proper establishment plants are shifted to net house for hardening.

### ***In-situ orchards establishment***

- Suitable for quick establishment of the orchard.
- Rootstocks are planted directly in the field.
- After one year grafting/budding performed in the field

## **FLORICULTURE IN INDIA**

The branch of horticulture that deals with the cultivation of ornamental plants, their marketing, and sales are known as floral horticulture or floriculture. Although floriculture is largely considered temperate horticulture or a greenhouse industry. Floriculture in India or elsewhere in the world has its own importance when it comes to supplying ornamental plants for special events and occasions. Be it living humans, dead or even celebrating survival, they all look for something decorative that makes them feel special. Moreover, flowers rank among the top priorities of humans and are considered a symbol of courtesy or respect.

The different types of floriculture that are flourishing in India are as mentioned below;

### **1. Bedding plants**

These plants primarily grow in nurseries in the early days. While they grow in outdoor areas during the season. The majority of this category are annual blooming plants and are well gelled with vegetable crops for the sustainability of the soil.

Some examples of these types of flowering plants are:

*Petunia, Busy Lizzie, Lobelia, etc.*

## **2. Herbaceous Ornamental Perennials**

These plants are non-woody plants that grow and develop as a part of their original part, continuously growing as bulbs, tubers, or grow as seeds. In addition, these crops are grown inside greenhouse nurseries and produced throughout the rest of the lifecycle in the open. These types of plants cold-sensitive and, thus, if exposed to harsh winter conditions, will dry up.

Some examples of herbaceous ornamental plants are as follows:

*Coneflower, columbine, Hostas, Plox, etc.*

## **3. Potted crops**

These crops grow, cultivated, marketed and sold in a pot throughout their lifecycle. Moreover, as per reports, these are one of the most sought-after flowering plants in floriculture. These can cultivate throughout the year, depending upon environmental conditions. Due to the time taking process and specifically required environmental conditions, these plants are costlier than other types of floriculture plants.

Some examples of potted plants are as follows:

*Mums, poinsettias, Easter Lilies, Shamrocks, etc.*

## **4. Indoor Foliage**

These crops cultivate and grow in tropical and sub-tropical regions on the planet. These plants are known for their unusually large and colourful leaves. Moreover, these plants are evergreen plants in floriculture. Used for conditional outdoor displays, these plants are special in temperate regions. Thus it used for decor outdoors, indoors, etc.

Some examples of this type are:

*Bromeliads, Ferns, Devil's Eivy, etc.*

## **5. Cut Flowers**

These do not qualify as complete flowers as part of them to sold independently. In addition, arrangements as per the suitability of the occasion. Also, these kinds are most commonly used in weddings, birthday celebrations, etc. Some of the examples are:

*Baby's breath, Carnations, Lilies, etc.*

## **CULTIVATION AND USES OF CROSSANDRA**

**CROSSANDRA (*Crossandra infundibuliformis* L.) Acanthaceae**

**Varieties:** Tetraploid types - Orange, Lutea Yellow, Sebaculis Red. Triploid types - Delhi Crossandra.

**Climate:** It requires a temperature of 30 - 35°C for growth. It is shade tolerant to some extent but susceptible to low temperature and frost.

**Soil:** Well drained sandy loam and red soils with pH of 6 - 7.5 are ideal. Soil is to be tested for nematodes before planting.

### **Propagation:**

**Tetraploids:** Propagated through seeds. Seed rate is 5kg/ha. 60 day old seedlings are transplanted in the main field.

**Triploids:** Propagated through terminal cuttings of 10 - 15 cm length (41,700 cuttings/ha)

**Seeds and sowing:** Fresh seeds are sown during July - October in raised beds at 15 cm apart in lines. Watering should be done daily. The seedlings will be ready for transplanting in 60 days.

**Seed rate:** The required seed rate is 5 kg/ha for optimum plant population. For Delhi Crossandra, rooted cuttings have to be used for planting.

**Preparation of field:** Land is ploughed thrice and FYM at 25 t/ha is incorporated. Ridges are formed 60 cm apart. Dip the roots of seedlings in Carbendazim (1 g/l of water) and plant on one side of the ridge at 30 cm spacing. For seed production the spacing may be 60 x 60 cm. For Delhi Crossandra a spacing of 60 x 40 cm is to be followed.

**After cultivation:** Spray Diuron (pre-emergence) 2.5 kg a.i/ha for controlling the weeds.

### **Manuring**

**Tetraploids:** Apply FYM 25 t/ha as basal and NPK at 75, 50 and 125 kg/ha as top dressing three months after planting. Repeat NPK application at the same dose at half yearly intervals for two more years (Instead of applying N at 75 kg/ha, N at 60 kg/ha + *Azospirillum* 2 kg/ha can also be applied).

**Delhi Crossandra:** Apply FYM 25 t/ha, Gypsum 100 kg/ha and P & K at 50 and 100 kg/ha



respectively as basal dose. Top dressing is done 30 days after planting with neem cake 250 kg and N 40 kg/ha. Apply N P K @ 40:20:60 kg/ha 90 days after planting and repeat this dose at quarterly intervals for a period of two years.

**For both Tetraploids & Delhi Crossandra:**

**Biofertilizers:** Soil application of 2 kg each of *Azospirillum* and Phosphobacteria per ha at the time of planting. It is to be mixed with 100kg of FYM and applied.

**Growth regulators:** Spray Ascorbic acid 1000 ppm (1 g/lit of water) before flowering.

**Top Dressing:** On 30 days after planting, apply Neem cake 250 kg and N 40 kg/ha. Again on 90 days after planting apply N P K 40:20:60 Kg and repeat this dose at quarterly intervals for a time period of two years.

**Irrigation:** Irrigation is done once in a week.

**Crop duration:** 3 years including ratoon crop.

**Harvest:** Flowering will start a month after transplanting. Fully opened flowers are picked once in two days.

**Yield:** An average yield of 2000 kg of flowers per ha/year can be obtained.

**Uses :**

**Ornamental plant:** *Crossandra* plants are prized for their showy, brightly-coloured flowers that bloom for several weeks each year. They are often grown as indoor or outdoor ornamentals and can be used in beds, borders, or as specimen plants in pots or containers.

- **Cut flowers:** *Crossandra* flowers are long-lasting and make excellent cut flowers. They can be used to add colour to floral arrangements or as a stand-alone cut flower in a vase.
- **Landscaping:** *Crossandra* plants are well-suited to tropical landscapes and can be used to create an exotic, tropical look in your garden. They are also a great choice for shady areas where other plants may struggle.

- **Medicinal uses:** Crossandra plants have been used in several traditional medical systems to cure a variety of illnesses, such as headaches, fevers, and skin disorders. More research is required because there is not enough scientific evidence to support these usages.
- **Natural insecticide:** The sap of *Crossandra* plants has insecticidal properties and can be used as a natural pest control measure. Simply crush the leaves or stems of the plant and apply the sap to the affected area.
  - Export of Floriculture Products from India
  - The value of cut flower export from India has increased twenty five fold during the last five years (Table 3). With more export oriented units coming into operation, exports are
  - likely to grow further in the coming years. The major share of the export trade is for roses, in
  - addition to orchids, gladiolus etc. The major markets are Europe (Holland, Germany and
  - U.K.) and Japan. The exports of roses to Japan, have really picked up in the three years from
  - Rs. 360 million in 2013-14 to Rs. 6090 million in 2015-16. As per the estimates for 2016-17,
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Floriculture in India is being viewed as a high growth Industry. Commercial floriculture is becoming important from the export angle. The liberalization of industrial and trade policies paved the way for the development of export-oriented production of cut flowers. The new seed policy already made it feasible to import planting materials of international varieties. It has been found that commercial floriculture has higher potential per unit area than most field crops and is, therefore, a lucrative business. The Indian floriculture industry has been shifting from traditional flowers to cut flowers for export purposes. The liberalized economy has given an impetus to the Indian entrepreneurs for establishing export-oriented floriculture units under controlled climatic conditions.

Agricultural and Processed Food Products Export Development Authority (APEDA) is responsible for export promotion and development of floriculture in India.

#### **Varieties:**

These mainly consist of cut flowers, pot plants, cut foliage, seeds bulbs, tubers, rooted cuttings and dried flowers or leaves. The important floricultural crops in the international cut flower trade are Rose, Carnation, Chrysanthemum, Gargera, Gladiolus, Gypsophila, Liatris, Nerine, Orchids, Archilea, Anthurium, Tulip, and Lilies. Floriculture crops like Gerberas, Carnation, etc. are grown in greenhouses. The open field crops are Chrysanthemum, Roses, Gaillardia, Lily Marygold, Aster, Tuberose, etc.

#### **Areas of Cultivation:**

Maharashtra, Karnataka, Andhra Pradesh, Madhya Pradesh, Haryana, Tamil Nadu, Rajasthan,

and West Bengal have emerged as major floriculture centers.

About 322 thousand hectares of the area were under Cultivation for floriculture in 2020-21. Production of flowers is estimated to be 2151.96 thousand tonnes of loose flowers and 828.09 thousand tonnes of cut flowers in 2020-21.

#### India Facts and Figures:

The country has exported 23,597.17MT of floriculture products to the world for the worth of Rs. 771.41Crores/ 103.47 USD Millions in 2021-22.

Major Export Destinations (2021-22): U.S.A, Netherland, Germany, U.K. United Arab EMTs, and Canada were major importing countries of Indian floriculture during the same period

#### Individual Sub – Products:

Bulbs, Tubers, Tuberous Roots	Plant For Tissue Culture
Bulbs Horticultural	Flowering Plants
Chicory plants	Other Live Plants
Other Bulb/Tubers	Live Mushrooms Spawn
Unrooted Cuttings	Cut Flowers for Bouquet / Fresh
Edible Fruit Trees Grafted or Not	Other Cut Flowers for Bouquets
Cactus	Moosses& Lichens for Bouquet Fresh
Rhododendrons (Grafted or Not) Fresh	Other Foliages / Buds For Bouquet
Roses Grafted or Not	Foliages/ Branch / Buds Not Fresh

### **CUT FLOWERS**

Cut flowers are fresh flowers, flower buds or spikes harvested along with their stalks attached to the flowers, the length of stalks being specified to individual flowers. Examples of cut flowers are alpinia, anthurium, antirrhinum, bird of paradise, carnation, freesia, gerbera, gladiolus, gypsophila, heliconia, iris (bulbous), lupins, narcissi, orchid, rose (improved

varieties), scabiosa, statice, tuberose, watsonia, etc. They are mostly used for bouquets and for vase arrangements.

### **CUT FLOWERS EXPORT POTENTIAL:**

- The cut flowers generally grown under greenhouse/polyhouses are being exported to The Netherlands, Japan and Germany.
- The international buyers are re-exporting the goods which they import from various developing countries.
- Spain, Kenya and Israel have also started exporting the flowers, accounting 2, 2 and 6%, respectively.
- The other countries including developing ones have only 20% of the total export, India's share in the total world export being less than 1%.
- The new markets for Indian flowers may be Japan, Northern America, South East Asia and the Gulf countries.
- India's geographical location particularly its proximity to a developing Far East offers a tremendous competitive advantage.
- Now the floriculture has become one of the extreme focus segments for development of export by the Government of India.
- Developing countries have only 6% share in the world market. This help in increasing the export from India which is otherwise negligible.

### **GREEN HOUSE TECHNOLOGY**

The science of supplying plants with a favourable environment is known as greenhouse technology." It also protects plants from harmful environmental factors including wind, cold, precipitation, excessive radiation, severe temperature, insects, and illnesses. Around the plants, a perfect microclimate may be established. Greenhouses are framed or inflatable buildings coated in transparent or translucent material that are big enough to produce crops under partial or complete environmental control for optimal development and yield.

#### **Types of greenhouse**

- A greenhouse that is naturally ventilated
- A hi-tech greenhouse
- Greenhouse that uses a fan and pad cooling system

- A greenhouse whose structure is made out of bamboo or any other wood

#### **Advantages of Green House Technology:**

- 10-12% increase in yield depending upon the type of greenhouse, type of crop, environmental control facilities
- Reliability of crop increases in green house cultivation
- Expands your growing season
- Expanding the variety among your produce
- Minimize external threats to your crop

#### **Disadvantages of Green House Technology**

- High upfront and operating expenses
- Lack of pollination
- Careful precautions must be taken to eliminate any pest or diseases to make sure your next crop won't be affected

#### **GERBERA**

**Cultivars:** Jaffa, Sangria, Rosula, Oprab, Romona, Salina, Tecora and Starlight.

**Planting:** Planting medium should be adequately porous and well-drained. The optimum planting, density recommended for large flowering cultivars is 8-10 plants/m<sup>2</sup>. Two –row or 4-row planting systems are generally used. Planting can be done round-the-year but preferably during September-October. The plants should be left undisturbed for 2 years for flower production (no separation of clumps). Treating plants with GA<sub>3</sub> (100 ppm) results in early flowering having long stems.

**Temperature requirement:** The temperature during day time should be 16-20<sup>0</sup>C and 12<sup>0</sup>C during nights.

**Harvesting and yield:** The harvesting stage is critical as the flowers should not be cut before the outer row of flowers show pollen, or the flowers will wilt and close at night. Optimum storage temperature (wet) for gerbera is 4<sup>0</sup>C. The flowers could be stored efficiently up to 4 weeks. Most modern cultivars of gerbera yield 250-300 good quality flowers/m<sup>2</sup>/year.

## **DENDROBIUM ORCHID (*Dendrobium sp.*)**

### **Orchidaceae**

*Dendrobium* species is a typical tropical orchid species suitable for Chennai and other coastal areas where the humidity is high.

#### **Varieties**

Sonia 17, Sonia 28, Emma White, Sakura Pink. .

#### **Climate**

75% green shade net with 70 - 80% humidity, 18 - 28°C temperature and light intensity of 1500-2000 foot candles is ideal for growing this tropical orchid.

#### **Growing environment:**

75% shade net house with 70- 80% humidity, day temperature of 21 - 29°C and night temperature of 18 to 21°C is ideal for growing this tropical orchid. In high rainfall zones, the shade net house should be provided with a rainshelter.

#### **Propagation:**

Division of clumps, keikis, back bulbs and tissue culture plants.

Containers and support : perforated earthen pots are ideal and the plants are staked with bamboo sticks

#### **Growing media:**

Most common potting mixture consists of charcoal, broken pieces of bricks and tiles, coconut husk and fiber.

#### **Irrigation:**

Mist or overhead sprinkler to provide water and to maintain humidity.

#### **Nutrients:**

Foliar application of NPK 20:10:10 @ 0.2% at weekly intervals starting from 30 days after planting.

#### **Growth regulators**

Foliar application of GA3 50 ppm at bimonthly intervals starting from 30 days after planting.

#### **Repotting**

Orchids need repotting regularly, usually every two to three years.

1. When the plant grows large and overgrows its container.
2. When the potting material deteriorates
3. When the plant has to be split or divided
4. It is better to repot epiphytes every year.

The best time for repotting is when fresh roots emerge at the bases of the previous year's growth. In monopodial climbers, repotting or division has to be done when new leaf growth shows at the top and there is new root growth.

### **Splitting or division of plants**

Plant grown to a large clump with 2 or 3 old canes and new shoots, - divided before repotting. Each division - at least one old cane of two years' growth, one new shoot & some new roots.

### **Pests:**

**Snail and slug:** Hand pick and destroy

### **Harvest**

Dendrobium flower fully matures only 3 or 4 days after it opens. Flowers are harvested when they are fully open as the flowers cut prior to their maturity will wilt before reaching the wholesaler. Immediately after harvest, the lower 0.75cm of the peduncle is cut off, and the flower is inserted into a fresh tube of water containing preservative. Harvesting the spike when 75 per cent of the flowers are open and remaining buds are unopen.

### **Yield:**

8 - 10 spikes/plant/year

## **ANTHURIUM (*Anthuriumandreanum*)**

### **Aeraceae**

### **Varieties**

**Red** : Temptation, Tropical Red, Red Dragon, Verdun Red, Flame, Mauritius Red .

**Orange** : Mauritius Orange, Peach, Casino, Sunshine Orange, Nitta.

**White** : Acropolis, Linda de Mol, Mauritius White, Lima, Manoa Mist.

**Pink** : Abe Pink, Candy Stripe, Passion.

**Green** : Midori, Esmaralda.

**Bicoloured** : Titicaca, Jewel, Akapana, Cardinal.

**Others** : Fantasia (cream with pink veins), Chocos, Chicos (chocolate brownish red).

### **Climate**

Anthurium requires porous, well drained aerated soil rich in organic matter content. The soil pH should be 5.5 and 6.5. It performs well under green shade net having 70 – 80 % shade intention with 80 -90 % humidity and 24 - 28°C temperature and 15 - 22°C night temperature with 1500 – 2000 foot candles light intensity.



**Growing environment:** 75% shade net house with 70 - 80% relative humidity, day temperature of 24 - 28°C and night temperature of 15 - 22°C.

### **Growing media**

A growing media containing 1:1 mixture of leaf mould and coco peat with a pH of 5.5 to 6.5 is ideal, which ensures good drainage as well as water holding capacity.

### **Propagation:**

Propagated through tissue culture or suckers. Tissue culture plants are widely used for commercial cultivation.

**Seed :** Seeds germinate within 10 days; transplanted after 4-6 months takes 2 - 3 years to bloom. Seeds scattered on a finely shredded medium & kept under 75 % shade. Also germinated aseptically under nitsch/ms media supplemented with BAP & Adenine

**Suckers :** Suckers produced from base of the plant at 4-5 leaf stage with 2-3 roots separated. 57 ppm BAP at monthly intervals on more than one year old plant encourage more suckers

**Stem cutting :** Top of the stem with few roots of 3 to 4 year old plants is removed and planted. Each cutting should have single eye or bud IBA 500ppm produce good roots.

**Tissue culture :** Becoming popular; explants – leaf segments, root segments, stem section, vegetative buds, flower stalks, spathe and spadix; MS medium

**Planting:** Grown in pots or raised beds. Tissue culture plants of 15 cm height with 4-6 leaves are ideal for planting.

**Irrigation:** Mist or over head sprinkler to provide water and to improve relative humidity.

**Pot cultivation:** Foliar application of 0.2% of NPK @ 30:10:10 during vegetative stage and 10:20:20 during flowering stage is adopted for pot cultivation. Fertigation can be adopted for raised bed cultivation.

**Raised bed cultivation:** For the first 6 months spray plants with a solution of cow dung and DAP @ 250 ml/plant (10 kg of cow dung + 2 kg of DAP dissolved in 200 l of water and the

decanted solution is used for spaying). After 6 months fertigation is adopted with the following schedule.

### **Bed system**

Soil is incorporated with organic matter. Bed size of 1.2 to 1.4m width with a spacing of 60 x 60 cm is found ideal.

### **Shade regulation**

Open condition with adequate shading facility are the best. Growing under polythene plastic with shade cloth prevents bacterial blight. 70-80% shade level is found to be best for Tamil Nadu and Kerala conditions. Excess light causes permanent damage to the leaves. Shade net should be laid at a minimum height of 3m from ground level.

### **Fertilizer requirement**

NPK @ 30:10:10 @ 0.2% is given from 30 days of planting as foliar application at weekly intervals

### **Growth regulators**

Application of GA3 200 ppm as foliar spray at 2 month intervals improves the growth and quality of flowers

### **After cultivation**

Leaf pruning retaining 4 – 6 leaves/plant has to be taken up then and there to avoid disease problem and to promote flowering. The roots formed on the lower leaf axils should be buried.

### **Excess light**

Leaves appear bleached in the center and may have brown tips. To control this problem, shade should be given so as to reduce the light level to 1800-2500 foot-candles.

### **Harvest**

Harvest commences after 3 – 6 months of planting. Each leaf unfold will give out one flower. Flowers are harvested when the spathe completely unfurls and the spadix is well developed with one third of bisexual flowers got opened. Harvesting has to be done during cooler parts of the day i.e.) early morning or late evening. In general, the blooms are placed in water held in plastic buckets immediately after cutting from the plant. Delay in keeping in water allows air entry into the stem and causes blockage of the vascular vessels. Cut flowers after harvest

should be shifted to pre cooling chambers in refrigerated vehicles having 2-4°C temperature as they deteriorate most rapidly at high temperature.

### **Yield**

An average 8 flowers/plant/year can be obtained.

## **TUBEROSE (*Polianthes tuberosa* L.)**

### **Amaryllidaceae**

#### **Varieties**

Single –Calcutta Single, Mexican Single, PhuleRajani, Prajwal, RajatRekha, Shringar, Khahikuchi Single, Hyderabad Single, Pune Single, ArkaNirantra  
Double –Calcutta Double, Hyderabad Double, Pearl Double, SwarnaRekha, Suvasini, Vaibhav.

**Climate:** Tropical conditions with a temperature range of 28 to 30°C

#### **Soil**

Well drained loamy soil having a pH of 6.5-7.5 is ideal for cultivation.

#### **Propagation and planting**

Bulbs are used for commercial propagation. Bulbs (25 to 30 g) are planted (1,12,000 corms/ha) on the sides of ridges at 45 x 20 cm spacing at 2.5 cm depth during June - July. Bulbs are planted after 30 days of harvest. Dip the corms in 5000 ppm CCC (5 g/lit) before planting to increase the yield

#### **Manuring and after cultivation**

Manuring can be done with FYM 25 t/ha and NPK 200:200:200 kg/ha (IIHR Recommendation). Full P and K can be applied during the final preparation of plots, while N can be applied in 3 equal split doses *i.e.*, at the final preparation of plot, 60 and 90 days after planting of bulbs.

#### **Micronutrients:**

Foliar spray of ZnSO<sub>4</sub> 0.5% + FeSO<sub>4</sub> 0.2% + Boric acid 0.1%.

#### **Growth regulators:**

Foliar application of GA<sub>3</sub> at 50 to 100 ppm thrice at 40, 55 and 60 days after planting.

#### **Plant protection**

##### **Pests**

**Thrips:** Spray Dimethoate @ 1.5 ml/lit or Fipronil 5 % SC @ 1.5 ml/ l

**Aphids:** SparyDimethoate @ 1.5 ml/lit or Imidacloprid @ 1.5ml/l

**Root knot nematode:**

Apply Carbofuran 3 G 1 g/plant near the root zone and irrigate immediately to control nematode infestation.

**Diseases**

**Basal rot (or) stem rot:** Soil drenching with Carbendazim @ 0.1 %

**Crop duration**

It extends up to 2 years. The crop can be maintained for one more year with good management practices.

**Harvest:**

**For Loose flower and concrete extraction:** Individual florets are plucked during early morning hours before 8 am daily, when they start to open.

**For cut flower:** Whole spike is cut leaving 4 to 6 cm from the base.

**Yield:**

Loose flowers: 14-15 t/ha; Cut flower: 2 - 3 lakhs spikes/ha/year; Bulbs &bulblets: 20 -25 t/ha (at the end of 3rdyear).

Concrete recovery: 0.08 - 0.11 %

**Yield**

Flower yield ranges about 14-15 t/ha. The concrete yield ranges about 8 to 10 kg/ha.

**GLADIOLUS (*Gladiolus* spp)**

**Iridaceae**

**Varieties**

Tropic Sea, White Prosperity, Priscilla, Summer Sunshine, PusaSwarnima, Jackson Ville Gold, KKL.1, Archana, BasantBahar, Indrani, Kalima, Kohra, Aarti, ArkaKesar, Darshan, Dhiraj, Agnirekha, Archana, Bindiya, Shree Ganesh

**Climate:** Subtropical and temperate climatic conditions are suitable. The crop performs well under a temperature range of 27 - 30°C. It requires full exposure to sunlight and performs well with long day conditions of 12 to 14 hour photoperiod.

**Soil:** Well drained sandy loam soil rich in organic matter with pH of 6 to 7.

### **Season**

This crop requires minimum 10 hours of sunlight to overcome blindness. So season should be adjusted or light substitution should be given.

### **Propagation:**

Commercial propagation is through corms. Cold storage of corms at 3 to 7°C for 3 months or treatment with Ethrel (1000ppm) or GA3 (100ppm) or Thiourea (500 ppm) is adopted for breaking corm dormancy.

### **Field preparation and planting:**

Beds of size 6 x 2 m are prepared and corms are planted at a depth of 5 cm adopting a spacing of 40 x 25 cm (88,888 plants/ha) or 25 x 25 cm (1,60,000 plants/ha).

### **Planting season:**

October for plains and March-April for hills.

### **Planting system**

Ridges and furrows system is adopted.

**Irrigation:** Irrigate at 7-10 day intervals in sandy soils and at less frequent intervals in heavy soils. Irrigation should be withheld at least 4-6 weeks before lifting of corms.

**Nutrition:** 120 kg N, 150 kg P<sub>2</sub>O<sub>5</sub> and 150 kg K<sub>2</sub>O per hectare is recommended, of which 60 kg N and entire dose of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O is applied as basal dose. The remaining N is given in two split doses, 30 and 60 days after planting.

### **Manuring**

#### **Basal**

N 60 kg/ha, P 150 kg/ha, K150 kg/ha.

#### **Top dressing**

N alone is given @ 30 kg/ha during 4 leaf stage as foliar spray and 30 kg/ha during bud stage as soil application.

### **Aftercultivation**

After the corms have sprouted well, watering should be done, if necessary. When the shoots are about 20 cm high they are covered by heaping the soil up to a height of 10 to 15 cm. This enables the plants to grow erect despite high winds and rains and suppresses weed growth. Earthing up the soil is a must in case of light soils. In case where spikes grow longer or stems are not strong enough to bear the lodging or mild stroke of wind, they are supported with about 1.5 meters strong stakes. Strings instead of stakes may be used at the time of the appearance of the spikes. Strings are stretched between the stakes along the row to provide easy and adequate support.

### **Plant Protection**

1. Before storage, corms are dipped in hot water at 40 - 45°C + fungicide (captan or thiram 2 g/lit) to control Nematode and fungal disease.
2. Thrips can be controlled by methyl demeton 25 EC 2 ml/lit. ordimethoate 30 EC @ 2 ml/lit.
3. Semilooper and *Helicoverpa* can be controlled by methyl demeton .

### **Leaf spot**

Spray Carbendazim or Mancozeb 2 g/lit to control leaf spot.

### **Wilt**

Drenching of Bavistin (0.2%) at fortnight intervals controls the wilt disease.

### **Blight disease**

Blight disease can be controlled by spraying Mancozeb @ 0.2 %

### **Storage rot**

Spraying of Benomyl (0.2%) controls the storage rot

### **Season of flowering and Harvesting**

When first bud shows the colour of the variety harvesting is started.

### **Fluoride injury**

Leaf scorch of gladioli is observed due to the presence of fluorine compounds in the atmosphere which got accumulated on the tips of leaves. The injury is associated with heavy application of super phosphate.

**Special practices:**

**Staking:** Large flowered varieties should be staked to avoid lodging.

**Plant protection****Pests**

Thrips: Spray Dimethoate 30 EC @ 2ml/l or Fenitrothion 50 EC @ 2ml/l or Malathion 50 EC @ 2ml/l

Semi looper and Helicoverpa: Methyl Demeton 25 EC or Dimethoate 30 EC @ 2ml/l

**Diseases**

**Leaf spot:** Foliar application of Carbendazim @ 1g/l or Mancozeb @ 2g/l

**Core or spongy rot:** Foliar application of Benomyl @ 1 kg/ha

**Bacterial scab blight and spots:** Dipping the corms in 1:100 Mercuric chloride solution for 12 hours before planting.

**Harvesting of spikes:**

Gladiolus takes 110-120 days to produce spikes. While harvesting, at least four basal leaves should be retained on the plant to ensure proper development of corms and cormels.

**Post harvest treatment and Grading**

Soak the stem in water to avoid wilting and lodging of stem and flower. Based on stem length and number of florets, the spikes are grouped into A, B, C, D grades.

**Yield**

2.0 - 2.5 lakh flower stalks/ha/crop.

**BONSAI**

Bonsai is an art of growing and training of a plant to a miniature form having a natural look of old age. It was originated from china, but it was called as the Japanese art. It involves techniques of extreme dwarfing. The optimum size of bonsai may be only 30 to 60 cm in height, but miniature sizes of below 25 cm have also been preferred. Bonsai of minimum 10

years old are period, but of 100 and even 200 years of age are available and are highly valued as 'venerable' specimens.

Bonsai requires special types of containers. They should be usually shallow with 5 to 7.5 cm deep (except for cascade type of bonsai for which deep pots can be used). Round, hexagonal or square shaped containers with 25 to 30 cm diameters are preferred. Containers with specific colours like mosaic, sky blue, terra cotta, grey or jungle green are well suited for bonsai culture. Plants adaptable for extreme dwarfing like juniper, pine, elm, maple, cypress are suitable materials for bonsai culture. But in tropical places like India, the tree species like Manilkhara, Sapota, Bassia, Tamarind and Ficus spp. and shrubs like West Indian cherry are well suited.

Trunk and branches may be bent, forced and tied by coiling them with heavy wire. This wire is removed after several months when training to shape has been accomplished. The bonsai plants may be trained to different shapes like twisted trunk, upright, S-shaped, semi-cascade, cascade, slanting or any other formal shape. Planting of both tips and roots is usually done at planting time and periodically pinching the tip and removing the excess side shoots are essential to maintain the general outline of design. Annually, the plants are either repotted or lifted from the pot, root pruned and reset.

The bonsai plant is fed sparingly of week fertilizer solution containing major and minor nutrients. Sometimes extracts of oil cakes may be also added. Similarly, the plant is given only minimum requirements of moisture. It is advisable to water twice a day to plants kept in shallow containers and once a day to plants kept in deeper pots.

Selection of hardened woody plants that have been subjected to adverse conditions is a good starting point. Such kind of planting materials may be collected from rock crevices or from the walls of any buildings. Old seedlings kept in containers from any nursery or cutting, grafted plants or layers may be also utilized in bonsai culture.

### **Rules for Bonsai making**

#### **For trunk**

- Height can be 6 times the caliper of the trunk.
- Should lean towards the viewer.



- It should anchor the plant.
- Roots should radiate.
- No eye poking roots.
- Should taper as it ascends
- Should not move back

### **For Branches**

- Should not cross the trunk
- No eye poking branches
- First branch should be at one third height of the tree
- No belly branches
- Should be opposite
- Should diminish in size as it ascends
- Secondary branches are to be alternate

### **Principles of Bonsai**

Look for

- Small leaves or needles
- Shorter internodes
- Attractive bark or roots
- Branching characteristics

### **To enhance the age, expose the one third of the roots**

- Before potting, the twisted and tangled roots are to be straightened.
- Upper branches should not overshadow the lower branches.

### **Styles of bonsai**

#### **Formal Upright**

It is one of the most natural styles where the trunk is perfectly straight. The branches should alternate left to right to suggest age. The bottom third branches are removed and the remainder is drawn downward.



### **Informal Upright**

This style is characterized by a lightly curving trunk displaying the harsh elements of nature. This can be achieved with ease using wire and/or cords. It is as appropriate for conifers as with deciduous trees.



### **Broom**

It has a straight trunk that begins to divide and subdivide into many branches. The characteristics are its thick and finely branched crown. Some trees for this style are Beech, Elm, False cypress and Maple.



**Broom style**

### **Slanting**

It is so called because the general slope of the trunk is highly pronounced. The branches should lie horizontal or droop slightly downward. The surface roots have an unstable appearance but have a well anchored impression.



**Slanting style**

### **Windblown**

It is rare in nature. This kind of tree is found on cliffs or mountains. The trunk, branches and twigs are trained in a single direction to give the affect of a strong wind and storm.



**Windblown style**

### **The Clasped-to-Stone**

It is a much loved but difficult to create style. The size and shape of the rock should complement the plant that is set on a gravel or water dish. A whole chapter could be spend on this style.



**Clasped-to-stone style**

### **Agrotechniques for Bonsai**

1. Propagation
2. Season
3. Potting and repotting

4. After care
5. Container
6. Planting media

### **Propagation**

Through seeds, cuttings, layering or grafting

Seeds: Pines and Junifers

Cuttings: Ficus, Pomegranate, Mulberry and Bougainvilleas

Layers: Jasmine, Ixora, Bougainvilleas and Pome granate

Grafts: Mango, Sapota, Citrus

### **Season**

1 July - August

2. Febraury - March

Best time is before opening of the buds

### **Potting and repotting**

- 1/3 of the roots can be trimmed
- Long tap roots are to trimmed
- Excessive branches are to thinned out
- Balanced nutrition and adequate watering is must
- Potting is not advisable during winter or hot months
- Repotting is done after 2-3 years

### **After care**

Pinching - Once or twice

Pruning - For its shape

Training - Desirable shape

It is achieved through copper wire or polythene tape. It is to be removed once the shape is attained.

### **Containers**

- Mostly terracotta or ceramic
- Small in size

- Square/round/rectangle/oval in shape
- Preferred is oval / rectangle

In round / square the plant is to be in the centre

In others placed in the sides of the containers.

### **Planting Media**

#### **Media consists of**

Loam soil	2 parts
Leaf mould	1 parts
Coarse sand	little

Media can be covered with moss and one or two pebbles can be placed to give a natural look.