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RECENT ADVANCES IN MANAGEMENT OF FRUIT FLY FOR GUAVA ORCHARDS: A SHORT REVIEW

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ABSTRACT

Guava is a popular fruit crop of tropical India, which is a rich source of vitamin C and has many medicinal properties. Guava has 2-3 crops in a year according to climatic and genetic condition of variety. It is a crop which gives high yield but due to damages of fruit fly, quality and quantity of fruits becomes poor. Infestation of fruit fly in India is high during rainy season which causes low demand by consumers. Among all the fruit flies, *Bactrocera* fruit fly damage fruit quality and quantity of guava crop most and gives significant worth losses. It is very challenging to manage fruit flies due to their adaptation to several regions, wide range of host and biology. New research and techniques are developing day by day but those are insufficient for their control. This review is focused on *Bactrocera* species which are more damaging in respect to guava orchards of India. Therefore, new methods for controlling the infestation of fruit fly in fruit crops are introduced. The potential of these methods is immense for commercial exploitation. The paper attempt to document the accomplishment made in guava fruit improvement in perspective to Indian conditions. The information is valuable for farmers and academician for further studies.

Keywords: Fruit Fly, Guava, Management of fruit fly, Male Annihilation

INTRODUCTION

Among all the myrtaceae family fruits, guava is popularly known for its sweet fruit. It is a tropical and subtropical climate suited fruit which gives 2-3 crops in a year. These three crops are known as; Ambebahar, Mrigbahar and Hast bahar. In north India, two crops come in bearing i.e. February flowering (Ambebahar) fruiting of which can be obtained from June to September (Rainy season) and June flowering (Mrigbahar) have fruiting during November to March. In Southern India, third crop flowering start in October (Hasta bahar) which harvest during spring season. Among these three crops, fruiting during rainy season is more severe for infestation of fruit fly in guava. Guava is most favourable crop for completing growth stages (egg, larvae, pupa, and adult) of fruit flies (Singh and Sharma, 2013). There are 200 species of fruit fly in 5 sub families are currently known in India and only 35-40 species have been associated with their host plants. Guava fruit fly belongs to order Diptera, and family Tephritidae was first described by Bezzi in 1916. Adult fruit flies lay their eggs on fruit causing blemishes and discoloration. The maggots bore into the fruit and develop inside the way for secondary invaders (fungi or bacteria), which results in extensive rotting and dropping of fruit and infected fruits are not in demand by consumer. Infestation of guava fruit fly in the range of 20- 46 % with crop loss of 16- 40 % is observed in U.P., India (Hasseb, 2007). Jana and Idris (2020) reported that rainy season produce a greater number of flowers and fruit in guava crop while fruit weight during winter. It has been revealed that 83 per cent *Bactrocera zonata* was trapped more in rainy season as compared to other species (*B. dosalis*, *B. cucurbitae* and *B.tau*) at ICAR-RCER Patna, India, whereas 47.25 per cent *B. correcta* was trapped more followed by *B. zonata*, *B. dorsalis* and *B. cucurbitae* in the same season at ICAR-RCER, Ranchi. Among three sub-families i.e., Phytalminae, Dacinae and Ceratitidinae, Dacinae consist highest damaging genera Bactrocera and Dacus. However, *B. zonata* and B. *dorsalis* compete strongly with *B. correcta* in guava in some of fruit growing areas in India, which may become a major threat (Kapoor, 2002; Meenakshi Devi *et al*., 2018). Guava fruit fly has been confirmed in India from Bihar, Tamil Nadu, Karnataka, South Gujarat, Madhya Pradesh, Haryana, Himachal Pradesh and Punjab. White and Elson-Harris (1992) recorded its presence in Pakistan, Nepal and Sri Lanka. However, *B. correcta* is officially quarantine pest in USA and declared as eradicated in the year of 2015 (NAPPO, 2015).

Growth Of Fruit Flies In Guava

Biological growth of fruit flies (*Bactrocera spp.*)

In India three *Bactrocera* spp. mostly damage the guava crop (Kapoor, 2002). Fruit fly grows best in warm and humid climate. Best temperature for *B. zonata*, *B. dorsalis*, *B. correcta* is 22-30°C, approximate 20 egg punctures per fruit, it takes 8 days formag gots to come out of fruit, whereas there are 48 maggots and larvae per fruit, pupal durationis 8 days, number of adult emerged per fruit is 44 and sex ratio 1:1.15in *B. zonata* (M: F), 1:1.30 in *B. dorsalis* and 1:1 in *B. correcta*. Among three species

B. zonata 20%, recorded as minimum crop damage as compared to *B. dorsalis* and *B. correctai. e.,* 80%.

Morphometric growth of fruit fly

Temperature : 24-29°C

Maggots : Length ×Width 7.40×1.80 mm
weight : 11.2b mg

Pupa: Length × Width 4.80× 2.15 mm
weight : 12.20 mg

Wing expense:

Male: 12.02 mm
female: 12.97 mm

The fruit fly population was higher during monsoon than in winter. Fruit fly activity was seen maximum at a height of 1.5 m where the fruits are highly distributed on the host tree (Mohamed Jalaluddin, 1996; Singh and Sharma, 2013).

Management Of Fruit Fly

Organic insecticide

Guava fruits have one of the obstacles in securing the productivity is fruit flies pest (*Bactrocera* spp.) which can cause 50% or even up to 100% yield losses, either by falling fruit, or by rotten fruit due to infestation of fruit flies' larvae into the fruits (Broughton, 2004). Fencing 3 m height around orchard and using chemicals for controlling fruit flies are old methods which are expensive and chemicals are not environment friendly. Use of organic insecticides is an environment friendly method to control fruit fly, which are prepared from plants as tea plant (*Melaleuca bracteata*) and basil (*Ocimum* spp) via distillation of leaves and extraction of methyl eugenol (attractant for fruit fly). By placing methyl eugenol ($C_{12}H_{24}O_2$) in trap, fruit flies get trapped. Fruit flies of guava orchard consume methyl eugenol before matting, which are acts as sex pheromone (Nishida, 1996; Nishida and Fukami, 1988; Kardinan, 2014). Studies on five trapped species (*Bactrocera dorsalis*, *B. zonata*, *B. correcta*, *B. verbascifoliae* and *B. cucurbitae*) of fruit fly complex were conducted in guava orchard. Out of them, *B. dorsalis* was attracted toward methyl eugenol followed by *B. zonata* while *B. cucurbitae* was attracted to the cue lure in guava orchards (Ukey *et al*., 2014).

Bait Application Technique (Bat)

Female fruit flies are important for multiplication of the pest. Attractive baits are needed in any applicative system against flies for monitoring and control (Mazor *et al.*, 2002). They need protein source to mature sexually and for the development of their eggs (Christenson and Foote, 1960). Which leads to female targeted system normally consists of traps baited with a liquid solution prepared by protein and fermenting sugar (Epsky *et al.*, 1999, Mazor *et al.,* 2002).Female fruit flies attract significantly to different protein food baits containing proteinex and 5 per cent ammonium acetate viz., *Bactrocera correcta* (5.17 fruit flies/trap/week), *B. dorsalis* (9.42 fruit flies/ trap/week), *B. cucurbitae* (2.25 fruit flies/trap/week) and total fruit flies (16.84 fruit flies/trap/week) in guava (Ravikumar and Vikartmath, 2007).

Male Annihilation Technique (MAT)/Eradication

Eradication and male attractant (MAT) are synonyms technique which held in an area of fly located site, for a minimum of nine square miles. Small gel like bait per square mile are applied which contain a powerful male attractant (methyl eugenol) that is mixed with the pesticide Spinosad in a small quantity. Bait station should be applied to the sides of individual utility poles and street trees on public path and should not apply at schools (Annonymous, 2020). Several male attractants such as methyl eugenol, cuelure, ceralure, terpinyl acetate, trimedlure, EGOlure, can be used with an appropriate toxicant. The bait placed area will attract and kill male fruit flies before they can breed. The attractant is very specific for this group of flies, other insects such as butterflies or bees will not be harmed because they are not attracted to the lure. Trapping has been found useful for both monitoring and management. Different traps viz., IIHR bottle trap, Steiner trap, McPhail trap, delta trap, Jackson sticky trap and open pan trap are in practice now a days. The most efficient traps for fruit flies monitoring are IIHR bottle trap and plastic McPhail-type trap baited with torula yeast lures. Beside this yellow sticky traps baited with sex-pheromone lures and ammonium carbonate, ammonium bicarbonate, or diammonium phosphate food bait also are commonly used to monitor fruit fly populations (Verghese *et al*., 2002). Using MAT in fruit orchards, against a guild of fly pests largely responsive to methyl eugenol lures (Stonehouse *et al*., 2007).

Wrapping of fruits

Wrapping of bagging is a superior option of fruit fly management over conventional practice of pesticide spray for its efficacy and zero pesticide residues in the fruit. Guava fruits, bagged with biodegradable poly-films before 6-9 weeks of harvesting which effectively controlled fruit fly. Bagging not only keeps the female flies away from the fruits but also improves the texture, color and quality of the fruits (Singh *et al.,* 2007; Mitra *et al*., 2008; Bilck *et al*., 2011). Martins *et al.,* (2007) observed that wrapping of guava fruit with paper bag one month prior to harvesting decreased black spot and anthracnose infestation. Wrapping can be done with materials like polypropylene, plain paper or newly developed non-woven poly fabric.

Finding the right wrapping material is very much important that can minimize fruit fly infestation, improve fruit quality and suit the local climate. Performance of nine different types of wrapping materials (butter paper bag, polypropylene bag of 20µ gauge with and without paper piece inside, non-woven poly fabric bags of white, green and blue color with 20 gsm and 40 gsm thickness) to control fruit fly infestation varied between 1.32 % and 17.31% in all treatments (Mondal *et al*., 2015).

Biological control

Entomopathogenic nematodes can be very effective against life stages in the soil (Dolinski, 2016). Ploughing or raking of soil and treatment with *Metarrhiziumanisopliae* @ 5 kg/ha to the soil underneath the tree canopy reduces fruit flies (Firake *et al*., 2013). Few parasites and predators are observed to suppress fruit fly *Bactrocera spp*., *Diachasmimorpha longicaudata* (*Biosteres longicaudatus*) and *Diachasmimorpha tryoni* for *Bactrocera dorsal* is was useful (Yao, 1989; Sangvorn Kitthawee, 2004) whereas, *Diachasmimorpha longicaudatus* was good for *Bactrocera zonata* (Chinajariyawong *et al*., 2000). The egg parasitoid, *Biosteres arisanus* (Sonan) is dominant parasitoid emerging from harvested guavas. *D. longicaudata* increased in abundance and parasitism rates on the ground after 6-10 days. The eulophid parasitoid, *Tetrastichusgiffardianus* (Silvestri) is more abundant in 4-9days old ground fruit (Purcell *et al*., 1994).

Cultural practices

Prevention is the best method to control of fruit flies. Deep ploughing of soil, land drainage, planting of resistant rootstock, destroy of fallen fruits by burning them in the ground, adopting clean cultivation of orchard, proper plant spacing, pre mature harvest of fruit and avoid flood and channel irrigation are some important practices followed for management of fruit flies (Firake *et al*., 2013; Sarwar M., 2015).

Chemical control

Chemical control is not much advisable due to its residual effect, but if necessary, a small quantity of it can be applied to control the pest. Chemical control also can be applied with integrated pest management. Pre harvest spray using either dimethoate 0.06%, carbaryl 0.2% or deltamethrin 0.0028% are recommended (Verghese *et al*., 2002) for control of flies. For guava orchard, poison bait for fruit flies and moths is Gur + fruit juice 20% + Malathion 2% @ 40 baits/ha (Firake *et al*., 2013).

Integrated Pest Management

Integrated pest management of guava fruit fly ranged from cultural practices to foliage and soil, bait-sprays, male annihilation techniques, releases of sterilized flies and parasitoids, and cultural controls while minimize the chemical spray. Hoeing under the tree canopy at 15 days interval along with collection of fallen fruits and burying deep in the soil and spray of Spinosad is most effective to reduce the fruit fly infestation 6% followed by hoeing and sanitation along with the spray Diptrex 80% WP @ 150 gm / 100 liters of water (Khan *et al*., 2017). According to Verghese *et al.,* (2004), the practice of IPM to control *B. dorsalis* can give very high reductions of infestation. Botanical pesticides are more effective control methods against *Bactrocera* species in the Integrated Pest Management program (Ilyas *et al*., 2017; Hikal *et al*., 2017).

Conclusion

In current scenario, fruit flies is an serious pest for guava orchard of country as well world, which is hard to control after spread, so proper quarantine should be apply for introducing this pest in an area. In India possibility to focus on genetic makeup of flies through RNA interface for their control, while integrated pest management and male annihilation technique for prevention of guava fruit flies are the best method for quality control of guava fruits.

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