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A General Overview on the threat of South American tomato leaf miner, Tuta absoluta

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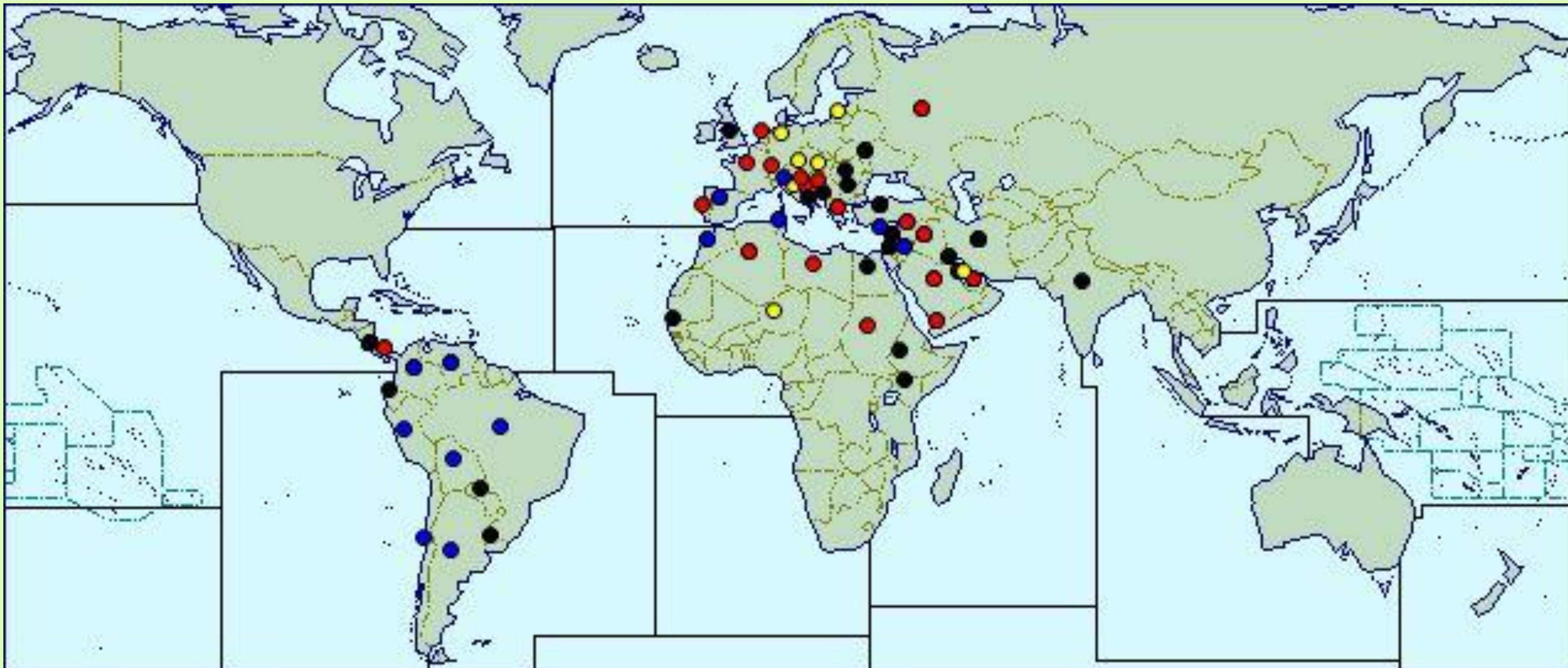
Origin of *T. absoluta*

Distribution of *T. absoluta*

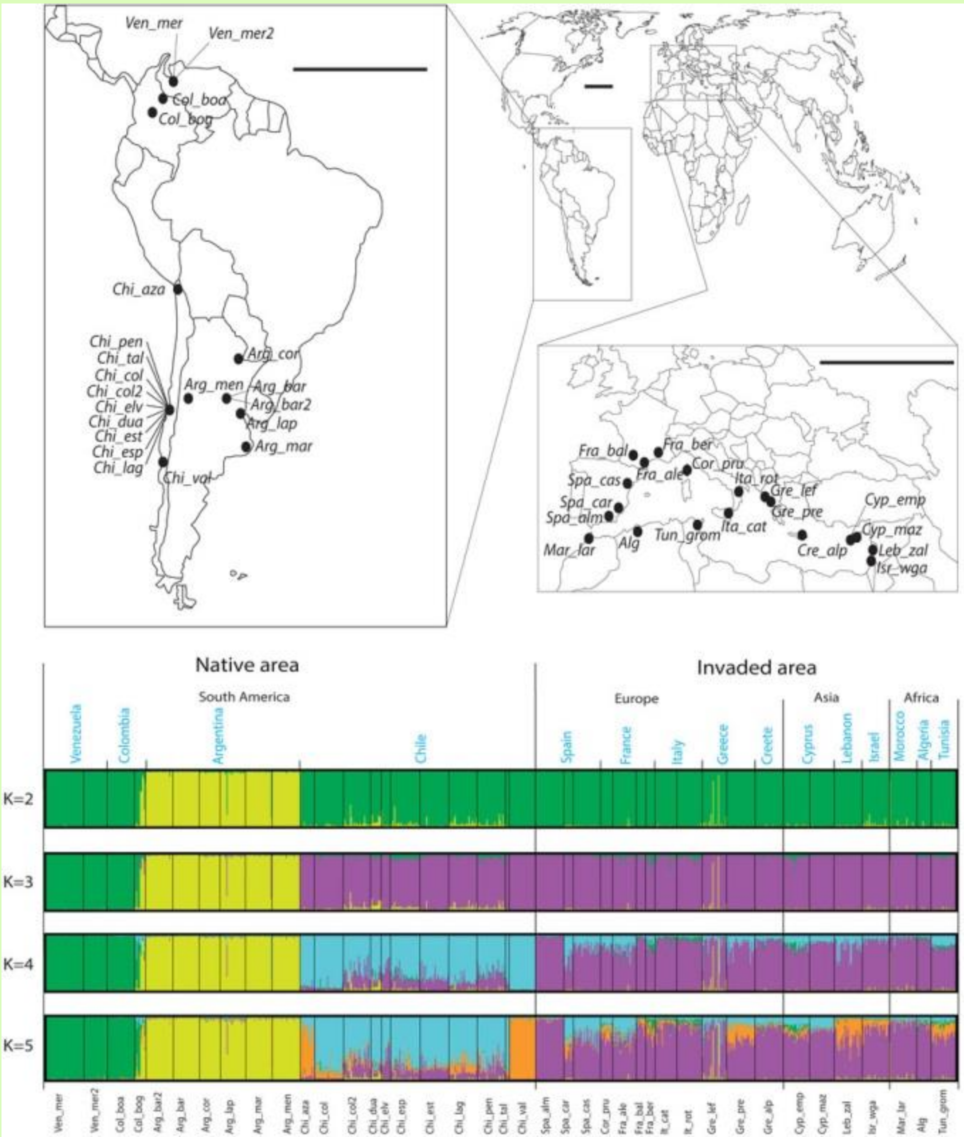


- Widespread
- Present, no further details
- Localized
- Confined, subject to quarantine
- Occasional or few reports

Region	Countries
South America	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela
Central America and Caribbean	Costa Rica, Panama
Europe	Albania (2009), Austria, Bosnia, Bulgaria (2009), Croatia, Cyprus, Czech Republic, Denmark, France (2008), Germany, Greece, Hungary (2010), Italy (2008), Lithuania, Malta, Montenegro, Netherlands (2009), Portugal (2009), Romania, Russian Federation, Serbia (2010), Slovenia, Spain (2006), Switzerland, UK (2009), Ukraine
Asia	Bahrain, India (2014), Iran, Iraq, Israel (2010), Japan (?), Jordan, Kuwait, Lebanon, Qatar, Saudi Arabia, Syria, Turkey (2010), UAE, Yemen
Africa	Algeria (2008), Egypt, Ethiopia (2012), Kenya, Libya, Morocco (2007), Niger (2012), Senegal (2012), Sudan (2012), Tunisia (2008)

(CABI, as of October 06, 2015)

What is the origin of invasion?



Geographic locations and Bayesian genetic clustering of the genotyped population samples of *T. absoluta*

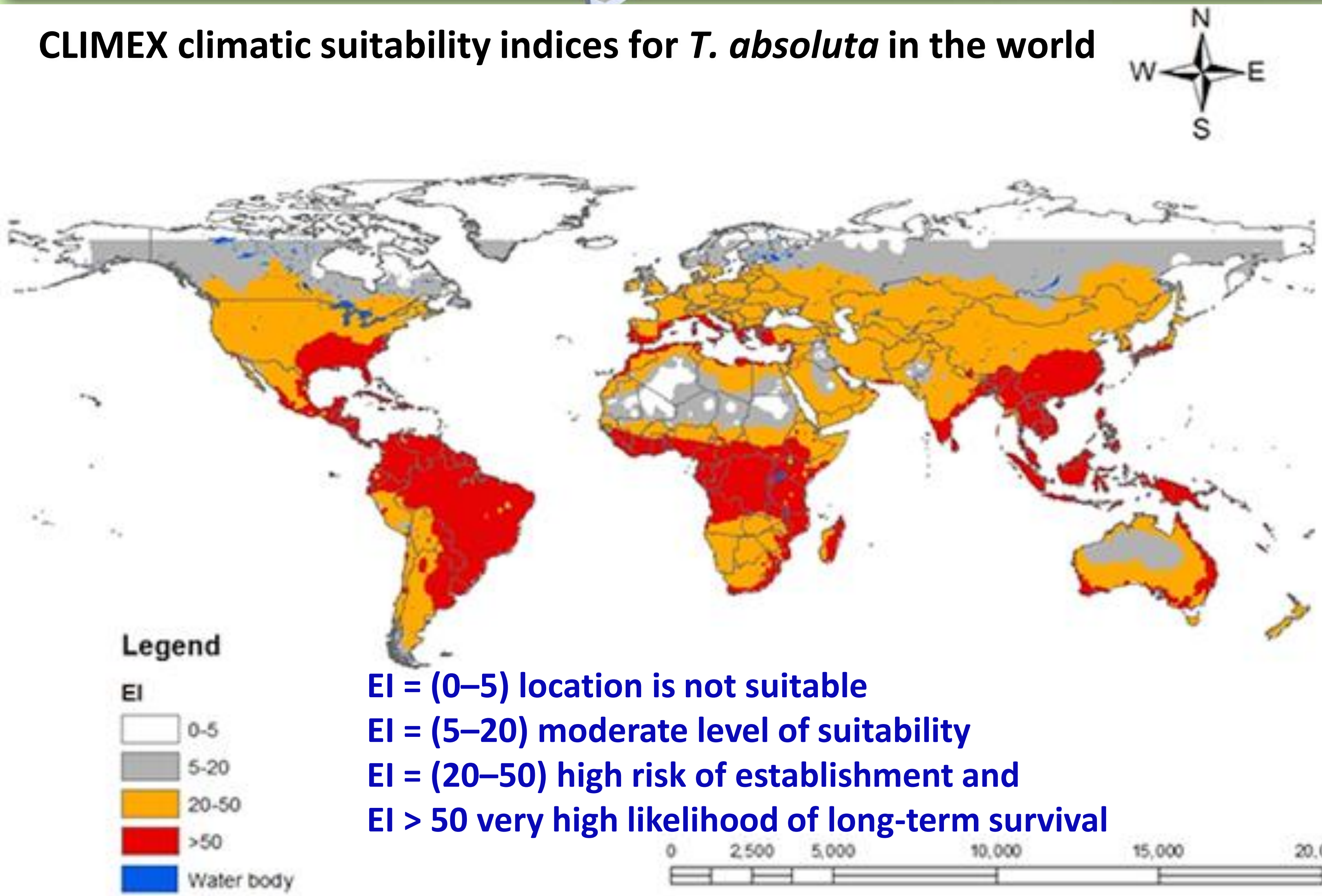
Guillemaud et al., 2015. *Scientific Reports* 5, Article number: 8371. doi:10.1038/srep08371

What is the origin of invasion?

The origin of the invading populations was unique and was close to or in Chile, and probably in Central Chile near the town of Talca in the district of Maule

Guillemaud et al., 2015. *Scientific Reports* 5, Article number: 8371. doi:10.1038/srep08371

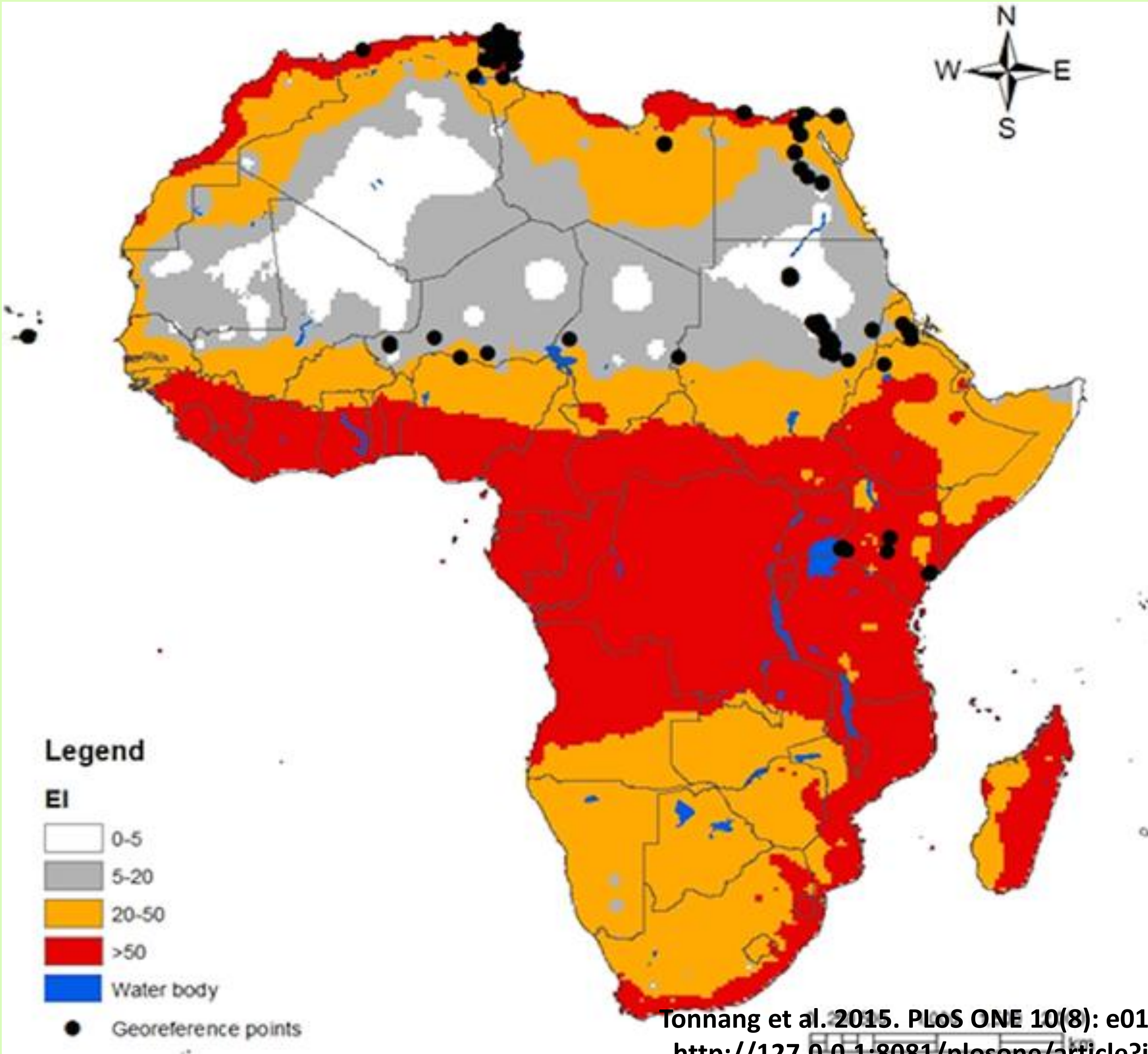
CLIMEX climatic suitability indices for *T. absoluta* in the world



EI = (0–5) location is not suitable
EI = (5–20) moderate level of suitability
EI = (20–50) high risk of establishment and
EI > 50 very high likelihood of long-term survival

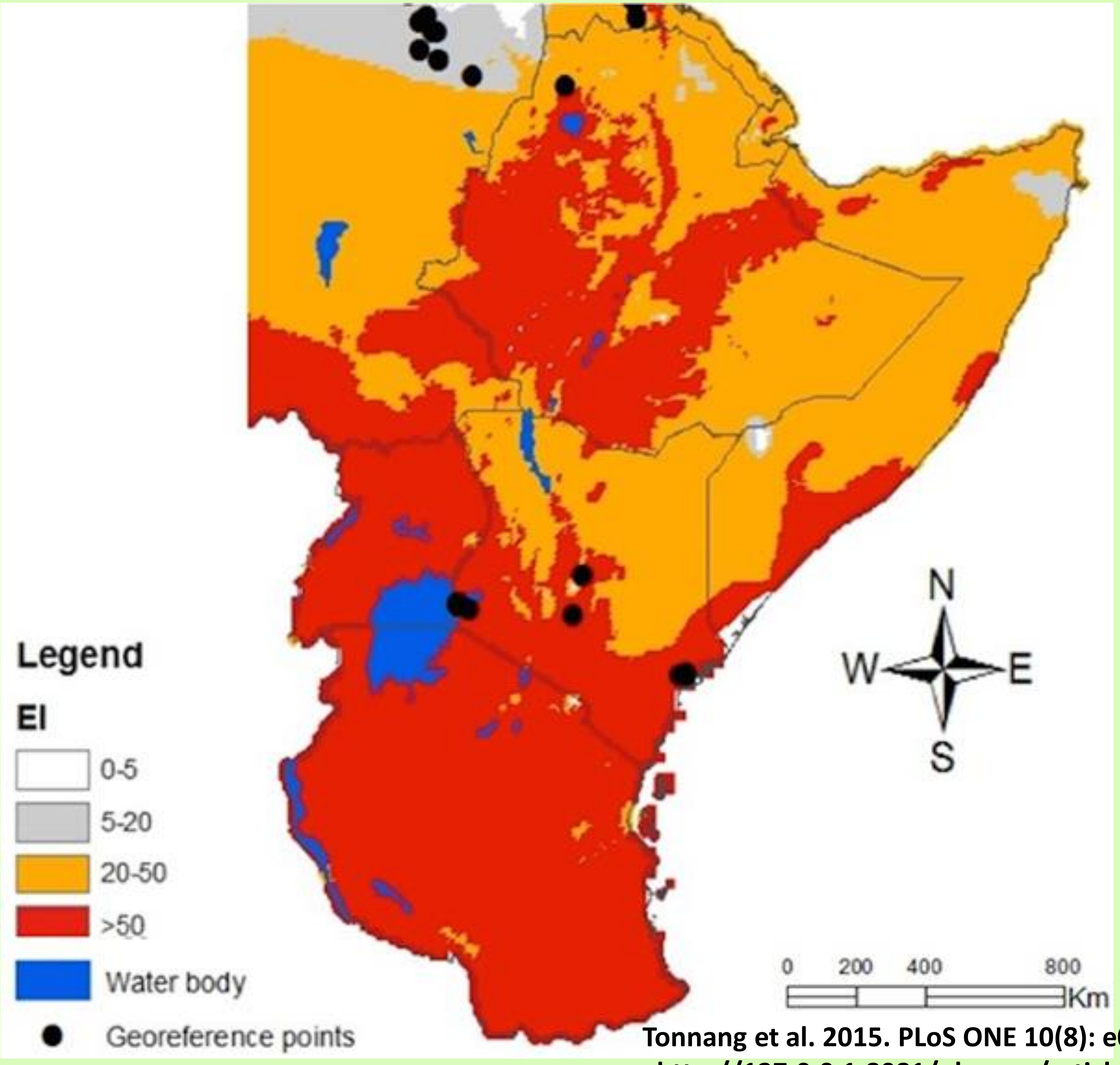
Tonnang et al. 2015. PLoS ONE 10(8): e0135283. doi:10.1371/journal.pone.0135283
http://127.0.0.1:8081/plosone/article?id=info:doi/10.1371/journal.pone.0135283

CLIMEX climatic suitability indices for *T. absoluta* in Africa



Tonnang et al. 2015. PLoS ONE 10(8): e0135283. doi:10.1371/journal.pone.0135283
http://127.0.0.1:8081/plosone/article?id=info:doi/10.1371/journal.pone.0135283

CLIMEX climatic suitability indices for *T. absoluta* in East Africa



Tonnang et al. 2015. PLoS ONE 10(8): e0135283. doi:10.1371/journal.pone.0135283
http://127.0.0.1:8081/plosone/article?id=info:doi/10.1371/journal.pone.0135283

Life stages of *T. absoluta* : Egg

- **Small (0.35 mm long), cylindrical**
- **Creamy white to yellow**
- **Laid mostly on the under surface of leaves, but also on stem, floral buds and calyx of unripe fruits**

Life stages of *T. absoluta* : Larva

- Cream in color with characteristic dark head
- Later it turns as green or pink
- Four larval instars

www.tutaabsoluta.com

Life stages of *T. absoluta* : Pupa

- Pupation may take place
  - in the soil
  - Or on the leaf surface in the cocoon built by last instar larva
  - Or within mines
- Brownish pupae
- About 6 mm long

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Life stages of *T. absoluta* : Adult

- **Small adults with a body length of 5-7 mm, and a wing span of 8-10 mm**
- **Filiform antennae (thread like antennae), the most important characteristic**
- **Grey scales with characteristic black spots present in anterior wing**

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- 30-40 days
- Multivoltine
- Up to 12 generations per year

Life-cycle of *T. absoluta*

4-7 days

overwinter as eggs, pupae or adults depending on environmental conditions

12-20 days

10-11 days (F)
11-13 days (M)

Damage symptoms


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Recorded host plants

- *Solanum lycopersicum*
- *Solanum tuberosum*
- *Solanum melongena*
- *Solanum nigrum*
- *Solanum elaeagnifolium*
- *Solanum americanum*
- *Solanum bonariense*
- *Solanum sisymbriifolium*
- *Solanum saponaceum*
- *Solanum dubium*
- *Solanum muricatum*
- *Solanum woronowii*
- *Capsium annuum*
- *Nicotiana tabacum*
- *Nicotiana glauca*

- *Datura stramonium*
- *Datura ferox*
- *Datura quercifolia*
- *Physalis peruviana*
- *Physalis angulata*
- *Lycium sp.*
- *Phaseolus vulgaris*
- *Malva sp.*
- *Amaranthus viridis*
- *Sorghum halepense*
- *Xanthium strumarium*

(USDA-APHIS, 2011; Muniappan, 2014; CABI, 2015)


Solanum tuberosum


Solanum viarum


Solanum nigrum

Solanum melongena

Economic impact of *T. absoluta*

- 100% yield loss, if left uncontrolled
- Significant increase in the use of chemical pesticides
- Disruption of IPM programs targeting other pests of tomato
- Trade bans
- Soaring tomato prices

Current pest management options

Chemical control

- **Significant increase in the use of chemical pesticides against *T. absoluta* (*e.g.,* up to 15 applications in Spain, and up to 30 applications in Brazil) (Guedes and Picanço, 2012; Tomé et al., 2012)**
- **18 active ingredients were introduced in Tunisia during 2009-2011 (Abbes et al., 2012)**
- **Spinosin, indoxacarb, abamectin, emamectin benzoate, etc., are commonly used chemicals against *T. absoluta***

Insecticide Resistance

- However, rapidly evolving resistance has also been documented. For instance, high level and widespread resistance is known to exist in field populations of *T. absoluta*, mainly to organophosphates (MoA group 1B), pyrethroids (MoA group 3A), chloride channel activators (MoA group 6) and benzoylureas (MoA group 15) (IRAC, 2011)
- Specifically, resistance to abamectin, cartap, and spinosad has been reported (Siqueira et al., 2000; Reyes et al., 2011; Haddi et al., 2012)
- It has also been reported to be resistant to diamide group of insecticides for the first time in Europe recently (Roditakis et al., 2015)
- Resistance mechanism – metabolic / polyfactorial / polygenic
- A Brazilian field population resistant to spinosad reached up to 180,000-fold resistance within seven further generations! (Campos et al., 2014)

Host Plant Resistance

- *Solanum habrochaites* (accession PI 127826), a good source of resistance to arthropod pests because of zingiberene present in its glandular trichomes
- F_2 genotypes resulting from *S. esculentum* and PI 127826 crosses showed high resistance (oviposition and feeding deterrence) (Azevedo et al., 2003)
- The heterozygotes for both zingiberene (ZGB) and acyl-sugar (AS) resulting from PI 127826 and *S. pennelli* (LA716) crosses showed higher levels of resistance to *T. absoluta* (Maluf et al., 2010)
- *S. habrochaites* var. *glabratum* PI 134417 and TOM-622 (both rich in 2-tridecanone), ZGB-703 (rich in ZGB), and TOM-687 (rich in AS) showed significant reductions in the oviposition rate and subsequent damage (de Oliveira et al., 2012)

Mass-trapping using sex pheromones


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Biological Control

- Parasitoids (egg and larval)
- Predators (*e.g.,* mirid bugs such as *Nesidiocoris tenuis* and *Macrolophus pygmaeus*)
- *Bacillus thuringiensis*
- Entomopathogenic fungi
- Entomopathogenic nematodes
- Neem