# IPM of *Tuta absoluta* in processing tomatoes in Israel

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# *T. Absoluta's* damage in open field tomatoes

Effect of *T. absoluta* in Jalur Libya

Photo taken on 26 Dec 2009 by Khalid Kekle

# Population dynamic of *T. absoluta* in newly invaded countries

- In the I stage (usually a year) there is a latent period with a build up of the population but with no damage to the crops.
- In the II Stage a **population explosion** with extensive damage to crops.
- In the III stage local natural enemies learn to prey upon the pest and lead to a gradual decline of the population.
- Ferran Garcia-Marí 2010

# توتا أسلوتا- المحفز للعمل بالمكافحة المتكاملة في محصول البندورة لصنيع

أعداد : ليؤورة شألتيئل وشاؤول جراف- محطة أبحاث الشمال

ترجمة : محمد يوسف أبو طعمة – خدمات الأرشاد, لواء الشمال, وزارة الزراعة

# An example of IMP thinking in Tomatoes

| Pesticide | IRAC Group | Pest | Damage to beneficials | Damage to *N. tenuis* Nymphs | Adults |
|---|---|---|---|---|---|
| ABAMECTIN | 6 | Tetranychus urticae Aculops lycopersici | High mainly to predatory mites | 4 | 4 |
| EMAMECTIN BENZOATE | 6 | T. Absoluta . A.lycopersici Thrips spp. | ? | ? | ? |
| ENDOSULFAN | 2 | Heliothis armigera Aphidoidae, Bemisia tabaci | Moderate | ? | ? |
| LAMBDA CYHALOTHRIN | 3 | Spodoptera littoralis, A.lycopersici B.tabaci | High General | 4 | 4 |
| PARAFINIC OIL | | A.lycopersici, Diseases | ? | 4 | 3 |
| PROPARGITE | 12 | Tetranychus urticae | ? | 1 | 1 |
| INDOXACARB | 22 | T. Absoluta and other moth | ? | 1 | 0 |
| SPINOZAD | 5 | Thrips spp., Liriomyza trifolii , T. Absoluta | Moderate to Parasitoids. Orius | 1 | 1 |
| SULPHUR | | A.lycopersici, Diseases | Low | 1 | 1 |

# Research objective:

To study the fauna of natural enemies of *Tuta absoluta* in Israel and evaluate their efficacy .

# Material and Methods

The research included 4 parts:

1. Survey of the fauna of natural enemies of *T. absoluta* in commercial fields.
2. Survey of the fauna of natural enemies of *T. absoluta* in a pesticide free experimental field.
3. Laboratory experiments.
4. Field experiment.

# 1.Survey in commercial fields

- 7 fields  of 100 Dunams (25 acres) were selected in 3 regions of the country .
- In each field 6 plots of 20 $m^2$ were randomly selected.
- Each plot was vacuumed for 1 minute to a separate bag.
- Additional information about spraying treatments in each plot was gathered from the pest scouts.

# Sampling in the field

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*Nesidiocoris tenuis* Reuter

Photos: Lotem Azoulay

# Research questions:

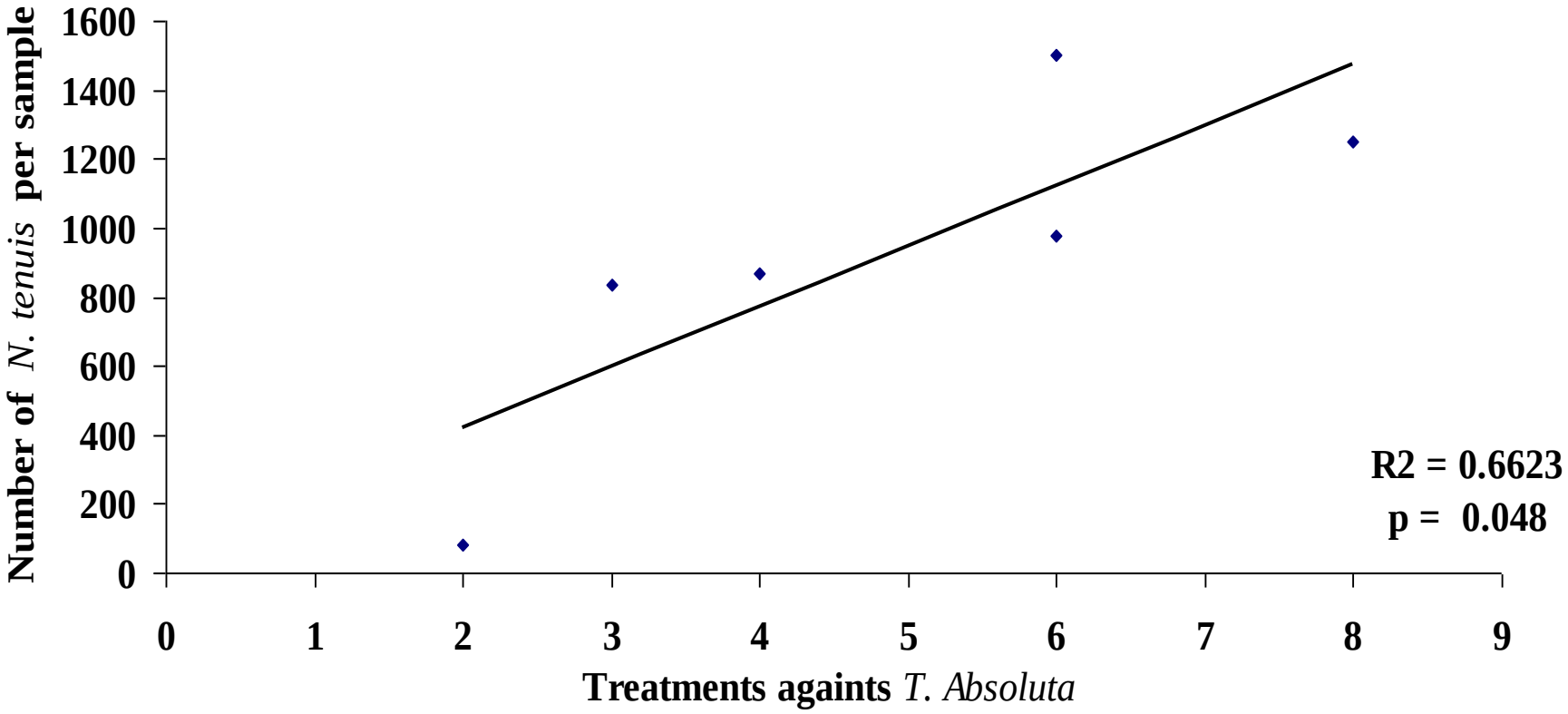
1. What is the natural density of *N.tenuis in* commercial fields of processing tomatoes in Israel?
2. Is there a correlation between the population of *T. absoluta* and *N. tenuis* in these fields*?*
3. Do chemical treatments in the fields effect the population of *N. tenuis?*

# Natural density of *N. tenuis* in commercial fields

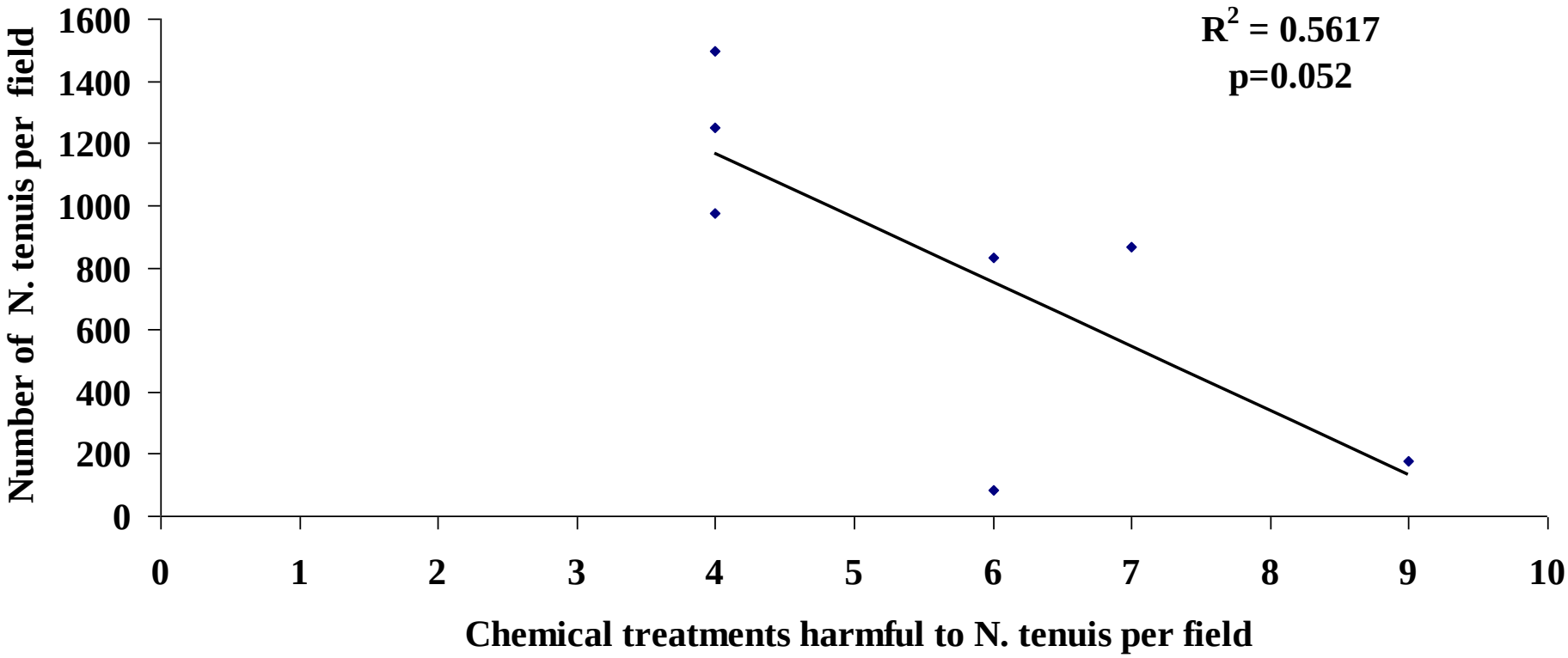
| **Field details** | **Average No. of *N.tenuis*** per plant ±SE | **No. Treatments against *T.absoluta*** | **No. Treatments harmful to *T.absoluta*** | **No. Treatments harmful to *N. tenuis*** |
|---|---|---|---|---|
| **Organic Izrael valley** | 0.25 (±0.07) | 7 | 7 | 9 |
| **Conventional western Gallee1** | 1.74 (±0.6) | 8 | 8 | 4 |
| **Conventional western Gallee2** | 1.36 (±0.4) | 6 | 6 | 4 |
| **Conventional western Gallee3** | 2.50 (±0.8) | 6 | 6 | 4 |
| **Conventional Hula valley 1** | 0.12 (±0.1) | 2 | 2 | 6 |
| **Conventional Hula valley 2** | 1.20 (±0.3) | 2 | 4 | 7 |

Natural density of *N. tenuis* in commercial fields is 0.25-2.5 plant

# Relation between *T. absoluta and N. tenuis* in commercial fields



# Effect of Chemical treatments on *N. tenuis* density in commercial fields



# Conclusions of the field survey

- *N.tenuis* naturally colonizes tomato fields in Israel.
- *N.tenuis* density in commercial fields varies between 0.25 -2.5 bugs per plant**.**
- Chemical application effects it's density.
- There seems to be a positive correlation between *T.absoluta* and *N. tenuis* populations.

# 2.Survey of the fauna of natural enemies of *T. absoluta* in a pesticide free experimental field

- Research questions:
- Who are the natural enemies that attach *Tuta absoluta* in the field؟
- What is the rate of parasitism in the field?
- Is there a correlation between parasitism rate and the population density of *T.absoluta*؟
- Can *N.tenuis* control the population of *T.absoluta* ?

# Materials and Methods

- In 12.5.11 a plot of 1 Dunam of the 2 verities 8896 (5 rows) and 2549 (2 rows) was planted in the Hulla valley.
- The Plot did not receive any chemical treatments.
- 1.6.11 we have started a weakly sampling.

# Sampling method

- Once a week we sampled the same plants in each row (61 plants).
- In every plant we counted the number of *T. absoluta* infected leafs, the number of galeeries, plant phenology and the number of *N.tenuis* that fell off while shaking the plant.
- In addition we have collected 50 infected leaves (from other plants in the field and took them to the lab to examine whether they had larva in them and if the larvae were dead or alive and we kept them to see what parasitoids came out .
- We have also collected 100 fruit to examine presence or damage of *T. absoluta* .
- In the center of the plot we placed a pheromone trap.

# Eggs of an ectoparasitoid on *T.absoluta larva*

Photo: Tamir Rozenberg

# Ectoparasitoid larva feeding on *T.absoluta*

Photo: Tamir Rozenberg

# An empty pupa of an ectoparasitoid


Photo: Tamir Rozenberg

# A pupa of an ectoparasitoid on *T.absoluta*


צילום: תמיר רוזנברג


***Habrobracon* sp. nr. *nigricans*** (Szépligeti 1901)

(Braconidae) identification Antoni Ribes


Photo: Tamir Rozenberg

***Habrobracon hebetor*** Say, 1836 (Braconidae)

identification Antoni Ribes


***Hemiptarsenus ornatus*** (Nees 1834) (Eulophidae)
identification Antoni Ribes

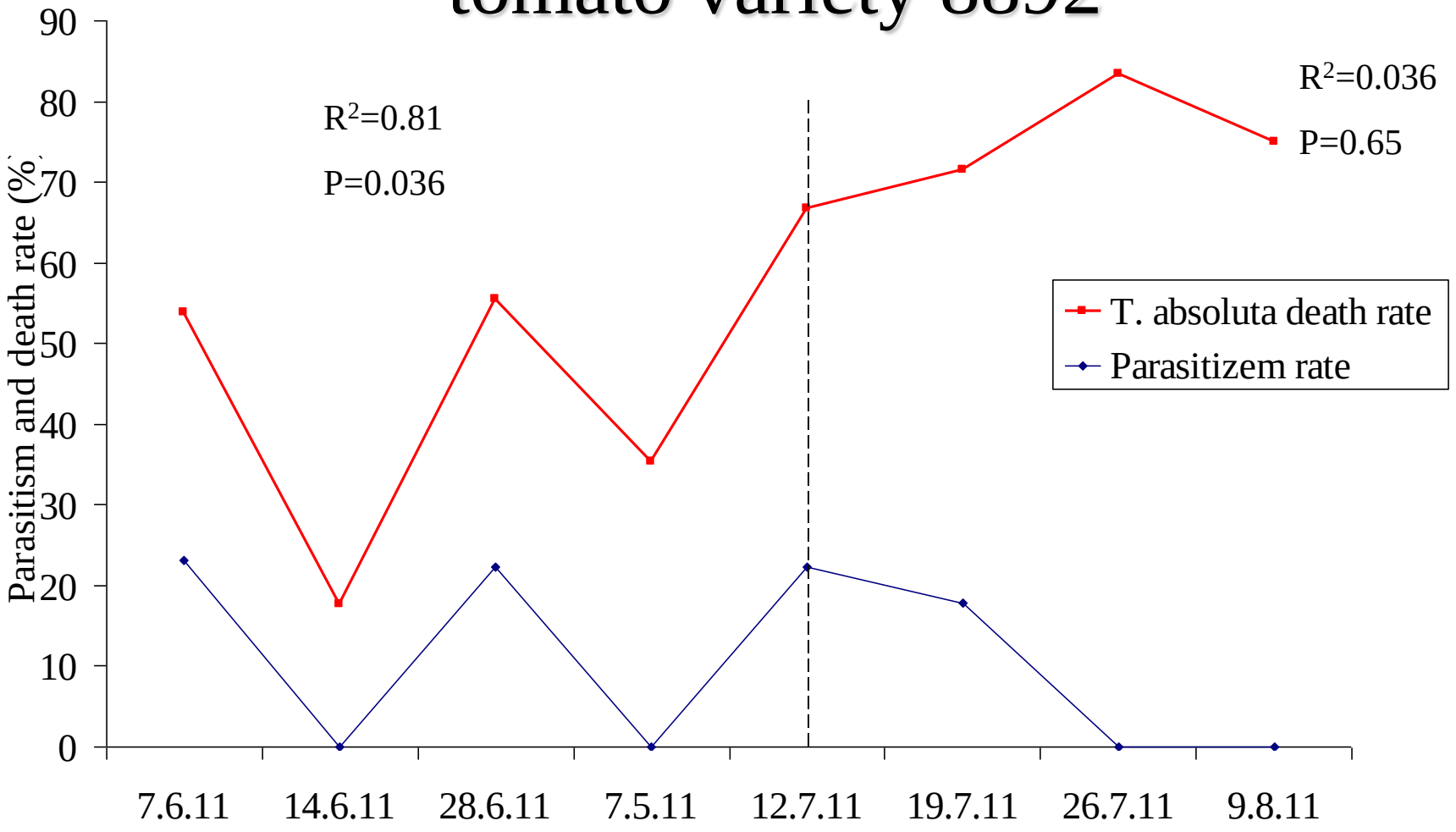

Photo: Tamir Rozenberg

***Sympiesis* sp. nr. *flavopicta*** Boucek 1958 (Eulophidae)

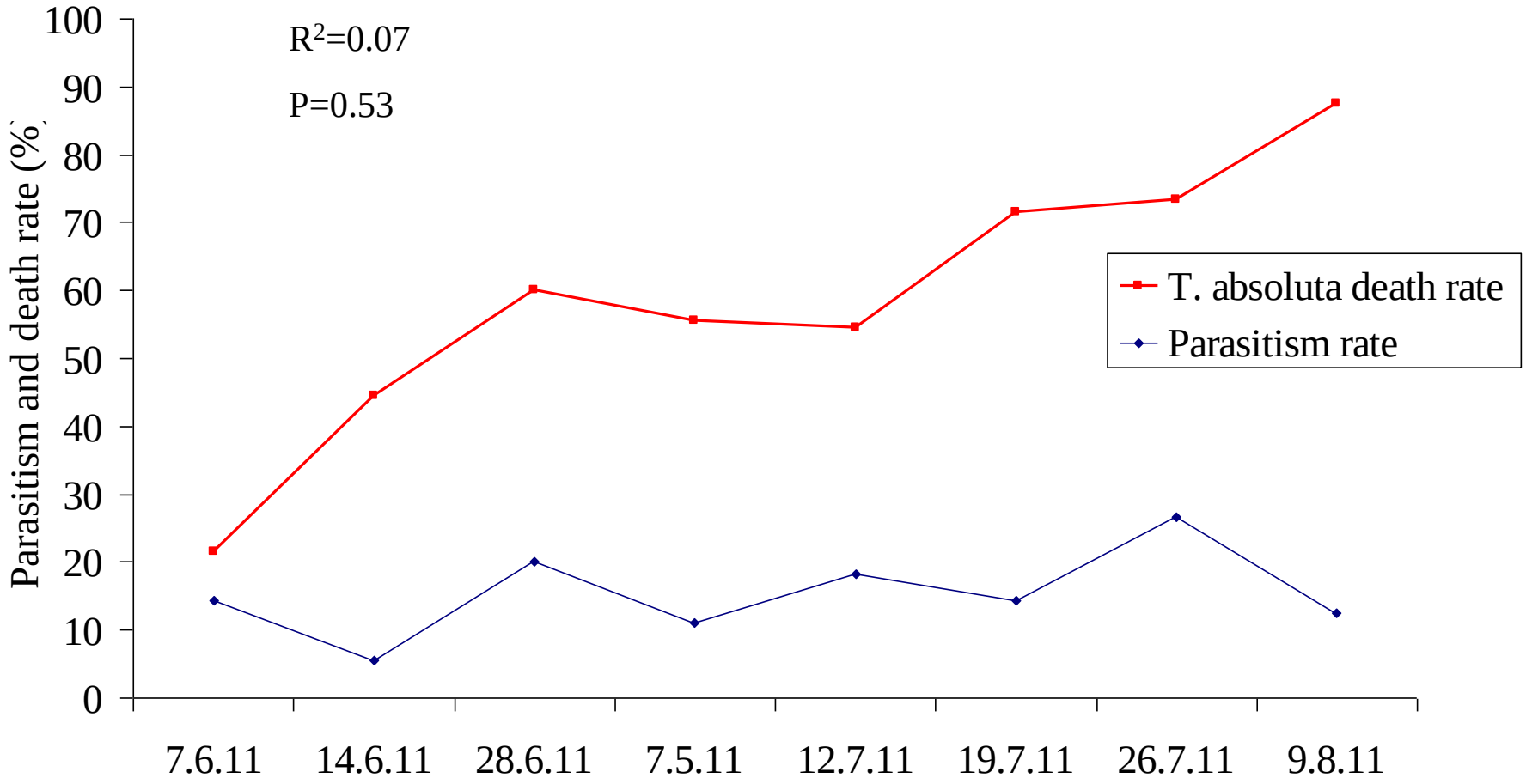
identification Antoni Ribes

- Is there a correlation between parasitism rate and the populating dynamic of *T.absoluta* in the field?

# Parasitism and death rate of *T. absoluta* in tomato variety 8892



# Parasitism and death rate of T. absoluta in tomato variety 2549



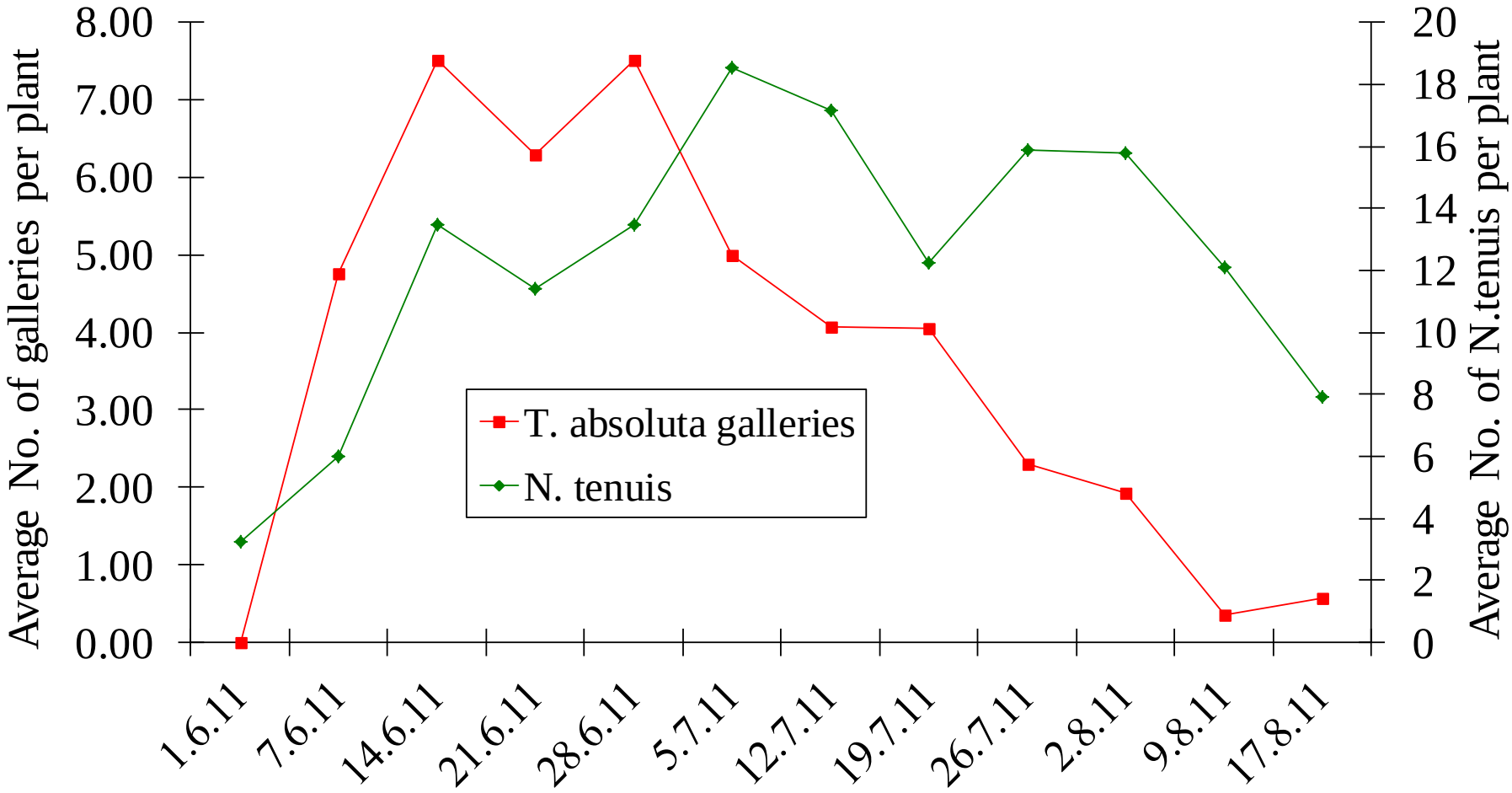
# Conclusion

- In the variety 8892 parasitism rate reached 23% and it seems there is a positive correlation between the death rate of the *T.absoluta* larva and parasitism at least in the first month.
- In the variety 2549 parasitism rate reached 26% but it seems that parasitism can not explain the death rate in this variety.

# Larva of *T.absoluta* eaten by *N.tenuis*


Photo: Tamir Rozenberg

# Population dynamics of *T. absoluta* and *N.tenuis*



# Conclusions

- The rate of *N.tenuis* in a pesticide free field can reach 20 individual per plant.
- It seems that in this rate *N.tenuis* can control *T.absoluta* population in the course of the season.

# 3. Laboratory experiments

Research questions:

Is *N.tenuis* an efficient predator of *T.absoluta?*

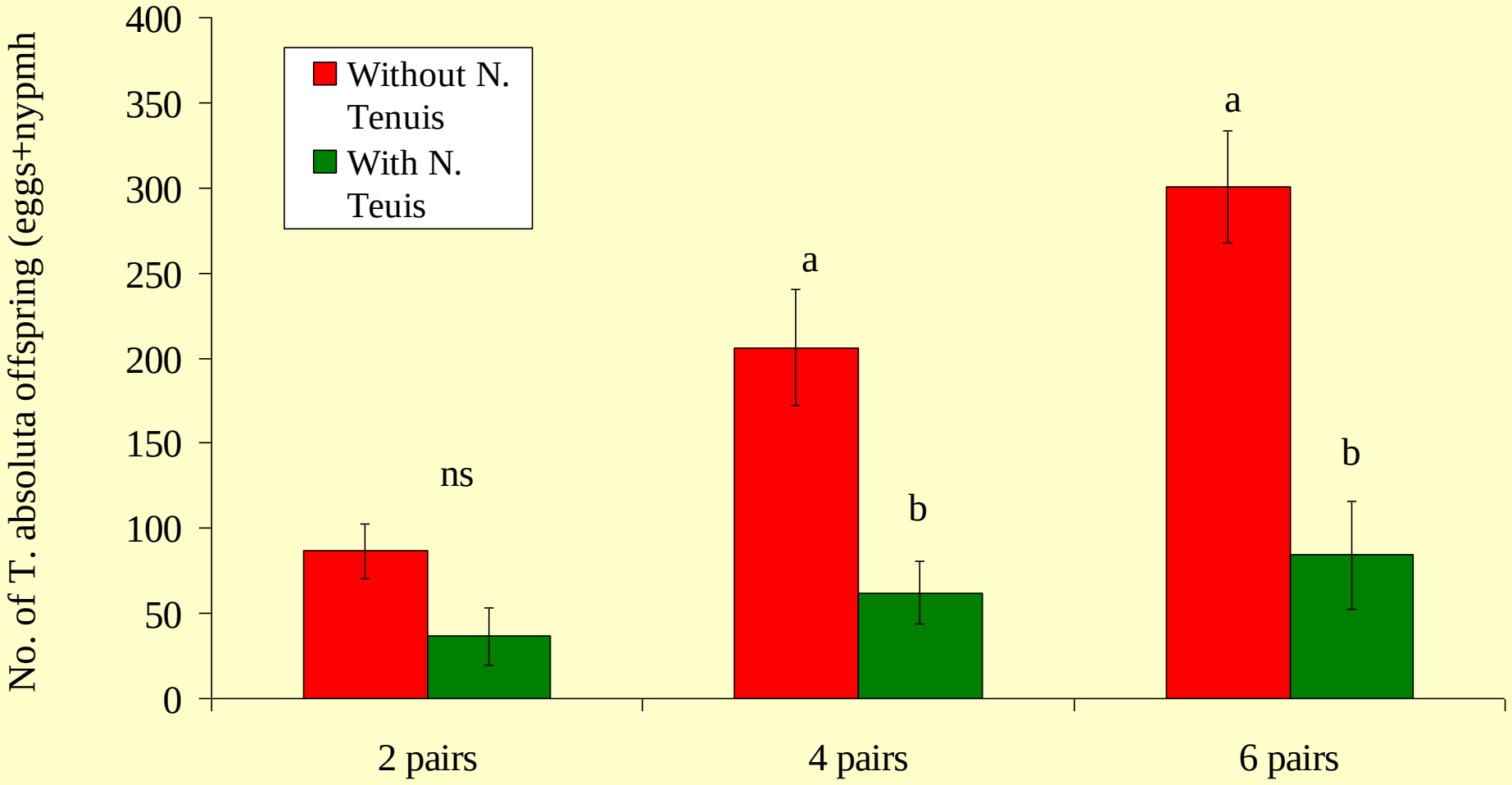
# Materials and methods

- 36 tomato seedlings (Variety 870) 2 weeks old were planted in pots in transparent polycarbonate cages and kept in a controlled environment Room (22-25ºC, 8:16 D:L) and received on of the following treatments:
- 2,4,6 pairs of *T.absoluta*

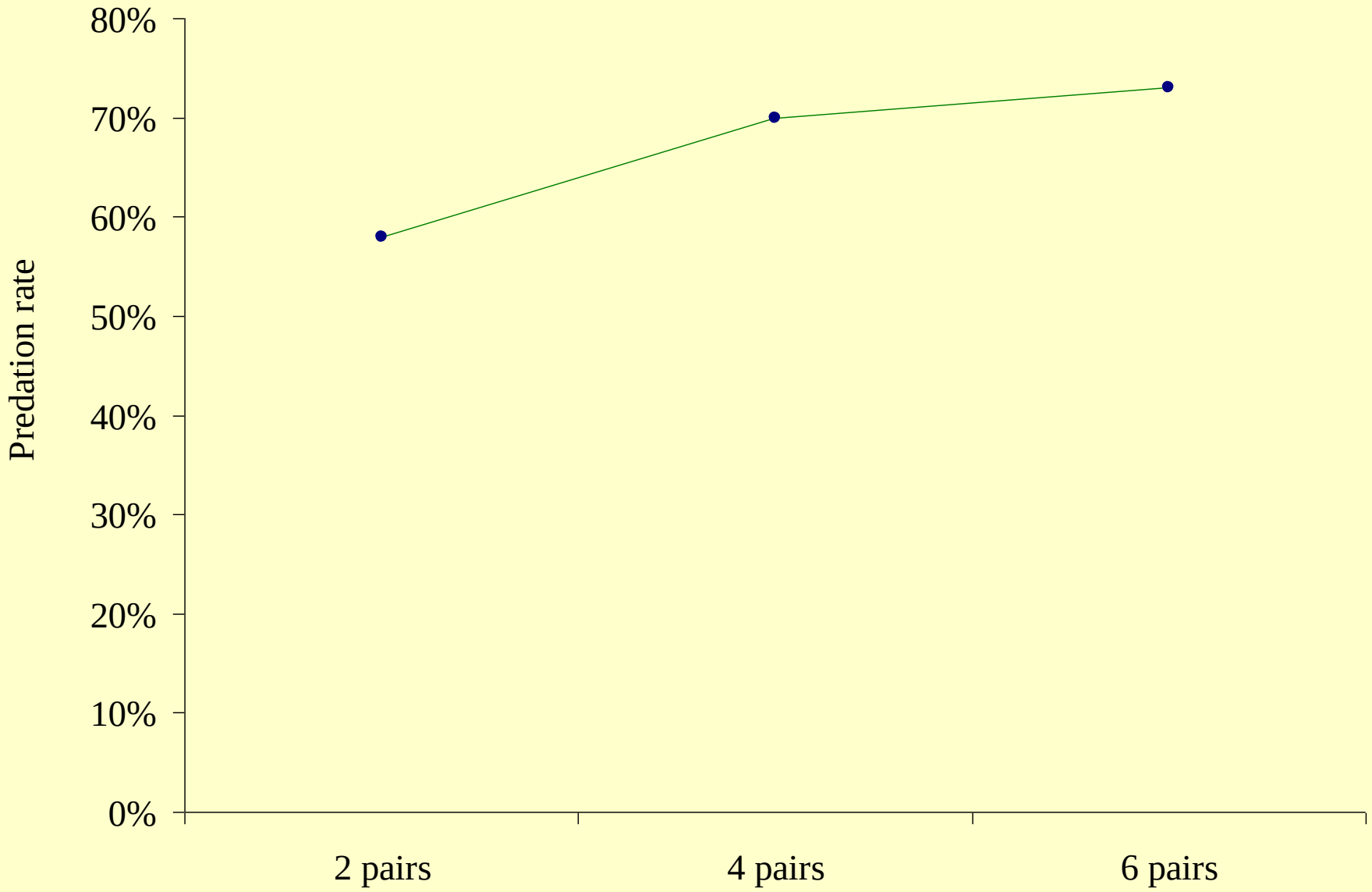
- X 1 or 0 copulated female of *N. tenuis*

- After a week we contend the eggs and nymphs of *T. absoluta*

# *T. absoluta* offspring in different initial densities with or without *N. tenuis*



# *N. tenuis* predation rate in different *T. absoluta* densities



# The next question

- Does the presence of *Bemisia tabaci* improves the predation rate of *N. tenuis* on *T. absoluta*?

# Material and methods

## At the same experimental setup, 6 treatments were applied:

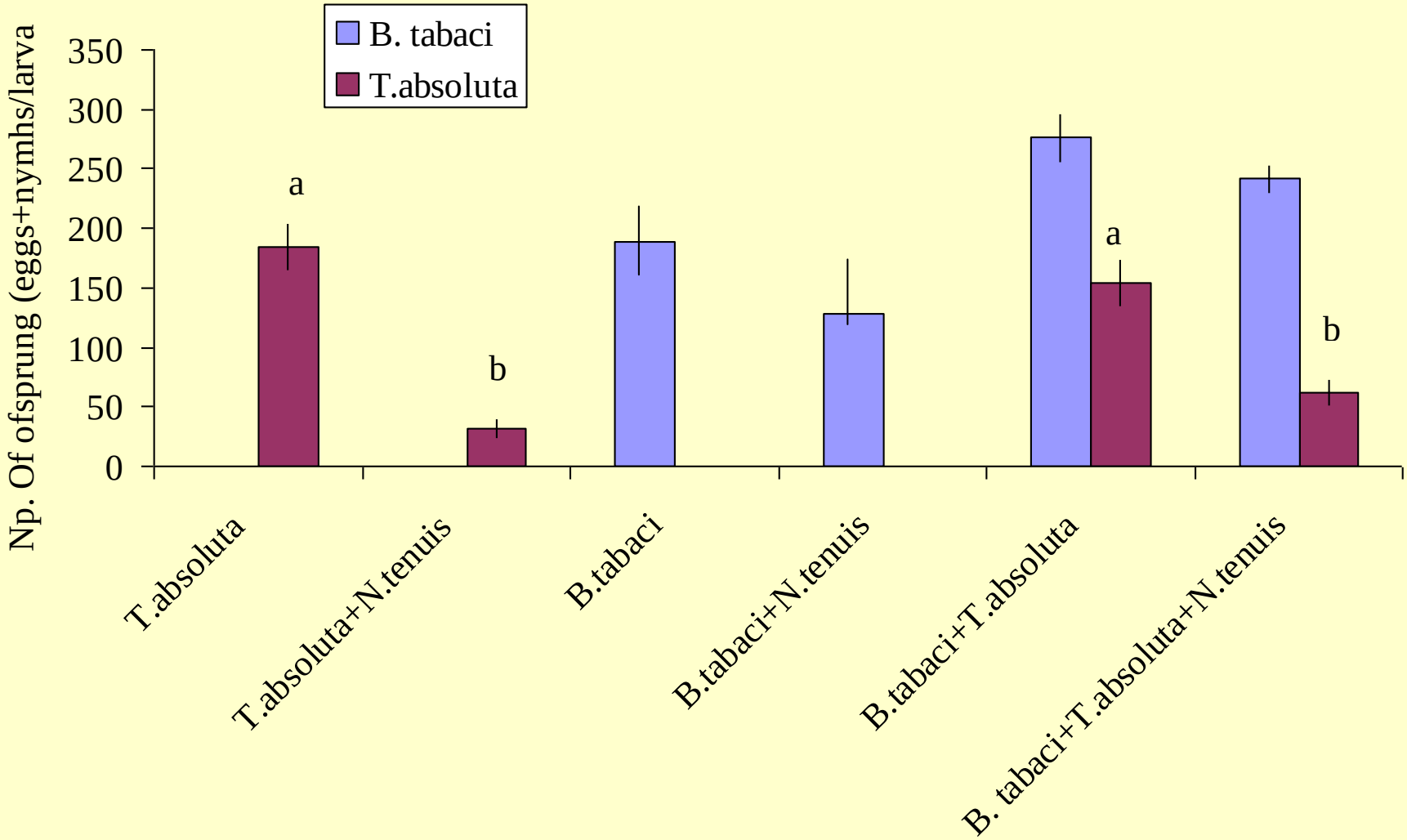
- 4 pairs of *T.absoluta*.

- 30 pairs of *B.tabaci* (a week in advance).

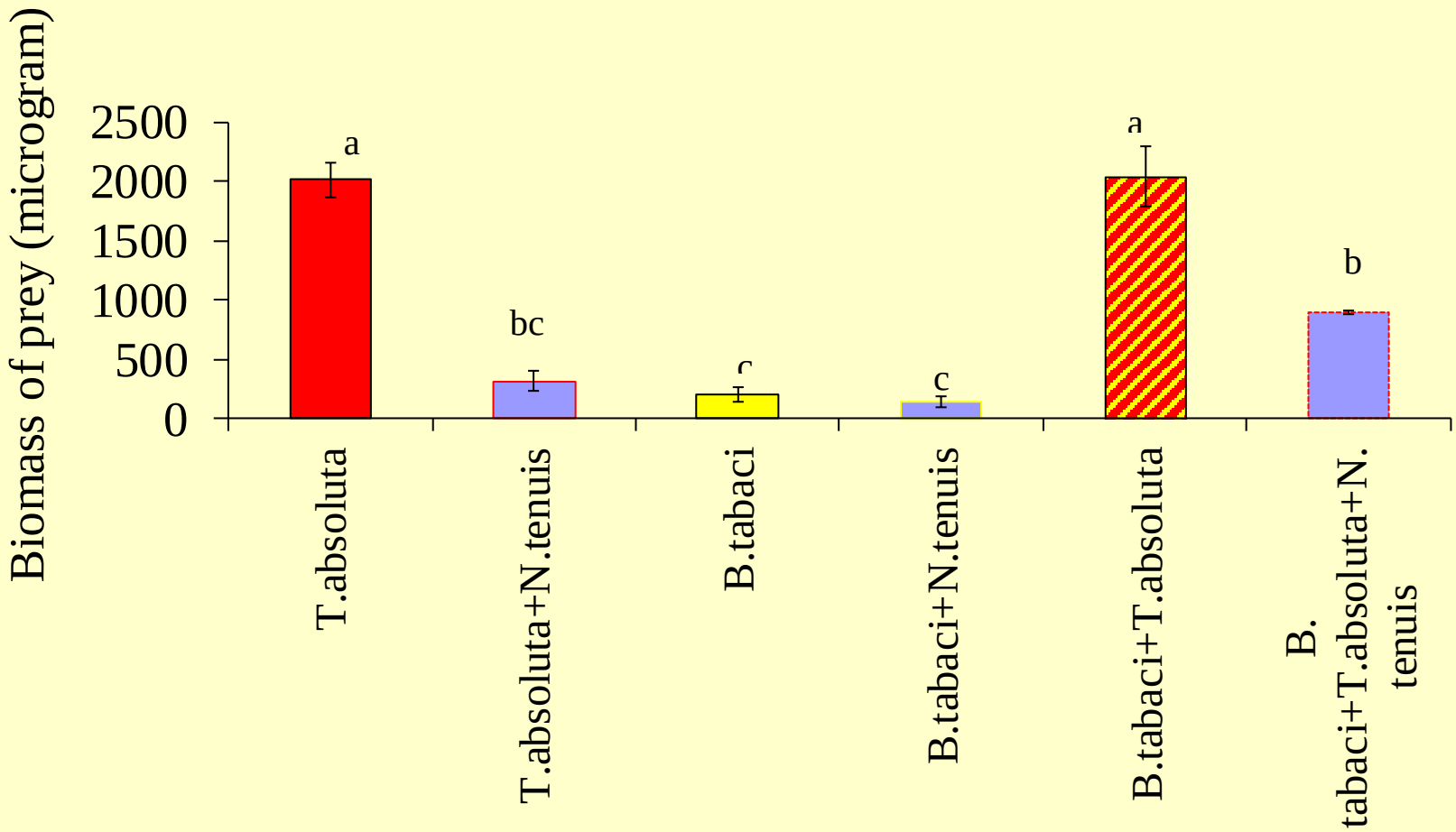
- 4 pairs of *T.absoluta* + 30 pairs of *B. tabaci*
- X 1or 0 copulated female of *N. tenuis*.

- After a week we counted eggs and nymphs of *T. absoluta* and *B. tabaci.*

# Predation rate of *T. absoluta* by *N. tenuis* with or without *B. tabaci*



# Biomass of prey consumed by *N. tenuis* in different combinations of prey



# Conclusion

- *N. Tenuis* can prey upon *T. absoluta* and significantly reduces the number of offspring (1 female can consume up to 150 offspring  a week).
- *N. Tenuis* predation rate rises with *T. absoluta's* density, a behavior typical to a type III functional response predator.
- *N. Tenuis* prefers *T. absoluta* upon *B. tabaci* and the presence of the alternative pray does not improved its efficacy.

# 4. field experiment

Research questions:

- Can *N.tenuis* control the population of *T. absoluta* in processing tomato fields?
- Does early establishment of *N.tenuis* improves its efficacy?
- Does the pesticide regime effects its efficacy?

# An egg of *N.tenuis* in a tomato leaf

Photo: Arnon Allouch Bio-Bee

# *N. Tenuis* emergence

Photo: Arnon Allouch Bio-Bee

# Material and methods

Variety: Brigitte planted on20.2.11

3 treatments:

a. Tomato Plants loaded with *N. tenuis*

and no Chemical treatments.

b. Regular plants and conventional pesticide application.

c. Regular plants and *N. tenuis* "friendly Chemical application).

Random block design with 15 plots in 5 blocks.
Each plot has 7 rows of 10 meter length.

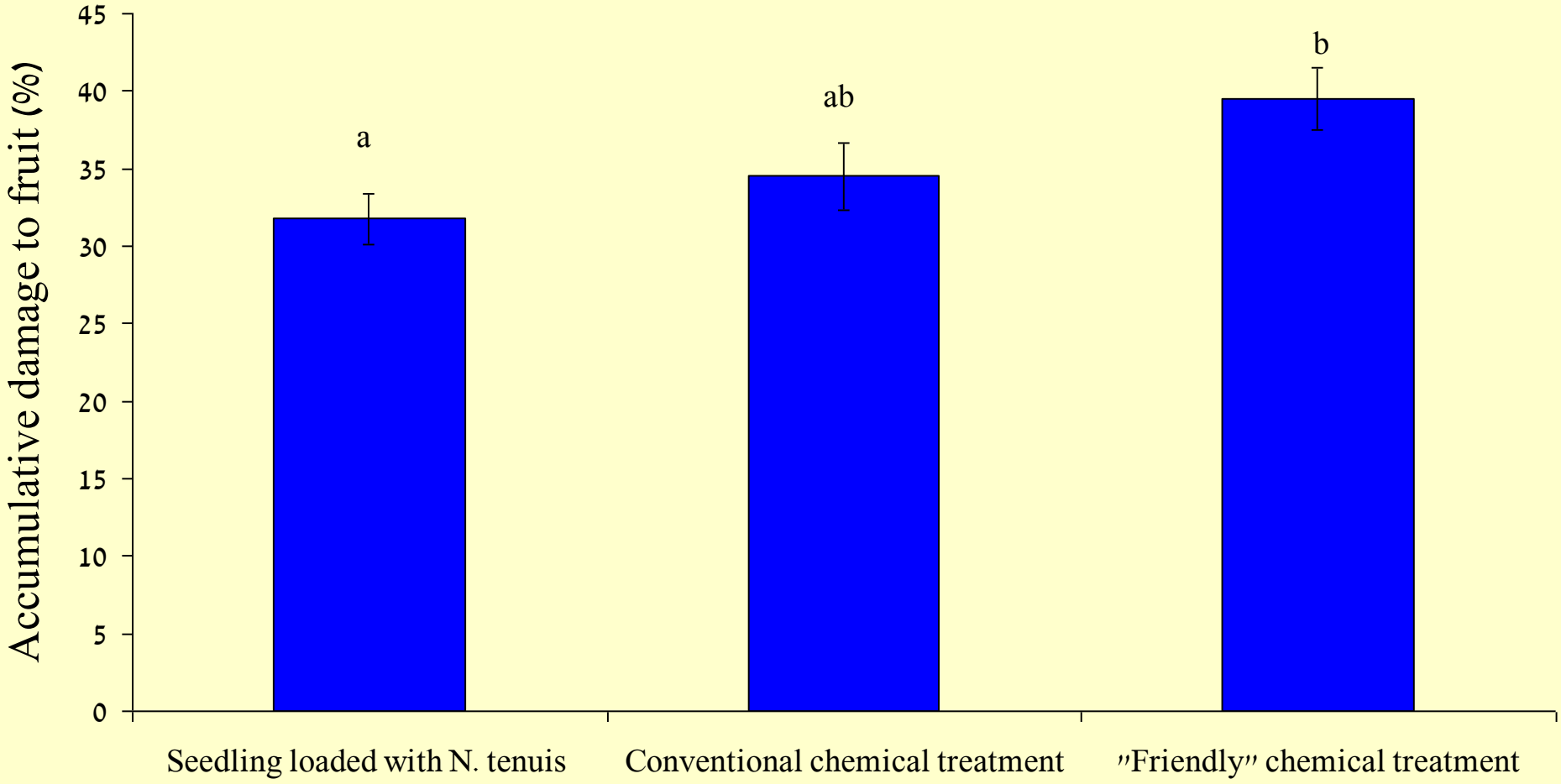
Distance between plots 75 meter.

*

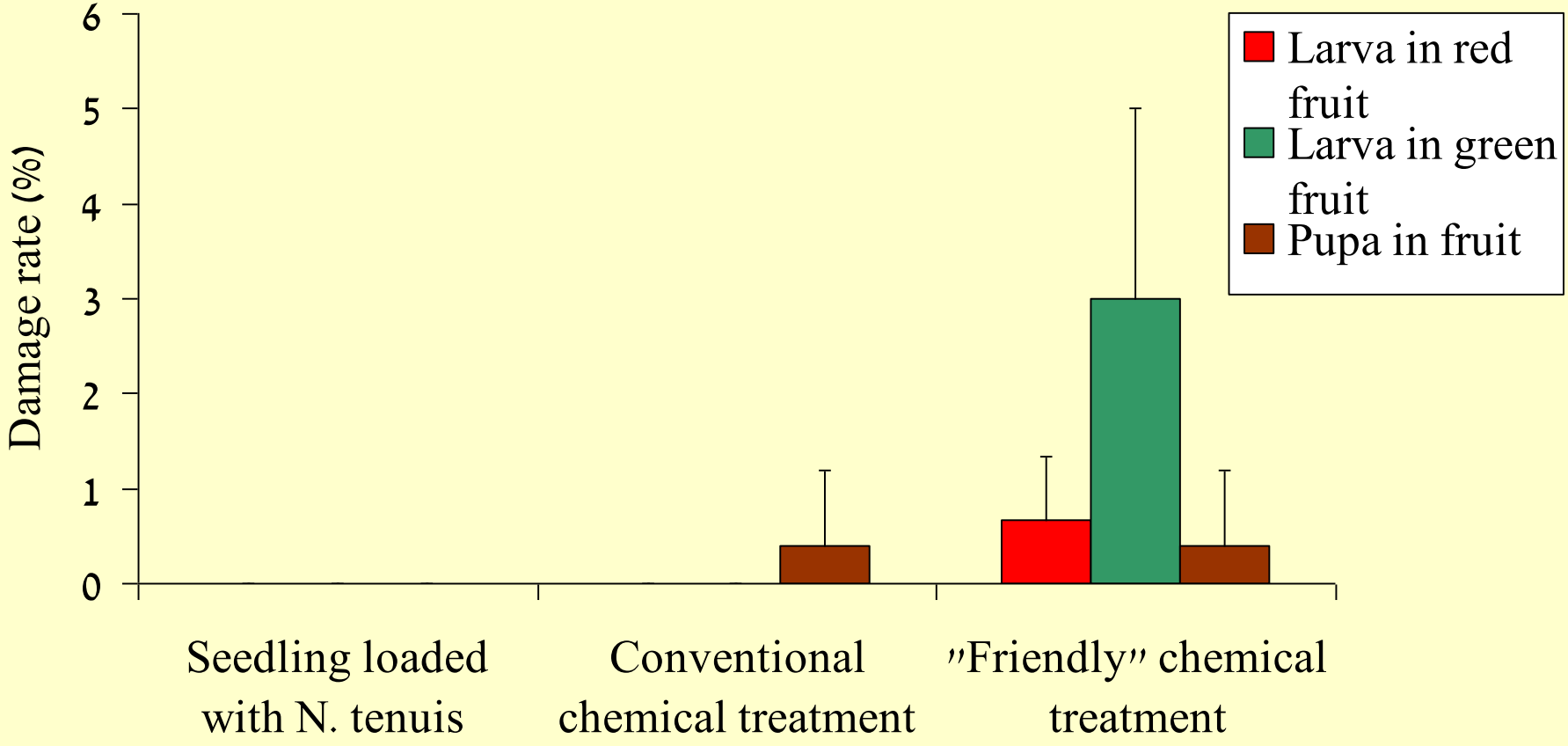
# Sampling

- Weekly random sapling of 30 leafs and 10 fruit per plot.
- At harvest 50 fruit from each plot

# Accumulative damage to fruit along the season in different treatments



# Commercial damage at harvest day



# Summery and conclusion

- In Israel there is a variety of predators and parasitoids who have adapted to consume *T. absoluta* and can keep its population in open fields of processing tomato under economic thresholds.
- *N. tenuis* is an efficient predator of *T. absoluta*.
- Early establishment of *N. tenuis* in the field can improve its efficiency.
- The use of pesticides in the fields harms the natural enemies and research is still needed to establish an IPM program that will include T. absoluta and all other pests of tomatoes..
- In this stage we do not see a population explosion of *T.absoluta* in Israel.

# Many thanks to :

You for your attention!

Israeli board of vegetables