

Controlling *Tuta absoluta*, a new invasive pest in Europe

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Clockwise from above: Healthy tomatoes, adult *Tuta absoluta*, leaf damage and damaged fruits (© J. Arnó, A. Mussoll and R. Berruezo, IRTA, Spain).

Introduction

The South American tomato leafminer, *Tuta absoluta* (Meyrick), is a micro lepidopteran moth belonging to the Gelechiidae family and is considered one of the most devastating tomato pests. It originates from South America and was detected for the first time in Europe in Spain in 2006. This newly introduced pest has spread very quickly along the Mediterranean Basin and to other Central and Northern European countries.

Biology

Tuta absoluta has a high reproductive potential and a life cycle that can take from 24 to 76 days, depending on the environmental conditions. Adults are silvery gray with black spots on the forewings and a wingspan reaching 10mm. Their activity is concentrated in the early morning and dusk; during the rest of the day they remain hidden among the leaves. Adult lifespan ranges between 10 and 15 days for females and 6–7 days for males. The female lays the eggs mainly on the leaves, although they can also be found on stems and sepals. Eggs are laid isolated, thus facilitating their distribution on the crop. The number of eggs per female is usually between 40 and 50 and may reach 260. Eggs are small, 0.35mm long, cylindrical and creamy white to yellow. Egg hatching takes 4-6 days. Young larvae are cream in color with a dark head. As they develop, the larvae become greener and slightly pink in the last instar. Larval development goes through four stages and pupation may take place in the soil, on the leaves and even within the galleries or other parts of the plant. The pupa is cylindrical



From top to bottom: adult and eggs, young larvae, fourth instar larvae and pupae of *Tuta absoluta*.
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and greenish when recently formed, later turning brown. It may be protected by a silky white cocoon.

Host plants

Its main host is tomato, but infestations of *T. absoluta* have also been reported on aubergine (eggplant), potato and common bean. Among non-cultivated plants it has been recorded mainly on *Solanum nigrum*, *Datura stramonium* and *Nicotiana glauca*.

Damage

Tomato plants can be infested from seedlings to mature plants. *Tuta absoluta* reduces yield and fruit quality, causing up to 100% yield losses in severely infested tomato crops. The main damage is produced on the leaves and fruits, but inflorescences and stems can also be affected. Larvae of *T. absoluta* feed on the mesophyll of the leaf leaving only the epidermis intact. The galleries produced by young larvae may be confused with those produced by leafminers (*Liriomyza* spp.), but the gallery produced by *T. absoluta* subsequently widens and the damaged tissue dries. In the gallery, the larvae of the moth and its black frass can be seen. During development the larvae may change gallery several times. Any part of the tomato fruits can be affected, although there may be a preference for the protected area beneath the calyx, especially in immature fruits where the damage may go unnoticed. Infestation in more advanced stages of maturation



***Tuta absoluta* damage seen on leaves and fruits. © J. Arnó and A. Mussoll, IRTA, Spain.**

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results in malformations and galleries in the pericarp. Damage by *T. absoluta* larvae facilitates the entry of other pathogens causing fruit rot. The presence of perforated stems is much less frequent than that of leaf galleries. This type of boring occurs mostly in the insertion of the leaves.

Pest monitoring

To avoid potential damage it is very important to detect symptoms early, especially the eggs or small galleries. Traps with sex pheromones are usually placed to monitor the abundance of male moths on the crop or in the area.

Control strategies

Cultural methods

1. **Screening the greenhouse** vents and installation of double-doors may be useful measures to exclude *T. absoluta* adults. To prevent the entry of the pest, nets with a minimum density of 9 x 6 threads/cm² have to be used. It has to be taken into account that screening the greenhouse will also reduce natural colonisation by parasitoids and predators, thus biological control based on the conservation of beneficials may be hampered. Nets also reduce greenhouse ventilation, so measures to encourage air movement have to be implemented.



A screened greenhouse with double-door to prevent entry of *Tuta absoluta*. © A. Antón, IRTA, Spain.

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2. Management of plant material. Use transplants free of pests. When the pest damage is low it is important to remove any leaves, stems and fruits affected by the presence of larvae or pupae and place them in plastic bags. Remove weeds that may be host to the pest. Do not leave infested plant material (from pruning or weeding) on the ground, as the larvae will quickly leave them and colonise new plants. Keep this material in closed containers until destroyed.



To prevent population build up, it is important that infested material is not left on the soil as the larvae will quickly colonise new plants. © J. Arnó, IRTA, Spain.

3. After harvesting destroy crop residues as soon as possible. They should be buried or covered with transparent plastic film to ferment them. Soil solarisation may be useful in warm climates to kill pupae that remain in the soil. Leave a minimum of six weeks between successive susceptible crops.

Biological control

1. Predators. Predatory bugs such as *Macrolophus pygmaeus* (commercially available as *Macrolophus caliginosus*) and *Nesidiocoris tenuis* have been identified as the most promising natural enemies of *T. absoluta* in Europe as they are large consumers of eggs

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of the pest. In the Mediterranean production areas, these two species naturally colonise tomato crops not sprayed with broad spectrum insecticides and they are also released for biological control in greenhouse tomato crops. Other identified predators of *T. absoluta* are the mirid *Dicyphus maroccanus*, the nabid *Nabis pseudoferus ibericus* and the two phytoseid species *Amblyseius swirskii* and *Amblyseius cucumeris* (these two mites in aubergine (eggplant)).



Nesidiocoris tenuis (left) and *Macrolophus pygmaeus* (commercially labelled as *Macrolophus caliginosus*) (right). © J. Roig, IRTA, Spain.

2. **Parasitoids** are the most widely used natural enemies of *T. absoluta* in South America, where the pest originates. In Europe, parasitoids have been found parasitising *T. absoluta* larvae in the Mediterranean area. At least two species of *Necremnus* have been identified in Spain and Italy. *Stenomesus* spp. and other undetermined species (mainly Braconidae) occur spontaneously in infested tomato plots in Spain, indicating that native parasitoids are adapting to the new host. Regarding parasitoids of *T. absoluta* eggs, *Trichogramma acheae* has been identified as a potential biological control agent of the pest and is currently being released in commercial tomato greenhouses.



Stenomesus sp. is one of the larval parasitoids of *Tuta absoluta*. © A. Mussoli, IRTA, Spain.

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3. Entomopathogens: the effectiveness of entomopathogens against *T. absoluta* is poorly documented, with the exception of *Bacillus thuringiensis* var. *kurstaki*, which has been used extensively to control the pest in crops where IPM programmes based on biological control are applied. In addition, the entomopathogenic nematodes *Steinernema carpocapsae*, *Steinernema feltiae* and *Heterorhabditis bacteriophora* have proved to be capable of infecting late larval instars of *T. absoluta*.

Insecticides

Chemical control is difficult because the larvae live inside leaves, fruits and stems. In addition, pests such as *T. absoluta*, with a high reproductive capacity and very short generations, have an increased risk of developing resistance. It is therefore crucial to avoid systematic applications, and only apply treatments according to pest population density and crop damage following the recommendations of advisers. It is also essential to alternate the use of active substances with different modes of action (chemical group).

To control the pest effectively it is critical to combine all the control measures available and not to rely only on insecticide sprays. It is very important to pay attention to the side effects of pesticides on natural enemies, especially predatory bugs. As these individuals often have a slow establishment process, the insecticide should be selected carefully, especially in the early growth stages of the crop.



At least two species of the larval parasitoid *Necremnus* have been identified in Spain and Italy. Top is a male *Necremnus artynes* and below it is a female. © A. Mussoll, IRTA, Spain.

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Summary

The South American tomato leafminer, *Tuta absoluta*, is a micro lepidopteran moth recently introduced in Europe. It has a high reproductive potential. Its main host is tomato, but it also infests other Solanaceae crops. Tomato plants can be attacked from seedlings through to mature plants and in severely infested tomato crops it may cause yield losses of up to 100%. The main damage is produced on the leaves and on the fruits. The larvae of *T. absoluta* feed on the mesophyll of the leaf producing galleries and can also penetrate the fruit and stems. To avoid potential damage it is very important to detect symptoms early and especially the eggs or small galleries. To control the pest effectively it is critical to combine all available control measures including cultural methods, biological control agents and the correct use of registered pesticides.

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About ENDURE

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- > Developing a holistic approach to sustainable pest management
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