

## MINI-REVIEW

# Studies of Tomato Fruit Flies (*Neoceratitis cyanescens*): A Serious Pest on Tomato Crop

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The authors declare that the manuscript was formulated in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Authors Contribution**

All authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

**Abstract**

Tomato is a key food crop in India, grown in different states and producing different products. It is a rich source of vitamins, minerals and fiber and is used in a variety of dishes. However, it is threatened by various insect pests, including the serpentine leaf miner, fruit fly, mealybugs, red mites, thrips and whiteflies. Fruit flies, especially *Neoceratitis cyanescens* are the most serious pests of fruits and vegetables worldwide, causing millions of dollars in damage annually. These pests reduce tomato quality and cause abortion, with losses varying between 30-100% depending on the season. Fruit flies are more demanding on ripe tomato fruits than on young ones. Female flies deposit their eggs in the fruit using their ovipositor, causing the color to change. The adult larvae eat the flesh, making the fruits unfit for consumption. Larval development depends on host fruit nutrients, size, developmental period, and maturation time of adult flies.

**KEYWORDS**

Tomato fruit fly, *Neoceratitis cyanescens*, Oviposition behavior, Oligophagous

## INTRODUCTION

Tomato (*Lycopersicon esculentum* L.) is one of the most important conservation food crops in India, (White et al., 1992). Tomatoes are a very popular ingredient in the Indian diet. It is grown on an area of 0.458 M ha with a yield of 7.277 Mt and a productivity of 15.9 mt/ha. The plants usually grow 1-3 meters tall and have a weak stem that often spreads to the ground and vines over other plants. It is a perennial in its natural habitat, although it is often grown outdoors as an annual in temperate climates, (Duyck et al., 2004). Bihar, Karnataka, Uttar Pradesh, Odisha, Andhra Pradesh, Maharashtra, Madhya Pradesh and West Bengal are the leading tomato growing states. The presence of fiber, calcium, potassium, vitamins A and C is greatly aided by the consumption of tomatoes. Tomatoes are used to make soups, salads, pickles, ketchups, purees, sauces, and are used as a vegetable in many other ways. These popular crops are devastated by many insect pests, including serpentine leaf miners, fruit flies, mealybugs, red mites, thrips and whiteflies. In addition to these insects, stink bugs have also been reported to damage tomato fruit, (Roitberg, 1985). Fruit flies (Diptera: Tephritidae) are the most serious pest of fruits and vegetables worldwide and are responsible for millions of dollars in damage to these commodities each year. *Neoceratitis cyanescens* is endemic to the western Indian Ocean area, but it has also been documented in Madagascar, La Réunion, Mauritius, and the Comoros Islands. There is no knowledge of it from the African mainland, (Hancock, 1984).

*Neoceratitis cyanescens* is an oligophagous species that attacks cultivated species in Solanaceae, especially tomato (*Lycopersicon esculentum* Mill.), but also sweet pepper (*Capsicum annum* L.), eggplant (*Solanum melongena* L.), tree tomato (*Cyphomandra betacea*) and pepper (*Capsicum frutescens* L.), (Fletcher, 1987). Pests are the main yield limiting factor for tomatoes. Fruit flies reduce the quality of tomatoes and cause abortions of infected fruits. Damage caused by fruit flies varies between 30 and 100%, depending on the season. Infestation levels were highest when fruits were ripening, with little or no infestation occurring in earlier fruit stages. Most fruits are susceptible to fruit fly damage just prior to harvest, (Krainacker et al. 1989). Fruit flies have also been reported to damage ripe tomato fruit more than young fruit.

## LIFE CYCLE






*Neoceratitis cyanescens* is capable of completing its life cycle in 45-46 days under 25°C conditions. The maximum age for an adult is 11 weeks. Six days after maturation, the female begins to lay eggs, (Brevault et al., 2008). Typically, the eggs are white to creamy yellow and can be found beneath or under the skin of the fruit. Their larvae are formed from eggs and consume fruit pulp as their nourishment. *Neoceratitis cyanescens* larvae can live anywhere from 5 to 31 days at temperatures between 15°C and 35°C, (Brevault, 2000). Mature larvae descend into the soil and create tunnels for pupation. An adult fly develops from its young at a temperature between 15°C and 30°C after 11 to 40 days of pupa development, (Brevault, 2000b).

## DAMAGE SYMPTOMS

Most species can develop on more than one host plant because they are polyphagous. The maximum length of tomato fly attack on green fruit is 10 to 24 days after flowering, (Baker, 1990). The use of ovipositors by female fruit flies involves depositing their eggs in host fruits or vegetables; signs and symptoms include discoloration around the oviposition sting on the floor of the fruit. Larvae feed on the

flesh of the ripe fruit from the outside, usually in the soil, (De Meyer, 2012). As the fruit matures, the host becomes inedible as the larvae feed on the fruit. Nutrient first rate of the host fruit, length of the fruit, duration of growth, and time to maturity of the adult fly all affect how fruit flies develop their larvae.

**Table 1: Developmental stages of fruit fly. (PPKB, 2019)**

				
<p><b>1. Egg clutch:</b> Eggs laid just beneath the skin of a green tomato fruit.</p>	<p><b>2. Young larva:</b> Juvenile larvae consuming the pulp of tomato fruit.</p>	<p><b>3. Pupae:</b> Pupae observed on the soil.</p>	<p><b>4. Adult female ovipositing:</b> A female is depositing eggs within an immature tomato fruit.</p>	<p><b>5. Damage symptoms:</b> Indications of impaired tomato fruit.</p>

## PREVENTION AND CONTROL

### Cultural Control and Sanitary Methods:

Attacked shoots and plants should be collected along with alternative host plants and destroyed or burned. Deep ploughing of fields during summer months to expose the hibernating pupae in sun or for parasitization by natural enemies. Fruit fly ovipositing eggs, maggots emerge from rotten fruit, (Aluja, M. 2008). Flooding the entire fields.

### Biological Control:

Biological control is the process of keeping pest populations below levels that are harmful by using live organisms. In untreated crops or their natural hosts, parasitoids help regulate *N. cyanescens* numbers, (Altieri, M. A., et al., 1979). Three main groups of natural enemies of *N. cyanescens* exist: pathogens, parasitoids, and predators.

### Chemical Control:

Chemical sprays cannot control adult fruit flies in tomatoes, as they migrate from neighboring fruit trees. Fruit fly larvae cannot be controlled by chemicals because the adults lay their eggs in tomato fruit, and the larvae develop inside the fruit. Some larvae burrow into the soil to pupate and then emerge, (Shelly, T., et al., 2014). Chemical control should mainly be the use of pyrethroids during the fruiting stage of the crop. Deltamethrin or lambda-cyhalothrin should be sprayed as soon as the crop reaches fruiting stage.

### Aerial and Ground Bait Spray Application:

Sprays should use minimal amounts of pesticides and proteins or sugars to attract fruit flies. Poisoning should be applied after fruit flies are trapped, (Jaime, C. P., et al., 2009). Use Methyl-Eugenol traps to kill the fruit fly adult's population.

### CONCLUSION

Since the mid-twentieth century, monitoring and control methods have been developed for the effective management of *Neoceratitis cyanescens*. A number of tools can be used at present to protect fruit from damage caused by this fly. The population of *Neoceratitis cyanescens*, which is the main fleshy fruit fly, decreases significantly after the application of control measures. However, tomato fruit fly attack persisted throughout the year, despite a reduction in fruit infestation in treated areas. Therefore, control measures are not effective enough to further reduce the tomato fruit fly population. Rotting tomatoes in the field act as a reservoir for pest. In most cases, fallen tomatoes remain on the ground and therefore contribute to the constant flooding of tomato fruit fly populations. Sanitation is an essential component of an integrated control program.

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