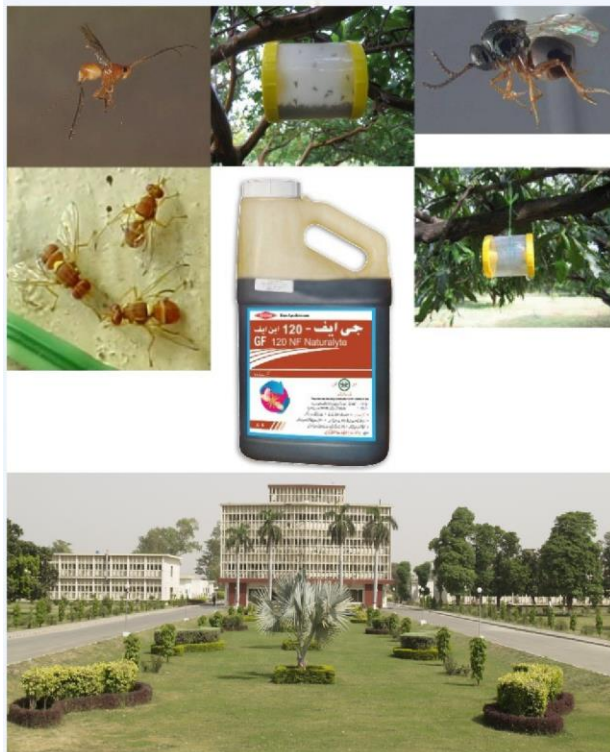




SUSTAINABLE MANAGEMENT OF FRUIT FLIES



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INTRODUCTION

The genus *Bactrocera* of family Tephritidae order Diptera is economically important pests in Pakistan. This genus distributed world wide and comprises of more than 500 species. These flies are regarded as the worst enemies of vegetables and fruits. Many of these plants are shared by more than one fly. Fruit fly adults most often lay their eggs in the fresh fruits and vegetables. The eggs hatch into maggots which most often feed inside of the fruit, resulting in a soft, mushy mess. Infestation by fruit flies causes economic losses in the fruits and vegetables in millions of dollars per year. Due to high valued crops there is need to apply certain management practices continuously to avoid its infestation.

Life cycle

Fruit fly development is dependent on temperature. Favorable conditions are $25\pm 2^{\circ}\text{C}$ at $60\pm 5\%$ RH). Characters common to all species are as follows

Eggs creamy white, up to 1/16 of an inch long. Eggs are laid in batches of 2-9 eggs and up-to 200-300 eggs are laid /female in its entire life cycle. Eggs hatch in 2-4 days and larvae having 3 instars ranges in length from 2-Smm ranging from 1st instar to 3rd full grown instar respectively. Just before pupating, the larvae often pop and flip to leave the fruit. 3. Pupation normally occurs 1-2 inches under the soil and pupal period lasts for 1-2 weeks. 4. Bright brown to black colored adult with shining wings are emerged out usually rest in shady locations unless feeding, mating or laying eggs. Most feed at dawn and mate at dusk. 5. Wing pattern is easiest and most distinguishing characteristic for its identification.

Peach fruit fly *Bactrocera zonata*: It is brownish in color and have a very diverse distribution on as many as 50 host plants like mangoes, guava, peach, chiku, apricots, figs and citrus.

Melon Fly: *Bactrocera cucurbitae*: It is somewhat like *B. zonata* in color appearance and known to infest over 100 hosts. Preferred hosts are Cucurbitaceae (squash and melon etc.). Other hosts include Solanaceae (tomato, eggplant, pepper, etc.) and Caricaceae (papaya).

Oriental Fruit fly *Bactrocera dorsalis*: It is darker in color than *B. zonata* and is reported on as many as 33 host plants primarily in conjunction with *B. zonata* on mango, guava apricot, plum, peach mandarin and apple.

The Lesser Pumpkin fly *Dacus ciliatus*: This fruit fly is much darker in color than *B. cucurbitae* and found in conjunction with melon fruit fly on cucurbitaceous vegetables.

The Baluchistan fruit fly *Myiopardalis pardalina*: These fruit flies mainly infest *Cucumis melo* (Garma, Sarda) and was first time reported from Baluchistan province.

The Ber fruit fly *Carpomyia vasuviana*: It is a monophagous pest of *Zizyphus* (Ber) and found mainly in coastal and sub-coastal areas of the country.

Integrated Management of Fruit flies.

Cultural Practices

Prevention Strategies

Healthy Ecosystem

Healthy plants, soils, and ecosystems are the foundation of plant defenses. Plan your cropping system to maximize populations of beneficial organisms and minimize potential pests.

Jeopardies reduction from Fruit Fly Damage

Remove fruits as they ripen. If they fall to the ground, be sure to kill any larvae in the fruits. Bury deep or put in air-tight container for four days or until no movement is found. Pupae should be checked before adding to manure stack. Fly pupae buried as deep as 2 feet have managed to emerge as adults from dry sand, wet sand, and soil. If burying infested fruit, soil must be tamped thoroughly
Early Harvest: By this, you can sometimes prevent infestation, nevertheless, by early harvest some fruits loose flavor.

Reduce populations: If fruit flies are present in your field prior to your crop ripening, reduce their population by baiting the adults to a poisoned area. This can be done by spraying a protein bait/safer insecticide mixture onto nearby plants or wind-breaks, or onto a planted crop border.

1. Monitor pests.
2. Remove ripe fruits from area
3. Harvest early.
4. Control with bait and insecticide sprays.
5. Enhance or conserve beneficial wasps.

Controls

Chemical Controls

Mostly Cyfluthrin, Trichlorphon, Gentrol (IGR), Nyguard (IGR) are highly adopted and recommended against fruit flies. Along with these a new commercial protein bait in the trade name of GF-120 Neutrolyte is also highly effective against fruit flies

Botanical Control:

Neem-treated sand was found to be toxic to fruit flies larvae but not to several parasites. This may provide a good potential for soil treatment to reduce fly development in the field; nevertheless, adult flies may still invade from outside areas.

Biological Control

Biological control is the intentional method of managing pest populations by use of parasites, predators and pathogens. Living organisms such as parasitoids, predators and pathogens have been engaged as an effective and safe use in IPM systems for longer time.

Parasitoids: Parasitoids are tiny wasps that attack only fruit flies. They can lay their eggs mostly in the larva or pupa of a developing fruit fly. It develops within the immature stages until the fruit fly pupa is consumed and the adult parasitoid emerges from the soil from host pupa. Plants generally known to attract beneficial wasps include *Trybliographa daci*, *Dirhinus giffardi* and *Dichasmimorpha aungicaudata* which are most important naturally occurring bio-control agents of fruit flies in Pakistan.

Predators: Although there are bugs that feed on fruit flies, they are rarely considered as pest control options due to the fact that they, too, are pests. Robber flies, yellow jackets and wasps consume fruit flies when they are available. In maggot's stage, fruit flies are vulnerable to becoming victims of ant and Staphylinid beetle. Other than that various vertebrate predators such as lizards also consume large quantity of fruit flies.

Pathogen: Several pathogens have been exploited as bio-control agents. These are very much effective because of their long broad term effectiveness. These include fungi, bacteria, nematodes and viruses. Mostly *Bauvaria bassiana*, *Metarhizium anisopliae* and *Trichoderma spp.* have been used. In bacterium *Wolbachia* have been successfully exploited throughout the world. In nematodes *Stenernema* and *Heterorhabditis* are used and in viruses Nuclear Polyhedrosis viruses and Cytoplasmic Polyhedrosis viruses have been successfully used as biocontrol agents throughout the world. A part from that some commercial formulation are also available like Emamectin benzoate formulated from *Streptomyces* fungi is available commercially and can be used against fruit flies.

Male Annihilation Technique: In this technique pheromone trap incorporated with lure and insecticides are installed in the field of fruits and vegetables to trap male population.

This technique is very useful in management of fruit flies and is already use on large for effective management.

Bait Application Technique: In this technique mostly protein hydrolyzate admixing with insecticides is used as an attractant because protein source is needed for female fruit flies for oviposition and this source is use as an attractant against fruit flies mainly females

Sterile Insect Technique (SIT): Sterile Insect Technique is widely used practice for managing fruit flies. In this tactic make fruit flies are sterilized by using radiation and release them in the field in minimum double proportion as compared to normal male for its effectiveness.

Pest Scouting Surveillance with Traps

Monitoring is important to identify pests and to keep track of changes in population levels of fruit fly pests in order to indicate when or whether to implement controls. Nevertheless, fruit infestation is the best indicator for presence of pests or evaluation of pest controls. Liquid traps with food bait: Para-pheromone lure traps use highly volatile lures which attract many male flies; these traps will need to be checked frequently. Amount of lure will determine how volatile and long-lasting these traps will be. Presently, only methyl eugenol for oriental fruit fly is available locally. To catch male fruit flies; use 3-5 drops of lure in a trap initially. Addition of an insecticide to the lure provides better catch than traps without insecticide. Use 1 drop of insecticide approved for use on your crop for every 20 drops of lure used. Replenish lure as needed, using more lure to catch males over longer distances and over longer time periods.

Traps for the most of flies should be placed in resting or feeding areas. Protein traps and other mild attractants should be placed close to host plants, in a shady area. Place lure traps at borders, comers, and outside areas of the field, before flies move into your field. Color attractants should be placed in the open for effectiveness.

Trap density or spacing is based on amount and type of attractant used. Protein bait traps have been used at 15-30 feet spacing in-field and lure traps have been spaced at 100 feet outside the field. Visual range for fruit flies is about 15-20 feet. Yellow traps should be placed within that distance from the host plants at greater densities than the lure traps. Mainland programs recommend monitoring traps to be 4-6 feet from ground level.

Attractants: Food baits are effective, mild attractants for males and females of all three said species. They are not very volatile, so bait traps typically have lower catches than the para-pheromone lure traps, but they can be used directly in the field. Other food baits Para-pheromone lures attract only the males, and Most are very volatile and longer-lasting than protein baits. The amount of lure necessary is determined by the purpose of the trapping. Pheromone lures are a very sensitive tool. They can be affected by exposure to elevated heat and direct sunshine. Direct touching by hand may cause cross contamination leading to mixed catches in the trap. Methyl Eugenol and cue lure are the para-pheromones used against fruit flies. Methyl Eugenol is used against *Bactrocera zonata* and *Bactrocera dorsalis* and cue lure is used as an attractant for *Bactrocera cucurbitae*.



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