

# GOOD MANAGEMENT PRACTICES IN LITCHI



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सत्यमेव जयते

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**National Research Centre for Litchi**

Mushahari, Muzaffarpur – 842 002, Bihar, India





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## Good Management Practices in Litchi

Litchi (*Litchi chinensis* Sonn) is an important subtropical fruit crop of the country. It is known as queen of the fruit due to its attractive deep pink/red colours and fragrant aril. It has high nutritive value and suitable for geotropic weak person. Litchi appears to be native of Southern province of China and northern Vietnam from where it was introduced into India during the 18<sup>th</sup> century in the North East region (Tripura) and over the period of time it travelled to eastern states and percolated in the northern states of India. From China, litchi spread further to West Indies, South Africa, Hawaii Islands, Florida, Vietnam, Indonesia, India, southern Japan, Formosa, Australia, New Zealand, Brazil, India etc. Litchi is now an important commercial fruit crop in India due to its high demand in the season and export potentiality. Cultivation of litchi is widely spread in eastern India covering approx. 100 km width from foot hills of Himalaya



Litchi Growing Areas in India

from Bengal to Punjab which provides livelihood opportunities to millions of people in the region. In India, the bulk of the litchi growing area lies in Bihar, other areas are sub-mountain tracts of Uttar Pradesh, West Bengal, Punjab, Assam, Tripura and Odisha. The concentrated pockets of litchi production in different states have been listed in table.

**Table: 1 Major Litchi growing areas in India.**

State	Districts
Tripura	West Tripura, North Tripura, South Tripura, Dhalai Tripura
Assam	Bongoigaon, Kamrup, Goalpara, Nalbari, Barpeta, Sonitpur, Naogaon, Lakhimpur, Golaghat, Jorhat ,Cachar
West Bengal	Murshidabad, 24- Parganas, Nadia, South 24-Parganas, Malda, Uttar Dinajpur, Dakshin Dinajpur, Hubli
Bihar	Muzaffarpur, Vaishali, Samastipur, Sitamarhi, East Champaran, West Champaran, Gopalganj, Sheohar, Darbhanga, Madhubani, Purnia, Katihar, Begusarai, Saharsa, Bhagalpur, Araria, Kishanganj, Khagaria, Madhepura, Munger etc.
Odisha	Sundergarh, Sambalpur, Angul, Deogarh
Uttarakhand	Udham Singh Nagar, Champawat, Nainital, Dehradun, Tehri Garhwal, Pauri Garhwal, Haridwar, etc
Punjab	Gurdaspur, Hoshiarpur
Uttar Pradesh	Saharanpur, Muzaffar Nagar, Kushinagar, Deoria, Basti, Gorakhpur etc.

### Composition and Uses

Litchi is a delicious fruit of excellent quality. The fruit has high sugar content varies from 10 to 22 per cent due to cultivar and climatic conditions. Besides sugars, litchi contains 0.7 per cent protein; 0.3 per cent fat; 0.7 per cent minerals (particularly calcium and phosphorus) and vitamin C (64 mg/ 100 g pulp), Vitamin A, B<sub>1</sub> and B<sub>2</sub> also present in considerable amount.

Litchi makes an excellent canned fruit. A highly flavoured squash is also prepared from fruits, which is a delicacy during summer months. Various other products such as pickles, preserve and wine can also be prepared from litchi. Dried litchi (litchi nut) and dried litchi aril (litchi resin) are some of the very popular products among the Chinese.

## Fruit availability period

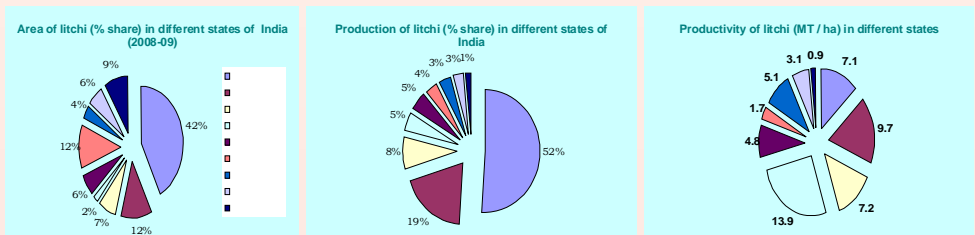
India has unique advantage as litchi start ripening from 15<sup>th</sup> April in Tripura and harvest season lasts in other states westernup to end of June, thus giving enough time to exploit litchi market of importing countries.

**Table 2. Harvesting season of litchi crop in India**

STATE/UT'S	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
Tripura												
Assam												
West Bengal												
Bihar and Jharkhand												
Uttarakhand												
Punjab and Himachal Pradesh												
Tamil Nadu												
Karnataka												
Kerala												

## 2. Area and Production

In India, about 73000 ha area is under litchi plantation which produces approximately 5,00,000 MT fruits every year. Although synonymity exists but more than 20 cultivars have been listed under cultivation. The important cultivars are Shahi, China, Bedana, Rose Scented, Bombai, Purbi, Saharanpur, Muzaffarpur and Kasba. Bihar is the premier state in litchi production and marketing. Litchi is being cultivated in large area of Bihar (30, 500 ha) with an annual production of about 2, 50,000 MT of fruits



**Area, Production and productivity of Litchi in India**

having productivity of around 7-8 tonnes/ha. It accounts for nearly 52 per cent of litchi production from 50 *per cent* of total area under litchi at country level. The area and production of litchi is increasing but at a very slow pace, however the productivity is declining due to plantation of new orchards in recent years and reduction in realizable yield in old senile orchards. The harvesting of litchi fruits starts from last week of April in Tripura to end of July in Himachal Pradesh and foot hills of Uttarakhand. In Bihar, the harvesting period lies between 2<sup>nd</sup> week of May to 3<sup>rd</sup> week of June for different cultivars like Early Bedana, Shahi, Mandraji, China, Purbi, Rose Scented, Longia, etc

The latest global review of area and production shows that India is the second largest producer of litchi next only to China with the highest productivity in the world, contributing about 25% of total world production. It occupies 1% area with 1.5% production of total fruits grown in India. There has been slow increase in the area and production of litchi in the country because of its specificity to the climatic requirements. It is restricted to northern parts of the country particularly in the foot hills of Himalayas from Tripura to Jammu and Gangetic plains. Frost free, cool, dry winters and humid summer, free from hot and dry winds, hails and storms are characterized as favourable growing zone for litchi.

### **3. Soil**

Litchi can grow in a variety of soil provided they are well drained. The ideal soil for litchi cultivation is deep well- drained loam soil rich in organic matter. The water table should be at least 1.25 m deep. It can't stand water-logging for long. Litchi prefers slightly acidic to neutral soil. The trees grow best in a pH range of 6.0 to 6.5. The roots of litchi trees are found to have a symbiotic association with mycorrhizal fungi which improves the nutrient uptake and availability in root zone. Before planting, it is worthwhile to inoculate the soil in pit by mixing some soil collected from the root zone of litchi orchards.

### **4. Climate**

Litchi prefers moist subtropical climate. Winter frost and dry heat in summer considerably damage the growth of the plants. Although it can grow up to an altitude of 800 m above the sea level, the best growth and



yield was, however found at lower elevations. Seasonal variation in temperature is necessary for proper fruiting. The temperature should not go beyond 40.5° C in summer and below the freezing point in winter. Good rain or adequate supply of irrigation water is essential for litchi cultivation. A constant rainfall at the time of flowering however, interferes with pollination.

## 5. Improved Varieties

In India, about 50 cultivars are under cultivation. However, Shahi, China and Purbi are ruling commercial varieties for North Bihar and eastern Uttar Pradesh. Rose Scented for Uttaranchal and adjoining area, Shahi, Ajhauri, China, Swarna Roopa and Purbi for Jharkhand and Bombay, Bedana and Rose Scented in Eastern parts of West Bengal are other commercial varieties of importance. Few varieties (Table 3) have been found promising for high yield with quality fruits and have been well adopted in the region. The description of few important varieties suitable for growing in different parts of the country has been given below.

**Shahi:** This is the most popular cultivar of North Bihar, Jharkhand, Uttaranchal and Uttar Pradesh. The fruits have distinct rose aroma and hence called as Rose Scented. It is known as “Shahi” in Uttaranchal and “Muzaffarpur” in Western Uttar Pradesh. This is an early season maturing cultivar ripens during second week of May to first week of June at various locations. It matures 12-15 May in Jharkhand, 25<sup>th</sup> May in North Bihar and by end of May in tarai region of Uttaranchal.



Litchi cultivar Shahi

Trees are very vigorous (7.6 m height and 8.2m canopy spread) and high yielder (90-100 kg/tree) but mature fruits are prone to cracking. Fruits are medium to large in size (3.2 cm length and 3.1 cm diameter), medium in weight (20.49 g/fruit), globules-heart or obtuse in shape having rose madder and fuchsia purple background with red tubercles at ripening. Pulp grayish-white, soft moderately juicy (54.8%) and sweet with 20° Brix TSS, 12.79% total sugar and 0.33% total acidity. Seeds are small (1.89 cm length, 1.32 cm diameter and 2.07 g weight), smooth, shining round-ovate in shape

and blackish-chocolate in colour. Rind: pulp : seed ratio by weight is 12.22 : 75.93:11.85. The fruits are known for excellent aroma and quality aril.

**Early Bedana** : It is also known as Early Seedless because of its early ripening and small seeds. The cultivar is very much popular in Uttar Pradesh and Punjab. Trees are medium, attaining an average height of 5.0 m and spread of 6.2 m. It is a medium yielder cultivar (50-60 kg/tree) but bears fruits regularly. Fruits are medium in size (3.2x3.0 cm) and weight (16.33g) having oval or heart shape, rough surface with uranium green skin covered with carmine red tubercles at maturity. Aril is creamy white, soft, juicy (69.0%) and sweet containing 19.8% TSS, 13.6% total sugar and 0.54% titrable acidity. Seed is very small, shrunken, glamorous, dirty chocolate in colour with an average weight of 0.82g. The rind: pulp: seed ratio by weight is 13.06: 83.19:3.75. The overall fruit quality of the cultivar is good.

**Late Bedana** : This cultivar is also known as Late Seedless. This is a late maturing cultivar which usually ripens in third week of June in Uttaranchal and end of May in Jharkhand. The trees are vigorous having an average height of 5.5 m and spread of 7.0m. It is a high yielder cultivar giving an annual yield of 80-100 kg/ tree. Although the fruit size is medium (3.2x 2.9 cm) but average weight is 25.0g. The fruits are conical in shape with vermilion to carmine in colour having dark blackish brown tubercles at maturity. Pulp is creamy white, soft, juicy (65.4%), sweet having 20.0% TSS, 13.8% total sugar and 0.44% acidity. Seeds are very small (1.8x0.9 cm in size and 0.85 g in weight), shrunken, glamorous, chocolate in color having fusiform shape similar to canine of dog. The rind : pulp : seed ratio (by weight) of late seedless is 14.76:81.89:3.35. Overall quality of fruits is very good.

**Ajhauri**: This is another early maturing variety becomes ready for harvest by 15-18 May and yields about 80-100 kg from a sixteen year old tree. The tree is vigorous in growth. It bears red fruits with average weight of 17.3 g and contains 59.3 mg/100 vitamin C. The TSS of the cultivar is 20% with 0.4% acidity and 12.37 g/100 g sugar. The full grown up tree yields 70-95 kg fruits every year.

**China**: This in one of the best cultivar of litchi for North India. It is tolerant to hot waves and fluctuations in soil moisture which escape to fruit cracking. It is also known by the names of Calcuttia in West Bengal.

This is a medium-late season cultivar and fruits ripen during end of May in West Bengal, first week of June in Jharkhand and during second week of June in North Bihar. Trees of cultivar China are dwarf (4.0 m height, and 6.0m spread) and high yielder (80-100 kg/tree) but prone to alternate bearing. It bears fruits in cluster of 12-18. The plants bear less fruit in southern direction. Fruits are large in size (3.86 cm length and 3.26cm diameter), medium in weight (22.0g/fruit), oblong in shape and tyrant rose in colour with dark tubercles at maturity. Aril is creamy-white, soft, Juicy, sweet having 18.17% TSS, 11.0% total sugar and 0.43<sup>o</sup> Brix titrable acidity. Seeds are glaucous, dark chocolate in colour, oblong to concave or Plano convex in shape, medium in size (2.9 cm length and 1.5 cm diameter average in weight (3.49 g/seed). The ratio of rind : pulp : seed by weight is 16.42 : 69.22 :14.36.



Litchi cultivar China

**Bombaiya:** This is an important cultivar of West Bengal. It is a vigorous cultivar attaining a height of 6-7 m and spread 7-8 m. The cultivar matures early (first to second week of May) and gives 80-90 kg yield per tree. Fruits are large in size (3.5 cm long and 3.2 cm diameter), obliquely heart shaped, weighing 15-20 g. The colour of ripe fruit is attractive carmine red with uranium green skin background. Like Chinese cultivar "Hom Shen Chi" this cultivar also has a small, tiny under developed fruit attached to the fruit stalk of each fully developed fruit. Pulp is grayish white, soft, juicy, sweet containing 17<sup>o</sup> Brix TSS, 11.0% total sugar and 0.45% acidity. Elongated, smooth and shining seed of light chocolate colour is 2.3 cm long with 1.6 cm diameter and weighs 3.4g. Ratio of rind : pulp : seed in this cultivar is 12.1 : 70.1 :16.8.



Litchi cultivar Bombaiya

**Dehra Rose:** This is an important cultivar of Uttar Pradesh, Uttaranchal and Punjab. Fruits start ripening by third week of June. Medium vigorous trees (5 m height and 7m spread) produce medium to high yield (80-90kg/ tree). Fruits are medium to large in size measuring 3.7 cm length, 3.5cm diameter, 15.2 g weight having oblique-heart to conical shape. Carmine red coloured fruits of Dehra Rose look very attractive at ripening. Pulp of this cultivar is grayish-white, soft, moderately juicy (61.9%), with 17% TSS, 10.4% sugar and 0.44% acidity. Seeds remain small (2.4cm length, 1.4 cm diameter and 2.4 g weight), shrunken, mostly oblong in shape and dark chocolate in colour. The rind : pulp : seed ratio is 18.4 : 64.4 : 17.2. The major defect of the cultivar lies in its susceptibility to sunburn and cracking.

## **6. Plant Propagation and nursery management**

Litchi is commercially propagated through vegetative method. The plants raised through seed have slow growth, long juvenile period (8-12 years) and do not produce true-to type fruit. Therefore it is recommended that only vegetatively propagated genuine planting material should be used for commercial production. The methods for plant propagation are being described:

### **Sexual propagation**

Seeds are mainly used to raise rootstocks for grafting. Litchi seeds have short viability period. If these are exposed to air in the shade under normal humidity conditions, they start shriveling within 24 hours and in five days become inviable. For raising plants from seed, only mature and bold seeds should be selected. Small seeds in which embryo have aborted never be used for raising rootstocks.

After being separated from the fruits the seeds are cleaned and sown horizontally to a depth of to 2.5 cm in a well drained sowing medium in a partially shady well irrigated location. The sowing medium may be of mixture of sand, soil and compost which can provide sufficient food and aeration to the newly germinated seeds. Incorporation of soil from old plantations of litchi has been found to encourage germination. Seed germination takes place within three days under normal conditions. Seeds can also be sown in the trays and transplanted into individual bags after

attaining a height of 10 to 15 cm for development of healthy root stock. In this case to facilitate transplanting, the seeds should be sown at a distance of double to the length of seed. Seeds are extremely slow to grow and therefore nourished properly so that it can be used as rootstock for grafting.

### **Vegetative propagation**

Vegetatively propagated plants are true to type in nature and start early bearing in the commercial litchi orchard. The different methods of vegetative propagation in litchi are given below.

#### **Air layering**

Among the various methods of vegetative propagation, air-layering is commercially one. Air layering can successfully be done just after fruit harvest (June-July) when plants are in active phase of growth. The best season for air layering is monsoon season. In mother trees maintained exclusively for propagation purposes, the layering can also be done during the spring with optimum water and nutrient management. Usually Sphagnum moss is used as rooting media.

For preparation of air layers, healthy terminal branch receiving good sun shine with a thickness of about 1.2-1.5 cm is selected. Better the branch used for layering, better the root system obtained. The branches must be selected on the periphery of the tree, so that they can easily be worked on. The newly flowered/fruited shoot which has exhausted its food material generally produces poor roots, thus should not be selected for air layering. On a selected branch, 2.5 cm ring of bark is removed about 45-60 cm below the tip of shoot. Further the cambium layer is rubbed off and woody portion is exposed properly. For early and proper rooting pasting of 1000



**Litchi propagation of through air layering (a) Rooted air layered shoots (b) Collection of gooties in Nursery (c) Planting of layers in green house**

ppm IBA may be done immediately. Applying 5000 ppm IBA in lanolin paste at the upper end of the ring also improves the root formation in air layers. A layer of moist sphagnum moss is placed and wrapped with a piece (20x25cm) of 400gauge polythene sheet and tied properly on both end to ensure supply of proper moisture and facilitates development of roots.

In the place of sphagnum moss, a decomposed mixture containing pond silt 40 kg, FYM 40 kg, well rotten jute bag or leaf mould 10kg, castor/karanj/ neem cake 2kg, urea 200g, 200g SSP/ bone meal and 100g Chloropyrifhos dust can used as ideal media for root initiation, development and better survival of the plants. The above mixture is heaped after proper mixing and covered with black/white UV stabilized polythene for 45 to 60 days under open sun. The soil lump is prepared by adding sufficient quantity of water at the time of air layering and a ball of approximately 200g is prepared for each air layers. The ball of rooting media is placed over the ringed portion covering about 2 cm from the upper end of the ring. After about 50-60 days the adequate root system is developed from the upper end of the ring which is visible through the polythene film. The layer is removed by giving sharp cut about 5 cm below the lower end of the ring. The air layers should only be removed when 6 to 8 roots can be seen through the polythene which are changing from white to creamy brown. Special care must be taken to avoid damaging the young root system while transplanting the layers. The detached layers are planted in partial shade and at the time of planting, excess vegetative growth should be removed to maintain balance between the top and newly developed root system. The young plants must be planted in individual bags (15x15x25 cm) filled with good mixture of soil, vermicompost, sand and Vermiculite. Two or three vegetative flushes must appear before the plants hardened off in the open air prior to final planting. Planting of detached air layers in the root trainer of 350 ml cup size facilitate the better root development in the litchi air layers.

### **Wedge grafting**

This is a detached method of grafting in which grafting operation is performed on about one year old seedling. The 3-6 month old scion stick is taken from the shoots. The best time for grafting is rainy season and spring season. For rainy season grafts, short (3-4 buds), round scions of green but



completely mature wood (just before the opening of new shoots), are preferred while for spring graft, hard and semi-hardwood is selected. It is advisable to take healthy and disease free scion sticks. However, for better success treatment of scion sticks with 0.1% Benomyl is recommended.

Under favourable temperature conditions, sprouting of buds takes place within 2-3 weeks of grafting. The new plants having 50-100 cm height may be planted after sufficient hardening within a year of grafting. For better success the rootstock should be raised in polythene bags of 4-5 kg capacity and the successful grafts should be transplanted in to bigger sized bags.

### **Nursery Management**

A high rate of mortality in the newly planted litchi layers in nursery beds/ polythene bags is quite often which is attributed to several post planting factors in the nursery. The details of the nursery management operations to be carried out are as follows.

#### **Preparation of potting mixture**

The mixture of rever bed soil, FYM or vermi compost (2:1) with vermiculite/perlite 50g/kg mixture should be prepared in the proportion. Preferably the soil from old litchi orchard should be incorporated in the mixture to improve the mycorrhizal colonization in the root which help in the development of better root system and plant growth. The areas having the infestation of termites in the nursery, use of anti termite, pesticides and /or Karanj /neem cake in the pot mixture or fumigating the pot mixture with appropriate soil fumigant is recommended. Addition of phosphorus in the pot mixture has given encouraging result. Therefore, single super phosphate/ bone meal @10g/bag should be added while planting the air layers.

#### **After care of the newly planted air layers in nursery**

The newly planted air layers should be given utmost care in the initial period of establishment. Maintenance of optimum temperature and humidity in the mist chamber and proper irrigation under shade after shifting should be ensured for better success. Control of foliage pest and diseases through appropriate pesticide/ fungicide should be done. New

flushes of litchi layers encounter the attack of litchi mite, leaf cutting weevil, shoot borer and leaf miner pests. Litchi mite can be managed by spraying 1.25ml / liter Phosphamidan or Kelthane thrice whereas for other pest two to three sprays of Nuvan (1.25ml/liter) should be made after noticing the pest. Generally litchi layers do not get infected by foliar diseases, however, soil borne pathogens do to the newly developing secondary and tertiary root system of the layers. Sometimes, excessive water stagnation in the bag/bed leads to rotting of collar region leading to mortality of the plants. Which can be managed by drenching of soil with Bavistin (2g/ltr) and avoiding excessive moisture in the root zone.

The main reason of the high mortality in the nursery plants is reduced formation of secondary roots. While planting two months old air layers in the bed/bag, the formation of secondary root is restricted. This can be improved by planting the layers in root trainers (350ml size) for initial two months under mist chamber (Temp $30+2^{\circ}\text{C}$  and RH 90% ). While planting in root trainers, a mixture containing two part FYM, one part sand a small amount of SSP (1 tea spoon/cup) and small amount of soil (20g/cup) from old litchi orchard should be used for filling the cups. Quick dip of air layer's ball in IBA solution (1000ppm) help increased secondary root formation. The root trainers should be kept at a height of 1.5-2.0 feet from the ground level on the iron frame so that air can blow beneath the root trainer. During the process, the primary roots growing through the root trainers are naturally pruned. Natural air pruning of the roots in root trainers helps in formation of secondary and tertiary roots in the root trainers. After two months, when first flush get matured, the individual saplings should be transferred to polythene bags (25x15x15cm size and 400 gauge thickness) containing the standard mixture. along with SSP (10g/bag) and kept under partial shade. Regular maintenance of the plants should be done to facilitate better establishment and growth after shifting from root trainer.

## **7. Planting and Orchard Establishment**

Litchi plant starts bearing after 5-6 years and attains commercial production stage after 10-12 years. The performance of orchard depends upon the proper layout, pit preparation, planting system, care and maintenance of young and bearing trees, scientific management of the orchard including water and nutrient management, stature and canopy management of plants, pruning, treatment of shoots for flowering and





fruiting and use of plant growth regulators to optimize the quality production. The suitability of a cultivar is the factor of ecological condition of the site, availability of genuine planting material, and consumers and market preference.

### **Selection of site**

Selection of location for litchi orchard is vital for optimum production owing to its specific climatic requirement. Frost free climate with mild cold (8-14°C minimum temperature) and dry period prior to flowering during autumn-winter, moderate temperature and humidity during flowering, fruit setting and fruit maturity and absence of high speed wind during fruit development and maturity is considered ideal for litchi orchards. Litchi plants are also specific to their soil requirement. Therefore, the site should have deep, mild calcareous, well drained soils with high organic matter.

However, litchi can be cultivated in almost all kind of soil, starting from sandy to clay loam with good drainage and rich in organic matter. Well drained deep sandy loam soil having high moisture holding capacity, rich in organic matter and calcium content have been found ideal for litchi cultivation. The rich soil with good moisture holding capacity facilitates better growth and fruiting. The well drained soil of north Bihar rich in calcium content have been observed to be suitable for better growth and quality fruits. The rolling uplands of Chotanagapur and organic matter rich Tarai regions of Uttaranchal have also been found to be highly suitable for the good crop of litchi. It has been observed that mild acid soil is ideal for association of mycorrhiza in the litchi rhizosphere. The soil having pH from 6.0 to 8.5 with abundance of soil moisture is suitable for proper growth and fruiting in litchi. Soils of poor physical condition, lacking in available nutrients can be improved for litchi cultivation by adding sufficient quantity of rotten FYM/ compost and green manuring. Apart from above ecological features, adequate infra structure facilities like cold storage, transport, electricity, etc. must be available near the production sites.

### **Land Preparation and Layout**

Before layout, the land should be cleared of bushes, weedy vegetation and ploughed deeply. Further the surface to be leveled with mild slope in the opposite direction of the water source. To improve fertility of the soil organic matter should be added, green manure crop such as dhaincha

(*Sesbania aculeate*) or sunhemp (*Crotalaria juncea*) may be grown and incorporated into the soil which will improve the fertility, moisture holding capacity and physical condition of the soil.

### **Planting techniques and pit preparation**

Litchi is an evergreen, spreading plant which attains the height of about 10-12 m at its full grown stage. The light penetration on its canopy is also desirable for proper fruiting, hence planting in square system at the distance of 9-12 m. within and between the rows has been advised. This will also help in cultural operations to be performed conveniently. However, planting of litchi in double hedge row system at a distance of 4.5x4.5x9 m accommodating 329 plants/ha and medium density at 6x6 m accommodating about 278 plants/ha have been suggested.

Before planting, pit of 90x90x90cm dimension to be dug at marked place during summer season in the month of April-May and soil should be spread on the ground. During this process the harmful insect and pest will be minimized/controlled. Further the pit should be filled with top soil mixed with about 40kg decomposed FYM/ compost, 2 kg neem/ karanj cake, 1 kg bone meal/ single super phosphate, 200-300 g muriate of potash, 20 g carbofuron 3G just before the onset of monsoon. About 2 baskets of soil from the root zone of old litchi tree also added which will be helpful for the mycorrhiza growth. Then the soil may be allowed to settle properly during first few rains and get leveled properly. During planting time a hole of about the size of earth ball to be made in the centre of the pit at marked point and planting is done. After proper fixing of the plants, preparation of ring and watering is done immediately for proper establishment of the plant. Further plant is regularly irrigated till it is properly established.

### **Time of Planting**

Litchi should be planted during rainy season which provide optimum soil moisture and better atmospheric humidity for survival of the plants. Litchi is an evergreen plant and atmospheric humidity helps in better establishment and survival of the plants. Hence in North India planting may be done from mid June to end of August avoiding peak rainy period, if there is problem for water logging in the field. Early planting provide



longer rainy period for the initial establishment and growth. About one year old air layered plants are ideal for planting in the field.

### **Protection of young plants**

During the winter months, excessive exposure to low temperature and in summers, exposure to scorching sun, lead to mortality of the newly planted litchi saplings. Thatching of plants from three sides leaving east side open with locally available weeds/paddy straw supported on 1.5m long three bamboo sticks during the October-February and March-June is essential for ensured establishment of the saplings. Mulching with paddy straw or local weed in the rings of the plants also improves establishment by maintaining proper moisture conditions near the root zone. Care should be taken for control of white ants, leaf cutters etc immediately after notice.

### **Intercropping**

Litchi is one of the fascinating fruit crops. In pre-bearing orchards up to 7-8 years, sufficient space is available in between the plants, that can be used for growing intercrops. Vegetable and flower crops have ample scope for cultivation in such interspaces. Moreover, these crops fit well in crop rotation in order to get more return per unit area and time. The crop rotation of cowpea-gladiolus is the best, followed by okra-potato-cowpea and cowpea-cabbage-onion. These intercrops are beneficial as they provide additional income to farmers, improving the growth of litchi. In the adult and junior adult bearing litchi orchard there is vacant area among the litchi plants which can be well utilized for partial shade loving plants like amorphophallus, turmeric,



colocassia, etc., which has great demand in the market. Most of the litchi growers belong to the middle-income group. Since after the litchi fruit set the unutilized area can be used for growing such shade loving plants by cultivating as inter cropping in between the vacant spaces and by this way the growers can generate some income. These intercrops not only help in generating additional income from the orchard but also keep the orchard clean and healthy.

## **8. Canopy architecture and Management**

Litchi plants require different kind of canopy architecture management strategies at different stages of growth and bearing which has been enumerated below.

### **Young non-bearing orchards**

Management and upkeep of young non-bearing orchards is essential which accelerate growth of the young plant and minimize juvenile period. Up to 3 years of age the main aim for the litchi orchard management is to accelerate the plant growth to develop better frame work which will make platform for higher production throughout the life span. Generally young litchi plant flushes five times in a year to form canopy with a certain quantity of vegetative growth. Therefore, in this period newly planted young sapling should be properly nourished to promote better vegetative growth. It has been anticipated that after attaining the age of 3 years, the plant develops good canopy and become ready for bearing few fruits. Other management practices like weeding, hoeing, cleaning of plant basins, plant protection and water management, etc. should be done time to time to facilitate better growth.

### **Young bearing orchard**

This is a very delicate stage of orchard management where more visionary approach should be followed in skillful manner. During this state (3-10 years) plant needs more nutrients for proper growth and bearing. At this stage, the tree keeps enlarging canopy and also produces fruits. Therefore, the management should be aimed to balance both vegetative and reproductive growth. It is important that at this stage of plant growth there must be optimum balance between vegetative growth and fruit production. Over vegetative growth adversely affects fruit setting while



excessive fruit load reduces development of tree canopy. Skillful orchard management at this stage includes maintenance of optimum number of bearing branches as per the nutritional status and health of the plant. Young trees tends to have more vegetative growth, therefore, it has been observed that sometimes fruit production is suppressed by excessive vegetative flushing particularly during autumn. Therefore, effective measures like ringing, girdling, fostering of winter shoots, use of paclobutrazol, etc. can be applied for proportional crop production.

### **Junior-adult bearing orchards**

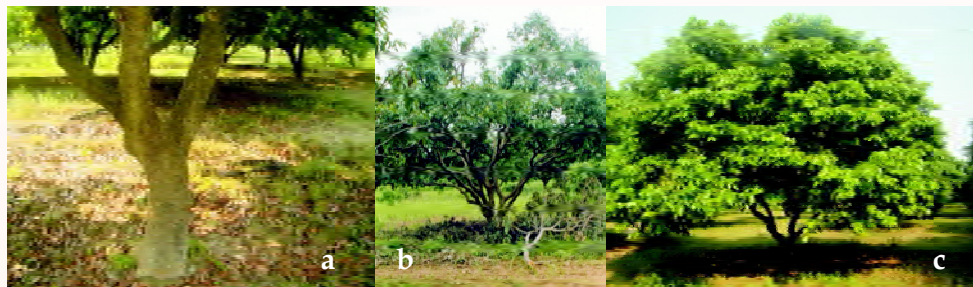
After attaining the age of 10 years, litchi tree enters in the phase where vegetative growth and fruiting remain relatively balanced and the phase is called as junior-adult bearing phase. The main aim of orchard management at this stage is to maintain a prescribed plant nutrient status so that tree can produce constantly high yield though out the bearing age. Various agro-techniques like rational fertilization, timely fostering of bearing mother branches, strengthening of nutrition accumulation in trees, plant protection etc. are applied to ensure optimum flowering and fruiting at this stage.

### **Senior-adult bearing orchard**

In this phase, tree reaches to its full yield potential. The age of tree may range from 20-100 years and can bear heavy fruits. The main aim of management of such orchard is to produce maximum yield with maximum feeding. At this stage, different fertilizers should be applied at different period of cycle. Foliar sprays of nutrients and plant growth regulators are also essential to ensure higher production. Timely plant protection, shoot treatment, intercultural operations, water and canopy management for higher production should be judiciously followed.

### **Training and pruning**

Training and pruning is very essential orchard operation in litchi. Since commercial harvest in litchi tree is obtained from two third of the lower canopy from the outer periphery, boosting more fruiting branches in this region is the main concern of training and pruning operation. Management of optimum stature of litchi tree with compact and stereo bearing canopy is an important aspect of orchard management. Generally, litchi tree grows continuously which results in larger canopy. In view of the present shortage



**Training of Litchi plants and canopy management (a) Selection of primary branches (b) Training-primary and open canopy in developed plants (c) After canopy management vegetative growth in litchi plants**

of space and requirement of high density orcharding, promotion of large bearing area, accommodation of more number of plants/unit areas, management of tree height, canopy concentration to provide more fruiting branches and penetration of more light to inner portion is more relevant. Hence, proper shaping of tree from initial stage and pruning of branches after fruit harvest in young plants, shaping is quite convenient at this stage. However, removal of 20 cm shoots after harvesting should be done every year to promote healthy vigorous shoots for the next year crop. Reiterative pruning is practiced to rejuvenate the old orchards whereas, corrective pruning by removing undesired, unfruitful and centre leader branches to ensure light and aeration inside the canopy should be adopted to enhance the stereo fruiting and thereby the productivity of the orchard.

Training is an important operation and should be initiated at the nursery stage itself. Single stem air layered plants should be raised in bags and allowed to grow up to 40-50 cm. The layered plants has strong tendency to produce branches at the ground level which should be pinched or pruned. Further, strong, well spaced, out facing with wider crotch shoot should be allowed to form the main branches. It is necessary to continue shaping by removing all the branches forming crotches with main branches as and when grow.

The main aim of frame working is to develop sufficient fruiting terminals. Compact and stereo-bearing canopy can only be achieved by well thought out pruning at early stage and shaping of young tree. The canopy should have well illuminated and sufficient number of strong and healthy branches for stereo bearing. To develop good and compact canopy,

25-30 cm fruit bearing shoots at the time of harvesting should be removed. In this way, 2-3 new terminals will develop which will consequently develop into fruiting branches next season. As principle, young trees are lightly pruned to provide larger area for photosynthesis. Severe pruning at young stage should however be avoided as it hinders the tree development and increases the period of juvenility. Besides, removal of dead and diseased shoots, small internal branches which prevent the sun rays to penetrate inside the canopy should be removed. Although, removal of branches along with the fruit bunch had shown its promise, but culturing compact canopy seems to be more useful in other litchi growing countries. The techniques includes, more pruning at top (open window) and outer parts of the tree canopy and less at bottom and inner side of the canopy which promotes stereo fruiting. In Israel however, dwarf stature litchi tree has been maintained by topping and hedging.



**Root primary and fertilizer applications trench in litchi plants**

The main objective of annual pruning is to control growth of the tree as in case of high density planting and promoting the flowering. The recent findings advocates pruning of litchi is facilitate healthy growth and better yield. However, in the past litchi trees were never pruned. Only at the time of fruit harvesting, a small portion of branches were used to be lopped off along with fruit bunch. This practice was considered to be helpful in improving subsequent fruiting by encouraging terminal shoot production. Sometimes root pruning and exposure also improves the flowering in adult trees. Time of annual pruning is very much important for the next year cropping. It should be done just after fruit harvesting. As soon as the fruit is harvested, the plants put forth new growth, therefore pruning must be completed before the initiation of new growth. Pruning after the initiation of new flush results the production of unhealthy shoots which do not mature for flower bud differentiation for the next fruiting season. During pruning tree vigour should be taken into consideration. Winter pruning should be strictly avoided. However the unproductive shoots arising from the main branches under the canopy should be removed as and when it is appearing. Rational supplementary pruning (light pruning) can be done after flower

bud formation in spring depending upon the requirement. Reiterative pruning is done to one year old bearing mother branches by removing 1/3 or 4/5 of the main branches. The damaged shoots due to severe cold, also needs to be removed just before the new growth initiation. After pruning, the leaves should be allowed to decompose in the basin of each tree. This can be done by removing the woody branches after drying of leaves followed by mixing of leaves in the soil before application of regular fertilizer dose.

**9. Nutrient management**

Inadequate nutrition often attributed for low yields in litchi. Therefore, balanced nutrition is important, both for young growing plant and grown up productive trees. However, a bearing tree requires balanced nutrient application for maintenance of vegetative growth along with fruit

**Table 3: Symptoms of nutrients deficiency in litchi**

Nutrients	Symptoms on leaf	Additional symptoms	Remedies
N	Chlorosis of old leaves; curling of leaf margins; increased leaf inclination and texture; decreased leaflet size; chloroplast disorganization; failure of leaf development and defoliation	Ununiform panicles; general stunting of growth; poor flowering; fruit set and fruit retention; lower yield with smaller size fruits or production of undeveloped fruits	Soil application of nitrogenous fertilizers in time
P	Tip and marginal necrosis of mature leaves proceeding towards the midrib; leaf curling premature desiccation and fall	Fewer vegetative and floral bud development; delayed fruit set	Soil application of phosphatic fertilizers in time
K	Leaf yellowing; necrosis are as first in leaf apices and gradually progress along the base; premature abscission of mature leaves	Stunted plant growth; poor fruit set	Soil application of potassic fertilizers in time



Nutrients	Symptoms on leaf	Additional symptoms	Remedies
Zn	Bronzing of leaflets; smaller leaflets; yellow interveinal areas and green veins (mottling). Premature flower dehiscence and ovule abortion	Long internodes; smaller fruits with reduced aril recovery and sugar content; flower drop and ovule abortion	Soil application of 25g ZnSO <sub>4</sub> , per plant during September or foliar application of 0.4% ZnSO <sub>4</sub> , 2-3 times during the period of fruit growth and development.
Fe	General chlorosis of young leaves; spreading of other leaves	Branch die back	Foliar application of 0.4% Ferrous sulphate, 2-3 times during flush emergence.
B	Leaves are smaller and withered; thickened petioles; curling may occur; exhibits blossom, wilting and necrosis, reduced pollen production and viability; poor fruit set	Small fruits with reduced pulp percentage; flower buds may fail to develop; cracking of fruits	Foliar application of 0.4% borax, 2-3 times during fruit development
Cu	Small leaves; interveinal chlorosis or mottling; small fruit with reduced pulp percentage; induces pollen sterility, thus limits fruit set in crops	Terminal die-back of young shoots	Foliar application of 0.2% Copper sulphate 2-3 times during flush emergence.

production. A fully grown up litchi tree gives an average yield of 80-120 kg depending upon varieties. Apart from fruits, a considerable amount of macro and micro nutrient is removed from soils through annual pruning of shoots. Hence, the application of manure and fertilizer in the required doses is therefore, of paramount importance for sustaining the regular production of the crop. The nutritional requirement in litchi plants depends upon the soil fertility condition. For example the soil of Doon Valley is deficient in N and P where as litchi orchard in Punjab are deficient in N, K, Mg, Zn and Mn. Therefore in these regions the optimum amount of nutrients should be applied after proper soil testing. The major symptoms of nutrient deficiencies have been presented in Table 3.

In the initial stage of establishment, however, application of 30 kg well decomposed FYM, 2 kg Neem/Karanj cake, 150 g urea, 150 g SSP and 150 g mutriate of potash per plant has been found to be optimum. As the plants advances in age, an additional dose of manure @ 5 kg FYM, 150 g Karanj/Neem cake, 150 g urea, 100 g SSP and 50 g muriate of potash

per plant should be added each year with the dose of previous year. Thus, a sixteen years old fully grown up Litchi tree should be supplied with 80-100kg FYM, 4 kg Neem/Karanj cake, 2 kg urea, 1.5 kg SSP and 0.8 kg muriate of potash per plant per year.

Application of organic manure in litchi improves the yield and quality of fruits. Application of lime in acidic soils @10-15 kg/tree at an interval of 3 years has been found to increase the yield. Since the litchi is a highly sensitive plant in respect of the deficiencies in the micro nutrient the application of zinc, boron, magnesium, iron and copper in appropriate doses along with calcium are necessary for satisfactory plant health, flowering and fruiting. Application of FYM, potassic and phosphate fertilizer in general should be done during June-July, just after harvesting of the crop. However, in early and heavy rainfall areas of Uttaranchal, Uttar Pradesh and West Bengal manures and fertilizers should be applied in the month of September-October just before end of monsoon. The application of annual requirement of nitrogen is done in two equal split doses. First dose is applied after fruit set in the month of March-April while the remaining half dose is applied immediately after harvesting of the crop. After application of fertilizer irrigation of the tree is essential to maintain proper soil moisture condition. Generally the total requirement of nitrogen, phosphorus and potash is applied through basal application. However, two sprays of 2 % urea during the fruit growth as per the need should be done to improve the fruit size and quality. Two foliar application of zinc sulphate (0.2%) should be done first at 10-15 days before flowering for improving sex ratio and second at pea stage of the fruit to improve the size and quality of fruits.

## **10. Irrigation and Water Management**

Optimum soil moisture and humid microclimate in the orchard is of utmost importance for growth development and fruit production in evergreen litchi plants. For the places receiving about 1000 mm annual rainfall distributed for longer period, litchi can be grown successfully and supplementary irrigation is required only during fruit development and maturity of the crop. However, during the initial 3-4 years of the establishment of the plant, much care is needed to protect the plants from extreme weather conditions. Protection of young plants from extreme



temperature during summer and winter months is very essential in the initial stage of establishment. The young litchi plant must be irrigated at weekly interval for better establishment. Desiccating winds during summer and frost during winter months are most damaging. Further the young plants should be irrigated during dry period and winter months at the interval of 10-15 days. In the basin weed should be removed and soil should be loosened. In young plants, mulching with dry local weeds in the basins help in better moisture conservation. In situ water harvesting through full-moon- terrace during rainy season and mulching with paddy straw in October helps in maximum soil water retention and improves the fruit yield and quality in grown up plants. The land should be ploughed time to time to minimise the weeds and to improve the soil physical condition.

Irrigation at the interval of 2-5 days to maintain the atmospheric humidity during fruit development and maturity is pre-requisite for successful litchi cultivation. Irrigation of plants at alternate days interval, 6 weeks before harvesting improves fruit retention and fruit development, and reduces fruit cracking and improves the fruit quality. Moisture conservation through mulching using dried weed or black polythene sheet has been found useful. Certain physiological disorders like poor sex ratio, poor fruit set, heavy fruit drop and high fruit cracking, besides sun burning of the fruits can be minimized with proper water and nutrient management.

In the first week of April, when fruit development starts, water management becomes essential. Thus, light irrigation at an interval of 4-5 days during April and May promotes aril development and checks fruit cracking. Irrigation of litchi tree through drip system from fruit set stage has been found highly beneficial in minimizing cracking and improving the fruit quality.

## **11. Flowering and fruiting**

Grafted or air-layered litchi trees start to bearing at the age of 4-5 years with proper care and management while the seedlings takes 8 to 10 years to flower. The flowering starts from later part of January or early February and fruits ripen in April and May. In litchi, the inflorescence is a much branched panicle normally arising terminally from the previous seasons growth. Panicle may be pure as well as mixed. The different litchi cultivars show variations in their flowering and bearing habits and may

accordingly be classified as regular, irregular, shy bearing etc. So, for effective pollination and fruit- set of litchi, planting of several cultivars in an orchard is suggested. The flowers are mainly staminate, hermaphrodite and pseudo-hermaphrodite. The first flowers to open are males, followed by hermaphrodites functioning as females and pseudo-hermaphrodites functioning as males. It was observed that if new flushes appear in autumn due to late rain, these shoots usually fail to bear flowers. Treatments with auxins and some other chemicals were found effective in inducing flowering. Two spraying with NAA at 100 mg/l, 1% potassium nitrate or ethrel 0.50 ml/l in the months of October and November or Cinturing of shoots in the month of October was found to promote flowering.

The time of floral initiation varies with genotypes and environmental conditions. In the northern hemisphere, it usually occurs between November and February, while in southern hemisphere, it usually occurs between June and September. In India, the flowering season generally extends from early or mid-January to third week of February in Punjab and sometimes it extends up to first week of March in West Bengal. Though flowering is almost simultaneous in all the cultivars, some cultivars like Purbi, Deshi and Muzaffarpur start little earlier. The inflorescence is a panicle with greenish white or grayish flowers. In some plants high percentage of axillary panicles was noticed, but no varietal characteristics could be established. When the terminal panicles appear generally in mixed forms, the lowermost buds produce only leaves, the buds in middle produce floral branches in the axil of leaves whereas the topmost only floral branches and sometimes very small leaves which do not persist. In male flower the pistil is pinkish white or grayish and abortive. In hermaphrodite, though there are anthers, they never develop and dehisce as in males. In pseudo-hermaphrodites, the anthers are as in males but the ovary is neither so ill-developed as in male nor so well- developed as in hermaphrodite (Das and Roychoudhuri, 1955). Anthesis and dehiscence continued throughout the day and night with two peak periods, the first within 10 a.m. and the second between 12 noon and 3 p.m.

### **Pollination and fruit- set**

Litchi is generally a cross pollinated crop and pollination is mainly done by insects, such as honeybees, flies, ants and wasps. In seedless fruits

in which the seed is shriveled, presumably, develop without fertilization and such cultivars are likely to be self sterile and perhaps cross-sterile also, while those with normal seeds are probably self and cross fertile. It is thought that pollination is necessary even for seedless type, this being a case of stimulative parthenocarpy. Though, litchi plants flower profusely but only 2 to 4.5 per cent of the total flowers set fruits. This may be due to lack of fertilization or embryo abortion.



**Flowering in Litchi plant (Left), Pollination through Honey bee (Centre),  
Initial fruit set in litchi (Right)**

## **12. Maturity and Harvesting**

Litchi is a non-climacteric fruit and harvesting is done when fruits are fully matured on the tree. At the time of harvesting development of colour on the fruit, flatness of tubercles, smoothness of epicarp and TSS : acidity ratio may be taken into consideration in addition to number of days taken from fruit set to maturity. However, the colour development is the major criteria to decide the harvesting stage. The red pigmentation in litchi is associated with anthocyanin pigments viz. cyanindin-3 glucoside, cyanindin-3 galactoside, pelargonidin-3 glucoside and pelargonidin-3, 5-diglucoside. The fruit is harvested in bunches along with portion of branch and few leaves. At the time of harvesting care should be taken to harvest the selected bunch which has attained desirable maturity stage. The fruit should be harvested early in the morning when temperature and humidity are congenial which gives longer shelf life of the fruit. At the time of harvesting, the fruit should be collected in bag and should not be dropped on the ground. The fruit should be precooled to remove the field heat which extends the shelf life. Further the fruits should be brought to the cold storage within two-three hours. The yield of fruits varies according to the age of the tree, agro-climatic condition and maintenance of the orchard. Usually

about 80-120 kg fruit/tree is obtained from 14-16 year old trees. However from the fully grown up tree a yield of 160-200 kg/tree can be obtained.

Litchi cultivar Shahi attains maturity between 73-78 days after fruit set. At the time of maturity, the fruit weights around 20 grams. Although climatic factors influence the time of flowering they do not necessarily affect fruit development or maturity. Harvesting takes around five to eight weeks, depending on the cultivars, production area and condition. The maturity groups of litchi cultivars based on heat unit summation have been worked out and its possible relation with sugar: acid ration at maturity has been derived. Shahi and Rose Scented are early maturing cultivars with less than 1400°C unit summation for maturity (Table 4).

**Table : 4 Grouping of litchi cultivars based on heat unit summation for maturity**

Degree days range	Cultivars
<1400	Ajhuli, Trikolia, Early Bedana, Shahi, Rose Sented
1400-1600	China, Purbi, Late Bedana
>1600	Dehradun, Kasba

Thus, the varieties should be harvested after attending proper stage of maturity. Litchi should be harvested in the morning hours or late afternoon when ambient temperatures are lower. Harvesting during hot periods can speed up the rate of water loss. At the time of harvesting the fruits should have the following characters.

Parameters	Standards
Fruit weight	20-25 g
Fruit colour	Red on outer and inner surface of the skin
Total degree days	1300-1400°C (Shahi and Rose Sented) 1400-1600°C (China)
Sugar content	15-17%
TSS: acid Ratio	60.0-70.0
Skin	Smooth textured and easily peeled off

### 13. Insect pest and disease management

The litchi is prone to attack by pests and diseases, which are one of the major limiting factors in its successful production of temperate fruits. Estimates of yield losses caused by pests and diseases attack range from 10



to 30 per cent in various parts of country during different seasons of the year. Unlike agricultural crops, litchi is grown as monoculture, the pest and disease problems are entirely different and complex in nature. Such pest and disease situations have led to repeated and excessive use of chemical pesticides. This has resulted in development of resistance in the pest species, contamination of fruits, environmental pollution as well as rejection of export produce. The global concern regarding the over and misuse of chemical pesticides has resulted in adoption of Integrated Pest Management for controlling the pest-disease problems. It is an ecofriendly approach encompassing cultural, mechanical, biological and need based use of chemical pesticides preferably in combination with botanicals and bio-pesticides. Agenda 21 of the United Nations Conference on Environment and Development (UNCED) at Riode Janerio in June,1992 identified IPM in horticulture as one of the requirements for promoting sustainable horticulture and rural development. Integrated Pest Management requires thorough preplanning even before establishing the orchard which includes selection of suitable site, type, improved and pest/disease free planting materials, regular pest/disease and weather monitoring in the orchard, balanced used of fertilizers, water management, proper training and pruning, improved cultural practices, augmentation and conservation of parasitoids and predators, application of bio-pesticides and neem based formulation and need based use of selective pesticides. With respect to promote greater IPM implementation, special emphasis is necessary to generate increased awareness and transfer of available realistic IPM programmes. The strategic steps will unclude determination of farmers pest management knowledge, attitude and practices, IPM trial demonstrations and appropriate training of the extension personnel and farmers.

### **Eriophyde mite/Erinose mite (*Aceria litchi*)**

It is a serious pest of litchi. Nymphs and adults, both infest litchi leaves and inflorescence. The adult mites are small and hardly visible with naked eyes. They live at base of hairs on the under surface of the leaves. The mites puncture and lacerate the tissues of the leaf with their stout rostrum and suck the cell sap. The affected young leaves develop yellow or greyish-yellow colour which later turns brown. On matured leaves, there are continuous or scattered patches of brown to deep-brown depressed regions

with the ultimate result of gall formation, curling, twisting, thickening and pitting of the affected leaves. The upper surfaces of the leaves give a characteristic greyish or dried appearance. The leaves may ultimately fall off. Mites have been found to attack and cause malformation of inflorescence. The affected flowers or buds show an enormous increase in size are thickened with yellow colour. An enlargement upto 4-5 times the normal size is not rare. In affected flowers, calyx is highly enlarged and sharply divided at the top showing the presence of 4 or 5 sepals. The peduncle is highly thickened and elongated. Some affected flowers have been found to develop highly thickened and elongated bracts, though they are normally ebracteate. Ultimate result is extremely low or 'no' fruit set.



Mite infected leaf (a) and fruit borer infected fruits (b)

### Management

Prune off the affected plant parts as soon as the mites make their first appearance and burn the wastes fallen on the ground.

Deep ploughing of the field and exposing the soil to sun (May-June and Sept- October) helps in minimizing its incidence.

Spraying of dicofol (0.05%) is found most effective to control the mite.

### Bark eating caterpillar (*Inderbela spp.*)

The attack of caterpillar can easily be detected by the presence of brownish ribbon-like loose masses of excreta which remain attached with the main scaffold branches at the point of injury. The adult moth lays eggs during May-June in groups of 15-25 which hatch after 8-11 days. The larvae web shelters of wood, silk and excreta and feed on the surface of the bark till September. After wards they bore into bark and underlying tissues in





the branches. These become fully grown up by December and pupate in late April.

Caterpillars bore inside the trunk or main stem/branches about 150-250 mm deep. At night they come out and feed on the bark protected by large silken webs that cover the entire affected portion. Later, they eat through the bark into the wood and in case of severe infestation with and the trees get revitalized and cease to flush.

Orchard sanitation is simple but important preventive measure in controlling bark eating caterpillar.

Clean the affected portions of the tree by removing all the webs etc. and insert the cotton wool into the holes, soaked in petrol or monocrotophos or dichlorvos and then seal the holes with mud.

### Shoot borer (*Chlumetia transversa* W.)

The caterpillars bore inside the newly growing shoot and feed inner parts resulting in drying of the twigs. In case of severe infestation the sap movement is interrupted and the tree ceases to flush.

### Management

Pruning and burning of affected twigs minimize its infestation.

Spraying of carbosulfan 0.05% or quinalphos 0.05% is found quite effective to control this pest.

### Fruit borer (*Conopomorpha cramerella* Snaller)

It is a major pest of litchi, causes maximum damage during fruit developmental stage. The small caterpillars bore through the stalk end of the fruit feed on the seed and skin of the fruit. As a result fruits become stalk end of the fruit. High humidity and intermittent rains favour its infestation. This pest also causes fruit drop.

### Management

Regular ploughing, removal of wrapping materials, weed destruction, burying of damaged fruits help in controlling the incidence of this pest. Spray neembicidine or Kamthenu Keet Niyatrak (4-5 ml/litre) two times at 7 days interval at colour break stage to minimize the incidence of borer.

Application of imidachlorpid 0.05% gives good result. First spraying should be done at pea stage and second, 15-20 days after first spray.

## Monthly Calendar of Operation

### January

The Litchi mite infested shoots should be removed.

To trap adult (Male) of fruit borer set pheromone trap (12-15/ha) at middle height of plants of trapped insect every week.

To minimize the population of fruit borer, use *Trichogramma* @ (50,000eggs/ha) before emergence of flower panicle.

### February

Apply nutrients based on the basis of leaf analysis.

Keep honey bee colonies (10-15 boxes/ha) in orchards after opening of 10% flower for effective pollination.

Spray any chemical or pesticide only after removal of honey bee boxes and proper fruit set.

### March

Spray planofix 2ml / 5 litre water or NAA 20ppm (20mg/litre) solution to control early stage fruit drop.

Apply remaining 1/3 nitrogen (450-500g Urea/ plant) and potassium (250-300g MOP/plant) and give irrigation for nutrient absorption. Irrigate orchard regularly to avoid deficiency of soil moisture.

Spray neembicidine or neem seed extract or Kamdhenu Keet Nyantrak or vermiwash 4-5 ml/liter water at pea stage of fruit to control population of fruit borer.

### April

To control fruit cracking give spray of borax (4g/litre) at 15 days interval after full stone formation.

Keep proper moisture in orchard for better development of fruit. Spray neembicidine or neem seed extract or Kamdhenu Keet Nyantrak



solution two times at 7 days interval at colour break to reduce fruit borer infestation. In case of severe incidence application of imidachlorpid 0.05% at pea stage and after 15-20 days of second spray gives good result.

## May

Irrigate orchard properly up to fruit ripening. Start harvesting of fruit in 3<sup>rd</sup> week of May.

Harvesting to be done in morning hour (4-8 am) and keep fruit in orchard at cooler place, where grading and packing should be done after pre cooling of fruits.

If packaging house facility is available, transport the fruit avoiding scorching sun light, so that proper grading and packing can be done in pack house.

Make arrangement to transport the fruit in card board boxes in refrigerated van maintaining cool chain for marketing or processing.

## June

Prune the trees just after harvesting.

Remove the insect affected dried branches and shoots arising from stem and branches towards outside.

Canopy management to be done for better penetration of light and aeration. Light ploughing and leveling of orchard to suppress the weed in orchard and provide proper aeration to soil.

Apply 60-70 kg well rotten FYM, 2kg Neem or Karanj Cake, 1 kg Urea, 1.5kg DAP and 800g MOP/ plant with first good rain.

Apply the FYM and fertilizer in 20-25cm wide and deep ring made 1.5 m away from the tree trunk and below the outer canopy.

Apply light irrigation after fertilizer application (if moisture is deficient) for proper absorption of nutrients.

## July

Plant star flushing which is most important flush for bearing fruits in the coming season.

Spray insecticide/ pesticide to control the leaf roller and leaf miner. Spray omite or Kalthane Solution (3ml/litre) two times at 7 days interval or dicofol (0.05%) to control infestation of mite.

## August

Field should be well drained and avoid water logging in the orchard.

To control stem borer/bark eating caterpillar clean the holes from infested portion with help of cycle spoke and insert diesel or petrol soaked cotton in the hole and plug the hole with wet clay soil.

In case of severe infestation 2-3 drop of Nuvan to be poured in hole and plugged with wet soil. Rejuvenate the old and senile orchard.

## September

For complete management of bark eating caterpillar repeat the process in the leftout live holes given in month of August.

Light ploughing of orchard to suppress the weed and provide proper aeration of soil. Spray sevin 2g/litre to control the leaf eating weevil.

Clean the orchard after last monsoon rain and paint the trunk up to 1-1.2m by Bordeaux mixture (lime: copper: water, 5:5:50).

## October

Light ploughing and leveling of orchard. Prune and destroy infected shoots due to mite and spray kalthane or omite @ 3ml/litre to Protect the plants from weevil and semilooper infestation if visible on plants.

In this month Copper deficiency symptoms appears on the leaves. Spray Copper sulphate 2g/ litre twice at 15 days interval to overcome the deficiency.

## November

Remove new sprout emerging form stem.



Keep watch on infestation of bark eating caterpillar and if required manage it properly.

### **December**

Spray Zinc sulphate (33%) 2g/litre at 15 days interval or apply (20-25g/plant) in soil.

Application of micronutrient (Zinc) increases number of female flowers.

### **Advice:**

Stop irrigation from November to emergence of flower.

Spraying of any chemicals or fertilizer application to be done when there is optimum moisture condition in soil.

Use mulches to conserve the soil moisture.

Mix Stickers while spray hormones/insecticide

Apply manures and fertilizer in trench

Maintain proper moisture and humidity in Orchard at the time of fruit development and ripening.

Harvest fruit in morning hours and keep in orchard at cooler place.



**Hardening of plants in nursery**



**Deficiency of iron**



**Mulching in plant basin**



**Ideal canopy for adult plant**



**Fruit cracking in litchi**



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