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منظمة وقاية النباتات للشرق الأدنى
NEAR EAST PLANT PROTECTION ORGANIZATION

IOBC/WPRS North Africa Commission

IRAC

IBMA International Biocontrol Manufacturers' Association

# Conception of an integrated pest management program to control the tomato leaf miner *Tuta absoluta* (Povolny) in industrial tomato crops in Tunisia

**Prof. Brahim CERMITI**
*Higher Agronomic Institute of Chott-Mariem, University of Sousse, Tunisia*
*In collaboration with General Direction of Plant Protection*
Mail: chermiti.ibrahim@iresa.agrinet.tn
chermiti54@yahoo.fr

Khaled ABBES
Ahlem HARBI
Abir HAFSI
Farouk BOUROGAA
Sondess YOUSSFI
Hatem KARBOUL
Najwa KHALDI

# Tomato: strategic crop in Tunisia

Cultivated area

27.000 ha in 2008/09
32.000 ha in 2009/10
32.000 ha in 2010/11

Production

1 million tones

Industrialized Tomato crops are the most important in area and production

# Experimental biotopes


TAKELSA :400- 450 mm/year

KORBA : 350-400 mm/year

TEBOULBA : 300-350 mm/year

KAIROUAN : 250-300 mm/year

To convince tomato growers to use sex pheromones traps against *T. absoluta* we tried to demonstrate the efficiency of integrated pest management program based on mass trapping (using different densities) compared to conventional strategies based on the single use of insecticides.

The following experiments were conducted between 2009 and 2011 in private commercial tomato crops. Implicated growers were advised to treat their crops depending on data collected from traps. Some of them were committed, some others were not!!!

Note 1: In the graphs:
-IPM crops parameters are in green,
-Conventional crops parameters are in red,
-Mass trapping curves are in blue.

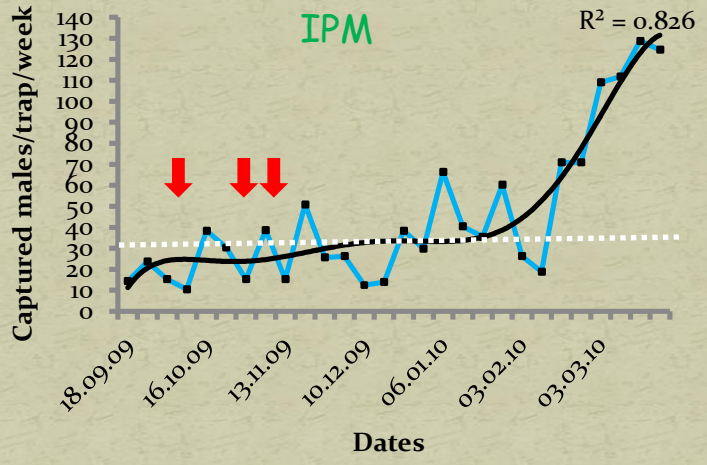
Note 2: When the infestation is:
-High parameters were expressed per leaf.
-If not, they were expressed per 100 leaves

# Biotope of Teboulba 2009/2010 : Compartive study of two protection strategies in late season open field crops (fresh tomato)

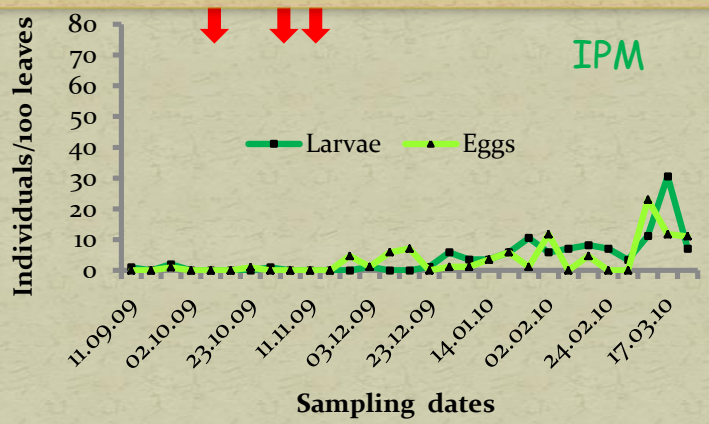
i) 1 ha IPM crop : 12 sex pheromone water traps/ha + release of 0.8 *N. tenuis*/m² ➡ 3 insecticide applications (2 Indoxacarb + 1 *Bt* ).

ii) 0.5 ha Conevnetional crop ➡ 8 insecticide applications (Abamectin , Chlorpyrifos-ethyl, Deltamethrin , Alphamethrin , Acetamiprid).

## Mass trapping



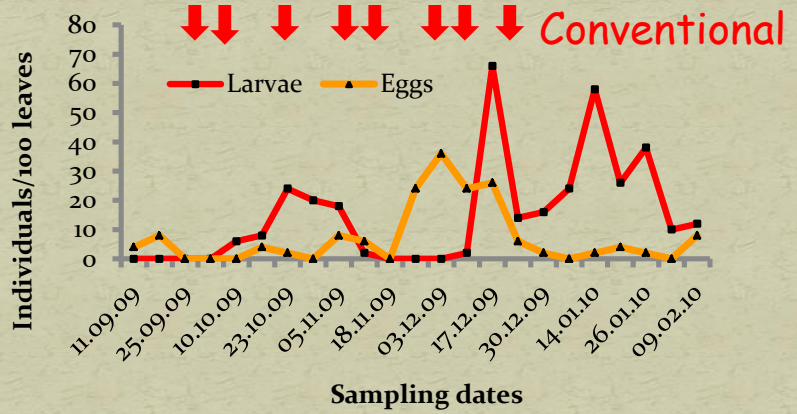

1)The use of 12 sex pheromone water traps installed from the transplantation of tomato seedlings of late season open field crop is not able either to delay or to replace the use of insecticides.




## Population dynamics

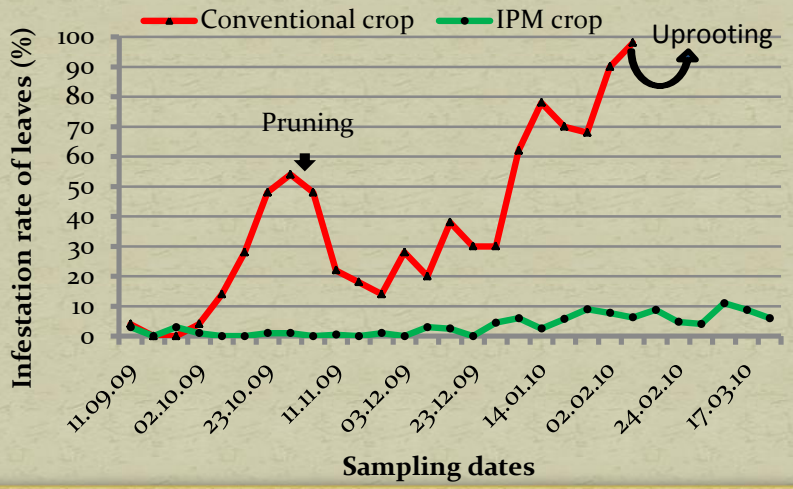
*T. absoluta*

2)The density of eggs and larvae of *T. absoluta* on apical leaves was higher in the conventional crop.

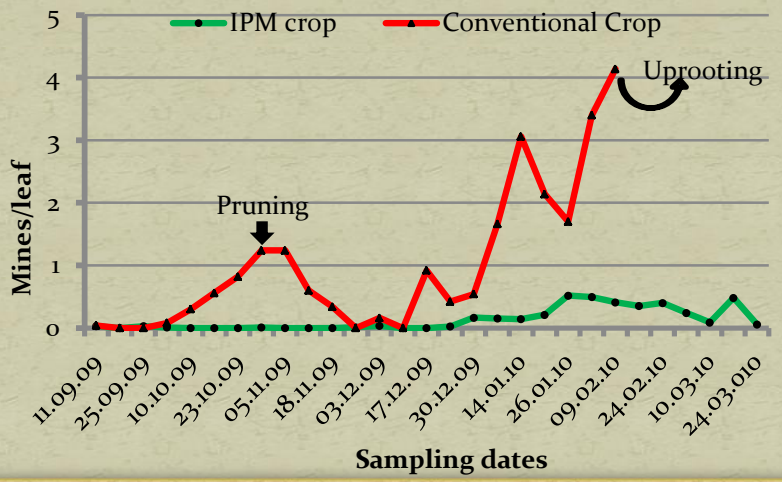


# Damage on leaves and fruits

## Infestation rate of leaves



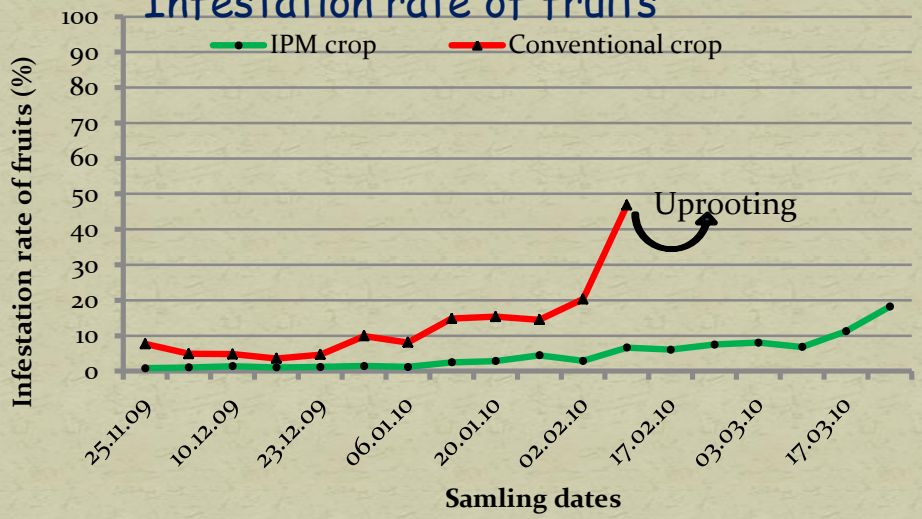

## Leafmines



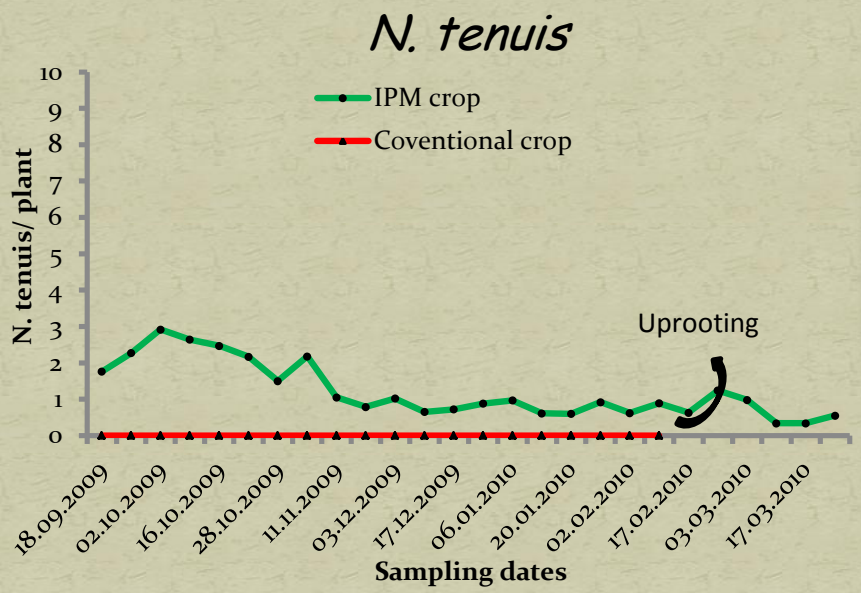

3)Integrated pest management was able to ensure a final infestation rate of leaves of 11% versus 98% in the conventional cropping system.

4)The density of mines was significantly higher in the Conventional crop

## Infestation rate of fruits




5)The infestation rate of fruits per plant increased steadily to peak at 46.81% in the conventional cropping versus 18.20% in the IPM crop.




6)The assessment of the introduction of *N. tenuis* in the conventional cropping field, showed its complete absence in the entire period of monitoring.

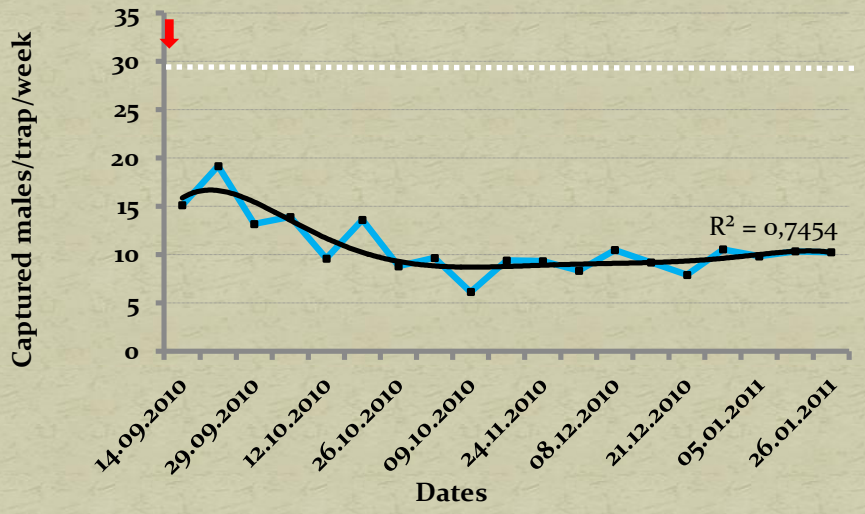
Conclusion: Using only 12 traps/ha and 3 insecticides applications we were able to:

- Reduce the infestation rate of leaves
- Reduce the number of mines/leaf
- Reduce the infestation rate of fruits.
- Maintain *N. tenuis* in the crop.

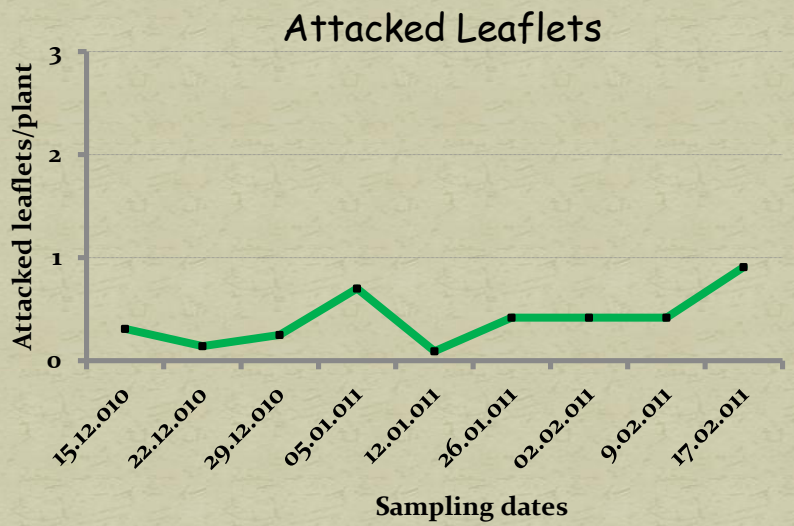
# Biotope of Teboulba 2010/2011 : Conservative biological contol

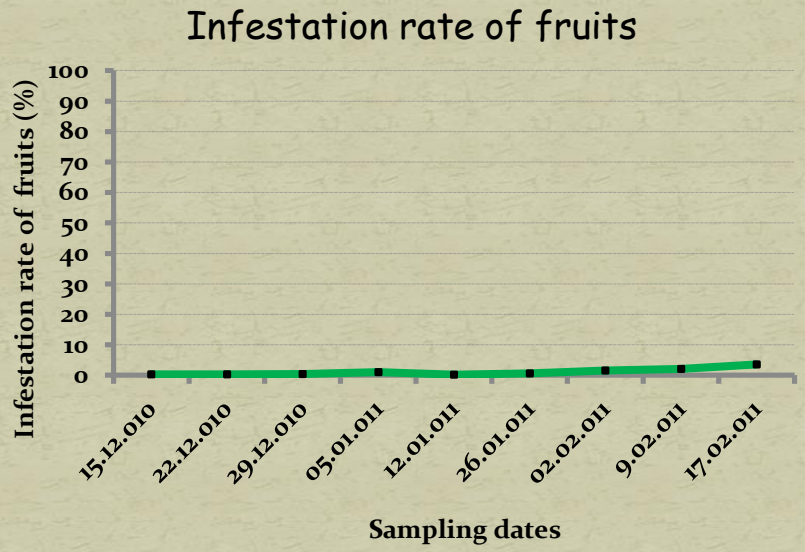
**1 ha IPM crop : 30 sex pheromone water traps/ha + spontaneous introduction of *N. tenuis* → 1 insecticide application ( Indoxacarb)**

## Mass trapping




## Damage on leaves and fruits



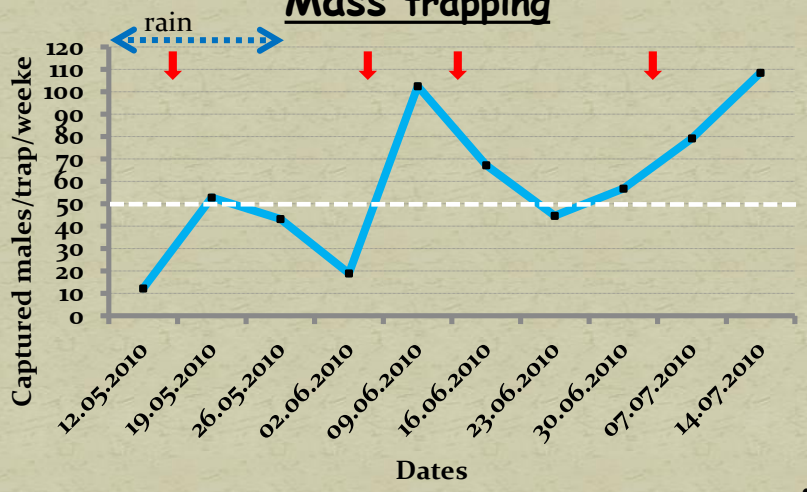




**Conclusion:** 30 traps/ha were sufficient to maintain a low number of attacked leaflets/plant and a low infestation rate of fruits/plant not exceeding 3.51%

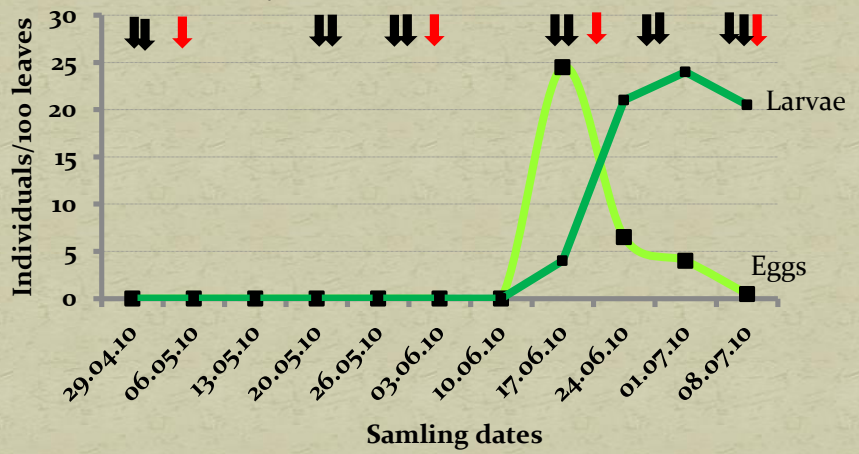
# Biotope of Takelssa 2010 : Evaluation of IPM based on mass trapping and augmentative biological control in industrialized tomato crop

2 ha IPM crop : 30 sex pheromone water traps/ha + 1.5 *N. tenuis*/m² + 2 x *Ephestia* eggs ➡ 4 insecticide applications ( Indoxacarb+ 2 x Bt + Spinosad).

## Mass trapping

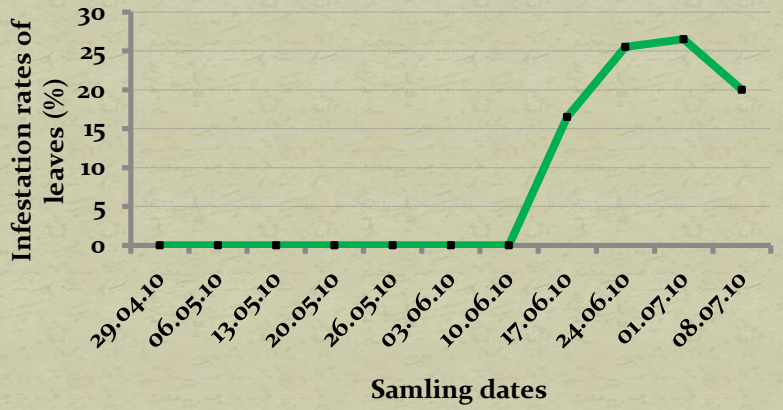



## Population dynamics

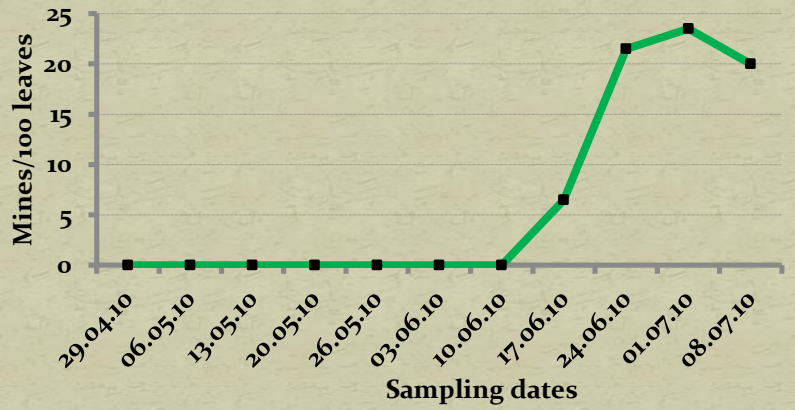



## Damage on leaves

### Infestation rate of leaves




### Leafmines

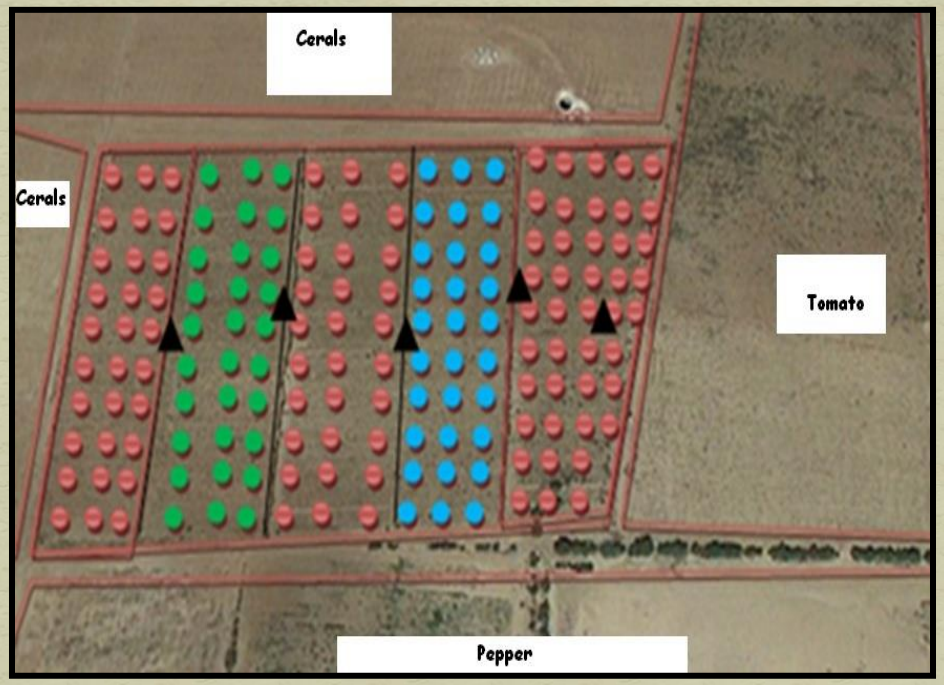


## Experimental tomato crop in Takelssa (2010)

Conclusion: Takelssa is one of the most infested areas by *T. absoluta* . Mass trapping was able to guarantee minimum damage on leaves. However, *N. tenuis* was not able to establish in the crop probably because of heavy fungicides applications against *P. infestans* (12 applications).
Heavy rains characterizing this humid biotope participated in the failure of the establishment of the bug.

# Biotope of Kairouan 2011 : Mass trapping based strategy and comparison of three lures

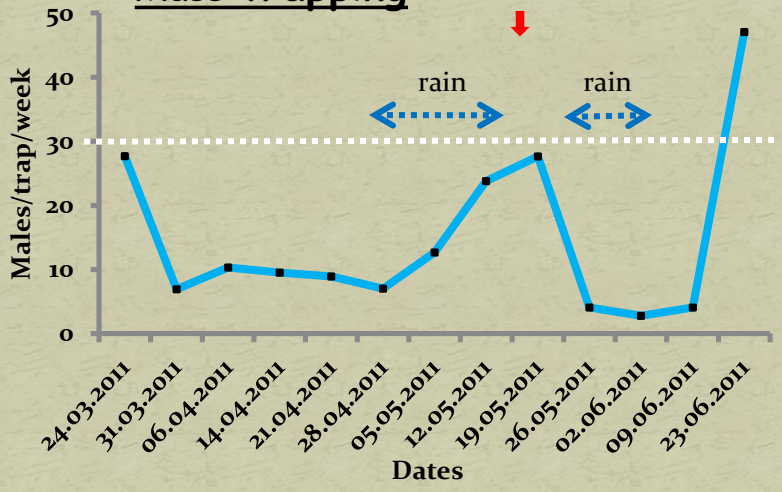
5 ha IPM crop : 32 sex pheromone water trap/ha 1 insecticide application (Indoxacarb).



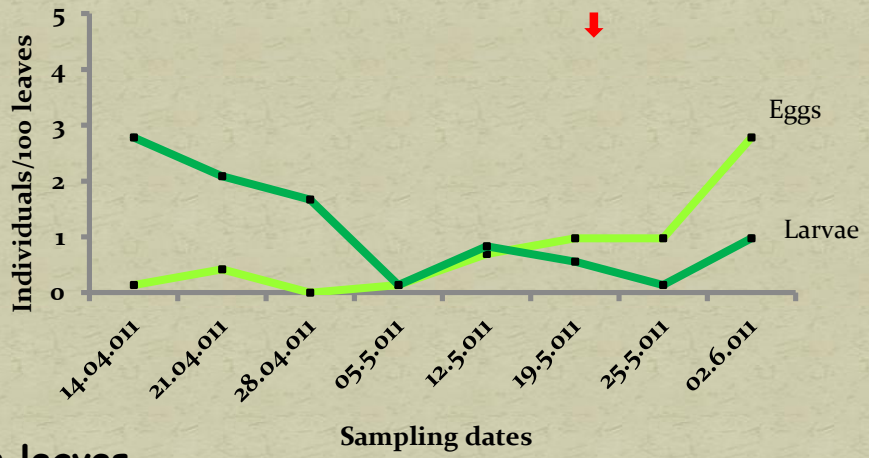

# Biotope of Kairouan 2011 : Mass trapping based strategy and comparison of three lures

**5 ha IPM crop : 32 sex pheromone water trap/ha ➡ 1 insecticide application (Indoxacarb).**

## Mass trapping

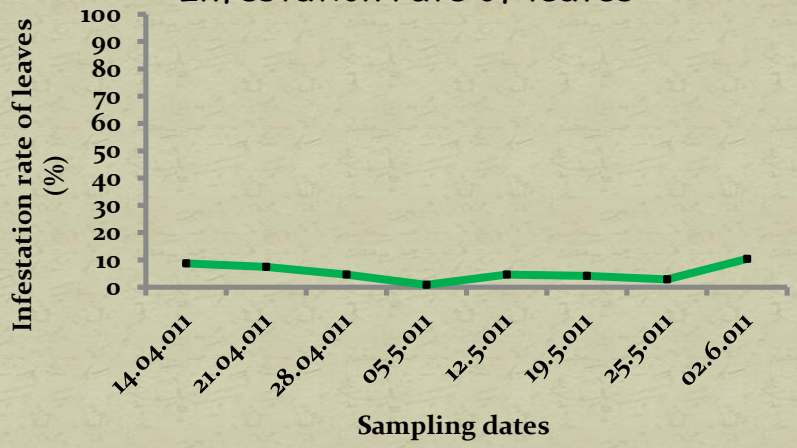



## Population dynamics

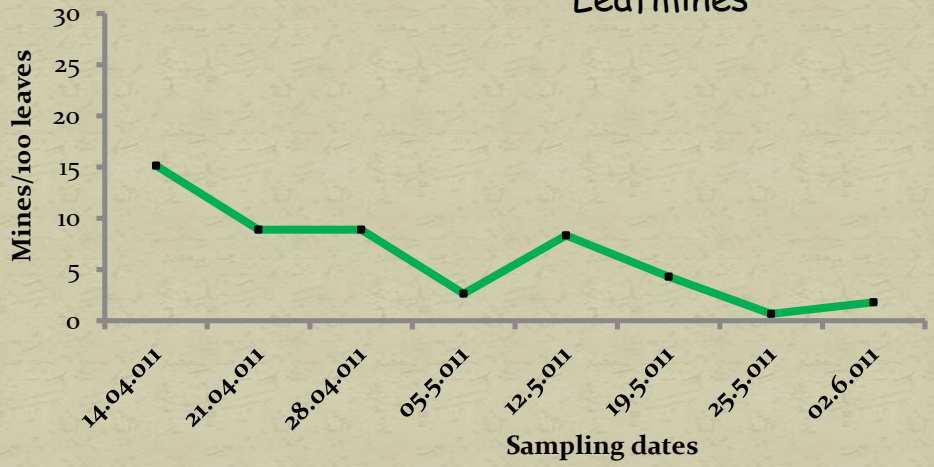



## Damage on leaves

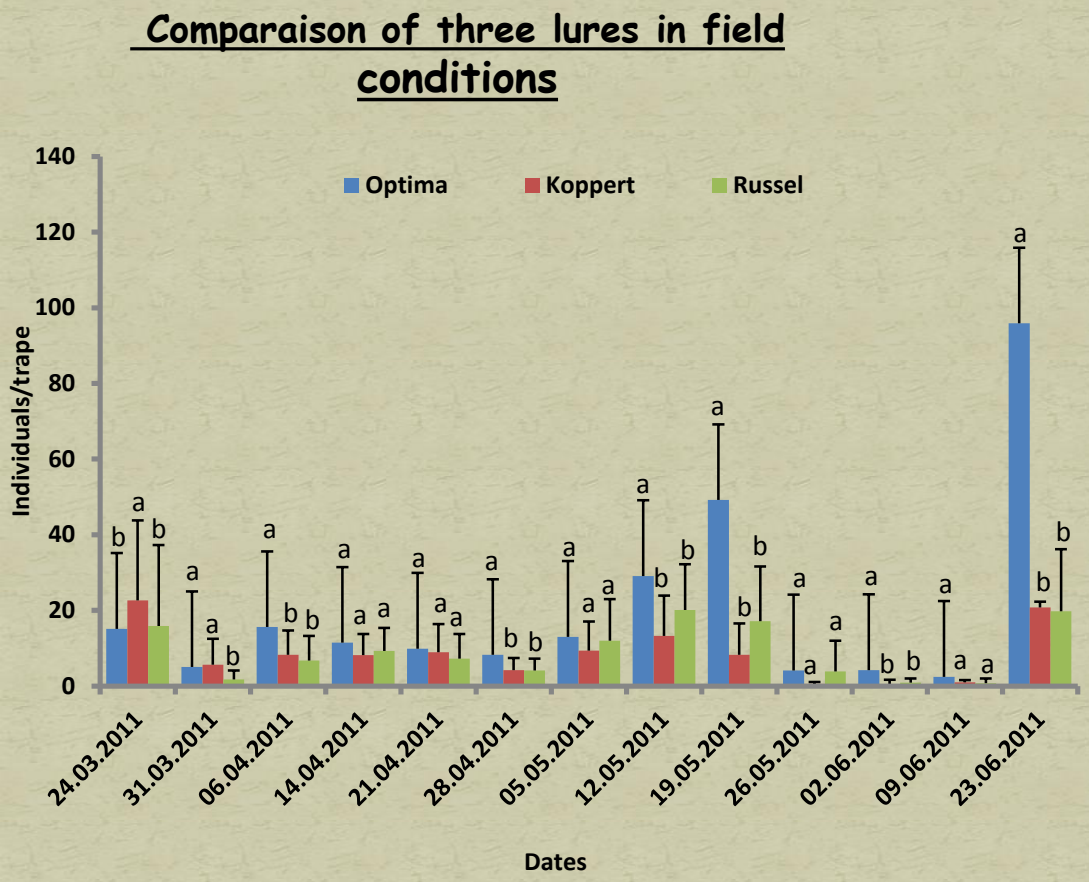
### Infestation rate of leaves




### Leafmines



1)The high density of traps combined with one single insecticide application (mainly oriented against *Helicoverpa armigera*) was able to ensure a low infestation rate of leaves and a reduced population on the crop.




2) Lures Mark TUA-optima (Russell IPM) were more attractive to males of the *T. absoluta*.

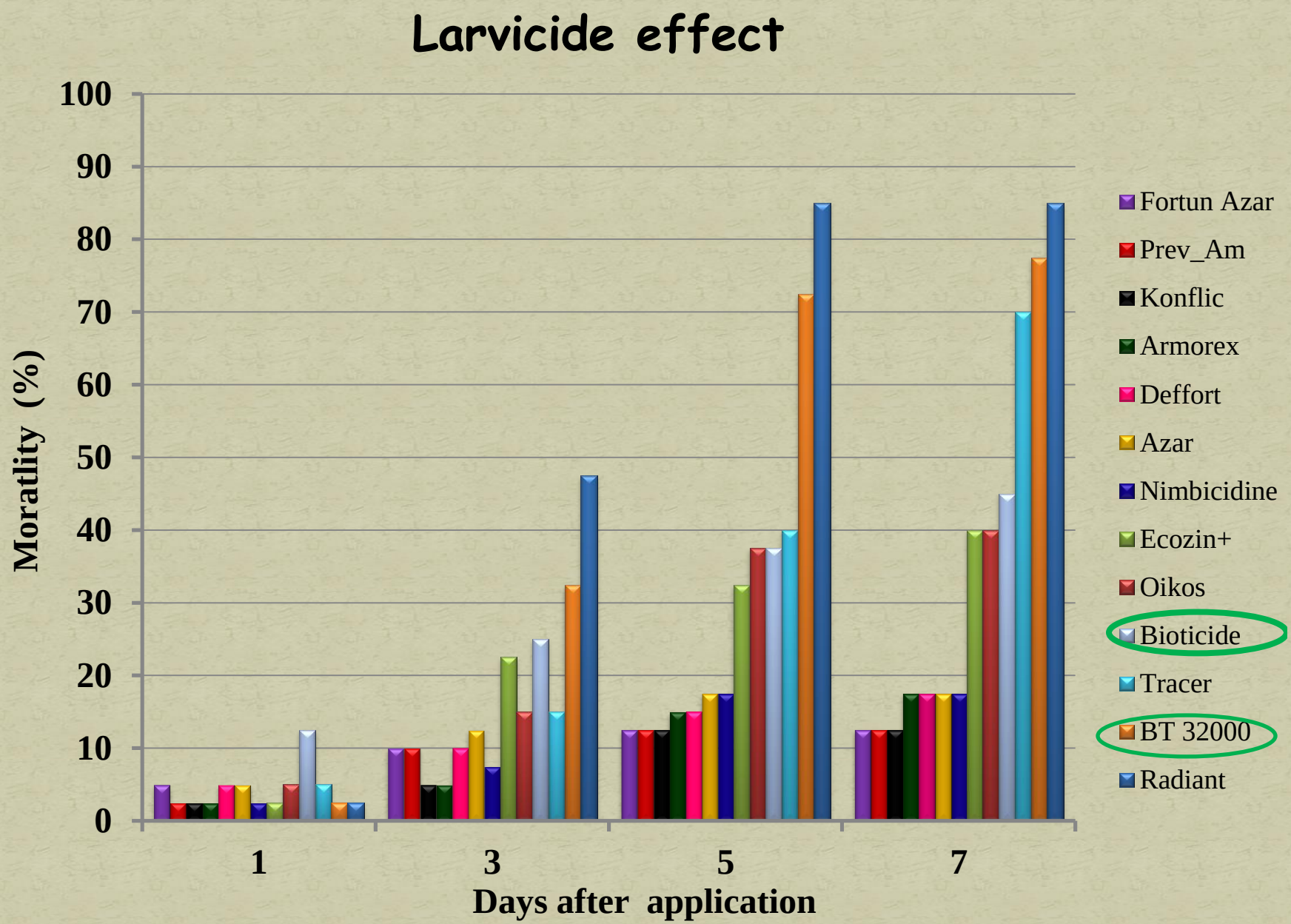
3) The effeciency of TUA-500 (Russell IPM) and Pherodis (Koppert) was similar.

Note: the experiment was stopped earlier than programmed after massive hail damage.

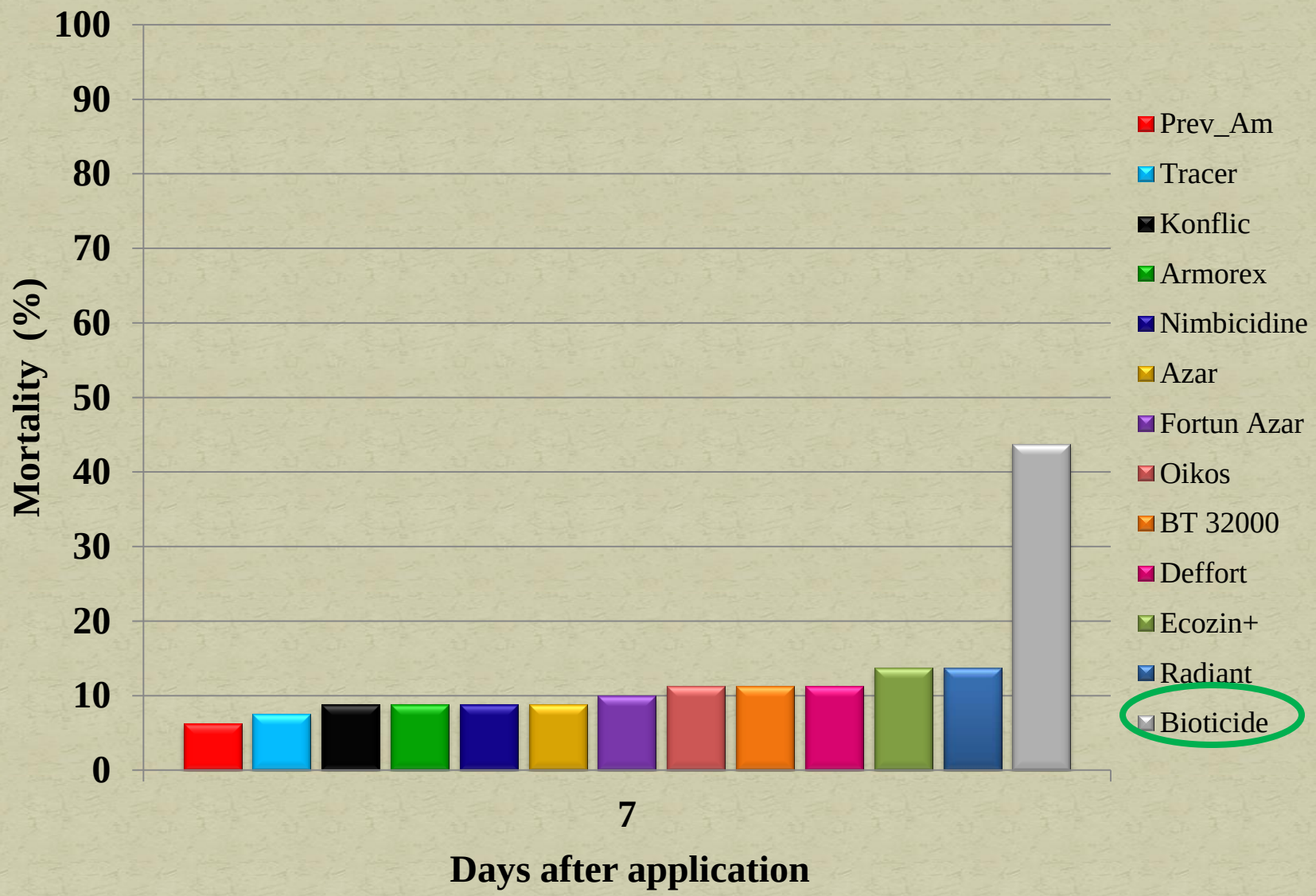
Conclusion : In Kairouan, one of the warmest and driest regions of Tunisia, the use of the density of 30 traps/ha was able to reduce the number of insecticides applications to just one mainly oriented against *H. Armigera.*

After evaluating the mass trapping technique in different biotopes and the comparison of some pheromone lures, it was necessary to choose the most adequate density and to pick some soft but efficient insecticides to be integrated with the use of mass trapping and biological control.

# Laboratory experiments on the response of *T. absoluta* to some insecticides



# Ovicide effect



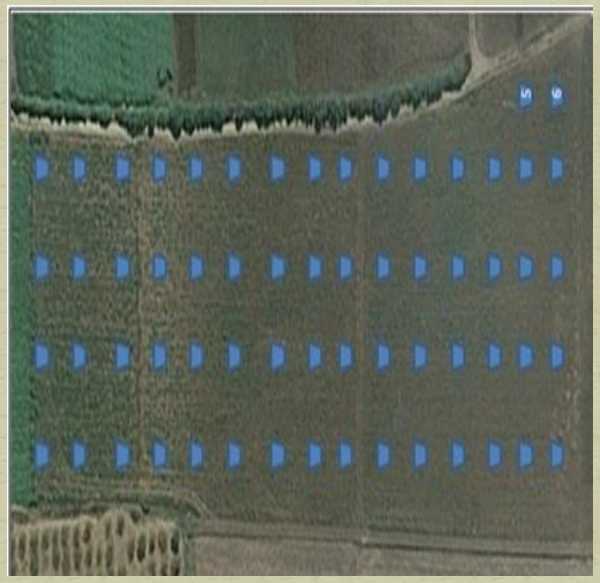
**Note** : On the basis of laboratory results, we choosed two insecticides which are Thuricide (*Bt* ) (larvicde effect) and Bioticide (ovicide and larvicide effect) and we compared them to Avaunt (Indoxacrb) which is the most used product against *T. absoluta* and *H. armigera*) by tomato growers in the region

# Biotope of Korba, first case : Mass trapping based strategy and field comparison of three soft insecticides

First case (Google earth, 2011)



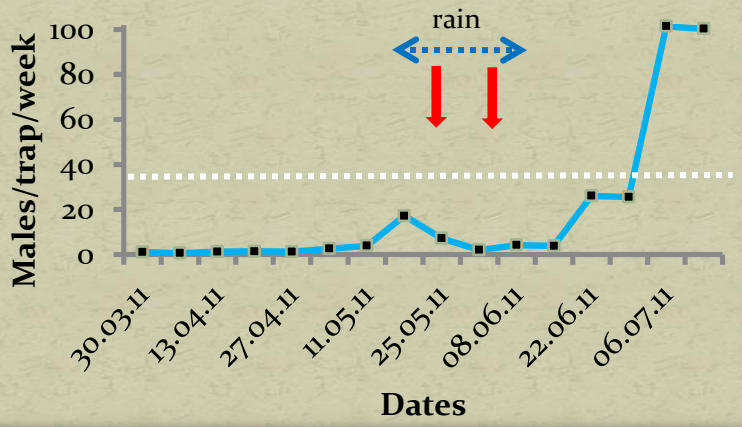
Second case (Google earth, 2011)

# Biotope of Korba, first case : Mass trapping based strategy and field comparison of three soft insecticides

**2 ha IPM crop : 30 sex pheromone water trap/ha ➡ 2 x *Bt* (Thuricide) or 2 x Neem oil + Azaderachtin (Bioticide) or 2 x Indoxacarb (Avaunt)**

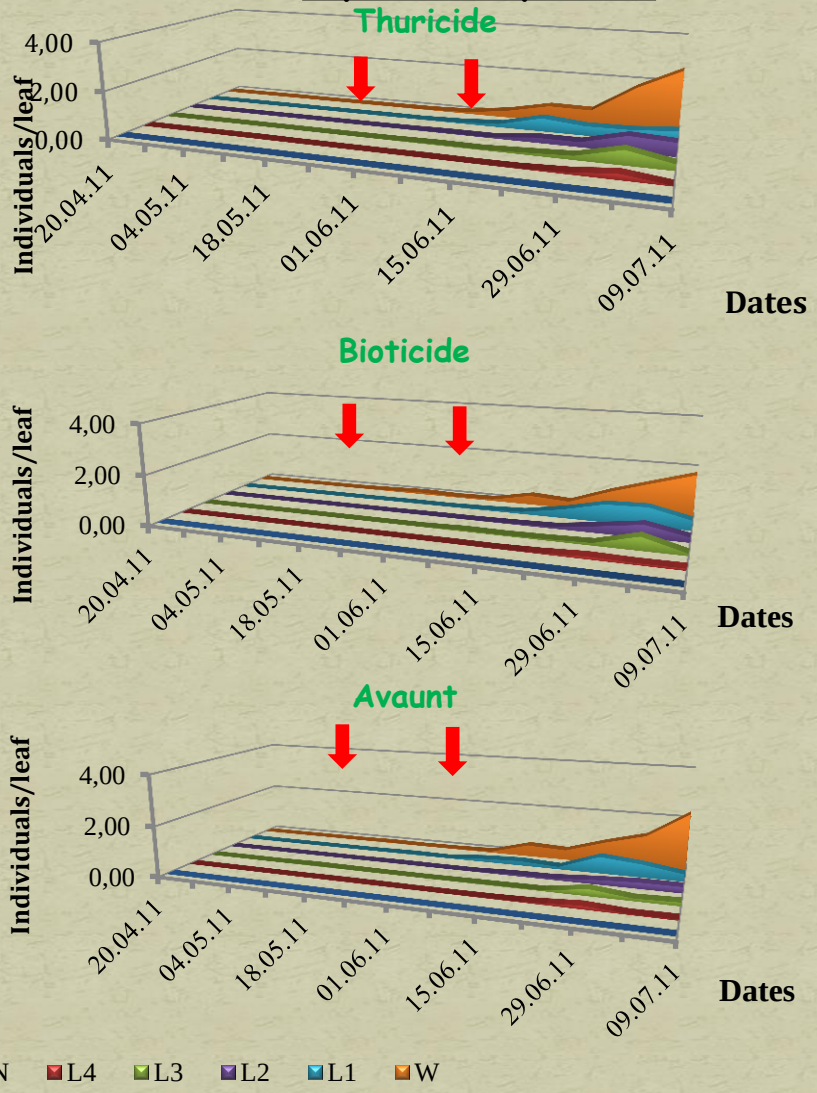
## Mass trapping




1) The density of traps was sufficient to keep the number of weekly trapped males under the economic threshold.

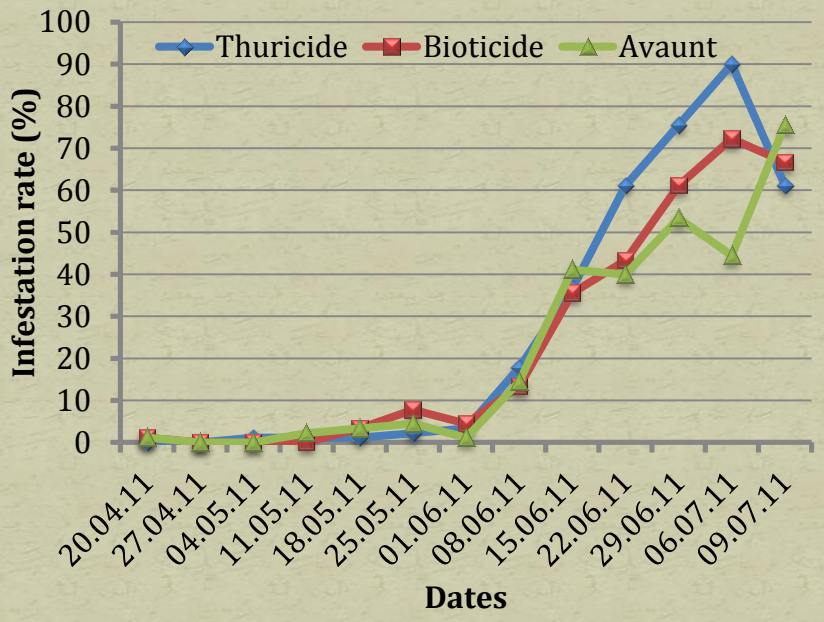
2)The population dynamics of *T. absoluta* on Leaves was similar among different blocs treated with different insecticides.

## Population dynamics

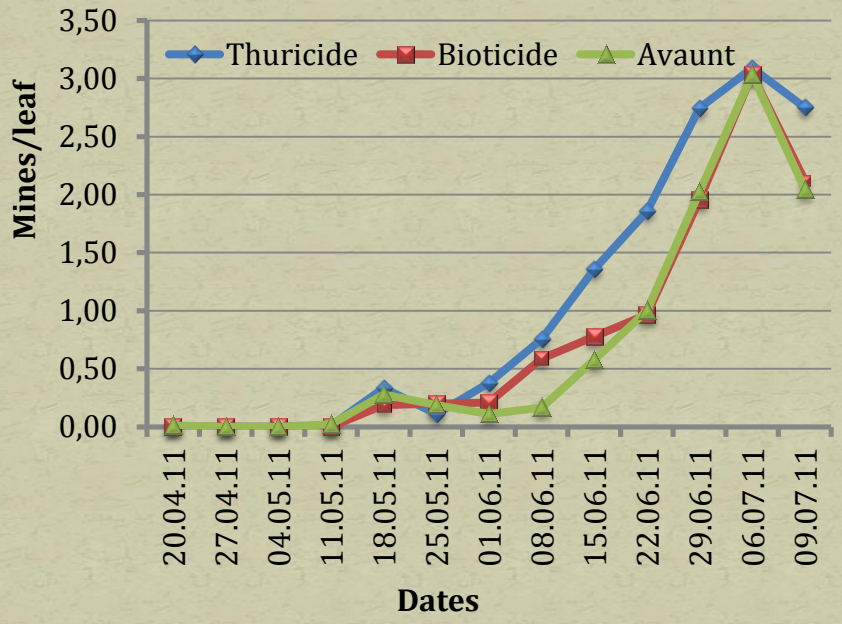


# Damage on leaves

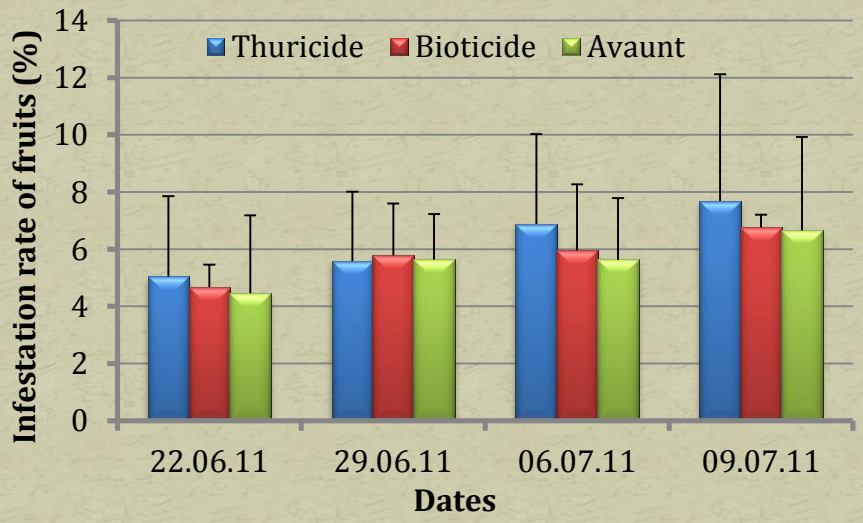
Infestation rate of leaves




Leafmines




# Damage on fruits

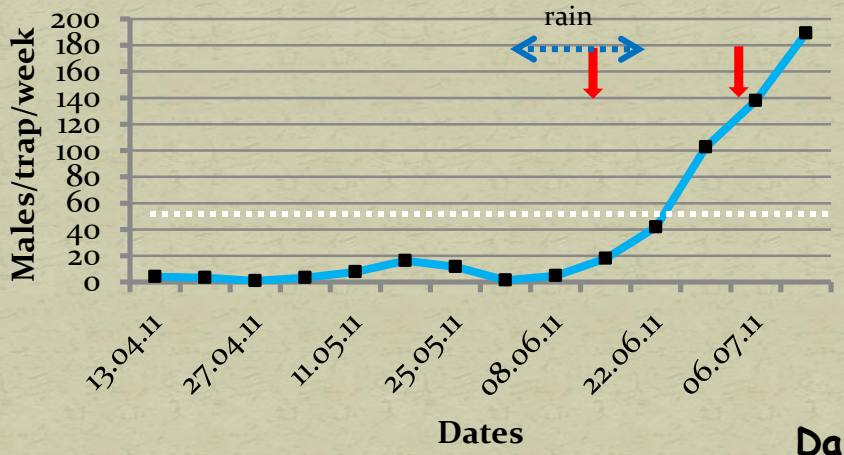



3) Monitoring of the infestation rate of leaves, the average number of mines/leaf and the infestation rate of fruits didn't revealed significant differences among the three evaluated strategies.

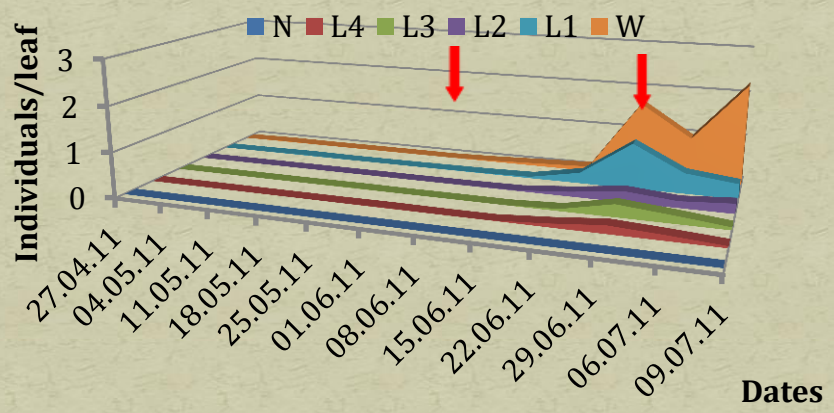
# Biotope of Korba, second case : Mass trapping based strategy

**2.8 ha IPM crop : 22 sex pheromone water trap/ha → 1x *Bt* (Thuricide) + 1x Indoxacarb (Avaunt).**

## Mass trapping

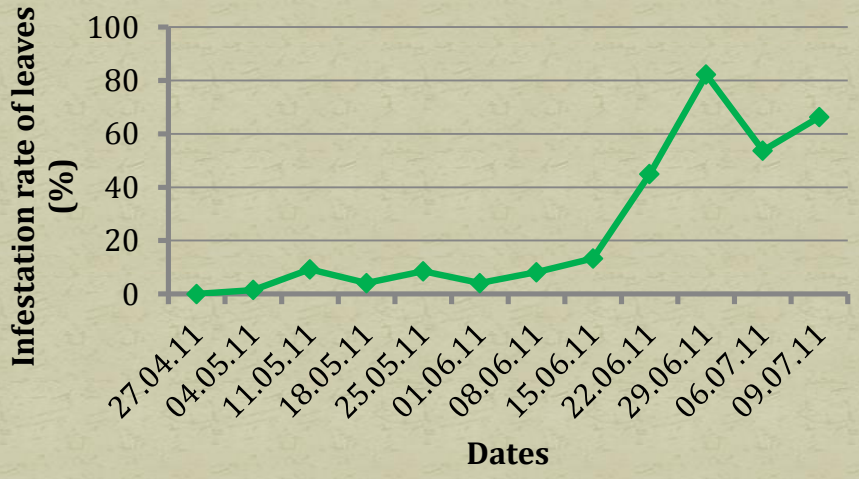



## Population dynamics

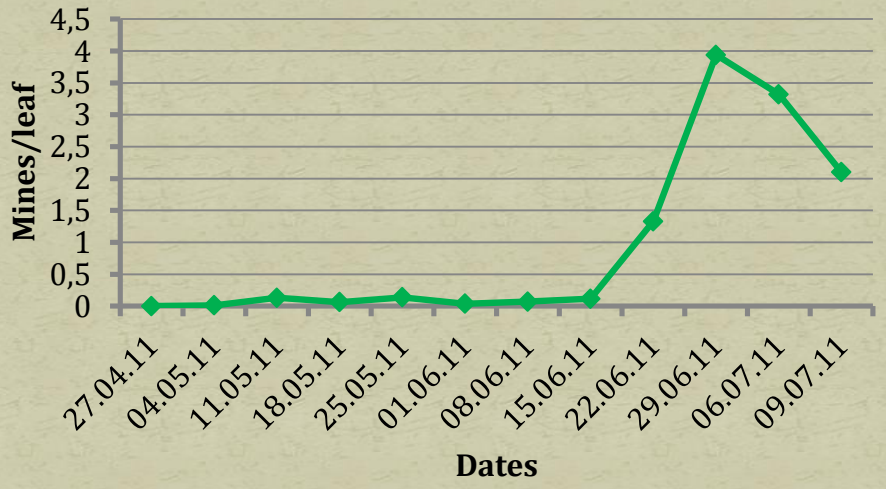



## Damage on leaves

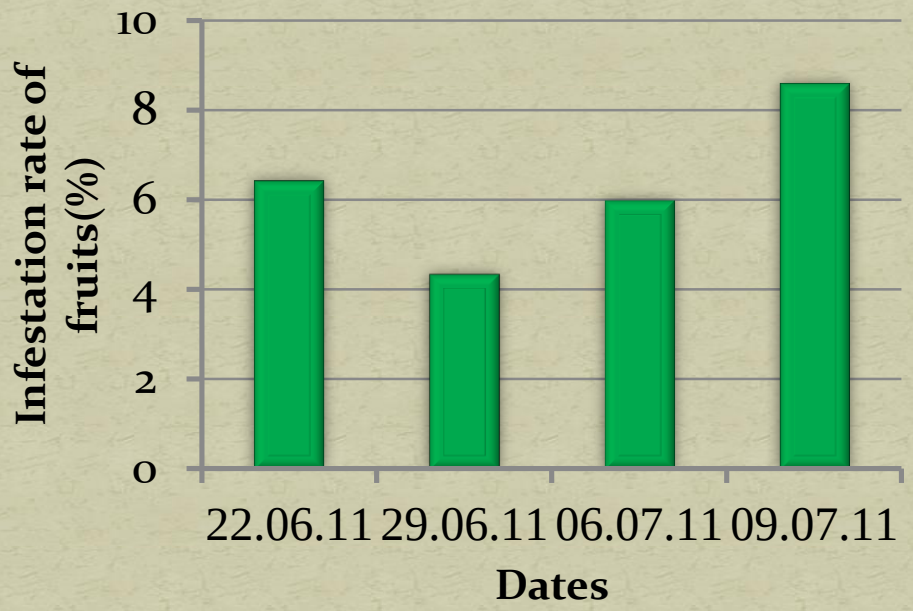
### Infestation rate of leaves




### Leafmines



## Damage on fruits




4) The comparative study between the two sex pheromone traps densities in open field tomato crops showed insignificant differences concerning population dynamics of *T. absoluta* and infestation rates of fruits

## Comparison between the two crops (July 9th , 2011)

| Biotope of Korba | Area (ha) | Trap density /ha | Number of insecticides application | Trapped males /Week/ha | Males /trap | Individuals /leaf | Infestation rate of leaves (%) | Mines /leaf | Infestation rate of fruits (%) |
|---|---|---|---|---|---|---|---|---|---|
| Case 1 | 2 | 30 | 2 | 1225 | 100.28 | 3.22 | 67.77 | 2.30 | 7.03 |
| Case 2 | 2.8 | 22 | 2 | 1765.7 | 189,09 | 2.91 | 66.29 | 2.09 | 8.59 |

5) Comparison of studied parameters in the end of the experiment revealed the absence of significant differences between the two crops.

Conclusion : in Korba, one of the most favorable regions for *T. absoluta*, experience showed that the use of 22 sex pheromone water traps/ha and 2 insecticides applications with *Bt* or Indoxacarb or Neem oil + Azadirachtin are sufficient measures to control the miner.

On the base of obtained results in laboratory and field experiments we propose the following strategy.

Transplanting

Infestation of *Tuta absoluta*

End

**Mass trapping (22/ha)**

**Bioticide**

***Bt***

**Bioticide**


However, trap design should be more resistant to water evaporation and traps should be put under drippers.


Thank you very much