

## (A) TROPICAL AND SUB-TROPICAL FRUITS

Tropical fruits generally prefer high temperature and they cannot stand even slight frost and sub-tropical fruits can withstand low temperature or occasional frost during winter and also high temperature during summer months. A strict classification between these categories can not be made since most of the fruits coming under this category can be grown in both tropical and sub-tropical zones. Important fruits under these categories are dealt here.

### 1. Mango (*Mangifera indica*) Family: (Anacardiaceae)

Mango undoubtedly deserves to be the national fruit of India. It is a favorite fruit of all parts of India and has been repeatedly acclaimed as the 'King of fruits'. It is one of the most ancient fruits of India and mention has been made in many ancient old literatures about its cultivation. It is found in several countries also but in no other country does it enjoy the status as it does in India. India is the only country where truly wild forests of mango are found in Assam and its adjoining Chittagong Hills. This genus is reported to have originated from South-East Asia with a natural spread in the Indo-Malayan region. About 40 species are recognized in this genus *Mangifera* and some important ones are *M. altissima*, *M. sylvatica* and *M. zeylanica* which closely resemble to *M. indica*.

Mango is an outstanding source of vitamin A and a good source of vitamin C, apart from the usual content of minerals and other vitamins. Good mango varieties contain over 20 per cent of total soluble solids (sugars) in which the non-reducing sugars are more than the reducing sugars. The acid content of ripe fruit varies from 0.2 to 0.5 per cent and the protein content is about one per cent.

In India, it is grown in almost all states of India with a total estimated area of 1.02 million hectares with an annual production of 8.33 million tonnes. India's contribution to the global production is the maximum (nearly 65%), followed by Pakistan, Philippines and Indonesia. Among the states in India, Uttar Pradesh, Bihar and Andhra Pradesh are the leading states in area and production wise. In Tamil Nadu, it is grown in about 41,000 ha almost in all districts excepting Nilgris. However the districts like Dharmapuri, Salem, North Arcot and Kanyakumari have maximum area.

### Soli and Climate

Mango is not very exacting in its soil requirements. It grows successfully almost in all states under different soil types. It is a large tree with deep tap-root system. The nature of the sub-soil is therefore important. The water-table should be below 180 cm. A well drained deep loamy soil is generally conducive

for successful mango culture. A pH range of 5.5 to 7.5 has been found good. In alkaline soils, young plants are susceptible to injury and they exhibit symptoms of burning. Mango is a tropical as well as semi-tropical plant. It grows upto an altitude of 1200 m, but the fruiting is poor above 600 m. It thrives equally well from Kanyakumari in Southern India to sub-mountainous region in the north. Annual mean temperature at which mango thrives best is around 26°C. But at low temperature (below 1°C), the plants are severely affected by frost. The prevailing temperature also affects the sex expression in mango. Higher temperature tends to produce more percent of perfect flowers. In India, mango grows equally well in area receiving both low and heavy rainfall (75 cm annually). However, with annual rainfall of 75 cm and above, it can be grown with little or no irrigation.

### Propagation

A number of vegetative propagation techniques such as grafting, budding, layering and cuttings have been successfully practiced. Inarching, veneer grafting and epicotyl grafting are commercially adopted in India. Yet, inarching is the only technique in vogue in commercial nurseries. For inarching, one year old seedlings are used as rootstocks. About 90 per cent success is obtained in this method. From the time of sowing of seeds, the grafts take one and a half to two years to be ready for planting in the field.

Recently, propagation by veneer grafting has been perfected. It can be done any time from spring to early monsoon. Success upto 80 per cent can easily be obtained. The grafts make rapid growth and are cheaper to be produced. The grafting can be done on rootstocks raised in pots or in the field (*in situ*). Besides epicotyl grafting has been standardized recently. Germinating seeds of about 8 to 15 days old are used as the rootstocks. The scions are prepared by prior defoliation of shoots of comparative thickness. Splice and wedge methods are used for grafting. The percentage of success in splice and wedge methods is 50.0 and 33.0 respectively.

There is no commercial practice of propagating mango either through cuttings or layering although success was indicated by various workers. Similarly propagation through budding is nowhere practiced as a commercial method of propagation.

### Varieties

There are hundreds of varieties in mango, out of which only a few happen to be of commercial importance. Some of the important commercial mango varieties in India are described in table 16.1. With the object of evolving a regular bearing variety with desirable characters, breeding work was initiated

in many research institutes and as a result more hybrid varieties are now available. They are described in table 16.2. The hybrid varieties No. 6-8 were developed at IARI, New Delhi, 9-12 were developed at IIHR, Bangalore and 13 and 14 were developed at Tamil Nadu Agricultural University, Periyakulam.

### Polyembryonic Varieties

The phenomenon of polyembryony is known to occur in number of mango varieties. Seedlings arising from the adventitious embryos nucellar origin are highly uniform. These can therefore be used for vegetative multiplication of a polyembryonic variety. If found suitable, they can also be utilized as standard rootstocks for some of the monoembryonic varieties. For example, experiments conducted at Horticultural Research Institute, Periyakulam showed that Bappakkai (Polyembryonic rootstocks) were found to be better rootstocks for 'Neelum' in respect of growth, yield and quality of fruits. In India, almost all the commercial varieties are monoembryonic. Few, that are polyembryonic, are comparatively of little economic value and are mostly confined to Kerala. Some of them are Bappakkai, Olour, Kurukkan, Chandrakaran, Goa and Bellary.

### Planting and Aftercare

Under Tamil Nadu conditions, planting season varies from June to September. In North India, planting can be done in February-March if irrigation is available.

The planting is done in previously dug, exposed and filled pits of the size of 0.9 m × 0.9 m × 0.9 m. Generally, a distance of 7 to 10 m is satisfactory. Recently at the advent of many hybrid cultivars, a closer spacing of 2.5 × 2.5 to 5 × 5 m is recommended.

Variety	Spacing	No. of plants/ha
Arka Aruna, Sindhu	5 × 5 m	400
Amrapali	2.5 × 2.5 m	1000

### Training and Pruning

Rootstock sprouts and low-lying branches have to be removed in the initial years of establishment. Besides, training is done to provide frame work for the future so that branches are spaced properly and do not break with the crop load at the bearing stage. Thereafter, overlapping, intercrossed, diseased, dried and weak branches are to be removed after their harvest season is over. In old and irregular bearing trees, Tamil Nadu Agricultural University recommends a kind of severe pruning to make it a regular bearer. In this method, few internal branches are removed only once to have open centre.

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Table 16.1 Important mango varieties.

S. No	Variety	Brief description
1.	Neelum Syn: Kasaladdu	Appreciably a regular bearer, quality fruits, precocious in bearing, each fruit weighs 200-250 g, taste is good with slightly acidic.
2.	Bangalora Syn: Kallamai or Kilimooku or Totapuri	Regular bearer, very good yield, early yielder in South India, large fruit weighing 400-450 g, shape is typical oblong, with a prominent beak, pulp is excellent for processing.
3.	Rumani	High yield, good keeping quality, fruit quality is only moderate, it remains sour if harvested slightly early.
4.	Alphonso Syn: Gundu, Khader, Badami	Fruits with excellent flavour, shape, size and colour, good keeping quality, each fruit weighs 250-300 g, very good variety for canning, flavour stable, suitable for export, limited adaptability, biennial in habit, flesh develops spongy tissue.
5.	Dashehari	Most popular variety in North India, excellent fruit quality, good keeping quality, each fruit weighs 200-250 g, biennial habit, external appearance not very attractive. Susceptible to mango malformation.
6.	Mulgoa	A late season, shy bearing variety, fruits are large, each fruit weighs 450-500 g, taste is excellent with good keeping quality.
7.	Langra	Most popular variety in North India, wide adaptability, fruits are medium to large, each weighing 250-300 g, excellent in quality, biennial in habit, poor keeping quality.
8.	Paiyur-1	A clonal selection from Neelum, developed at Regional Research Station, Paiyur (T. Nadu). Trees dwarf, suited for high density planting, fruits are medium sized, each fruit weighing 150-200 g.
9.	Niranjan	A clonal selection developed at Marathwada Agricultural University, Parbhani. An off-season bearing variety, it flowers during June-July and matures in October, yields 600 fruits/tree, each fruit weighs 165 g.

and the terminal whorl of shoots are thinned out annually during August-September so as to retain only one or two healthy shoots (Fig 16.1). This has resulted in greater yield than in previous years in Cv. Mulgoa. Recently, another method of pruning is recommended. It involves heading back of flowering shoots after harvest below a node. This helps to produce 3-5 new shoots below the pruned node which will bear the fruit buds during the next season by Nov-December. This pruning should be followed by immediate irrigation and thereafter also at regular intervals to get desired effect.

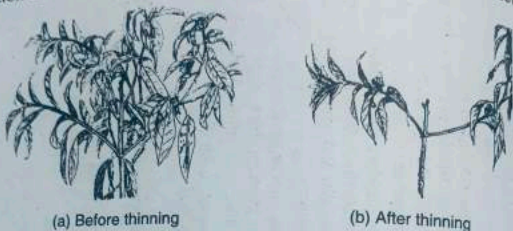


Fig 16.1 Cluster thinning of shoots in mango.

### Manures and Fertilizers

The following quantities of manures and fertilizers are applied

Manures and Fertilizers (Kg/tree)	1 <sup>st</sup> Year	Annual increase	6 <sup>th</sup> year onwards
FYM	10.00	10.00	60.00
N	0.20	0.20	1.00
P	0.20	0.20	1.00
K	0.25	0.20	1.50

For the bearing trees, half the quantity of NPK is applied after harvest and the remaining half of NPK besides full quantity of FYM are applied during September-October. Application of manures and fertilisers is usually done in a ring around the tree. Such rings are dug around the base of the tree 2.0 meters away from the main trunk with a depth upto 15 to 20 cm.

### Intercropping

The intercrops chosen for mango should be separately irrigated or fertilized so as not to compete or clash with those of mango. Vegetable crops like onion, tomato, radish, beans and fruit crops like papaya, guava can be grown in the initial years and with the increasing age of mango plants, area under intercrops should be progressively decreased to minimize competition.

### Irrigation

Mango needs 125 to 170 cm of precipitation annually; but on account of deep tap root system, it requires little irrigation after the first few years. When the planting is done in spring, the young plants require irrigation fourth or fifth day during the first summer till the rains break. During rains, irrigation should be given only if the soil dries up. The bearing plants are often given no irrigation but irrigation during flowering reduces fruit drop and gives larger fruits. Irrigation if withheld during the preflowering phase increases flowering, otherwise, irrigation during this period is likely to promote vegetative growth. Trees receiving heading back pruning needs to be provided 2-3 irrigation at that time to induce new shoot formation.

### Cropping

Fruit buds are borne on past season shoots terminally in mango and is a pure bud. The inflorescence is a large terminal panicle which carries both male and bisexual flowers. Each panicle carries 300 to 4000 flowers in which the percentage of perfect flowers vary from 2.0 to 65% depending upon cultivars. Nectar is produced to attract insects. Fruit is a fleshy drupe. Fruit bud differentiation occurs between October to December and flowering takes place as early as November-December in A.P, December-January in Tamil Nadu, February-March in Northern India. The duration of flowering is very short, usually of 2 to 3 weeks. The fruitset varies with cultivars and generally in a shy bearing cultivar, 0.1% is considered as optimum. Many chemicals are recently recommended to induce flowering and fruit set. Potassium nitrate ( $KNO_3$ ) at 1% concentration sprayed at the time of flowering/fruit set stage improved the earlier flowering and fruiting.

Due to the various causes, fruitdrop occurs in mango rather at a higher rate even upto about 99 percent in various stages of growth, more during the initial four weeks. The extent of fruits drop can be reduced significantly by (a) Regular irrigation during the fruit development period, (b) Timely and effective control measures against major pests and diseases, and (c) Through the application of growth regulators like NAA (50 ppm) and 2,4-D (20 ppm) during off years about six weeks after fruitset.

Grafted mango trees start bearing from the age of five years and commercial crops can be obtained in about seven years. Seedlings take nearly 10 years. A year of good crop may follow one or more years of poor or no crop. The year in which good crop is obtained is referred to 'on year' and the year in which poor or no crop is obtained is referred to 'off year'. This phenomenon is called 'irregular bearing' or 'biennial bearing'. Various factors are reported to be responsible for this phenomenon. They are:

1. **Climatological factors:** High humidity, heavy wind and low temperature during the 'on' year convert into an 'off' year directly or indirectly by promoting the incidence of diseases like powdery mildew or anthracnose.
2. **Age and size of shoots:** It is generally found that the flowering shoots should have attained certain amount of physiological maturity atleast 8-10 months old. But this hypothesis does not hold true in many cases.
3. **Carbon/Nitrogen ratio:** It is generally indicated that higher starch reserves, total carbohydrates and C/N ratio favour flower bud formation and anything to alter this or to favour higher N content may tend favoring vegetative growth.
4. **Hormonal balance:** Physiological studies on flowering in mango established that higher level of auxin-like substances and an inhibitor (ABA) and lower level of gibberellin like substances are vital for a floriferous shoots in mango. This situation is often altered by the development process as there is an inhibiting-influence of developing fruit on vegetative growth.

### Control of Biennial Bearing

1. Proper care and maintenance of trees in a healthy condition may help to reduce erratic or irregular bearing but it may not induce regular bearing in biennial cultivars.
2. Deblossoming during the 'ON' year so as to obtain some crop every year has been recommended but the response to this practice depends on the cultivar, stage of the panicle etc.,
3. Use of growth retardants: spraying of growth regulators like etrel during 'OFF' years to induce flowering is recommended which results in some success in few cases not in all the cases. Similarly, application of Paclobutrazol, a anti-gibberellin synthesis, when drenched around the trees @3-5ml/tree during August/September induces the trees to flower within 100-120 days of application. Drenching process involves dissolving the growth retardant in 6 litres of water and pouring it around the trees in drip circle in previously made 5-6 holes using the crowbars. This operation should follow regular irrigation. Use of paclobutrazol is recommended wherever the trees are in healthy stage with regular manuring and irrigation.
4. Growing of regular bearing cultivars like Neelum, Bangalora, Ratna, Sindhu etc.



## Harvesting

The mango fruit ripens in about 90 days after flowering. All fruits on a tree is generally harvested when a few fruits ripen naturally and fall from the trees. Another criterion for harvesting is a slight change of colour in certain varieties. The fruit is harvested with a harvesting pole.

The harvested fruit takes about five days under tropical condition for ripening and becomes over-ripe after seven or eight days. Usually, merchants ripen the fruits in closed but well ventilated store-houses. The fruits are placed in a single layer over paddy or wheat straw spread 6 to 8 cm thick on the floor of the house. The fruits can be ripened quickly in about two days if a small piece of calcium carbide is placed in a covered heap of mangoes. The acetylene gas emitted by the calcium carbide gives the fruit good colour but the rating quality remains poor. This technique of ripening is now banned on health ground, instead, artificial ripening using ethrel is recommended. Ethrel at 2500 ppm kept in a beaker in the ripening room with a pinch of Sodium or Potassium Hydroxide pellets evolve the ripening gas, ethylene, which induces ripening in 24 hours with good colour and quality. Fruits ripened in the trees are unsuitable for storage due to their high susceptibility to low temperature injury. Most varieties are best stored under cold storage at 5.6 to 7.2°C with 85 to 90 per cent relative humidity. The cold storage fruits once brought outside at 15.5 to 21°C will ripen in about six days. The yield of mango varies greatly. The average yield in our country is about 7.5 to 10 tonnes per hectare. The number of fruits per tree during its steady bearing age (i.e., after 20 years) generally varies from 1000 to 2000 fruits.

## Physiological disorders

1. **Spongy tissue:** This disorder is common in the fruits of Alphonso wherein a non-edible, sour, yellowish sponge-like patch with or without air pockets develop in the mesocarp of the affected fruits during ripening. Externally, the affected fruits present a healthy appearance. The incidence is reported to be more if fruits are harvested at full maturity than at 3/4th maturity. Higher temperature coupled with radiation is believed to induce more of this problem. No other exact cause for the malady is known as on today. Mulching using organic materials along with irrigation can reduce this incidence.
2. **Mango malformation:** This is a serious one in North India than in the South. It is of two types *viz.*, vegetative and floral. The former is more common in the nursery seedlings and young plants, wherein malformed vegetative shoots are characterized by the appearance of small leaves in whorls on thick; stunted shoots which may crown the

apex, giving a bunchy-top like appearance. In the case of floral malformation, the floral parts are transformed into compact masses of sterile flowers appearing in the form of a bunch, causing total loss to the crop. Various causes such as cultural practices, nutritional practices, mites, virus, fungi etc., have been attributed, but the precise causal organism/substance is yet to be established. Malformed trees can be improved by a single spray of NAA (200 ppm) in the first week of October and deblossoming and at the budburst stage.

- 3. Black tip:** It refers to the development of a small etiolated area at the distal end of the fruit which gradually spreads and turns black and covers the tips completely. Such black tipped fruits fetch very low market price. This disorder is prevalent in Punjab, U.P., Bihar and West Bengal if orchards are located near the brick kilns (within a distance of 1–1.5 km). Gases like carbon-di-oxide, sulphur-di-oxide and acetylene which constitute the brick kiln fumes are reported to cause the above symptoms. Spraying borax (0.6%) and caustic soda (0.8%) thrice, *i.e.*, before flowering, during flowering and at the fruitset stage are reported to prevent the disorder as these chemicals are basic

# GRAPES

**BOTANICAL NAME-VITIS VINIFERA**

Scientific classification:-

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Vitales

Family: Vitaceae

Genus: *Vitis* L.

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## INTRODUCTION:-

- ▶ It is a deciduous crop. Its natural habitat is temperate climate
  - ▶ It was introduced into north India from Iran and Afghanistan in 1300 AD by the Muslim invaders; and into south India in 1832 by the Christian missionaries from France.
  - ▶ However, grape was known in ancient India though it was not commercially cultivated until the 14th century.
  - ▶ Wild grapes grown in Himachal Pradesh were used to prepare local wine.
  - ▶ Presently grape cultivation is concentrated in the peninsular India (surrounded Arabian Sea, Bay of Bengal & Indian Ocean), accounting for 90% of the total area.
  - ▶ Major grape-growing states are Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, and the north-western region covering Punjab, Haryana, Delhi, western Uttar Pradesh, Rajasthan and Madhya Pradesh.
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# VARIETIES:-

## Anab-e-Shahi:-

- ▶ This variety is grown in the states of Andhra Pradesh, Punjab, Haryana and Karnataka.
- ▶ Juice is clear and sweet with TSS 14-16%.
- ▶ It is highly susceptible to downy mildew.
- ▶ Average yield is 35 t/ha



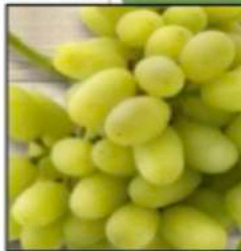
## Bangalore Blue:-

- ▶ This variety is grown in Karnataka
- ▶ Berries are small sized, dark purple, ovoid, seeded with thick skin.
- ▶ Juice is purple coloured, clear and pleasantly flavoured with 16-18% TSS.
- ▶ . It is resistant to anthracnose



### Thompson Seedless:-

- ▶ This variety is grown in Maharashtra, Andhra Pradesh, Tamil Nadu and Karnataka.
- ▶ . The juice is straw coloured, sweet with a TSS of 20-22%.
- ▶ Variety has a good keeping quality and is used for table purpose and raisin making.
- ▶ Average yield is 20-25 t/ha



### Sharad Seedless:-

- ▶ It is a variety local to Russia called as Kishmish Chorni
- ▶ The berries are seedless, black, crisp and very O sweet.
- ▶ The TSS is upto 24 Brix.
- ▶ It has a good shelf life.
- ▶ It is grown mainly as table purpose variety.



### Black Seedless Grapes:-

These grapes are seedless,  
Black and make very good  
Table and Wine Grapes.



### Red Flame Seedless Grapes:-

Are the result of a cross between Thompson,  
Cardinal and other grape varieties.  
Flame grapes are one of the most popular  
varieties along with Thompson grapes .These  
grapes are seedless, sweet-tart, and crunchy.



## AREA AND PRODUCTION:-

In terms of production, grape occupies the 7th position (only 0.02% of total fruit production) among all fruits, but it has the highest productivity among all fruits.

Variety	Area (ha)	Production (t)
Anab-e-Shahi (white, seeded)	3,000	135,000
Bangalore Blue Syn. Isabella (black, seeded)	4,500	180,000
Bhokri (white, seeded)	500	15,000
Flame Seedless (red, seedless)	500	10,000
Gulabi Syn. Muscat Hamburg (purple, seeded)	1,000	30,000
Perlette (white, seedless)	1,500	60,000
Thomson Seedless and its mutants (white, seedless)	22,000	550,000
<b>TOTAL</b>	<u>33,000</u>	<u>980,000</u>



# CLIMATE:-

- ▶ Grapes generally require a hot and dry climate during its growth and fruiting periods.
- ▶ It is successfully grown in areas where the temperature range is from 15-40 °C.
- ▶ High temperatures above 40 ° C during the fruit growth and development reduce fruit set and consequently the berry size.
- ▶ The fruitfulness of buds is influenced by light.
- ▶ Light intensity of 2,400-ft. candle is essential for optimum growth.
- ▶ It is most successfully grown at elevations ranging from 200-250m above mean sea level
- ▶ Area with annual rainfall not exceeding 900mm well distributed throughout the year is ideal.
- ▶ However, rainfall during flowering and fruit ripening is not favourable as it leads to the spread of downy mildew disease.

## SOIL:-

- ▶ Grapes can be cultivated in variety of soils including sandy loams, sandy clay loams, red sandy soils, shallow to medium black soils and red loams.
- ▶ . The soil should be well drained, having good water holding capacity and devoid of any hard pan or impervious layer in the top 90-cm, with water table at least 6.5m below.
- ▶ soils having pH range of 6.5-8.0 are considered ideal.

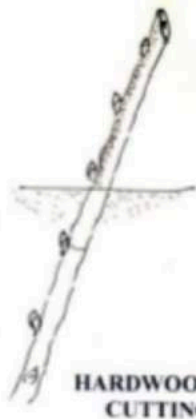
Major Grape Growing Regions	Soil Types
Uttar Pradesh & Haryana	Sandy loams sandy clay loams.
Andhra Pradesh	Red sandy soils.
North interior Karnataka & Maharashtra	Shallow-medium deep black.
South interior Karnataka & Tamil Nadu	Red loams

## PROPAGATION:-

- ▶ Grapevines are propagated by seeds, cuttings, layering, budding, or grafting.
- ▶ Grape is mostly propagated by **hardwood stem cuttings**.
- ▶ The diameter of cuttings should be 8-10mm. Cuttings are mostly obtained from October pruning in the peninsula.
- ▶ Quick dip method is preferred. Cuttings after treating with IBA should be planted in the nursery or directly in the field.

Spacing:- Spacing varies with variety and soil fertility. Generally under organic cultivation, spacing of 2.5 m x 1.5 m, 2.75 m x 1.50 m and 3.0 m x 1.5 m are followed

Planting:- Pits of 90 cm x 90 cm x 90 cm are dug and filled with soil and well decomposed FYM/Compost @ 55 t/ha. The pits are then irrigated in order to allow the soil to settle. Rectangular system of planting is adopted for growing grape. (The best season for planting the rooted cuttings of cultivated varieties in the main field is **September-October** whereas for rootstocks it is **February-March**)



HARDWOOD  
CUTTING

## LAND PREPARATION AND VINE ESTABLISHMENT:-

The land is tilled and laid into plots of 120 m x 180 m separated by 3 m wide roads. Land within a plot is levelled perfectly to have a gradient of less than 1 percent in any direction to ensure uniform discharge of water through the emitters of drip irrigation systems.

Trenches of 75 cm width, 75 cm depth and 118 m length in a north-south direction with a gap of 3 m between trenches are opened with heavy machinery. They are closed with topsoil, up to a height of 45 cm after 15 days exposure to sun. The remaining gap is filled with a mixture of soil, cattle manure, single superphosphate, sulphate of potash and micro-nutrients. Usually, 50 kg of cattle manure, 2.5 kg of superphosphate, 0.5 kg of sulphate

## IRRIGATION:-

Grape requires less water during fruit bud formation and more water during berry growth. Reduced irrigations during ripening improve the quality. Drip irrigation is becoming more popular. Water requirements under drip are:

- ▶ 1-40 days after summer pruning -48000-60,000 liters/day/ha
- ▶ 41-100- days after summer pruning-24000-32,000/litres/day
- ▶ 101-winer pruning days after summer pruning- 15000-20,000 liters/day
- ▶ 1-45 days after winter pruning 20,000-24,000 liters/day
- ▶ 46-75 days after winter pruning -20,000-24,000 liters/day
- ▶ 76-100 days winter pruning 48,000- 60,000 liters/day
- ▶ 101- harvest summer pruning 36000-48000 liters/day

# TRAINING OF VINES:-

Many training systems are in vogue in India, but the most popular are Bower, Telephone and Flat Roof Gable systems

**1. Bower System:** Owing to the high productive potential, bower was a very popular system of training in the past. It is highly suited for vigorous varieties like Anab-e-Shahi, Bangalore Blue and Gulabi. But in varieties like Thompson Seedless and Tas-A-Ganesh where vine vigour and excessive foliage density affects the productivity adversely, this system is not popular.

**2. Telephone System:** T-trellis is used in this system of training. With three top wires and 'T' shaped supports, the trellis looks like a telephone pole and wires. This system is followed for moderately vigorous varieties like Thompson Seedless and other seedless cultivars in about 25-30 percent of the vineyard area in Maharashtra.

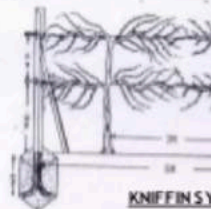
**3. KNIFFIN SYSTEM:** Here, 2 trellies of wires are strung supported by vertical posts. The vine is trained so that it bears 4 canes one along each wire and bearing shoots can hang freely. In this system, 2 wires are stretched horizontally at the height of 0.90m and 0.60m height. Vines are planted at 2-4m distance between 2 poles supported by sticks to allow single stem to grow with one arm horizontally to either side so that each arm having with the results into 4 arms.



Bower System



Telephone System



KNIFFIN SYSTEM

Vine trained on Kniffin System

## PRUNING IF VINES:-

- ▶ Three distinct pruning practices are in vogue in relation to cropping in the three **grape growing regions of the country.**
- ▶ In the sub-tropical region, vines are pruned **only once in December** and the crop is harvested once. Half of the canes are pruned to renewal spurs and the rest to fruiting canes (3-4 nodes for Perlette).
- ▶ In hot tropical regions, vines are **pruned twice but only one crop** is harvested. All canes in a vine are pruned back to single node spurs in March-May to develop canes and the canes are forward pruned in October-November for fruiting. The number of nodes retained on a cane varies with the variety and cane thickness. There is no scope to prune earlier than October and later than November due to unfavourable weather conditions
- ▶ In the mild tropical region, vines **are pruned twice and the crop is harvested twice.** In varieties like Gulabi and Bangalore Blue, which are fairly resistant to rain damage and in which fruit bud differentiation is not impaired by cloudy weather and rains, pruning is done at any time of the year. As a result, five crops are harvested every two years.

## THINNING OF FRUITS

The removal of flower clusters before flowering or parts of such clusters after fruit set is called thinning.

Types of thinning methods:

1. Flower cluster thinning
  2. Flower thinning
  3. Cluster thinning
  4. Berry thinning
- Thinning of fruits

Shoot pinching: Shoot pinching is done when the main shoot attains 7-8 leaf stage. During pinching the tip of the mature shoot is pinched by retaining only five nodes. As a result the terminal bud along with 1-2 laterals resumes growth. These laterals are called as sub-canes. Buds up to third node from the base on the sub-cane were found to be invariably fruitful resulting in 2-3 clusters/cane

Girdling: Girdling is removing a narrow ring of 4-5 mm width of bark entirely around some member of vine like arm or cane. It is done to improve fruit set increase berry size & advance maturation.



## MANURING:-

Manuring is done by applying FYM at the rate of **55 t/ha**. Biofertilizers like Azotobacter, Phosphate Solubilizing Bacteria (PSB), Effective Microorganism (EM), Neem cake and vermiwash are being used to supplement the nutrient requirement of crop. Trichoderma, Azotobacter and PSB are applied at the rate of **25 g/plant**. Neem cake is applied at the rate of **1.25 t/ha**. Jeevamrut is prepared by adding **10 kg** cow dung, **5 l** cow urine, **2 kg** black jaggery, **2 kg** ground pulses powder, handful of bund soil in **200 l** of water. The solution is kept for 2 to 7 days in shade for fermentation. During the fermentation, the solution is stirred daily. To improve the quality of grapes, a solution of sugar, humic acid and coconut water is sprayed at bud development stage.

## WEEDING:-

In the vineyards, weeding is generally done mechanically. Frequent weeding is required to allow feeder roots to absorb the nutrients and moisture without any competition. Bullock drawn or tractor drawn implements can be used for inter-cultivation and weed control. Weeding is done 3-4 times in a year.

# PEST AND DISEASES

The major pests affecting the grape crop are flea beetles, thrips, mealy bugs and leaf hoppers. The major diseases are downy mildew, powdery mildew and anthracnose. The schedule of plant protection measures are given below:

<u>PEST AND DISEASES</u>	<u>PLANT PROTECTION MEASURES (SPRAYING OF)</u>
Downy mildew or powdery mildew	Trichoderma, 1% Bordeaux mixture + Dasparni arka + Gomutra
Mealy bug	Cowdung urine
Thrips	Dasparni arka
Anthracnose	Solution of acacia leaves

# HARVESTING

- ▶ Grapes should be harvested only after ripening. The heat requirement of most of varieties ranges from 2900 to 3600 units.
- ▶ The grape berries can be kept without spoilage for 7 days at room temperature.
- ▶ Grapes can economically be stored upto 40-45 days in cold storage. The optimum storage temperature recommended is  $-2$  to  $-1.5^{\circ}\text{C}$ .
- ▶ Raisins from grapes form an important by product industry in several grape growing countries in the world.



# YIELD

- ▶ Seedless : 15t / ha / year
- ▶ Muscat : 30t / ha / year
- ▶ Pachadraksha : 40t / ha / year
- ▶ Anab-e-Shahi and Arka hybrids : 20 t / ha / year

## Post harvest management:

**Grading** :It is mainly done based on the size and colour of the grapes to maintain uniformly berries in a package.

**Pre-cooling**: Pre-cooling is done to reduce the field heat, moisture loss and subsequently increase the storability of grapes.

- ▶ Fruit needs to be pre-cooled to a temperature below 4.40° C within six hours after harvesting in cold rooms, forced air coolers, refrigerator cars and tunnels.

## STORAGE:-

- ▶ The shelf life of grapes is only one week at room temperature
- ▶ The storage life of grapes can be increased by employing suitable means to reduce desiccation, decay due to growth of fungi .
- ▶ Pre-cooled grapes are packed in corrugated boxes in 4.5/5/9 kgs and kept in cold storage Boxes that are specially designed with perforations to allow cool air to pass through
- ▶ The boxes are palletized to facilitate easy handling .

## PACKAGING:-

- ▶ Table grapes meant for local market are picked and packed directly in containers in the field
- ▶ Raisin, juice and wine grapes are subjected to suitable treatments and processed
- ▶ Different types of containers are used for packing grapes in India
- ▶ For the European market, bunches of grapes of approx. 300 to 700 gms. are packed in food grade plastic pouches .

## TRANSPORTATION:-

- ▶ Table grapes are mostly transported through roadways for local, short distance or long distance markets
- ▶ About 5 % of the produce is transported by rail and the quality of produce transported through air cargo is almost negligible
- ▶ The cold chain for grapes is maintained meticulously right from pre-cooling state to selling of the same
- ▶ The produce for international market is sent through refrigerated vans by road upto the sea port and then again by sea in refrigerated containers in the ships to their respective destination

## CLASSIFICATION OF ROSES

- **Hybrid tea:-** (Hybrid perpetual xTea roses)  
Most popular rose. Bears large & highly centered flowers, borne singly at the end of a stem.



First variety:- La France created in 1867. Some known varieties are Melody, Darling, Sonia, Only Love etc.

**Floribunda:-** (Hybrid tea x Poliantha) They combined the beautiful forms of the Hybrid Teas with the perpetual flowering habit of the Polyanthas. Flowering in clusters with small size and open centre. Good for garden display.



Important Varieties are :- Kiss, Florence , Mercedes, Jaguar etc.



- **Grandifloras:** Mainly obtained from crosses between Hybrid Tea and Floribunda type. Produces large number of flowers in cluster with fine form. Eg: Montezuma (1955), Queen Elizabeth (1954),
- **Miniature / Button Roses:** Popularly known as Baby roses with small leaves & flowers. They are hardy and good for pot culture. Multiplied by cuttings as well as budding on root stocks.



- **Climbers and Ramblers:** They bears large clusters of small, single or double flowers, mainly belong to two groups. Used for training on arches, pergolas.

- **Cabbage roses:**

The cabbage rose is called such due to their numerous petals that create a large, full bloom resembling a cabbage . They belongs to species *R.centifolia*.



- **Scented Roses**

- **Musk roses:** *R. moschata* is the musk rose, derived its name from the musky fragrance of the flowers. They make good shrub roses as well as pillar roses.
- ***Rosa* × *damascena*** more commonly known as the **Damask rose**, or sometimes as the **rose of Castile**, is a rose hybrid, derived from *Rosa gallica* and *Rosa moschata*

The flowers are renowned for their fine fragrance, and are commercially harvested for rose oil used in perfumery and to make rose water and "rose concrete". The flower petals are also edible. They may be used to flavor food, as a garnish, as an herbal tea,

and preserved in sugar as gulkand. *Rosa Damascena* is grown on commercial-scale to produce concentrates of the aromatic principles and is recognised as the best commercial species of the fragrant roses.

- **Varieties** Indica, Jwala, Super jwala, Himroz, Hot himroz

### **Morphology of *Rosa × damascena***

- *R. damascena* is a perennial bushy shrub reaching approximately 1 to 2 meters in height with large, showy and colorful flowers. The leaves are imparipinnate and compound with 5-7 leaflets .
- Its life span is up to 50 and economic period is about 25 years. Gestation period is three years for attaining economic production level. Its propagation is mostly by cutting and using Suckers but micropropagation is a developing propagation method .

**Flowering:** Summer Damask rose flowers from early March to mid of April in North Indian plains, from 10th April to 20th May in mid hills of Himachal Pradesh and early May to early June in Kashmir Valley. Exact flowering time depends upon prevailing temperature in the locality.

Autumn Damask rose (*Rosa damascena* var. *bifera*) also flowers during September to November in sub-tropical plains but yield of flowers is comparatively lower than the main flowering season. Sporadic flowering may continue throughout the year in some cases. The total period of flowering is about 25-35 days but major part of the yield (about 75%) is received within 15 days of peak flowering period.

- **PROPAGATION OF ROSE**

Commercial method of propagation is by cutting and budding.

- Budding Type:- **T budding**

### **COMMON ROOT STOCKS:**

1. *Rosa bourboniana* (**Edourad rose**) –Popular in northern plains of India. They have straight and Long stem.

2. *R. canina inermis* (**Dog rose**) : popularly used in Europe and India, very hardy and is an excellent rootstock.

3. *R. indica var. odorata*: Tolerant to powdery mildew & other insects. Resistance to extreme soil conditions.

4. *R multiflora var. Inermis* : Good for outdoor roses. Resistant to nematodes.

In Northern India Plains Budding is done in Nov.-Dec.

- **LAYOUT OF BEDS:**

The width of the bed should be such that operations like weeding, hoeing forking, cutting of flowers, etc. can be done from both the sides of the bed without stepping in the bed.

Shape should be Rectangular with width 1.2-1.6 m and the length depends on the size of the garden.

**Ideal method of  
planting of rose double  
row system**



**SPACING:** It varies from types of roses, soil to soil and place to place and purpose of planting.

Generally 60×60 cm (Row-Row and Plant-Plant) or 60×30 cm is adopted.

**IRRIGATION:**

- In general water the rose beds once in a week or 10 days in winter and twice a week during the summer season.

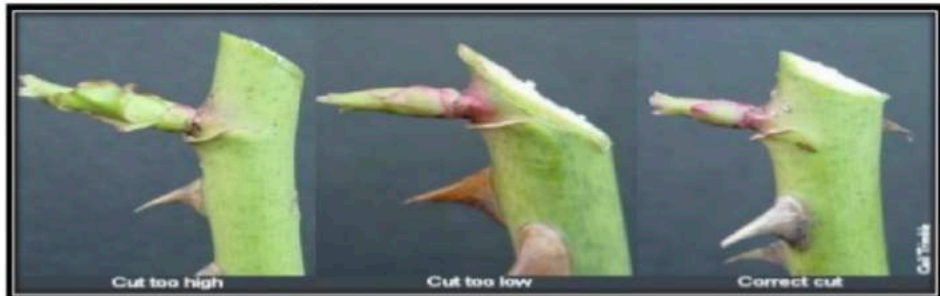
**Nutrient management**

Farm yard manure @ 18-20 tonnes/hectare and 100-125 kg NPK should be applied at the time of transplanting of rooted cuttings into the pits. After two years, 160-200 kg nitrogen, 60-90 kg phosphorus and 40-60 kg potash per hectare per annum are needed .



# Pruning

- Pruning is the judicious removal of plant parts to induce production of quality flowers and to maintain vigour of plant.
- Generally pruning is done only once in a year after monsoons.
- All cuts are made at an angle of 45 degree about 5cm above a strong eye.



## SPECIAL PRACTICES.

### 1. BENDING OF ROSE

- Bending helps in maintaining enough leaf area on the plants. The maximum leaf area is required to build up a strong root system. Leaves are important for producing carbohydrates



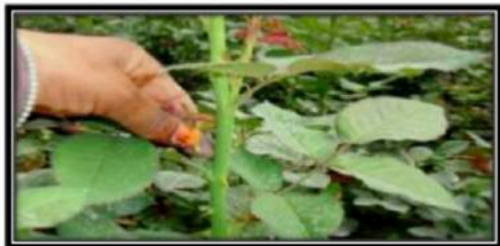
## 2. Disbudding

Disbudding is the practice of removing undesirable buds. It is achieved by placing the bud between thumb and index.



## PINCHING AND REMOVAL OF WILD ROOT STOCK OF ROSE

- Removal of part of terminal growing portion of stem is called pinching.
- This operation **reduce plant height** but **promotes auxiliary branching**.
- Chemical pinching also done by using BA, Promilin(BA+GA<sub>3</sub>), ethephon etc.



## Postharvest handling

Roses must be placed in a bucket of water inside the polyhouse immediately after harvesting and transported to cold storage (2-4°C). The length of time depends upon the variety and quality of the roses . The flowers are graded according to the length. It varies from 40-70 cm depending on the variety and packed in 10/12 per bunch.

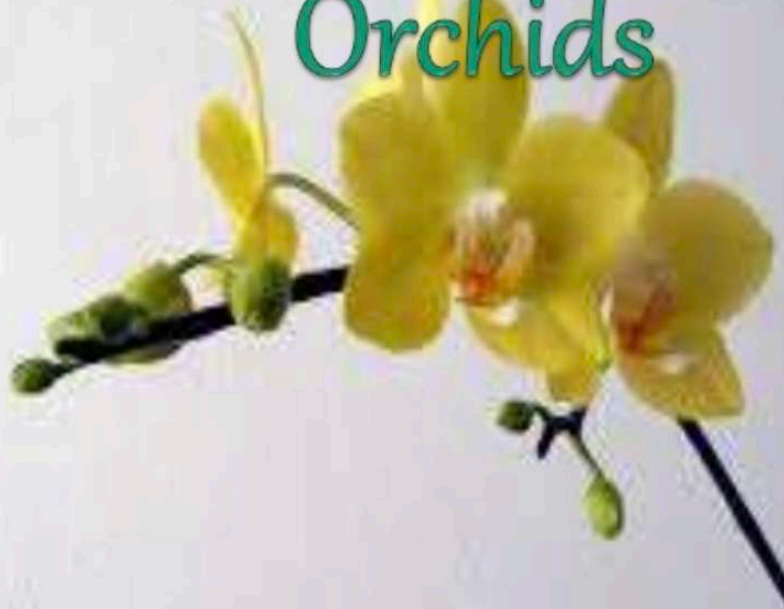
# INSECT PESTS ATTACKING ROSE

Insect-Pest	Symptom	Control
Aphids (Jan.-Feb)	Suck the cell sap discolour the leaves flower buds fall and lose their beauty	Spraying 0.1% Malathion or Metasystox (0.1-0.2%)
Red Scale (Aug.-Sept.)	The branches covered with reddish-brown encrustations under which the insect sucks the juice of the plants	Spraying Malathion (0.1%) in April and again in October.
Chaffer Beetel (Aug.-Sept.)	Cut away the leaves	Monocrotophos (1ml/l) or Dimethoate (1.5 ml/l)

# DISEASE AFFECTING ROSE

Disease	Symptom	Control
Die Back	The drying up and blackening of pruned shoots start from top to downwards	Bordeaux paste, application of optimum dose of fertilizer
Black Spot	Conspicuous circular black spot with fringed margins appear on either side of leaf; leaves become chlorotic, dry up and prematurely drop	Carbendazim (1g/litre of water) or Captan (0.2%) fungicide at fortnightly intervals
Powdery Mildew	Infected leaves turn purplish and drop Flower buds may fail to open.	Dusting with 80% Sulphur or spraying 0.1% Kerathane fungicide at fortnightly interval.

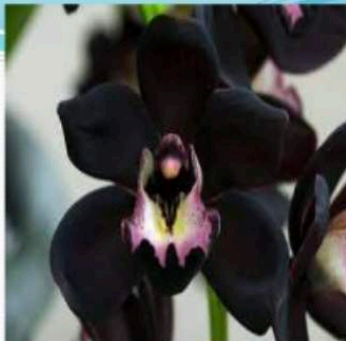
# Orchids





## What are orchids?

- The family Orchidaceae is one of the three largest families of flowering plants.
- Orchids are monocots.
- They exhibit a wide range of diversity in form, size, colour and texture of flowers beyond the imagination of human mind.
- They are of immense horticultural importance and play a very useful role to balance the forest ecosystem ( Kaushik, 1983)



Major characteristics of Family Orchidaceae according to Dr. Robert L. Dressler, 1989 are as follows

- Most orchids have only one stamen.
- Stamens and pistil are partly or completely united which is called gynostemium or column.
- The median petal opposite to the fertile stamen is often greatly modified and called the labellum or lip.
- A modified stigma called a rostellum plays a role in transfer of pollens.
- Pollen grains are in masses, called pollinia.

## Orchid can be divided into two basic growth types

- Monopodial (one footed) have a main stem which continues to grow year after.

(Eg. Phalaenopsis, Renonthera, Vanda, etc.)

- Sympodial (many footed)

The Plant produces a series of adjacement shoots which grow to a certain size, bloom, then stop growing to be replaced by the next growth.

(Eg. Cattleya, Cymbidium)

## Orchids can be divided into four types according to growing condition

### Grouping

1. Epiphytes - Air Plants, which grow on trees
2. Lithophytes - The rock growers, cling to the surfaces of rocks.
3. Saprophytes- Those that grow in mulch, often on the forest floor,
4. Terrestrials - Which anchor themselves in soil or sand.

As most Orchids are epiphytes, they can be grown in tree bark, crumbled charcoal, pebbles or on wooden or cork plaques



## Orchids and its uses

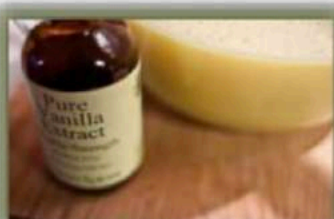


### Orchids as medicine

- In China *Dendrobium* is used as a source of tonic, astringent, analgesic and anti-inflammatory substances.
- In India, in the preparation of 'Chyavanprash', four orchids are used.
- Round the world it is used to care rheumatism, malaria, tuberculosis, cuts, wounds and burn injuries, asthma and several other ailments.

# Orchids as spice, flavouring agent and food

- The use of vanilla (vanillin) extracted from the pods of *Vanilla planifolia* is used as a flavouring agent in chocolates and ice creams.
- The popular beverage called 'Faham' or 'Madagascar Tea' on the islands of Madagascar is prepared from the orchid *Jumellea fragrans*.
- In N. America, bulbs and tubers of orchid spp. were consumed.



## Other uses



- Pendants, earrings or pins are made by casting a metal mould on it and then by gold or silver plating the same is common in Singapore.
- *Phaius tankervilleae* is for make fishing nets in India.
- Some orchid sp. Are used as colouring agent.
- *Rhynchostylis retusa* is used to adorn young ladies hair in NE India.



## Some of the common orchid species

### 1. Cattleyas

*Cattleyas* were discovered in 1824 when William Cattley received a sickly plant of *Cattleya labiata* used as packing material in a shipment of orchids and nursed it back to health. When it bloomed, it created quite a stir! *Cattleyas* are still among the most popular types of orchids today.





## 2. Cymbidium

*Cymbidium* orchids are among the showiest types of orchids, with sprays with numerous large, colourful flowers, usually in winter. These plants are quite popular, and some have been cultivated for thousands of years. They need cool temperatures to initiate blooming.



### 3. *Dendrobium*



- *Dendrobium* is a large genus, with about 1200 species. They tend to like bright light, but most other care requirements have exceptions. They are one of the most popular types of orchids, and many are quite beautiful.

## 4. Lady Slipper Orchids

- Lady Slipper Orchids is a catch-all term for a few types of orchids, typically referring to any plant in tribe Cypripedioideae, which includes the genera

*Cypripedium*,

*Paphiopedilum*,

*Phragmipedium*,

*Mexipedium* and *Selenipedium*.

These types of orchids all have a "slipper", a pouch-shaped labellum in which their pollinating insects get stuck.



## 5. Paphiopedilums

- *Paphiopedilums* are slipper orchids that come from southeast Asia. Many have attractive, mottled leaves, too! They grow well in relatively low light, which can be convenient for indoor orchid. They are quite easy to grow.



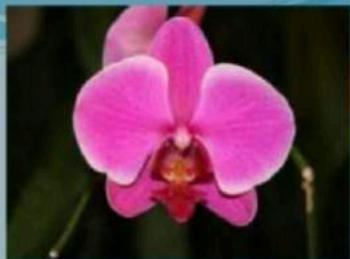
## 6. Phaius

- *Phaius*, including *Phaius tancarvilleae*, the Nun Orchid, is a genus of terrestrial orchids. They are quite easy to grow, and have numerous (usually 10-20 per stem) large and showy flowers, with tube-like **labellums**.



## 7. Phalaenopsis

- *Phalaenopsis*, the Moth Orchid, is one of the most commonly available and easiest to grow orchid genera. It is an especially good choice for **beginners** to orchid growing. They have large, showy flowers that come in a wide variety of colors. Most species have several flowers per stem, but some have more, and others have as few as one or two. There are a great many hybrid varieties on the market.



## 8. Vandas

- *Vandas* are beautiful orchids that like lots of light and warm temperatures. They tend to have large, round flowers. Most other types of orchids in the *Vanda* alliance like similar care.



# How to Care Orchid

- Indirect sunlight is ideal for Orchid
- Seedlings requires less sunlight than adult plant.
- Very poor light tends to produce weak plants and retards flowering
- Optimum requirement varies between species to species
- *Cyrtopodium* and *Phalaenopsis* required only 200 – 300 foot candles.
- *Vanda* & *Aranda* best under 800 foot candles
- Growers have used shadenets in 35% to 85% shade percentage to grow Orchids of different genera. • Orchids in nature grow pretreated from the tropical sun by the shades of trees.
- Under controlled conditions the Orchids can be grown in Orchid house.



- Running North to South and made from materials like split bamboo, glass, shade nets etc.
- Central trunk filled with water or by using artificial fogging nozzles helps in increasing humidity.
- All types of Orchids cannot be grown under one roof.
- Tropical Orchid enjoy humid, warm atmosphere.
- Temperate Orchid should be growing in cool houses.
- Proper ventilation is must to provide fresh air.
- Orchids dislikes sudden change in temperature., the best suitable range is 18 oC to 30 oC
- However Orchids likes Vanda, Aranda, Arachnis, Renanthera, Kegawara, Mokara can be grown in open sun in trenches filled with brick pieces and characoal.

## How to manure orchids

- In nature, Orchids obtain their supply of inorganic nutrients like calcium,
- Magnesium, Iron, Potassium, Nitrogen and traces of manganese, boron, copper, zinc etc. from the tree on which they are growing and also from atmosphere and decaying vegetables and dropping of birds,
- Under control conditions they have to be supplied these major and minor nutrients.
- Solid and liquid fertilizer mixtures are available in the Market.
- Liquid fertilizers are much more quickly absorbed and can be applied more frequently.
- Usage of fertilizer depend on stage of growth.
- During vegetative growth, large quantities of nitrogen are required while during flowering, nitrogen should be reduced and amount of phosphate increased.
- NPK 20:20:20 or 18:18:18 is good during vegetative growth.
- NPK 10:20:30 or 7:12:40 is good during flowering stage.
- In general, PH of the nutrient solution should be slightly acidic or neutral but not alkaline.
- Fertilizer should be made on sunny days during 8.00 a.m. – 10.30 am. for better absorption.

# How to propagate orchids

- Orchids like other Horticultural crops may be propagated either sexually or Asexually.
- Since most of the commercial Orchids are highly heterozygous they are not raised through seed and are propagated through vegetative means to get true to type plants.

# Propagation methods

- Cutting
- Off shoots and keikis
- Aerial shorts
- Seed
- Tissue Culture

## How to Propagate Orchid : Cutting

- Orchid like *Aerides*, *Arachnic*, *Epidendrum*, *Renanthera*, *Phalaenopsis*, *Vanda* and *Dendrobium* can be propagated by cutting.
- Cut ends should be treated with fungicides to prevent rotting.
- Most of the sympodial Orchids like *Ceelogyne*, *Cattleya*, *Dendrobium* and *Cymbidium* are propagated through this method.

## How to Propagate Orchid : Off shoots and Keikis

- Same monopodium Orchids like Ascocenda, and Phalaennopsis, Keikis or off shoots emerge frequently on the main stem.
- Induction of Keikis can also be induced through the use of cytokinins which force the dormant bud to develop into keikis.

# How to Propagate Orchid : Aerial Shoots

- Most of the dendrobium produce Aerial shoots or bulbs on old back bulbs devoid of leaves. Usually arise on the upper part of the back bulbs. In genera like Good year, Rhizomes gives off special lateral branches which turn up and produce aerial shoots.

# How to Propagate Orchid : Seed

- Orchids produce seed pods with literally hundreds of thousands of seed that are released and scattered by the wind. (1,300 to 400,000)
- Colour may be white, Cream, Pale green, reddish orange or dark brown and have very diverse shapes.
- Orchid seeds must establish a symbiotic relationship with a special fungus to survive its first year of life.
- The fungi gathers water and minerals for itself and the seedling, and the seedling shares its sugars from photosynthesis with the fungus.
- Only one or two orchid seeds will ever germinate and survive on that perfect crevice or depression that is both moist and has the fungus present.
- Its chances to survive in the wild long enough to bloom are slim.



- To avoid this problem, greenhouse growers sow orchid seeds on moist, sugar-rich, sterile agar, or they cut out growing clumps of orchid cells and place them on the agar.
- These techniques allow many hundreds of orchid plants to survive to maturity.
- New and improved hybrids can be mass produced rapidly.
- This is important as orchids are very slow growing as many orchids take five to seven years to mature to flowering.
- Breeding three or four orchid generations could span a person's lifetime just to get one new hybrid propagated sufficiently for sale.

## How to Propagate Orchid : Tissue Culture

- Tissue culture technique were applied to orchids in 1960.
- Tissue culture technique is highly successful to get virus free plants.
- Today tissue culture is preferred for commercial propagation of orchids.
- Both liquid and solid media are used for the orchid tissue culture.
- The explants after being isolated from the shoots are cultured in or on the desired medium – under sterile conditions; offer to produce clones of a plant.

- Following advantages are having over traditional methods of propagation.
- The production of exact copies of plants that produce particularly good flowers.
- To quickly produce mature plants.
- The production of multiples of plants in the absence of seeds or necessary pollinators to produce seeds.
- The regeneration of whole plants from plant cells that have been genetically modified.
- The production of plants in sterile containers that allows them to be moved with greatly reduced chances of transmitting diseases, pests, and pathogens.
- The production of plants from seeds that otherwise have very low chances of germinating and growing, i.e.: orchids and nepenthes.
- To clean particular plant of viral and other infections and to quickly multiply these plants as 'cleaned stock' for horticulture and agriculture.

# Diseases and Pests

- Number of diseases caused by fungi, Virus, bacteria, insects and pests.
- Various fungicides likes Capton, Dithane, Agrosan and Ceresan are effective against fungal & Bacterial Diseases.
- In case of virus diseases is control measures all infected plans should be isolated to prevent spreading.
- The most commonly reported insects pests are thrips, aphids, spidermite, soft scale, mealy bugs, orchid weevil, snail and slugs.
- Can be controlled by insecticides like Parathion, Malathion, BHC, Aldrin, Dieldrin etc.
- Metaldehyde has proved to very effective in killing slugs and snails. Even Beer can be used as a bait.

# Breeding of New Varieties

Some of the important intergeneric hybrid are,

- Ascocentrum X Vanda  $\longrightarrow$  Ascocenda
- Arachnis X Vanda  $\longrightarrow$  Aranda
- Aerides X Vanda  $\longrightarrow$  Aeridovanda
- Brassovola X Cattleya  $\longrightarrow$  Brassocattleya
- Phalaenopsis X Vanda  $\longrightarrow$  Vandanopsis
- Cattleya X Laelia  $\longrightarrow$  Laeliocattleya
- Cattleya X Sophronitis  $\longrightarrow$  Sophrocattleya



# BRINJAL



Botanical name : *Solanum melongena*

Family : Solanaceae

Chromosome No. :  $2n = 24$

Origin : India

• **Common name : Eggplant, Aubergine.**



### Economic importance and uses :-

- It is an annual crop cultivated all over India.
- The fruits are available practically throughout the year.
- Brinjal fruits are a good source of calcium, phosphorus, iron and vitamins particularly 'B' group.
- Analysis of 100 g of edible fruit contains 91.5g of water, 6.4 g of Carbohydrates, 1.3g of Protein, 0.3g of fat and 0.5g of mineral matters.
- Its green leaves are the main source of vitamin C (38-104.7mg/100g).

- Dark purple brinjal has more vitamin C than those with white skin.
- Bitterness in brinjal is due to presence of glycoalkaloids. Generally, high amount of glycoalkaloids (20mg/100g) produces a bitter taste and off flavour.
- Brinjal is reported to stimulate the intrapeptic metabolism of blood cholesterol.
- Dry fruit is reported to contain goitrogenic principles.



### Area and production :-

- In India it is well distributed in Orissa, Bihar, Karnataka, West Bengal, Andhra Pradesh, and Maharashtra and UP. Brinjal covers 8.14% of total vegetable area and produces 9 per cent of the total production.

### Popular varieties and hybrids

#### A . Long varieties:-

##### Pusa Purple Long :-

- It is a selection from a local variety 'Batia'.

##### Pusa Purple Cluster:-

- This cultivar is resistant to bacterial wilt and little leaf disease.

### Pusa Kranti:-

- This cultivar is dwarf and spreading habit. Fruits are oblong with attractive purple colour. This cultivar is good for both spring and autumn planting under north Indian conditions. The average yield varies from 25-30 t/ha.

### Arka Sheel:-

- The fruits are medium long, with deep shining purple colour.

### Arka Kusumakar:-

- The finger shaped fruits are borne in clusters.

### Arka Anand :-

- It is a high yielding F1 hybrid with resistance to Bacterial wilt. Suitable for Kharif and Rabi.

### Other long varieties :-

- Arka Keshav, Arka Navneeth, Azad Kranti.

### B. Round varieties

### Pant Rituraj:-

- Resistant to bacterial wilt.

### Pusa Purple Round:-

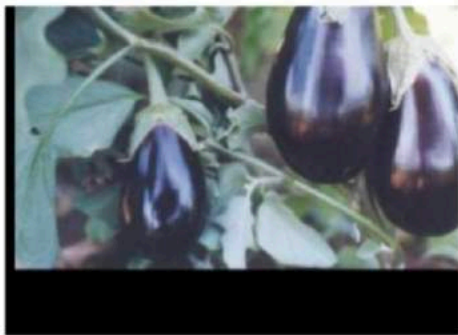
- It is highly resistant to little leaf virus diseases.

### Other round varieties :-

- Manjri, Krishnanagar Purple Round.

### C. Hybrid varieties :-

- Pusa Bhairav (Resistant to phomopsis blight and fruit rot) Pusa Kranti, Pusa Kranti, Pusa Anmol.



**Arka Anand**

## Climate :-

- Brinjal is susceptible to severe frost.
- A long and warm growing season with temperature range of 21-27°C is most favourable for its successful production.
- Climatic conditions especially low temperature during the cool season cause abnormal development of the ovary (Splitting) in flower buds which then differentiate and develop into deformed fruits during that season.
- Late cultivars, however, withstand mild frost and continue to bear some fruits.

## Soil :-

- The brinjal can be grown practically on all soils from light sandy to heavy clay loam soils are good for an early crop, while clay loam and silt loam are well suited for higher yield.
- Generally silt loam and clay loam soils are preferred for brinjal cultivation.
- The soil should be deep, fertile and well drained. The soil pH should not be more than 5.5 to 6.0 for its better growth and development.

## Sowing time

Winter crop	Summer crop	Hilly regions crops
June-July	December- January	March- April

## Nursery :-

- Raised beds should be prepared (7.5×1.2×10-15cm) and seeds are sown in rows of 7.5 to 10cm apart.
- The seeds should be covered properly by a mixture of FYM and soil.
- To avoid fungal diseases, the seeds should be treated with captan or thiram at the rate of 2g/kg of seed.
- About 250-375 g seed is sufficient to cover one hectare of land with 30,000-45,000 seedlings.
- The seedlings are ready for transplanting in about 4-5 weeks.



### Preparation of land :-

- Soil is prepared to fine tilth by giving 4-5 ploughings. Well rotten organic manure (25t/ha) is incorporated into the soil well before the final preparation.

### Spacing :-

- 60×45, 75×60cm and 75×75 cm.

### Nutrition:-

- It is a heavy feeder of nutrients and requires more nutrients for better yield and quality.
- F.Y.M requirements :-25 tonne par ha

- Nitrogen :- 100 kg par ha.
- Phosphorus :- 60 kg par ha.
- Potassium :- 60 kg par ha.
- Basal dose :- Half dose of nitrogen and full dose of phosphorus and potassium.
- Top dressing :- remaining dose of nitrogen is applied after 30 days .

### Irrigation :-

- It requires several irrigation for successful cultivation. Timely irrigation is essential for fruit set and its development. Usually the crop is irrigated weekly once for higher yield.

## Weed control :-

- It is essential to keep weeds under control from the initial growth itself.
- Three to four hoeings are normally followed for effective control of weeds.
- Orabanche is one of the serious weed affecting solanaceous crops in some areas. It is a root parasite and should be controlled effectively.
- A pre-planting treatment of 1.0 kg ai/ha of fluchloralin followed by one hand weeding at 30 days after transplanting is effective.

### Use of growth regulators and chemicals:-

- Application of 2, 4-D (2ppm) at flowering induces parthenocarpy, increases fruit set, advances fruit maturation and significantly increases total yield.
- NAA (60ppm) alone or in combination with BA (30ppm) applied on open flowers improved fruit set

### Harvesting and yield :-

- Brinjal fruits are harvested when they have developed a good colour and marketable size, are still immature, tender and have not lost culinary qualities
- Early crop normally yields 20-30 t/ha. While long duration crop yields 35-40 t/ha. Many F1 hybrids yield about 40-80t/ha.

## PHYSIOLOGICAL DISORDER/CONSTRAINTS

### 1. Calyx withering :-

- This disorder occurs between mid-February and mid - April. The affected fruits become reddish brown in colour and lacking in normal luster and thus marketability of fruits is hampered. The affected fruits have much higher calcium and nitrate content than healthy ones.

### 2. Poor fruit set :-

- In brinjal, four types of flower, according to length of style :- long styled, medium styled, pseudo short styled and short styled. Pseudo short and short styled flowers do not normally set fruit but their numbers in a plant are normally higher than long and medium styled of lower which produce fruits.

### Control:-

1. Spraying the plant with 2 ppm 2, 4,-D at flowering stage when few flower clusters appear.
2. Spraying with 60 ppm NAA or 500 ppm PCPA (Parachloroacetic acid) at full bloom stage.

## **Seed production :-**

- An isolation distance of 100 to 200m for certified and foundation seed plots respectively should be maintained between two cultivars.

**Scientific Name : *Abelmoschus esculentus***

**Family : Malvaceae,**

**Chromosome number :  $2n=72, 108, 130$**

**Origin : Asiatic region /Ethiopia/Africa.**

**Common names : Bhendi, Lady's Finger**



## Economic importance and uses :-

- **C** is more remunerative than the leafy vegetables.
- Tender green fruits are cooked in curry and also used in soups. The root and stem are useful for clearing cane juice in preparation of jaggery.
- **C** is rich in vitamins, calcium, potassium and other minerals. 100g consumable unripe bhendi fruits contain 10.4g dry matter, 3,100 calorie energy, 1.8g protein.
- The dry seeds contain 13-22% edible oil and 20-24% protein.



## **Area and production:-**

- India is the largest producer of okra in the world. The major bhendi growing states are Uttar Pradesh, Orissa, Bihar and West Bengal.

## **Popular varieties:-**

- Pusa Makhmali
- Pusa Sawani
- Arka Anamika (Selection 10)
- Arka Abhay (Selection
- Punjab Padmini
- Punjab -7
- Parbhani Kranti
- Varsha Uphar (HRB 9-2)
- Gujarat Bhendi 1

## Climate:-

- It is basically adapted to tropical climate and vigorous warm humid weather for best growth and production.
- Seed germination optimum soil moisture and a temperature **range between 25 and 35oC**. fast germination observed at 35oC.
- Seeds fail to germinate below 17oC And temperature above 42oC flower buds in most of the cultivars may desiccate and drop causing yield losses.
- The optimum temperature range for growth is 20-30oC.

**Soil:-** It can be grown in all kinds of soils ranging from sandy loam to clay. However, high yields can be obtained in loose friable, well manured loamy soils having better drainage. The soil optimum pH for okra ranges from 6- 6.8,

**Seasons:-** Sowing in plains is done in June-July for kharif and February-March for spring/summer crop. The best time is from May 25th to June 25th.

- In hilly region, the crop is sown from April to July.

**Seed sowing :-**

- Seed is sown directly in the soil by seed drill, hand dibbling or behind the plough.

## **Seed rate:-**

- The recommended seed rate per ha is 18-22 kg for spring summer crop and 8-10 kg for kharif crop.

## **Spacing:-**

- Plant distance of 60 X 30 cm accommodating 5000 plants/ha is recommended for branching types.
- 45 X 30 cm accommodating 66,000 plants/ha for non branching type.
- spring summer season with less plant growth these spacing is kept at 45 x 20 cm or Less.
- The seed should be sown at a depth of 2.5cm.

## Manures and Fertilizer:-

- The quantity of manures and fertilizers depends upon the type of soil, but in normal condition **25 tonnes of FYM** should be added at the time of last harrowing. In addition to **this, 125kg N, 75kg P and 63 kg K/ha** will be required in medium type of soils.

## Irrigation:-

- During kharif, irrigate the crop as and when required. In summer season the crop should be irrigated at an interval of 5-6 days. Flooding of plants should be avoided.

## **Weed control:-**

- Fluchloralin @1.5kg a.i/ha as pre sowing soil incorporation and alachlor @ 2kg a.i/ha as post sowing gives control of weeds.

## **Use of chemicals and growth regulators:-**

- The highest average fruit set and yield were obtained with cycocel at 100 ppm as seed soaking for 24hrs on seed treatment by GA (400 ppm), IAA (200 ppm) or NAA (20 ppm) enhanced germination, ethephon (100-500ppm) reduced vegetative growth and weakened apical dominanc.

## Physiological disorder:-

- **Poor seed germination:-** Seed germinate poorly when soil temperature remains at or below 20°C. The problem occurs during early spring summer cultivation when seed are to be sown at low temperature condition.

## Control:-

- a. Soaking the seeds in water for 24 hours.
- b. Soaking the seeds in hot water at 45°C for 1 ½ hours.
- c. Seed treatment with alcohol for half an hour

## Harvesting :-

- The pods should be harvested when they are immature and green and have attained edible size. In general, harvesting every alternate day is advisable. Field is divided into blocks to ease harvesting at one or two intervals.
- The best length at which the pods should be harvested is 8 to 10 cm. For distant market harvesting in the late evening and transporting the produce during coolness of night is practiced.

## Yield:-

- An average yield of 8 tonnes green fruits per hectare during spring-summer and 12.5 tonnes during rainy season.



## Storage:-

- Fruits could be stored at 7-9°C temperature and 70-75% RH for a couple of days without much loss in colour, texture or weight. The pods can be stored at room temperature for 2-3 days if water is sprinkled on the pods during day and once in night to keep them cool and fresh.