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Pest of Papaya and Their Management: An Overview

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Papaya (*Carica papaya* L.) is one of the most popular fruit plants grown widely under tropical and sub-tropical climates still it is suffering with many insect pests globally. It is affected by insect pest papaya fruit fly, webworm, whitefly, mites, aphids, scales, mealy bugs, grey weevil, grasshoppers, leafhoppers and hornworms. Of these pests, the papaya fruit fly and mealybugs are difficult to control . Since single control method alone is not effective and environmentally friendly for these pests, Integrated management strategies have been developed in the way that combining various control measures like cultural, biological and chemicals for sustainable farming.

Introduction

Papaya (*Carica papaya* Linn.) belongs to the family Caricaceae was introduced in India in 16th century by the Portugese. It is one of the few plants which produce fruits throughout the year. It owes its popularity to various simple reasons like, it requires less area per tree, comes to fruiting in a year, easy to cultivate, provides per hectare income next only to banana and has a high nutritive and medicinal value. The papaya is a semi-woody, latex producing plant. It is usually single stemmed and short lived perennial herb. Due to the bioactive components (carpaines, BITC, benzyl glucosinolates, latex, papain, zeaxanthin, choline, etc.) in its seeds, leaves, and fruits, it is known for its excellent antioxidant, digestive, and nutraceutical benefits therefore it has high nutritive and medicinal value. Papayas are highly rich in vitamins A, B, C, E and K, folate, pantothenic acid, zeaxanthin, lycopene, lutein, magnesium, copper, calcium, and potassium. Being rich in fiber, antioxidants, and vitamin C it helps to lower the cholesterol in the arteries; prevents arthritis; reduces aging, cancer, macular degradation, risk of cardiovascular diseases, and stress; increases platelet count; controls dengue fever; facilitates digestion, and lowers body weight. Papaya leaf extract, with many in vitro and case studies in combination therapies with modern medicine has been found to be an efficient cure for cancers and many other viral diseases However, a number of stresses are there that hinder the successful production of papaya. Papaya is affected by several arthropods that can be considered as key or secondary pests . World wide, 134 species of arthropods affect papaya and most species belong to the Hexapoda, while 12 belong to the Acarina. At least 12 species are known vectors of important papaya diseases. Homoptera is the largest group associated with papaya with 65 species (49% of the total) from eleven families.

Pests of papaya

Papaya mealybug, *Paracoccus marginatus* William and Granara de Willink (Hemiptera: Pseudococcidae)

Biology: Egg: Females usually lay 100 to 600 eggs. Eggs are greenish yellow and are laid in an ovisac sac that is three to four times the body length and entirely covered with white wax. Egg- laying usually continuous over a period of one to two weeks.

Nymph: Eggs hatch in about 10 days, and nymphs or crawlers begin to actively search for feeding sites.

Adult: The adult female is yellow, approximately 3 mm long and 1.4 mm wide and is covered with a white waxy coating. Adult males are pink, especially during the pre-pupal and pupal stages, but appear yellow in the first and second instars. Adult males are approximately 1.0 mm long, with an elongate oval body that is widest at the thorax (0.3 mm).

Damage symptoms:

- Initially the affected portion will be chlorotic, later changed to brown and dry away.
- These bug excrete honey dew and as a result infested portion becomes shiny and moist and to this, secondary infection by sooty fungus, Capnodium growth results in black covering the affected parts.
- Papaya mealybug is polyphagous pest. Symptoms can be observed on leaves, stems and fruits as clusters of cotton like masses **.**

Management

Cultural control

- Removal of weeds and alternate host plants like Hibiscus, bhindi, custard apple, guava etc in and nearby vineyards throughout the year.
- Application of sticky bands (or) alkathene sheet (or) a band of insecticide on arms (or) on main stem to prevent the movement of crawlers.
- Prevention of the movement of ants and destruction of already existing colonies.

Mechanical control

- Detrash the crop on 150 and 210 day after planting**.**

Biological control

- Natural enemeis of papaya mealybug: Parasitoids*: Acerophagus papaya, Phygadium spp., Leptomastix menciona, Anagurus leckii,* etc.
- Predators: *Spalgis epius, Cryptolaemus montrouzieri, Rodolia fumida* etc. The entomogenous fungus *Beauveria bassiana*.

Whitefly, *Bemisia tabaci* Genn. (Aleyrodidae: Hemiptera)

Biology

Egg: The females mostly lay eggs near the veins on the underside of leaves. Each female can lay about 300 eggs in its lifetime. Eggs are small (about 0.25 mm), pear-shaped, and vertically attached to the leaf surface through a pedicel. Newly laid eggs are white and later turn brown.

Nymph: Upon hatching, the first instar larva (nymph) moves on the leaf surface to locate a suitable feeding site. Hence, it is commonly known as a “crawler”. It then inserts its piercing and sucking mouthpart and begins sucking the plant sap from the phloem. Adults emerge from puparium through a T-shaped slit, leaving behind empty pupal cases or exuviae.

Adult: The whitefly adult is a soft-bodied, and moth-like fly. The wings are covered with powdery wax and the body is light yellow in color. The wings are held over the body like a tent. The adult males are slightly smaller in size than the females. Adults live from one to three weeks**.**

Damage symptoms:

Both the adults and nymphs suck the plant sap and reduce the vigor of the plant. In severe infestations, the leaves turn yellow and drop off. When the populations are high they secrete large quantities of honeydew, which favors the growth of sooty mould on leaf surfaces and reduces the photosynthetic efficiency of the plants.

Management:

Cultural control

- Water sprays may also be useful in dislodging adults.
- A small, hand-held, battery-operated vacuum cleaner has also been recommended for vacuuming adults off leaves. Vacuum in the early morning or other times when it is cool and whiteflies are sluggish. Kill insects by placing the vacuum bag in a plastic bag and

freezing it overnight. Contents may be disposed of the next day. Fumigating with a small petrol soaked cotton ball.

Biological control:

- Natural enemies of whitefly: Parasitoids: *Encarsia formosa*, *Eretmocerus spp*., *Chrysocharis pentheus* etc.
- Predators: *Dicyphus hesperus*, lacewing, ladybird beetle, big-eyed bugs (Geocoris sp) etc.

Green peach aphid, *Myzus persicae* Sulzer (Aphididae: Hemiptera)

Biology:

Egg: Eggs are very tiny, shiny-black, and are found in the crevices of bud, stems, and barks of the plant. Aphids usually do not lay eggs in warm parts of the world.

Nymph: Nymphs (immature stages) are young aphids, they look like the wingless adults but are smaller. They become adults within 7 to 10 days.

Adult: Adults are small, 1 to 4 mm long, soft-bodied insects with two long antennae that resemble horns. Most aphids have two short cornicles (horns) towards the rear of the body.

Damage symptoms:

- Infesting tender shoots and under surface of the leaves.
- Curling and crinkling of leaves.
- Stunted growth..
- Development of black sooty mould due to the excretion of honeydew.

Management

Cultural control

- Check transplants for aphids before planting.
- Reflective mulches such as silver colored plastic can deter aphids from feeding on plants.
- Sturdy plants can be sprayed with a strong jet of water to knock aphids from leaves.

Biological control

- Release larvae of green lacewing bug (*Chrysoperla zastrowi* sillemi) @ 4,000 larvae/acre.
- Natural enemies of aphid: Parasitoids: *Aphidius colemani*, *Aphelinus sp* etc. Predators: Fire ant, robber flies, big-eyed bug (*Geocoris sp*), earwig, ground beetle, Cecidomyiid fly, dragonfly, praying mantis, lacewing, ladybird beetle, spider etc

Fruit fly, *Bactrocera dorsalis* (Tephritidae : Diptera)

Biology

Egg: Female flies insert eggs under the skin of fruit in clusters of 10 to 50 about 1/25 to 1/8 inch below the fruit surface. The eggs measure about 1/25 by 1/250 inch and are white, elongate, and elliptical. They hatch in 1-1/2 days.

Larva: The white larva is legless, and resembles an elongated cone. The mouth is at the pointed end of the body. There are 3 larval stages, or instars. The third instar is about 2/5 inch long. The entire larval stage lasts for 11-15 days.

Pupa: When mature, larvae drop to the ground and pupate in the soil. The puparium is yellowish-brown and seed-like. Adults emerge in about 10 days.

Adult: Generally, the abdomen has two horizontal black stripes and a longitudinal median stripe extending from the base of the third segment to the apex of the abdomen. These markings may form a "T" shaped pattern, but the pattern varies considerably. Females begin to lay eggs about 8 days after emergence from the puparium. Under optimum conditions, a female can lay more than 3,000 eggs during her lifetime, but under field conditions approximately 1,200 to 1,500 eggs per female is considered to be the usual production. Ripe fruit are preferred for egg laying, but immature ones may be also attacked.

Damage symptoms

- The female punctures outer wall of mature fruits with the help of its pointed ovipositor and insert eggs in small clusters inside mesocarp of mature fruits.
- On hatching, the maggots feed on fruit pulp and the infested fruits start rotting due to further secondary infection.

Management

Cultural control

- Prior to harvest, collect and dispose off infested and fallen fruits to prevent further multiplication and carry-over of population.
- Ploughing of papaya plantation during November-December to expose pupae to sun's heat which kills them.
- If infestation is heavy, do bait splash on the trunk only, once or twice at weekly interval is recommended. To prepare bait splash, mix 100 g of jaggery in one litre of water and add 1 ml of killing agents by using an old broom.
- Managing fruit flies also reduces anthracnose disease and prevents late fruit fall.

Physical control

- Hot water treatment of fruit at 48 ± 1 ºC for 45 min.
- Male annihilation technique: Set up fly trap using methyl eugenol. Prepare methyl eugenol 1 ml/L of water + 1 ml of malathion solution. Take 10 ml of this mixture per trap and keep them at 25 different places in one ha between 6 and 8 am. Collect and destroy the adult flies.

Biological control

- Natural enemies of fruit fly: Parasitoids: *Opius fletcheri*, *Fopius arisanus*, *Diachasmimorpha kraussi* etc.
- Predator: Ants

Grey weevil, *Myllocerus viridians* Faust. (Curculionidae: Coleoptera)

Biology:

- This species is a medium sized insect.
- Body is black and sometimes uniform light green in colour. Colour varying to pale greenish white with chalky-white .
- Head narrowed from back to front. Rostrum evidently longer than the head, mandibles reddish brown.
- Antennae black or piceous.
- Prothorax sub-conical.

Damage symptoms

- Adult weevils have been observed in numerous plants as they are known to defoliate the tender leaves and shoots extensively.
- Grubs feed on roots resulting in wilting of plants. Hence, it is considered as serious polyphagous pest of economic importance.

Management:

Cultural control

- Collection and destruction of infested and fallen fruits at weekly interval till harvesting is completed.
- Destroy all left over seeds in the field and also in the processing industries