

Integrated Pest Management of Fruit Borer (*Helicoverpa armigera*) of Tomato

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SUMMARY

Tomato is one of the leading crops of India after Potato. It is also known as the protective and conventional food. However, it is attacked by many insects and *Helicoverpa armigera* is one of the major insects of Tomato in India. It is highly polyphagous widely distributed throughout the world on food, fibre, oilseed and fodder, horticultural and ornamental crops. Achieving such a magnificent goal requires in depth knowledge about biology and method of spread of pest. Integrated pest management aims to maintain pest population below economic injury level. 90% of tomato fruit can be damaged by *Helicoverpa*. With a reported 30 to 50% yield loss in tomato crops, the loss assessment due to this insect pest is significant. Botanical materials have been used as an alternative to chemical pesticides for controlling tomato fruit borer. Three times weeding, three times handpicking and indoxcarb @ 370 ml/ha is most effective for management of *Helicoverpa* larva but hand picking is best from economic point of view. Bacillus thuringiensis K. @ 3 g per liter of water is effective for management of *Helicoverpa*. Pheromone traps are used to monitor the presence and activity of male moths, which are responsible for mating with female moths and laying eggs on tomato plants. Adult is nocturnal in nature so that it can be monitored through light traps. Sticky traps are another type of trap that can be used to monitor adult moths and other flying insects in the field.

INTRODUCTION

Tomato [*Solanum lycopersicum*] belongs to the family of Solonaceae. Tomato is an important source of vitamins, minerals, carotenoids, and phenolic compounds. Tomatoes are widely distributed, but the top three producers according to 2020 are China, India, United States and Turkey. In 2020, tomato production in world is 182 million tonnes, China contributing 35% to the total production. In India, tomato is cultivated in 8.2 lakh hectares with 19.6 million tonnes production. Tomato fruit borer, *Helicoverpa armigera* (Lepidoptera: Noctuidae) is the key pest of tomato crop in India. It is a polyphagous pest which feeds on more than 15 crops. It is responsible to cause yield loss in tomato ranging from 18 to 55% in India. *Helicoverpa* cause 90% damage to fruit which is of up to 3.48% of economic damage level. Fruit damage results into disfiguration of surface, rotting through secondary infection by bacteria (Ti). The production of tomatoes has been hampered by a number of biotic and abiotic issues. It is estimated that pesticide use in fruit and vegetables in India ranges from 30% to 60% depending on the crop and region.

Nutritional status of tomato:

The tomato has 95% water content, while the remaining 5% is composed of carbohydrates and fibre. Carbohydrates comprise 4% for a medium sample of 100 grams, the raw tomatoes contain less than 5 grams of carbohydrates. Nearly 70% of the carb content is simple sugars, such as glucose and fructose. Tomatoes are a good source of fiber, which provides for an average sized tomato, 1.5 grams. The essential nutrient and antioxidant is vitamin C. One medium-sized tomato can provide about 28% of the Reference Daily Intake (RDI). Potassium, an essential mineral, has a beneficial effect on blood pressure control and heart diseases. In normal tissue development and cell functions, Vitamin B (folate) is essential.

Health benefits of tomato:

In tomatoes, lutein and zeaxanthin are present that protect the eye's retina (Arunkumar et al., 2020; Sauer et al., 2019). This helps to prevent or control age associated macular degeneration and cataracts. It is believed that tomatoes are beneficial in terms of skin health. A tomato based food rich in lycopene and other plant compounds may protect against sunburn. Tomatoes are laxative fruits. Eating foods that contain a high amount of water and fibre, for example tomatoes, may promote hydration and regularity of bowel movements. Through the release of stomach and digestive juices, fibre is also capable of stimulating peristaltic movement within the

delicate muscle of the gastrointestinal tract. It reduces the incidence of cancer, cardiovascular disease and enhancing the immune system and bone health (Eggersdorfer and Wyss, 2018; Rodriguez Concepcion et al., 2018). Lycopene, based upon the antioxidant, polyphenol and plant components contained in tomatoes, has been demonstrated to be effective against prostate cancer. That's why the tomatoes have that Red colour in them. The tomato has diuretic properties that allow urine to form in our bodies. It also helps rid the environment of toxic substances as well as excessive amounts of water, salt and nitric acid. Vitamin C & Bioflavonoids are used to heal wound by strengthening teeth, capillaries necessary for the growth and regeneration of body tissues (George Mateljan Foundation, 2010).

Integrated pest management:

Physical control:

Burning : Damaged fruits and crop residue should be burn to avoid carry-over of pest.

Refrigeration : Cold storage of fruits and vegetables reduces pest infection.

Moisture : At optimum moisture there is no infection while at high moisture in field increases infection of pest.

Use of light : Light traps are used for pests like hairy caterpillar, stem borer.

Cultural control:

Summer ploughing: Ploughing the field after summer showers, removing the crop debris from the field, exposing the different stages of insects viz., egg, larvae and pupae to sunlight greatly reduce the pest abundance and prevent the pest population buildup.

Certified seeds: Certified seeds free of insects and disease causing organisms should be used. This can prevent the carryover of pest species through the seeds.

Time of sowing: Synchronization of vulnerable host crop stage and pest species determine the extent of damage. Asynchronization can be achieved by adjustment of time of sowing.

Judicious and proper application of fertilizers: Judicious and proper application of manures and fertilizers at proper time can directly manage the insect pests. Excessive use of nitrogenous fertilizer attracts pests. Phosphorus fertilization has been known to reduce the incidence of jassid.

Water management: The availability of water in requisite amount at the appropriate time is crucial to the very lives of the plants. Water can accentuate or hinder growth and development of insect pests. Overmoist soil attracts cutworms, slugs, etc. Water stress has been employed for the management of whitefly (*Bemisia Tabaci*).

Weed management: Weeds serve as the alternate and associate hosts of several insect pests. Weeds support the growth and development of insect pests by providing nutrition and substrates for oviposition. Hence, removal of weeds directly control the population buildup of pests.

Crop rotation: Monocropping helps in the sustenance of insect pests throughout the year and aids in great damage by them. It is advisable to rotate the crops and avoid monocropping. Especially, monocropping of cotton, tomato and brinjal is not advocated.

Trap crop: Planting of yellow tall marigold (*Tagetes* spp.) or bidil rustica tobacco around tomato (1:5) has been found promising. All the eggs of *H. armigera* deposited on yellow *Tagetes* flowerbuds could be destroyed by the inundation of *Helicoverpa* adapted strain of egg parasitoid (*Trichogramma chilonis*). The main crop of tomatoes is also sprayed either with hHaNPV or Bt, both of which are compatible with *Trichogramma*.

Resistant varieties:

S. No.	Name of variety	Type of variety	Developed by	Resistant to insect pests and diseases
1	Arka Vikas	Hybrid	Indian Institute of Horticultural Research (IIHR)	Resistance to both fruit borer and bacterial wilt.
2	Arka Abha	Hybrid	Indian Institute of Horticulture Research (IIHR)	Resistance to both fruit borer and early blight.
3	Pusa Early Dwarf	Open-pollinated	Indian Agricultural Research Institute (IARI)	Resistance to both fruit borer and leaf curl virus.
4	F1 Hybrid 904	Hybrid	East-West Seed Company	Resistance to both fruit borer and bacterial wilt.
5	F1 Hybrid 955	Hybrid	East-West Seed Company	Resistance to both fruit borer and early blight.

Biological control:

Study and utilization of natural enemies of insect like predators, parasites and pathogens by man to manage pest population below economic injury level is called biological control of insect pest.

Predators: Lady bird beetle: This insect feeds on aphids.

Chrysoperla carnea: The larvae of this insect feeds on all soft bodied insects like aphids, jassids, white flies, mealybug etc.

Parasites: Egg parasite: *Trichogramma chilonis* parasites egg of *Helicoverpa armigera*.

Larval parasite: *Bracon hibitor* parasites larvae of *H.armigera*.

Egg larval parasite: *Copidosoma kohleri* parasites egg of potato tuber moth and comes out at larval stage by killing the pest.

Pathogens Bacteria: *Bacillus thuringiensis* develops disease in many lepidopterous pests.

Virus: Though there are many reports of entomopathogenic viruses Nuclear Polyhedrosis Virus (NPV) and Granulosis Virus (GV) are commonly used in insect pest control.

Fungus: *Beauveria bassiana* is used for control of lepidopterous pests.

Botanical pesticides:

Indian farmers used a variety of plant products and extracts for pest control. The most commonly used botanicals are neem (*Azadirachta indica*), pongamia (*Pongamia glabra*) and manhua (*Madhuca indica*). Neem seed kernel extract (2 to 5%) has been found effective against several pests including cutworm, plant hopper, leafhoppers, tobacco caterpillar, several species of aphids and mites. Mahua seed kernel extract (5%) is effective against sawfly (*Athalia lugnes proxima*) and others. Root extracts of Targets or Asparagus work as a nematicide for plant parasitic nematodes. Similarly, leaf extracts of many higher plants can inhibit a number of fungal pathogens. Neem seed extract was used for management of rootknot nematode in tomato.

Chemical control:**Tomato Fruit borer [*Helicoverpa armigera*]**

Insecticides	Trade names	Dosage (ml/gm)/ lit
Broflanilide 300 g/l SC	Exporus	0.1
Chlorantraniliprole 18.50 % SC	Coragen	0.2
Chlorantraniliprole 35 % WG	Altacor	0.1
Cyantraniliprole 10.26 % OD	Benallia	1.0
Deltamethrin 11% w/w EC	Decis 100	0.1
Flubendiamide 20 % WG	Fluton, Takumi	0.2
Flubendiamide 39.35 % w/w SC	Fame	0.1
Indoxacarb 14.50 % SC	Avaunt	0.5
Lambda-cyhalothrin 04.90 % CS	Matador	0.3
Lambda-cyhalothrin 05 % EC	Judo, Karate	0.3
Methomyl 40 % SP	Dash, Lannate	1.1
Novaluron 10 % EC	Rimon	0.7

CONCLUSION

Tomato producers in India use excessive amount of insecticides, thereby posing a serious threat to the environment and public health. To address this issue, it is important that farmers should be educated on the principles of integrated pest management (IPM), which endeavors to cultivate robust crops with minimal harm to the agro-ecosystem. Employing IPM strategies is an efficient means of curbing the impact of the tomato fruit borer and ensuring the longevity of sustainable agriculture. Biological control agents, such as *Trichogramma wasps* and *Bacillus thuringiensis* can be used effectively to manage the pest populations. It is important to note that chemical control should only be considered as a last option and only when necessary. To control the *Helicoverpa* larva, it is recommended to implement a rigorous weeding and handpicking schedule, ideally three times each. From an economic point of view, handpicking is the most efficient method for small and marginalized farmers. IPM is a sustainable approach that minimizes the use of pesticides and promotes environmental conservation while ensuring high yields of healthy tomatoes. By implementing an IPM program for tomato fruit borer, growers can achieve effective pest control while minimizing environmental impacts and reducing costs.

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