LEC. 4 MANGO – SOIL, CLIMATE, PLANTING, HIGH DENSITY PLANTING, NUTRIENT AND WATER MANAGEMENT, INTERCROPPING, OFF-SEASON PRODUCTION

Mango *(Mangifera indica),* the king of fruits, is grown in India for over 400 years. India shares about 56% of total mango production in the world. Its production has been increasing since independence, contributing 39.5% of the total fruit production of India. Andhra Pradesh tops in total production, whereas Uttar Pradesh tops area-wise. Andhra Pradesh, Uttar Pradesh, Bihar, Karnataka, Maharashtra, West Bengal and Gujarat together contribute for about 82% of the total production in India.

Climate and Soil

Mango can be grown on a wide variety of soils under varied climatic conditions. It can be grown from alluvial to lateritic soils except in black cotton soil having poor drainage. It grows well in soils with slightly acidic pH. It does not perform well in soils having pH beyond 7.5. Soils having good drainage are ideal for mango.

Mango is a tropical fruit, but it can be grown up to 1,100m above mean sea level. There should not be high humidity, rain or frost during flowering. The temperature between 24 and 27°C is ideal for its cultivation. Higher temperature during fruit development and maturity gives better-quality fruits. The areas experiencing frequent showers and high humidity are prone to many pests and diseases. Thus it can be grown best in regions with a rainfall between 25cm and 250cm. Regions having bright sunny days and moderate humidity during flowering are ideal for mango growing.

Varieties

India is the home of about 1,000 varieties. Most of them are the result of open pollination arisen as chance seedlings. However, only a few varieties are commercially cultivated throughout India.

Commercial mango varieties grown in different states

Andhra Pradesh	Banganapalli, Suvarnarekha, Neelum and Totapuri
Bihar	Bombay green, Chausa, Dashehari, Fazli, Gulabkhas, Kishen Bhog, Himsagar, Zardalu and Langra
Gujarat	Kesar, Alphonso, Rajapuri, Jamadar, Totapuri, Neelum, Dashehari and Langra

Haryana	Chausa, Dashehari, Langra and Fazli
Himachal Pradesh	Chausa, Dashehari and Langra
Karnataka	Alphonso, Totapuri, Banganapalli, Pairi, Neelum and Mulgoa
Madhya Pradesh	Alphonso, Bombay Green, Dashehari, Fazli, Langra and Neelum
Maharashtra	Alphonso, Kesar and Pairi
Punjab	Chausa, Dashehari and Malda
Rajasthan	Bombay Green, Chausa, Dashehari and Langra
Tamil Nadu	Alphonso, Totapuri, Banganapalli and Neelum
Uttar Pradesh	Bombay Green, Chausa, Dashehari and Langra
West Bengal	Fazli, Gulabkhas, Himsagar, Kishenbhog, Langra and Bombay Green

State wise availability of mango in India

Andhra Pradesh	March to mid – August
Bihar	May-end to mid-August
Gujarat	April to July
Haryana	June to August
Himachal Pradesh	mid-June to mid- August
Karnataka	May to July
Madhya Pradesh	Mid-April to July
Maharashtra	April to July
Rajasthan	May to July
Tamil Nadu	April to August
Uttar Pradesh	Mid-May to August
West Bengal	May to August

In India, mango is available from March to mid-August. The north Indian cultivars are alternate-bearer whereas south Indian ones are generally regular-bearer. About 20 varieties are grown commercially. They are

Alphonso

One of the most popular variety of India, it is mainly grown in Ratnagiri area of Maharashtra and to a small extent in parts of south Gujarat and Karnataka. Its fruits are medium-sized (250g), with attractive blush towards the basal end. Pulp is firm, fibreless with excellent orange colour. It has good sugar: acid blend. Keeping quality is good. It is susceptible to spongy tissue.

Banganapalli

A widely cultivated, early-maturing mango of south India. It is the main commercial variety of Andhra Pradesh. Its fruits are large-sized, weighing on an average 350-400g. The pulp is fibreless, firm and yellow with sweet taste. Fruits have good keeping quality.

Bombay Green

It is one of the earliest varieties of north India. Its fruits are medium-sized, weighing about 250g each. Fruits have strong and pleasant flavour. Pulp is soft and sweet.

Chausa

Late-maturing variety of north India, it matures during July or beginning of August. Fruits are large, weighing about 350g each. Fruits are bright yellow with soft'and sweet pulp. It is shy bearing.

Dashehari

One of the most popular variety of north India, it is a mid-season mango. Fruits are medium-sized, with pleasant flavour, sweet, firm, and fibreless pulp. Stone is thin and keeping quality good.

Fazli

This is indigenous to Bihar and West Bengal. Fazli is a late-maturing (August) mango. Fruits are large, with firm to soft flesh. Flavour is pleasant and pulp is sweet and fibre less. Keeping quality is good.

Gulab Khas

It is indigenous to Bihar. Regular and heavy-bearer, it is mid-season mango. Fruits are small to medium-sized. It has rosy flavour. Fruits are ambre-yellow with reddish blush towards the base and on sides. Keeping quality is good.

Himsagar

Very popular in West Bengal, it is a regular-bearing mango. Its fruits are medium-sized, having good quality. Flesh is firm, yellow, fibreless with pleasant flavour. Keeping quality is good.

Kesar

Popular in Saurashtra region of Gujarat, Kesar is an irregular-bearing mango. Fruits are medium-sized. Flesh is sweet and fibreless. It has excellent sugar: acid blend. Fruits ripen to attractive apricot-yellow colour with red blush. It has good processing quality.

Kishenbhog

Indigenous to West Bengal, it is a mid-season mango. Fruits are medium to large-sized, good with a pleasant flavour. There are traces of turpentine. Flesh is firm with few fibres. Keeping quality is good.

Langra

An important commercial mango variety of north India, it is biennial-bearer and a mid-season variety, with good quality fruits. Flesh is firm, lemon-yellow in colour and scarcely fibrous. It has characteristic turpentine flavour. Keeping quality is medium.

Mankurad

It is a mid-season variety, popular in Goa. Fruits are medium-sized with yellow skin. Flesh is firm, cadmium yellow and fibreless. Keeping quality is good.

Neelum

A heavy-yielding, late-season mango in south India, it has regular-bearing habit. Fruits are medium-sized with good flavour. Flesh is soft, yellow and fibreless. Keeping quality is good.

Pairi

A native to coastal Maharashtra including Goa, it is an early-maturing, heavy and regular-bearer mango. Fruits are medium-sized with good quality. It has good flavour with sugar: acid blend. Flesh is soft, primuline-yellow and fibreless. Keeping quality is poor.

Totapuri

Widely grown in south India, Totapuri is a regular and heavy-bearing mango. Fruits are medium to large with prominent sinus. Fruit quality is medium. It has a typical flavour and flat taste. Flesh is cadmium-yellow and fibreless.

A number of selections/hybrids of mango have been evolved. These include Clone C-51 from Dashehari selected at the CISH, Lucknow, and an off-season selection, Niranjan, selected at Parbhani. New clonal selections from Langra and Sunderja have been made at Varanasi and Rewa. A clonal selection, Paiyur 1, has been made from Neelum, in addition to few dwarf polyembryonic selections made in the north-eastern region.

As a result of systematic hybridization, several hybrids have been released. However only a few have become commercially acceptable. Of these, Mallika, Ratna and Arka Puneet are becoming quite popular.

Mango hybrids and their characters

Hybrid	**Place of research**	**Parentage**	**Important characters**
Mallika	IARI, New Delhi	Neelum x Dashehari	Regular-bearers, high TSS, good colour, uniform fruits, moderate keeping quality
Amrapali	IARI, New Delhi	Dashehari x Neelum	Dwarf, regular-bearers, cluster-bearing, small-sized fruits, good keeping quality
Ratna	FRS, Vengurla	Neelum x Alphonso	Regular-bearers, free from spongy tissue and fibre
Sindhu	FRS, Vengurla	Ratna x Alphonso	Regular-bearer, stone thin
Arka Puneet	IIHR, Bangalore	Alphonso x Banganapalli	Regular-bearer, attractive skin colour, medium-sized, free from spongy tissue. Good keeping quality, good sugar, acid blend

Propagation

Mango is a highly heterozygous and cross-pollinated crop. There are 2 types of mango varieties. Most of the varieties in south are polyembryonic and thus give true-to-type seedlings. In north, the varieties grown are monoembryonic and need to be propagated vegetatively.

Mango is propagated on mango rootstock. For raising rootstock, the seeds of mango are sown within 4-5 weeks after extraction otherwise they lose their viability. For sowing the seeds, raised beds are prepared with a mixture farmyard manure, red soil and sand. In some places,

seeds are sown directly in polythene bags. After germination, the leaves turn green in 2-4 weeks. These seedlings are transplanted to polythene covers containing red soil, sand and farmyard manure. Addition of nitrogenous fertilizer to polythene covers after the establishment of plants helps in quick growth of seedlings. The seedlings thus raised should be used for grafting at different ages. Several methods of grafting are practiced. They are:

lnarching: It is one of the most widely practiced methods of grafting. One can get a big-sized plant material for planting with over 95% success rate.

Veneer and side grafting: These can be utilized for preparing a grafted plant material or for *in-situ* grafting, i.e. for the rootstocks which are already planted.

Epicotyl /stone grafting: This method is widely practiced in the Konkan region of Maharashtra. The germinated seedlings of 8-15 days old are used for grafting.

CULTIVATION

Planting

Different systems of planting like square, rectangular and hexagonal are followed at different places. However, square and rectangular systems are also popular. The spacing depends on the vigour of the variety and the cropping system. The planting season varies fron Jun to Sep. The main field is brought to fine tilth. Pits of 1m x 1mx 1m size are dug. These are exposed to sun for about 30 days. Before planting, pits are filled with well-rotten farmyard manure. The top and sub-soil are taken out separately while digging the pits. The grafts should be planted during rainy season. In the *in-situ* grafting, rootstocks are planted in the main field. Then they are raised for 6 months to 1 year. Then the scions of the variety that need to be grown are taken and grafted. This is usually done when humidity is high. After grafting the scions are covered with polythene covers.

High-density planting

High-density planting helps increase the yield/unit area. In north India, mango Amrapali is found amenable for high-density planting with a spacing of 2.5m x 2.5m. Soil drenching with paclobutrazol (2 ml/tree) induces flowering during off year. It has become a commercial practice in Konkan region of Maharashtra. If coupled with pruning, it, helps increase production /unit area in Dashehari. The polyembryonic mango Vellaikolumban when used as rootstock imparts dwarfing in Alphonso.

AFTER CARE AND MANAGEMENT

Training and pruning

Training is an important practice during the first few years after planting. It is essential to space the branches properly to facilitate intercultural operations.

Manuring and fertilization

The nutritional requirement of mango varies with the region, soil type and age. A dose of 73g N, l8g P_2O_2 and 68g K_2O_5 / year of age from first to tenth year and thereafter a dose of 730g N, l80g P_2O_5 and 680g K_2O should be applied in 2 split doses during June-July and September-October respectively.

Spraying of zinc sulphate (0.3%) during February, March and May is recommended to correct the zinc deficiency. Spraying of Borax (0.5%) after fruit set twice at monthly intervals and 0.5% manganese sulphate after blooming corrects boron and manganese deficiencies respectively.

Organic manures and phosphatic fertilizers should be applied immediately after harvest, whereas ammonium sulphate should be given before flowering.

Intecropping

In mango, intercropping helps check weed growth and reduces nutrient losses. Intercropping blackgram-wheat-mango and brinjal-onion-mango gives better monetary benefits. Besides, taking up cover crops like sunhemp, cowpea, pea help to prevent soil erosion.

Irrigation

The young plants upto 2-year-old should be watered regularly. The newly-planted grafts need about 30 litres of water every week. Irrigation during preflowering phase increases flowering. Irrigating grown-up trees after fruit set at 10-day interval increases the yield.

Harvesting and Postharvest Management

Mangoes should be harvested with pedicel. Injury to the fruits during harvesting brings down their quality and also makes them prone to fungal attack. An average mango tree yields 8 tonnes /ha. The number of fruits per tree doing its bearing age generally various from 1000 to 2000 fruits. The productivity of mango is higher in Andhra Pradesh and Bihar. The north Indian

mangoes Langra and Dashehari are alternate-bearers, whereas most of the south Indian mangoes are regular bearers. Mango Mallika and Amrapali are also comparatively regular-bearer.

After harvesting, mangoes are graded according to their size. To maintain the quality, proper packaging is a must. In western region, bamboo baskets are used for packing. A basket contains 50-100 fruits. Straw is used for packing. Wooden boxes are also used in some place. However, now perforated cardboard are generally used. In these boxes either fruits are individually wrapped with tissue paper before packing or paper shavings are used for cushioning.

Minimizing the post harvest losses is one of the most important aspects. Usually green and mature mangoes are stored better than ripe ones harvested from trees. Low temperature storage, controlled atmospheric storage, use of chemical treatment for delaying ripening, irradiation, heat treatment, packaging and shrink wrapping are methods to increase their shelf-life. The temperature of 5-16°C for different varieties is ideal for storing. Mangoes are highly susceptible to low temperature injury. Loss of flavour and development of undesirable softening are major symptoms of chilling injury.

Under controlled atmospheric storage, retardation of respiratory activity, delaying of softening, colour development and senescence of fruits take place. Hence, this method has not been adopted in mango. The combination of waxing (3%) along with hot-water treatment results in good quality fruits with extended storage life. Individual wrapping of fruit imparts uniform colour and reduces shrinkage. Hydro-cooling at 12°-15°C and holding for 2 weeks at 15°C followed by storage for 1 week at ambient temperature gives good storage life to fruits.