

Tuta absoluta

Biology, Damage and Control, a South African Perspective



Background

- *Tuta absoluta* is one of the most destructive pests of tomato
 - It originated in South America
 - Europe: First reported in 2006
 - South Africa: First reported in 2016
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- Latin name: *Tuta absoluta*
 - Common name: Tomato leafminer
 - Because of the easy pronunciation, the pest is mostly known as *Tuta absoluta*

Host plants

Hosts for *Tuta absoluta* mainly include plants in the potato family Solanaceae

Main host

Tomato

Other crops as hosts

Potato*, eggplant, *Capsicum*, tobacco** and Cape gooseberry

Additional hosts

Many weed species, mostly solanaceous weeds, are hosts for *Tuta absoluta*. Rare or doubtful hosts include; bean, cabbage, mallow and others.

*foliage only (research is currently being conducted for verification)

**to be confirmed

Tuta absoluta: summary of life cycle

Eggs

- Laid on foliage or fruit (usually singly, but also in groups of 2-5)
- 4-5 days to hatch (slower under cool conditions)

Larvae

- Light in colour when young – becoming greenish
- Feed inside leaves, stems or fruit
- Duration approximately 8-14 days (slower under cool conditions)
- Fourth instar exits from feeding locations to pupate

Tuta absoluta: summary of life cycle

Pupae

- Pupae are formed inside strong silken cocoons, constructed by the fourth instar
- Cocoons are constructed mostly at soil level, but also in leaf mines and folded foliage
- Cocoons are mostly hidden or camouflaged by foliage or sand/dirt particles
- Duration approximately 7-10 days (slower under cool conditions)

Moths

- Active at night
- Lay up to 260 eggs (most eggs are laid within the first week)
- Live for approximately one to two weeks in summer (longer in cool environments)

Complete life cycle

- As short as three weeks in summer – much longer in cool environments

Leafminers that attack solanaceous crops

(note: limitless variations of damage symptoms may be encountered)



Potato tuber moth

Tuta absoluta

Potato leafminer

American leafminer

Tuta absoluta

Tomato leafminer

Phthorimaea operculella

Potato tuber moth

Differences

Average size

The most prominent difference

Tuta

Tuber moth

6 mm

8 mm

Antennae

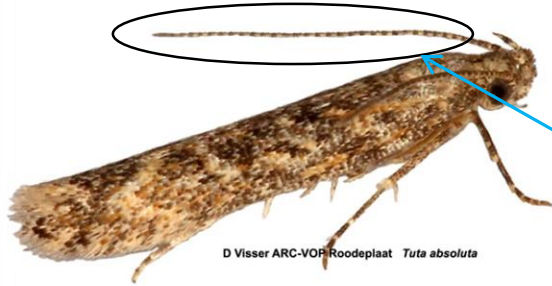
More clearly banded
in *Tuta*

Marks on wings

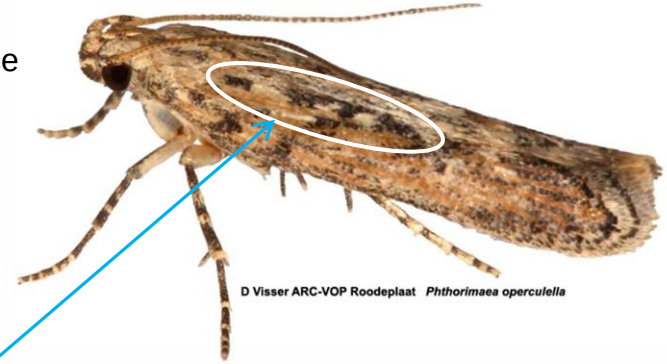
Black marks more
pronounced and clear in
tuber moth

Marks on thorax

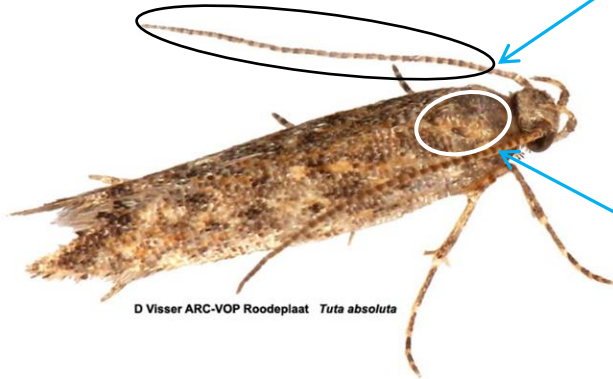
Three stripes in tuber
moth, none in *Tuta*



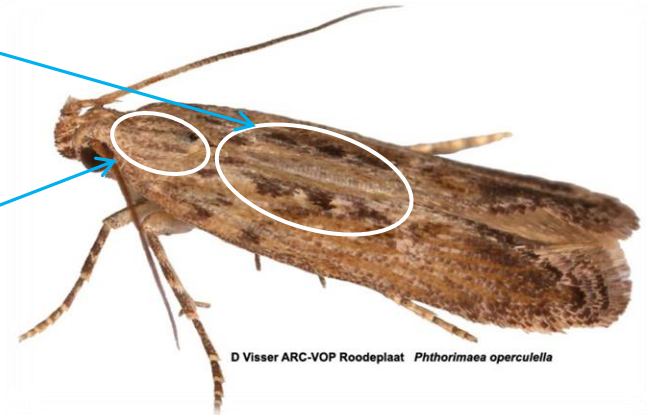
D Visser ARC-VOP Roodeplaat *Tuta absoluta*



D Visser ARC-VOP Roodeplaat *Phthorimaea operculella*



D Visser ARC-VOP Roodeplaat *Tuta absoluta*



D Visser ARC-VOP Roodeplaat *Phthorimaea operculella*

For final and conclusive identifications, analyses of the genital structures of the male moths are necessary.

Adult moths



D Visser ARC-VOP Roodeplaat *Tuta absoluta*

Tuta absoluta

Tomato leafminer

A micro-moth in the family Gelechiidae

Length: 6 mm

Colour: mottled grey/brown

Antennae: long, filiform & banded



D Visser ARC-VOP Roodeplaat *Phthorimaea operculella*

Phthorimaea operculella

Potato tuber moth

A micro-moth in the family Gelechiidae

Length: 8 mm

Colour: mottled brown with black marks on wings

Antennae: long, filiform & banded

Fully grown larvae



Tuta absoluta D Visser ARC-VOP Roodeplaat

Tuta absoluta

Tomato leafminer

Length: 8 mm
Abdomen colour: greenish
Prothoracic shield: green with black line
Second thoracic segment: greenish



Phthorimaea operculella D Visser ARC-VOP Roodeplaat

Phthorimaea operculella

Potato tuber moth

Length: 10 mm
Body colour: greenish brown to pinkish
Prothoracic shield: dark brown to black
Second thoracic segment: pinkish

Tuta absoluta

colour forms of the larvae

The normal colour of larvae is greenish (top left photo).

When larvae shed their skins (three times), their body colour changes to whitish for a few hours. The middle photograph shows a larva shedding its skin, with the old skin compressed and still attached at its rear.

When larvae are mature, most exit their mines to search for pupation locations. They are then usually fattish and pinkish in colour (bottom photo).



Tuta absoluta pupae



Length of pupa: 5 mm

Colour of pupa: Green or light brown, becoming darker to black with age.

Pupation locations: Mostly on the ground, and then inside a strong silken cocoon, impregnated with sand particles (right photo; a pre-pupa). Other locations include leaf folds (left photo), and between leaves, then using a silky lining to seal off openings before pupation. Pupation can take place anywhere, including in stores, packing material and containers.

Tuta absoluta leaf mines



Larvae feed between the upper and lower leaf surfaces, thereby causing “leaf mines”.

Leaf mines may be formed on any part of any leaf; larvae may also mine into growth points and stems.

Mature mines are “blotched leaf mines”, large and blister-like, mostly with short finger-shaped extensions.

Larvae and excrement may be noticed when holding a leaf mine against the light (right photo).



D Visser ARC-VOP Rooideplaat *Tuta absoluta* leaf mine



D Visser ARC-VOP Rooideplaat *Tuta absoluta* leaf mine



D Visser ARC-VOP Rooideplaat *Tuta absoluta* leaf mine



D Visser ARC-VOP Rooideplaat *Tuta absoluta* leaf mine

Tuta absoluta leaf mines vary considerably, and may easily be confused with tuber moth mines. Not all mines exhibit clear finger-shaped extensions, e.g. photo top left. Leaf mines may be formed between two leaves, or individual leaves may be folded, with a mine in the fold. A large proportion of mines will be empty, most larvae exit mines to pupate, usually in the soil.



Damage to tomato plants

Tuta absoluta damages plants predominantly by feeding inside leaves (top left photo).

When population levels are high, leaf mines may merge, causing entire leaves and sometimes stems to die off. Most of the foliage may be destroyed in such cases, and large portions of plants may die off (left lower photo).

Larvae may move from one infested leaf to another, especially when leaves become chlorotic due to many larvae feeding together.

Young plantings may completely be destroyed while older plantings may suffer yield losses of 80 – 100%.

Damage to foliage is the primary cause of economic losses when larval numbers are high, but fruit may also be attacked (see next slide).



Fruit damage



- Larvae often move from leaves to fruit, although some eggs may be laid on fruit and/or its calyx.
- Entry holes may be found anywhere on the fruit (left photo), but often under or near the calyx (photos middle and right).
- Excreta are often found extruding from entry holes.
- Larvae may enter the fruit up to 1,5 cm deep under the peel.
- Entry holes act as secondary pathways for pathogens that may rot fruit quickly.

Control

Control is mainly with insecticides (see next slide for a list).

No “small-pack” insecticides are currently available (for home and small gardeners).

The following aspects of IPM will play important roles in effective control:

- use of registered insecticides
- resistance management
- sanitation
- crop rotation
- monitoring
- natural enemies (biological control)

These aspects will be discussed below.

***Tuta absoluta* insecticides and pheromones**

The following insecticides have emergency registrations in South Africa, December 2016 (Registrar of Act 36 of 1947)

<u>Product name</u>	<u>Active ingredient</u>	<u>Crops</u>	<u>IRAC group</u>
1. Coragen	Chlorantraniliprole	Tomatoes, potatoes, eggplant	28
2. Prevathon	Chlorantraniliprole	Tomatoes, potatoes	28
3. Belt	Flubendiamide	Tomatoes, potatoes, tobacco	28
4. Ampligo	Lambda-cyhalothrin & Chlorantraniliprole	Tomatoes, potatoes, eggplant, capsicums, tobacco	28 and 3
5. RB Hook Tuta	<i>T. absoluta</i> pheromone & Cypermethrin	Attractant & pyrethroid on import permit	3
6. Tracer	Spinosad	Tomatoes, potatoes, cabbage, cucurbits, spinach, lettuce	5
7. Delegate	Spinetoram	Tomatoes, potatoes	5
8. Steward	Indoxacarb	Tomatoes, peppers, eggplant	22
9. Denim Fit	Emamectin benzoate & Lufenuron	Tomatoes, eggplant, tobacco, capsicums	6 and 15
10. Delfin	<i>Bacillus thuringiensis</i>	Tomatoes, potatoes, eggplant, capsicums, tobacco	11
11. Eco BB	<i>Beauveria bassiana</i>	Tomatoes	unclassified
12. RB Splat Tuta	<i>T. absoluta</i> pheromone	Attractant; on import permit	na (no killing action)
13. RB Tuta Lure	<i>T. absoluta</i> pheromone	Attractant; on import permit	na (no killing action)

all group 28

all group 3

all group 5

Preventing resistance against insecticides

There is a high risk that *Tuta absoluta* will develop resistance against insecticides because of:

- short life cycle
- high reproductive capacity
- resistance history
- overuse of the limited number of effective insecticides in the past

For more information on insecticide resistance, see www.irac-online.org
(IRAC = Insecticide Resistance Action Committee)

Actions to prevent resistance include:

- alternate insecticides correctly (see next slide)
- always follow label instructions
- include the principles of integrated pest management in control strategies (IPM - see next slides)

Alternating insecticides to prevent resistance

Concept

- Some insecticides kill insects with the same “mode of action” (MoA).
- IRAC classifies insecticides with the same MoA in specific groups (www.irac-online.org).
- Resistance in insects against an insecticide in a specific group will show cross-resistance against other insecticides in the same group.
- The concept is to kill a target insect with an insecticide in a specific MoA/group when resistance has developed against an insecticide in another MoA/group.

How to alternate

- Determine the IRAC resistance groups for insecticides to be used (see insecticide list).
- Use insecticides that fall into the same IRAC group, in a specific block.
- A block is defined as the same insecticide/group, sprayed a few (2-4) times successively.
- Then remove that insecticide/group from the spraying program for at least 60 days.
- During this time, other insecticides/groups should be used, also in a block.
- If no other insecticides/groups are available, return to the first insecticide/group.
- Do not return to the same insecticide/group within 60 days.
- It is recommended to use an insecticide/group (in a block) only once per season.

Integrated Pest Management (IPM)

Principles of IPM, applicable to *Tuta absoluta*, include the following:

- sanitation
- crop rotation
- monitoring
- the roles of natural enemies (biological control)

Sanitation

Sanitation is defined as the removal, destruction or decontamination of any material/area that may contain living stages of a pest. These may include:

- infested plants, or parts of plants
- residues in harvested fields or greenhouses
- discarded parts of plants or fruit
- solanaceous weeds, including volunteer plants
- previously used greenhouses
- used containers



Crop rotation and monitoring

Crop rotation

In areas with known problems with *Tuta absoluta*, and where more than one crop can be planted, it is recommended to rotate crops with ones that are not known to harbour the pest. Crops that are not affected by *Tuta absoluta* mostly include plants in families other than the Solanaceae.

Monitoring with pheromone traps

- Monitoring enable growers to detect pests long before they, or their damage, become noticeable.
- *Tuta absoluta* pheromone lures (listed in our insecticide list), placed inside Delta traps (right photo), are used to monitor male moths.
- Self-made water pan traps, (soap added), can be used.
- Traps should be placed out before, or as soon as crops are planted (to determine pest pressure).



Biological control

Biological control is defined as the control of one living organism with another living organism. In the insect pest environment, these include:

- predators
- parasitoids
- diseases

All three occur naturally, and some, e.g. the diseases *Beauveria bassiana* (fungus) and *Bacillus thuringiensis* (bacterium), are commercially available in South Africa to control *Tuta absoluta* (see our insecticide list).

Predators are wide feeders, also feeding on other pests, e.g. the Mirid bug feeding on an aphid (right photo). Mirids are known to feed on *Tuta absoluta* eggs, as well as larvae when encountered outside mines.

Parasitoids are usually minute wasps that lay their eggs on, or nearby eggs or larvae of pests. Several parasitoids of the potato tuber moth already occur in South Africa, and may attack *Tuta absoluta* in the field.



Recommendations for small scale farmers and home gardens

In situations where the use of insecticides are problematic (e.g. because of the lack of “small-pack” insecticides), the focus must fall on the following strategies:

- Monitor with pheromone traps two weeks before planting to determine pest pressure. Self-made water pan traps with commercial lures can be used.
- Use plant material without traces of *Tuta absoluta* on them.
- Scout daily for mines on leaves and infested fruit.
- Remove and destroy infested plant material as well as dropped fruit by burying it 50 cm, or deeper (sanitation).
- Remove *Solanum* weeds near the planting area (sanitation).
- Implement sanitation on a weekly basis.
- Implement crop rotation in planting regimes, e.g. tomato, then beans, then cabbage, then sweet potato, then back to tomato, etc.
- If not rotating, leave harvested fields fallow for at least six weeks.
- When spraying is an option, implement IRACs rotation schedule.

Conclusion

Tuta absoluta is known to destroy tomato fields when not treated.

Commercial farmers will have to manage spraying programs carefully.

Several alternative control strategies are available for the control of *Tuta absoluta*.

Small scale farmers and home gardeners may be impacted severely.

Information dissemination about the pest, its damage and control is crucial to prevent catastrophic crop losses in the future.



Tuta absoluta
The tomato leafminer

D Visser ARC-VOP Roodeplaat

Please report any new sightings of *Tuta absoluta* to DAFF

This presentation is an output of the *Tuta absoluta* Task Team of the South African Department of Agriculture, Forestry and Fisheries

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