



INSECT PEST MANAGEMENT



Insect pests cause enormous loss to litchi through direct and indirect invasion on various plant parts. Use of chemicals has been one of the conventional methods to reduce these losses, however, now-a-days due to various unwarranted side effects, pest management is relied upon many other options along with pesticides. The integration of all these options is called IPM (Integrated Pest Management). Integrated Pest Management is a strategy to manage pests on the basis of a systems approach that looks at the whole orchard ecosystem. This includes understanding how the pests interact with their plant hosts, with the general climatic conditions, plant health and nutrition and with each other. When implementing an IPM system, growers should select ways to reduce overall pest levels in their orchard and ensure that the management of pests is compatible with their other crop management strategies. It is important that growers realize that IPM system is updated from time to time in response to biological changes that occur in their orchard and new techniques or technologies are introduced as soon as additional relevant information becomes available.

Integrated Pest Management

There are many insects that are present in the orchard. All of them do not cause economic damage. A few of them (key pest) may cause damage to that extent where initiation of action becomes essential. Do not apply pesticide just by seeing a few insect in the orchard. Identify other climatic and cultural factors that may reduce pest numbers or damage. There are many natural enemies of insect pests; these are called predators and parasite. Recognize these beneficial insects, which are found in unsprayed orchards and reduce pest damage in orchards.

- Visit your orchard even if there is no fruit, exclusively for pest record. Monitor the incidence of pests and beneficial insects to determine the abundance, life cycles and levels of damage. If possible, keep a pest record register. Record and summarize the monitoring information so that relationships and seasonal trends of pests' damage and beneficial insects can be recognized within the orchard.

- Pests vary with age and stage of the tree. Therefore, collect information on pest damage in relation to the phenology (growth patterns) of the trees. Read books, take help of experts or decide yourself for the optimum time to apply control methods.
There is a list of pest control options. Consider the control options available and select from the list, which is the best suited to your current circumstances to minimize the use of chemicals.
There are chemicals which have less effect on natural enemies. Therefore, select chemicals which minimize adverse effects on beneficial insects.
- Keep your orchard vigorous. Make attempts to optimise the nutrition of orchard because pest attacks are usually reduced in vigorously growing healthy trees.
- Realise that centre opening, skirting and hygiene like pruning operations can reduce some pest problems (e.g. scale/ mite) by altering the density of the tree, but may increase others (e.g. shoot borer) by encouraging flush growth.

Important Insect Pests

Nearly 42 insect species and mite pests have been reported to attack litchi trees and fruits in different stages of growth; nevertheless, litchi is relatively free of any serious pests. Fruit borers, bugs, nut borer, leaf rollers and mites are the important pests affecting litchi production.

1. Erinoze Mite

Erinoze mite is a major litchi pest. The incidence of litchi mite is seen during March which remains active up to June-July. Severe infestation has been observed in Bihar during March-September and its population decline from November-February. However, mites remain active throughout the year in one stage or the other. It is found active on litchi trees from January to October and under hibernation in adult stage under the hairy and velvety growth (erineum) from November to December on the under surface of the leaf.

The adults start multiplying from the end of March and the peak activity is noticed around July. The female adults lay eggs singly at the base of the hair on the lower surface of the leaves. The eggs hatch within 2-3 days and newly emerged nymphs feed on soft leaves (Fig. 14.1).



Fig. 14.1: Mite infestation



Fig. 14.2: Velvety growth on mite affected leaves

Both nymphs and adults damage the leaves, inflorescence and young developing fruits. They puncture and lacerate the tissues of the leaves with their stout rostrum and suck the cell sap. As a result of its infestation, undersurfaces of the infested leaves show abnormal growth of epidermal cells in the form of hair like velvety growth of chocolate brown colour. In some cases, the mites cause galls or wart-like swellings or depressions on the upper surface of the infested leaves. Chocolate-brown velvety growth on the ventral surface of leaves indicates the presence of this pest. The attacked leaves become thick, curl, wither and ultimately fall off (Fig. 14.2). The infestation generally begins from the lower portion of the trees and gradually extends upwards. In addition to leaves, the mite also infests the newly formed leaf bud; inflorescence and epicarp of the newly formed fruit. The attacked leaf buds fail to bear flower or fruit. The growth of

green patch on the epicarp indicates the mite infestation on fruits. Young plants and plantlets in nurseries are very susceptible and could even be killed if leaf drop is excessive. Dispersal of the erineum mite from one orchard to the other usually takes place through old infested litchi leaves or by winds. The current of the wind carries the erineum along with the mite from one orchard to the other and initiates infestation in uninfested orchards. Planting material obtained as layers may also be source of infestation if they have been taken from trees with the mites. Later infestations occur when the mites are moved around the orchard by direct contact between trees or carried around by orchard workers, wind and bees.

Management

Litchi mite control measures must be preventive. Once the mite is established, it is almost impossible to eradicate, hence depending upon infestation it is recommended that:

- Layers should be prepared only from non-infested plants.
- Layer saplings may be sprayed with 0.05 per cent dimethoate when they leave the nursery. Prior to planting out, the operation should be repeated twice at 10-14 day intervals.
- The leaves should be checked regularly for symptoms over summer and autumn. All trees in an orchard are not to be flushed or infested at the same time. Therefore, branches infested with the mite should be cut off and burnt.

- After harvesting in June, infested branches must be removed.
- In September-October, trees must be treated just prior to vegetative flushing with 0.05 per cent dimethoate either alone or in combination with 0.12 per cent dicofol. Spraying should be repeated two weeks later and monthly thereafter until new growth is free of all symptoms of infestation. Infested leaves should be gathered and burnt or buried deeply into the ground.
- In December-January, just before flush/flower buds, the affected shoots must be removed and spraying of 0.15% kelethane may be done. In the month of Feb., two sprays, one each before and after flowering have been found useful.

2. Bark Eating Caterpillar

Litchi is damaged to a considerable extent by the bark-eating caterpillars, which attack trees of all ages, particularly the older ones, lowering their vitality. They bore into trunk, main stems and thick branches of litchi trees (Fig. 14.3). They have a wide range of host plants including litchi. The old, shady and neglected orchards are more prone to attack by this pest. When severely infested, the entire branch or tree may die.

The female moth lays eggs in cuts and crevices in the bark in cluster in early June. Egg hatches in 8 to 10 days and newly emerged caterpillars come out. The newly emerged caterpillars start nibbling at the bark. The attack by this pest is characterized



Fig. 14.3: Bark eating caterpillar damage

by the presence of long-winding, thick, blackish or brownish ribbon-like masses composed of small chips of wood and excreta, both of which intermix with the help of adhesive material secreted by the caterpillar. After 2-3 days, larvae bore into the trunk or main branches usually at the forking place and make tunnel downwards. There is only one larva in each hole, and there may be 2-16 holes in each tree, depending upon the intensity of infestation and age of the tree. By continuously devouring the tissues, it tunnels through the stem and branches. The caterpillars remain within the bored holes during day and come out at night to feed upon the bark. The attacked trees show the presence of windings and silken galleries full of frass and faecal matter. As a result of feeding in the trunk or main branches, the translocation of sap is disrupted and in case of severe infestation, the growth of tree is arrested. Fruiting capacity of tree is adversely affected. Severe injury weakens the stem, resulting in drying of the branches and finally of the tree itself.

Management

- The caterpillars can be killed by inserting an iron spoke into the tunnels.
- This insect has also been successfully controlled by injecting kerosene oil into the tunnel by means of a syringe and then sealing the opening of the tunnel with mud.
- Another method of control is dipping a small piece of cotton in any of the fumigants, like carbon bisulphide, chlorosal or even petrol and introducing it into the tunnel and sealing the opening with clay or mud.
- Remove the webs from tree trunks and put emulsion of DDVP (0.05%) in each hole and plug them with mud. Mix chlorpyrphos 2 ml per litre of water and apply the bark eating caterpillar infested area with a brush at 15 days interval.
- As a preventive measure, spraying of the attacked trunk and branches with 0.05%DDVP may be done.

3. Litchi Leaf Roller

The incidence of leaf roller is reported during July to February. The number of larvae is the highest during December to February, preceding flowering season of litchi. The breeding season of the leaf roller on litchi leaves is from August to February when new leaf flush is available and restricted breeding takes place during off-season (March to July) on alternate hosts such as kath-jamun (*Eugenia jambolana*) and chhota amaltas (*Cassia tora*) growing around litchi orchards. It may attack flower also. The female moth lays eggs under the surface of newly emerged tender leaves which hatch within 2-8 days. The last instar larvae pupate in larval clip, a small portion of the leaf on the margin, both anteriorly and posteriorly and conceal themselves by bending and sealing the clipped piece of the leaf (Fig. 14.4 and Fig. 14.5).

The symptoms of leaf injury by the larvae are manifested through rolling of tender leaves and feeding inside. As a result of larval injuries, the infested twigs distort and wither. Litchi trees whose foliage is attacked by the larvae, very poor flowering or in



Fig. 14.4: Rolled leaf



Fig. 14.5: Leaf roller larva

case of younger tree, no flowering is seen in the season. Thus, the crop yield gets reduced considerably.

Management

- The damage caused by leaf rollers is tolerated as long as it is restricted to the foliage and unlikely to affect flower initiation.
- The rolled leaves that contain larvae may be removed manually during light infestations.
- If necessary, carbaryl 2g/l can be applied when 20 per cent of leaf flushes are infested to minimize damage to young trees or at critical periods of leaf growth in older trees.

4. Litchi Fruit Borer

This pest is known as litchi fruit borer or litchi stem end borer or litchi seed borer (Fig. 14.6). It is apparently found infesting litchi most often, and elicits the greatest economic effects. Female lays eggs singly on the under surface of the leaf or near the calyx of litchi fruits. During winter months, the leaf buds are preferred for oviposition.

Newly hatched larvae are milky white, slender with distinct light brown head. The newly emerged larvae start boring into the fruits and feed on its pulp. The infested fruits do not attain normal size and can be identified by the formation of black spot near pedicel. Larvae do not enter much deeper into the pulp but feed below the calyx about 15mm deep. When fully grown, they come out of the fruit and pupate on the leaf surface. In this way, the larvae cause direct damage to litchi fruits. The full grown larva starts spinning cocoon, which is usually formed on the old litchi leaf.

Females clearly prefer fruits over shoots for oviposition. If no fruits are available, they are constrained to lay their eggs on shoots. The survival rate is higher on shoots than in fruit. During July, they cause indirect damage by making mines in young shoots. The young larvae



Fig. 14.6: Fruit borer in litchi. Adult moth (left) and larvae (inset), Affected fruits (right)

make mine in the lamina and bore into mid-rib of young leaves and tunnel through it, as a result branches wither and drop. The pest has now established itself as one of the major pests of litchi in India particularly in Bihar and Uttar Pradesh.

Management

- Moths can be excluded by enclosing the fruit panicles in nylon mesh bags, but is uneconomic in areas with high labour costs.
- NRC on Litchi, Muzaffarpur has recommended the use of *Trichogramma chilonis* @50000eggs/ha and use of pheromone trap, however, this pheromone is not giving consistent results in all the situations.
- Fallen fruit should be removed to reduce the build-up of moths and ploughing may be done after fruit harvesting.
- Bearing trees should be inspected during early flush development and sprayed if necessary. The leaf flush before flower initiation is very important as it supplies the carbohydrates needed for fruit development. Young, non-bearing trees do not need to be sprayed. This also allows the parasitoids to build up in the orchard.
- Fruits may be inspected weekly from fruit set to detect eggs of borers, which are very small and almost invisible to the naked eye. Infested fruit should be picked and destroyed at infestation levels of 1 to 2 per cent. When the pest becomes more active, spraying 0.05 per cent fenitrothion or dichlorvos or carbaryl 2g/l may be done.
- Permethrin is applied weekly, up to two weeks before harvest. Cypermethrin, deltamethrin or fenthion during early fruit set is recommended to prevent damage later in the season.
- Affected shoots may be removed and all agronomic efforts such as ploughing and nutrient management should be done so that flushing takes place before the month of September.
- Neem based products may be applied at the time of new shoot emergence to avoid heavy population of the pest.
- Monocrotophos 0.05 per cent may be applied in the case of severe shoot damage.

5. Shoot Borer

The shoot borer has been observed causing serious damage to new flush of litchi throughout the country. This pest is usually active from August to October. Female moths lay eggs on tender leaves. After hatching, the larvae first bore into the veins of young leaves and later into the soft stems of shoots situated close to the apex, working their way downwards (Fig. 14.7). New shoots are damaged by the caterpillars by tunneling from growing tip downward. As a result, the shoots droop and finally dry and wither. Larvae also bore into the inflorescence stalk. When full grown, these caterpillars come out and enter into the slits and cracks in the bark of the tree, dried inflorescence or cracks or crevices in the soil for pupation. Upper and



Fig. 14.7: Litchi shoot borer. (A) Damage by shoot borer on new flush, (B) Larva of shoot borer

lower parts of the plants are more infested than middle parts. The affected plants become stunted. Young trees up to the age of 8-10 years are more susceptible.

Management

- The attacked shoots may be clipped off and destroyed.
- Spraying of Carbaryl (0.2%) or Quinalphos (0.05%) or Fenitrothion 0.047% or 0.05% Malathion at fortnightly intervals from the commencement of new flush gives effective control of the pest. A total of 2-3 sprays may be done depending on the intensity of infestation.

6. Fruit Sucking Moths

Fruit-piercing moth attacks many fruit crops including litchi in night. Fruit-piercing adult moth is the damaging stage and the larvae are not harmful. The mouth parts of the moth are long and strong enough to penetrate through tough-skinned litchi fruit (Fig. 14.8). Once the moth has punctured the skin of the fruit, it feeds upon the juices of the fruit. Fruit flesh damaged by this moth becomes soft and mushy. Damage caused by this pest is not only a result of the direct feeding but also by the fungal and bacterial infections that develop at the wound site. When moths are abundant green fruit is also attacked, causing premature ripening and dropping of fruits. Incidence of damage by this moth is normally low, however when outbreaks occur, most of the crop is affected.

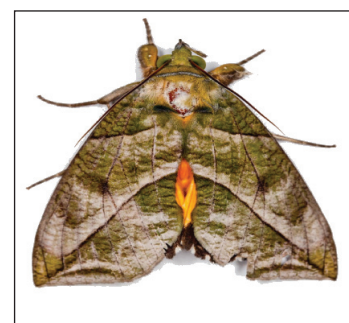


Fig. 14.8: Fruit sucking moths

Management

- Capture and destruction of moths is done an hour after sunset when there is sufficient darkness with the aid of torches or a strong flashlight. However, this method is not very effective but recommended only if no other control means is not possible.
- This moth prefers darkness and avoids light, therefore the illumination of orchards with the help of lanterns and lights has been tested as a possible means of deterring moth attack but not very effective.
- Bagging or screening of fruits may be done by covering the fruits with brown paper or transparent oil paper bags. Although this method is labour intensive, it is most practical when fruits are easily accessible and have compact bunches.
- Smoking of the orchard masks the odour of mature and ripening fruit that attracts the moth. Containers full of inflammable material, oil, tar and some green plant trimmings to enhance the smoke are placed within the orchard at a rate of 2 to 4 per acre. The smoking process is started a half an hour before dusk and continued for 2 to 3 hours after nightfall. This period represents the time in which the moths are seeking their night time feeding grounds. If the smell of the orchard is masked, the moths choose various wild hosts and remain on them throughout the night to feed.
- Regular collection and proper disposal of all attacked and spoiled fruit. These procedures dissipate the odour emanating from the spoiled fruit so they cannot serve as an attractant for the moths
- The effectiveness of chemical control is variable and remains ineffective in most of the cases.

7. Litchi Bugs

There are many species of bugs that attack litchi. Bug (*Tessaratoma javanica*) is the most destructive (Fig. 14.9). It lays globular and off pink eggs, mostly in bunch of fourteen on lower surface of leaves. Newly emerged nymph is dirty white and soft bodied insect but colour changes to yellow red after few days. Both adults and nymph feed mostly on tender plant parts such as growing buds, leaf petioles, fruit stalks and tender branches of litchi tree. Excessive feeding causes drying of growing buds and tender shoots and ultimately fruit drop. The bugs when feed on the developing fruit, it causes the fruits to fall a couple of days later.



Fig. 14.9: Litchi bug

Management

- This pest is combated by shaking the trees in winter, collecting and dropping them into

kerosene.

- The eggs of *T. javanica* are in group and visible which can be removed and destroyed.
- There are natural enemies which parasitize 70 to 90 per cent of eggs laid late in the season. The adults are attacked by several fungi, birds and red ants may also be used as biological means of control.
- If chemicals are used, the timing of sprays is critical because the bugs vary in their susceptibility to insecticide at different times of the year, depending on body fat content and its nature. Many of these bugs may be controlled with dimethoate and fenthion.

8. Leaf Eating Weevils

Grey weevil is a polyphagous pest. Adult has long snout with grey color, though poor flier but very active feeder on the leaves of litchi. It attacks leaves, shoot and flower. Adult weevils congregate on the tender leaves and nibble irregular holes on the leaves and sometimes consume the entire leaf leaving the midrib only (Fig. 14.10 and Fig 14.11).

Another weevil recorded recently at NRC Litchi, so far not properly identified, feeds on tender leaves. The damage of this weevil is more severe at the time of shoot emergence.

Management

- The grubs of these weevils feed on organic matter in the soil below the canopy, hence, ploughing and exposing these grubs reduces the problem.
- Hand picking of the adult weevils reduces their problem to some extent.
- When severe damage is seen, spraying of Carbaryl 2ml/l may be done.

9. Litchi Nut Borer

Litchi nut borer is a polyphagous pest and infests as many as 33 fruit crops. The scale-like eggs are laid singly on the fruits. Newly hatched larva feeds on the fruit skin and then tunnels towards the seed. When this occurs in green fruit, the fruit drops, although larva is most likely to be able to develop in the fallen fruit (Fig. 14.12 and Fig. 14.13). Ripening fruit generally does not fall, and the larva often drowns in the juice if the skin is penetrated in the equatorial region where the flesh is thickest.



Fig. 14.10: Grey weevil



Fig. 14.11: Unidentified weevil

The rind tissue around the entry hole may appear to be scalded and such damage is sometimes wrongly attributed to fruit fly. Mature fruit damaged by nut borer may stain other fruits in a cluster or those hanging below. One larva can cause perhaps 10% more damage through this secondary staining effect. In immature fruit, the young larva bores directly into the seed which is completely eaten. A single larva may damage two or three fruit, if the fruits are small.



Fig. 14.12: Nut borer damage

Management

- Examine 5 fruit panicles on 20 trees widely spaced throughout the crop, commencing when green fruit are 20 mm long. Spray if more than 5 out of 100 panicles are infested with live, unhatched and unparasitised eggs. Check developing fruit weekly for larval entry holes and or frass. Infestation levels increase as the fruit mature due to immigration of moths from alternative hosts. Oozing juice from maturing fruit may also be an indication of nut borer infestations.
- The nut borer is attacked by various species of egg, larval and pupal parasitoids; however, these do not always keep borers below economic thresholds.
- Spray with carbaryl 2 g/l when 5% of panicles have fruit with fresh, unparasitised eggs. Full cover spray 40 days before harvest or two sprays at fortnight apart commencing when the fruit are 10 mm in diameter are recommended.
- Alternatively, the panicles can be covered with paper bags.



Fig. 14.13: Nut borer damage

10. Semilooper

In addition to above, foliage defoliating semi-looper (castor semilooper/stick worms) have been reported occasionally (Fig. 14.14). These semiloopers attack tender leaves *en mass* and defoliate the new shoots.

Management

- Spray of Quanoalphos or chlorpyrifos @ 1.5-2.0 ml per litre water.
- Alternatively delta-Sypermethrin @ 1 ml per litre can be sprayed.



Fig. 14.14: Semilooper