Integrated Pest Management of

Fruit Fly

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Introduction

Fruit flies of the family Tephritidae are among the most destructive pests of Horticultural crops around the world and pose a significant risk to fruit crops. The genera *Bactrocera* cause significant loss to Indian agriculture especially to the fruit and vegetable growing states. The extensive damage and wide host range of fruit fly become a serious concern to the agri-horticultural diversification and trade.

The state of Jammu & Kashmir (32-36^{0}N, 73-80^{0}E) has bestowed with the varied habitats and climatic conditions that have encouraged the cultivation of a number of fruits, vegetables, and other commercial crops. The subtropical area of J&K state has a total area of 1,57,585 hectares under horticultural crops. The major constraint in the production of these crops is the ravages caused by fruit flies which not only result in the low production of fruits and vegetables but also drastically impair their quality rendering it unfit for consumption, reducing marketable value and thereby posing a serious threat to fruit and vegetable for the export potential.

Most fruit and vegetable crops in India suffer from attack by fruit flies belonging to the genus Bactocera (Diptera: Tephritidae) and losses may be up to 100 % if, not regulated in time. Pest control using large amounts of chemical pesticides is often mentioned as an important cause of residues on food stuff for the

consumers. In Indian subcontinent, there are more than 200 known species of fruit flies; however, the species that are considered to be the serious pests of fruits and vegetables are hardly more than ten.

Fruit fly Species and host range

Most of these species are polyphagous, having high rate of fecundity and ability to quickly spread over a wide area that makes them real and challenging threat for fruit and vegetable growers. In India, among many species of fruit flies that infest various kinds of fruits and vegetables, (*Bactrocera zonatus* Saunders), (*Bactrocera dorsalis* Hendel), *Bactrocera tau*, and (*Bactrocera cucurbitae* Coquillett) are the most important ones. The *Bactrocera zonatus* is a serious pest of fruits like guava, peach, mango, citrus, jamun, papaya, apricot, loquat and plum and cosmopolitan in distribution. Among the vegetable crops, cucumber, squash, bittergourd, sponge gourd, chhppan kaddu, tinda, bottle gourd, tomato, brinjal, cauliflower, cabbage etc are seriously affected by fruit fly.

Jammu District comprising large area under rainfed condition where hardy fruits like, mango, guava, ber, citrus, phalsa, aonla, lasoda, litchi, custard apple papaya and karonda are extensively grown. The rainfed crop production are seriously infested with fruit flies especially *Bactrocera zonatus* (Saunders) and *Bactrocera dorsalis* (Hendel) and causing heavy quantitative and qualitative loss.

Management Options

Chemical attractants and cue lure are very useful for surveying, monitoring and controlling fruit flies. Effective biological control agents and understanding of how these could be used by farmers will be developed based on literature, research and experimentation. 'Sterile insect technique' and 'lure and kill method' are used to control fruit flies throughout the world. These methods are relatively less damaging to environment and are ecologically sound. A number of other methods to control these important pests of fruits, such as soft chemical control, cultural control and combinations of soft insecticides and available plant products strategy for the fruit fly suppression.

Some other techniques, Male Annihilation Techniques (MAT) already proved its importance for fruit fly management. Male fruit flies of most *Bactrocera* species are strongly to moderately attracted to scents (methyl eugenol, protein hydrolyzate, cue lure, molasses, gur or jaggary etc.) commonly used as food additives known as Baits (Pheromones). These synthetic/ natural lures are used to attract males and, when mixed with soft pesticides, form the basis of the MAT that is the primary control strategy for use in eradication programs.

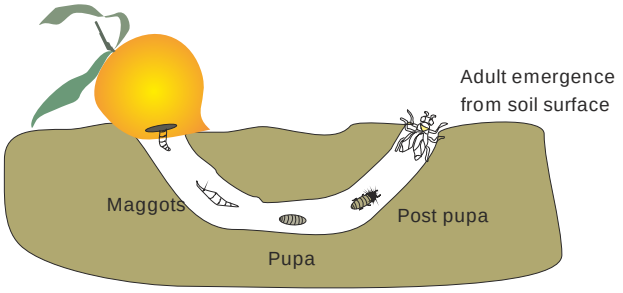
Life Cycle of Fruit Fly

The life cycle of most of the fruit fly species is similar. The female oviposits or implants its eggs in the young fruits of the host plant, which become attractive as they reach maturity. The larvae or maggots develop in the flesh of fruit by making tunnels (which provide opportunities for secondary infections when the larvae emerge from the fruit). The growth of the larvae accelerates maturation of the fruit, which detaches and falls to the ground. The larvae come out from the fruit when get maturity and the pupae develop in the top layer (top few inches) of the soil. Upon emergence, the adult soon starts looking for the food source which requires to reach sexual maturity, copulation, and lay eggs.

Pathways for movement

Transport for the infested fruits for marketing is the main source of dissemination while, adult flies are strong fliers and migrate to the long

Fallen infested fruit



B. zonatus ovipositing eggs in peach fruit

Eggs of fruit fly

B. tau probing for oviposition on chhappan kaddu

Fruit fly traps in cucumber

distances.

Fruit fly Activity

The fruit fly activity is observed almost throughout the year except during severe winter months (December to January). Because of fruit fly issue, some countries had already put a ban on import of fruits from India.

For controlling fruit flies, presently farmers rely only on pesticides as cover sprays. In some of the crops like guava, the cover sprays of insecticides are applied about 5 to 7 times at 10-15 days interval and 2 to 3 times in mango, 2 times in plum, peach, persimmon, pear, apricot, and at weekly interval in melons for protection from fruit flies. Under WTO regulations the international standards of exportable fruits and vegetables have to be followed under which these must be free of pest and pesticides residue. Therefore, effective control of insects is to be achieved through application of Integrated Pest Management programmes.

IPM Strategies

- Deep ploughing of orchard immediately after harvest or during summer months to expose eggs and pupae of fruit fly to natural enemies and sun heat.
- Heavy irrigation of orchard in October also helps in destruction of eggs of diapausing pupae of fruit fly.
- Early harvesting of mature fruits to avoid fruit fly infestation, and collect fruit fly infested and dropped fruits and destroy them.
- Fruit fly population can easily be monitored with poison baits, although trap catches are not sufficient enough to avoid the risk to the crop in different areas.
- Potential biocontrol agents like *Diachasmimorpha longicaudata* which have been recovered abundantly may be exploited and mass reared for the fruit fly suppression.
- To encourage the biocontrol agents, 10 per cent area of orchard should be planted with flowering herbs and annuals.
- Fruits should be harvested earlier and put in 5 per cent brine solution for an hour to deactivated the egg mass of fruit fly.
- Treat harvested mango fruits with hot water (48°C) for 1 hour.

B. dorsalis ovipositing on mango fruit

B. zonatus ovipositing on citrus fruit

Two different fruit fly species ovipositing on guava fruit

Dichasmimorpha parasitoid on mango

B. cucurbitae on cucumber

B. tau on cauliflower

Fruit fly catches in Traps

Fruit fly traps on guava

Banana+diazinon Trap

Dichasmimorpha parasitoid

Gur+Malathion Trap

Fruit fly traps in cucumber

How to prepare low cost Methyl Eugenol traps with used water bottles

For making low cost traps, use empty mineral water bottle and cut two circular holes at half of the bottle.

Preparation of lures – 30 lures @ 4ml/lure

Methyl Eugenol: Mix Ethyl Alcohol-60ml+ Methyl eugenol-40ml + Malathion/ DDVP (pesticide)- 20ml (i.e. in the ratio of 6:4:2).

Cue Lure: Mix Ethyl Alcohol-60 ml + Cue lure (p-Acetoxyphenylbutanone- 2)-40ml + Malathion/ DDVP (pesticide)- 20ml (i.e. in the ratio of 6:4:2).

Usage of Methyl Eugenol Lure

For Monitoring

No. of lures per KM^2: 1

Timing: Through-out the year

Replacement: Once in 30 – 40 days

Total lures to be used per KM^2 : 8 – 12/ year

For Area-wide Control

No. of lures per Acre: 6 - 10

Timing: From fruit-set to harvest

Replacement: Once in 30 – 40 days

Total lures to be used in a season per acre: 12-20 or 18-30 depending on the crop

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