Tuta absoluta: the tomato leafminer

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Tuta absoluta (Meyrick, 1917

Family: Gelichiidae

Order: Lepidoptera

Class: Insecta

Phylum: Arthropoda

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Tuta absoluta

- Described in 1917 by Meyrick as *Phthorimaea absoluta* from specimens collected in Peru
- *Gnorimoschema absoluta* by Clarke 1962
- *Scorbipalpula absoluta* by Povolny 1974
- *Tuta absoluta* by Povolny in 1994

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Tuta absoluta (Gelichiidae)

Related Pest Species

Tomato pinworm – *Keiferia lycopersicella*

Guatemalan potato tuber moth – *Tecia solanivora*

Potato tuber moth – *Phthorimaea operculella*

Groundnut leafminer- *Aproaerema modecella*

Pink bollworm - *Pectinophora gossypiella*

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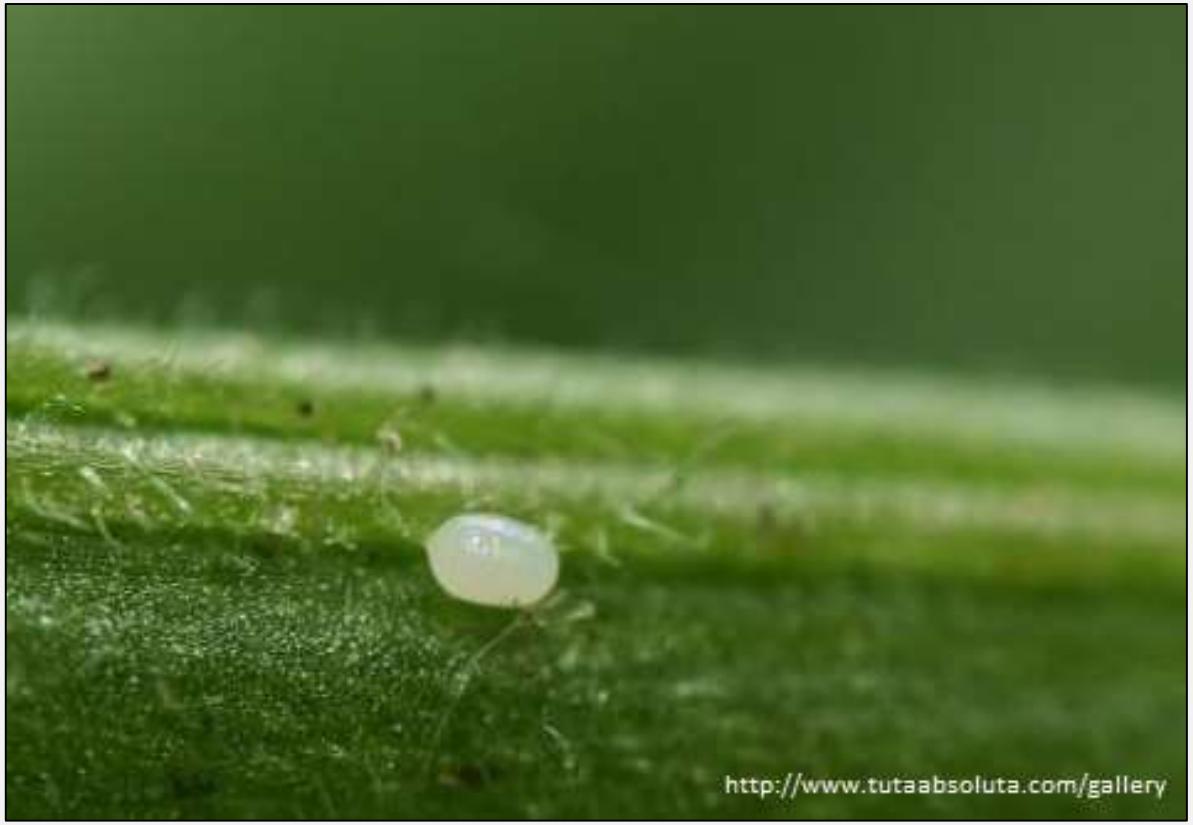
Egg

Duration: 7 days

Eggs are oval-Cylindrical, usually are laid on under side of Leaves, Buds, stems and calyx of unripe fruits



Tuta absoluta - Eggs

- **Oviposition:**
  - **–Leaves -73%**
  - **–Veins and stems - 21%**
  - **–Sepals - 5%**
  - **–Fruits - 1%**

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Larva

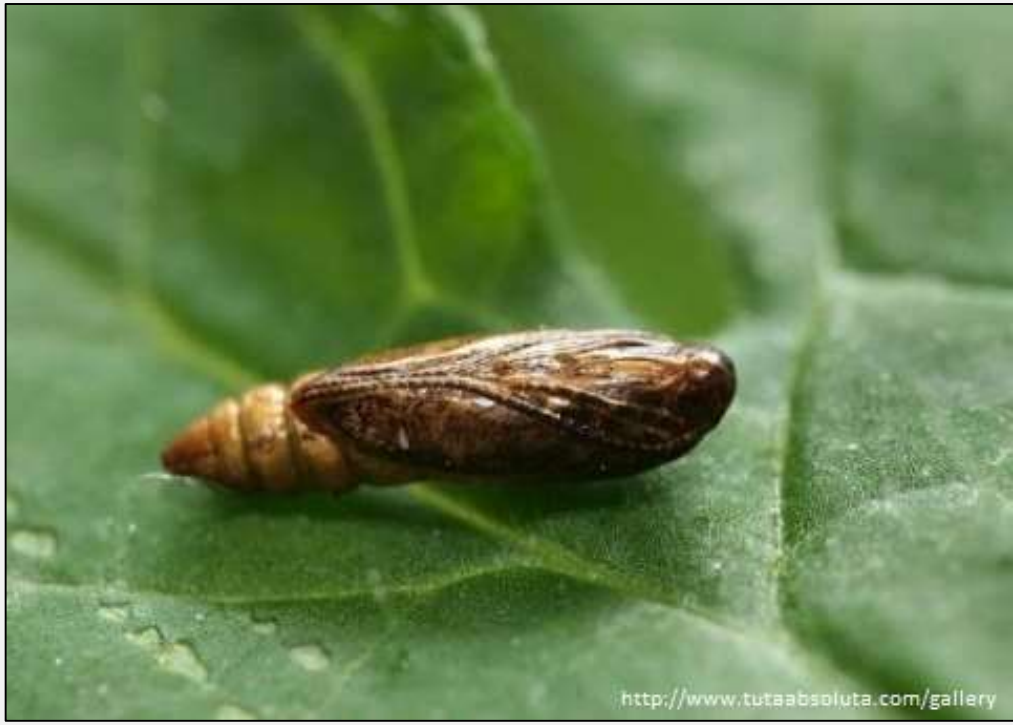
Duration: 8 days

There are 4 instars.
Early instars are
white or Cream with
a black head, later they
turn pink or green.
Fully grown larvae
Drop to the ground
in a silken thread
and pupate in soil

Pupa

Duration: 10 days

Pupae are brown, 6 mm long. Pupation takes place in soil or on plant parts such as dried Leaves and stem.

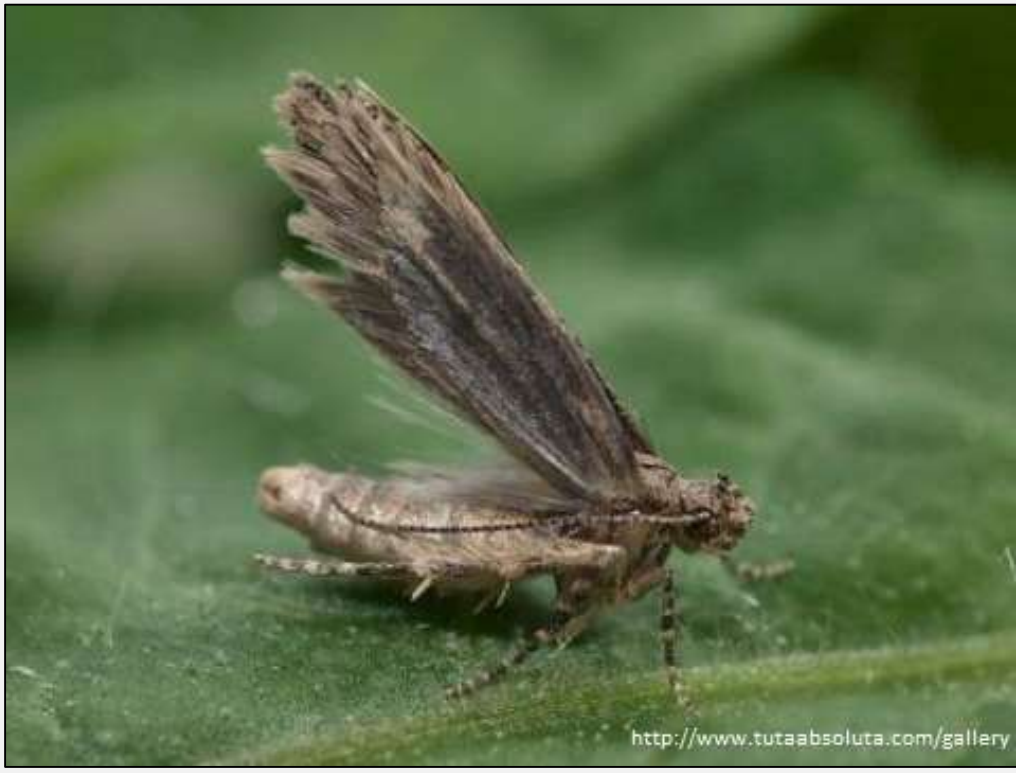


Adult

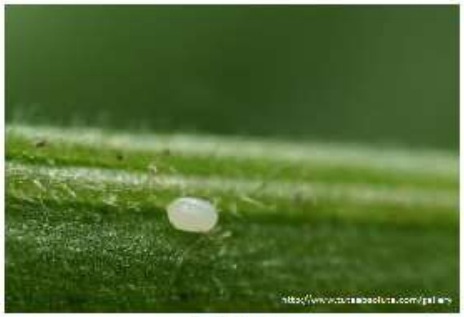
Female lives 10-15 days

Male lives 6-7 days

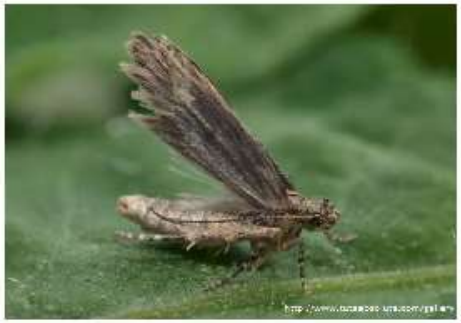
Adult moths are small
Body length 7mm.
They are brown or
Silver color with
Black spots on the wings



The Life Cycle of Tuta absoluta

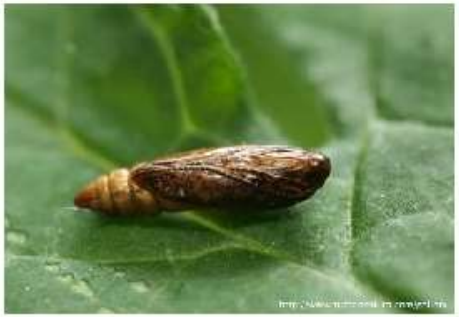


Eggs



Adult

Larvae



Pupa

Tuta absoluta - Life Cycle

- **Duration of life cycle:**
  - **–At 14^{0}C -76 days**
  - **–AT 20^{0}C - 24 days**
  - **–At 27^{0}C - 24 day**

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Tuta absoluta - Life Cycle

- Life cycle: Multivoltine
- Twelve generations in a year
- Average 260 eggs laid by a female
- Larvae mine in the mesophyll of the leaf
- Four larval instars
- Pupates in the soil and sometimes in the leaves
- Prefers tomato but can complete in other solanaceous plants

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Tuta absoluta – Host plants

- ***Solanum lycopersicum*** **(tomato)**
- ***Solanum tuberosum*** **(potato)**
- ***Solanum melongena*** **(eggplant)**
- ***Capsium annuum*** **(pepper)**
- ***Nicotiana tabacum*** **(tobacco)**
- ***Solanum nigrum***
- ***Datura stramonium***
- ***Solanum eleagnifolium***
- ***Physalis peruviana***

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Tuta absoluta – Host plants

- ***Solanum bonariease***
- ***Solanum sisymbriifolium***
- ***Solanum sapponaceum***
- ***Lycopersicum puberulum***
- ***Datura ferox***
- ***Lycium* sp.**
- ***Malva* sp.**

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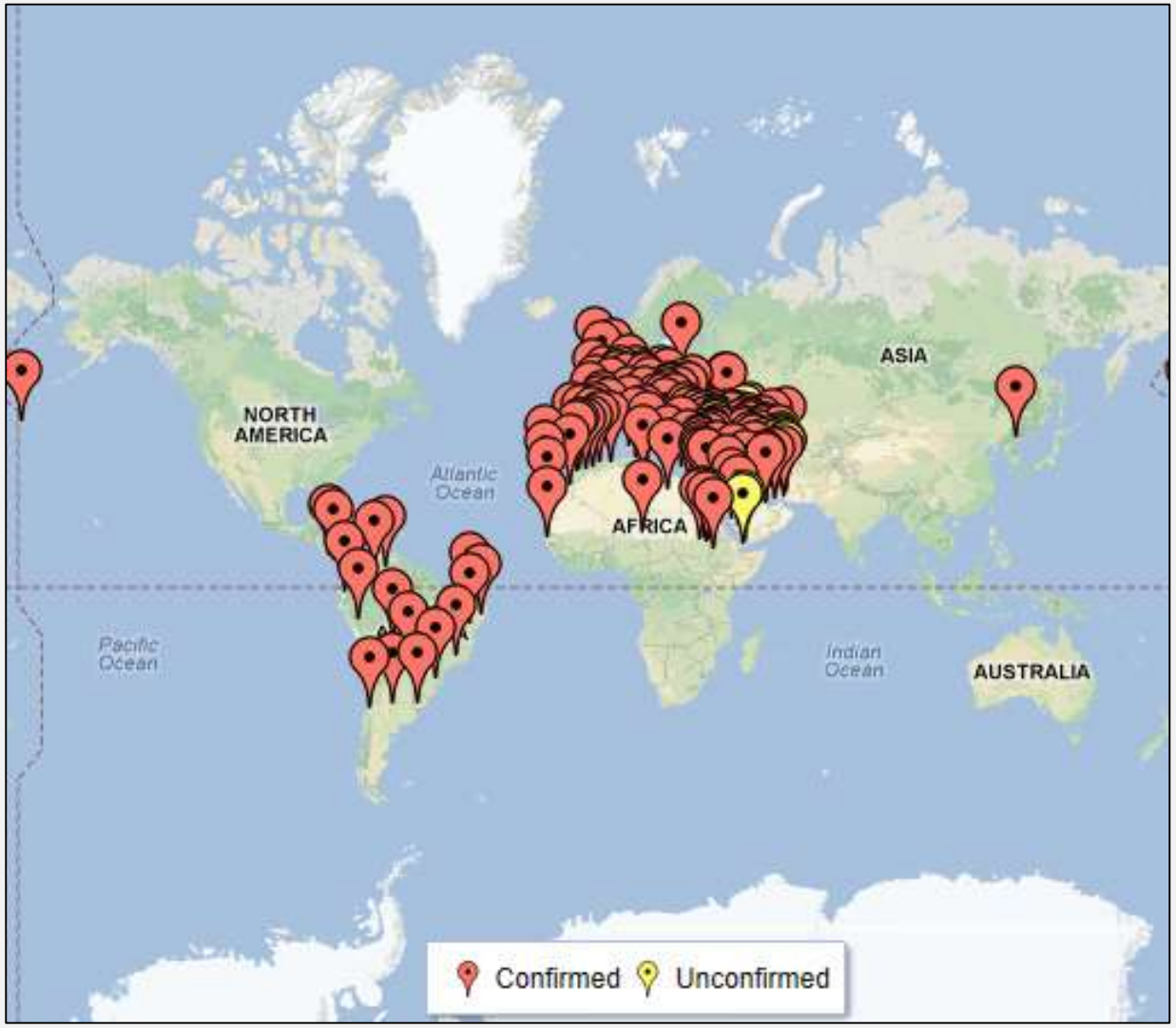
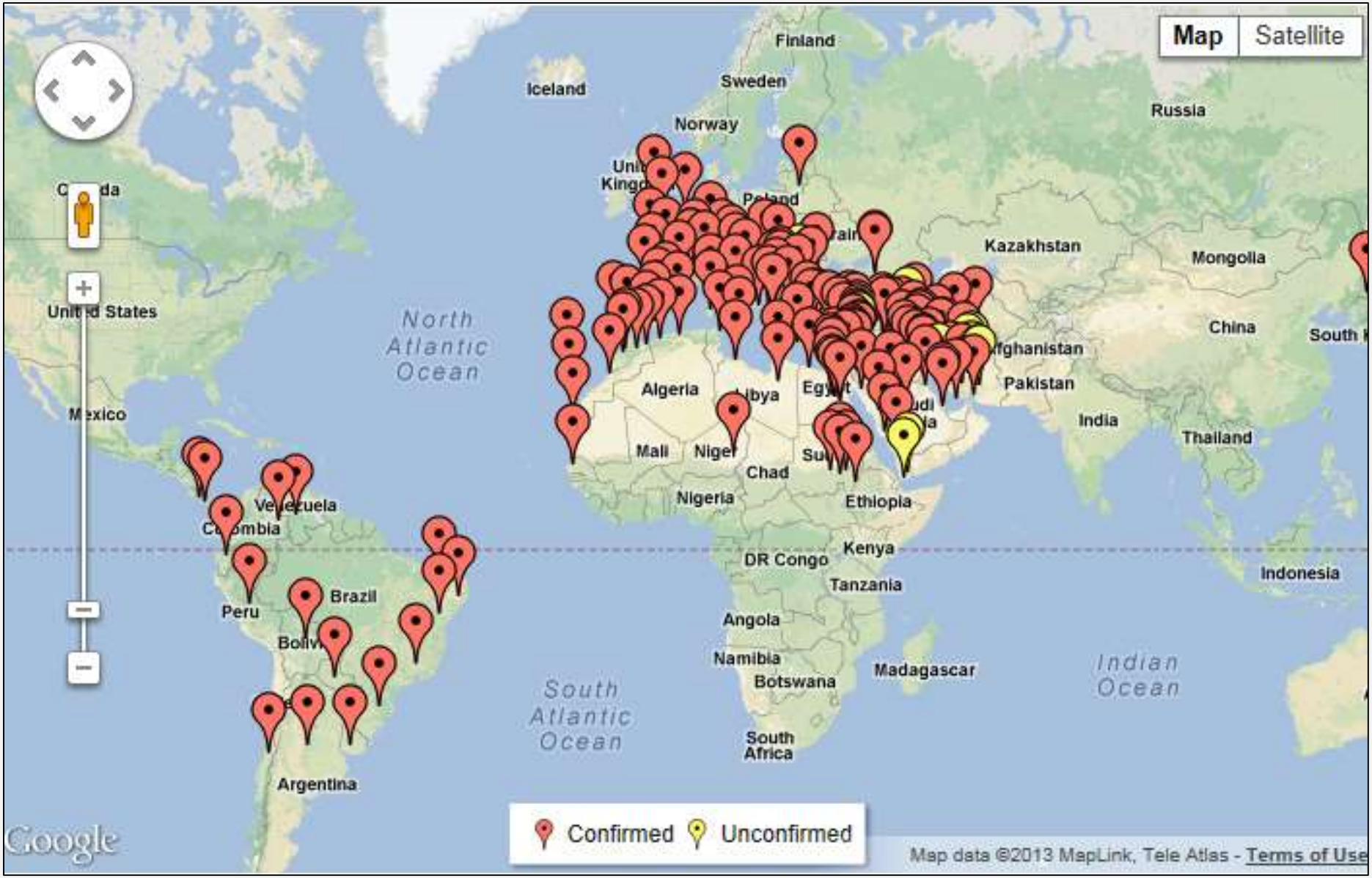
Tuta absoluta Distribution

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North Atlantic Ocean
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Tuta absoluta – Estabishment

- Spain 2006
- Morocco 2007
- Tunisia 2008
- France 2008
- Italy 2008
- Canary Islands 2008
- Algeria 2008

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Tuta absoluta – Estabishment

- Albania 2009
- Bulgaria 2009
- Netherlands 2009
- Portugal 2009
- United Kingdom 2009
- Bulgaria 2010
- Israel 2010
- Hungary 2010
- Turkey 2010
- Serbia 2010

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Tuta absoluta – Estabishment

- **Sudan** **2012**
- **Ethiopia** **2012**
- **Niger** **2012**
- **Senegal** **2012**

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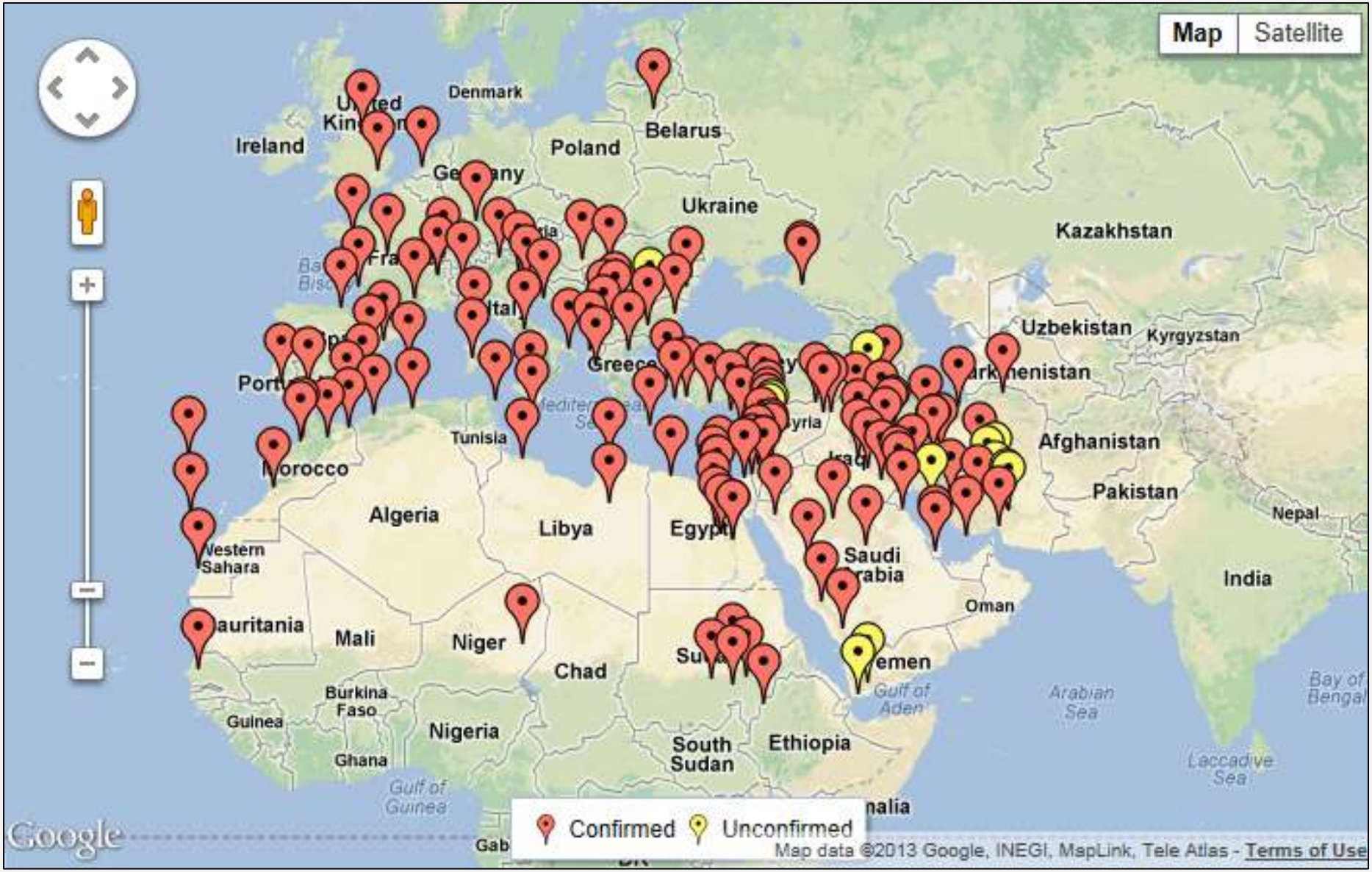
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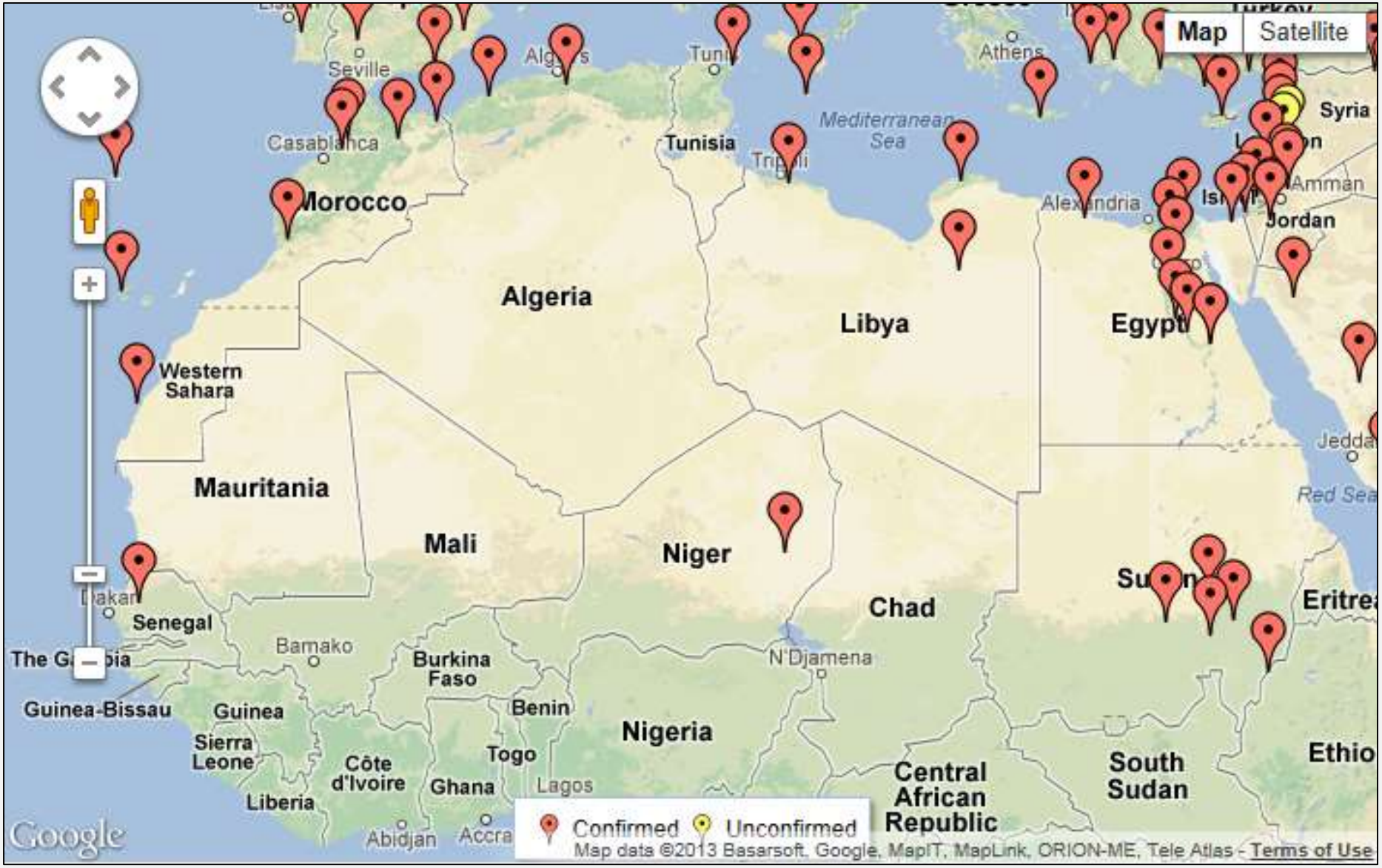
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Dakar
Senegal
Bamako
Burkina Faso
N'Djamena
The Gambia
Guinea-Bissau
Guinea
Sierra Leone
Liberia
Côte d'Ivoire
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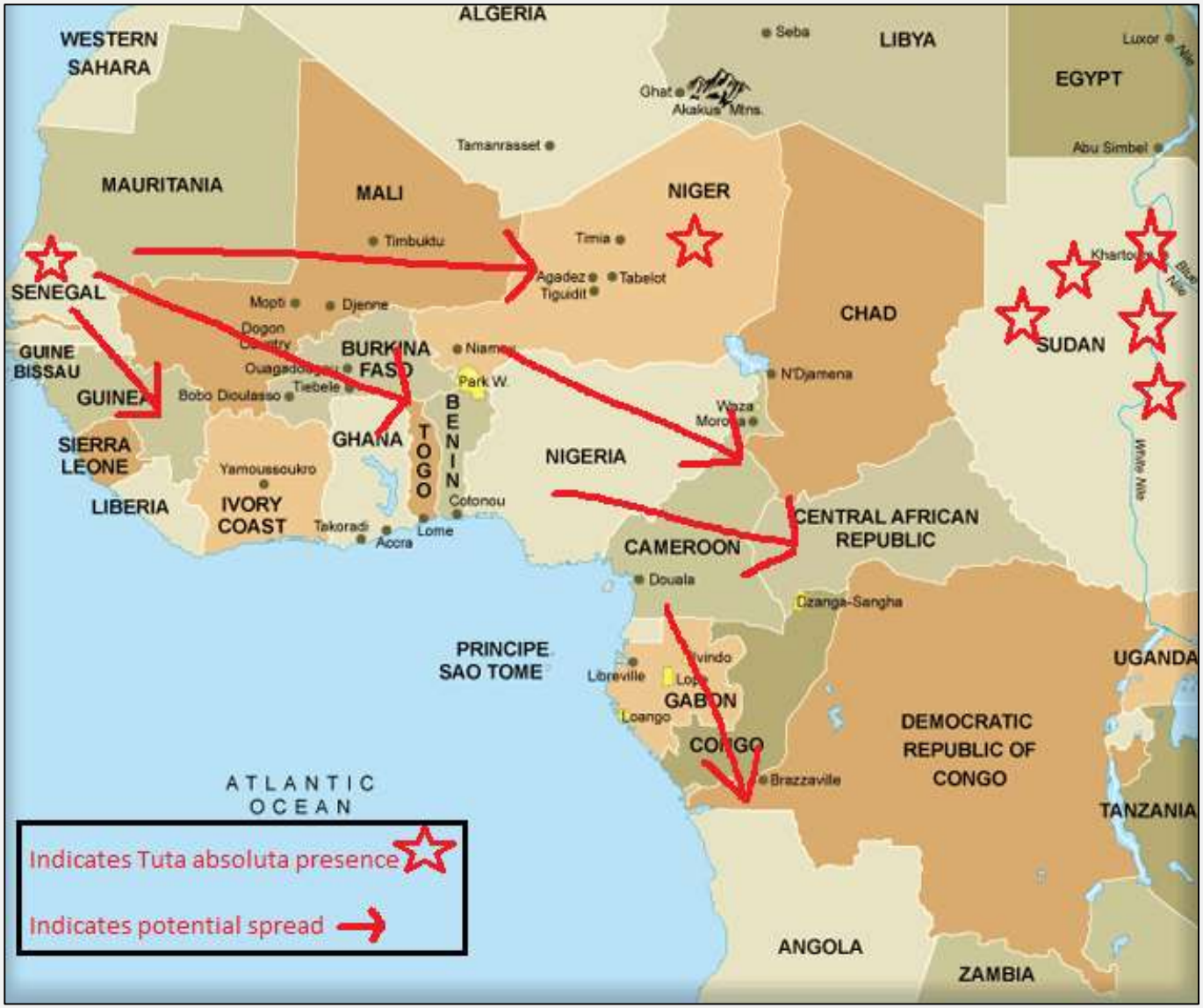
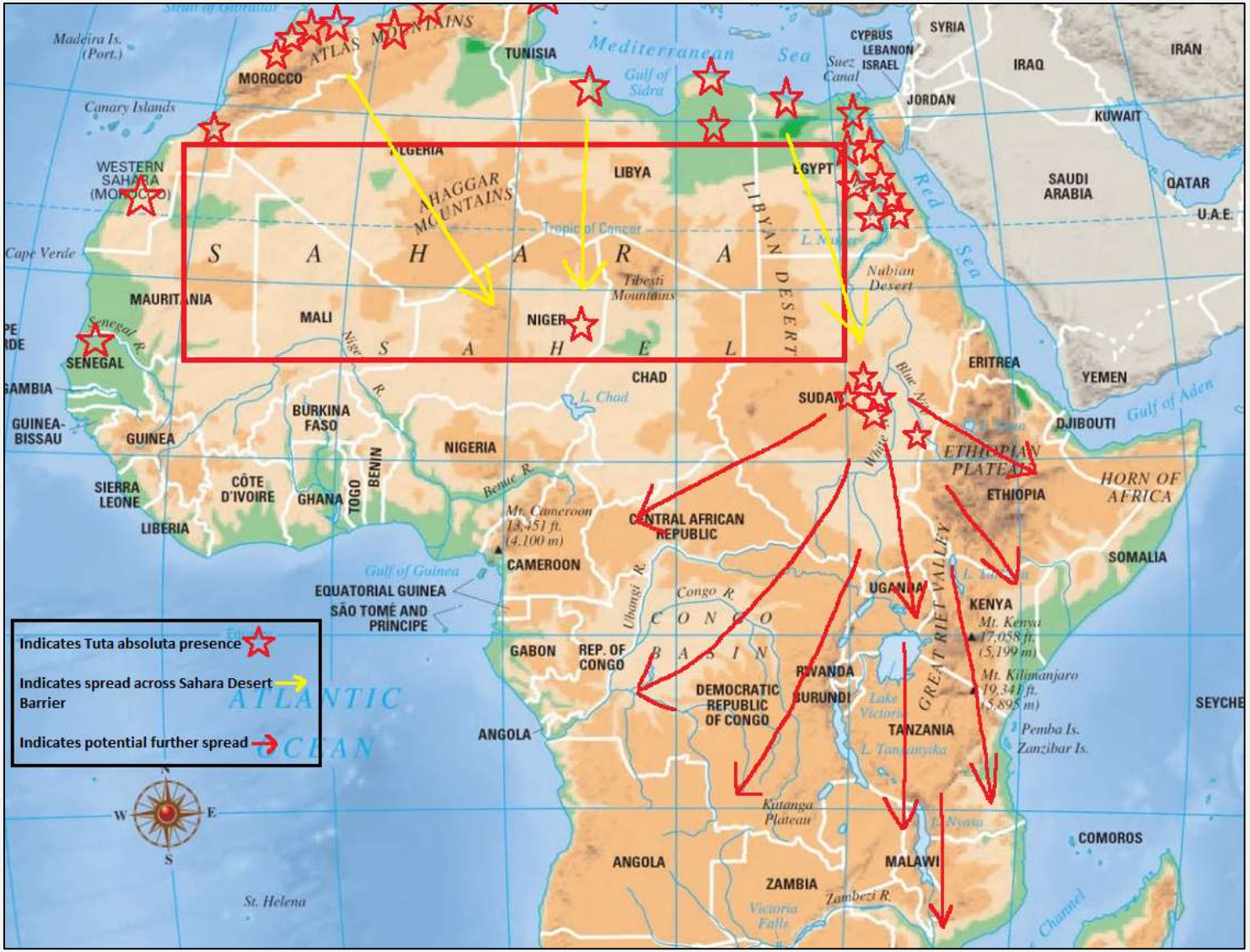
Predicted Spread of *Tuta absoluta* in West and Central Africa



Predicted Spread of *Tuta absoluta* in East and Central Africa



Tomato

- World production in 2009 - 152 M tons
- Production area - 4.4 M ha
- Top 10 tomato producing countries –
  China, U.S.A., India, Turkey, Egypt, Italy, Iran, Spain, Brazil, and Mexico.

In 2011, *T. absoluta* infested 1.0 M ha of tomato cultivated area (22% of cultivated surface)

Now it is a threat to Asia and Africa (South of Sahara)

Nigeria has 5% of tomato cultivated in the world

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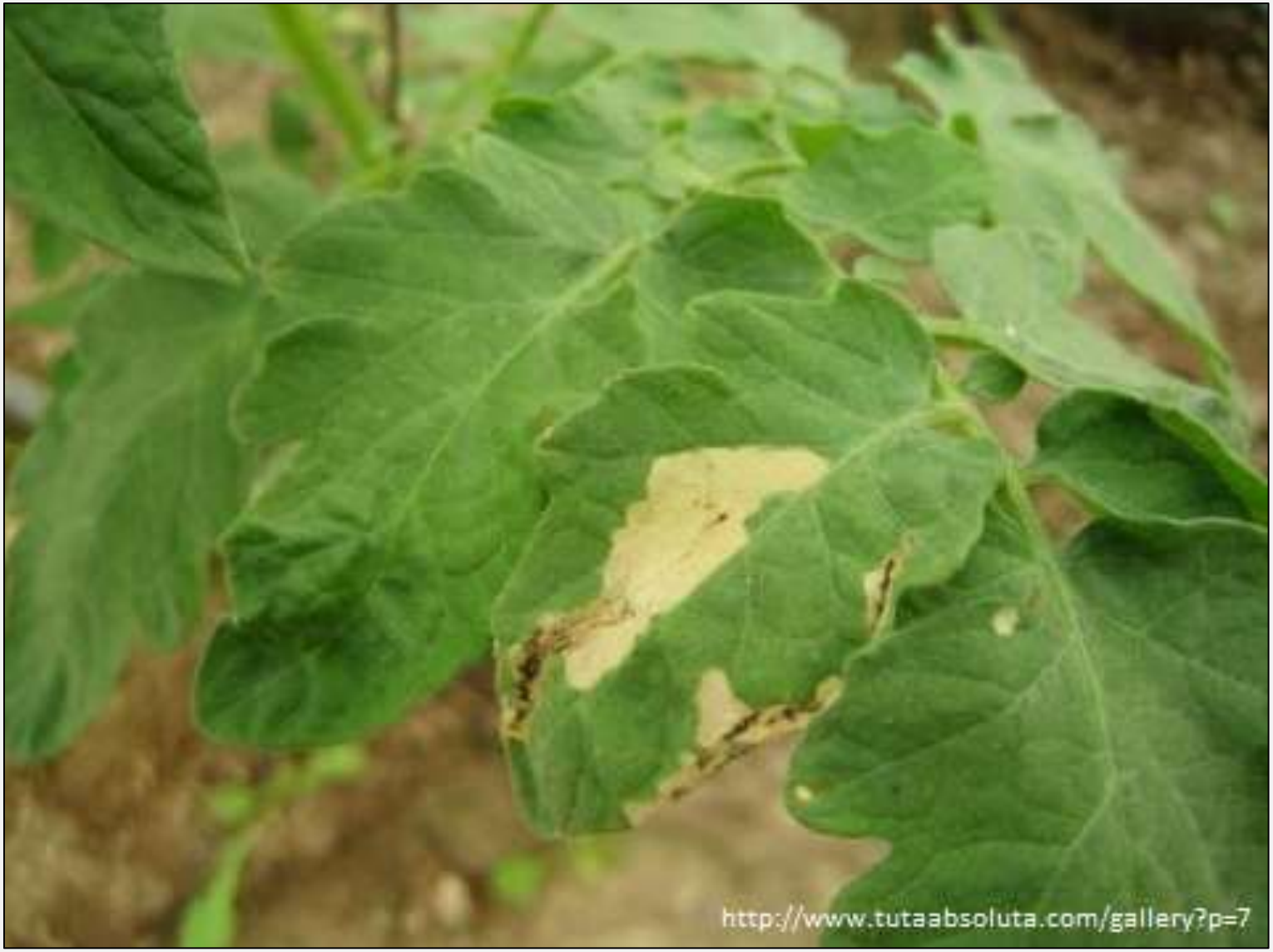
Tuta absoluta – Leaf damage



Tuta absoluta – Fruit Damage

Tuta absoluta in the Calyx

Economics of *T. absoluta* Establishment

- In Spain, in the first year of introduction, pesticides were applied 15 times per season.
- The cost went up by 450 Euros per hectare.
- When *T. absoluta* invades rest of the World, the tomato pest management cost will go up by $500 M per year.

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Economics of *T. absoluta* Establishment

- Invasion is irreversible.
- Management requires coordinated efforts of research scientists, extension agents, and growers in invaded countries and those at risk.

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Management of *T. absoluta*

Detection	- Pheromone traps
Cultural control	- removal of crop residues, alternate hosts, etc.
Chemical control	-
Biological control	-
Resistant varieties	-
Biopesticides	-

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Management of *T. absoluta*

Pheromone traps:

Russell IPM is a leading producer

0.5 mg and 0.8 mg lures are produced

0.8 mg is more effective

45 males/trap – action needed – Brazil

100 males/trap – action needed- Chile

Management of *T. absoluta*

South America:

- Chemical control
  - In 1970s - Pyrethroids used
  - In 1980s - Cartap used
  - In 1990s – Cartap alternated with Pyrethroids
  - In early 2000 – Ten new molecules of Pyrethroids used

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Management of *T. absoluta*

Biological control:

- **Classical biological control**
- **Augmentative biological control**
- **Conservation biological control**

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Management of *T. absoluta*

Classical biological control

- High success rate with invasive species
  - Papaya mealybug control
  - Cassava mealybug control
  - Spiraling whitefly control
  - Mango mealybug

Not yet found a silver bullet for *T. absoluta*

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Management of *T. absoluta*

Augmentative biological control

Used against native and invasive pests

Trichogramma spp.

Bracon habetor

Pediobius foveolatus

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Natural enemies of *T. absoluta*

(Mediterranean)

Parasitoids

Necremnus artynes	Eulophidae	Hym.
Hemiptarsenus sp.	Eulophidae	Hym.
Braconidae sp.	braconidae	Hym.
Trichogramma achaeae	Trichogrammatidae	Hym.
Trichogramma sp.	Trichogrammatidae	Hym.

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Management of *T. absoluta*

Augmentative biological control

Trichogramma acheae **is used in Spain at the rate of 750,000 adults/hectare – every 3-4 days.**

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Natural enemies of *T. absoluta*

(Mediterranean)

Nematodess

Heterorhabditis bacteriophora

Steinernema feltiae

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Natural enemies of *T. absoluta*

(Mediterranean)

Predators

Nesidiocoris tenuis	Miridae	Hem.
Macrolophuspygmaeus	Miridae	Hem.
Dicyphys marrocannus	Miridae	Hem.
Vespidae sp	Vespidae	Hym.
Amblyseius swirskii	Phytoseiidae	Acari
Amblyseius cucumeris	Phytoseiidae	Acari

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Natural enemies of *T. absoluta*

(South America)

Egg Parasitoids

Trichogramma spp.	Trichogrammatidae	Hym.
Anastatus sp	Eupelmidae	Hym.
Arrhenophagus sp.	Encyrtidae	Hym.
Copidosoma sp.	Encyrtidae	Hym.
Copidosoma desantisi	Encyrtidae	Hym.
Copidosoma hoehleri	Encyrtidae	Hym.

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Natural enemies of *T. absoluta*

(South America)

Larval Parasitoids

Goniozuz nigrifemur	Bethylidae	Hym.
Apanteles spp.	Braconidae	Hym.
Bracon spp.	Braconidae	Hym.
Chelonus sp.	Braconidae	Hym.
Dineulophus phthorimaea	Eulophidae	Hym.
Diadegma sp.	Ichneumonidae	Hym.
Archytas sp.	Tachinidae	Dip.

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Natural enemies of *T. absoluta*

(South America)

Pupal Parasitoids

Apanteles sp.	Braconidae	Hym.
Conura sp.	Chalcididae	Hym.
Invreia sp.	Chalcididae	Hym.
Horismenus sp.	Eulophidae	Hym.
Elasmus sp.	Eulophidae	Hym.

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Natural enemies of *T. absoluta*

(South America)

Predators

Only casual observations on generalist predators such as spiders, carabids, earwigs, hemipterans, wasps, ants, lace wings have been reported.

Natural enemies of *T. absoluta*

(South America)

Predators collected by Europeans: van Lanteran

Campyloneuropsis infumatus	Miridae	Hem.
Engytatus vaians	Miridae	Hem.
Maccroplophus basicornis	Miridae	Hem.
Orius incidiosus	Anthocoridae	Hem.
Geocoris punctipes	Geocoridae	Hem.

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Management of *T. absoluta*

Conservation biological control

- Avoiding use of chemical pesticides
- Use of biopesticides that have less or no adverse impact on natural enemies
- Adoption of biological control

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Management of *T. absoluta*

Biopesticides:

- ***Bacillus thuringiensis* formulations**
- ***Beauveria bassiana* applications**
- **Nucleopolyhedrosis virus**
- **Nucleogranulosis virus**
- **Neem formulations**

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Management of *T. absoluta*

Combinations:

- **Bt and neem**
- ***B. bassiana* and neem**
- **Nucleopolyhedrosis (NPV) and neem**
- **Granulosis viurs and neem**
- **Bt and *Nesidiocoris***

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IPM for tomato

Components

- Seed or seedling treatment with *Trichoderma*, *Pseudomonas,* and *Bacillus subtilus*
- Solarization of seed beds and in greenhouses
- Use of VAM, neem cake, and other organics
- Use of virus disease-resistant varieties
- Grafting on resistant rootstock for bacterial wilt, cork root disease, and others
- Staking and mulching
- Yellow sticky traps for thrips, leafminers, etc.
- Pheromone traps and use of NPVs for *Tuta, Heliothis* and *Spodoptera*
- Host free period and roguing for control of virus diseases

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Management of *T. absoluta*

What need to be done in this region?

- **Establish a *Tuta* monitoring program**
- **Establish international quarantine regulations**
- **Establish national quarantine regulations**
- **When *Tuta* established: conduct survey of local natural enemies recruited by it; identify effective ones; publish results.**

Management of *T. absoluta*

What need to be done in this region?

- **Take up Classical, Augmentative and/or Conservation Biological Control.**
- **Develop an IPM.**
- **Integrate it with IPM package for Tomato.**

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