

**18BBO6EL-NON-MAJOR ELECTIVE-PLANTS AND HUMAN WELFARE -II**  
**Unit -V**

**Floriculture, cultivation of commercial flowers – rose and jasmine. Olericulture – cultivation of Brinjal and cucumber. Cultivation of important fruit trees – Mango and Banana.**

**FLORICULTURE**

**PRODUCTION TECHNOLOGY OF ROSE**

**Scientific Name:** *Rosa hybrida*

**Local Name:** Gulab

**Hindi Name:** Gulab

**Family:** Rosaceae

**Origin and History**

Rose is also mentioned in the Bible and is believed to be known before the Bible era. According to archaeological findings, the Palestinians cultivated roses before the birth of Christ. Rose is surely very much steeped in history. It is the national flower of England, and some American States adopted rose as their emblem. It is assumed that some of the important rose species were hybridized in nature and the present day improved forms have been evolved/small over centuries. In fact, Crimson China Rose is considered as the father of modern roses. In the early nineteenth century itself, one or two hybrids closely allied to *R. chinensis* were introduced to Europe from China. These were actually hybrids between *R. odorata* and *R. gigantea*. La France was the hybrid Teas rose, by M. Guillot of France and was developed out of open pollination.

However, out of over 120 species of roses distributed in the old as well as the new world, only eight species have played a major role in the development of the modern gardenroses.

**Area and Distribution**

Roses are being cultivated from ancient times in France, Cyprus, Greece, India, Iran, Italy, Morocco, USA and Bulgaria for production of perfume. In India, several species are found growing wild mostly in the Himalayan ranges. Their cultivation is concentrated at Aligarh, Kannauj, Ghazipur, Ballia and Jaunpur in Uttar Pradesh, at Haldighati in Rajasthan, Chandigarh



and in Tamil Nadu in a total area of about 8,000 ha. The major rose producing areas are Karnataka, Maharashtra, Punjab, Uttar Pradesh, Delhi and Chandigarh, while in Gujarat, Haryana, Himachal Pradesh, Madhya Pradesh, Rajasthan, Tamil Nadu and West Bengal they are grown to a limited extent.

**Uses / Nutrient Values**

The rose, because of its place amongst the flower crops and is one of the oldest of fragrant flowers to be cultivated by man. Its different types having beautiful flowers of exquisite

shape, sizes, bewitching colours and most delightful fragrance has made it an important flower for its varied uses. Most important uses of flower are given below.

### **Cut flower**

Roses are of foremost commercial importance and cut roses have the highest demand throughout the world and year round. The cut flowers are used for vase and table decoration.



### **Garden Display**

Roses are also the most important perennial garden plants in almost all parts of the world. Roses are not only hardy, the variation in growth and many forms of flowers having numerous colours have made them the suitable garden plants for different uses. They can be used as bushes, standards, climbers, hedges and edges, hangers and in rock gardens.



### **Pot plants**

Roses as pot plants in suitable containers are also commercially grown and kept both indoors as well as outdoors.



## **Perfume and allies products**

### **Rose water**

Rose water is also an important commercial product from rose petals. It is used as a perfume and in medicines and confectionary. It has the property of cooling the body and is often used in eye lotions and eye drops for its soothing qualities. It is also used in drinking water and sprinkled on the guests at weddings, feasts and other social functions.

### **Rose oil**

Rose oil is an important commercial product obtained from rose petals. Apart from sweet fragrance, it has medicinal properties and is often used in Ayurveda. Bulgarian rose otto is largely used in perfuming soaps and cosmetics.

### **Gulkand**

Rose petals are also preserved for direct consumption, by making gulkand which is prepared by pounding equal proportions of petals and white sugar. It is considered both as a tonic and laxative.

### **Pankhuri**

Dried rose petals are known as pankhuri which is occasionally used for preparing sweetened cold drinks.

### **Gul-roghan**

It is rose hair oil prepared from rose petals by effleurage with wet sesamum seeds.

### **Source of Vitamins**



Rose hips are very good sources of ascorbic acid, every 100 g of rose hip syrup contains 150 mg of ascorbic acid compared with only 50mg present in fresh orange juice, 20 mg in tomatoes and 5 mg in apples.

### **Other uses**

Rose are also use for making pot-pourri, conserves, rose vinegar, rose petal wine, jams, jellies etc.

### **Botanical Description**

The stem is prickly. The leaves are alternate and pinnately compound. The oval leaflets are sharply toothed. The fleshy berry like fruit is known as hip. Roses have a determinant inflorescence that may assume corymbs, paniculate or solitary form.



### **Climate**

#### **Temperature**

Temperature is an important factor regulating the growth of rose plant. Plants are planted at a place where flower yield was highest in plants kept at night temperature between 15 to 18°C and day temperature of 20 to 25°C. During winters, because of the low temperature the quality of flowers is good.

#### **Light**

A light duration lesser than 12 hrs leads to lower number of flowers and the flowers are of inferior quality too.

#### **Humidity**

Humidity plays an important role in the incidence of pests and diseases affecting the growth and flowering. In case of higher humidity in the atmosphere, water drops accumulate on

the rose leaves which if remain over there for a longer period leads to many fungal diseases. Certain diseases like mildews are associated with relative humidity.

### **Season in which the crop is grown**

It can be grown throughout the year. The best planting time is between September and October in plains & in the hills it is during October-November or February-March.

### **Growing of roses under open conditions**

Roses for local market and for preparing different products are grown under open conditions. The details are as follows:

### **Soil requirement and preparation**

Preparation of soil is the key to success in roses. Although any soil is good for rose cultivation provided it has proper drainage. The ideal soil should be medium loam having sufficient organic matter, with a pH of 6.0 and 7.5. The soil should have a fine tilth up to a depth of 50 cm and should have a good drainage facility. The soil should be free from gravel, stones, brick pieces and other foreign material and exposed to sun for at least a week.

If the soil is deficit of organic matter then 10-12 per cent of additional organic matter may be added to it. Upon land preparation, beds/ plots of 1- 1.5m wide and 30-40m long should be prepared.

### **Planting Distance**

The planting distance depends on the types of roses and location. For cut flower production, a spacing of 60 x 30 cm is recommended. Normally roses are planted at 60 x 60 cm spacing.

### **Varieties**

There are different classes of roses according to the type of flowers they bear:

#### **Hybrid Tea**

This is the most important class of roses. The flower buds of this class are longer and look beautiful. The flowers of this class are slow opening and hence can be kept in vases for a longer time. The flower spikes are also longer. Flowers of wide range of colours are available in this class but red, orange, yellow and some other dark colours are more preferred in the market. **Red:** First Red, Avon, Happiness, Mr. Lincoln, Raktagandha, Black Lady, Montezuma, etc.

**Yellow:** Aalsmeer Gold, Gold Medal, Golden Star, Golden Time, Yellow Success, Pusa Sonia

**Orange:** Super Star, Summer Hoilday, President and Grand Gala

**Bi-colour:** Anvil Spark, Mudhosh, Double Delight, Supriya, Abhisarika, Kiss of Fire, Tata Centenary.

**Scented:** Avon, Granda, Papa Meilland, Blue Perfume, Eiffel Tower, Oklahoma

## **Floribunda**

There is profuse flowering in this class of roses but the flowers shed soon. That's why this class of roses is largely used for decoration and bedding purpose. The important varieties under this class are as follows:

**White:** Iceberg, Summer Snow, Margette Maril, Chitchor, Chandrama

**Pink:** Prema, Sadabahar, King Arthur, Bridal Pink

**Yellow:** Arthur Bell, Dr. Foun, Allgold, Sea Pearl, Golden Times

**Mauve:** Neelambari, Angel Face, Africa Star

**Orange:** Doris Norman, Suryakiran, Jorina, Jambra

**Bi-colour:** Charisma, Mask Red, Paint Box, Nav Sadabahar, Red Gold, Rare Addition

**Scented:** Angel Face, Delhi Princess

## **Polyantha**

The rose plants of this class are small and the flowers come in cluster. The main varieties of this class are Anjani, Rashmi, Nartaki, Priti, Swati, etc.

## **Miniature**

The roses of this class are dwarf in stature and the twigs and the leaves are also small.

The flowers of this class are used in flower arrangement:

**Red:** Beauty Secret, Dark Beauty, Fast Fire

**White:** Green Ice, Z-Trail, Aany

**Pink:** Windy City, Sweet Fairy, Dizzler

**Yellow:** Baby Gold Star, Kale Gold, Delhi Star Late

**Mauve:** Silver Tip, Blue Bird

**Orange:** Angel Ripyance, Petayit Foly

**Bi-colour:** Star and Strip, Jainy Williums, Over the Rainbow

## **Climber**

The branches of these roses are soft and spread like climber. They flower at the end of the branches in small clusters. They are used for raising over the pergolas and the walls. The important varieties are as follows:

**Red:** Climbing Crimson Glory, Blaze, Cocktail, Black Boy

**White:** Delhi White Pearl, Shelderer White, Rambler, American Pear, Lamark **Pink:** Climbing Show Girl, Lady Water Loo, Climbing of Silk, Soft Silk, Climbing Piece, Pink Meradan

**Lemon:** Miracle Neel, All Gold, Golden Shower, High Moon

There is profuse demand of red, pink and orange coloured cut roses. It is suggested that the following varieties are more profitable to grow.

Gladiator, Queen Elizabeth, Bull's Red, First Red, Happiness, Grand Gala, Confetti, etc.

### **Preparation of Field**

Beds are prepared for the cultivation of roses. If the soil is light and proper drainage is there, the planting can be done even without making beds but if the soil is heavy and proper drainage is not there, raised beds (40 cm above the ground) should be prepared. Pits must be dug before the onset of rain so that the soil may settle down. Pits of 20-30 cm wide & 30 cm deep should be prepared and likewise the beds should be prepared. Care should be taken that the top soil should remain on the top.

### **Propagation**

**Commercial method of propagation is by cutting and budding.**

#### **a) Cutting**

Scented roses are mainly propagated through cuttings. Hard wood Cuttings in case of polyanthas, climbers, ramblers and soft or semi hardwood cuttings for miniatures are used. Cuttings are collected from healthier plants with 15-20 cm length and 3-4 nodes. Cuttings are treated with IAA, BA 100ppm. Cuttings are planted in mist chamber for easy and quicker rooting.

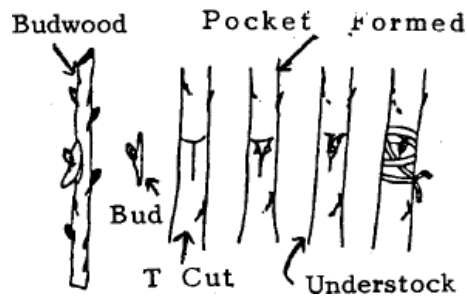


#### **B) Budding**

Hybrid and Floribunda roses mainly propagated through budding. 'T' budding is the common method. Root stocks used are *R. multiflora* (Briar root stock), *R. indica* var. *odorata*, *R. bourboniana*, *R. laxa*, *R. canina* and *R. noisettiana*.



When a rose plant comes into flower small swellings are visible between the stem and stalk of the leaf. Select the eyes which are plump and not started to elongate and grow. Cut off the portions of the branch with the eyes selected is called as 'bud wood' with a budding knife remove a shield shaped piece of the bark and the eye. The Root stock should be kept ready by cutting the branches and side shoots which are not required. Make a sharp horizontal cut at a suitable height in the stock and then make a vertical ' T ' shaped cut in the stem of the stock. The 'eye' should point towards the top and is tied with fibre.



### Steps in T / Shield Budding

Preparation of buds from Scion



'T' shaped cut in the stem of the stock



Inserting and wrapping of the bud



### **Preparation of Beds and pits**

The beds or pits for planting are prepared at least a month before the date of planting. The preparation of beds may be taken up during May or June so that the soil gets a thorough exposure to sun and air, and during the rainy season it gets a chance to settle down before planting. The beds are prepared to a depth of 60-75 cm and a trench of 45-60 cm across is dug to 30 cm depth. The trench is again dug and forked. While forking a basketful of well-rotten cow dung manure and a double handful of bone meal may be mixed in the soil.

If the soil of the bed is heavy clay with poor drainage, the beds are raised to a level of 5 -10 cm above the ground. To improve the heavy clay soil, hydrated lime @ 1.5 kg/sq.m is forked 30 cm deep into the soil at the bottom of the bed. Gypsum @ ½ kg /sq.m can also be applied. If the soil is light or sandy, plenty of compost or FYM can be added to improve the water-holding capacity. Pits of size 45 cm 3 can be dug while planting in pits.

### **Season**

Planting can be avoided during hot summer and heavy rains. In plains roses can be bestplanted during Sep-Oct after the cessation of the rains. In hills, planting fan be done during Oct- Nov/ Feb-Mar. depending upon the temperature but the former season is more suited.

### **Spacing**

For,

Cut flower production – 60 x 30 cm

Oil extraction – 2.5 x 0.5 m

Vigorously growing cultivars. 60 x 75 cm / 75 x 75 cm

Polyanthas – 45 cm

Miniatures – 30 cm

Climbing types – 3 m

## **Selecting plants**

Plants may be pruned lightly by removing the suckers and the dead, unhealthy and diseased twigs. Plants selected for planting should have at least three strong canes.

## **Planting**

Before planting, the top 30 cm soil from the pits should be removed. The plant along with the earth ball may be gently lowered into the pit, keeping the main stem in the centre of the pit. The bud union point where the scion joins the stock is kept just above the ground level. Generally, in temperate countries the bud union point is kept below the ground level. While planting it is necessary to spread out the roots evenly. The soil is returned to the pit and firmed towards the center. The plant must be watered copiously immediately after planting.

## **After care**

The newly planted roses require frequent watering in the beginning. After that they may be watered once in five days during summer, and once in ten days during winter. If the soil is sandy, more frequent watering may be necessary. On the other hand if the soil is heavy and retentive of moisture the watering interval may have to be increased. Care should be taken to avoid 'wet feet', i.e. to avoid stagnation of water too long in the beds or near the base of the plants as it is harmful to the roots. Suckers originating from the root stock must be removed frequently to prevent the loss of vigour of the plants.

## **Manuring**

After pruning basins formed around the plant sand manures are applied 10-15 cm depth.

6:6:12 g NPK/plant - Edward and Red rose

8:8:16 g NPK/plant - HT/Polyanthas/FB

Application in 3 stages

15 DAP

After first flush of bloom

After second flush of bloom

Dose/plant - FYM 10 kg, Urea 65 g, Super phosphate 25 g, MOP 50 g

Foliar feeding - micro-nutrients - 20 g  $MnSO_4$  + 15 g  $MgSO_4$  + 10 g  $FeSO_4$  + 5 g Boron @ 2g/l of water results in bright coloured flowers.

Organic manures- oil cakes and bone meal are excellent sources of N and P respectively and may be applied after pruning.

## **Plant Growth Regulators**

**GA3** @ 250 ppm sprayed during the flushing if found very effective to,

Increase the length of the stem/shoot

Increases the no. of shoots/plant

Induces early flowering

Prolongs the flowering period

Enhance the flower yield

**CCC @ 3%** results in more no. of buds and also,

Increase the flowering and size

Increase the yield.

#### **Field view**



#### **Irrigation**

Flood irrigation is given at 10 days interval depends upon the soil and climate. Avoid irrigation immediately before and after pruning.

#### **Weeding**

Mulching 2 to 4 inches of organic material like wood chips if found to reduce annual weeds and make hand weeding easier. Manual weeding is effective. Hoeing and roguing is also effective. Effective control of broad leaved weeds by spraying with 2,4-D, at the rate of 2 kg/600 l of water/hectare 25–30 days before flowering followed by cultivation of soil to a depth of 6-10 cm.

#### **Pruning**

Pruning is the removal of unwanted and unproductive portions of the plant and makes the plant more vigorous and productive.

#### **Objective**

Remove the unproductive shoots

Improve the quality of blooms

Bush in desired shape and size

Open up the bush to penetrate sun light

Rejuvenate the old plants

Facilitate cultural operations

### How to prune

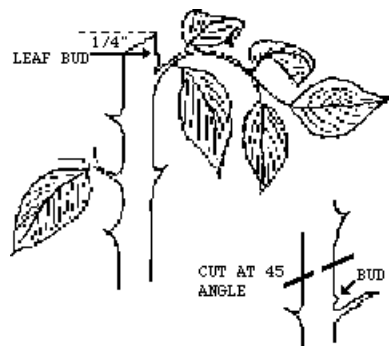
Remove dead, diseased or damaged wood.

Remove branches that grow towards the centre of the plant

Remove the weakest crossed branch and sucker growth (growth coming from below the bud union)

Shape the plant

Make a cut at 45 degree angle  $\frac{1}{4}$  inch above an outward facing bud.



Too high

Too low cut

Correct cut



### Time of pruning

Exactly 45 days prior to the date of requirement of flowers during October-December.

Pruning is necessary when the yield and quality declines.



## **Method**

1<sup>st</sup> Year: Cut back the shoots to four developed buds remain. Allow the lateral shoots.

2<sup>nd</sup> Year: Retain all strong shoots and remove weak and diseased shoots. Cut back the strong shoots to 4-5 buds.

3<sup>rd</sup> Year: Cut back vigorous shoot to half of its growth.

## **Rejuvenation**

After 5-6 years the plants are to be rejuvenated. Cut back all the main branches at 15-20cm from the base. Apply Bordeaux paste over cut ends to prevent diseases.

## **Harvesting**

Flowering starts from 1<sup>st</sup> year onwards. Economic yield 2<sup>nd</sup> to 10<sup>th</sup> year. Flowers are harvested when the flower buds are in half open stage. For cut flowers, they are harvested at tight bud stage with long stalks.

## **Handling**

As soon as the flowers are harvested, the stems are harvested the stems are lowered in to clean buckets containing water with preservative. The flowers are then cooled down to 2-4 ° C for 5-6 hours. The flowers are graded according to the length of the flower stalk. It varies from 40-110cm depending on the variety and packed 20 per bunch.

## **Yield**

Loose flowers : 7.5 t/ha

Cut flowers : 1<sup>st</sup> year : 100-120 flowers/m<sup>2</sup>

2<sup>nd</sup> year: 200-240 flowers/m<sup>2</sup> 3<sup>rd</sup> year: 300-360

flowers/m<sup>2</sup>

## **Pest management**

### **Aphids (*Macrosiphum rosae*)**

The incidence is more in the months of January-February on leaves and flower buds. These are small, black in colour with green tinge. The young and adult both suck the sap from the young twigs, buds and flowers. They suck the cell sap, discolour the leaves and affect flowerbuds which fall and lose their beauty. This can be effectively controlled by spraying 0.1% Malathion or Metasystox (0.1-0.2%) or Rogor (0.1-0.2%).

### **Red scale (*Lindigapsis rosae*)**

It is very serious pest of roses which attack mostly in August and September. The branches are covered with reddish-brown encrustations under which the insect sucks the juice of the plants. These pests can be controlled by spraying Malathion (0.1%) or Parathion (0.25%) in April and again in October.

### **Chaffer beetles (*Onycetonia varsicolor*)**

The adults of these beetles appear in August-September and cut away the leaves. This can be controlled by Monocrotophos (1ml/l) or Dimethoate (1.5 ml/l).

### **Disease Management**

#### **Dieback (*Diplodia rosarum*)**

This is a very serious disease of roses and appears after pruning. The drying up and blackening of pruned shoots start from top to downwards. The stems become black and die. At the point where dry and healthy twigs meet, there appears brown lining and also black spots appear at these places. The conditions favourable for the prevalence of the disease include: application of large fertilizers and manure, excessive irrigation and poor drainage facility, incidence of stem borer, continuous incidence of mites, less light penetration. For its effective control, the infected portion should be dehisced and burnt and the cut ends should be painted with Chaubattia paste (4 part Copper Carbonate + 4 part Red lead + 5 parts linseed oil) or Bordeaux paste, application of optimum dose of fertilizer and by facilitating proper drainage or spray of 3g/ litre of Copper oxychloride (50%).

#### **Black spot (*Diplocarpon rosae*)**

This disease appears in during the humid months. Conspicuous circular black spot (less than 1 cm) with fringed margins appear on either side of leaf; leaves become chlorotic, dry up and prematurely drop. It can be easily controlled by spraying Carbendazim (1g/litre of water) or Captan (0.2%) fungicide at fortnightly intervals.

#### **Powdery mildew (*Sphaerotheca pannosa var. rosae*)**

It is a serious disease that occurs when days are warm & nights are cool. Young growing shoots and leaves are covered with white powdery growth. Infected leaves turn purplish and drop. Flower buds may fail to open. It can be checked by removing all the infected leaves at the time of pruning so that the source of infection is damaged or dusting with 80% Sulphur or spraying 0.1% Kerathane fungicide at fortnightly interval.

### **Post Harvesting**

After harvesting the flowers they are dried on floor under shade for 2-3 days. Upon drying, the seeds are separated by hammering the flowers and the flower straw is separated out by winnowing of the hammered flowers. The seeds are thoroughly cleaned and graded before packing in poly bags or cloths bags, and are stored in cool places. The moisture contents of the seeds must be examined before the packing.

### **Extraction of Oil and Quality Control**

All parts of *Tagetes patula* contain essential oil, which can readily be extracted by steam distillation. The oil has a pronounced odour and acts as a repellent to flies. It has been reported that 1-limonene, ocimene, 1-linalyl acetate and 1-linalool have been extracted from *Tagetes erecta*. While evaluating the different species for essential oil contents, *T. signata* contained higher essential oil (4.25 of dry matter) of very good quality which can be used in perfume industry.

### **Marketing, Distribution and Transportation**

Crop has a good demand in decoration, garlands, loose flower and religious function etc. So can be marketed to major/ big cities where these can be supplied to hotels, institutions, etc. For garlands distribution distributed to the market flower should be packed in bamboo basket which should be covered under moist muslin cloth.

### **Pinching**

Apical portion of shoot if removed early, a large number of axillary shoots arise resulting in well shaped bushy plants bearing more number of uniform flowers. The removal of shoot apices 40 days after transplanting enhances the flower yield.

### **Important tips and best practices for crop cultivation**

Always use disease free planting material

Timely weed management should be done.

Flower should be harvested at proper time and stage. These are distributed to the market in bamboo basket which should be covered under moist muslin cloth.

### **Alternative Uses**

Loose flower, cut flower, perfumery industry, bedding purpose, medicinal and cosmetic industry, colour making, garland, decoration, etc.

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## **PRODUCTION TECHNOLOGY OF JASMINE**

Scientific name: ***Jasminum* spp.**

Local name : **Jasmine**

Hindi name : **Juhi, Chameli, Mogra, Champa Bela etc.**

Family: **Oleaceae**

### **Origin and History**

Jasmines are native of tropical and subtropical regions and introduced in the mid sixteenth century. Among the large number of species existing, only three species have attained importance in commercial cultivation. *Jasminum sambac* is considered as a native of the East Indies. Jasmine blossoms have been in use in India, China and countries of mystic orient for ceremonial purpose, as religious offerings and for perfuming the hair oils, etc. since time immemorial. The name Jasmine is of Arabic origin and is believed to have been derived from Yasmin. It is reported

that the height of its popularity reached its peak two to five hundred years ago at canton and metropolis of southern China.

***Jasminum auriculatum* - Mullai**



***Jasminum grandiflorum*- Jathimalli (or) Pitchi (or) Spanish jasmine**



***Jasminum sambac* - Gundumalli / Malligai / Arabian jasmine / Tuscan jasmine**



***Jasminum pubescens* - Kakada**



**Uses/Nutrient Value**

Jasmine has been cultivated for various purposes since very early times. Flowers and buds are used for making garlands, bouquets, and for religious offerings. They are also used for the production of perfumed hair oils and attar. The world famous jasmine oil is extracted from the flowers of Spanish jasmine (*J. grandiflorum*). The oil is also used in soap and cosmetic industry. The flowers of Arabian jasmine (*J. Sambac*) are reported to be used in China for flavoring tea. They also contain yellow pigments and hence used as substitute for saffron. Flowers and other parts also used in medicines.

**Area and Distribution**

Though jasmines are distributed in tropical and subtropical countries of the world, a large number of scented species are around the regions comprising India, China and Malaysia. Among these, about 40 species are reported to occur in India. Gamble (1957) recorded 20 species in the former Madras Presidency State and some of these species are found in



Mumbai, Bihar, Orissa, Chotanagpur, upper Gangetic plains and sub Himalayan tracts. The distribution of some important jasmine is given below: -

|                       |                    |                        |  |
|-----------------------|--------------------|------------------------|--|
| <i>J. auriculatum</i> | India              | <i>J. grandiflorum</i> | Subtropical Himalayan Region           |
| <i>J. favreri</i>     | Myanmar            | <i>J. humile</i>       | Tropical Asia                          |
| <i>J. flexile</i>     | India              | <i>J. multiflorum</i>  | India, China, Myanmar, Malaysia, U.S.A |
| <i>J. officinale</i>  | Iran, India, China |                        |  |

### Botanical Description

The genus *Jasminum* belongs to the family Oleaceae and order Oleales. They are climbing, trailing and erect shrubby flowering plants and these are both ever green and delicious species. Leaves are opposite or alternate, simple, trifoliate or pinnate, leaflets entire. Flowers are white, yellow or rarely reddish, sometimes solitary, more often in cymose clusters of three to many, usually fragrant; corolla tubular with four to nine lobes, stamens two, ovary 2 loculed with 1-4 erect ovaries. Fruit is a berry and black in colour.

### Cultural requirements

#### Climate Requirement

The ideal conditions for their successful cultivation are warm summer and mild winter. *Jasminum spp.* is usually grown in the open field for commercial flower production. The Cool house species should be kept in a temperature of 45-55° F (7-13° C). *J. grandiflorum* and *J. sambac* are sensitive to frost.

#### Soil Requirement

Jasmine prefers well drained rich sandy loam to clay soil. *Jasminum* species are usually grown in the open for commercial flower production.

### Varieties

#### *J. auriculatum*

Parimullai: Selection from a local type.  
Medium round bud. Resistant to gall mite.  
Yield



8 t/ha with flowering duration about 9 months/year.

CO.1: Selection from a Long Round type. Flowers have long corolla tube; easy for harvesting and marketing. Yield 8.8 t/ha.

CO.2: Induced mutant from a Long point type. Longer corolla tube; flower buds bolder; field tolerant to phyllody; Yield 11.1 t/ha.

Others: Long Point, Long Round, Medium Point, Short Point and Short Round.

### ***J. grandiflorum***

CO.1: Clonal selection from germplasm. Suitable for both loose flower production and oil extraction. Pink streaks are found on external surface of petal. Average yield 10 t/ha. The concrete recovery is 0.29 per cent.

CO.2: Induced mutant from CO1 Pitchi. Bolder pink buds with long corolla tube yield 11.68 t/ha.



### ***J. sambac***

Ramanathapuram gundumalli: Round flowers with good fragrance; yields 7 to 8 t/ha.

Khoya: Flowers familiar to *J.sambac*, but bolder buds with less fragrance.

.Others: Ramabanam, Madanbanam, Single Mogra, Double Mogra, Iruvatchi, Kasthurimalli, Oosimalli, Soojimalli.



### **Preparation of field**

Land with proper drainage, irrigation facilities and sunny location are essential. Pits of 45 cm<sup>3</sup> are dug at least one month before planting and exposed to sunlight. A few days before planting, pits are filled with 2 parts of FYM and one part each of fresh earth and coarse sand.

### **Propagation**

Jasmine can be propagated by cuttings, layering, sucker, grafting, budding and tissue culture.

|                        |                                      |
|------------------------|--------------------------------------|
| <i>J. auriculatum</i>  | Semi hard wood cuttings              |
| <i>J. grandiflorum</i> | Terminal cuttings                    |
| <i>J. sambac</i>       | Terminal and semi hardwood cuttings. |



### **Semi hardwood of *J. sambac***

Growth regulators. Quick dipping (of the basal cut end) in IAA (or) IBA @ 1000 ppm for terminal cuttings and 2500 ppm for semi hard wood cuttings is done.

Best rooting medium: - sand: vermiculite: moss at 1:1:1 ratio.



## Plant Spacing, density and season

| Species                | Spacing       | Density (Plants/ha) | Season           |
|------------------------|---------------|---------------------|------------------|
| <i>J. auriculatum</i>  | 1.5 x 1.5 m   | 4400                | June to November |
| <i>J. grandiflorum</i> | 2.0 x 1.5 m   | 3350                | - do -           |
| <i>J. sambac</i>       | 1.25 x 1.25 m | 6400                | - do -           |

## Time of Planting

The best time for planting in most parts of India is during the monsoon but one can plant jasmine almost round the year in climates as of Bangalore. Once planted, the jasmine remains in the field for 10-15 years.

## Planting

Land with proper drainage, irrigation facilities and sunny location are essential.

Pits of 45 cm<sup>3</sup> are dug at least one month before planting and exposed to sunlight.

A few days before planting, pits are filled with 2 parts of FYM and one part each of fresh earth and coarse sand. Pits are to be watered to settle the mixture.

Well rooted, healthy and strong plants are planted one in each pit.

## Nutrition

Jasmine responds to intensive manuring.

Too much of manuring encourages vegetative growth and hampers quality and quantity of blooms.

## Nutritional requirement

| Species                | Quantity(g/plant) |                               |                  | Method   |
|------------------------|-------------------|-------------------------------|------------------|--|
|                        | N                 | P <sub>2</sub> O <sub>5</sub> | K <sub>2</sub> O |  |
| <i>J. auriculatum</i>  | 60                | 120                           | 120              | 6 split doses at bimonthly intervals                       |
| <i>J. grandiflorum</i> | 100               | 150                           | 100              | 2 split doses :<br>June - July<br>December - after pruning |
| <i>J. sambac</i>       | 60                | 120                           | 120              | 2 split doses :<br>June-July<br>November - after pruning   |

## Foliar Nutrition

Spraying of zinc 0.25% and magnesium 0.5% before flowering increases flower yield.

For Fe deficiency, FeSO<sub>4</sub> at 5g/lit. is sprayed at monthly intervals until the chlorotic symptoms disappear.



## Irrigation

Flooding once in a week or once in ten days depending on the soil and climatic conditions.

## Pruning

Need for Pruning

In jasmine, flowering habit is terminal and axillary. So increasing the number of shoots would increase the yield, for which pruning is essential. Pruning influences growth, flower bud initiation, differentiation and ultimately the flower production.

Pruning period

| Species                | Time of pruning       |
|------------------------|-----------------------|
| <i>J. auriculatum</i>  | Last week of January  |
| <i>J. grandiflorum</i> | Last week of December |
| <i>J. sambac</i>       | Last week of November |

Pruning height: 45-50 cm from the ground level.

## Weeding

Commonly done manually but is expensive.

Chemical weed control is effective and economical.

Spraying Oryzalin 1 or 2 applications is effective.

Mulching also reduce weed population.

## Harvesting

Jasmine gives economic yield only from the third year and up to 12-15 years and then the yield starts declining.

The stage of harvest depends on the purpose of flowers to be harvested. For fresh flowers, fully developed unopened flower buds are picked in the early morning, while for extraction of concrete only fully opened fresh picked flowers are required.

Picking of flowers after 11 a.m. will considerably reduce the yield and quality of the concrete.



Damage to flowers during harvest and transit will affect shelf life of fresh flowers and concrete recovery.

### Yield

| Species                | Flowers yield (kg/ha) | Concrete recovery (%) |
|------------------------|-----------------------|-----------------------|
| <i>J. auriculatum</i>  | 4733 to 9152          | 0.28 to 0.36          |
| <i>J. sambac</i>       | 739 to 8129           | 0.14 to 0.19          |
| <i>J. grandiflorum</i> | 4329 to 10144         | 0.25 to 0.32          |

### Grading

There are no standard grades available for jasmine.

The flowers may be graded according to the corolla tube length, bud size, shape and freshness.

### Packing

Harvested flower should be given cold treatment before packing.

Packing should be functional, economical and attractive besides being acceptable in markets.

Corrugated cardboard boxes are good for distant market.

Wholesalers pack flowers in bamboo baskets.

They are packed so as to maintain some moisture and air circulation in the baskets.

Water is sprinkled on the newspapers covering the inside of the basket.

The top is covered with paper again and closed with a bamboo basket cover or gunnysack which is stitched at the edges.

Packing Jasmine for local market



Special Packing for Export



### Longevity of flowers

Stage of harvest and pre and post harvest handling markedly influence the quality of picked flowers. In *J. sambac* var. Khoya treatment with boric acid (0.5%), sucrose (1%), aluminium sulphate (0.1%) and silver nitrate (0.01%) flowers remained fresh up to 72 hrs.

## **Plant protection**

### **Pests**

**Bud worm (*Hendecasis duplifasciallis*):** The bud worm which is a greenish larva with a black head bores into immature buds and feeds on floral structures. Spray of Monocrotophos 2 ml/l should be applied for the control of bud worm.

**Red Spider Mite (*Steneotarsonemus pallidus*):** The incidence of red spider mite is high during warm and dry weather, especially during summer. The mites are seen feeding on under surface of the leaves which become yellow and drop off. Thimet 2g/l should be given. Five applications of Aldrin at ten days interval were found effective.

### **Blossom midge**

Spray Monocrotophos 36 WSC 2 ml/lit or Endosulfan 35 EC 2 ml/lit

### **Diseases**

#### **Leaf Blight**

Caused by two fungi viz., *Cercospora jasminicola* and *Alternaria jasmini*. Symptoms are reddish brown spots on upper surface of leaves. Spray of Benlate (0.4%), Bavistin (0.1%) and Bordeaux mixture (1%) are equally effective.

#### **Wilt**

Caused by *Fusarium solani*, symptoms are yellowing of lower leaves which gradually spread upwards and finally resulting in death of the plant. Drenching of soil around the plants with Bordeaux mixture (1%) is the control measure.

#### **Yellowing of leaves**

It is caused by 3 factors viz., iron deficiency, nematode infection and root rot disease.

#### **Iron deficiency**

It can be rectified by spraying ferrous sulphate 5 g/lit at monthly intervals until the chlorotic symptoms disappear.

#### **Nematode**

Initially test the soil for nematode infection. Apply 10 g of Temik granules near root zone and then irrigate the field.

#### **Root rot**

Drench the soil around the plant with Copper oxychloride at 2.5 g/lit.

### **Season of flowering and harvest**

Flowering commences in March - April. Fully developed unopened flower buds should be picked in the morning hours.

## **Extraction of jasmine concrete**

Jasmine concrete obtained from Jathi Malli (Pitchi) – *Jasminum grandiflorum* is a wax like substance containing the natural flower perfume together with some plant waxes, albumin and colouring matter. The natural perfume is available in very small quantity (0.25%) in jasmine flowers in the form of volatile oil. The usual and simple method of steam distillation for the extraction of the volatile oil could not be adopted in this case as jasmines do not yield the perfume oil on steam distillation. Hence, the solvent extraction method is practiced in which the principle is that the odoriferous substances of the flower are allowed to be absorbed by a highly volatile solvent and then the solvent is evaporated leaving the odoriferous principles.

### **STEP I – Solvent treatment**

Flowers are soaked in Food Grade Hexane (Having Boiling point of 70°C).



Mixing Hexane 2 litres / kg of flowers for 30 minutes.



Rotate the container slowly for 20 minutes in the rotary type of extractor.



Perfume substance along with wax and pigments dissolved in Hexane

### **STEP II – Evaporation**

Perfume laden solvent is led into the evaporator



Evaporation at a constant temperature of 75°C.



Vapour of the solvent condensed into liquid for recycling



Liquid (Perfume, wax & pigments) is distilled in a vacuum distillation unit for complete removal of solvent in the still



Floral concrete settled in the still in the form of molten wax



Cooled and Stored in glass (or) aluminium containers

### **Marketing, Distribution and Transportation**

Transporting of jasmine flower is done through trucks, ships (Refrigerated) etc. Before long distance transportation it is better to keep flowers in bamboo basket which should be

covered under moist muslin cloth. Proper care should be taken so that flowers are not handled badly or damaged during transportation.

### **Intercultural operations**

#### **Pruning**

In Jasmine flowering habit is terminal and axillary so increase in the number of shoots is main criterion for increasing yield. In *J. auriculatum* pruning from 24 January is best time. In *J. sambac* pruning in either November or February to 30 cm gives highest flower yield. In *J. grandiflorum* mid December time is found suitable for pruning.

#### **Important tips and best practices for crop cultivation:**

Always use disease free planting material.

Timely weed management should be done.

Flower should be harvested at proper time and stage. These are distributed to the market in bamboo basket which should be covered under moist muslin cloth.

#### **Alternate Use**

Veni, gajra, garland, loose flower, flower arrangement



### **Olericulture – cultivation of Brinjal and cucumber.**

#### **ORIGIN, AREA, PRODUCTION, VARIETIES, PACKAGE OF PRACTICES FOR BRINJAL**

**BRINJAL - (Syn: Egg plant) (Solanum melongena L.) (2n = 24) Hindi: Banigan)**

Brinjal is one of the most common tropical vegetables grown in India. It is known by different names like aubergine (French), begun (Bengali), ringna (Gujarathi), baingan (Hindi) badane (Kannada), waangum (Kashmiri), vange (Marathi), baigan (Hindi) badane (Kannada), waangum (Kashmiri), vange (Marathi), baigan (Oriya), Vashuthana (Malayalam), Kathiri (Tamil), venkaya (Telugu) and Peethabhala (Sanskrit). A large number of cultivars differing in size, shape and colour of fruits are grown in India. Immature fruits are used in curries and a variety of dishes are prepared out of brinjal. Fruits are moderate sources of vitamins and minerals like phosphorous, calcium and iron and nutritive value varies from variety to variety.

Brinjal is also valued for its medicinal properties and has got decholesterolizing property primarily due to presence of poly-unsaturated fatty acids (linoleic and lenolenic) present in flesh and seeds of fruit in higher amount (65.1%). Presence of magnesium and potassium salt in fruits also impart de-cholesterolizing action. In native medicines, role of brinjal in treatment of liver diseases, cough due to allergy, rheumatism, cololithiasis, leucorrhea and intestinal worms has been mentioned.

#### **Origin and distribution**

Brinjal is originated in Indo- Burma region (Vavliov, 1926). Crop is distributed in south and south East Asia, southern Europe, China and Japan. India is the second largest producer of brinjal in the world next to China and produces 83.47 lakh tonnes from an area of 5.02 lakh ha. Cultivation of brinjal is maximum in Orissa, West Bengal, Bihar and is also distributed in almost all states.

Taxonomy Genus *Solanum* comprises approximately 2000 species, which include both tuber bearing and non-tuber bearing forms. Important edible species under non-tuber bearing forms are *S. melongena*, *S. torvum*, *S. nigrum*, *S. macrocarpom*, *S. ferox* and *S. aethiopicum*

***S. torvum*** – used for its small clustered fruits for curry purpose and for drying. It is grown as a wild plant in backyards and roadsides. Due to its resistance to *Fusarium* wilt and bacterial wilt, *S. torvum* can be a resistant root stock for grafting cultivated *S. melongena*

***S. macrocarpom* and *S.aethiopicum*** – grown for edible fruits and leaves.





***Solanum macrocarpon***



***Solanum aethiopicum***

***Solanum nigrum*** – Small clustered acidic fruits are also edible and are harvested ripening stage when it turns purple in colour. In Tamil Nadu this species is cultivated and for frying. Leaves and flowers of *S. nigrum* have more resemblance to that of chilli.



### *S. nigrum*

Several species of Solanum are used in native medicines through out tropics. *S.melongena var. insanum*, *S. incanum*, *S. indicum*, *S. viarum* are a few among them.

Studies on inter-specific hybridization revealed incompatibility between cultivated *S.melongena* with other species, except with *S. incanum*. Further taxonomic studies revealed that *S. incanum* is only a variety under *S. melongena* and can be treated as *S. melongena var. incanum*.

Based on growth habit and fruit shape, four botanical varieties are reported under *S.melongena*.

*S.melongena var. melongena* (Syn: *S.melongena var. Esculenta* Nees) includes cultivars with round and egg shaped fruits

*S.melongena var serpentinum* Desf. Includes long and slender fruited cultivars

*S.melongena var. depressum* includes early and dwarf cultivars

*S.melongena var. incanum* includes wild and prickly plants with small fruits.

### **Botany**

Brinjal is a diploid with  $2n=2x=24$ . Plant is erect, semi erect or prostrate, herbaceous and branched with around 1.0m height. Stem is spiny or non spiny with or without purple pigmentation which is due to anthocyanin. Flowers are bisexual, pentamerous and are solitary or in 2-7 flowered cyme. Calyx is persistent and spiny or non spiny. Corolla is lobed with different shapes and purple, light pink or white coloured. Stamens are free and form a loose cone surrounding the style. Dehiscence is poricidal. Ovary is bilocular with many ovules. Heterostyly is very common. Fruit is a berry with wide variation in shape, colour and size. Fruit

shape may be long, oval, round, ovoid, cylindrical or elongated. Fruit colour may be nearly black, different shapes of purple, white, green or variegated.



### **Flower biology and pollination**

Though reported as a self pollinated crop, cross pollination to varying degree has been reported in brinjal. Cross pollination is due to its heteromorphic flower structure and is mainly by honey bees and bumble bees.

Depending on length of style in relation to position of anthers, four types of flowers – heterostyly are available.

Long styled – stigma well above the anthers  
Medium styled – stigma and anthers at same level  
Short styled – style short

Pseudoshort styled – style rudimentary

Fruit set in long styled flowers ranges from 60 to 70% whereas in medium styled flowers it is 12.5 to 55.6%. Short styled and pseudoshort styled flowers act as male flowers and there is no fruit.

Opening of flower and dehiscence of anthers are almost simultaneous and it takes place at 6-7.30 am during summer and is delayed up to 11 am during winter. Flowering depends on climatic factors and high temperature and humidity in the morning hasten flower opening and dehiscence of anthers. In addition to climatic factors, fertility level of the soil also influences flower initiation and development.

### **Climate**

Brinjal is warm season day neutral plant and is susceptible to severe frost. A long and warm growing season with a temperature range of 21-27°C is ideal for its production. Crop is adversely affected by chilling temperature of winter in North India. Generally late cultivars can

withstand low temperature than early ones. Plants grown luxuriantly and yield heavily during rainy season under warm humid climatic condition of Kerala.

**Soil**

Brinjal is a hardy crop and is cultivated under a wide range of soils. Since a long duration crop with high yield, well-drained and fertile soil is preferred for the crop. Crops grown in sandy soils yield early and those grown in clayey soils yield more. Ideal pH for cultivation of crop is 5.5-6.6

**Varieties**

A large number of cultivars and improved varieties differing in size, shape and colour of fruits are grown in India. Since consumer preference varies from region to region and from district to district, judicious selection of varieties plays an important role in success of brinjal cultivation. Quite a large numbers of local cultivars like Banaras Giant, Wayanad Giant, Mukthakeshi and Manjiri Gota are grown in specific areas.

Fruits of some local cultivars exhibit bitterness due to presence of glycolalkaloids like solanin. Generally glycol-alkaloid content varies from 0.37 to 4.83 mg/ 100g in most of cultivars. High glycol –alkaloids (20 mg/100g fresh weight) produces bitter taste and off flavour. Varieties also vary for content of polyphenol oxidase which imparts brown discoloration when the fruits are cut open.

Pest and disease resistant/ tolerant varieties with upright and sturdy growth habit, high yield, fruits with soft flesh, low seediness, low solanin content and attractive glossy skin are generally preferred for commercial cultivation.

The important features of improved brinjal varieties developed in India are furnished below:

| <b>Developing institution</b> | <b>Variety</b>      | <b>Special features</b>  |
|-------------------------------|---------------------|--|
| IIHR, Bangalore               | Arka Kusumakar      | Small green fruits borne in clusters of 5-7                        |
|                               | Arka Sheel          | Medium long deep shining purple fruits.                            |
|                               | Arka Nidhi (BWR 12) | Resistant to bacterial wilt, medium long blue black glossy fruits. |
|                               | Arka Shirish        | Extra long fruits with green colour                                |
|                               | Arka Neelkanth      | Resistant to bacterial wilt, short                                 |

|  |                     |   |
|--|---------------------|---|
|  |                     | purple fruits borne in clusters of two  |
|  | Arka Keshav         | Resistant to bacterial wilt, Fruits long red purple and glossy.               |
| IARI, New Delhi                                | Pusa Kranti         | Oblong, 15-20 cm long dark purple fruits                                      |
|  | Pusa Purple Cluster | 10-12 cm long deep purple fruits borne in clusters tolerant to bacterial wilt |
|  | Pusa purple long    | Long purple glossy fruits   |
|  | Pusa Anupam (KT4)   | Cylindrical purple fruits borne in clusters                                   |
|  | DBR 8               | Round dark purple fruits of 295g  |
|  | Pusa purple round   | Fruits round and purple   |
|  | Pusa Bairav         | Resistant to phomopsis blight. Fruits long and purple                         |
|  | Pusa Uttam          | Early variety with oval dark purple fruits                                    |
|  | Pusa Utkar          | Early variety with round dark purple fruits                                   |
|  | Pusa Bindu          | Early. Small oval-round violet-purple fruits                                  |
|  | Pusa Ankur          | Fruits oval round, dark purple and glossy                                     |
| Kerala Agril. University, Thrissur             | Surya (SM 6-7)      | Resistant to bacterial wilt, small purple oval fruits                         |
|  | Swetha (SM6-6)      | Resistant to bacterial wilt, small white elongated fruits                     |
|  | Haritha             | Resistant to bacterial wilt, long light green elongated fruits, Long duration |
| Tamil Nadu Agricultural University, Coimbatore | CO 1                | Oblong, pale green fruits   |

|                                   |                     |  |
|-----------------------------------|---------------------|--|
|                                   | CO 2                | Oblong fruits having dark purple streaks under pale back ground  |
|                                   | PKM 1               | Small ovate fruits with green stripes, developed through mutation breedings  |
|                                   | PLR 1               | Small to medium sized egg shaped fruits with purple colour   |
|                                   | MDU 1               | Large, round and purple fruits   |
|                                   | KKM 1               | Small, white coloured and egg shaped fruits borne in clusters of 2-4   |
| Annamalai University, Tamil Nadu  | Annamalai           | Aphid resistant. Fruits oblong, purple, few thorns on the calyx  |
| GBPUA&T, Pantnagar                | Pant Rituraj        | Large purple round fruits  |
|                                   | Pant Samrat         | Resistant to bacterial wilt and phomopsis blight, less infestation of shoot and fruit borer and jassids. Fruits long and purple. |
| Haryana Agrl. University, Hisar   | Hisar Pragati (H 7) | Fruits dark bright purple, tolerant to little leaf round, dark and bright purple fruits oblong dark purple fruits.               |
|                                   | Hisar Shyamal (H8)  | Round, dark and bright purple fruits.  |
|                                   | Hisar Jamuni        | Oblong dark purple fruits  |
| Punjab Agrl. University, Ludhiana | Jamuni GOI (S 16)   | Long plummy and shining purple fruits  |
|                                   | Punjab Barsati      | Tolerant to fruit borer, fruits medium long and shining purple   |
|                                   | Punjab Neelam       | Long purple fruits   |
|                                   | Punjab Sadabahar    | Long black purple fruits   |
|                                   | PH 4                | Fruits medium to long, thin and dark purple  |
| CSAUA&T, Kanpur                   | T-3                 | Round light purple fruits with white   |



|                       |                        |  |
|-----------------------|------------------------|--|
|                       |                        | styler end   |
|                       | KS 331                 | Long purple fruits of 218 g weight   |
|                       | Azad Kranti            | Medium thick and long purple fruits tapering to distal end   |
|                       | Azad B 2(KS 224)       | Solitary round purple fruits of 135 g  |
| MPKV, Akola           | Aruna                  | Fruits round to oval with light purple rind  |
| DARL, Pithoragarh     | ARU 1                  | Long light purple fruits borne single or double  |
|                       | ARU 2 C                | Resistant to bacterial wilt, cylindrical and violet fruits borne in clusters of 4-6  |
| CHES, Ranchi          | CHBR -1                | Round dark violet fruits   |
| JNKV, Jabalpur        | JB 15                  | Long violet purple fruits of 270 g weight  |
|                       | JB 64-1-2              | Small round purple fruits of 95 g weight   |
| OUA &T<br>Bhubaneswar | Utkal Tarini (BB 77)   | Resistant to bacterial wilt, mediumsized oblong deep purple fruits   |
|                       | Utkal Madhurai (BB 44) | Resistant to bacterial wilt, mediumlong green fruits with white striped distal end   |
|                       | UTkal Jyothi (BB 13)   | Tolerant to bacterial wilt, small to medium long purple fruits   |
|                       | Utkal Kesari (BB 26)   | Tolerant to bacterial wilt, small to medium long purple fruits<br>Tolerant to bacterial wilt. Fruits deep purple, medium large, cylindrical with slightly thick basal portion. |
| RAU, Sabour           | Green long             | Long green fruits of 135 g   |
| APAU, Hyderabad       | Gulabi (Sel 4)         | Light purple, medium long fruits   |

|                           |                         |   |
|---------------------------|-------------------------|---|
|                           |                         | borne in clusters of 3-5 suitable for long distance transport. Very small purple round fruits |
|                           | Shyamala<br>Bhagyamathi | Oblong and deep purple fruits   |
| PRVV, Akola               | Aruna                   | Small round deep purple fruits  |
| MPKV, Rahuri, Maharashtra | Vaishali                | Fruits oblong, purple with white stripes  |
|                           | Pragati                 | Fruits oval, purple with white stripes and spines on peduncle                                 |

### Exploitation of Heterosis

Brinjal continues to be a choice of breeders for exploitation of heterosis due to hardy nature of crop, comparatively large size of flowers and large number of seeds in a single fruit enabling production of a large number of F1 seeds with a single act of pollination. Highly varied consumer acceptance from region to region also demands for development of a large number of high yielding F1 hybrids. Hand emasculation and pollination are still followed in the hybrid seed production of brinjal. Quite a large number of heterotic hybrids are developed in ICAR institutes and State Agricultural universities and details are furnished below:

| Developing institution | Hybrid        | Parents                           | Special features                                     |
|------------------------|---------------|-----------------------------------|--|
| IARI, New Delhi        | Pusa Anmol    | Pusa Purple long<br>x<br>Hyderpur | Produce 80% more than Pusa Purple Long, yield 62t/ha |
|                        | Pusa Hybrid 5 | -                                 | Long glossy dark purple fruits. Yield 51.6t/ha       |
|                        | Pusa Hybrid 6 | -                                 | Early. Round glossy purple fruits. Yield 45.0t/ha    |
|                        | Pusa hybrid 9 | -                                 | Early dark purple round fruits. Yield 56.0t/ha       |
| IIHR, Bangalore        | Arka Navneeth | IIHR 221 x                        | Large dark purple round to slightly                  |

|   |                          |                                     |  |
|---|--------------------------|-------------------------------------|--|
|   |                          | Supreme                             | oval fruits. Yield 65-75 t/ha  |
|   | Arka Anand               | IIHR -3 x<br>SM6-6                  | Resistant to bacterial wilt, fruits green long & medium sized (50-55g). yield 65t/ha         |
| Tamil Nadu<br>Agricultural<br>University,<br>Coimbatore | COBH 1                   | Cross<br>between<br>EP 45 x<br>CO 2 | Fruits are purple in colour. Highyield 56.40 t/ha  |
| Haryana Agrl.<br>University,<br>Hisar                   | Hisar Shyamal<br>(H8)    | Aushey x<br>BR 112                  | Resistant to bacterial wilt, tolerant to little leaf, rufts round bright purple              |
| Kerala Agrl.<br>University,<br>Thrissur                 | Neelima                  | Surya x<br>SM116                    | Resistant to bacterial wilt, protracted fruiting. Round to oval purple fruits. Yield 62 t/ha |
| GAU, Anad   | ABH 1                    | M2 x M35                            | Early variety with purple oval fruits, yield 37.0t/ha  |
| CSAUA&T,<br>Kanpur                                      | Azad Kranti              | Pusa<br>purple<br>Loong x<br>BGL    | Long dark purple fruits  |
| GBPUA &T,<br>Pantnagar                                  | Pant Brinjal<br>Hybrid 1 | PB 121 x<br>PB225                   | To learnt to bacterial wilt. Fruit long and borne in clusters                                |

In addition, a large number of F1 hybrids are marketed by private seed companies. Supriya, Suphal (IAHS), Kalpatharu, Ravaiya (Mahyco), Kanhaiya, Novkiran, Pragati (Sungro Seeds), Apsara, Nisha (Namdhari) etc are a few commercial hybrids popular among farmers.

### Season

In hills, brinjal is sown during March and transplanted during April. In,lains there are three seasons for growing brinjal.

### Autumn-winter crop

Crop is sown in June and transplanted in July Spring -summer crop: Crop is sown in early November and transplanted in January-February. Due to low temperature, seedlings take

6 to 8 weeks for attaining normal size for transplanting and nursery beds are to be protected from frost.

### **Rainy season crop**

Seeds are sown in March-April and transplanted during April-May. Being a low priced vegetable, rainy season crop is the most economical in many parts.

### **Sowing**

Seeds are sown in nursery bed and transplanted to main field after four weeks during summer and after 7 to 8 weeks during winter, when it is 8 - 10 cm tall. Depending on growth of varieties and seasons of cultivation, 300 to 3:500 g seeds are required for one hectare. Since brinjal seedlings grow fast, sufficient care must be taken to sow seeds as thin or loose as possible. Hardened seedlings withstand transplanting shock better and establish well in main field.

### **Main field preparation and transplanting**

Proper drainage is essential for growth of brinjal. Soil should be prepared to a fine tilth by 4 to 6 ploughings. FYM should be incorporated in soil at the time of final ploughing. Seedlings are transplanted in levelled land in plots of convenient size for irrigation. It may be grown on raised beds/ ridges during rainy season. In undulating land, in order to avoid soil erosion, small pits are dug at the point of planting and seedlings are planted.

Spacing depends on variety, season and fertility of soil. For long duration spreading varieties, a spacing of 75-90cm x 60-75 cm and for bushy and non-spreading varieties a distance of 45-60cm on either side are given. For early and less spreading varieties, paired row planting is advantages due to, easiness in harvesting and other cultural operations.

### **Manures and fertilizers**

Brinjal is a long duration crop with high yield potential. Flower and fruit production will be adversely affected when crop is grown under low fertility conditions. Depending on availability, 25 tonnes of FYM/ha may be incorporated in soil at the time of final ploughing. Application of wet cow dung as a band, 10 -12 cm away from the plant, followed by earthing up at fortnightly interval during rainy season is a common practice for high productivity in Kerala.

Fertilizer requirement of crop varies with variety, season and type of soil. Fertilizer requirement for targeted production in Co-2 under Tamil Nadu condition is estimated and 7.6 kg N, 1.4 kg P and 17.3 kg K/ha are required to produce one tonnes of fruits. Fertilizer studies at various centres of AICRP (Vegetables) indicated varying results. Under Bangalore condition, 150 kg N and 100 Kg P2O5 were optimum while at Hisar it was 100 kg N and 60 kg P2O5/ha. For a balanced nutrition, 30 to 60 kg ~O is included in fertilizer package of brinjal in most of the

states. 1/3 N, full P and full K should be applied as basal dose and remaining N in 2 split doses, 1/3 at 25 days after planting and remaining 1/3 N 45 days after.

Application of fertilizers in Tamil Nadu : Apply FYM 25 t/ha. N 50 kg, P 50 kg and K 30 kg/ha as basal dose, N 50 kg/ha 30 days after transplanting during earthing up. Apply 2 kg of Azospirillum and Phosphobacteria in the mainfield at planting. Spray 2 ppm (1 ml in 500 lit.) Triaccontanol plus Sodium borate or Borax 35 mg/lit. of water 15 days after transplanting and at the time of full bloom to increase the yield.

### **Irrigation**

Though brinjal cannot tolerate water logging, timely irrigation is essential especially for fruit set and development. In plains, irrigation is required at every third or 4th day during summer while in winter it should be at 10-15 days interval. During winter, care should be taken to keep soil moist to avoid crop loss due to frost injury. Being a row planted crop, drip irrigation is advantageous and water used in drip irrigation is only 24.47 cm compared to 69.18 cm under furrow method.

Brinjal is mainly grown as a rainfed crop in high rainfall states like Kerala by transplanting seedlings just before onset of South West monsoon. Here also transplanted seedlings should be given one or two life irrigations for initial establishment.

### **Intercultivation**

It is essential to keep the field free of weeds especially at initial stages of crop growth and is usually done by 2-3 light hoeing or earthing up. This facilitates better aeration to root system and gives support to plants. Application of fluchloralin @ 1.5 kg a.i./ha as a pre-emergent weedicide, applied one week after transplanting seedlings, followed by one hand weeding at 30 days after planting controls a broad spectrum of weeds. Use of black polythene mulches is also efficient for suppression of weeds and for better growth of plants.

### **Application of growth regulators**

Whole plant spray of 2-4, D (2 ppm) at an interval of one week from 60 -70 days after planting from commencement of flowering increase fruit set, early yield and total yield in brinjal. Spray Mixtalool (long chain C24-C34 aliphatic alcohol) at 4 ppm, 4-6 weeks after transplanting, is also effective and gave additional yield of 7.1% in F1 hybrid Arka Navneet.

### **Harvesting**

Brinjal fruits are harvested at immature stage after attaining full size, but before losing its glossy appearance. Dullness of fruit indicates over maturity. Usually fruits are harvested along with its stalk with a slight twist by hand. In some varieties, a sharp knife is also used for harvesting fruits along with fleshy calyx and a portion of fruit stalk. The harvested fruits are

graded and packed in baskets or in loose gunny bags. Care should be taken to remove the fruits affected by Phomopsis blight.

### **Yield**

Early short duration varieties: 20-30 t/ha Long

duration varieties: 35-40 t/ha

Fl hybrids: 55-80 t/ha

### **Storage**

Fruits can be stored for 7-10 days in a fairly good condition at 7.2-10°C with 85-90% RH. Keeping quality of fruits varies with variety. It is better to store at 20°C than at 6°C and in perforated polythene bags than under open condition.

### **Seed production**

Though brinjal is considered a self pollinated crop, varying amount of cross pollination takes place because of heterostyly. Cross pollination is mainly through honey bees and bumble bees. To encourage pollination, it is advisable to plant Mimosa pudica in the vicinity of brinjal plot. Isolation distance recommended for brinjal is 200 m for foundation seed and 100 m for certified seed.

To maintain genetic purity, rouging should be conducted at pre flowering, flowering and initial fruiting stages. Leaving initial one or two harvests for vegetable purpose is advisable for detection and removal of off types and to avoid chances of contamination from off types.

Fruits are harvested at full ripe stage and crushed with help of a wooden hammer or stone. Crushed fruits are soaked overnight in buckets for softening. This results in easy separation of seeds from pulp when pulp is stirred next day morning. Seeds are then washed with running water and dried under open sun light for half to one hour and later under partial shade till 8% moisture is reached. Depending on variety used and agronomic packages followed, yield varies from 100-350 kg/ha.

### **Pests**

Pests Fruit and shoot borer, jassids, epilachna beetle and mites are the major pests.

#### **Fruit and shoot borer (*Leucinodes orbonalis*)**





The larvae bore into tender parts causing drooping of young shoots and rotting of fruits. Effect plant parts should be removed along with larvae and destroyed crushing or by immersing in insecticide solution.

### **Jassids (*Empoasca* spp.)**



Adults and nymphs suck sap by feeding from under surface of leaf resulting in typical yellowing and drying up of leaves. Varieties . Punjab Barsati and Pusa Kranti have tolerance to jassid attack.

### **Epilachna beetle**

Yellow coloured nymphs seen on under surface leaves feed on foliage resulting in skeletonization of leaves. Since nymph are seen in large numbers on a single leaf plucking infested leaves along with nymph is an effective way control of pest.

Five sprays of cipermethrin @ 30 g a.i./ha or ethofenprox @ 75 g a.i/ at 15 days interval starting from 30 DAT is effective for control of jassi and fruit and shoot borer. Four sprays of carbaryl (800 g a.i/ha) at days interval starting from 30 DAT is also equally effective for control- pest.

### **Mites**

Red spider mites and other mites seen on under surface of leaf suck sap and cause characteristic yellowing. Spray of neem oil garlic solution in initial stage of attack is effective for control of mites. Under severe infestation spray Kelthane (0.03%) or metasystox (0.03%).

### **Diseases**

Diseases Bacterial wilt Fusarian wilt, phomopsis blight, little leaf, mosaic and damping off are the major diseases.

### **Bacterial wilt (*Ralstonia solanacearum*)**

Disease results in sudden wilting and drying up of plants. Plants are more affected during flowering and early fruiting stages. Grow resistant varieties like Swetha, Haritha, Arka Nidhi, Arka Neelkant, Pant Samrat, Utkal Tarini, Utkal Madhuri and F1 hybrid Neelima in wilt prone areas.

### **Fungal wilt**

Fungi like *Fusarium* and *Verticillium* cause wilting of plants. Lower leaves turn yellow and progress slowly leading to browning and complete death of plants. *Pythium* and *Phytophthora* also cause collar rot and wilting of plants. Crop rotation burning with dry leaves prior to planting and drenching the soil with copper oxychloride are effective for control of wilt.

### **Phomopsis blight**

This is a major disease particularly when crop is raised for seed production. Soft and water soaked brown lesions of fruits which turn black and mummified in appearance are the common symptoms. Leaves and stem may also develop dark brown spots. Seed treatment with Bavistin (1 g a.i./kg) and seedling dip in Bavistin (0.05%) for 30 minutes before transplanting, followed by two sprays of Bavistin are recommended for control of disease.

Little leaf:



Diseased plants produce small sized leaves and result in bushy and stunted growth and will not produce fruits.

### **Mosaic**

Uproot and destroy mosaic and little leaf affected plants as soon as symptoms are noticed. Avoiding ratooning and raising seedlings in seed beds treated with Phorate (1.25 kg a.i./ha), treating seedlings with systemic insecticides for eight hours followed by application of Phorate (1.25 kg a.i./ha) at 21 DAT control both little leaf and mosaic.

### **Damping off**

This is a major nursery disease. Affected seedlings topple over and die in patches. For reducing disease incidence sow seeds as loose/ thin as possible on raised beds. Adequate drainage and drenching nursery bed with Bavistin (0.1 %) control disease effectively.

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## **CUCUMBER** (*Cucumis sativus* L.)

Cucumber is a common cucurbitaceous summer vegetable. Cucumber plant, as a creeper, has a climbing or trailing habit. The tender fruits are eaten raw or with salt in salad. They are also used as cooked vegetables. Fruits are good for people suffering from constipation, jaundice and indigestion.

### **Cultivars**

Meghalaya Local, Japanese Long Green, Straight Eight, Pusa Sanyog.

### **Climate and Soil**

Cucumber is a warm season crop and grows best at a temperature of 18-24 °C. It does not withstand frost.

Cucumber can be grown in all types of soil from sandy to heavy soil. Loam, silt loam and clay loam soils are best for getting higher yield.



### **Field Preparation**

Soil should be ploughed thoroughly 3-4 times through digging with spade. Well rotten compost or FYM is mixed at the time of ploughing. Apply BHC @ 15-20kg/ ha to control termites and cutworms in the soil at the time of land preparation.

### **Seed Rate**

2.5 to 3.5 kg/ha

### **Time of Sowing**

Cucumber is cultivated both as summer and rainy season crop. Summer crop:

January to February

Rainy season crop: June to July

In hills of Meghalaya the seeds are sown in April.

### **Spacing**

1.5 to 2.5m (row to row) x 60 to 90cm (plant to plant)

### **Manure and Fertilizer**

Well rotten FYM @ 10-15 t/ha should be applied at the time of land preparation. NPK @ 100:60:60 kg/ha should be applied at the time of planting.

### **Intercultural Operation**

**Weeding:** During early stage, the crop should be kept weed free by giving shallow cultivation.

**Staking:** The plants should be provided a suitable support made of bamboo sticks particularly in rainy season to check against rotting of fruits.

### **Irrigation**

The summer crops require frequent irrigation at an interval of 4-5 days. No irrigation is given in rainy season crops.

### **Plant Protection**

**Red pumpkin beetle (*Aulacophora foevicollis*)** -The larvae and the adult of this pest caused damage by eating away young leaves and flowers at the seedling and flowering stage. The grub bores into the roots and fruits lie on the ground and pupate in the soil. Hand picking and dusting kerosinised ash controls this pest. Spraying the crop with Malathion 50EC @ 2ml/1 of water is also recommended.

**Epilachna beetle (*Epilachna sp.*)** -The adult and grub feed voraciously on the leaves and tender part of the plant leaving skeletonized patches and lace like appearance on leaves which later dry away. Spraying the crop with Endosulphan @ 2ml/1 of water is recommended to manage this pest.

**Powdery mildew-** This disease is caused by fungus *Erysiphe cichoracearum*, symptom first appears as white circular patches on the under surface of the leaves. In severe cases, the patches coalesce and cover both the surface of the leaves and defoliation occurs. Fruits of the affected plant remain small and do not develop fully. This disease can be controlled by dusting sulphur or spraying Karathane @ 2ml/1 of water.

**Downy mildew** -This disease is caused by fungus *Pseudoperonospora cubensis*. It is prevalent in areas of high humidity especially when summer rains occur regularly. The disease is characterized by formation of yellow, angular spots on upper surface of leaves. The disease spreads rapidly killing the plant quickly through rapid defoliation. Application of fungicidal spray such as Dithane M-45 once a week is effective in controlling this pest.

**Cucumber mosaic virus-** This disease is transmitted by aphids. Mottled leaf with roughened surface occurs. In severe cases, the plants are yellow and dwarfed and bear little or no fruit. Crop rotation with non-cucurbitaceous crops preferably cole crops and spraying the crop with Rogor @ 1 ml / 1 of water (controlling the insect vector) are the recommended control measures of this disease.

### **Harvesting and Yield**

The full grown fruit should be harvested when they are still green. Delay in harvesting causes the fruit to become unfit for marketing.

The average yield is 80-120q/ha.

## **Cultivation of important fruit trees**

### **Mango Cultivation**

Mango (*Mangifera indica*) is the leading fruit crop of India and considered to be the king of fruits. Besides delicious taste, excellent flavour and attractive fragrance, it is rich in vitamin A&C. The tree is hardy in nature and requires comparatively low maintenance costs.

Mango occupies 22% of the total under fruits comprising of 1.2 million hectares, with a total

production of 11 million tonnes. Uttar Pradesh and Andhra Pradesh are having the largest area under mango each with around 25% of the total area followed by Bihar, Karnataka, Kerala and Tamil Nadu.

Mango fruit is utilised at all stages of its development both in its immature and mature state. Raw fruits are used for making chutney, pickles and juices. The ripe fruits besides being used for dessert are also utilised for preparing several products like squashes, syrups, nectars, jams and jellies. The mango kernel also contains 8-10 percent good quality fat which can be used for soap and also as a substitute for cola in confectionery.

Fresh mangoes and mango pulp are the important items of agri-exports from India. India's main export destinations for mango are UAE, Kuwait and other Middle East countries with a limited quantity being shipped to European market. Although, India is the largest mango producing country, accounting about 60% of world production, the export of fresh fruit is limited to Alphonso and Dashehari varieties. India's share in the world mango market is about 15 percent. Mango accounts for 40 percent of the total fruit exports from the country. There is good scope for increasing the area and productivity of mango in the country.

#### **Climate :**

Mango can be grown under both tropical and sub-tropical climate from sea level to 1400 m altitude, provided there is no high humidity, rain or frost during the flowering period. Places with good rainfall and dry summer are ideal for mango cultivation. It is better to avoid areas with winds and cyclones which may cause flower and fruit shedding and breaking of branches.

#### **Soil :**

Mango comes up on a wide range of soils from alluvial to laterite provided they are deep (minimum 6') and well drained. It prefers slightly acidic soils (pH 5.5 to 7.5)

#### **Varieties :**

Though there are nearly 1000 varieties of mango in India, only following varieties are grown in different states : Alphonso, Bangalora, Banganpalli, Bombai, Bombay Green, Dashehari, Fazli, Fernandin, Himsagar, Kesar, Kishen Bhog, Langra, Mankhurd, Mulgoa, Neelam, Samarbehist, Chausa, Suvarnarekha, Vanaraj and Zardalu.

Recently some mango hybrids have been released for cultivation by different institutes / universities. A brief introduction to such varieties is presented below :

**Mallika** - It is a cross between Neelam and Dashehari. Fruits are medium sized cadmium coloured with good quality, reported to be a regular bearer.

**Amrapali** - It is a cross between Dashehari and Neelam. It is a dwarf vigorous type with regular and late bearing variety. It yields on an average 16 t/ha and about 1600 plants can be accommodated in one hectare.

**Mangeera** : It is a cross between Rumani and Neelam. It is a semi vigorous type with a regular bearing habit. Fruits are medium sized with light yellow coloured skin, firm and fibreless flesh and sweet to taste.

**Ratna** : It is a cross between Neelam and Alphonso. It is a regular bearer and free from spongy tissue. Fruits are medium sized with excellent quality. Flesh is firm and fibreless, deep orange in colour with high TSS (19-21 Brix).

**Arka Aruna** : It is a hybrid between Banganapalli and Alphonso with regular bearing habit and dwarf in stature. About 400 plants can be accommodated per hectare. Fruits are large sized (500-700 gm) with attractive skin colour. Pulp is fibreless, sweet to taste (20-22 Brix). Pulp percentage is 73 and the fruits are free from spongy tissue.

**Arka Puneet** : It is a regular and prolific bearing hybrid of the cross between Alphonso and the Banganapalli. Fruits are medium sized (220-250 gm) with attractive skin colour, having red blush. Pulp is free from fibre, pulp percentage being 70 percent. Fruits are sweet to taste (20-22 Brix) with good keeping quality and free from spongy tissue. It is a good variety for processing also.

**Arka Anmol** : It is a semi-vigorous plant type from the cross between Alphonso and Janardhan Pasand. It is also a regular bearing and free from spongy tissues. Fruits ripen to uniform yellow colour. Keeping quality of the fruit is very good and it is suitable for export. It has got excellent sugar and acid blend and fruits weigh on an average about 300 g Pulp is orange in colour.

### **Propagation :**

Farmers should always get vegetatively propagated, true to type plants from recognised nurseries. Inarching, veneer grafting, side grafting and epicotyl grafting are the popular methods of propagation in mango.

**Planting** : Land should be prepared by deep ploughing followed by harrowing and levelling with a gentle slope for good drainage. Spacing varies from 10 m x 10 m, in the dry zones where growth is less, to 12 m x 12 m, in heavy rainfall areas and rich soils where abundant vegetative growth occurs. New dwarf hybrids like Amrapali can be planted at closer spacing. Pits are filled with original soil mixed with 20-25 kg well rotten FYM, 2.5 kg single super phosphate and 1 kg muriate of potash.

One year old healthy, straight growing grafts from reliable sources can be planted at the centre of pits along with the ball of the earth intact during rainy season in such a way that the roots are not



expanded and the graft union is above the ground level. Plants should be irrigated immediately after planting. In the initial one or two years, it is advisable to provide some shade to the young plants and also stake to make them grow straight.

### **Training and pruning :**

About one meter from the base on the main trunk should be kept free from branching and the main stem can be allowed thereafter spaced at 20-25 cm apart in such a way that they grow in different directions. Branches which cross over/rub each other may be removed at pencil thickness.

### **Fertiliser Application :**

In general, 170 gm urea, 110 gm single super phosphate and 115 gm muriate of potash per plant per year of the age from first to tenth year and thereafter 1.7 kg, 1.1 kg, and 1.15 kg respectively of these fertilisers per plant per year can be applied in two equal split doses (June-July and October). Foliar spray of 3% urea is recommended before flowering in sandy areas.

### **Irrigation :**

Young plants are watered frequently for proper establishment. In case of grown up trees, irrigation at 10 to 15 days interval from fruit set to maturity is beneficial for improving yield. However, irrigation is not recommended for 2-3 months prior to flowering as it is likely to promote vegetative growth at the expense of flowering.

### **Inter cropping :**

Inter crops such as vegetables, legumes, short duration and dwarf fruit crops like papaya, guava, peach, plum, etc. depending on the agro-climatic factors of the region can be grown. The water and nutrient requirements of the inter crops must be met separately.

### **Plant Protection :**

Mango is prone to damages by a large number of pests, diseases and disorders. The recommended control measures for most important and common among them are briefed below :

**Mango hopper** : Two sprays (at panicles emergency and at pea size of fruits) of carbaryl (0.15%), monocrotophos (0.04%) or phosphamidan (0.05).

**Mealy bug** : Ploughing inter spaces in November and dusting 2% methyl parathion @200 g per tree near the trunk and fixing 20 cm wide 400 gauge polythene strips around the trunk with grease applied on the lower edge in January as prophylactic measures and two sprays of monocrotophos (0.04%) at 15 days interval as control are needed.

**Powdery mildew** : Two to three sprays of wettable sulphur (0.2%) or Kerathane (0.1%) at 10-15 days interval.

**Anthracrose** : Two sprays of Baristin (0.1%) at fortnight interval.

**Malformation** : One spray of 200 ppm NAA in October followed by deblossoming at bud burst stage in December - January.

**Fruit drop** : Regular irrigation during fruit development, timely and effective control of pests and diseases and spraying 20 ppm NAA at pea size of fruits.

#### **Harvesting and yield :**

Graft plants start bearing at the age of 3 - 4 years (10-20 fruits) to give optimum crop from 10-15th year which continues to increase upto the age of 40 years under good management.

#### **Post Harvest Management :**

**Storage** : Shelf life of mangoes being short (2 to 3 weeks) they are cooled as soon as possible to storage temperature of 13 degree Celcius. A few varieties can withstand storage temperature of 10 degree Celcius. Steps involved in post harvest handling include preparation, grading, washing, drying, waxing, packing, pre-cooling, palletisation and transportation.

**Packaging** : Mangoes are generally packed in corrugated fibre board boxes 40 cm x 30 cm x 20cm in size. Fruits are packed in single layer 8 to 20 fruits per carton. The boxes should have sufficient number of air holes (about 8% of the surface area) to allow good ventilation.

Financial institutions have also formulated mango financing schemes in potential areas for expansion of area under mango. Individual mango development schemes with farm infrastructure facilities like well, pumpset, fencing and drip irrigation system etc. have also been considered.

Farm model for financing one hectare mango orchard is furnished in the Annexure I.

**Unit Cost** : The unit cost varies from state to state. The cost presented here is indicative only. The entrepreneurs and the bankers are requested to consult our Regional Offices for the latest information in this regard. The unit cost estimated for this model scheme is Rs.34400/- per ha capitalised upto the fifth year. The break-up details are given in Annexure I.

**Financial Analysis** : Results of financial analysis are indicated below :

NPW at 15% DF : Rs.59058 (+)

BCR at 15% DF : 2.34

IRR : 25.59%

Detailed analysis is presented in Annexure II.

**Margin Money** : The margin money assumed in this model scheme is 5% of the total financial outlay.

**Interest Rate** : Interest rate may be decided by the banks as per the guidelines of RBI.

**Security** : Banks may charge such security as permissible under RBI guidelines.

**Repayment** : The bank loan with interest is repayable within 14 years with 7 years grace period as shown in Annexure-III.

### **Annexure - I**

#### **Cost and Income from Mango Cultivation (Rs. per ha)**

Spacing : 10m x 10m

Plant population : 100

#### **Estimated cost:**

| <b>Sr. No.</b> | <b>Particulars</b>    | <b>Year</b>  |             |             |             |             | <b>Total</b> |
|----------------|-----------------------|--------------|-------------|-------------|-------------|-------------|--------------|
|                |                       | <b>1</b>     | <b>2</b>    | <b>3</b>    | <b>4</b>    | <b>5</b>    |              |
| 1              | Planting material     | 2200         | --          | --          | --          | --          | 2200         |
| 2              | Manures & Fertilisers | 3000         | 1100        | 1100        | 1400        | 1400        | 8000         |
| 3              | Plant protection      | 1100         | 600         | 600         | 700         | 700         | 3700         |
| 4              | Sprayer & implements  | 1500         | --          | --          | --          | --          | 1500         |
| 5              | Fencing               | 2500         | --          | --          | --          | --          | 2500         |
| 6              | Irrigation            | 1800         | 500         | 500         | 500         | 500         | 3800         |
| 7              | Labour                | 3200         | 1200        | 1200        | 1500        | 1500        | 8600         |
| 8              | Intercropping         | 1500         | --          | --          | --          | --          | 1500         |
| 9              | Miscellaneous         | 600          | 500         | 500         | 500         | 500         | 2600         |
|                | <b>Total</b>          | <b>17400</b> | <b>3900</b> | <b>3900</b> | <b>4600</b> | <b>4600</b> | <b>34400</b> |