COLEACP PIP

New pests and invasive diseases

Tuta absoluta (Meyrick)

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An invasive pest of vegetables for Sub-Saharan Africa

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FOR SUSTAINABLE DEVELOPMENT OF
THE ACP HORTICULTURAL INDUSTRY

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PIP
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Tuta absoluta (Meyrick): an invasive pest of vegetables for Sub-Saharan Africa

Description of the pest

T. absoluta is a nocturnal Lepidoptera insect of the Gelechiidae family that originated in South America. The adults are 6-7 mm long with a wingspan of about 8 to 10 mm. They are silvery grey to brown, with brown to black scales on the forewings (Photo 1). The males are slightly darker and smaller than the females. The antennae are filiform and measure 5/6 of the wings. The eggs – about 1 mm – are cylindrical, and cream to yellowish in colour (Photos 2 and 3). The caterpillars are cream (1st stage) before turning greenish and pinkish in the final stage (2nd and 4th stages). They measure 0.6 to 0.8 mm in the 1st stage and up to 7.3 to 8 mm in the 4th stage (Photos 4 and 5). *T. absoluta* caterpillars feature two narrow black bands on their heads, one lateral and one ventral. The chrysalis (4 to 5 mm) is initially green before gradually turning brown (Photo 6).

Adult of Tuta absoluta

Eggs of T. absoluta in a tomato leaf (microscope view)

Eggs of T. absoluta on a tomato leaf

Lateral view of a caterpilar of T. absoluta

Dorsal view of a caterpilar of T. absoluta

Chrysalis of T. absoluta

T. absoluta adults are normally nocturnal and usually hide under the leaves of the plant during the day. The adults can be seen early in the morning flying through the tomato foliage. Studies in Chile show that the adults are most active between 7 a.m. and 11 a.m.

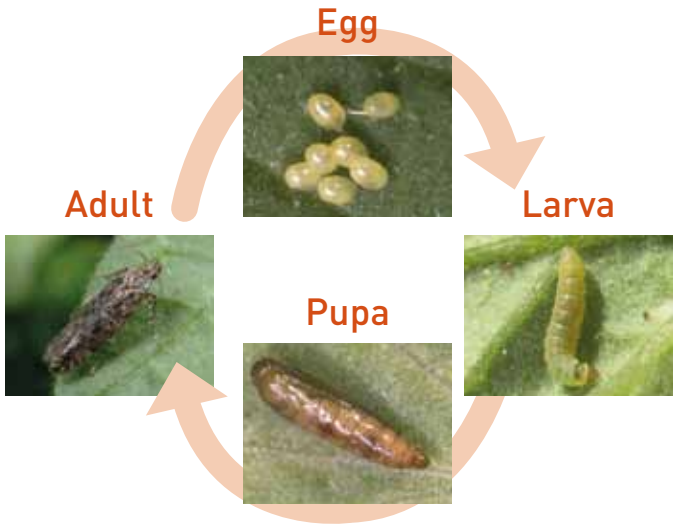
Tuta absoluta can be confused with closely-related species of agronomic interest belonging to the Gelechiidae family that have Solanaceae as host plants:

1. *Tecia solanivora* (Povolny) is a major potato pest *(Solanum tuberosum). T. solanivora* is not present on the African continent at present, but was reported in the Canary Islands in 1999.
2. The potato tuber moth *Phthorimaea operculella* (Zeller) originated in America. The species is found around the Mediterranean basin, in South Africa and in West Africa. The best way of distinguishing between this species and *T. absoluta* is a much wider black band on the pronotum of the caterpillars. The legs are also black.

Biological cycle

T. absoluta has a particularly high reproduction rate. Its life cycle has four development stages: egg, caterpillar, chrysalis and adult (Figure 1). The adults lay 40 to 250 eggs, mainly on the underside of the leaves or on young tender shoots and sepals of unripe fruit. The females lay their eggs individually during the night on the upper third of the plant.

Figure 1 : Biological cycle of T. absoluta



Depending on the ambient temperature, hatching occurs four to six days after laying. Four larva stages then succeed each other. The caterpillars from the first stage penetrate the tissue of the leaves, stems and flowers, and dig mines in them. The second stage caterpillars leave their mines often, and can then attack the fruit. Outside their mines, the caterpillars move quickly using silk threads to colonise other parts of the plant, or other plants. Once they have developed fully, the caterpillars pupate either inside the mines, or on the plant, or in the ground. When the chrysalis does not form in the ground, the caterpillar makes a cocoon. Pupation lasts ten to twelve days in temperatures close to 25°C. At 25°C, the approximate lifetime of the adults is six to seven days for the males and ten to fifteen days for the females.

The length of the *T. absoluta* cycle varies according to the temperature: at 14°C, it lasts 76 days, and 24 days at 27.1°C. In the conditions of the Mediterranean basin, there can be up to ten to twelve generations a year. In Sub-Saharan Africa, it could develop at any season. There is no information on the ability of this species to go into diapause in unfavourable conditions such as drought or the high temperatures found in the Sahelian region.

Geographical distribution

The geographical distribution is available on the site http://www.tutaabsoluta.com/ . The pest is reported in the following ACP countries: Senegal, Sudan and Niger (Sub-Saharan Africa). For further information, visit the site http://archives.eppo.int/MEETINGS/2011_conferences/tuta_absoluta.htm and http://www.aphis.usda.gov/import_export/plants/manuals/emergency/downloads/Tuta-absoluta.pdf.

Description of damage

On tomatoes, the *T. absoluta* caterpillars can attack all the plant's organs during the largest part of the tomato cycle (Figure 2).

The females prefer to lay their eggs on the leaves (73%), then on the stems (21%), sepals (5%) or the green fruit (1%). The first damage by *T. absoluta* is located preferentially on the young parts of plants: leaf apex, young fruit and flower. The destruction of the plant's buds results in deformations to its architecture. As they develop, the caterpillars perforate the various organs, digging clearly visible mines.

Figure 2. Tomato cycla and favorable stages to *T. absoluta*

Cycle of a tomato plant	Number of days after sowing (Sénégal)	Possible presence of *Tuta absoluta*
Seeds		
Sowing	0	
Nursery		
Transplantation	+ 30 days	Stages very favorable to the pest
Flowering	+ 50-55 days	
Fruit set	+ 55-60 days	
Start of fructification		
First harvesting	+ 85-95 days	
Full harvesting		Favorable stage
End of harvesting	+120 – 150 days	

The larvae only devour the parenchyma of leaves, leaving the epidermis aside; the attack features the presence of irregular and discoloured patterns. The attacked leaflets subsequently dry out entirely. The mines in the leaves form whitish, irregular spots covered with droppings. They gradually become brown and necrotic (Photos 7 and 8). Severely-attacked leaves can dry out entirely (Photo 9). If the damage is severe, the caterpillars can eat all the foliar tissue, leaving behind large quantities of black droppings.

Caterpillar damages on tomato leaves

Caterpillars damages on a tomato leaflet, whitish spot becoming brown

Severe damages due to T. absoluta on a tomato plant

On stems, flowers or peduncles, the nutrition and activity of the larva disrupt the development of the organs and can cause the flowers or young fruit to drop. Mines can appear in the young stems, thereby disrupting plant development

Damages of T. absoluta on a tomato fruit: holes and droppings

In fruit, the tomatoes show necroses on the calyx and exit holes on the surface of the integument (Photo 10). The fruit are perforated by mines which are colonised rapidly by secondary pathogens that cause general rotting and loss of the fruit. The fruit are attacked as soon as they form, right up to maturity, but there have been no signs of eggs being laid on ripe tomatoes. One larva can damage several fruit on a single cluster.

Sometimes the caterpillars use the silk produced by the salivary glands to weave silk shelters or enclose shoots, peduncles or young leaves.

It is important not to confuse the damage by Agromyzidae leaf-miner flies (serpentine leaf mines) with the damage created by *T. absoluta*. Its mines in leaves are wider than those of leaf miners which never create wide patterns that necrose then dry out.

Host plants

The tomato *(Lycopersicon esculentum)* is the main host plant for *T. absoluta*. This Lepidoptera is considered as one of the main tomato pests in several South American countries and can cause losses of up to 80% to 100%, both in open field and glasshouse production.

The species attacks other species of cultivated Solanaceae: potatoes *(Solanum tuberosum)*, eggplants *(Solanum melongena)*, pepino dulce *(Solanum muricatum)*, peppers *(Capsicum spp.)* and wild Solanaceae such as *Lycopersicon hirsutum, Solanum americanum, S. elaeagnifolium, S. hirtum, S. lyratum, S. nigrum, S. puberulum, Physalis angulata, Datura stramonium, D. ferox and Nicotiana glauca,* etc. Since becoming established in Europe, *T. absoluta* has also occasionally been found on several species of plants, such as the Cape gooseberry *(Physalis peruviana),* green beans *(Phaseolus vulgaris), Lycium sp.* and *Malva sp.*

In Sub-Saharan Africa, it is possible that *T. absoluta* attacks not just the cultivated Solanaceae but also local species of the genus *Solanum,* such as African eggplants *(S. aethiopicum, Kumba and Gilo group, S. anguivi, S. americanum, S. macrocarpon, S. scabrum and S. villosum)* (Photo 11).

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T. absoluta coulddamage local Solanum species, like S. aethiopicum (Djakatou) and S. macrocarpon

Monitoring methods

Monitoring involves visual inspections of seedlings in nurseries, seedlings when being transplanted, crops, packaging material and also installing traps to catch adults.

Visual inspection of the packaging material

One hypothesis on how *T. absoluta* arrives in Europe is that the pest is introduced as a chrysalis in the packaging material for harvested fruit. If the presence of *T. absoluta* is suspected, it is recommended to destroy or disinfect this material.

Visual inspection of seedlings and sampling in the field

This takes place through frequent inspection of potential hosts of *T. absoluta* in and around the field to look for signs of adults, therefore underneath the leaves. Special attention will be paid to the upper third of the seedling, a favoured spot for *T. absoluta* attacks. Random samples from several seedlings will be taken in the plot to detect the presence of eggs, mines or mobile stages. Samples can also be taken in an insect net by several sweeps in each field. It is also essential to inspect new seedlings meticulously before they are transplanted into the field or under shelter. Under shelter, look carefully at the upper sections of door frames and window frames. If the rooms are not well sealed, these are the preferred entry route for adults into the shelter.

Pheromone traps


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Delta trap for catching of T. absoluta adults, a pheromone dispenser is suspended inside the trap

Natural pheromones for *T. absoluta* have been identified. Synthetic pheromones can be used to entice adults into the traps. These products are currently sold by specialised companies like Russell IPM, BIOBEST, KOPPERT BV, Internatinal Pheromone Systems (IPS) and PRI PHEROBANK. Various types of trap can be used: Delta traps, water bowl traps, McPhail traps and ‘box’ traps. Delta traps are triangular (28 x 20 x 15 cm) and contain a pheromone capsule and a sticky plate to which the males adhere (Photo 12). The water bowl traps are round containers (30 cm in diameter) containing 3.5 litres of water and a few drops of vegetable oil or soap, with the pheromone hanging above the container (Photo 13). The McPhail traps are closed containers with an entrance in the

Bowl trap Ferrolite with water, to attract and kill T. absoluta adults with light and pheromone.

bottom; they are filled with water and a little soap and the pheromone device. Lastly, the 'box' traps consist of a closed plastic container 21 cm high and 17 cm wide, in different colours and with one or two small entrances on the sides. The insecticide and the pheromone are placed inside these containers, normally in a small capsule hanging from the top of the box. 'Box' traps are ideal for dusty environments and/or where temperatures are very high.

It is advisable to install one trap for a plot of less than 3,500 m2 and two traps for larger plots. The Delta, McPhail and 'box' traps are installed off the ground at the same height as the crop (30 to 60 cm maximum above the plants) and near the entrance to the glasshouse crop. The bowl traps are placed at the bottom of the plants, preferably in crops under shelter. They remain in place for the entire cultivation season. The traps are collected every month. The adults thus gathered are counted and observed. These observations are used to monitor the populations after the treatments and the release of biological control agents. The traps may have to be changed more often if infestation levels are high.

Light traps

The *T. absoluta* adults are strongly attracted to light. The Ferolite trap uses a combination of light with a specific wavelength and the sexual pheromone of the insect to attract and catch the adults.

Determination

If there are any suspicions, the species can only be determined from an adult. The sample must be sent to a specialist entomologist or a laboratory, for example:

- La Clinique des plantes (Plant clinic): http://www.cliniquedesplantes.be/
- British Museum : http://www.nhm.ac.uk/about-us/contact-enquiries/identification-and-general-science-enquiries/index.html
- Anses, Laboratoire de santé des Végétaux, Unité d'Entomologie, Montpellier, CBGP, CS 30016 F-34988 Montferrier-sur-Lez Cedex: http://www1.montpellier.inra.fr/CBGP/

Control methods

During cultivation (in the field, under shelter or in a nursery):

Observe the plants regularly in the field (detection of eggs, mines, larvae or droppings), particularly the underside of fruit and calyces. Remove the affected leaves, stems and fruit and burn them rapidly. Remove the leaves regularly from infested plants and eliminate them. Plug the openings in glasshouses and tunnels with insect-proof netting. Install double doors and fine netting (with mesh <1.6 mm).
Destroy the crop residues or dig them more than 50 cm into the ground along with all plant matter. Harvesting machines and ploughs should be cleaned after use in the infested fields. In a nursery, it is recommended to disinfect the ground.
In the event of major infestations, halt the production of Solanaceae (and the elimination of alternative hosts) in the region in question for at least five to six weeks.

Install pheromone traps to reduce the population present.

Use of Plant Protection Products

Insecticides will be applied taking into account counting in the pheromone traps. When more than thirty *T. absoluta* adults are caught in the plot in one week, chemical control should be applied every ten days. If no trap is installed in the plot, the insecticide treatments will commence when one plant in five has a living larva.

The choice of pesticides depends on country regulations. Several insecticides approved by the Sahel Pesticides Committee (June 2012 version) on vegetables are used against *T. absoluta* in certain countries (Brazil, Malta, France, Spain and United States) and have proved fairly effective: abamectin, indoxacarb and spinosad.
Imidacloprid, chlorfenapyr, emamectin benzoate and *Bacillus thuringiensis* are also effective substances.
Their effectiveness in the conditions of Sub-Saharan Africa requires checking.

Biological control

T. absoluta has a number of natural enemies that can be used in biological control:

- Hemiptera predators, Nesidiocoris *tenuis* Reuter and *Macrolophus pygmaeus* Rambur (Miridae) (Photo 14), *Podisus nigrispinus* Dallas (Pentatomidae);
- the parasitic Hymenoptera: *Dineulophus phthorimaeae* De Santis (Eulophidae), *Pseudoapanteles dignus* Muesebeck, *Trichogramma achaea* Nagaraja & Nagarkatii, *Trichogramma pretiosum* Westwood (exotic) and *Trichogramma spp.* (Trichogrammatidae);
- mites like *Amblyseius swirskii* Athias-Henriot and *A. cucumeris* (Oudemans).

Mirid Macrolophus sp., a predatory insect eating eggs of T. absoluta.

Points to be monitored

Packaging of tomatoes and imported fruit from areas where there is proof of the presence of Tuta absoluta.
The seedlings used to install a crop.
In the shelters: on the door frames and window frames.
On the plants: the upper parts of the plants.

New pests and invasive diseases

1 Mango bacterial disease

2 Tuta absoluta (Meyrick)

3 Papaya mealybug

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