



Success and extension of biological control strategies for managing *Tuta absoluta* populations in the Mediterranean area

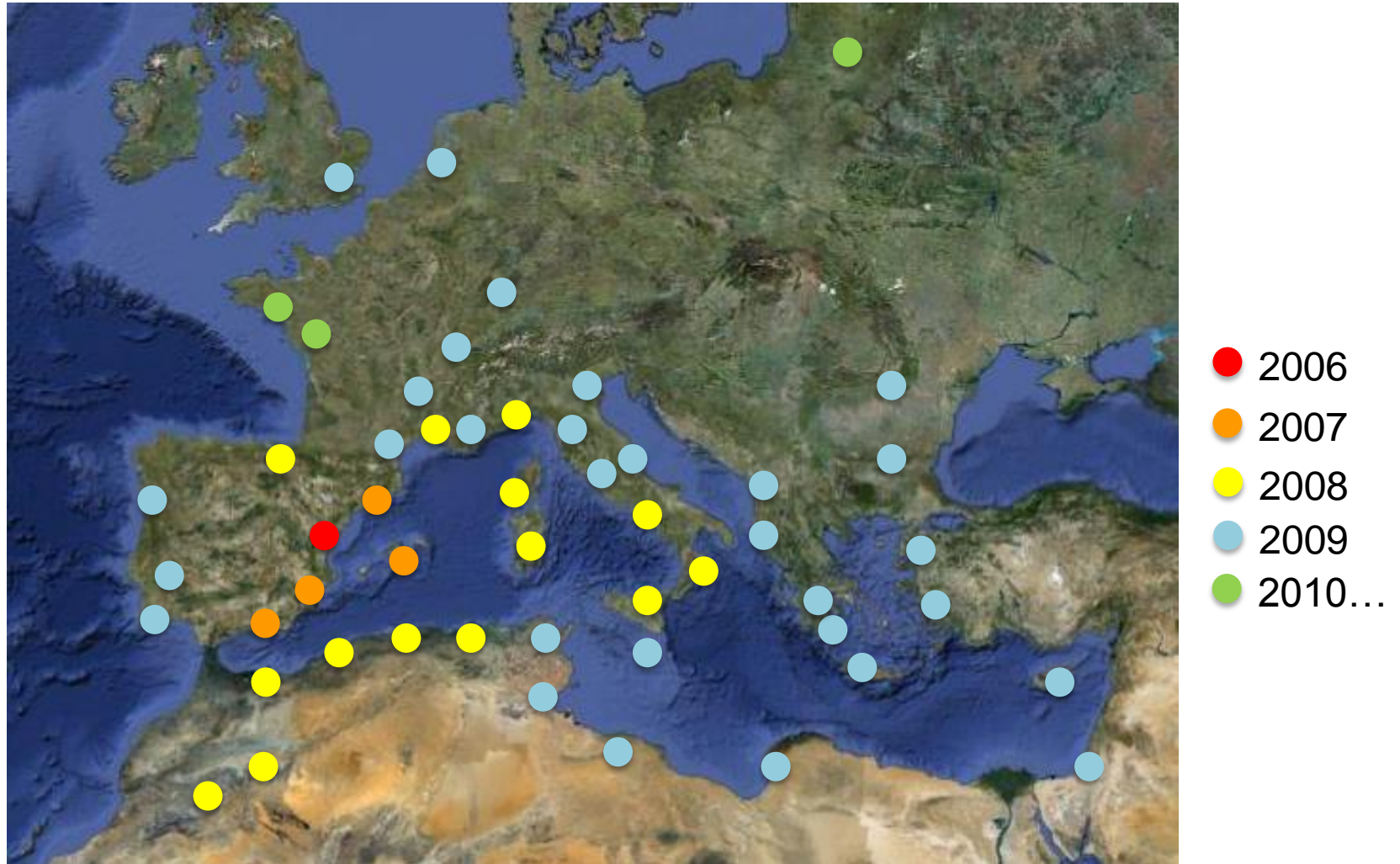
José E. Belda, Antonio Giménez, F. Javier Calvo
Koppert España S.L.
C/ Cobre 22, 04745 La Mojonera, (Almería). jbelda@koppert.es



EPPO/IOBC/FAO/NEPPO Joint International Symposium on
management of *Tuta absoluta* (tomato borer)
Agadir, Morocco – 16-18 Nov 2011

KOPPERT
BIOLOGICAL SYSTEMS

Introduction of *Tuta absoluta* in Europe and the Mediterranean countries



(Desneux *et al.*, 2010. J.Pest.Sci.)

Studies on *Tuta absoluta*

In the pest origin area

- Barrientos *et al.* (1998)
- Estay (2000)

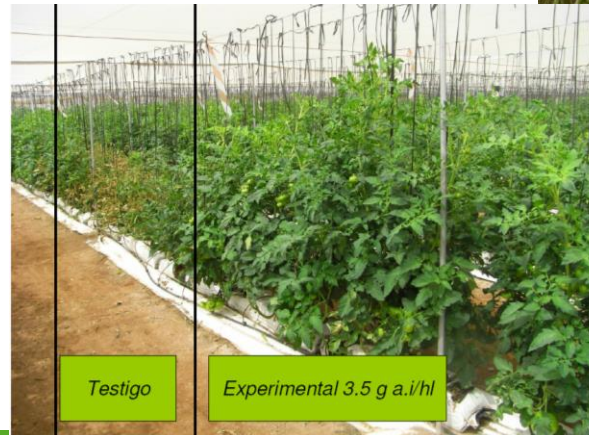
Since its introduction in Europe

- Urbaneja *et al.* (2007, 2008)
- Mollá *et al.* (2008)
- Monserrat (2009)
- Cabello *et al.* (2009)
- Desneux *et al.* (2010)
- ...



Control of *Tuta absoluta*

- Preventive / agronomics
- Biotechnics / pheromones
- Chemical control
- Biological control



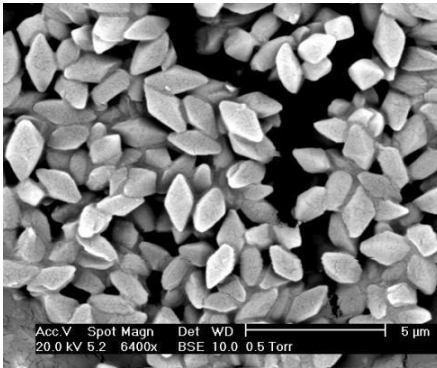
Control of *Tuta absoluta*

Biological control

- Parasitoids
- Predators
- Entomopathogens



Imag. T.Cabello



Control of *Tuta absoluta*

Biological control in its origin area

■ Egg parasitoids

Trichogramma pretiosum

Trichogrammatoidea bactrae

Trichogramma spp.



Parasitized

Healthy



Control of *Tuta absoluta*

Biological control in its original area

■ Larval parasitoids

Pseudapanteles dignus

Dineulophus pthorimaeae

Bracon lucilae

Neochrysocharis formosa

Habrobracon hebetor,

Dolichogenidea gelechiidivoris

Orgilus lepidus

Campoplex haywardi

Orgilus spp. , *Chelonus* spp.

Diadegma spp., *Temelucha* spp.

Agathis spp.

Goniozus nigrifemur

Etc...



(Urbaneja, 2008)

Control of *Tuta absoluta*

Biological control in its origin area

■ Predators

Xylocoris sp. (Het.: Anthocoridae)

Podisus nigrispinus (Het.: Pentatomidae)

Tupiocoris cucurbitaceus (Het.; Miridae)

Cycloneda sanguinea (Col.: Coccinellidae)

Thrips (Thy.: Phlaeothripidae))



(Urbaneja, 2008)



***Nesidiocoris tenuis* as the basis for biological control of *Tuta absoluta* in tomatoes in the Mediterranean basin**

Nesidiocoris tenuis as the basis for biological control in tomatoes

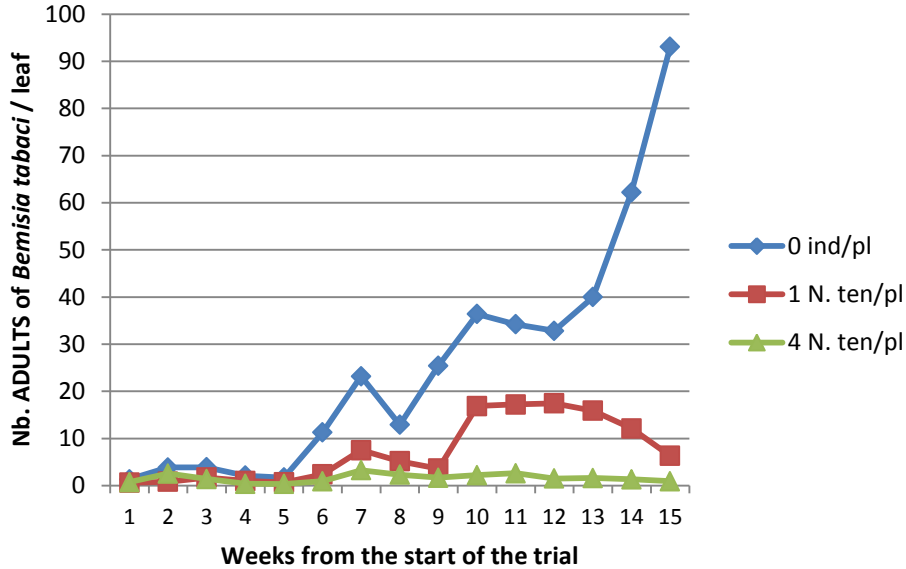
- 🦋 Indigenous in the Mediterranean countries
- 🦋 Mass reared since 2003
- 🦋 Polyphagous predator
- 🦋 Control of whiteflies
- 🦋 Control of secondary pests in tomatoes
- 🦋 Damages to crop are managed



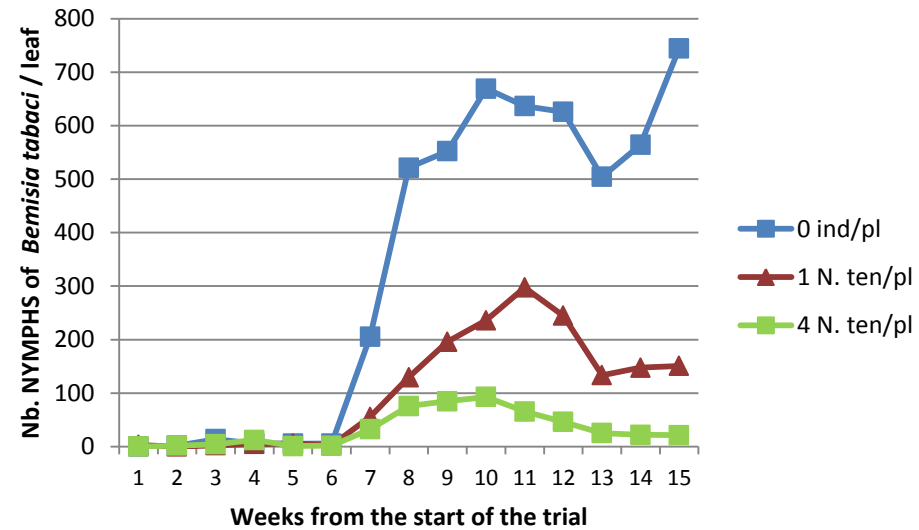
Nesidiocoris tenuis predator of whiteflies

Semi-field trial

Adults *B.tabaci*/leaf



Nymphs *B.tabaci*/leaf



Tuta absoluta in tomatoes: the challenge

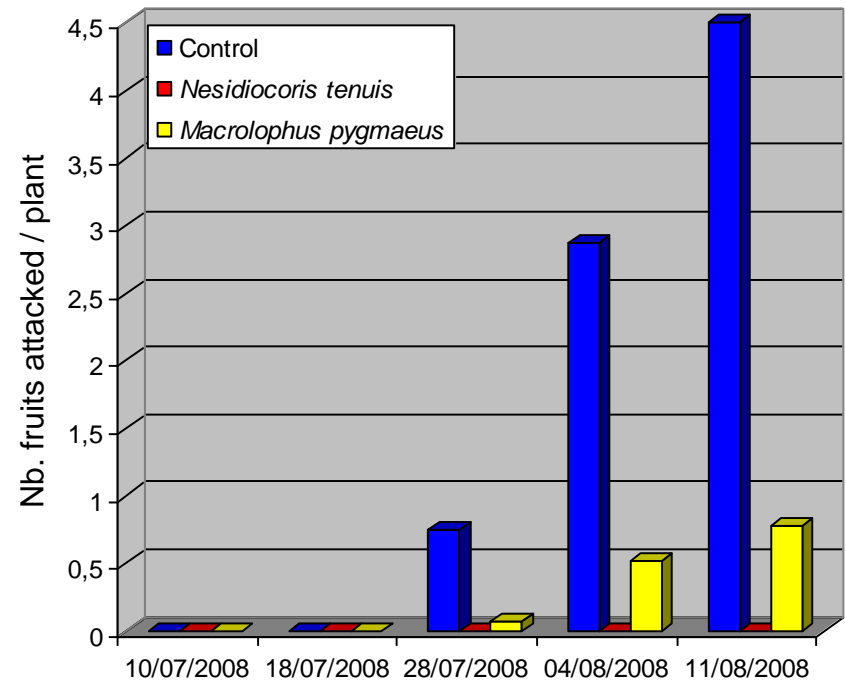
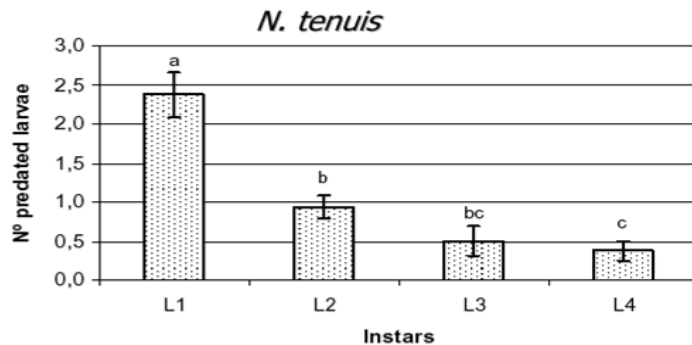
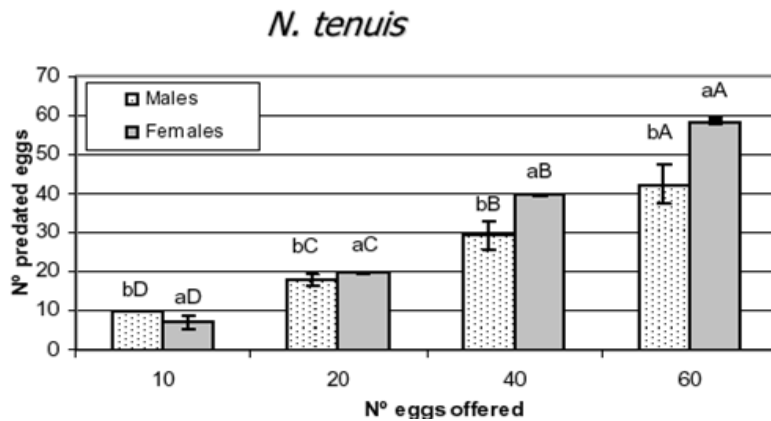


■ 1997 → Arrival of *Tuta absoluta*

Nesidiocoris tenuis predator of *Tuta absoluta*

Laboratory / semi-field trials

(Urbaneja *et al.*, 2009. J.Appl.Entom.)



Improving installation of *N.tenuis*

Alternatives:

- Pre-planting
- Baker plants

Transplanting

IPM standard strategy



Pre-planting

1 2 3 4 5 6 7 8 9 10

6 -8 Weeks

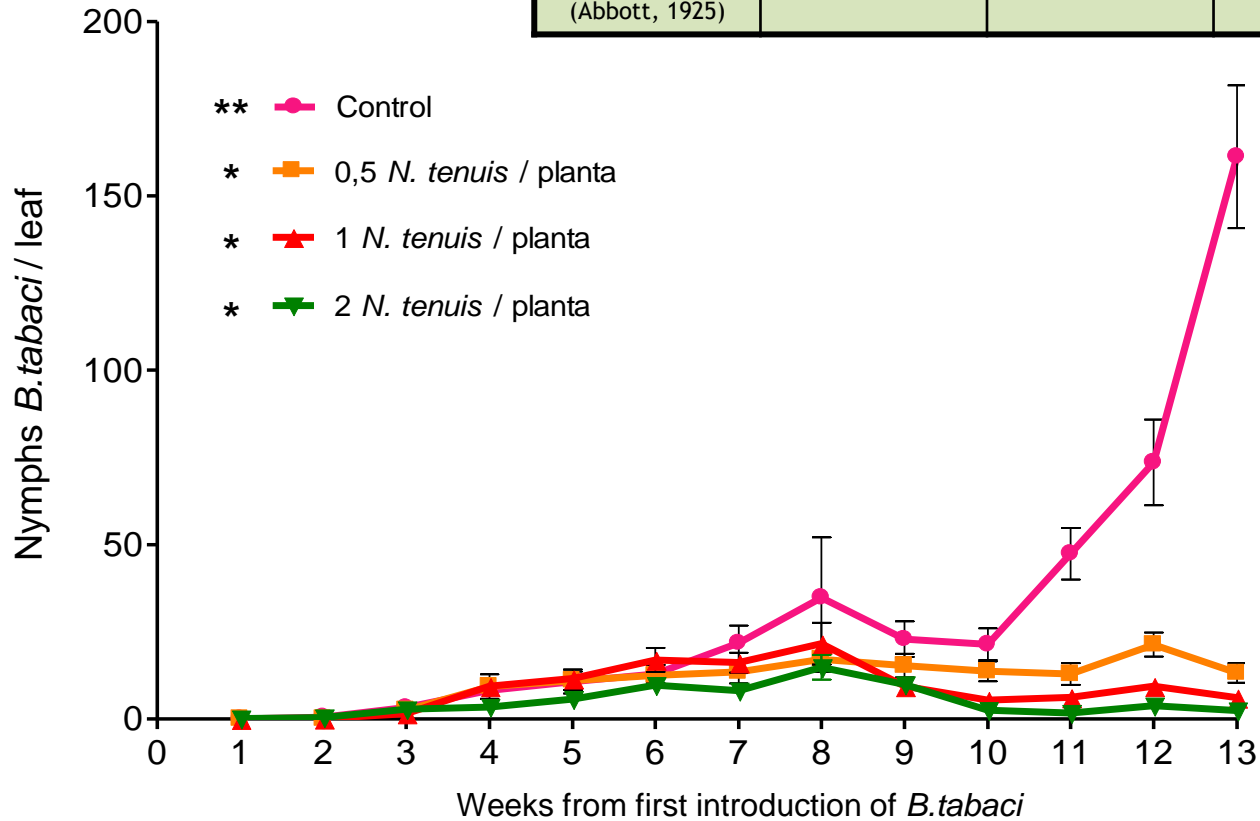


Developing the biological control strategy for *Tuta absoluta* in tomatoes with *Nesidiocoris tenuis* in pre-planting releases

Efficacy of *Nesidiocoris tenuis* pre-planting releases against whitefly

Semi-field trials

	CONTROL	0.5 N.t./plant	1 N.t./plant	2 N.t./plant
Nymphs-day	822.0 ± 133.00 a	120.9 ± 20.40 b	54.5 ± 9.26 b	22.1 ± 4.20 b
% Reduction (Abbott, 1925)	-----	92%	96%	98%

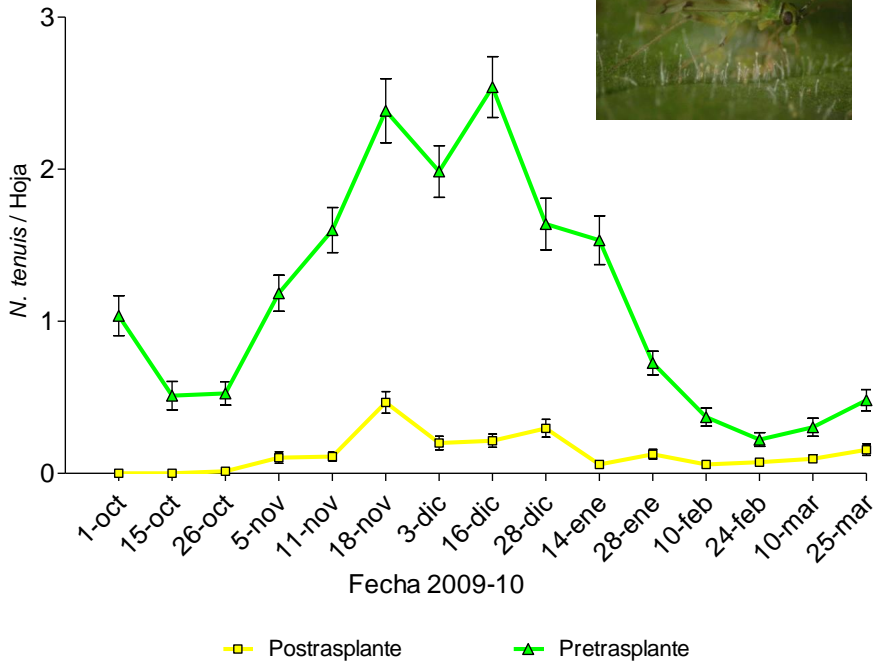


(Calvo y Belda, *In Press*)

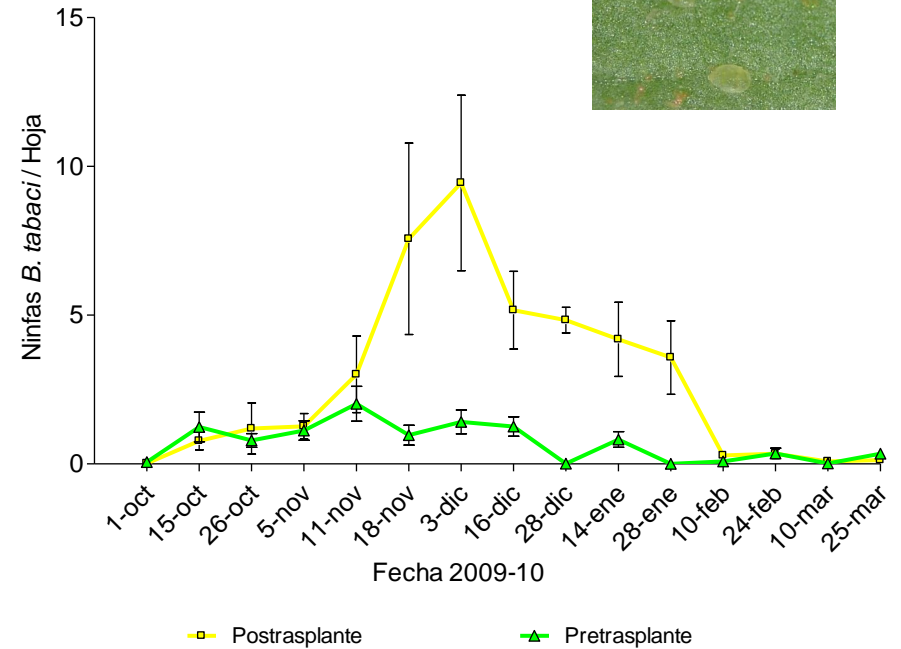
Efficacy of *Nesidiocoris tenuis* pre-planting releases against whitefly

Field trials – Commercial greenhouses

N. tenuis / leaf

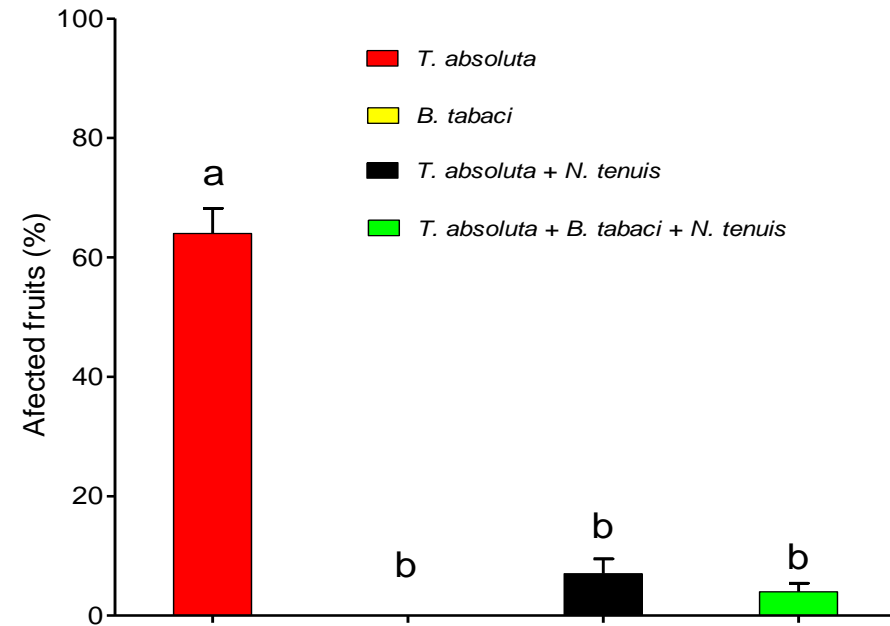


B. tabaci nymphs / leaf



Efficacy of *Nesidiocoris tenuis* pre-planting releases against *Tuta*

Semi-field trial
Bemisia + *Tuta*



(Calvo FJ, Lorente MJ, Belda JE, *In Press.*)

Efficacy of *Nesidiocoris tenuis* pre-planting releases against *Bemisia tabaci* and *Tuta absoluta*

Field trials

1. Koppert R&D greenhouse (Sep 2009 – April 2010)

- Control
- Standard IPM (2 *N.tenuis*/m²)
- Pre-planting (0.5 *N.tenuis* /plant)

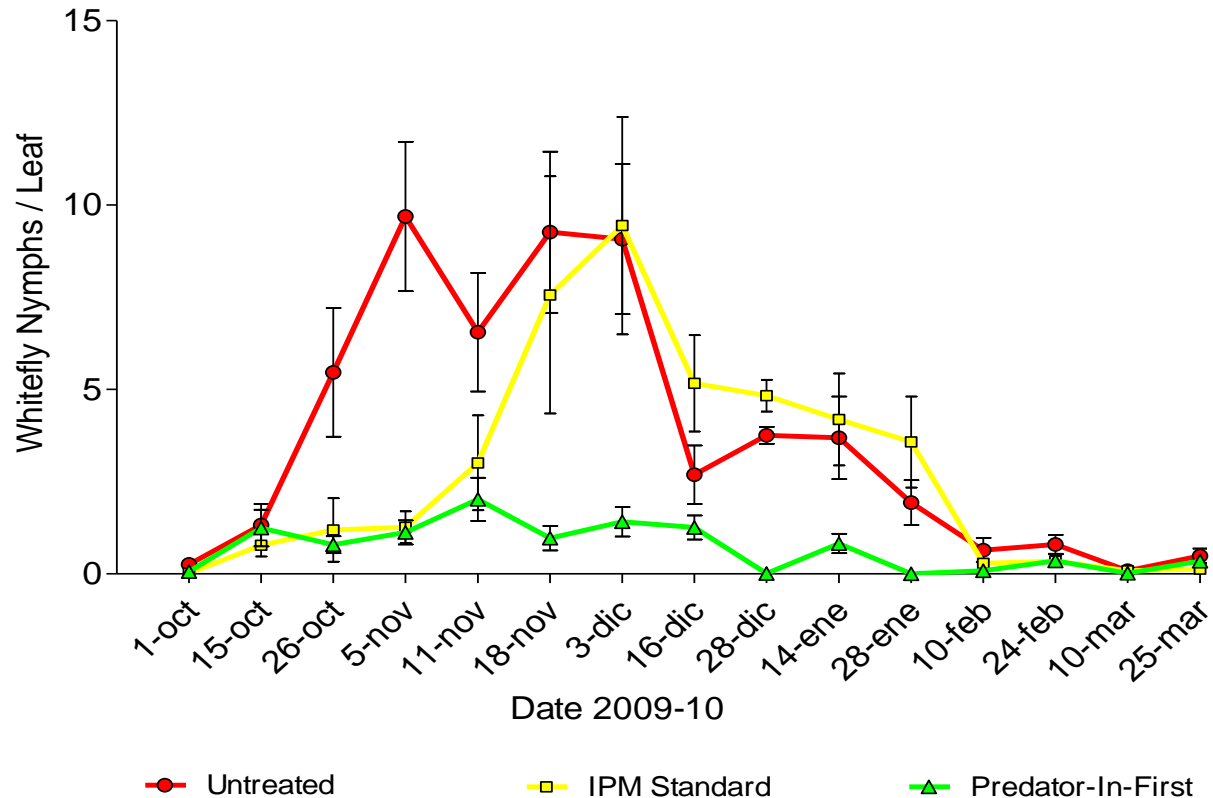
2. Commercial greenhouses (11) (Ag 2009 – Feb 2010)

- Standard IPM (2 *N.tenuis*/m²)
- Pre-planting (0.5 *N.tenuis* /plant)



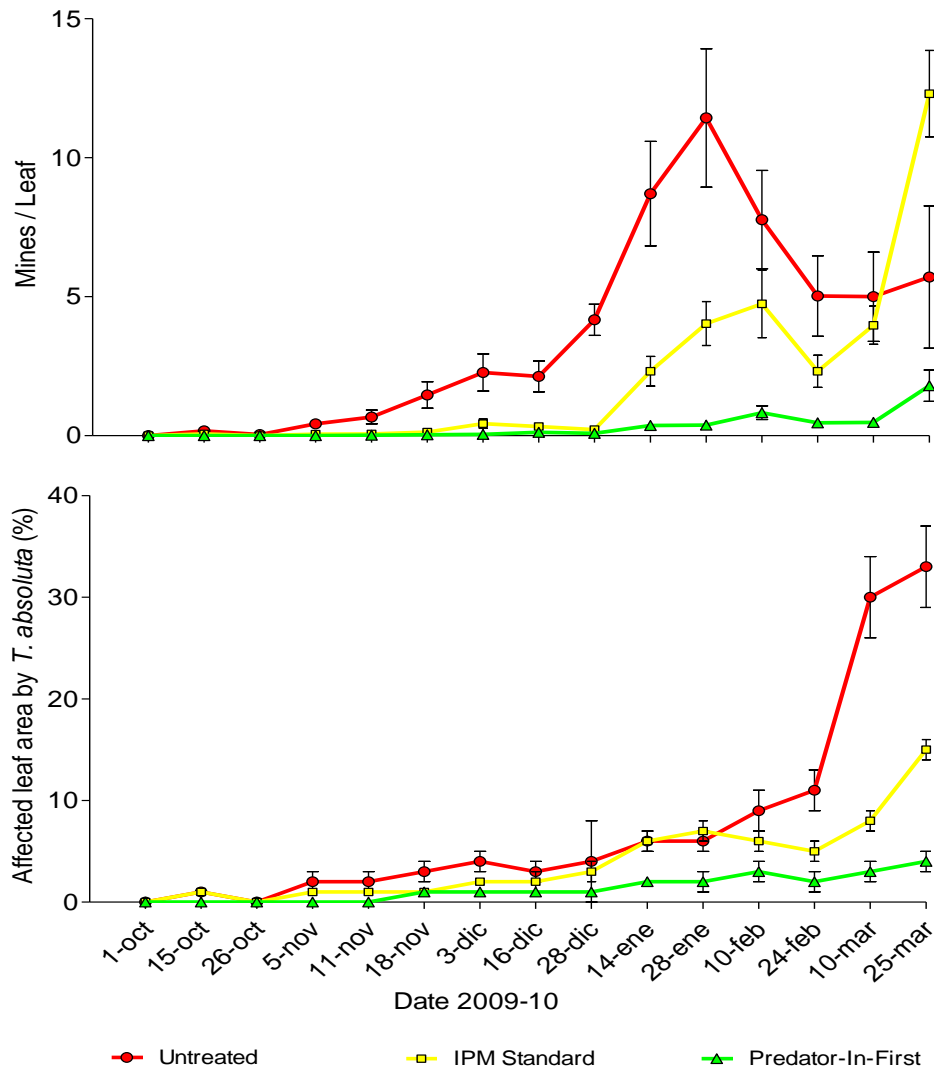
Efficacy of *Nesidiocoris tenuis* pre-planting releases against *Bemisia tabaci* and *Tuta absoluta*

Bemisia tabaci control (field trial #1)



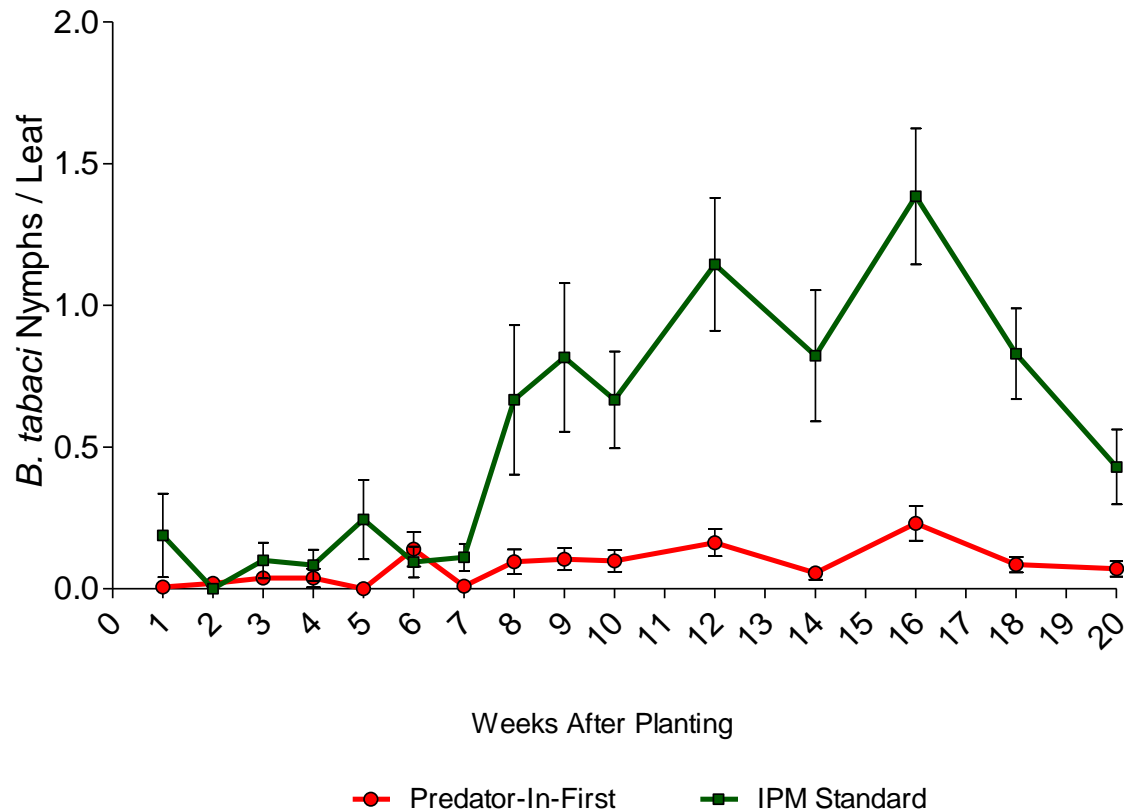
Efficacy of *Nesidiocoris tenuis* pre-planting releases against *Bemisia tabaci* and *Tuta absoluta*

Tuta absoluta control (field trial #1)



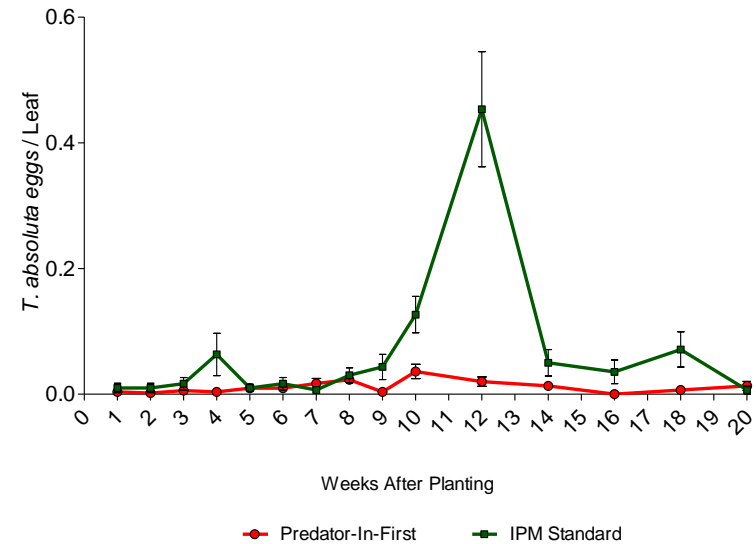
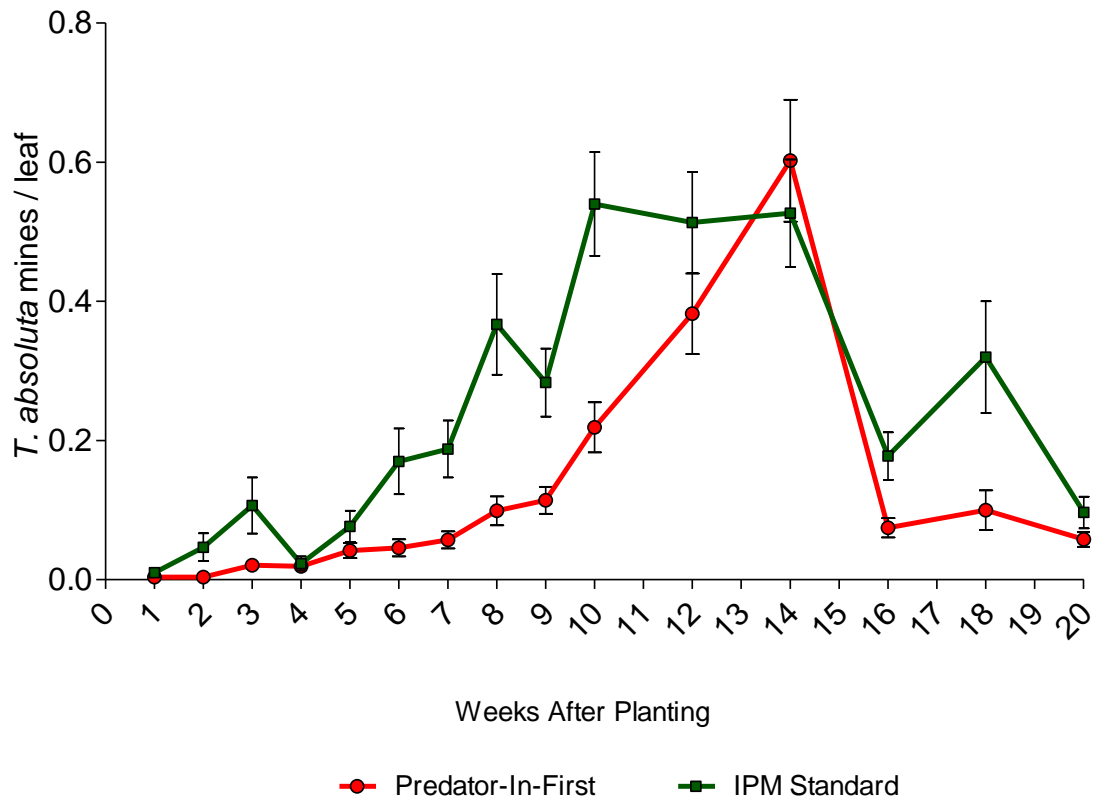
Efficacy of *Nesidiocoris tenuis* pre-planting releases against *Bemisia tabaci* and *Tuta absoluta*

Bemisia tabaci control (field trial #2)



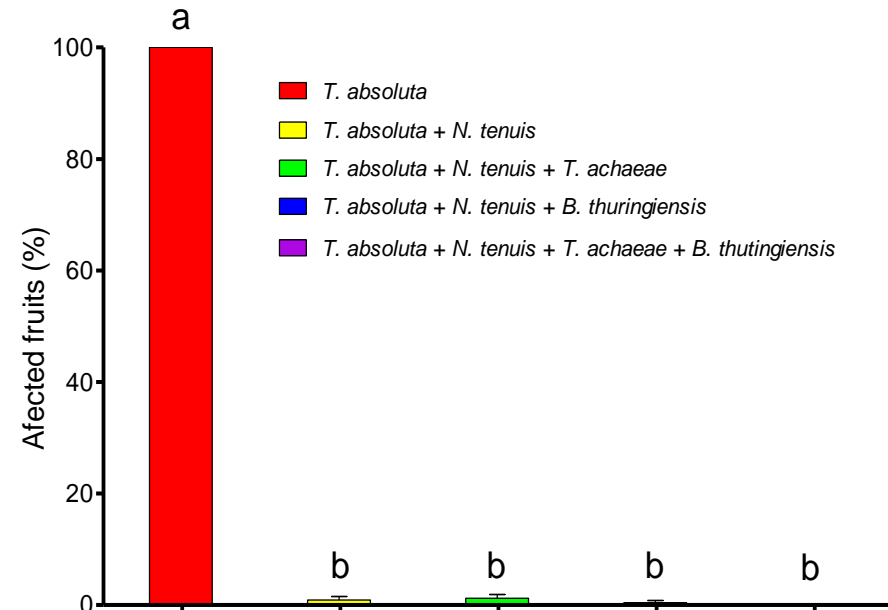
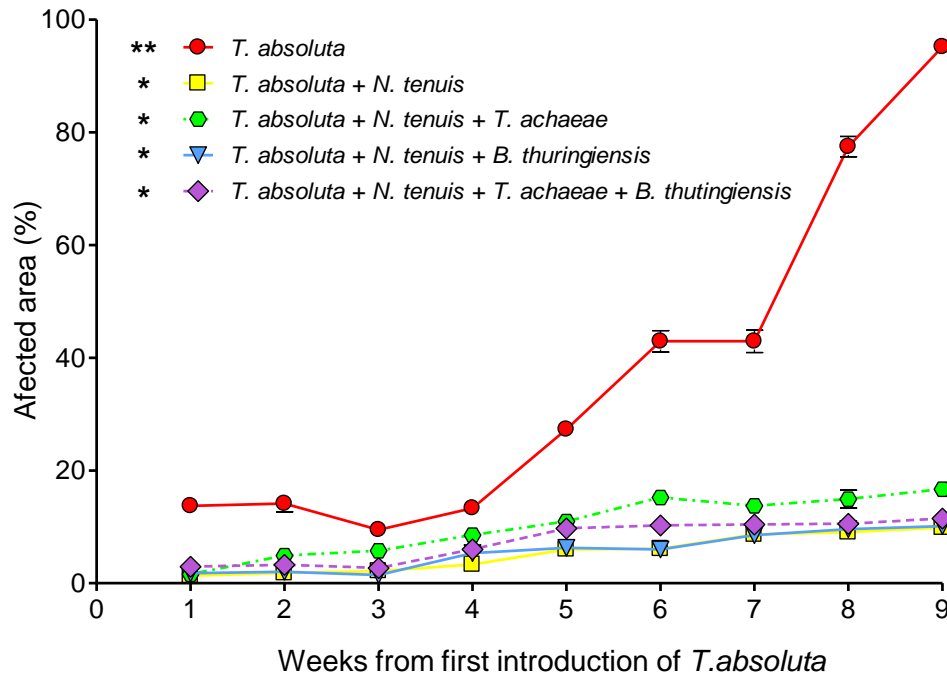
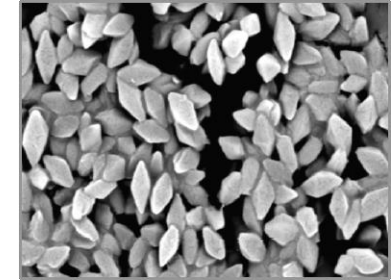
Efficacy of *Nesidiocoris tenuis* pre-planting releases against *Bemisia tabaci* and *Tuta absoluta*

Tuta absoluta control (field trial #2)



Improving the *Nesidiocoris tenuis* pre-planting strategy against *Tuta absoluta*

Semi-field trial
Different strategies



Calvo FJ, Lorente MJ, Belda JE, *In Press*.



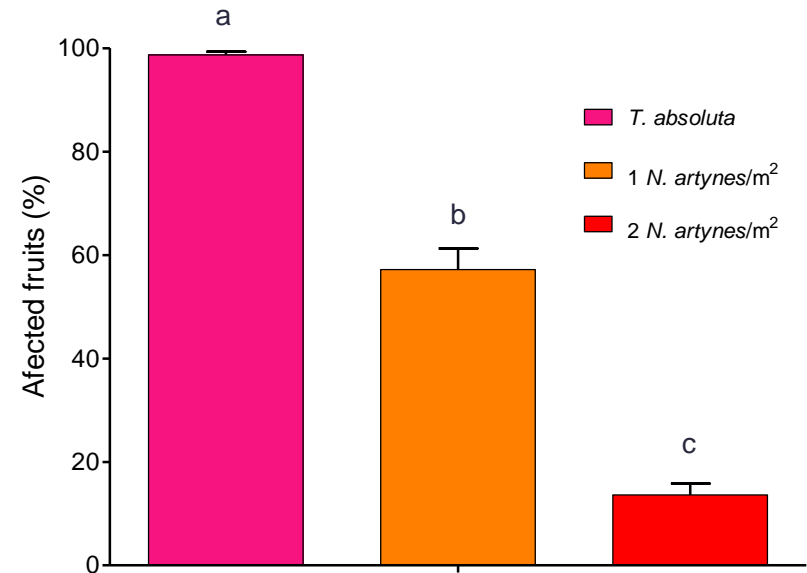
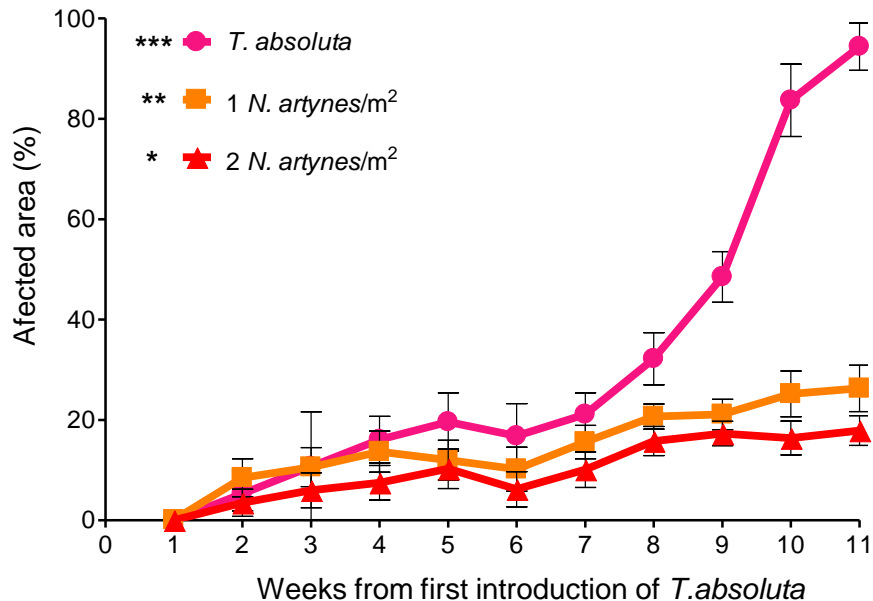
Necremnus artynes

Could a larval parasitoid improve the efficacy of *Nesidiocoris tenuis*?

Efficacy of *Necremnus artynes* controlling *T. absoluta*

Semi-field trial

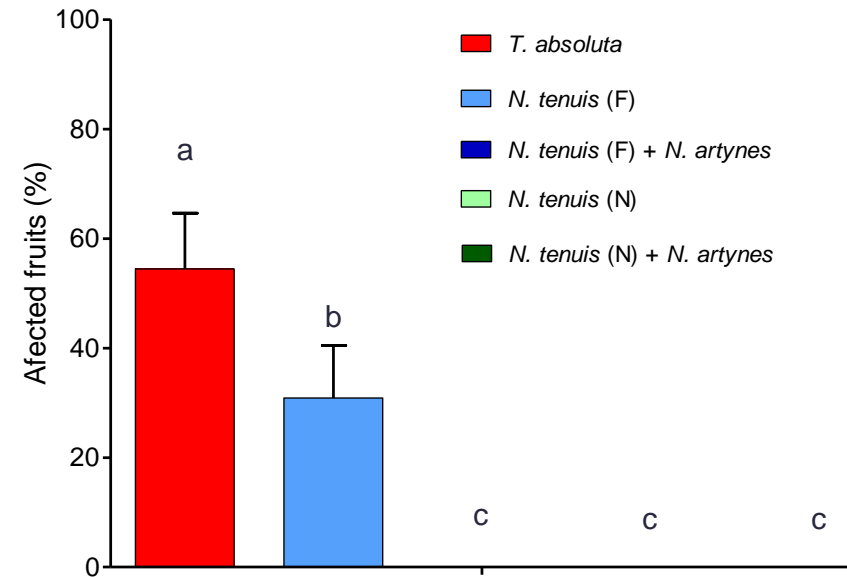
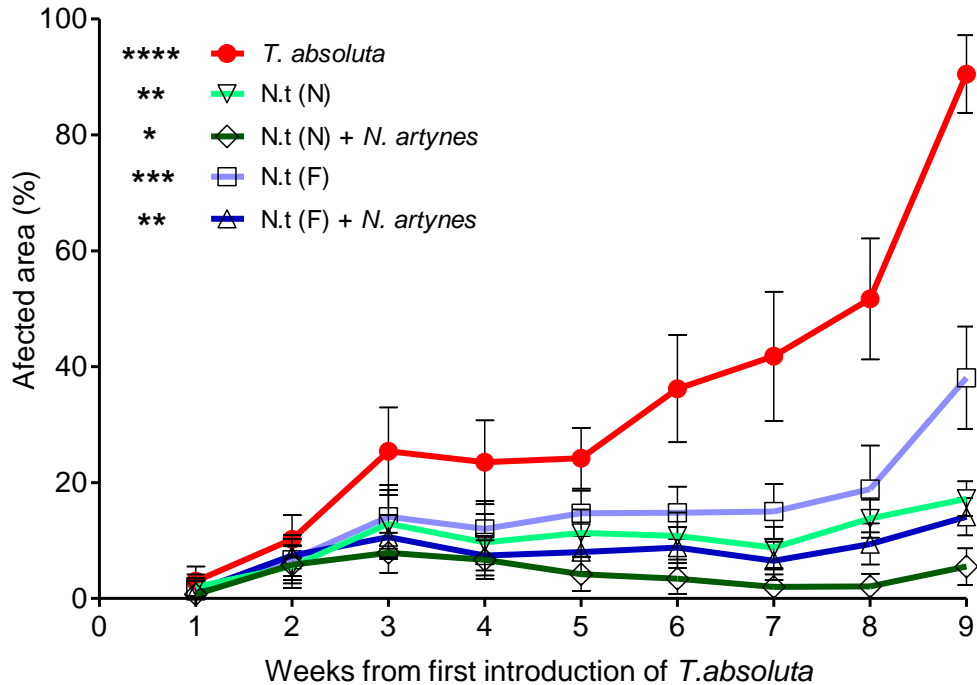
1. *T. absoluta* (1 couple/plant)
2. *T. absoluta* (1 couple/plant) + 1 *N. artynes* /m² (7 weeks)
3. *T. absoluta* (1 couple/plant) + 2 *N. artynes* /m² (7 weeks)

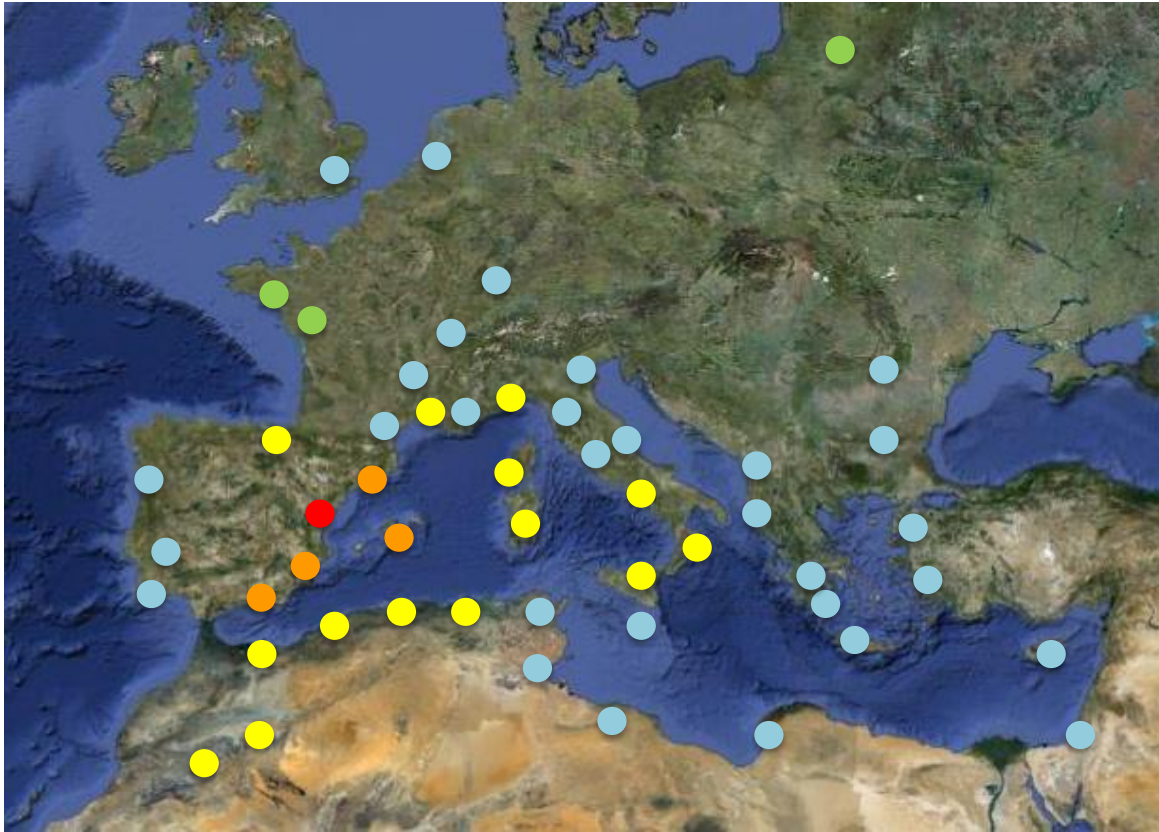


Additive effect of *Necremnus artynes* controlling *T. absoluta*?

Semi-field trial

1. *T. absoluta*
2. *T. absoluta* + 0,5 *N. tenuis*/pl
3. *T. absoluta* + 0,5 *N. tenuis*/pl + 1 *N. artynes*/m² x 4
4. *T. absoluta* + 1,5 *N. tenuis*/m²
5. *T. absoluta* + 1,5 *N. tenuis*/m² + 1 *N. artynes*/m² x 4

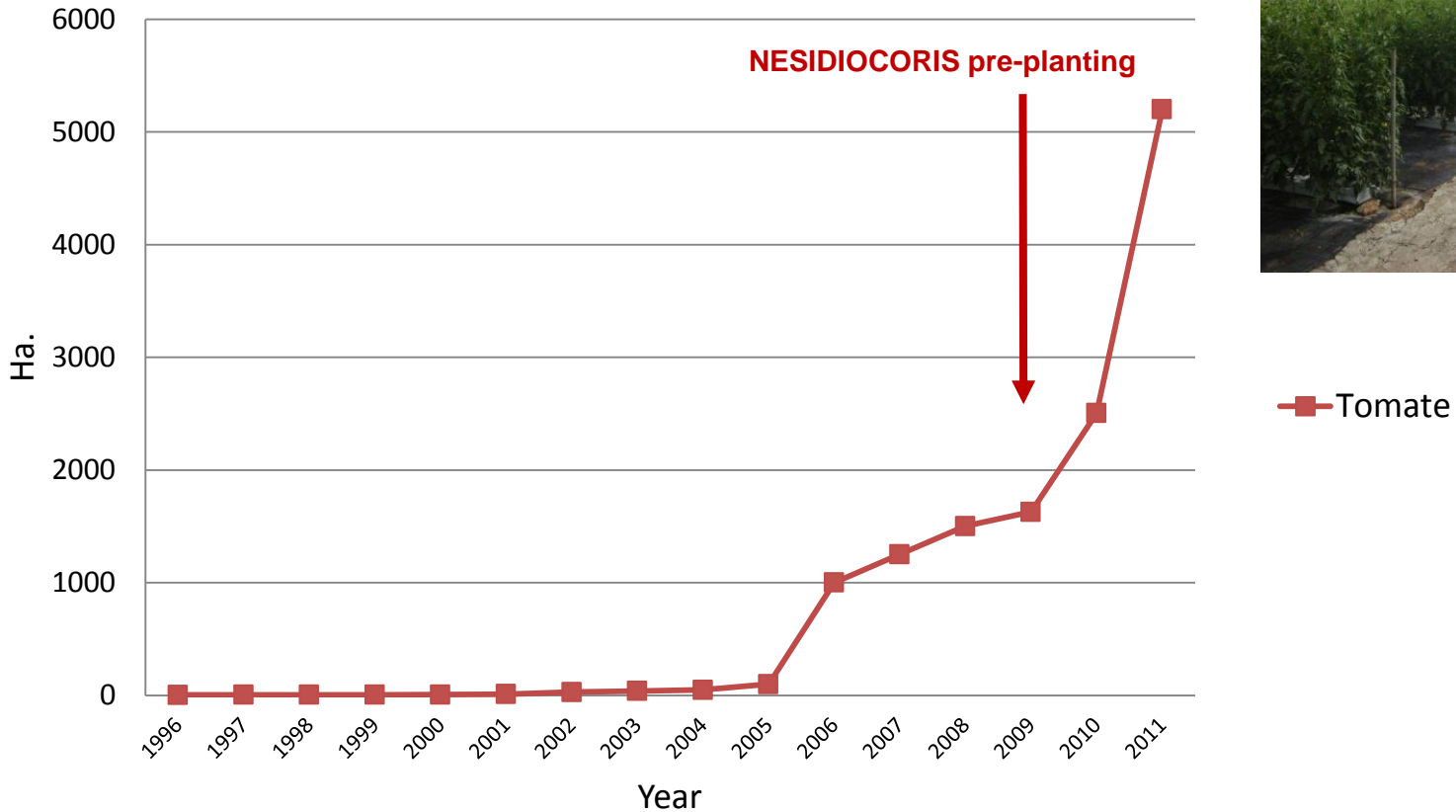




Success and extension of the biological control of *Tuta absoluta* in tomatoes in the Mediterranean basin

Biological Control in tomatoes: Almería

Surface with Biological Control



■ Tomato

Extension of Biological Control of *Tuta absoluta* in tomatoes with *Nesidiocoris tenuis* in pre-planting strategy

Spain:

- Greenhouses (Almería, Murcia, Granada, Canary Islands, Valencia)
- Open field (Granada, Valencia)
- Processing tomatoes (Extremadura, Sevilla)

Morocco:

- Greenhouses

Turkey:

- Greenhouses

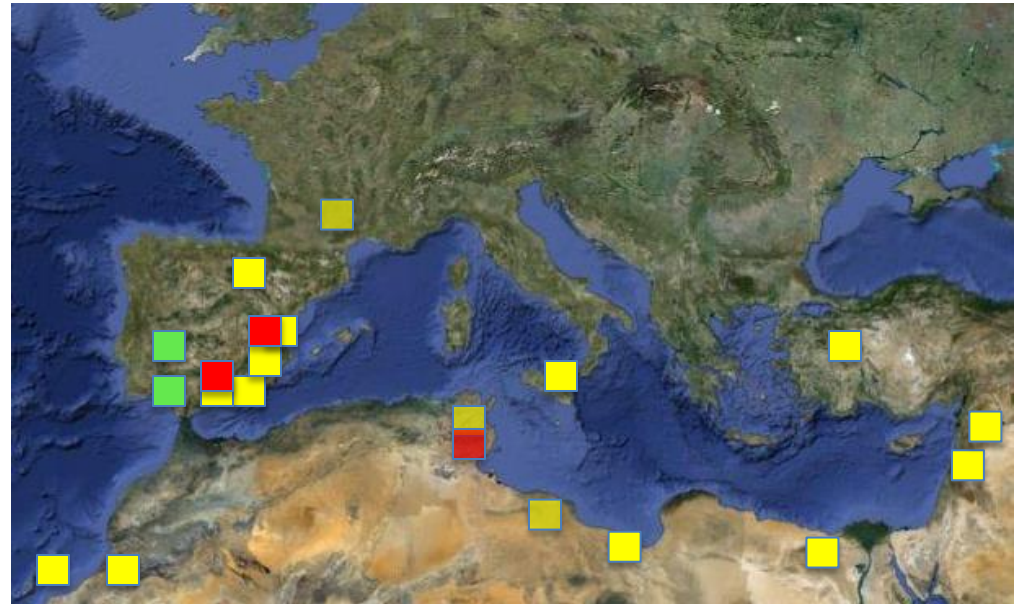
Italy

- Greenhouses

Libya, Tunisia, Israel, Algeria,

France (tests)...

- Greenhouses tomatoes
- Open field tomatoes





Thanks for your attention!



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