

**LEC .8 CITRUS - CLASSIFICATION, SOIL, CLIMATE, VARIETIES,
PLANTING, NUTRIENT AND WATER MANAGEMENT,
INTERCULTURAL OPERATIONS**

CITRUS

Citrus spp. Family : Rutaceae

Citrus fruits include oranges, lemons, limes, pummelo and grape fruit. Being a native of tropical and subtropical region of South East Asia, these have been under cultivation from time immemorial in South China, Malaya and sub-Himalayan parts of Assam. From here, they spread to other tropical and subtropical parts of the world. Next to mango and banana, citrus represents the third most important group of fruits in India. The botanical classification of the genus is highly confusing since more and more inter-specific and inter-generic hybrids are going on added to the list each one deserving a separate species status.

All the edible fruits of citrus come under subgenus *Eucitrus* which can be divided into 5 horticultural groups.

1. Acid group :

Acid lime : *Citrus aurantifolia*

Tahiti or Persean lime : *Citrus latifolia*

Rangpur lime : *C. limonia*

Lemon : *Citrus limon*

Rough lemon : *C. jambhiri*

Citron : *C. medica* (Kidarankai in Tamil, used for pickling)

Sweet lime : *Citrus limettoides*

2. Orange group :

Sweet orange : *Citrus sinensis*

Sour orange : *Citrus aurantium*
(Narthankaai in Tamil, used for pickling)

Multiple leaf orange : *C. multifolia*

Japanese summer grape fruit : *C. natsudaidai*

3. Mandarin group : (loose jacket)

Coorg mandarin, Nagpur

Santra and Kodai orange

: *C. reticulata*

Japanese Satsuma mandarin : *C. unshiu*

Willow leaf mandarin : *C. deliciosa*

King mandarin : *C. nobilis*

Kinnow mandarin : King x willow leaf

Tangerine orange var Dancy

(trifoliolate x mandarins)

: *Citrus tangerina*

4. Pummelo and grape fruit group:

Pummelo : *C. grandis*

Grape fruit : *C. paradisi*

Kumquat : *Fortunella* sp.

5. The fifth group consists of mainly hybrids of different citrus fruits with trifoliolate orange (*Poncirus trifoliata*) and mainly used as rootstock.

e.g. Citrange (*Poncirus trifoliata* x *C. sinensis*) var. Troyer, var. Carrizo

Citrangor (Citrange x *C. sinensis*)

Tangelo (Tangerine x grape fruit)

Citrangquat (Citrange x kumquat)

Mandarinorange: *C. reticulata*

The group of orange is otherwise called Kamala orange. Nagpur santra of Maharashtra, Coorg of Karnataka and Kodai orange of Tamil Nadu. This group is characterized by the loose skin of fruits.

Soil and climate

Subtropical 500-1500 m MSL elevation. A rainfall of about 150 cm to 250 cm is required. The winter should be mild and there should be no strong or hot wind during summer. A medium or light loam with a pH 5.5 to 6.5 would be ideal to grow.

Season : November – December

Planting: Seedlings and budded plants

Spacing: 6 x 6 m pit size 75 cm³ planting during May-June and September – October.

Though the crop is grown as rainfed one, the young plants should be irrigated whenever there is failure of monsoon as well as during summer season.

Manure and fertilizers

Applied twice in a year during June and October.

For Palani hills

Manures & Fertilizers	1year	II year	III year	IV year	V year	VI year on wards
FYM	10	15	20	25	25	30
N	0.100	0.200	0.300	0.400	0.500	0.600
P	0.040	0.80	0.120	0.160	0.160	0.200
K	0.050	0.100	0.200	0.300	0.300	0.400

For shervaroyan hills (for trees above 6 years old)

700: 375:600 g/tree NPK along with VAM (*Glomus fasciculatus*) @ 1 kg/tree. Manures are applied in the basin 70 cm away from the trunk and incorporated. Application of lime or dolomite at 4 kg/tree during January – February once in 2-3 years (not mixed with chemical fertilizer).

Micronutrient

ZnSO ₄ – 600 g	} In 450 lit of water applied during new flush
MnSO ₄ – 600 g	
MgSO ₄ – 600 g	
FeSO ₄ – 600 g	

After cultivation

Removal of water shoots

Rootstock sprouts

Dead and diseased shoots

Removal of laterals of the main stem upto 45 m from ground level

Basins should be provided for each tree with gradient slope.

Growth regulators

To increase the fruit retention spraying the trees at flowering and again at marble stage with 2,4-D at 20 ppm or NAA 30 ppm.

Harvest: Starts bearing from 3-5 year after planting in budded plants. Incase of seedlings 5-7 years.

Yield: 15-20 t/ha/yr.

A small crop can be obtained from 4 year old tree and the yield will be higher from 7th year. From flowering to maturity it takes 9 months.

Varieties**1. Kodai Orange** (*Citrus reticulata*)

Trees are vigorous, fruits are very small characterized by loose rind and medium flavour. But it is a heavy seeded variety.

2. Nagpur Santra (*Citrus reticulata*)

It is the most important commercial cultivar of India. This cultivar is considered to be one of the finest mandarins in the world orange vigorous growing variety. Fruits are

medium to subglobose having a loose rind. Flesh is fine textured with abundant juice.

Fruits mature in January – February.

3. **Coorg** (*Citrus reticulata*)

Medium to large fruits, bright orange with a loose rind. It has a good flavour, ripens later than Nagpur Santra. It is a regular bearer. It is the commercial variety in the coorg region of Karnataka.

In Darjeeling district of West Bengal, the variety grown is known as Darjeeling orange and it is Desi in Punjab. In Sikkim, the mandarin cultivar grown is known as ‘Sumithira’ while in Meghalaya it is called as ‘Khasi Mandarin’ or ‘Sohniamtra’.

4. **Sastuma Mandarin** (*Citrus unshiu*)

It is a Japanese variety with small spreading tree. Fruits are seedless with thin rind having orange colour at maturity. The quality of fruit is excellent with good blend of sugar and acidity.

5. **King Mandarin** (*Citrus nobilis*)

It is a commercial variety of USA. The trees grow 5-6 M, petioles narrowly winged small, flattened, orange, red fruits with distinctly sweet pulp which is juicy and of excellent quality.

6. **Willow Leaf Mandarin** (*Citrus deliciosa*)

It is another commercial variety of USA. Trees medium sized with drooping growth habit. The distinctive characteristics are presence of mild and pleasant aromatic flavour in fruit juice, plump spherical seeds, high degree of seed polyembryony and marked alternate bearing tendency of the trees.

7. **Kinnow (King x Willow leaf)**

It is a hybrid between king and willow leaf mandarins. It was developed by Dr. H.B. Frost at citrus Experiment Station, California 1915. It has performed very well in Pakistan, Punjab, Uthrangal, Haryana, Karnataka and foot hills of Himachal Pradesh. This hybrid cultivar produces excellent quality fruits and holds export potential. Fruit medium in size, globose to slightly oblat, rind thin rather adherent for a mandarin but peelable, tough and leathery, surface very smooth and glossy, colour yellowish orange at maturity. Segments (9 to 10) do not separate easily, very juicy, flavour rich aromatic and distinctive, TSS 10% brin, acidity 0.8%. Seeds numerous, (2 to 2H) polyembryonic and cotyledone

pale greenish yellow.

8. Dancy Tangerine (*Citrus tangerine*)

This is the commercial variety of Florida in united states.

[(deliciola as male parent) experiment station California in 1915. It was first quality introduce in Punjab.

Plants are medium to large, erect, symmetrical, dense foliage with a few scatted spaes, leaves broadly lanceolate.]

9. Khasi Mandrin

This cultivar is commercially grown in the North – East region of India. It is mainly grown as seedling trees. The cultivar produces excellent quality fruits with depressed globose bright orange, surface smooth and glossy, stalk end even or obtuse, Occasionally short necked rind thick, adherence very slight, segments 8 to 13 usually 10, pulp vesicle uniformly orange coloured coarse but melting, flavour agreeable, juiced abundant and orange colour, sweetness and acidity well blended, seeds 10 to 15, cotyledons green, polyembryonic.

10. Clementine:

This cultivar is native of Algeria. The cultivar is monoembrynic, matures early and produces fruits of excellent quality.

11.Dancy:

Dancy is the most important cultivar of USA. It matures mid season, it is of excellent quality, productive with a tendency to alternate bearing Dancy is closely related to ladu and keonla cultivasrs of India.

12. Beaury:

It is a popular mandarin cultivar of Australia. The cultivar is similar to Dancy is closely related to Ladu and keonla cultivars of India.

13. Campeona:

It is a large fruited mandarin cultivar of increasing importance in Argentina and Uruguay.

14. Ellendale:

It is the principal late ripening cultivar of Australia. The fruits are large sized with attractive colour and good keeping quality.

15. Emperor:

It is a leading cultivar of Australia Frit large, early mid season in maturity but quality deteriorates rapidly if stored on tree after ripening.

16. Ponkan

Ponkan is the famous and highly reputed cultivar of South China and Formosa. It is the foremost tropical mandarin cultivar, matures in mid-season, highly productive and strongly alternate in bearing.

17. Desi

It is mainly grown in Punjab and adjoining hills of Himachal Pradesh. Fruits orange colour uniform, golden yellow, rind medium thick some what thicker than coorg mandarin, segments vary between 7 and 10; pulp light reddish yellow, texture tender, sufficiently juicy, acidic but moderately flavored; seeds few, usually 3-7.

18. Darjeeling orange

Also known as sikkim orange and is cultivated widely in and around Darjeeling hills. The trees are vigorous and prolific bearer. Fruits are relatively small in size, somewhat flat in shape colour yellowish to orange when fully ripe; rind thin, adherence little; juice plenty and sweet with good flavour ; seeds are few.

Propagation

Most of the Mandarin cultivars are propagated through seeds except kinnow and Nagpur mandarins; usual practice in coorg, Assam and North Eastern hills is to use seedlings as planting material. But with concerted efforts made to find out suitable rootstocks for different regions, orchardists have shifted to vegetative methods, particularly T. budding because budded plants bear early, tolerant to biotic and abiotic stress. The seedling trees not only bear late but also tend to become thorny and grow tall and slender.

By seed

For quality planting material, select uniformly matured fruits from healthy, true to type and heavy bearing plants to extract seeds. Freshly extracted seeds should be mixed with ash and dried in shade otherwise, they may lose their viability seeds are sown at a distance of 2 – 3cm. Germination may take place within 3 – 4 weeks. Since the seeds are polyembryonic growth are rogued out and the rest that are produced from

the cells of nucleus are allowed to grow. The seedlings thus selected are more or less uniform in growth and production.

By ' T ' Budding

Budding is done using the buds of bud wood taken from the disease free mother plants orn Rangpur lime, Cleopatra, Jatti khatti karna katta and Troyer citrange. Rangpur lime is a vigorous, hardy rootstock with good adaptability to a wide range of soil particularly heavy soil, tolerant to tristeza and salt; it is susceptible to footrot, exocortis and xyloporosis. Cleopatra mandarin is the most salt tolerant root stock with the ability to exclude sodium and chloride taken up by root system. It is tolerant to tristeza, exocortis and fairly tolerant to foot rot. Rough lemon, well adapted to high sandy soils. IT is susceptible to foot rot and scab and tolerant to tristeza. This is the most important rootstock for light soils Troyer citranges are used in areas where cot of hardiness and resistance to tristeza are necessary they are also resistant to foot rot but susceptible to exocortis

Karna khatta (*Citrus karma*)

It is extensively used as a root stock in North India.

Seeds of identified root stock for a particular area should be extracted from fully matured, healthy fruits. They are sown in lined (10-15cm deep) on raised seed beds inside a polyethylene house. About 1 – 2 months old seedlings are shifted to secondary beds. These are finally budded when they attain a height of 25-30cm and 1-2cm diameter. Scion should be selected from healthy, vigorous, matures, virus free and high yielding trees. They should also be free from water sprouts and chimeras.

Further use of dormant scion bud wood from past season's growth is used after it has hardened. The bud wood should be taken from round or cylindrical green twigs. T budding is done on one and a half to 2 years old seedling. In about 6-9 months, the budded plants will be ready for transplanting in the main field.

Cultivation

Planting: Generally, planting is done during monsoon in all mandarin growing areas i.e., June – December. In sub mountainous tracts, where planting is generally done on slopes, proper terraces are necessary, while in plains the land should be leveled properly. Pits of 45 cubic centimeters are dug at a spacing of 6 x 6 m and filled with FYM, sand and top soil and then basins are formed. The buddlings are planted in the center of the pits and irrigated.

In N-E parts of India, Khasi mandarins are very closely spaced (4.5 x 4.5 m) is ideal for kinnow budded on Jattikhatti. Kinnow can be grown successfully under high density planting by using Troyer citrange as a rootstock and by spacing the plants 1.8 x 1.8 m, accommodating 3000 lr/ha. The optimum spacing for Nagpur mandarin is 6 x 6 m when budded on Rough lemon. In Karnataka, coorg mandarin on Trifoliate orange and Rangpur lime can be planted at a distance of 5 x 5, and 6 x 6 m, accommodating 400 & 275 trees / ha respectively.

In Tamil Nadu, Mandarin are planted at a spacing of 6 x 6 m in 75 x 75 x 75cm size pits. The planting seasons are May – June and September – October.

Training and Pruning

The water shoots and rootstock sprouts should be periodically removed. Trees are trained to single stem with 4 – 6 well – spaced branches for making the basic framework. Further no branches should be allowed from the trunk up to height of 45-50 cm from the ground level. An ideal mandarin tree should be low headed with dome like crown.

The bearing trees require little or no pruning. Pruning of bearing trees consists of removal of dead, diseased, criss-cross and weak branches. Removal of water shoots and suckers of rootstocks is also highly essential. Pruning of non-bearing trees can be done at any time of the year, but for bearing trees, the best time is after harvesting, during late winter or early spring when these are in somewhat dormant stage.

Root pruning is also practiced in some parts of central and southern India to regulate flowering season. However, such prunings are not beneficial in the long run.

Crop Regulation

In such and central India, mandarins bloom thrice a year. The February flowering is known as ambe bahar; June flowering as mring bahar and October flowering as hast bahar. Under such circumstances, plants give irregular and small crops at indefinite intervals. To overcome this problem and to get fruitful yield in any of the 3 flowering seasons', treating mandarin trees has been practiced which is called **resting** or **root exposure** or **bahar** treatment.

In this method, roots of the plant are exposed too sun by removing up to 7 -10 cm soil around 40-60 cm radius of tree trunk. The water is withheld for a month or two before flowering. As a result of water stress, leaves show wilting and fall on the ground. At this stage the roots are again covered with a mixture of soil and FYM and irrigated immediately. Subsequent irrigations are given at suitable intervals. Consequently, plants give new vegetative growth, profuse flowering and fruiting. However, in light sandy and shallow soils, exposure of roots should not be practiced and mere withholding of water for 2-3 weeks is sufficient for wilting and debilitation of trees.

It depends upon the choice of the grower as to which of the 3 bahars is to be taken to get maximum profit. As the availability of water is a problem in central India during April – May, the farmers prefer mring bahar (June) so that the plants are forced to rest in April – May.

Resting treatment is not feasible in North India, as mandarin plants normally rest in winter and flower once a year. It is experienced that resting treatment in general is a devitalizing process and should be resorted to only under the advice and direction of a technical expert.

Manuring and Fertilizarion

Mandarin, like other citrus fruits also require judicious application of mineral nutrients for proper growth, development and production of quality fruits. Mandarins also require zinc, copper, manganese, iron, boron and molybdenum but not sodium and chlorine, which are rather harmful for mandarins. Improper supply of nutrients may cause serious disorders which may lead to orchard decline.

For palani Hills (Kg./ tree / Yr.)

Manures/

Fertilizers

1 yr II yr III yr IV yr V yr VI on wards

FYM 10 15 25 25 25 30

N 0.100 0.200 0.300 0.400 0.500 0.600

P 0.040 0.080 0.120 0.160 0.160 0.200

K 0.050 0.100 0.200 0.300 0.300 0.400

For Shervaroyan hills (For trees above 6 year old)

NPK @ 700:375:600 g/tree along with VAM @ 1 kg / tree.

The fertilizers are to be applied in two splits on in May-June and another in September – October.

Manures are to applied in the basin 70 cm away from the trunk at a depth of 10 cm, with topsoil covered and irrigated.

In hilly areas where the pH is very low, depending upon the pH, 2 – 4 kg of lime or dolomite should be applied for each tree once in 2 years, one month ahead of the application of regular fertilizers.

The spray solution containing following micronutrients can be applied once in three months at the time of new flesh production.

Zinc sulphate - 0.5%

Manganese - 0.05%

Iron - 0.25%

Magnesium - 0.5%

Boron - 0.1%

Molybdenum - 0.003%

In addition to that apply 50 g in each of ZnSO₄ and Fe per tree per year.

Application of VAM @ 20g/tree will help to accumulate Phosphorus, Zn, Cu and sulphur.

The Fertigation treatment consisting of 500:240:70 NPK dose with 20% depletion of available water content found best to increase the highest canopy volume, fruit weight, TSS, Juice & yield in Nagpur mandarin.

Intercropping

eg: pea, cowpea and blackgram.

Irrigation

In south India, mandarins are grown under rainfed conditions in high rain fall areas. In winter, mandarins should be watered at 10-15 days intervals, while in summer at 5-7 days. In tarai region of UP, soil has high moisture retention capacity, thus lesser number of irrigations are required. However in Punjab, Haryana, Rajasthan and AP, more number of irrigations are required.

Since root activity of mandarins is confined to a radial distance of 120 cm and to a depth of 24 cm, too much wetting should be avoided. Plants should be irrigated at 8-10 days intervals, during drought (April – June in North India and October – December in South-Central India) Mandarins are highly susceptible to water logging; therefore, stagnation of water around tree trunk should be avoided. Water should also be free of salts.

Weed control

Weeds are a serious problem in mandarin nursery and young plantations. Better way to eradicate weeds is to use weedicides. Pre-emergence application of Diuron (5kg/ha) or Terbacil (4.5kg/ha) or postemergence application of Atrazine (5-6 kg/ha) controls weeds significantly.

Others: Bromocil (6 kg/ha) – Mono & dicotweeds.

Glyphosate (5 lt/ha) – Perennial grasses

Simazine (5 kg /ha) - Perennial grasses

Harvest and yield

Generally, mandarins start bearing from the 4th year having 15-20 fruits/tree.

However, its trees attain the level of full bearing at the age of 7-10 years. From flowering to maturity it takes 9 months.

Main harvesting periods of mandarin in different regions of India.

Region Main crop Off season

North –Western plants Dec - Feb -----

North –Eastern India Nov- Feb April - May

Central India Feb - March October - November

South India - Coorg December - April July - August

Nilgiris August - October Feb - March

In Tamil Nadu, the main season is November – December, Harvest should be done at right maturity. Therefore, fruits should be harvested when they attain full size, develop attractive colour with optimum sugar; acid blend.

Yield

About 1000 – 1500 fruits can be harvested from a tree per year and 15 –20t/ha/year. The common practice of harvesting is to pull the fruits from the branch, which may rupture the skin near the stem-end leading to fungal infection and rotting. Therefore, fruits should neither be plucked nor torn off, but should be cut off with clippers, shears or secateurs. Although mandarins may attain optimum maturity standard but the fruits may not be attractive at the time of harvesting due to lack of good yellow colour. Accordingly, degreening of mandarins with the application of ethrel (50 ppm) one week before the harvesting develop golden yellow colour within 5 days of the treatment.

Grading and Packing:

Generally mandarins are graded according to their size and appearance. Fruits are usually packed in wooden boxes for distant markets, while for local marketing; baskets of split bamboo and mulberry are used. Chopped straw and dry grasses are mostly used for padding. The fruits should be cleaned and polished lightly with a piece of cloth, before wrapping them in tissue paper or newspaper. Use of CFB carrions in place wooden boxes is highly beneficial. Mandarins are generally transported by rail or road as ordinary cargos without refrigeration, which often leads to heavy losses due to decay and fungal infection.

Storage

Green coloured fully ripe mandarins can be stored successfully at 8 -10° C with 85 – 90% RH without impairing fruit quality. Kinnow mandarin fruit wrapped in HDPE 10G Poly bags having 0.5% ventilation area can be safely stored up to 60 days and 80 days at ambient and cold storage respectively without much loss of quality. In Nagpur Santra, neem leaf extract @ 20% sprayed on fresh and fully matured fruits and packed in perforated polythene bags then stored in cool chamber. The results indicated that after 42 days of storage a minimum PLW (18%) & rotting (18%) Fruits (Green mature, colour break and ripe stage) dipped in 8% wax retained the freshness of fruits up to 60-3 days under ambient condition.

Acid lime: *C. aurantifolia*

It is also called or sour lime. The fruit juice is rich in citric acid and ascorbic acid.

Climate and soil requirement

Tropical and subtropical. Can be grown upto 1000 m above MSL. Deep well drained loamy soils are the best. They are sensitive to frost. The optimum temperature is 20 to 30°C. Soil pH should be 6.5 to 7.0.

Season : December – February and June – September

Planting: Healthy seedlings may be planted during June to December at 5 to 6 m spacing in 75 cm³ pits.

Irrigation: Irrigated copiously after planting. After establishment, irrigation may be given at 7-10 days interval. Avoid water stagnation.

Manures and fertilizers per plant

N to be applied in two doses during March and October. FYM, P₂O₅ and K₂O are to be applied in October.

Manures and fertilizers	1 year (kg)	Annual income (kg)	From 6 th year (kg)
FYM	10.00	5.00	30.00
N	0.200	0.100	0.600
P	0.100	0.025	0.200
K	0.100	0.040	0.300

Spray zinc sulphate at the rate of 0.5% (500 g/ 100 lit of water) thrice in a year (March, July and October) after the emergence of new flushes.

After cultivation

Remove branches of main stem upto 45 cm from ground level. Application of green leaves 30 kg per tree once in 3 months.

Intercropping

Legumes and vegetable crops can be raised during prebearing age.

Growth regulator

To increase fruit set spraying 2,4-D-20 ppm during flowering. Fruit retention spraying- 2,4-D@ 20 ppm or NAA 30 ppm after fruit set (marble size).