

Model Profile of 1.0 ha Citrus cultivation

1. Introduction

Citrus is native to a large area, which extends from Himalayan foot hills of northeast India to north-central China, the Philippines in east and Burma, Thailand, Indonesia and New Caledonia in Southeast. In India, in terms of area under cultivation, citrus is the third largest fruit crop after Banana and Mango. The average yield of citrus fruits in India is alarmingly low (8.8 t/ha) compared to other developed countries like Indonesia, Turkey, Brazil and USA (22-35 t/ha). Among mandarins, Nagpur mandarin (Central India), Kinnow mandarin (North–West India), Coorg mandarin (South India) and Khasi mandarin (North-East India) are the commercial cultivars of India. Whereas, Mosambi (Maharashtra), Sathgudi (Andhra Pradesh) and Malta and Jaffa (Punjab) are the sweet orange cultivars traditionally grown.

2. Scope for Citrus Cultivation and its National Importance

Citrus cultivation in India is plagued with various problems due to limiting growing conditions, limiting water resources and high incidence of pests and diseases warranting great care from planting till the plants come to bearing in order to sustain a productive life of a minimum of 15-20 years. There is growing interest/awareness among the citrus growers for adoption of latest technologies for commercial cultivation of citrus. The National Research Centre (NRC) for Citrus (ICAR), Nagpur has come out with the package of practices for citrus cultivation in different regions of the country. In the present bankable project on citrus, recommendations of the NRC for Citrus and the views of the citrus growers and their experience has been taken into consideration. The distribution of major citrus fruits is given in Table 1.



Table 1 : Distribution of major citrus fruits

	Global Scenario	National Scenario
Mandarin	13%	44%
Lime & lemon	10%	28%
Sweet orange	71%	18%
Others	6%	10%

The area, production and productivity of major citrus fruits in the country is given in Table 2.

Table 2 : Area, production and productivity of major citrus fruits grown in India (2010-11)

Major citrus fruits	Area(000 ha)	Production(000t)	Productivity(t/ha)
Mandarin	324	3255	10.0
Sweet orange	157	1316	8.50
Lime / lemon	219	2108	9.75
Others	146	785	5.5
Total	846	7464	9.00

Source : National Horticulture Board, Horticulture Information Service-2010-2011

Citrus is grown in more than 26 states in the country. The important states producing major citrus fruits in the country are given in Table 3.

Table 3: Important States producing major citrus fruits in India

Name of the Citrus fruit	States	Varieties
1. Sweet orange	Punjab, Rajasthan, Uttar Pradesh	Pineapple, Jaffa, Hamlin, Valencia, Late Campbell Valencia
2. Mandarin	Maharashtra	Nagpur mandarin
	Madhya Pradesh, A.P., North Eastern region, Punjab, Rajasthan, U.P., West Bengal and Sikkim	Nagpur mandarin Khasi mandarin Kinnow, Nagpur mandarin and local Darjeeling mandarin
	Karnataka and Tamilnadu	Coorg mandarin
3. Acid lime	Andhra Pradesh, Rajasthan, Karnataka, Uttar Pradesh, Gujarat, Madhya Pradesh, Maharashtra	Kagzi lime, Indore seedling Baramasi, Kagzi lime
4. Grapefruit	Andhra Pradesh	PKM (Jayadevi)
5. Lemon	Gujarat, Andhra Pradesh, U.P. Assam	Eureka Hill, Galgal Assam lemon
	Karnataka	Baramasi, Nepali oblong, Italian lemon, Lisbon lemon, Eureka lemon, Seville
6. Pummelo	Andhra Pradesh, Assam, NEH	Red fleshed, White fleshed

Source: National Horticulture Board, Horticulture Information Service-2010-2011

3. Technical Requirements of Citrus Cultivation

3.1 Climate

Citrus fruits in India are cultivated under varied agro-ecological conditions right from arid and semiarid areas of southwest region to humid tropical climate of northeast India. Citrus trees are evergreen, grown in truly subtropical climates of the world although in tropical regions of the world they tend to produce cyclic growth flushes and hence regulating cropping in tropical areas for forcing them into concentrated bloom needs judicious management of water deficit stress according to soil type and growing season. Citrus fruits grow best between a temperature range of 13⁰C to 37⁰C. Temperatures below – 4⁰C are harmful for the young plants. Soil temperature around 25⁰C seems to be optimum for root growth. High humidity favours spread of many diseases. Frost is highly injurious. Hot wind during summer results in desiccation and drop of flowers and developing fruits. Barring these limitations citrus is grown in all subtropical and tropical areas of the world. The subtropical climate is best suited for citrus growth and development. Khasi and Darjeeling mandarins are grown in high altitudes upto 2000 m as it is adapted to a cooler climate.

3.2 Soil

Citrus plants are grown in a wide range of soils ranging from sandy loam or alluvial soils of north India to clay loam or deep clay loam or lateritic/acidic soils in the Deccan plateau and north-eastern hills. Citrus orchards flourish well in light soils with good drainage properties. Deep soils with pH range of 5.5 to 7.5 are considered ideal. However, they can also be grown in a pH range of 4.0 to 9.0. High calcium carbonate concentration in feeder root zone may adversely affect the growth.

3.3 Planting Material

Availability of quality planting material is of utmost importance in citrus cultivation. Citrus plants are very sensitive to various biotic and abiotic stresses. Therefore selection of an ideal rootstock is a continuing challenge for the citrus industry of India. Currently used rootstocks viz. rough lemon and Rangpur lime have gone through a lot of variation over the last five decades. Therefore ideal selections developed from the conventional rootstocks by National Research Centre for Citrus (NRCC), Nagpur and at other places under State Agriculture Universities may be obtained for propagating quality planting material. For budwood selection, disease free mother plants developed from the elite progeny of known pedigree through shoot tip grafting method available at NRCC, Nagpur may only be used.

Primary nursery beds are prepared on light fertile soils or in the HDPE trays under shade net structures. Selection of nucellar seedlings is done by eliminating weak seedlings, off types and non uniform seedlings in 2-3 stages in the nursery beds. Secondary nursery seedlings may be raised in

polythene bags also as they become ready for plantation in the main field after attaining the height of about 30-40 cm after one year.

3.4 Land preparation

Land needs to be thoroughly ploughed and levelled. In hilly areas, planting is done on terraces against the slopes and on such lands, high density planting is possible as more aerial space is available than in flat lands. Since citrus trees are highly sensitive to water logging and water stagnation during rainy season providing drainage channels of 3-4 feet depth along the slopes around the orchard is essential.

3.5 Plant density

a. Mandarin (*Citrus reticulata* Blanco)

Normal spacing – 6 m x 6 m ; Plant population – 277 / ha

b. Sweet orange (*Citrus sinensis* Osbeck)

Normal spacing - 5 m x 5 m, 5.5 x 5.5 m; Plant population – 400/330 per ha

c. Limes/lemons (*Citrus aurantifolia* Swingle & *Citrus limon*)

Normal spacing – 6 x 6 m / 5 x 5 m, Plant population – 277/400 per ha

In light soils, spacing will be 4.5 x 4.5 m or 5 x 5 m

3.6 Planting

The best season of planting is June to August. Pits of the size of 1m x 1m x 1m may be dug for planting seedlings. 15-20 kg of FYM and 500 g of super phosphate is applied per pit while planting. With good irrigation system, planting can be done in other months also.

3.7 Irrigation

Citrus requires critical stage watering in the initial year. It further reduces fruit drop and increases the fruit size. Diseases like root rot and collar rot occur in flooded conditions. Light irrigation with high frequency is beneficial. Irrigation water containing more than 1000 ppm salts is injurious. Quantity of water and frequency of irrigation depends on the soil texture and growth stage. Micro irrigation systems not only saves water and nutrients but also ensure good retention of fruits during crucial stages of crop growth in March – April even in situations where water is not a limitation.

3.8 Manures & fertilizers

Manuring is done in three equal doses three times in a year in February, June and September. The recommended manurial and fertilizers doses are given in Table 4 & 5 respectively.

Table 4 : Year wise requirement of farm yard manure (FYM) (Kg/plant/year)

FYM	I Yr	II Yr	III Yr	IV Yr	V Yr	VI Yr	VII Yr onwards
Kg/plant	20	10	15	20	25	30	40

Table 5 : Year wise requirement of various nutrients (g/plant/year)

Nutrients	I Yr	II Yr	III Yr	IV Yr	V Yr	VI Yr onwards
Nitrogen	100	200	300	400	450	500
Phosphorus	50	100	150	200	200	250
Potash	25	50	75	200	200	250
ZNSO ₄	25	25	50	50	100	150
FeSO ₄	25	25	50	50	100	150
MnSO ₄	25	25	50	50	100	150

One or two sprays of micro nutrient mixtures if required may be given.

3.9 Interculture

Ploughing, spading of basins, weed control, etc., are important inter-culture operations for soil aeration and health. Chemical control of weeds with pre-emergence weedicides like diuron (3 Kg/ha), simazine (4 Kg/ha), glyphosate 4 l/ha, paraquat (2 l/ha), etc. may also be adopted.

3.10 Intercrops

Leguminous crops like soybean, gram, groundnut, cow peas, french bean, peas etc., may be grown in citrus orchards. Intercropping is advisable during the initial three-four years after planting.

3.11 Training and Pruning

In order to allow the growth of a strong trunk, initially shoots upto 40-50 cm from the ground level should be removed. The centre of the plant should remain open. Branches should be well distributed to all sides. Cross twigs and water suckers are to be removed early. The bearing trees require little or no pruning. All diseased, injured and drooping branches and dead wood are to be removed periodically.

3.12 Pests and Diseases Management

3.12.1 Pests

Important insect-pests of citrus are citrus black fly and whitefly, citrus psylla, Citrus thrips, leaf miner, scale insects, bark eating caterpillar/trunk borer, fruit fly, fruit sucking moth, mites, etc. Other

pests attacking citrus particularly mandarin orange, specially in humid climate are mealy bug, nematode, etc. Control measures of major pests are indicated below:

Leaf miner: Foliar sprays either with quinalphos 1.25 ml or fenvalerate 0.5 ml or monocrotophos 1.0 ml/litre of water at weekly intervals on new flush as soon as infestation is noticed.

Citrus black fly and white fly : One spray against adults and two at 50% egg hatching stage (I half of April & Dec. and II fortnight of July) at 15 days interval either with acephate 1.25 g or quinalphos 1.5 ml or imidacloprid 0.5 ml/ litre of water.

Citrus psylla: Foliar spray either with quinalphos 1.0 ml or acephate 1.0 g or monocrotophos 0.5 ml/litre of water at bud burst stage or as and when infestation is noticed during Feb, - Mar., Jun., - Jul. & Oct, - Nov.

Citrus thrips :Foliar spray either with dimethoate 1.5 ml or monocrotophos 1 ml/litre of water at bud burst stage and berry size fruits.

Scale insects: Spraying of parathion (0.03%) emulsion, dimethoate 150 ml and 250 ml kerosene oil in 100 litre of water or malathion @ 0.1 % or carbaryl @ 0.05% plus oil 1 %.

Trunk borer: Swabbing of tunnel either with dichlorvos (0.1%) or carbaryl (1%) or monocrotophos (0.02%) kills the grub effectively.

Bark eating caterpillar: Plugging of larval tunnels with cotton wad soaked either in dichlorvos (0.1%) or carbaryl (1%) or monocrotophos (0.01%) effectively checks the pest.

3.12.2 Diseases

The important diseases of citrus are *Phytophthora* gummosis, citrus tristeza virus, citrus greening (HLB-*Huang Long Bing*), citrus canker, powdery mildew, anthracnose, etc. Control measures of these diseases are stated briefly below:

***Phytophthora* Gummosis :**Scraping of the affected area and application of Bordeaux paste or copper oxifluoride paste or ridomil + carbendazim.

Citrus greening (HLB--*Huang Long Bing*): Removal of infected branches/unproductive trees and their replacement by disease-free plants. Application of ledermycin 600 ppm with ZnSO₄ and FeSO₄.Meticulous control of citrus psylla vector.

Citrus tristeza virus: Control of aphids and use of cross protected grafts and shoot tip grafted plants or disease free grafts are recommended.

Citrus canker: Cutting of infected twigs followed by spraying of 1 % Bordeaux mixture or copper fungicide. Foliar spray application of 100 ppm streptomycin sulphate is also effective.

Powdery mildew: Pruning of dead twigs followed by foliar spray of wettable sulphur @ 2 g/litre, copper oxychloride @ 3 g/litre of water in April and October.

Anthracnose: Pruning of dead twigs followed by two foliar sprays of carbendazim @ 1 g/litre or copper oxychloride - 3 g/litre at fortnightly interval.

3.13 Harvesting

There are two main crops in mandarins and sweet oranges. One is called as *Ambiabahar* (mango flowering) the flowering of which occurs in the month of January (at the time of flowering of mango hence the name *Ambia*) the fruits of which are available in the months of October-December The other crop is *Mrigbahar*(Monsoon bloom) the flowering of which occurs in the month of June-July and the fruits are harvested during February-April. Mandarins and sweet oranges normally take 240-280 days to arrive at maturity. Mature fruits at colour break stage are picked up in 2 - 3 intervals of 10-15 days. Limes and lemons take 150-160 days for maturity. There may be 2 or 3 crops in a year in limes and lemons.

3.14 Yield

Mandarin: Commences from the 5th year with about 50 fruits per tree and stabilises in the 8th year. Average production is about 700-800 fruits per tree after stabilisation.

Sweet Orange: Commences from 5th year with 40-50 fruits per tree & stabilises around the 8th year. Average production is about 500-600 fruits per tree after stabilisation.

Lime/Lemon :Commences from the 3rd year with 50-60 fruits per tree & stabilises in the 8th year. Average production is about 1000-1500 fruits per tree after stabilisation.

Economic life of plantation: 15 to 25 years

3.15 Post-harvest management

For imparting uniform yellow-orange colour to the fruits application of ethephon @ 250 ppm along with 1 % calcium acetate as foliar spray at maturity stage is recommended. Sweet oranges and mandarins may be treated with ethylene gas for de-greening and development of colour. A temperature of 6-7°C, 5-10 ppm of ethylene and 90-95% RH in a de-greening chamber can set a change in colour in about 48 hours. The cold storage conditions for long term storage for different citrus fruits are available. Pre-cooling of citrus is done by forced air system. The storage conditions

for each group are stated below. Oranges may be packed in well ventilated CFB boxes - 30 cm x 30 cm x 30 cm.

The storage conditions for various citrus fruits are as under:

Mandarins: Mandarins can be stored at 5- 7°C with 85-90 % RH for 4-8 weeks.

Sweet oranges : Sweet oranges can be stored at 7-8°C with 85-90% RH for 4-8 weeks.

Lime/Lemon: Limes and lemon can be stored for 6-8 weeks at 9-10°C storage temperature with 80-90% RH. Limes are subjected to pitting after storage at temperature below 7°C. Waxing treatment further reduces moisture loss extends shelf life in all citrus fruits.

3.16 Marketing

Citrus fruits being perishable in nature need to be handled delicately and hygienically. Sweet oranges, limes and lemons remain fresh under ambient conditions and hence can be transported to distant places for marketing. More care and attention is required for mandarins during handling and transport.

The techno-economic parameters for the model project are detailed in **Annexure I**.

4. Financial viability and Bankability

4.1 Project Cost

In the present model, the unit cost of development of mandarin in 1 hectare of land has been presented. This may be modified to suit other types of citrus fruits taking into account the local conditions, techno-economic parameters stated elsewhere and the prevailing wage rate as per the minimum wage act of the concerned state. Unit cost in the model works out to Rs. 140700/hectare spread over a period of five years. The detail cost of development of mandarin orange is given in **Annexure II**.

4.2 Margin Money

The margin money / down payment prescribed are 5 %, 10 % and 15% for small, medium and other farmers respectively. The rest of the investment cost will be provided as bank loan. However, in the present model, 10 % of the unit cost i.e. Rs.14100/ha has been considered as margin money.

4.3 Bank Loan

Bank loan of 85 – 95 % of the total cost of development shall be available from the financing institution. Bank loan considered in the model is 90%. It works out to Rs.126600/ha in the model.

4.4 Rate of Interest

The rate of interest to be charged to the ultimate borrower would be guided by RBI guidelines issued from time to time. However, the ultimate lending rate has been considered as 12 % for working out the bankability of the model project.

4.5 Security

Banks are guided by RBI guidelines issued from time to time in this regard.

4.6 Financial Analysis

Financial analysis was carried out for one hectare of citrus cultivation. For financial analysis, the income was assessed on a conservative basis. The detailed calculation of project's income and expenditure has been indicated in **Annexure III**. IRR, NPW and BCR for the model works out to 34.1 %, Rs. 1,76,556/- and 1.98 respectively and the details are given in **Annexure IV**.

4.7 Repayment period of loan

Based on the cash flow the detailed repayment schedule has been worked out and furnished in the **Annexure V**. The repayment period works out to nine years including four years grace period for repayment of principal.

DISCLAIMER

The views expressed in this model project are advisory in nature. NABARD assume no financial liability to anyone using the report for any purpose. The actual cost and returns of projects will have to be taken on a case by case basis considering the specific requirement of projects

Annexure III : Income – Expenditure Statement

(Amount in Rs.)

Items	Year							
	5	6	7	8	9	10	11	12
Income								
Yield (kg per plant)	10	30	50	60	70	80	80	80
Yield (kg per ha)	2750	8250	13750	16500	19250	22000	22000	22000
Income	22000	66000	110000	132000	154000	176000	176000	176000
Expenditure								
Cost of FYM	4000	4000	4000	4000	4000	4000	4000	4000
Cost of fertilizers	5463	5463	5463	5463	5463	5463	5463	5463
Manures & fertilizers application	4000	4000	4000	4000	4000	4000	4000	4000
Irrigation	6000	6000	6000	6000	6000	6000	6000	6000
Plant protection measures	3500	3500	3500	3500	3500	3500	3500	3500
Appl. of plant protection	1600	1600	1600	1600	1600	1600	1600	1600
Interculture	5000	5000	5000	5000	5000	5000	5000	5000
Harvesting	4000	5000	5000	5000	5000	5000	5000	5000
TOTAL	33553	34553	34553	34553	34553	34553	34553	34553
Rounded off	34000	35000	35000	35000	35000	35000	35000	35000
Surplus	-12000	31000	75000	97000	119000	141000	141000	141000

Annexure V : Loan Repayment schedule

(Amount in Rs.)

Year	Loan O/s at the beginning of the year	Interest@12.0%	Gross surplus	Repayment		Total outgoing	Net surplus	Loan O/s at the end of the year
				Principal	Interest			
1	30510	3661	10000	0	3661	0	3661	0
2	47250	5670	10000	0	5670	0	5670	0
3	66870	8024	10000	0	8024	0	8024	0
4	91890	11027	10000	0	11027	0	11027	0
5	126630	15196	22000	3000	15196	0	18196	3804
6	123630	14836	31000	8000	14836	0	22836	8164
7	115630	13876	75000	30000	13876	0	43876	31124
8	85630	10276	97000	40000	10276	0	50276	46724
9	45630	5476	119000	45630	5476	0	51106	67894

*Interest during first four years would be met out of inter crop.