



CANOPY MANAGEMENT AND REJUVENATION

Apart from the various biotic and abiotic factors which limit yield and quality in litchi, overcrowding of branches, less circulation of air and poor light inside the canopy lead to production of more unfruitful branches in a litchi tree. Thus happens due to lack of knowledge about initial tree framing and canopy management.

Pruning plays an important role in regulating and controlling growth, flowering and fruiting of litchi trees. Young litchi trees are usually trained in order to obtain a framework that is strong and accessible for other cultural practices. Generally, the grown trees are pruned to maintain the canopy height, spread and density required for easy spraying, fruit thinning and harvest. However, the main reason of pruning of mature litchi trees is to encourage them for better fruiting by way of maintaining a balance between vegetative and reproductive growth. Pruning can also be used to limit excess number of fruits by removing some fruit bearing branches, giving a thinning effect that can improve fruit size and quality. It facilitates light penetration into the interior of the tree canopy, which improves fruit colouration.

Developing desirable plant ideotype is an important tool for litchi plantation as it allows the producer to restrain the exuberant vegetative growth of litchi to manageable sizes and forms. Pruning in litchi general a matter of common sense at the time of fruit harvest but main objective of pruning in litchi is to develop a good tree structure which meets desired requirements and facilitates harvesting and movement of machinery through the orchard. In senile trees with huge unproductive canopy, rejuvenation pruning forces the development of productive fruiting shoots.

Importance of Canopy Management

Most of the litchi orchards are dense and over-crowded and their bearing is low. They harbour various pests and disease causing agents due to change in micro-climate inside the canopy. Pruning is usually carried out to shape trees and open up the centres, allowing free movement of air and sunlight into the tree. This facilitates the penetration of sprays through the trees making control of pests and diseases much more efficient. It reduces the cost of plantation

and management by reducing the incidences of diseases and pests and also expenses on their management.

- The ability of sunlight to penetrate the tree enhances the colour of the fruit and improves quality. Litchi tree bears 90 per cent fruit or one can say produce commercial yield from lower canopy in the peripheral of the tree. Therefore, developing ideal canopy in litchi is very much important from the beginning of the plantation.
- It lowers the cost of harvest by reducing the time and required labour for harvesting. This is also important to reduce production and harvest costs, synchronize vegetative growth and flowering period, extend the production cycle and sales season, increase productivity of the plants, stimulate precocious flowering, extend the productive life of the plantation; recuperate overgrowth in older plantations and increase air circulation inside the plantation, which ultimately lowers costs and losses.
- Specific activities such as irrigation, pruning and harvesting at field level and post harvest management operations like grading and packing can be synchronized if all the litchi plants have ideal canopy. Related services like pack houses, refrigerated-van, labour force can be efficiently utilized when the plant canopy is ideal and uniform.
- Ideal canopy improves the appearance and quality of litchi fruits and helps in predicting yield of a tree which ultimately helps in planning for marketing and export of fruits.
- Pruning has direct impact on yield. Litchi has tendency to bear at the terminal ends of the shoots, however, some fruits are also produced from auxiliary panicles as well as old branches. The pruning helps to activate the quiescent fruit bearing buds owing to redistribution of the endogenous hormonal substances to favour flowering and fruiting.
- An important aspect of the periodic pruning is that by limiting the length of the branches, wind damage is reduced. Even though it might take time for the overall yield of pruned trees to approach that of unpruned trees, fruit picking and treatment are made easier by pruning, the actual amount of fruit harvested from pruned trees in the third year, or even before, might be greater than from larger, unpruned trees.
- Pruning results in, increased dry matter content of leaf and stem which reaches the maximum level by October-November, thus the C/N ratio of the shoot reaches the highest level during November-December. This becomes possible owing to increased photosynthetic efficiency of litchi plant due to improved light penetration inside the trees.
- As a result of pruning, the RNA content of leaf becomes higher. The pruning increases the ascorbic acid content in litchi leaves from September onwards which helps in more flower formation.
- Pruning also increases the total phenolic content in litchi. Phenolic acids act as inhibitors similar to abscisic acid which favours the flower bud formation. Lower IAA Oxidase activity has been observed as a result of pruning which possibly makes optimum levels of auxin available to favour flowering.

- The respiration rate of leaves during September and November-December is increased due to pruning which helps in increased flower bud formation and flowering.
- The gibberellins-like substances in the leaves of pruned trees are found to be lower than those of unpruned trees. The lower contents of GA are associated with normal flowering. Similarly, the higher level of cytokinins which favours the flowering also increases due to pruning. A higher level of cytokinins induces and increases flow in the xylem sap which activates the latent buds from their innate dormancy resulting in flowering.
- Better fruit set of pruned trees might result from increased water and nitrogen supply to the remaining wood but not from increased photosynthate resources. However, there is some evidence that pruning can stimulate photosynthetic activity of leaves. This effect is thought to be result of an enlargement of leaf and mesophyll cell size, an increase in chlorophyll content and a lengthening of daily period of stomatal opening caused by an increased leaf water content. Increased water supply to shoots and leaves of the pruned trees is the result of the change in the proportion of foliage area to root system, not the reduced transpiration per leaf area unit. Pruning reduces the transpiring area in proportion to the temporarily unaffected root system and thus increases water supply to leaves, flowers and fruits.
- It is evident from many studies that pruning changes total dry weight partitioning in such a way that more dry weight is added to new shoots than to remaining wood of frame, trunk and roots. The high production of new shoots would be expected to decrease the reserves of nutrients, particularly carbohydrates, stored in the remaining parts of the tree, which are indispensable for such important processes as fruit bud formation.
- Heavy pruning at the on-set of rainy season (i.e. in June-July) results in decreased foliage area at the beginning of the growing season, but due to rapid growth of shoots (particularly in juvenile litchi plants), the foliage area is restored and may be equal to that of unpruned plants. When pruning is done late in the season (September-October), leaves which are removed by pruning is not compensated and growth of young tree or fruiting of bearing trees is adversely affected. But, if the tree has excessive vegetative growth, a dense foliage influence its photosynthesis indirectly by reducing the interception of light and its distribution within the tree canopy. Although this is done to assure good photosynthesis of the fruit bearing parts, these aims are not always realized. If pruning involves numerous heading cuts of shoots and small branches, it induces excessive sprouting of new shoots on the outer mantle of the tree canopy, which hinder light penetration to the fruit bearing parts.
- Fruit setting also seems to be influenced by tree vigour. As a rule, fruit set is better on vigorous older trees than on young ones. Vigour of the tree can be improved with the pruning of limbs or growing shoots. Also, since hormonal levels are modified by pruning, it is possible that pruning increases fruit set as a direct result of growth hormone action. The balance between the hormones supplied by the root system and the above ground part of a tree is disturbed by pruning.

- Flower formation in a severely pruned tree is retarded not by deficit of assimilates but by hormonal imbalance. Firstly, hormones supplied by the roots become unbalanced when the top part is removed. Secondly, hormones produced by the green parts of the tree cannot be utilized when the number of meristem is reduced. Quick growing shoots of pruned trees are thus overloaded with growth promoting hormones (auxins, gibberellins) that prevent flower bud initiation. Any pruning that stimulates growth of pruning trees prolongs the vegetative phase and delays reproductive processes. Because pruning of very young plants delays fruiting and lower yield, some fruit growers have replaced pruning with shoot bending in order to obtain the required tree frame and early bearing.
- The yield depressing effect of pruning operation depends on how much it stimulates new shoot growth. Thus, dormant (winter) pruning decreases yield more than summer pruning, heading back cuts more than thinning out cuts and many small cuts more than a few large cuts even when the same amount of wood is removed. Litchi tree is evergreen and never becomes dormant, but vegetative flushing is restricted during winter, thus pruning winter greatly reduces the yield. Therefore, when litchi trees come into full bearing in a commercial orchard, the grower is usually constrained to prune trees in order to control tree height, spread, and density. This may lead to imbalance in the canopy structure in the long run. All care must be taken to contain mature trees by pruning to their allotted space and all such pruning must be carried out immediately after harvesting the crop.

Planning for Canopy Management

Canopy management is a skill cum art which needs a lot of planning and knowledge about behaviour of plant after pruning. Therefore, before taking up canopy management operation in litchi, certain facts and knowledge is essential. Following points need to be looked into:

- (i) **Tree's growth and fruiting behaviour:** The growth pattern of all the litchi varieties is not same. Some are more vigorous whereas, others are less. Therefore, pruning depends upon the variety. All pruning is done after harvest. Litchi trees do not have to be pruned annually to bring on flowering or increase yield as is the case with deciduous fruit trees. They are terminal bearers and usually flowers are borne on mature wood. In fact, pruning at the wrong time may have a detrimental effect. Pruning tends to stimulate shoot development in litchi trees usually resulting in vigorous vegetative growth. If trees are cut back too heavily, they may not fruit for two to three years.
- (ii) **Intended plant canopy architecture:** The ideal canopy for litchi may be variable depending upon the needs and requirement. For high density, the small canopy will be ideal whereas, for wider plantations the canopy should be little bigger. At any cost, the canopy of two plants should not touch to each other. This can be managed by regular

pruning. Regular pruning is essentially needed in high density litchi plantations which should be done just after crop harvest.

The desired plant canopy can be visualized by seeing a perfectly pruned tree and gaining experience in plant canopy by visiting top gardeners and research stations etc. When one becomes able to visualize a desirable tree shape for a mature tree, it will provide significant assistance to pruning decisions on the young plants. Knowing which shoots and branches to leave on young plants to form the basic tree framework is critical, as these shoots will remain throughout the life of the tree. The ideal tree should have three and not more than four main branches, oriented in such a manner that inside of the tree should remain open in vase shape. The branches should be low-set, i.e. 4-5 metres. Over this height, harvesting becomes difficult. The crop canopy refers to leaf area and its orientation, height and tree girth. The quality of the canopy is best measured as the percentage of light falling on a field that is intercepted by leaves. Normally leaves should be oriented in such a way that light passing by one is captured by the leaf below. Thus, canopy management is one of the most important steps in orchard management which is done with a goal to shape the tree for maximum light utilization and efficient cultural operations in the coming years.

- (iii) **Balance between vegetative growth and fruiting:** A good balance between vegetative and fruitful growth should be maintained by pruning. Factors such as soil type, climate, variety and nutrition play critical roles, however the severity of pruning is very important. On vigorous varieties, there is need to increase fruit and slow down the vegetative growth. It has been observed that slower vegetative growth usually favours more flowers and increased fruitfulness. Selective pruning to remove vigorous, less fruitful shoots and to retain less vigorous shoots can assist in swinging the balance from vegetative to fruitful production.
- (iv) **Time and method of pruning:** Generally, the bearing litchi plant should be pruned after fruit harvest. The developing plant, however can be pruned during dormant season (November-December). In bearing trees, delayed pruning results in weak growth of sprouts. Marking of the branches is essential before pruning to avoid error. Cut the side branches at least 50 cm from the target. Cut the remaining branch close to the main branch and parallel to it. Make a clean cut to avoid later infection. The cut surface should be painted with Bordeaux paste or clay+cowdung, or coal tar to seal the surface and promote healing of the wound and remove small branches and dead twigs from the upper half of the canopy.

Canopy Management Practices

Developing Strong Framework/ Tree Architecture

There is a strong tendency of layered trees to form defective branch unions or to produce branches almost at ground level and this is why it is virtually important to shape the trees

properly in the early years. Shape pruning begins when a branch is chosen for layering. The branch chosen for layering must have a single stem. If it does not, the other stems must be removed either at the time of layering or when the layer is transplanted into a bag or planted out. This is of course not applicable for plantations obtained from plants propagated by seed, cuttings or grafting. One definite aim in litchi shaping is to develop sufficient fruiting terminals.



Fig. 13.1: Frame development in litchi plant

During early years of orchard establishment more emphasis is given on development of framework. Pruning at this stage is a constructive operation which determines general outline of the tree. This is also referred to as “pruning for training”. The first pruning cut is made on a newly planted layer to reduce the size of the top to compensate for roots that were lost during digging planting operation in the nursery and to establish the trunk height. Pruning of nearly 75% leaves of the litchi layers can be done for better survival in the nursery (Fig. 13.1).

Litchi plants tend to branch low and thus it is necessary to select the branches to be retained as scaffolds or to be removed to get a longer trunk. Litchi tree should consist of four or five primary branches extending in different directions to form a well balanced canopy. The canopy is maintained well above the ground level to facilitate cultural operations. Scaffold limbs are selected around the trunk and other weak or poorly placed shoots are removed.

The first primary scaffold is allowed within 60cm height from the ground in the second year. Second primary scaffold is also selected on the trunk in the same year. This branch is spaced 20-25 cm apart vertically and as closely as possible to 120° laterally around the circumference of the trunk. Third and fourth primary scaffolds are selected in third year. Likewise fifth and sixth primary scaffolds are allowed in fourth year. Fifth year onward all strong laterals emerging on the main trunk are thinned out and no limb is usually allowed to be a scaffold. Two secondary scaffold limbs arise about 60-70 cm above the junction of the primary branch and the trunk. Two tertiary branches fork another 60-75 cm above the junction of the secondary scaffold branches and must be oriented tangentially so that the trees will finally resemble an inverted cone. In such shaped litchi trees, secondary or tertiary branches are developed to be nearly equal in size. This is achieved by suppressing the growth of the most vigorous scaffold branches through moderate pruning and by promoting the least vigorous ones through light pruning.

When two equal size branches with a narrow angle between them grow for some years at the same rate, a V shaped crotch is formed at their meeting point. Eventually considerable

amount of bark inclusion develops between the two branches at their junction, with little or no connecting wood. With heavy loads of fruits and strong winds, these limbs are liable to split apart. This problem can be prevented by completely removing one of the branches when they are young or heading back one of them heavily so that the other becomes the main limb and the headed branch becomes a lateral. Branches with weak, narrow crotch angles should be removed where the bark is folded into the crotch. Don't remove branches until the trees are at least one year old.

Trees should be inspected regularly during the first four years and the required action is taken as per need. Severe pruning should, however, be avoided as it hinders plant development and significantly increase time to first harvest. This process of allowing new branch sprouts to grow and then to cut off their growing tips after the leaves have turned dark green is repeated for two years. After this the trees should start branching by themselves. It is therefore, recommended that the shoots on terminal branches be 30-35 cm from the apex just prior to a new vegetative flush. In this way, for each terminally pruned branch on an average 2.5 or 3 new terminals will be produced and top-spread will be denser. Downward and inward growing branches or branches that cross over each other should also be removed. Young trees can be pruned at any time of the year. The aim should be to develop a spreading tree rather than a tall tree.

Annual Pruning

Young litchi plants are pruned to provide a strong structure, minimize wind damage and increase fruit bearing area. Wind damage is an important issue for some cultivars. Cultivars with long branches are susceptible to branch splitting, while others with short dense crowns can break off at the ground. When the bunches of fruit are cut, branch lengths of 20-30 cm are lopped off with them. The litchi flowers are borne mostly on new shoots. The old branches rarely produce flowers. Snipping of old branches to produce fresh growth is considered desirable. In India, the fruit is harvested in bunches along with shoots and this serves the purpose of pruning. No additional pruning is usually done. In a pruning trial conducted at Malda, pruning panicle at harvest caused maximum panicle emergence and yield in subsequent year. Quality of fruits improved with respect to TSS, sugar, acidity and ascorbic acid.

The severity of pruning varies with tree age. Old litchi trees in low vigour are pruned more heavily. On long term basis, however, the orchard will be more productive than if left unpruned. In this practice, up to 50 cm of the branch is removed and is believed to help improve subsequent fruiting since it encourages terminal shoot production. However, severe pruning of terminals is not usually as effective as other practices such as cincturing or fertilization. In many areas where litchi is cultivated, usually after the harvest, removal of dead wood, small internal branches, as well as all branches preventing the sun's rays from penetrating the tree is recommended. At many places, one to two pairs of leaflets are removed together with the floral stem at harvesting.

Flowering and fruiting of older branches must be encouraged, at the same time growth of additional new shoot system is also required. In a practical sense, no single pruning technique is adequate to achieve the different goals. Managing litchi trees through this transition requires co-ordination of pruning with other practices such as limb positioning and fruit thinning so that the equilibrium between shoot growth and fruiting is maintained. At this point the interactions among all forms of growth, including growth of the crop that constitutes vigour must be thoroughly considered before the appropriate technique is selected.

Old litchi tree does not produce fruit uniformly. Only certain branches of the tree produce during a given season. Often, trees have only a few fruits on some branches whereas; most of the trees have no fruit. This means that the tree is not producing up to its potential. A well-managed tree produces fruit on all of its branches. If the tree does not produce its maximum, this will not only reduce the return per tree, but will also increase the cost of harvesting as pickers must visit more trees to harvest a given amount of fruit. Pruning of all branches of a tree ensures that all branches will produce at the same time. Doing this to all trees in a plantation can bring all the trees into harvest during a relatively short time and can significantly improve the efficiency of harvesting and marketing activities. Maximization of production in litchi is achieved by pruning, which stimulates all the branches to flower and produce fruit together.

Cincturing

Cincturing or girdling of shoots can be to improve flowering. Girdling redirects assimilates that normally support stem and root growth. In this process a ring of bark is removed around the major lower branches of a tree to a depth just below the soft tissue under the bark or cambium layer. The operation may be carried out on the main stem or on primary branches also, provided the diameter at the point of cincturing is not less than 1.5 cm. Often only half the branches are cinctured while the others are treated in alternate years. The ring is cut with a hacksaw, 3 mm wide and 3 mm deep. Healing time depends on tree vigour, the cultivar and the size of the incision. Cuts must be painted with a pruning paint. The cut is covered with copper oxychloride to prevent disease infection.

Cincturing can induce vegetative dormancy in autumn and winter giving rise to better flowering, fruiting and yield. This technique is used in shy-bearing trees to induce flowering. This prevents new shoot growth for about three months, so that the next activity of bud growths occurs when conditions are favourable for flowering. Cincturing stops the interchange of sugars and other growth promoting materials between the leaves and the roots. After cincturing, sugars and growth inhibitors tend to build up in the leaves and assist flower development. With time, the tissue on each side of the cincture cut grows across and rejoins the conducting vessels, so that the plant resumes normal development. The length of time that this healing process takes is vital to the health, performance and survival of the trees.

Cincturing is not continuous. It has been observed that in warm, moist conditions it does not promote flowering. Responses to cincturing are much less consistent under low

temperatures and low humidity conditions. Cincturing is not recommended as a general practice, since continuous use of the technique often leads to retarded growth, small fruit, leaf scorching, branch die-back and loss of trees. It may also develop the tendency toward alternate bearing. Cincturing a few months after pruning has been done to overcome the alternate bearing, but this practice has not been effective even though it improves flowering in the following season.

Main factors which influence the response of litchi trees to cincturing are seasonal conditions, the cultivar, tree vigour, stage of flush development and the timing of cincturing. Therefore, cincturing or even girdling should be practiced on case-to-case basis.

Heading Back to Control Growth

Under high density planting system, litchi trees are pruned regularly to control size and shape. Hedging or topping may be required by the fifth or sixth year after planting, depending on location and initial tree spacing. This is in addition to the normal pruning done during initial years. Hedging is typically accomplished using large saws. It is most effective if done in June-July or in August-September under North Indian conditions. Hedging during this period allows improved light penetration into the canopy during vegetative flushing, reduces canopy volume and promotes growth of lateral buds. Hedging at this time will not remove flower and thus does not cause any substantial decrease in yields. Usually hedging and topping of litchi trees decrease yields in the following year compared with unpruned trees. Nevertheless, average yields over a period (7-8 years) are similar and hedging and topping improve fruit quality and increase fruit numbers. Severe pruning decreases yields compared with unpruned trees in the pruning year, but yields are almost the same as unpruned trees in the next fruiting year when no pruning occurs.

Different patterns of hedging or pruning is used. Some growers cut only one side of the tree in a particular year, while others cut both sides along the row in the same year. In the first case, hedging cost are less on a yearly basis, but fewer advantages of hedging viz. improvement of regrowth and increased light penetration in the canopy are realized. In the second instance, tree which is controlled in both directions further improves light penetration into the canopy. Most effective hedging programmes will remove only the outer 15-20 cm of the canopy, thereby cutting twigs of 0.5 to 1.0 cm in diameter. A routine maintenance programme avoids cutting of large limbs and provides opportunity for growth renewal each year and reasonable for fruiting on all sides. In contrast, trees allowed to grow together between rows over a number of years will become unproductive and require more severe pruning into older woods. Generally, more severe the cuts, the more vigorous and vegetative the regrowth will be, often requiring 2 years or more to return to normal crop level on that surface. By then, the surface will require severe cuts again.

Topping is also done with mechanical saws mounted on adjustable arms. Topping improves light penetration into the upper canopy and decreases tree height to reduce the cost

of harvesting and spraying operations. It also improves spray coverage. Under high density planting, tree height should not be greater than twice the width between the outer perimeter of the tree canopies between rows for optimum interception of light. Limiting tree heights becomes increasingly important in high density plantings with very narrow between row spacings.

Trees are topped in different patterns. Some growers prune straight across the top of the tree in a flat top. Others set the cutting angle of the saw between 10 and 25° creating a root top effect. These patterns also remove varying amounts of wood from the sides of the trees. It is preferable to reestablish required tree height by making small cuts over several seasons rather than cutting into large woods. With hedging, removing large limbs produces vigorous, vegetative shoots from new growing points, thus defeating the purpose of topping. Therefore, a much greater concentration on balancing the competition between the two operations is required.

In orchards where tree spacing is narrow, hand or mechanical pruning must be done to prevent overcrowding and to make branches most exposed to sunlight. Because litchi trees are slow growing, this can be done only once every five or six years. The best time for this type of pruning is immediately after harvesting in a very productive year to allow good vegetative flushing the following year. It could be postponed until late winter but no later, because the trees must be well covered by early summer to prevent scorching. If the trees are pruned later than this, the stem and branches would have to be painted with agricultural lime or some similar substance. Although it would be advisable to apply a healing substance to the wounds caused by this type of pruning, this is in fact not done because it is a complicated and costly operation.

Similar work is being done in other areas on very erect trees. The trees are cut back to a height of three metres from the ground to allow easier harvesting, which is one of the aims of the pruning.

Skirting

Pruning of lower branches of the tree is done for weed control, surface mulch applications, mini-sprinkler irrigation distribution and to prevent fruit of the lower branches from touching the ground. This is the removal of low hanging branches which could hinder orchard operations such as fertilizer application and under tree spraying for weed control. The best time to do this is at early flowering during cool weather, when trees are not in a strong vegetative-growth phase. Repeated skirting by selective hand pruning can eventually result in strong, robust branches able to support fruit without touching the ground.

Skirting is done from the third year onwards by removing all branches and shoots to a height of 50 cm leaving a clean single trunk (Fig. 13.2). Some cultivars, which have compact foliage are easily twisted out of the ground in strong cyclonic or stormy winds. This can be reduced by removing 20% of major branches within the canopy and by skirting. This allows

wind through the trees and stops the twisting effect. There are indications that less compact cultivars may also benefit from such pruning.

The skirt of the mature tree in most of the cases is at least 1-2 metres above the ground and major branches are removed after harvest in every alternate or 2-3 years. Ant and scale control is made easier and fewer fruit are damaged by insects and rots if skirting is done.

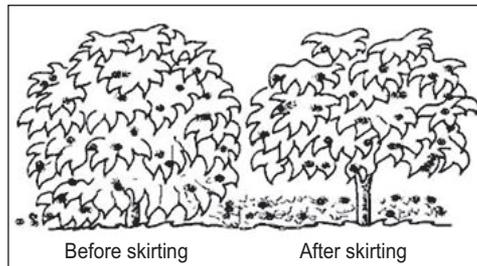


Fig. 13.2: Tree skirting

Centre Opening Up

Litchi plant is a multi-branched evergreen tree having a compact canopy. As a result of number of growth flushes (3-4) during a year, overcrowding of the foliage in the canopy often takes place. This leads to poor penetration of sunlight inside the canopy, resulting in long unfruitful branches and higher incidence of insect pests. In litchi, the lower 2/3rd of the canopy contributes for the maximum economic yield. The fruiting at the top of the canopy generally becomes uneconomical due to obvious reasons. Thus, the branches inside the tree which cross over or cluster up the centre of the tree restricting the penetration of sun light and air circulation should be pruned (Fig. 13.3). The litchi trees are often trained to open-centre system because this helps in the development of low spreading tree-top. Also, the open-centre or modified centre leader trees affords maximum light penetration, which gives a more uniform distribution of fruit on the tree. Among the three systems of training, the plants under open vase system record maximum height and girth of the stem besides well spread canopy. While



Fig. 13.3: Centre opening in litchi plant facilitates better light and air circulation inside the canopy

opening up the canopy, the care is taken to make balance and healthy canopy by removing all unwanted, dried and diseased twigs which do not contribute to tree yield.

Thinning

Thinning out of very dense cultivars is necessary. Removing approximately 10 to 20 per cent of the branches within the canopy in the third year is recommended. One should be able to see broken sunlight on the ground under the canopy when thinning work has been finished. This practice allows wind to move through the canopy and reduces the risk of the tree twisting out during heavy winds. Since litchi is usually propagated by layering, there is little difference between plants of the same cultivar. It is therefore, desirable to follow the initial planting layout to avoid crowding. Thinning of branches gradually, but must be done as soon as the branches of neighbouring trees begin to touch the alternate plants as per layout (Fig. 13.4 and 13.5).

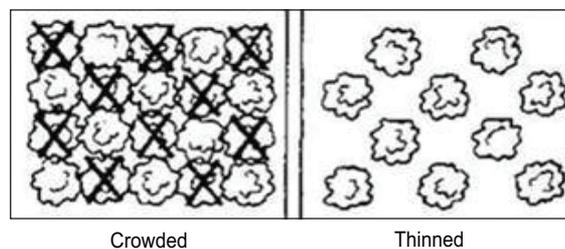


Fig.13.4: Thinning of crowded orchard

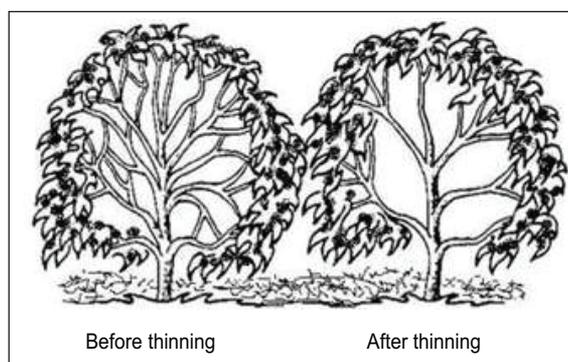


Fig.13.5: Tree thinning

Root Pruning

Root pruning is usually practiced when the tree is making too much vegetative growth particularly in heavy soil. The objective is to restrict the vegetative growth and encourage the tree to bear a good crop. Like cincturing, the responses of root pruning have also been inconsistent. A wide trench is dug around the canopy area to prune the root (Fig. 13.6). Because of the severe damage done to litchi's shallow root system, this practice should be done carefully.



Fig. 13.6: Root pruning

To replace the removed roots, the plants regenerate new roots. Regeneration consists of elongation of existing roots and initiation of new laterals with subsequent elongation. Root generation is stimulated by increased levels of growth promoting hormones or

reduced levels of growth-inhibiting hormones in the rhizosphere. The new roots require carbohydrates and other assimilates which are translocated from the top discouraging excessive vegetative growth. This finally produces a dwarfing or growth restricting effect. As the root system regenerates, uptake of nutrients and water may increase accordingly.

Rejuvenation

It has been observed in general that litchi orchards after attaining the age of 50-60 years, turns dense with compact top canopy covering most of the branches at the bottom and bearing fruits only on the high-tops. Such plants yield less *vis-à-vis* pose problems in proper management such as annual pruning, pest control and harvesting, etc.

Under such circumstances, it may not be economical to maintain these old senile orchards of above 60 years of age. Such orchards need to be rejuvenated for further higher production of quality produce. Prior to selection of orchard for rejuvenation, it is important to look for the health, location and value of the litchi trees. Only such trees should be selected for rejuvenation or reiterative pruning which has healthy trunk intact bark and has ability to will regain vitality and vigour. These are important factors to be considered with the trees to be rejuvenated.

Considering the various pros and cons of rejuvenation, it will only be programmatic to undertake it after giving proper training for acquiring knowledge to the orchardist to develop the expert system and apply the methodology in scientific manner. The orchardist should have equipped himself with technological development and ideas that litchi tree has strong renewable ability and the breakeven point is only two years, whereas establishment of new orchards will take 10-12 years to come into commercial bearing. The harvest of enhanced quality production like young commercial bearing orchards can further be obtained for at least another 12-15 years.

The Process

In case of rejuvenation, heavy reiterative pruning of litchi tree is done at the height of 2 meters to 3 meters depending upon the girth and type of main trunk. About 3 to 5 main branches with outward growth from the base are marked for pruning at required height, with a plan of developing umbrella like or semi circular frame work of tree canopy (Fig. 13.7). Pruning can be done either with manual saw or power operated saw. Care should be taken to avoid bark splitting or debarking at the cut end due to falling of heavy branches at the time of pruning. It is always advised to go for reiterative pruning for rejuvenation pruning in phase manner starting from the top light pruning to reduce weight upto the final point. After care is very important for successful rejuvenation. To avoid any external infection at the cut portion, it should be pasted with Bordeaux mixture or Copper-oxy-chloride (Blitox) immediately after pruning. Any wound on the tree may attract the organisms of diseases from the surrounding atmosphere. So they should be properly treated to encourage healing. If wound is small,

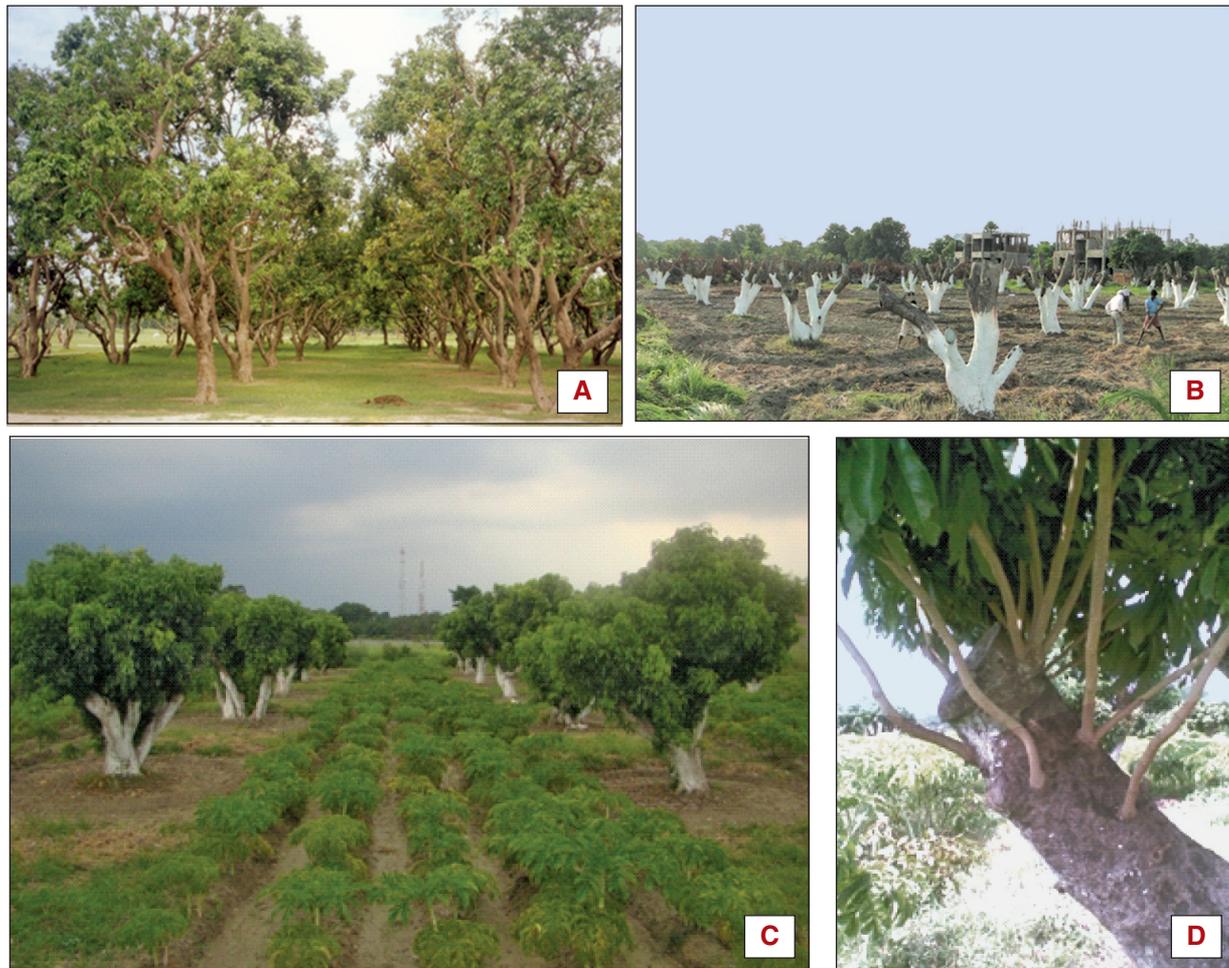


Fig. 13.7: Rejuvenation in Litchi (A) Old orchard, (B) Rejuvenated orchard, (C) Canopy development in rejuvenated plant, and (D) Orientation of branches in rejuvenated plant

simply painting with colour or any other disinfectant may suffice the purpose. Big hollows may be strengthened by scrapping off the inside diseased or rotten parts smearing the exposed portion with coal tar and filling them properly.

The best time to go for reiterative pruning for rejuvenation is August-September i.e. mainly after the rainy season. Rejuvenation is labour intensive operation and it is extremely necessary to complete the operations in time (August-September) for achieving the desired/ results.

Managing Rejuvenated Plants

After the reiterative pruning, the tree should be fed with optimum fertilizer doses, followed by irrigation near the root zone, just like the commercial orchards. The manures and fertilizers should be applied through ring method (Fig. 13.8). The dose per tree as an adult bearing stage i.e. 75-80 kg well rotten FYM, 2 kg Neem/Castor cake, 1.00 kg Urea, 1.50 kg Single

Super Phosphate and 500 g Muriate of Potash should be applied preferably in two split doses one during August-September and another in February-March. The micronutrients like Zinc ($ZnSO_4$, @ 2-3 g/l) and Boron (Borax @ 2 g/l) may be applied through foliar application from one year after the reiterative pruning.

It has been observed that the pruned trunk/ branches during the month of August, starts putting forth vegetative sprouts just after 25-30 days in case of cv. Shahi and 40-45 days in case of cv. China. The enormous numbers

of branches come out and cover the entire body of the pruned plant. At this juncture, careful thinning operation is required to be done with the ultimate aim of developing solid, semi-circular or open umbrella type canopy. Shoot removal should not be done just after their emergence, rather, these should be removed sequentially after 6-8 months of rejuvenation. In this attempt, it is required to remove the sucker growth around the bottom of the trunk and thin out the excessive branches as well, keeping only 3-4 numbers nearly top-side portion on each pruned limbs of the trunk projecting all the directions and further training for acquiring desired shape. The air and light must have access to all the parts of the tree. The horizontally developing limbs should be cut back to the point where they will not hang under the weight of fruit into the row or to the ground on lower limbs.

Rejuvenated trees require immediate irrigation if any dry spell occurs, to avoid drying out of the trees. Irrigation is must after the manure and fertilizer application. Irrigation at regular interval of 8-10 days during hot summer season and 15-16 days during winter season helps faster vegetative growth and good canopy development. Irrigation applied to the intercrops also gives the added advantage to the rejuvenated trees, apart from maintaining/improving soil physical condition (soil health) and complete check over weed growth. Mulching during the months of April-May and September-October have been found beneficial in conserving soil moisture beneath the tree canopy, reducing the frequency of irrigation and enhancing growth.

Just after the completion of reiterative pruning for rejuvenation, the open interspaces between the plants/trees is created in the orchard like newly planted orchard. Intercrops during summer season like black gram, mung, maize, cucurbitaceous vegetable, fodder crops etc. and during rabi season, the crops like cowpea, french bean, pea, potato, mustard, etc have been found most suitable. Flowering plants and annual fruit crops like papaya and banana have also been found to give good income for 2-3 years. Apart from the significant income obtained by the intercrops in rejuvenated orchards, the added advantages like improvement in the soil tilth (health), almost complete check over weed growth as well as less incidence of pests diseases are also obtained.



Fig. 13.8: Nutrient application in rejuvenated plants

Plant protection measures are equally important for healthy growth. Intensive care to manage the infestation of important pests like stem/ shoot borer, bark eating caterpillar, mite, leaf roller, leaf miner and leaf cutting weevil etc. and the diseases like microbial infestations are required. Control methods may be biological, mechanical or chemical or the combination depending upon the growers' preference and specific circumstances. Leaf roller, leaf miner and leaf cutting weevil start damaging right from the beginning of the rejuvenated trees, hence care is required from that moment itself, spraying with endosulfan/ monocrotophos @ 2ml/l or cypermethrin @ 0.5ml/l 2-3 times during new flush emergence will save the damage from these insects. The mite can be controlled by applying miticide like dicofol/omite @ 3ml/l at least 2 to 3 times during the months of September-October and February-March. The serious damage is being observed by the attack of bark eating caterpillar, which can be controlled by the spray of insecticide at initial stage but at tunneling stage, it is require to clean the fresh frass and webbing, finding the hole, notching the hole with and pointed spoke/poker, plugging with DDVP/nuvan (0.1%)/kerosene oil soaked cotton and ultimately sealing the hole with mud. Spraying of copper fungicide during the month of October and March takes care of most leaf spot and other algal/ fungal diseases. Brushing/ pasting of bordeaux paste to the main trunks/ branches up to one meter from the bottom keep the plant clean and save the crop from many pests infestation.

The Outcome

It has been found that the yield obtained from the old trees (non rejuvenated) is high but fetching very less price in the market due to inferior quality particularly with respect to size and wastage due to attack of many physiological disorders and attack of pests-diseases. Fruit yield and physiochemical characters of mature fruits were found to be better in fruits obtained from rejuvenated trees. Maturity period is found to be slightly delayed in rejuvenated plants.

Tools for Canopy Management

There are different tools and equipments required for canopy management. Some of them have been mentioned.

1. **Secateurs:** Secateurs are handy for tip pruning and cutting out shoots and suckers. They should be kept sharp at all times. Regular cleaning and a drop of oil prevents the blades from sticking. A good pair may cost a few Rupees more, but are usually more robust and stay sharp longer. They often have the added advantage of having replaceable blades.
2. **Lopping shears:** These are useful for removing quite large branches, up to 50 mm in diameter. There are two types, one has a cross over cutting action where the blade is curved and passes across a cutting plate. This type is prone to splaying if used on very big branches. The other has an anvil type cutting action, the blade is straight and cuts

down onto a cutting plate/anvil. This type is more robust and can cut through larger branches by taking two or more cuts

3. **Pruning saw:** This tool is capable of cutting through large branches and trunks up to 150 mm in diameter. These have a fairly narrow, slightly curved blade, which enables them to be used in quite restrictive situations such as narrow forks of trees. Some brands are also designed to fit onto a long handle to enable the user to reach higher branches in the tree.