



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 10, October 2024

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

**Impact Factor: 8.524**

 9940 572 462

 6381 907 438

 [ijirset@gmail.com](mailto:ijirset@gmail.com)

 [www.ijirset.com](http://www.ijirset.com)

# Integrated Pest Management Strategies of Melon Fruit Fly (*Bactrocera cucurbitae*) in Cucurbits

Shamik Dey, Nandini Pramanik, Rumjhum Das, Sanchita Karan

Faculty of Agriculture, JIS University, Kolkata, West Bengal, India

**ABSTRACT:** A major difficulty in managing economically significant pests is the recurrence and resistance to pesticides caused by the careless and illogical use of chemical pesticides. Integrated pest management (IPM) farming approaches secure soil, plant, and human health while using less chemical pesticides. This is achieved by combating pests simultaneously. Cucurbitaceous crops, including over 70 different hosts, are severely harmed by *Bactrocera cucurbitae*. Less attention has been dedicated to creating successful and efficient integrated pest management systems, even though numerous control techniques have been developed to combat melon fruit flies. The life cycle and behavior of the melon fruit fly are briefly described in this review, along with a thorough analysis of the various integrated pest management (IPM) strategies that have been developed for their control. These strategies include biological control methods like using entomopathogenic fungi (*Beauveria bassiana*, *B. pseudobassiana*), using botanicals (neem, jholmol), and using pesticides.

**KEY WORDS:** *Bactrocera cucurbitae*, IPM, Management, Host plant resistance, Species

## I. INTRODUCTION

Melon fruit fly A significant pest of cucurbits and numerous other fruit trees is *Bactrocera cucurbitae* (Diptera Tephritidae). Since its initial discovery in the Solomon Islands in 1984, it has spread throughout the entire globe. Over 70 host plants are infected by *B. cucurbitae*; these include 31 different host species, 15 vegetable crops from families other than cucurbitaceous, and 17 host plants from the cucurbitaceous family. The melon fruit fly is generally more attracted to the fruits of four different types of gourds: muskmelon (*Cucumis melo*), snake gourd (*Trichosanthes anguina* and *T. cucumeria*), bitter melon (*Momordica charantia*), and snap melon (*Cucumis melo* var. *momordica*). The primary source of the damage is the growing maggots that begin eating the fruit's interior flesh and rendering it unfit for human consumption. Damage to several crops caused by the pest has been recorded to be 25.73% in India, 30-54% in Bangladesh, and 26.2% in Nepal.

In order to achieve long-term insect pest control and prevention, integrated pest management, or IPM, is a comprehensive approach that makes use of the best resources available. These are suppression and prevention, assessment, monitoring, decision-making, nonchemical approach, choice of pesticide, usage of fewer pesticides, counter-resistant tactics, and evaluation. Melon fruit flies cause moderate to severe damage to immature fruits, closed flowers, and fragile stems. crop failure with total yield loss in extreme condition. The objective of this study is to find out the different IPM approaches for *B.cucurbitae* so that a level can be maintained that would suppress the insect pest population and reduce its infestation.

## II. DISTRIBUTION

The melon fruit fly is distributed all over the world, but India is considered as its native home. It was discovered in Solomon Islands in 1984, and is now widespread in all the provinces, except Makira, Rennell-Bellona and Temotu. In the Commonwealth of the Northern Mariana Islands, it was detected in 1943 and eradicated by sterile-insect release in 1963 but re-established from the neighbouring Guam in 1981. It was detected in Nauru in 1982 and eradicated in 1999 by male annihilation and protein bait spraying but was re-introduced in 2001. Although it is found in Hawaii, it is absent from the continental United States.

(Source: - <https://www.researchgate.net/publication/360237231>)

**Various fruit fly species**

Fruit fly Species	Host plant recorded
Zeugodacus cucurbita	Cucumber, bitter gourd, spiny gourd, sponge gourd, ridge gourd, bottle gourd, snake gourd, ash gourd, pumpkin, pointed gourd and water melon.
Zeugodacus tau	Cucumber, bitter gourd, spiny gourd, sponge gourd, ridge gourd, bottle gourd, snake gourd, ash gourd, pumpkin, pointed gourd and water melon
Z. diversus	Flowers of pumpkin, ridge gourd, ash gourd and bottle gourd
Z. cilifera	Flowers of spiny gourd.

(source: - Nair et al., 2021)

**III. LIFE CYCLE**

**Egg**

The first stage in the life cycle of a fruit fly is the egg stage. A female fly can lay up to 500 eggs. She starts this process by finding the perfect place, like your bowl of fruit. The fruit is even more attractive for laying eggs if the fruit is very ripe or beginning to ferment, or rot. The fermentation process causes more sugar to be available as a nutrient source for the eggs and the later stages. The female fly will deposit her eggs inside the food to ensure the eggs are surrounded by sugar. The egg stage typically lasts for approximately 30 hours. You will not be able to see the eggs with your naked eye because they are too tiny. Under a microscope, they look like yellow grains of rice. The eggs develop best at the temperature in which you are most comfortable in your home: between 75 and 80 degrees. The process will be slower in colder temperatures.

**Larva**

The second stage is the larva stage. At this point, the eggs have hatched, and the fruit fly is a maggot: short, fat, little worms. Not a lot happens at the larva stage other than a whole lot of eating. The maggots will consume as much fruit or other sweet, moist foods as possible. This is important since they will need the nutrients in order to develop into the next stage.

**Pupa**

The pupa stage marks the beginning of the fruit fly metamorphosis or change in form from earlier stages to becoming an adult. The pupa is surrounded by a puparium, which is a firm, pupal case. During this stage, the pupa is completely dependent on the food and nutrients that it consumed during the larva stage. Inside the puparium, the pupa is developing three pairs of legs and a set of wings. Over the six days of this stage, it is also getting bigger. Towards the end of the six days, the eyes turn red. You can tell when a pupa is about to emerge as a fly because the pupa will be dark in colour.

**Adult**

If everything goes well during the pupa stage, then it will make it to the last stage, the adult fly. At this point metamorphosis is complete and the fly pushes its way out of the front portion of the puparium. The fly immediately starts eating as it depleted all its nutrients during the pupa stage.

(Source:<https://study.com/academy/lesson/fruit-fly-life-cycle-eggs-larva-metamorphosis.html>)



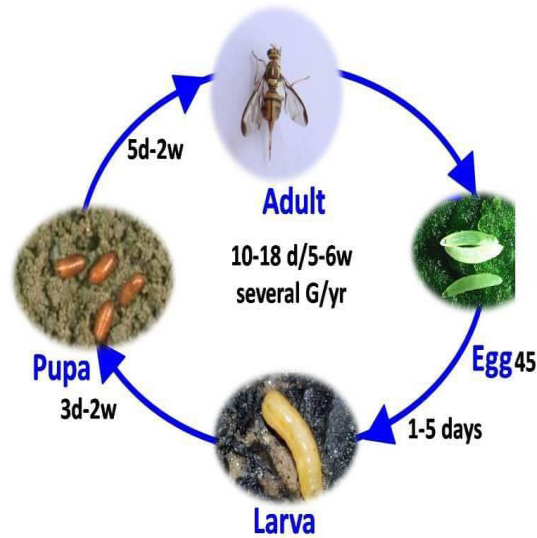


Fig 1:- Melon fruit fly life cycle

(Source:- jamesfrsall- world press.com)

#### IV. DAMAGE SYMPTOMS

According to Mir et al., 2014, melon fruit flies have been shown to prey on 81 distinct crop species, the majority of which are members of the Cucurbitaceae family. Cucurbitaceous plants, including cucumbers, pumpkins, watermelon, zucchini, and other crops including beans, Chinese wax gourds, edible gourds, eggplant, green beans, luffa, peppers, squashes, and tomatoes, are primarily affected by this insect pest. According to Stonehouse et al., 2002, fruit flies reduce crop yields by 50% in squash, 29% in melon, 36.24% in bitter gourd, and 38.69% in cucumber. In the Solomon Islands, Hollingsworth found that snake gourds (90%) and bitter gourds (95%), as well as pumpkin fruits (60–87%), had the highest insect infestation.

The fruit is harmed by the developing maggots inside the immature fruits and secondary infection from invasive germs and microorganisms that cause the fruit to deteriorate. Following oviposition, the maggots grow beneath the fruit's skin and gradually make their way into the fleshy part of the fruit (Ronald and Jayma 2007). The fruit bends abruptly at the oviposition site because the tissue at the injection site stops developing while the resting tissue keeps growing. Damage to developing buds and unopened flowers has also been documented; the maggot then grows successfully and begins feeding on taproots, stems, and leaf stalks, which leads to crop loss. These puncture sites allow entry points for many pathogens, which causes the fruit to gradually curve at the oviposition site. This is the main observable sign of *B. cucurbitae* infestation on the fruit (Ronald and Jayma 2007). The fruit deteriorates as the infection spreads and falls to the ground, where larvae pupate in the soil (Mir et al., 2014). The appearance of twisted and misshapen fruits as well as the oozing of brown, resinous, gummy fluid from the puncture site are additional indicators of a pest infestation.

#### V. INTEGRATED PEST MANAGEMENT

The fruits of cucurbits, of which the melon fly is a serious pest, are picked up at short intervals for marketing and self-consumption. Therefore, it is difficult to rely on insecticides as a means of controlling this pest. In situations where chemical control of melon fruit fly becomes necessary, one must rely on soft insecticides with low residual toxicity and short waiting periods. Therefore, keeping in view the importance of the pest and crop, the melon fruit fly management could be done using integrated pest management tools like cultural control, Mechanical control, physical control, biological control, Host plant resistance chemical control respectively.

### **Cultural Control**

- Adhikari et al., 2020 have identified several cultural practices that are effective in reducing the severity of pests in various crops.
- These practices include tillage, removal of host plants, crop rotation, clean cultivation, weeding, pruning, conservation of natural enemies, early harvesting, traps, and repellent crops.
- One of the most crucial aspects of integrated pest control (IPM) is field sanitation. It stops insect outbreaks and tampers with the pests' reproductive cycle.
- Burying the infected fruits 0.46m deep into the soil has been found to disrupt the reproduction cycle of *Bactrocera cucurbitae* (Klungness et al., 2005).
- Poor water availability reduces the survivability of adult melon fruit flies.

### **Mechanical Control**

- Mechanical control of pest control includes wrapping/bagging/netting of fruits with either newspaper or paper bags. This is done to avoid the egg laying of adult female flies on the fruits to produce fruits which are free from the infestation of fruit fly.
- Wrapping of fruits should be done before the attack of fruit fly like at least one month prior to harvesting. Though this is a laborious practice but is an effective method to prevent the attack of fruit flies on fruits (Badii et al., 2015).

### **Physical Control**

- The physical method involves using the net house and bagging fruits and flowers.
- Bagging fruits and flowers is a time and labour consuming task; however, this technique has been found to minimize the risk of pest infestation in many crops.
- The pest does not respond much to known male lures, cue-lure, and methyl eugenol, making it more difficult to control (Royer et al., 2014).
- Black plastic mulch can be used as an effective way to reduce pest infestation of *B. cucurbitae*.
- An efficient way to manage this pest is to use *O. sanctum* as the border crop and treat it with protein bait that contains Spinosad as a toxin.

### **Biological Control**

- *Opius fletcheri* has been known as a dominant parasitoid of *B. cucurbitae*.
- In India and the Indian subcontinent, *Psytalia fletcheri* (Silvestri) is another common larval-pupal parasitoid of *B. cucurbitae* (Vargas et al., 2012).
- After four days of inoculation, it has been observed that *Metarhizium guizhouense* PSUM02 considerably reduces the mating tendency and mating competitiveness of both male and female adult melon fruit flies (Thaochan and Ngampongsai 2015).
- It has also been observed that the fungi *Rhizoctonia solani*, *Gliocladium virens*, *R. solani*, *Trichoderma viride*, and *G. viride*'s cultural filtrate is effective in eradicating the pest *B. cucurbitae*.
- In addition to biological control methods, nematodes such as *Steinernema carpocapsae* Weiser (*Neoaplectana carpocapsae*) can cause 0 to 86% mortality in adult melon fruit flies when exposed for 6 days at 5000 to 5,000,000 nematodes/cup in a controlled environment, and 87.1% mortality in the field when exposed to 500 infective juveniles/cm<sup>2</sup> soil.

### **Host plant resistance**

Programs for integrated pest management must take host plant resistance into account. The farmers do not bear any additional expenses, nor does it have any negative consequences on the environment. Sadly, efforts to create fruit fly-resistant and highly productive cultivars have not shown much success. Table 1 contains a list of fruit fly resistance sources. Through widespread hybridization, there is a clear chance that farmed genotypes of cucurbits will acquire resistance genes from their wild counterparts, creating variations resistant to melon fruit flies.

Host plant	Genotypes	Remarks
Bitter gourd	IHR 89, IHR 213 and Hisar II	Resistant, thick and tough fruit rind
Pumpkin	IHR 35, IHR 40, IHR 79-2, IHR 83	High resistance
Bottle gourd	NB 29	High resistance
Sponge gourd	NS 14	Moderate resistance
Ridge gourd	NR 2, NR 5, and NR 7	Moderate resistance
Round melon	Arka Tinda	Resistant
Wild melon	Cucumis callosus	High resistance

Table 1: - Some genotypes that show resistance against melon fruit fly

(source: - <https://www.researchgate.net/publication/6677688>)

### Chemical Control

- When it comes to protecting bottle gourds from melon fruit flies, insecticides like Spinosad, dichlorvos, lambda cyhalothrin, jholmal, and azadirachtin are the most effective (Gautam et al., 2021).
- Spinosad @ 60 g/ha, acephate @300 g/ha, and Chloroform @ 50 g/ha can be effectively used to control melon fruit fly infestation in fruits of bitter gourd.
- Abamectin (0.0015%) in both cucumber and bitter gourd, λ-cyhalothrin (0.004%) and emamectin benzoate (0.002%) in cucumber, and Spinosad 480 SC (0.4ml/l) @ 500 l/ha in round gourd
- It has also been observed that diflubenzuron works well to repel melon fruit flies.
- The emergence of pesticide resistance in melon flies underscores the necessity of creating and implementing substitute management strategies.

### VI. CONCLUSION

A potentially effective strategy for stopping the melon fruit fly (*Bactrocera cucurbitae*) from colonizing, spreading, and dispersing is integrated pest management. Adopting IPM strategies can reduce the danger of pest resurgence, pesticide resistance, and harmful pesticide effects on the environment. The pest level will not remain below the threshold level with solo control methods. The present review study strongly advocates for the logical application of integrated pest management (IPM) strategies and components to mitigate the issue of melon fruit fly damage to a range of cucurbitaceous crops in agricultural settings.

### REFERENCES

1. Adhikari, D., S. L. Joshi, R. B. Thapa, V. Pandit, and D. R. Sharma; Ministry of Agriculture and Livestock Development, Kathmandu, Nepal. 2020. "Fruit Fly Management in Nepal: A Case from Plant Clinic." *Journal of Biological Control* 34 (1): 8–14.
2. Billah, M. K., Afreh-Nuamah, K., Obeng-Ofori, D., & Nyarko, G. (2015). Review of the pest status, economic impact and management of fruit-infesting flies (Diptera: Tephritidae) in Africa. *African Journal of Agricultural Research*, 10(12), 1488-1498.
3. Gautam, M., Poudel, S., Dhungana, N., & Bhusal, N. (2021). Comparative efficacy of different insecticides against cucurbit fruit fly (*Bactrocera cucurbitae*) on bottle gourd (*Lagenaria siceraria*) in Sarlahi District, Nepal. *International Journal of Natural Resource Ecology and Management*, 6(2), 27-37.
4. Klungness, L. M., Jang, E. B., Mau, R. F. L., Vargas, R. I., Sugano, J. S., & Fujitani, E. (2005). New approaches to sanitation in a cropping system susceptible to tephritid fruit flies (Diptera: Tephritidae) in Hawaii. *Journal of Applied Science and Environmental Management*, 9(2), 5-15.
5. Mir, S. H., Dar, S. A., Mir, G. M., & Ahmad, S. B. (2014). Biology of *Bactrocera cucurbitae* (Diptera: Tephritidae) on cucumber. *Florida Entomologist*, 97(2), 753-758.
6. Nair, N., Chatterjee, M., Das, K., Sehgal, M., & Malik, M. (2021). Fruit fly species complex infesting cucurbits in India and their management. *International Journal of Agriculture, Environment and Sustainability*, 3(2), 8-17.

7. Ronald, F.L and L. Jayma, (2007). *Bactrocera cucurbitae* (Coquillett). *Crop. Knowledge. Master*, 4, 1-5. <https://doi.org/10.1603/0022-0493-97.5.1659>
8. Royer, J. E., De Faveri, S. G., Lowe, G. E., & Wright, C. L. (2014). Cucumber volatile blend, a promising female-biased lure for *Bactrocera cucumis* (French 1907)(Diptera: Tephritidae: Dacinae), a pest fruit fly that does not respond to male attractants. *Austral Entomology*, 53(3), 347-352.
9. Thaochan, N., & Ngampongsai, A. (2015). Effects of autodisseminated *Metarhizium guizhouense* PSUM02 on mating propensity and mating competitiveness of *Bactrocera cucurbitae* (Diptera: Tephritidae). *Biocontrol Science and Technology*, 25(6), 629-644.
10. Vargas, R. I., Leblanc, L., Harris, E. J., & Manoukis, N. C. (2012). Regional suppression of *Bactrocera* fruit flies (Diptera: Tephritidae) in the Pacific through biological control and prospects for future introductions into other areas of the world. *Insects*, 3(3), 727-742.





INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details