Integration of Entomopathogenic Nematodes (EPNs) in Large Scale Agriculture Systems

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White Grub, Maladera materida

Capnodis tenebionis

Red Palm Weevil

Rhynchophorus ferrugineus

White Grub, Maladera materida

Damage to peanuts

Field trails

Location: Magen

Treatments: One appl. 500,000 IJ/m^2
Two appl. 250,000 IJ/m^2
Three appl. 175,000 IJ/m^2

Nematodes: *H. bacteriophora** -MAGEN

Supplied by 'Koppert'

Nematode monitoring: 2-3 wk. from last application

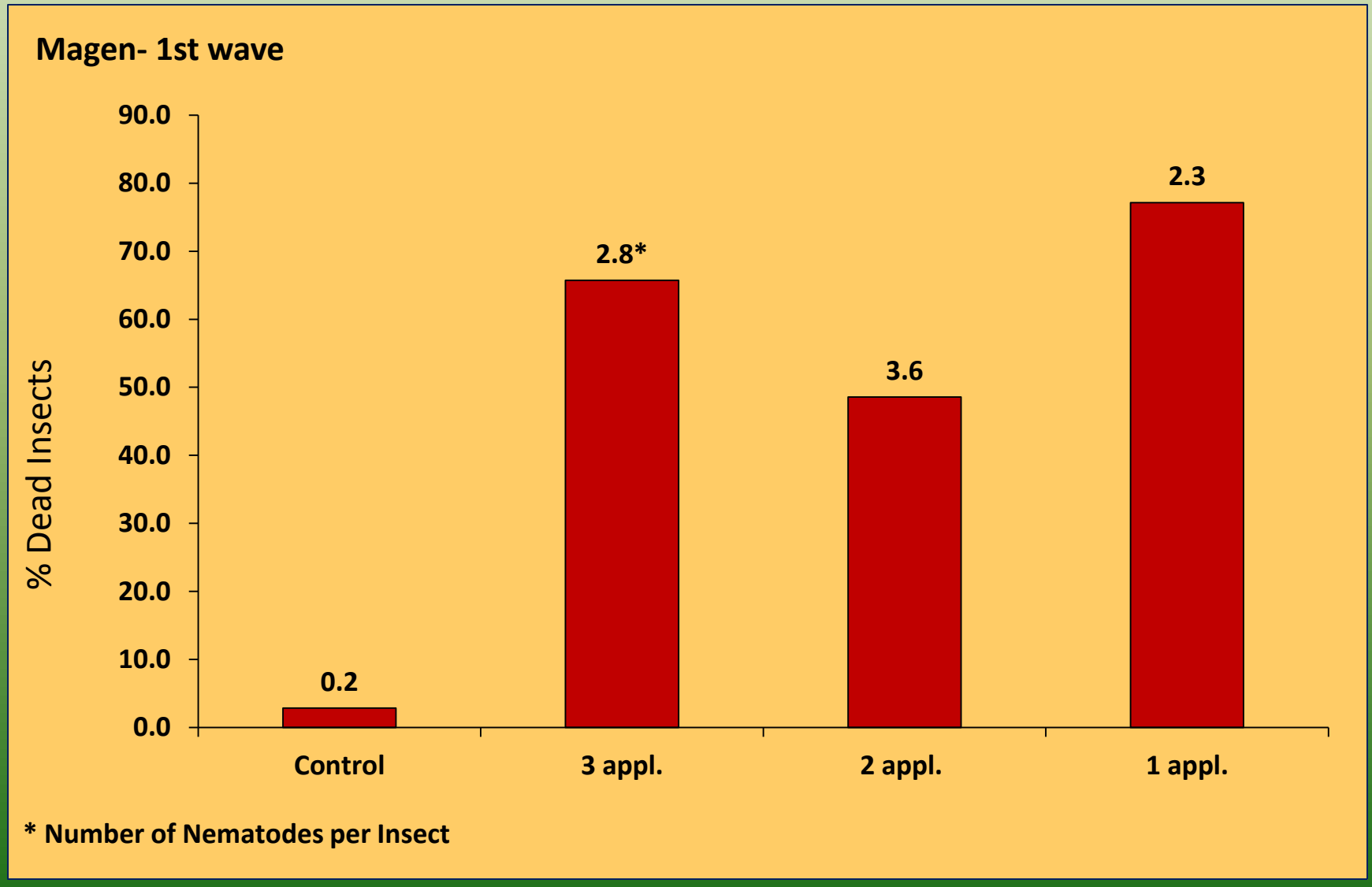
Effect on yield: End of season, QC procedure.

*Imported by BioBee'

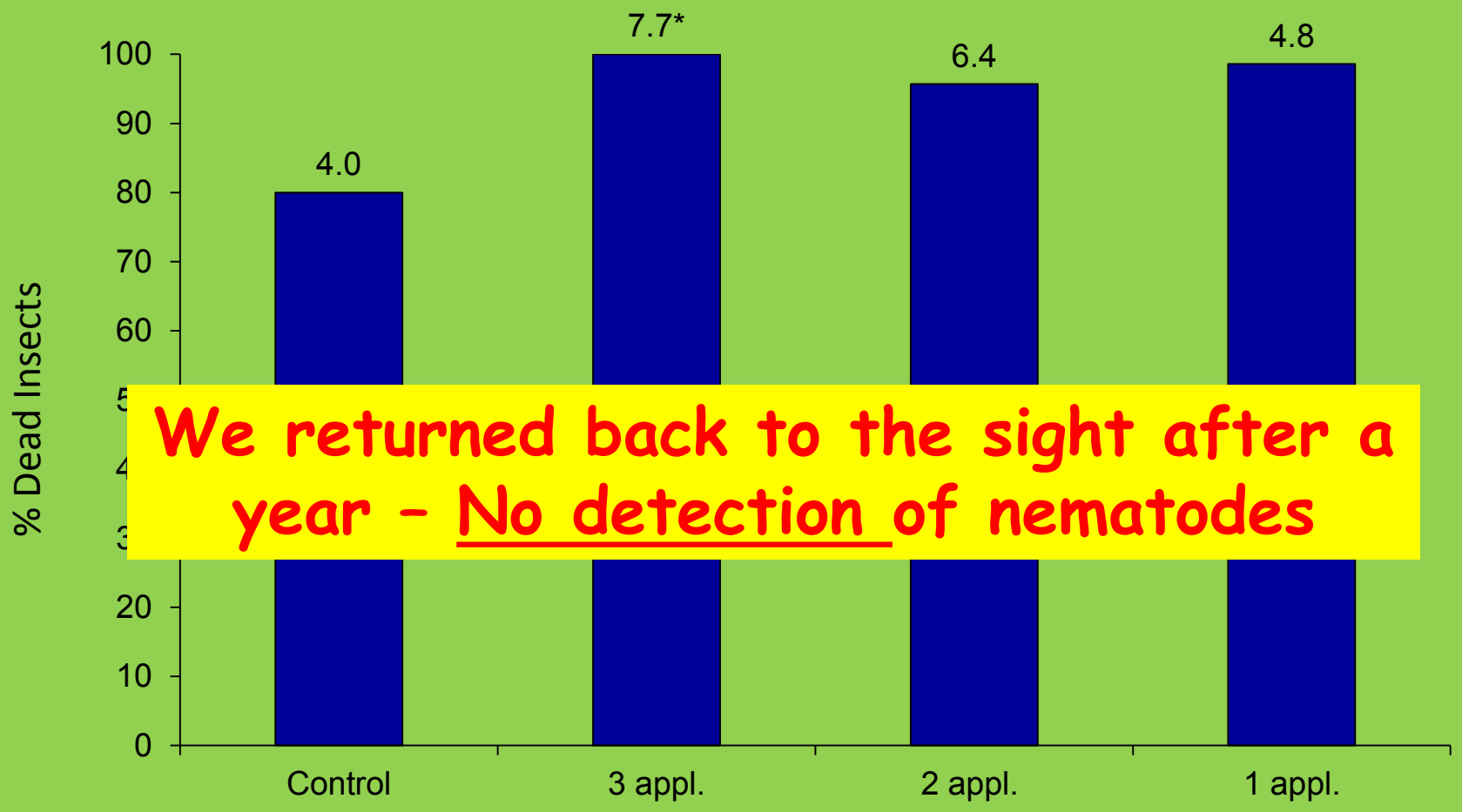
Application procedure

Detection of nematode persistence

Nematode activity 1st wave
MAGEN

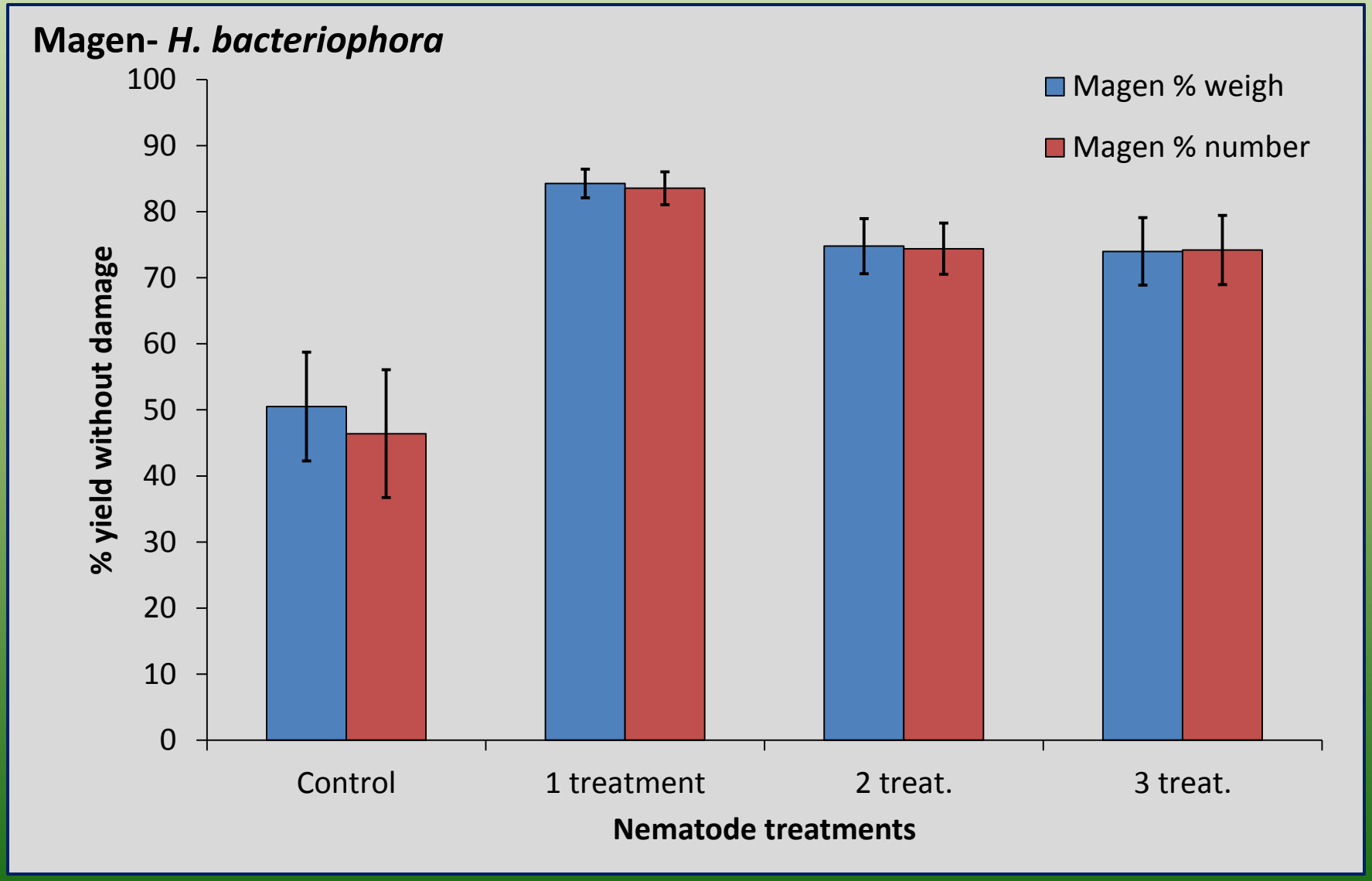


Nematode activity 2st wave
MAGEN



We returned back to the sight after a year – No detection of nematodes

Effect of Nematode treatments on yield- MAGEN



Field trails

Location: Magen

Treatments: One application per insect flight wave

Application Techniques

- Spraying: 500,000 IJ/m^2
- Injection: 500,000 IJ/m^2
- Irrigation: 500,000 IJ/m^2

Nematodes: *H. bacteriophora**

Nematode monitoring: 2-3 wk. from last application

Effect on yield: End of season, QC procedure.

*Supplied by 'Koppert'

Application Techniques

Spraying

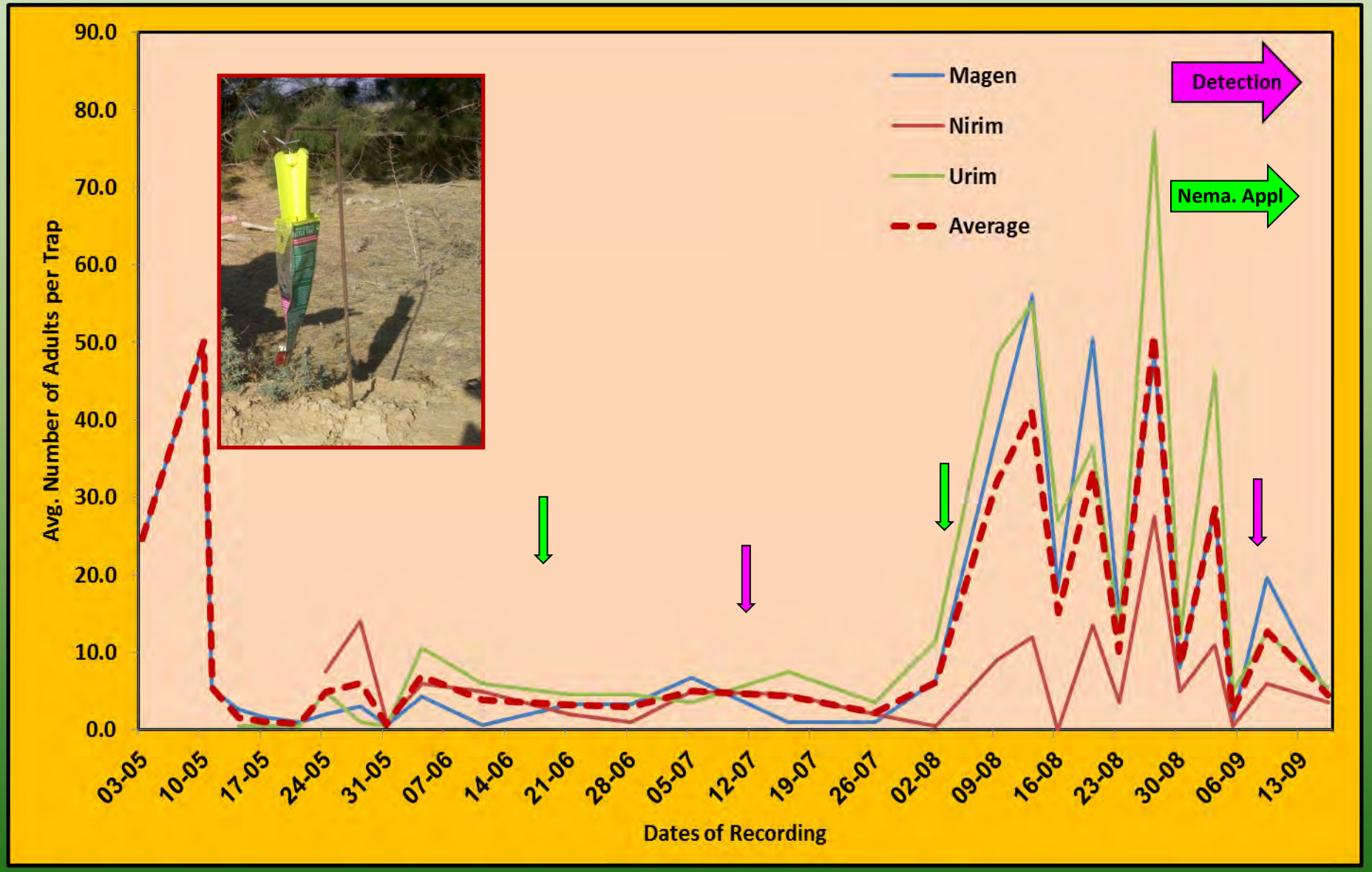
Injection

Irrigation

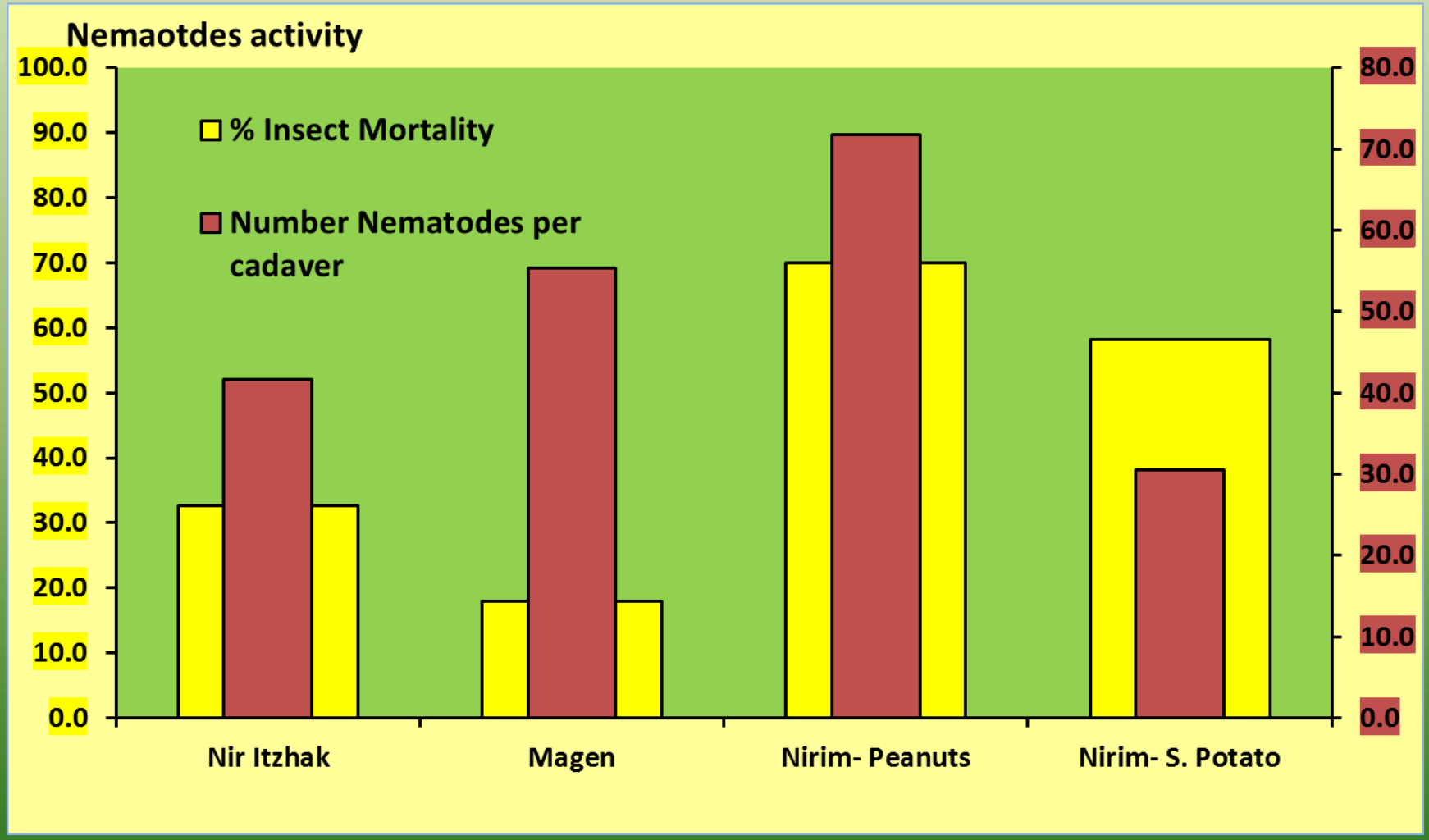
Injection system

Spraying equipment

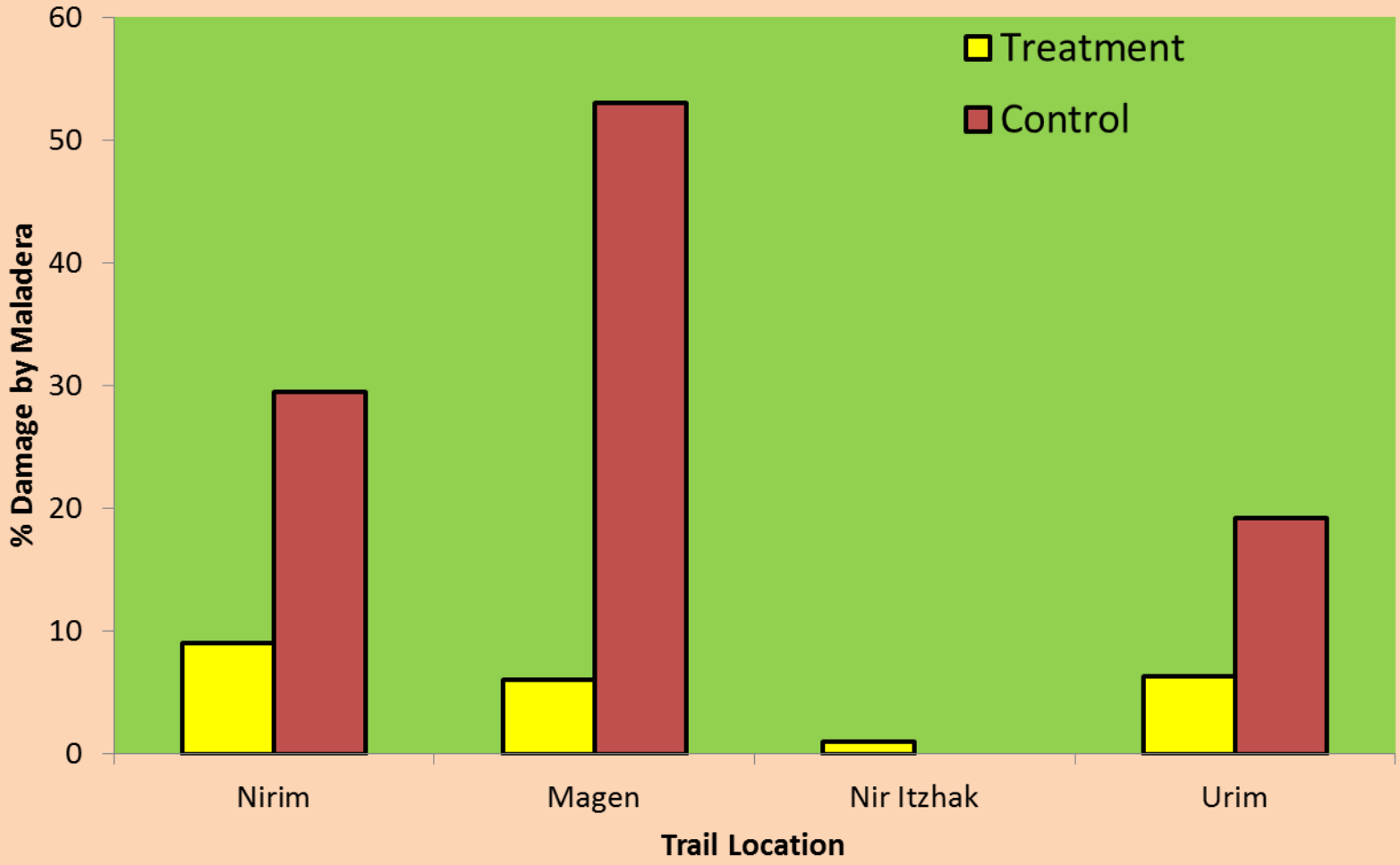
Application Schedule



Nematode activity in soil



Damage of the pest



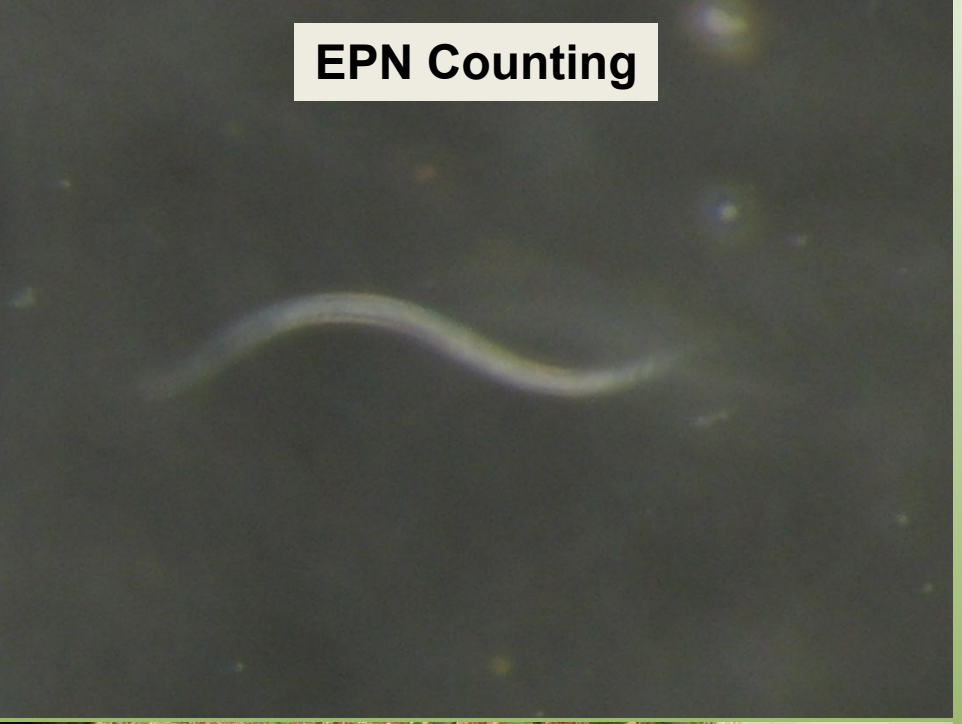
Biological control of Capnodis by insect parasitic nematodes

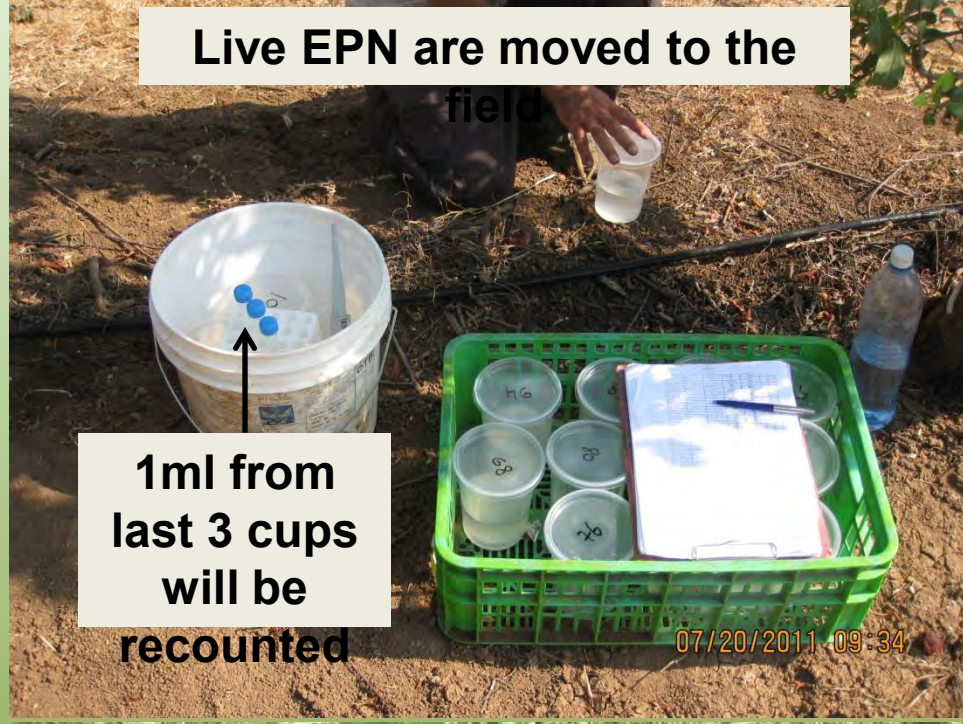
Rearing Capnodis Adults

Planting Apricot Trees

Release of fertilized Capnodis adults in net house

Capnodis adults leave the cage independently

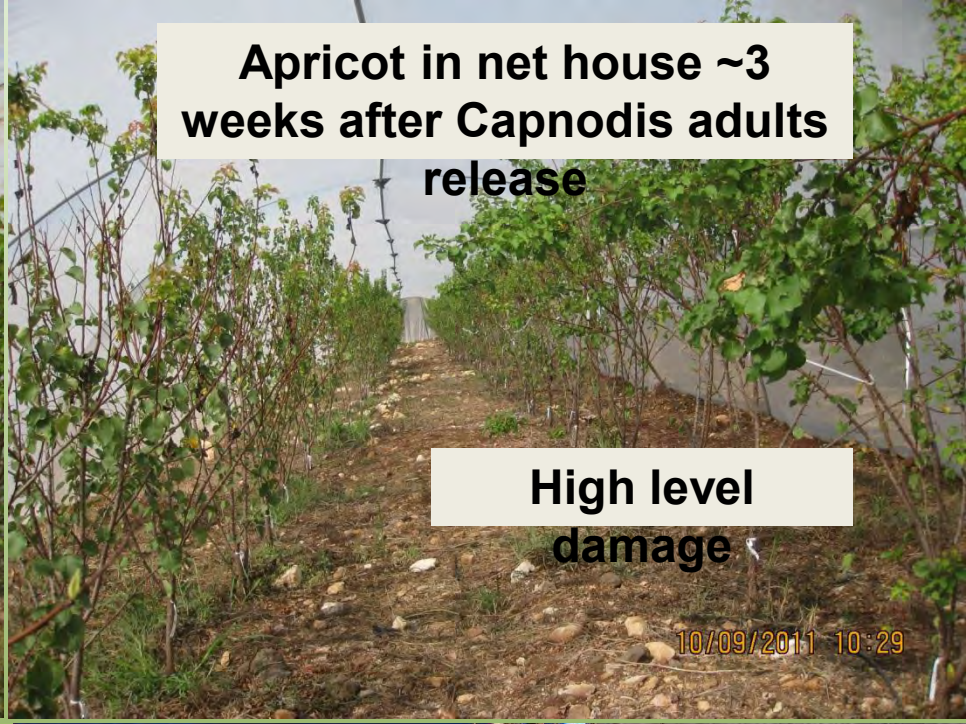

EPN Counting


Live EPN are moved to the field
1ml from last 3 cups will be recounted
07/20/2011 09:34


EPN Applied by drenching trunk
07/24/2011 08:17


07/24/2011 08:20


Apricot in net house before Capnodis adults release
04/17/2011 10:40


Apricot in net house ~3 weeks after Capnodis adults release
High level damage
10/09/2011 10:29


Removal of all apricot trees 6-8 month after trt. applied
12/11/2011 10:05


Examination of root damage
12/11/2011 13:55

EPN applied ($3*10^6$. Jul -Sep. 2011)

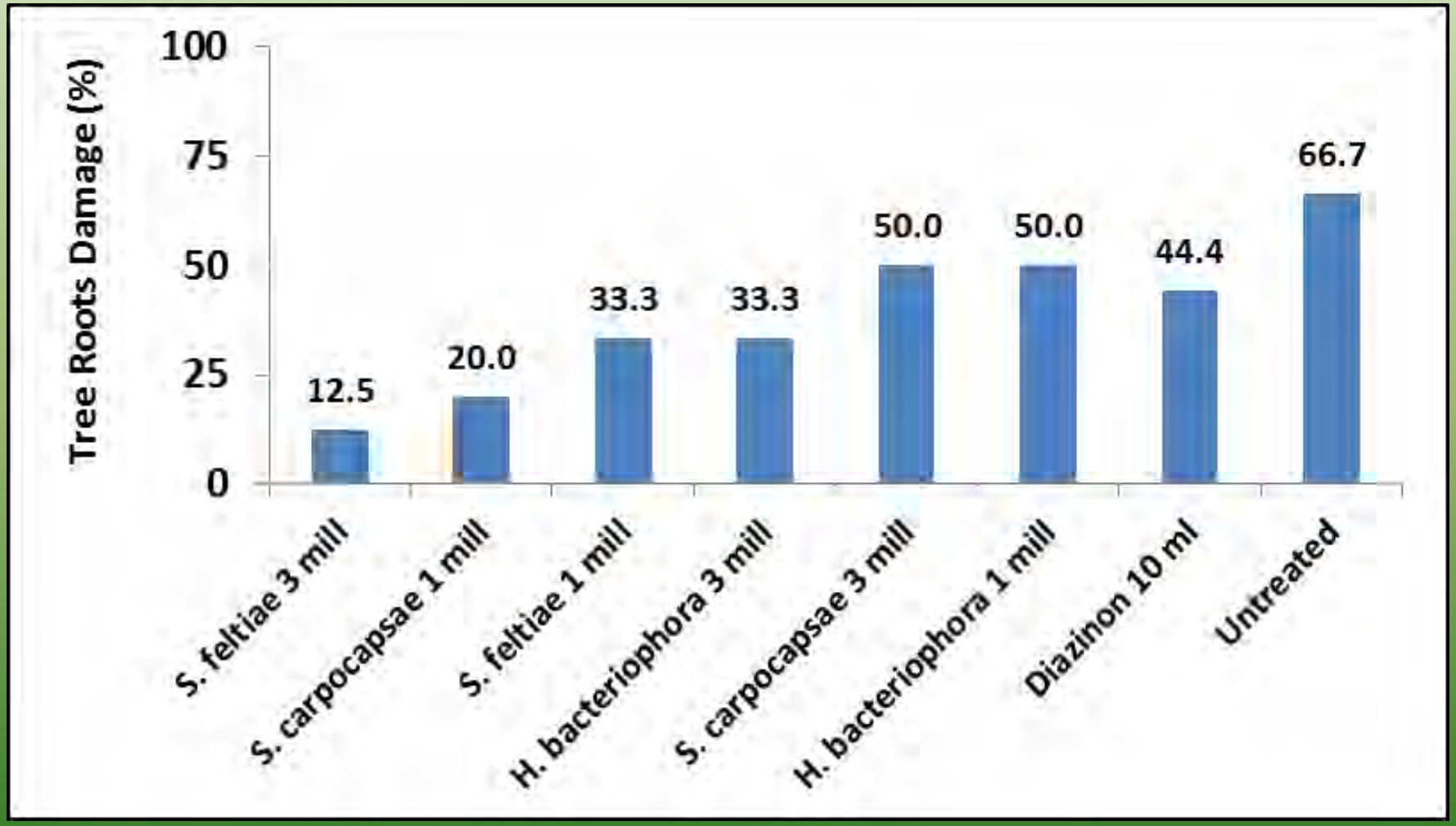
in commercial plum infected orchard

Soil sample 0-20 cm deep every 2 weeks after EPN applied

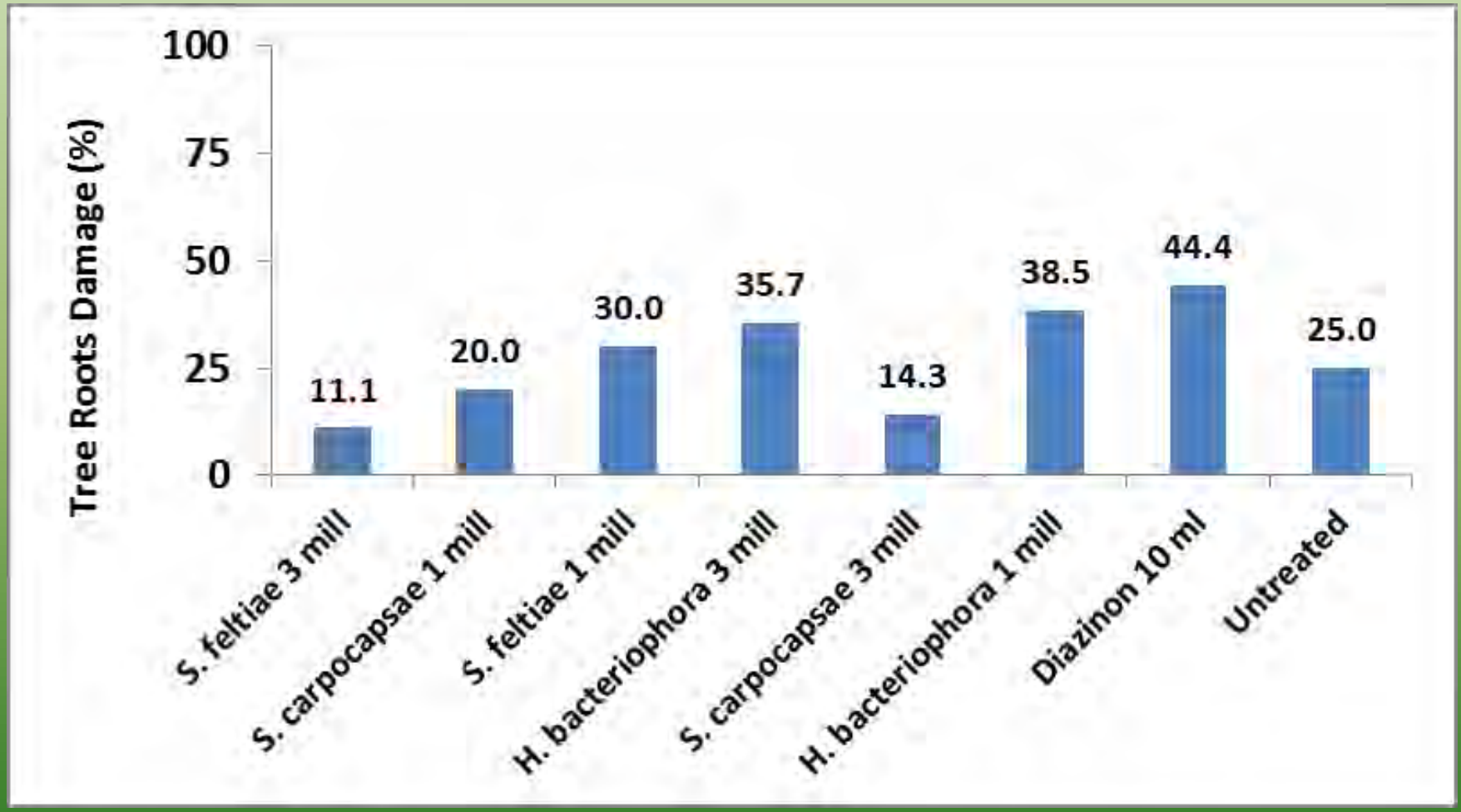
EPN application through drip irrigation

מהד"ם IPMC

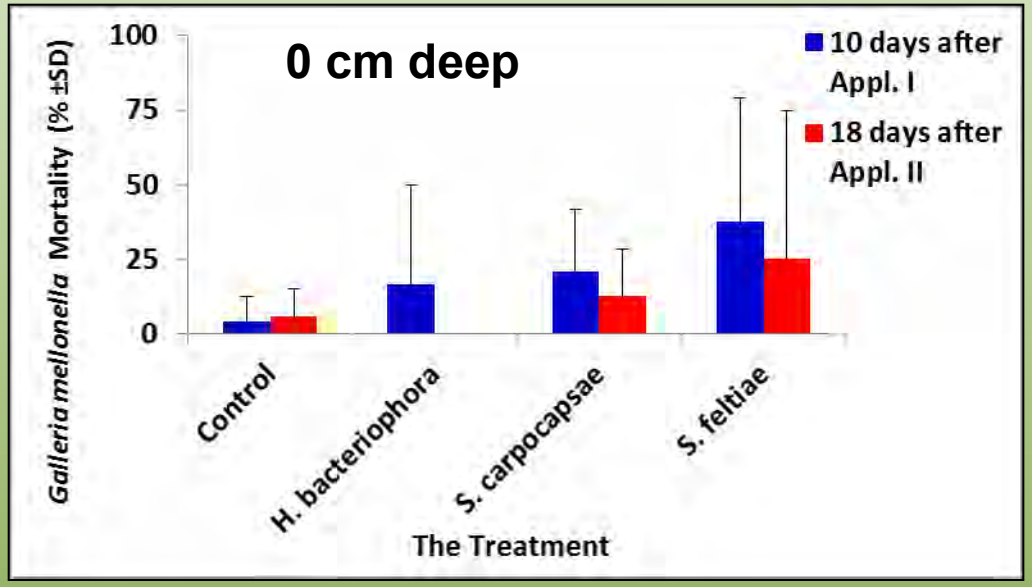
Results of Exp. 1

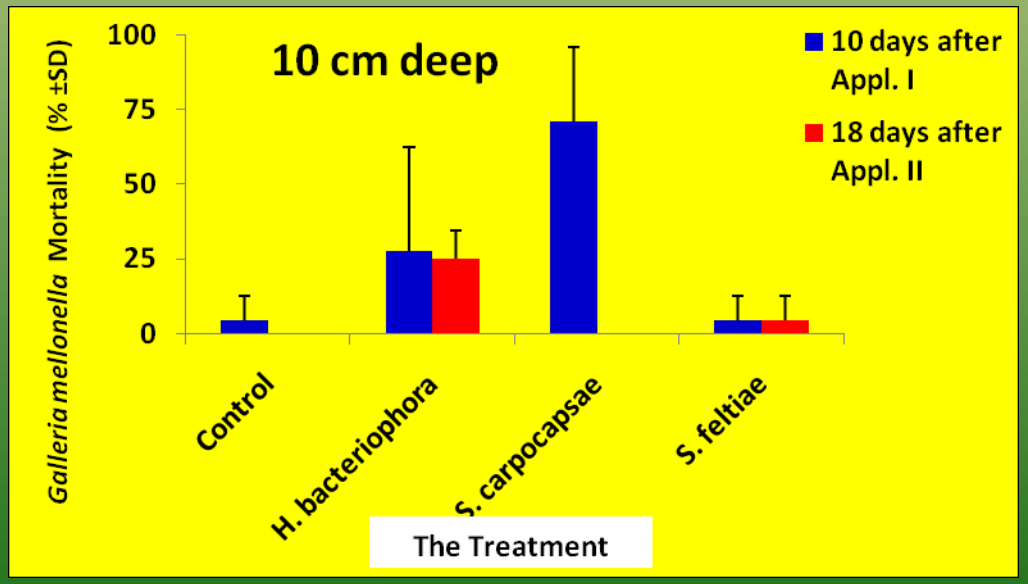


Results of Exp. 2

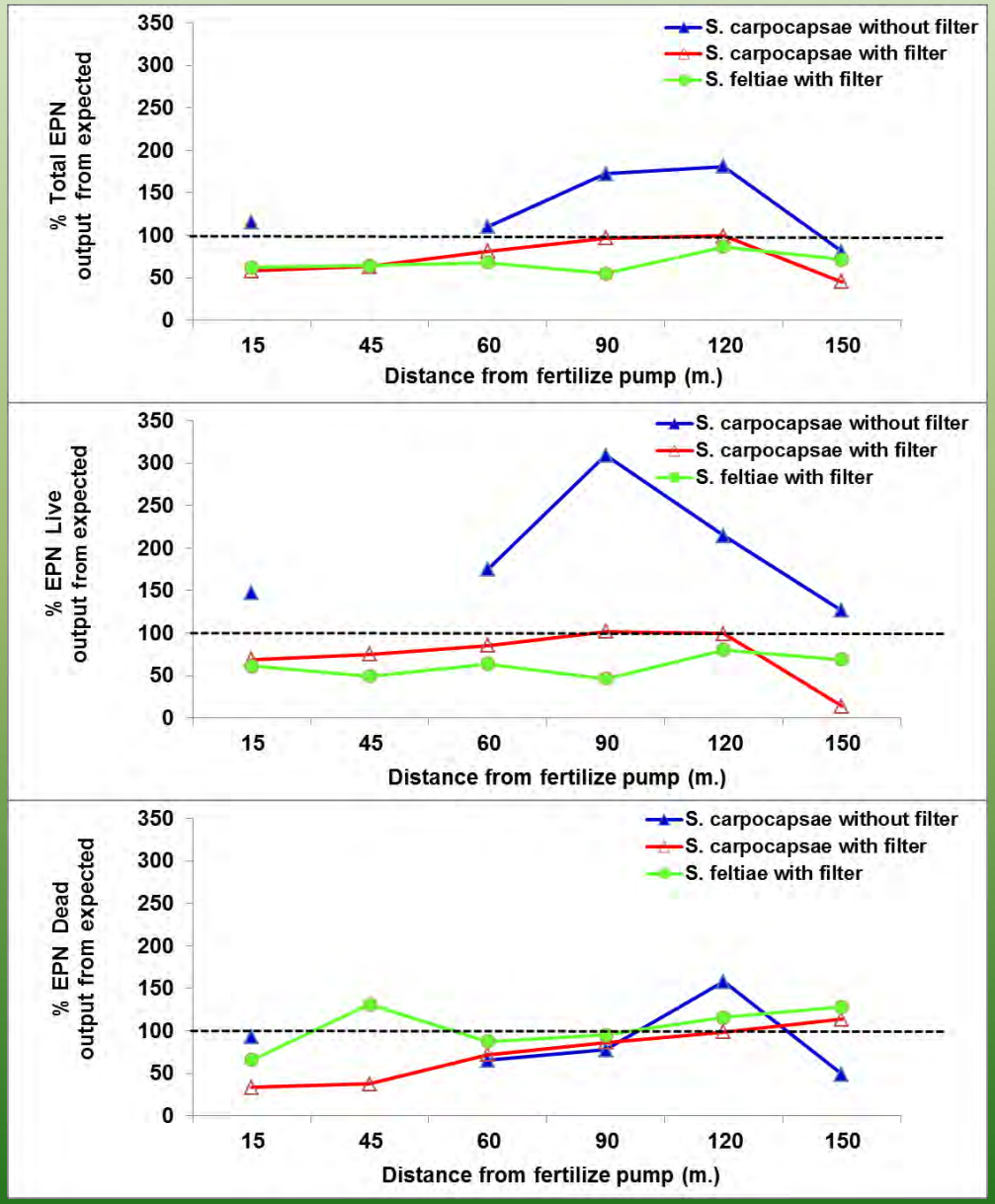


Results of EPN persistence in soil sample





EPN output from drip irrigation



Use of EPN *Steinernema carpocapsae* (Sc-e) and *Heterorhabditis bacteriophora* (Hb-e) against the Red Palm weevil *(Rhynchophorus ferrugineus)*

The Red Palm Weevil is a major pest of Date-Palms trees

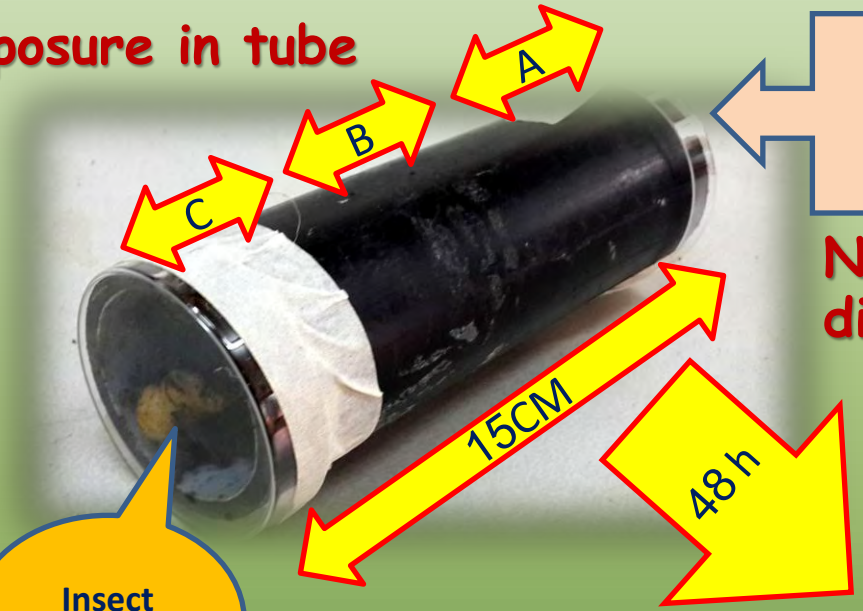
It bores in the trunk and kill trees

Damage to trees

Insect Larvae Movement in the Trunk

Experimental system for characterization of nematode movement toward the insect

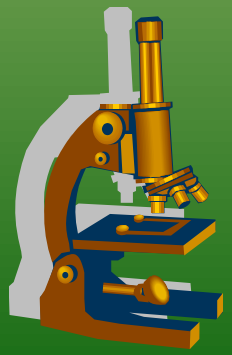
Exposure in tube



Nematodes (10,000)

Nematode extraction from different section of tube

24 h



Nematode counting

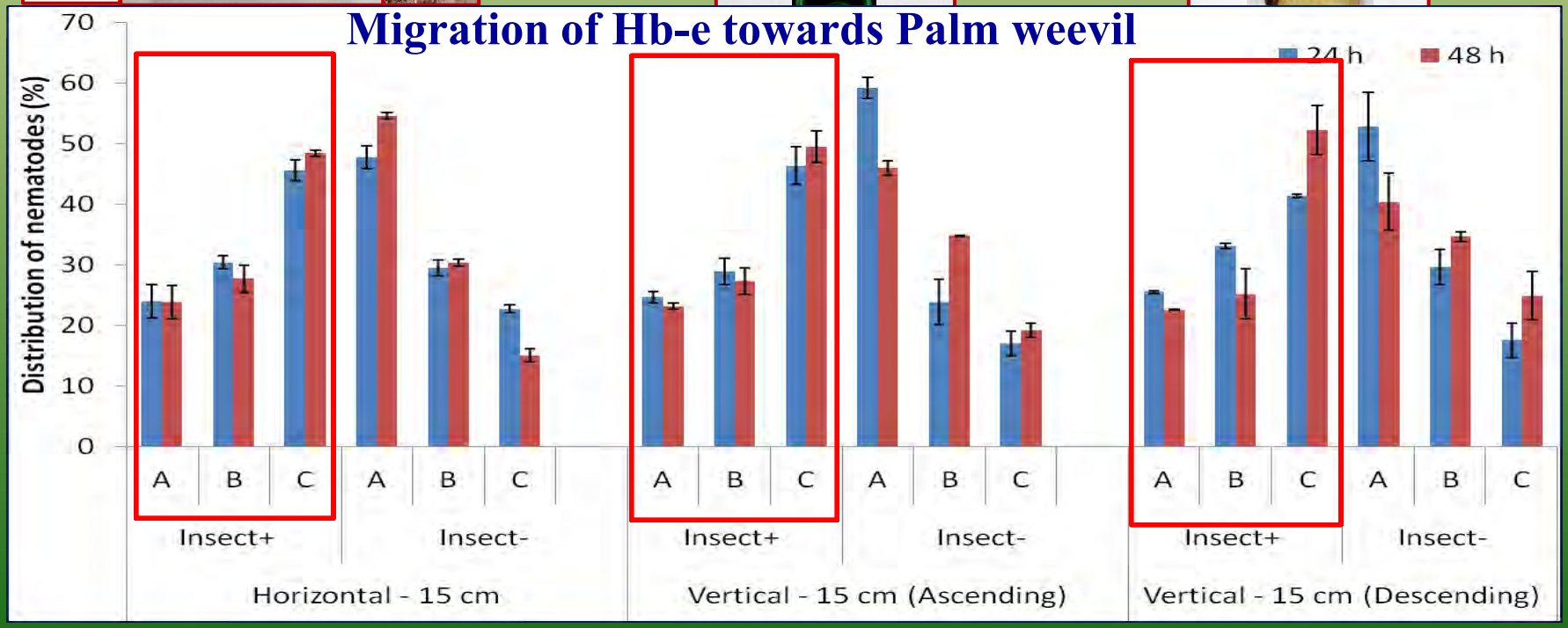
Attraction of EPNs to Palm weevil at 25°C

Horizontal

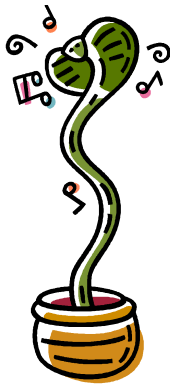
Vertical – 15 cm (Ascending)

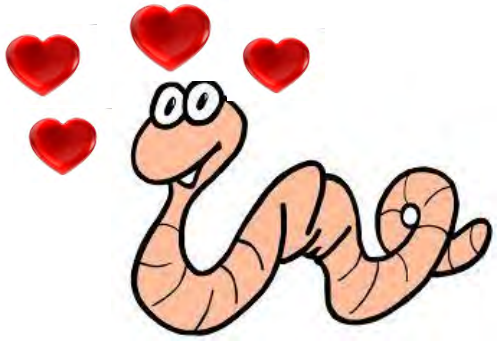
Vertical – 15 cm (Descending)

Migration of Hb-e towards Palm weevil



Effect of insect voices on EPNs behavior



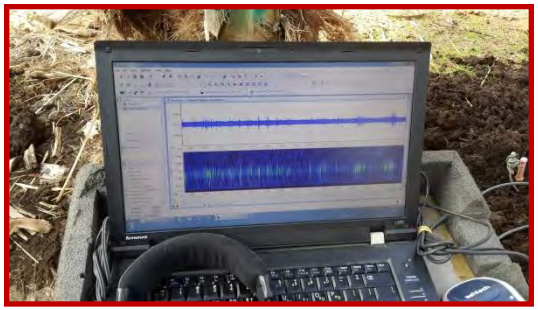


Detection of insect noises in the field

The Red Palm Weevil is a major pest of Date-Palm trees

It bores in the trunk and kill trees

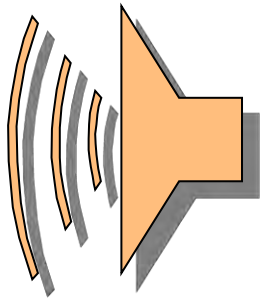
We recorded the noises made by the feeding insects



We built a device with a speaker that can be attached to the column

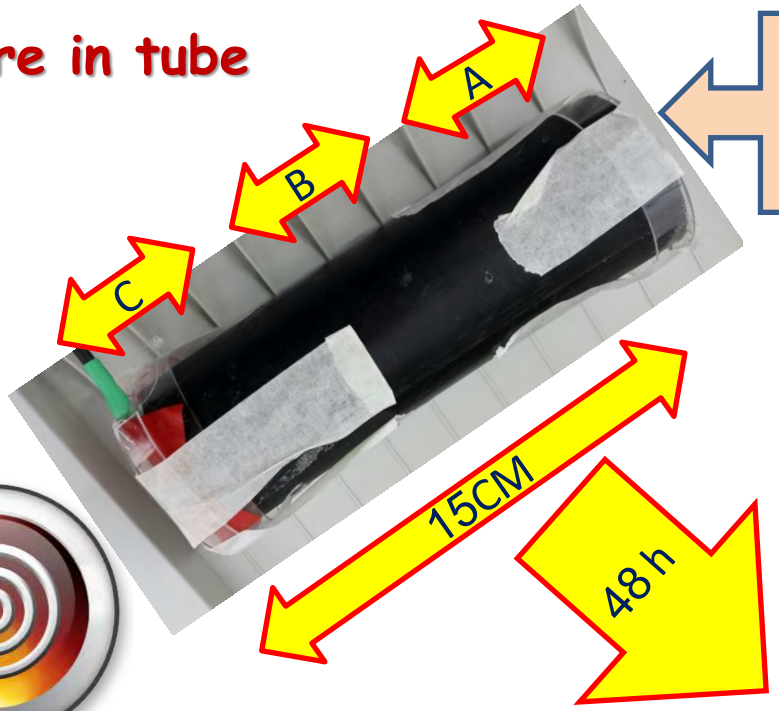
We exposed the nematodes to the noises continuously for 48 h

Nematodes



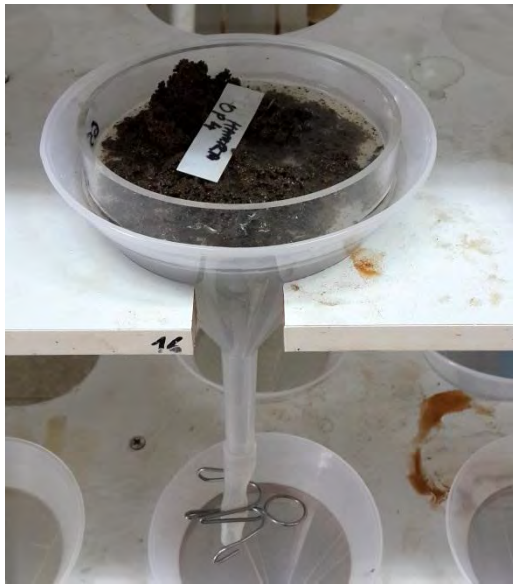
Modification for evaluation of noise effect

Exposure in tube



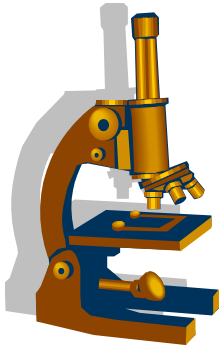
Nematodes
)20,000(

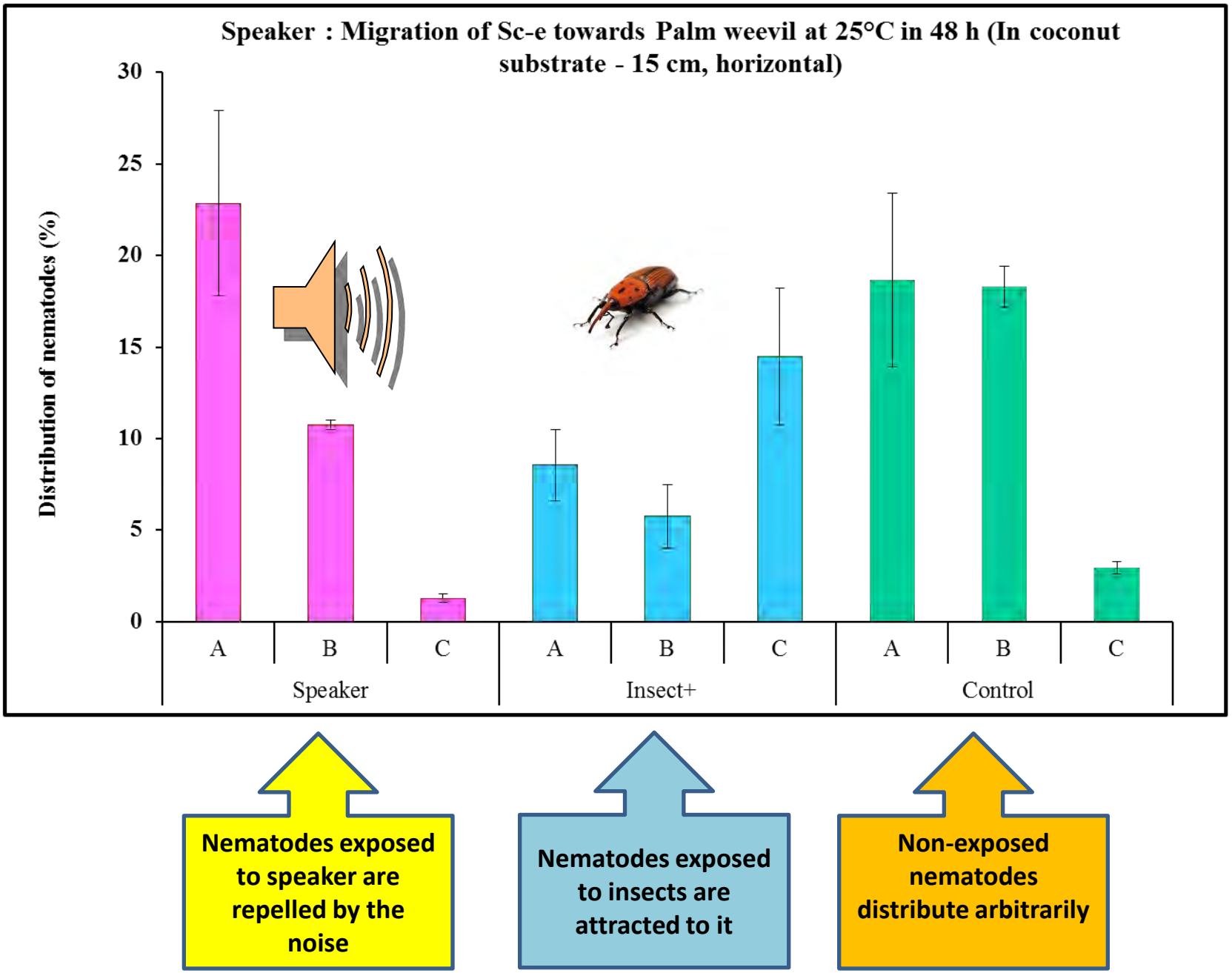
Nematode extraction from different section of tube

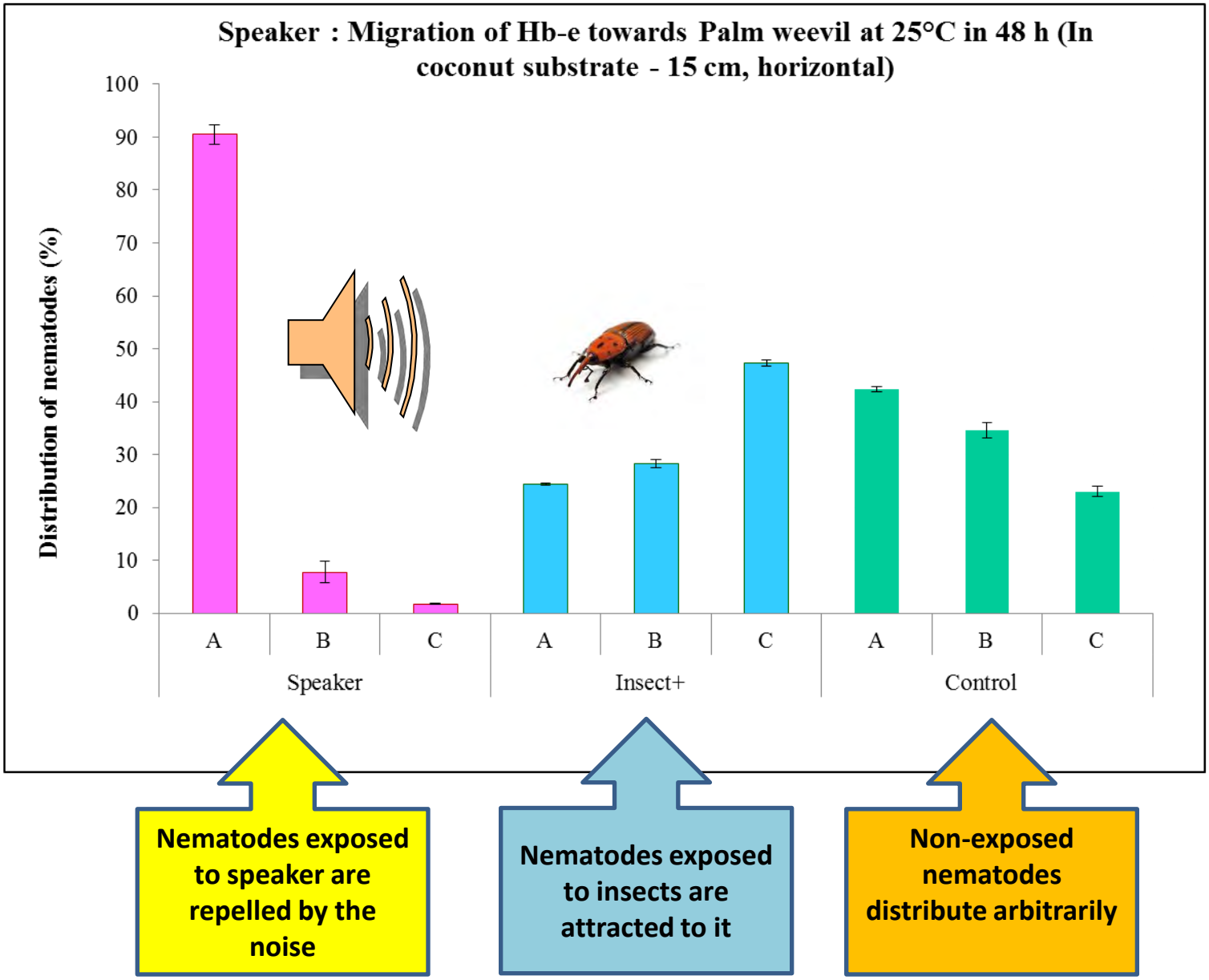


24 h

Nematode counting




Speaker : Migration of Sc-e towards Palm weevil at 25°C in 48 h (In coconut substrate - 15 cm, horizontal)
Distribution of nematodes (%)
30
25
20
15
10
5
0
A
B
C
A
B
C
A
B
C
Speaker
Insect+
Control
Nematodes exposed to speaker are repelled by the noise
Nematodes exposed to insects are attracted to it
Non-exposed nematodes distribute arbitrarily


Speaker : Migration of Hb-e towards Palm weevil at 25°C in 48 h (In coconut substrate - 15 cm, horizontal)
Distribution of nematodes (%)
100
90
80
70
60
50
40
30
20
10
0
A
B
C
A
B
C
A
B
C
Speaker
Insect+
Control
Nematodes exposed to speaker are repelled by the noise
Nematodes exposed to insects are attracted to it
Non-exposed nematodes distribute arbitrarily

Thanks to

Maladera materida

ARO- D. Ben-Yakir
Liora Salame
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O. Buchshtev
Y. Yafe
BioBee-
S. Steinberg
Tz. Bar
A. Alouch

Red Palm Weevil

ARO- V. Soroker
L. Salame
S. V. Santhi
BioBee-
S. Steinberg
Tz. Bar
G. Yaakobi

Capnodis tenebionis

ARO- Z. Mendel
Liora Salame
Growers Org.-
H. Reuveni
BioBee-
S. Steinberg
Tz. Bar
A. Alouch

ARO

Peanut Growers Org.

Chief Scientist MOAG


Thank you
for kind
attention