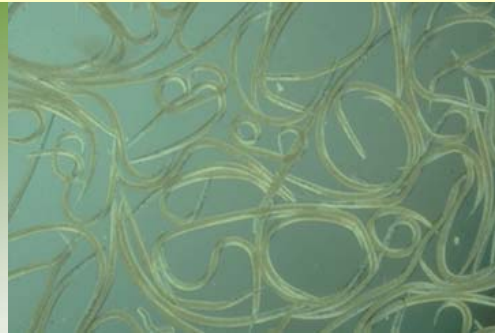


# Control of European cherry fruit fly *Rhagoletis cerasi* L. with entomopathogenic nematodes

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## ***Rhagoletis cerasi* L.**

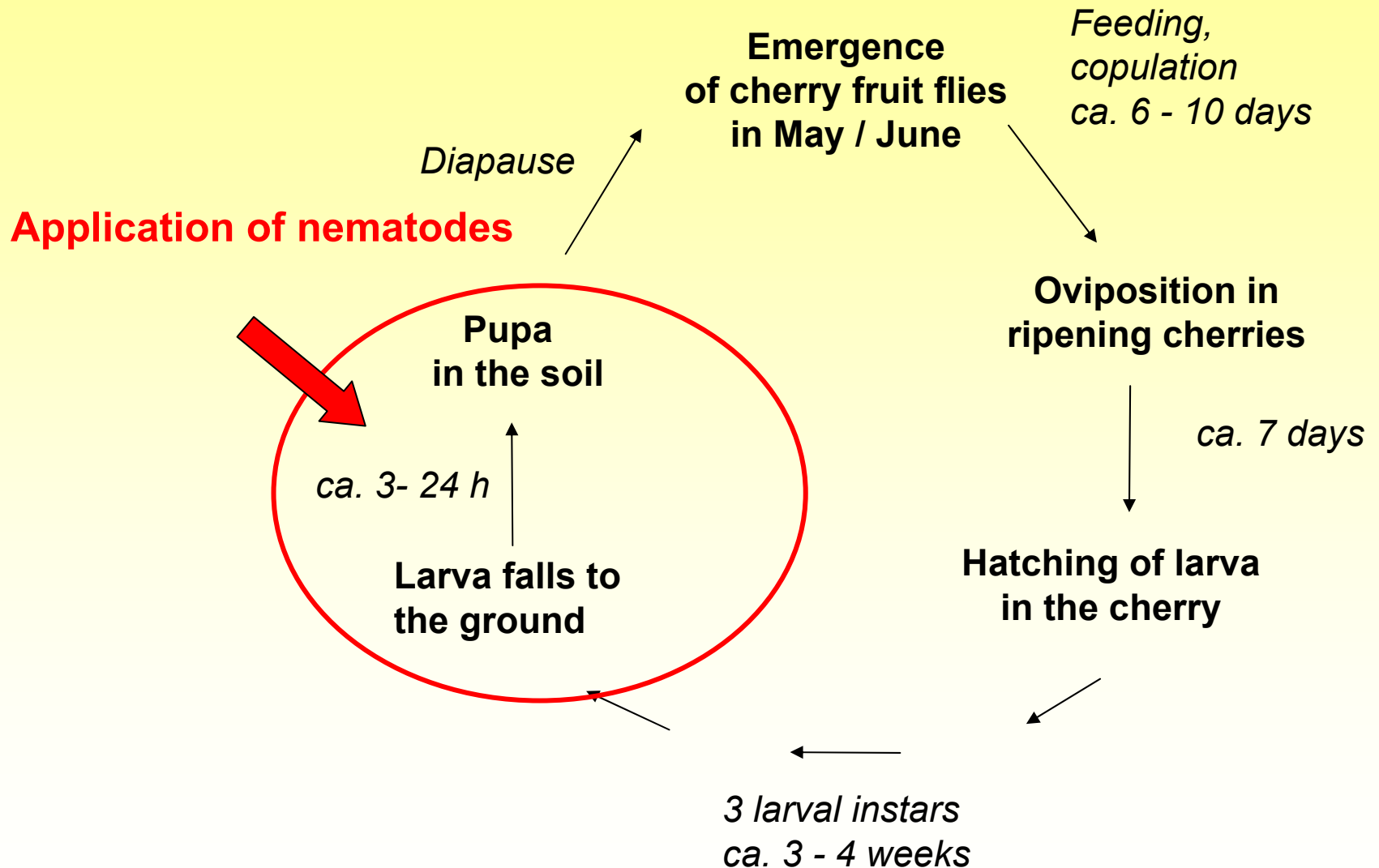


## **General Information:**

- body length male: 2,9 - 4,0 mm  
female: 3,8 - 5,3 mm
- yellow scutellum
- typical bands on the wing
- univoltine
- infests mainly sweet cherries, but also sour cherries to some extent, and *Lonicera* species
- infestation tolerance limit: 2 %, main pest in cherry orchards

## **Distribution:**

Palaearctic: Europe, except British Is., & w. Siberia to Caucasus & Central Asia.



## Used species and strains of nematodes:

### 2002:

*Heterorhabditis bacteriophora* (**H.b.**)

*Steinernema bicornutum* (**S.b.**)

*Steinernema carpocapsae* (2 strains, **S.c.**, **S.c.C.**)

*Steinernema feltiae* (**S.f.**)



### 2003 (soil sample and turkish isolates):

*Heterorhabditis bacteriophora* + 1 strain

*Heterorhabditis megidis* (1 strain)

*Heterorhabditis* spec. (3 strains)

*Steinernema* affine (4 strains)

*Steinernema bicornutum*

*Steinernema carpocapsae* (2 strains)

*Steinernema feltiae* + 3 strains

## Laboratory

- Larvae / Pupae
- Dosages (10,25,50 75 IJs/cm<sup>2</sup>)
- Temperatures (20,24°C)
- Soil types (sand, standard soil: e.g. sandy, loamy, clay)



exposure scenarios



## Semi Field

- Larvae
- 50 IJs/cm<sup>2</sup>
- Natural soil from orchard in fruit boxes



## Cherry Orchard

- Releasing of larvae
- 50 IJs/cm<sup>2</sup>
- Capture of adults with soil photoeclectors





**Origin of CFF Larvae and Pupae:**  
From field collected infested cherries

**Larvae:** manual isolation

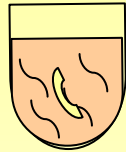
**Pupae:** emigration of larvae into sand and pupation



## Different exposure scenarios in a tiered approach



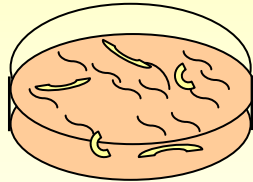
cell wells (cw)



Mini cells with a single host to screen out effective nematodes rather quickly (sand)



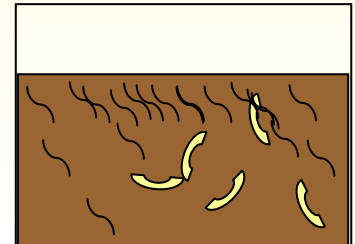
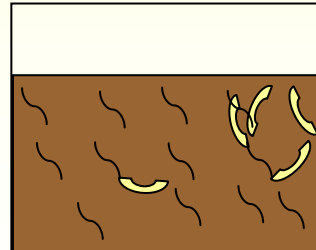
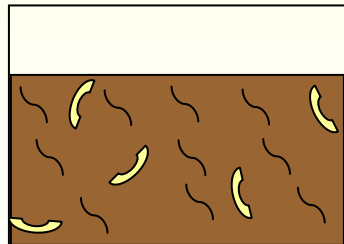
petri dishes (pd)



Bigger units with 5 hosts to increase reality of exposure  
(pd: sand & orchard soil,  
pb: sand & standard soil types - sandy loam, loamy sand, loam, loamy clay)



plastic boxes (pb)





**Infested larva (S.c.C)**



**In larval stage infested pupa (H.b.)**



**Uninfested pupa**

## Variables

- **Nematode species and strains**

↪ significant differences between nematodes  
*Steinernema carpocapsae*, *S. carpocapsae* strain China,  
*S. feltiae* revealing highest efficacy

- ***R. cerasi* - larvae / pupae**

↪ EPNs cannot infest pupae

- **Doses:** 10, 25, 50, 75 IJs/cm<sup>2</sup>:

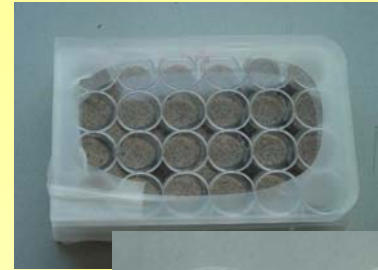
↪ no significant increase of efficacy with higher dosages  
from 25 up to 75 IJs/cm<sup>2</sup>, significant less efficacy with 10  
IJs/cm<sup>2</sup>

- **Temperatures** (cell wells: 20°C & 24°C)

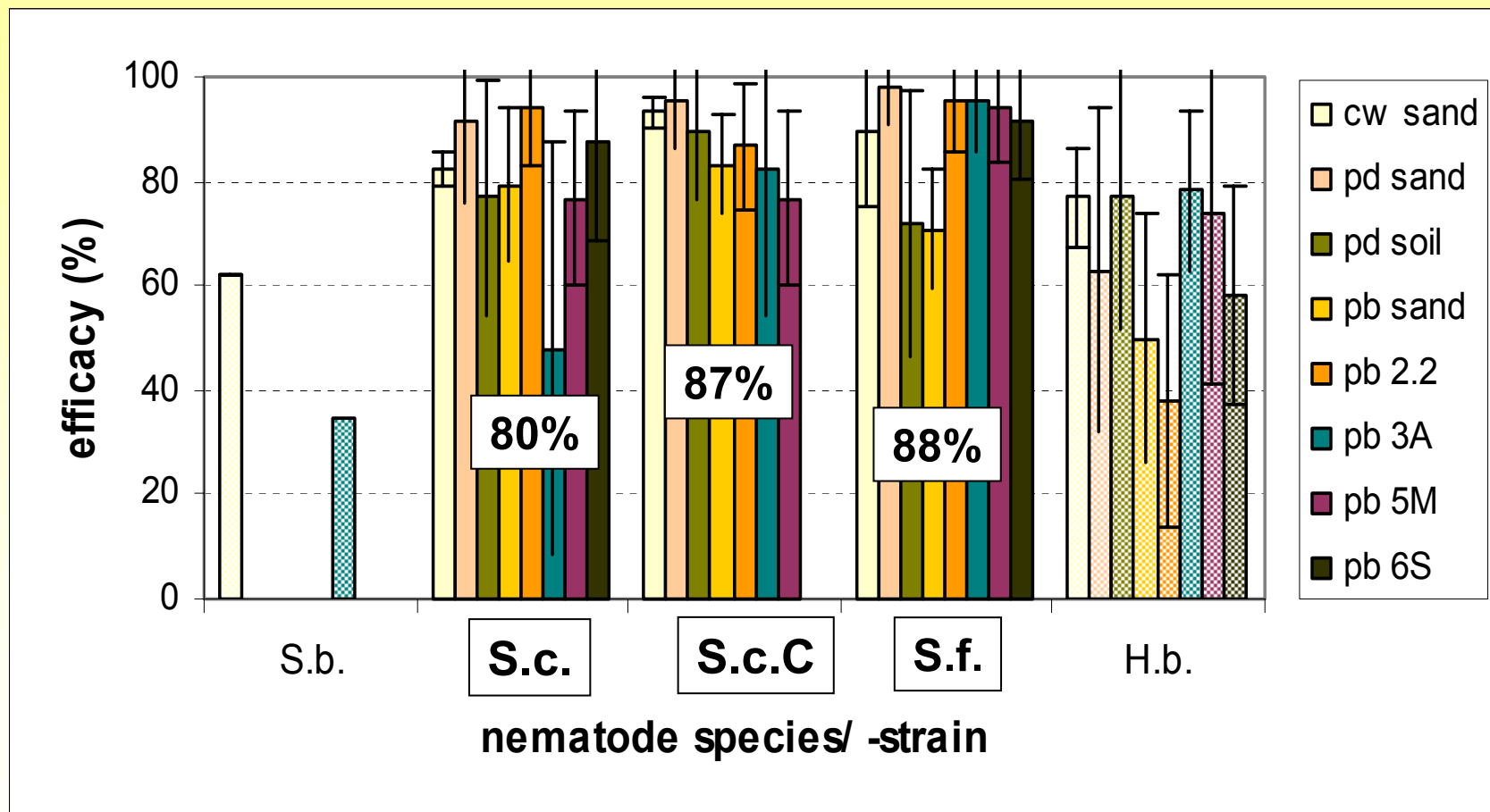
↪ no permanent significant differences

- **Soil types** (quartz sand, field & standard soil)

↪ no permanent significant differences

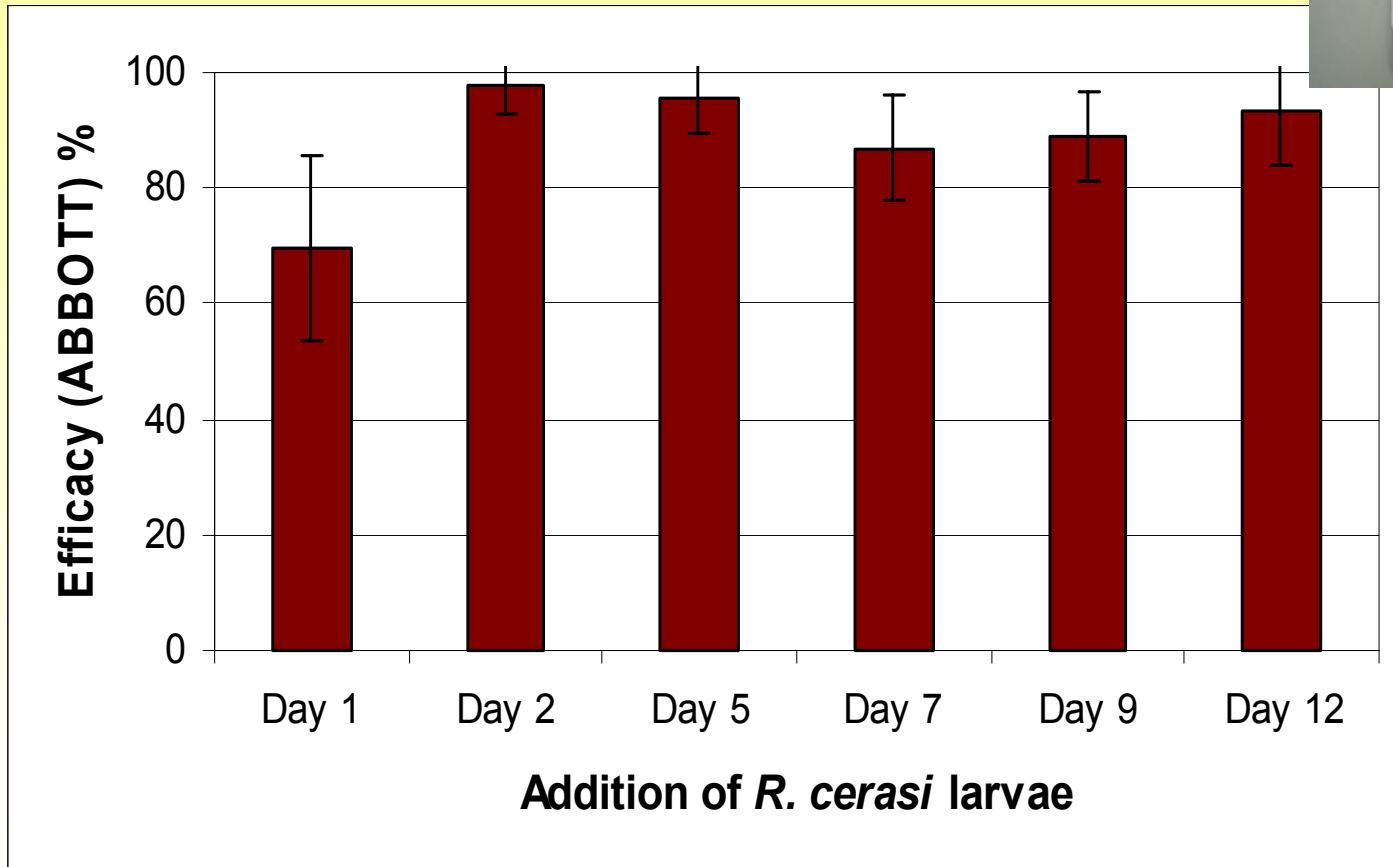


## Mean efficacies (ABBOTT) of laboratory trials



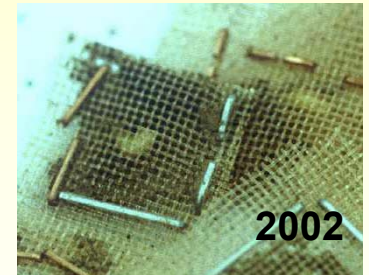
2002: cell wells (cw), petri dishes (pd), 2003: plastic boxes (pb)  
Each with 50 IJs/cm<sup>2</sup> (20°C)

## Persistence of nematode infection potential

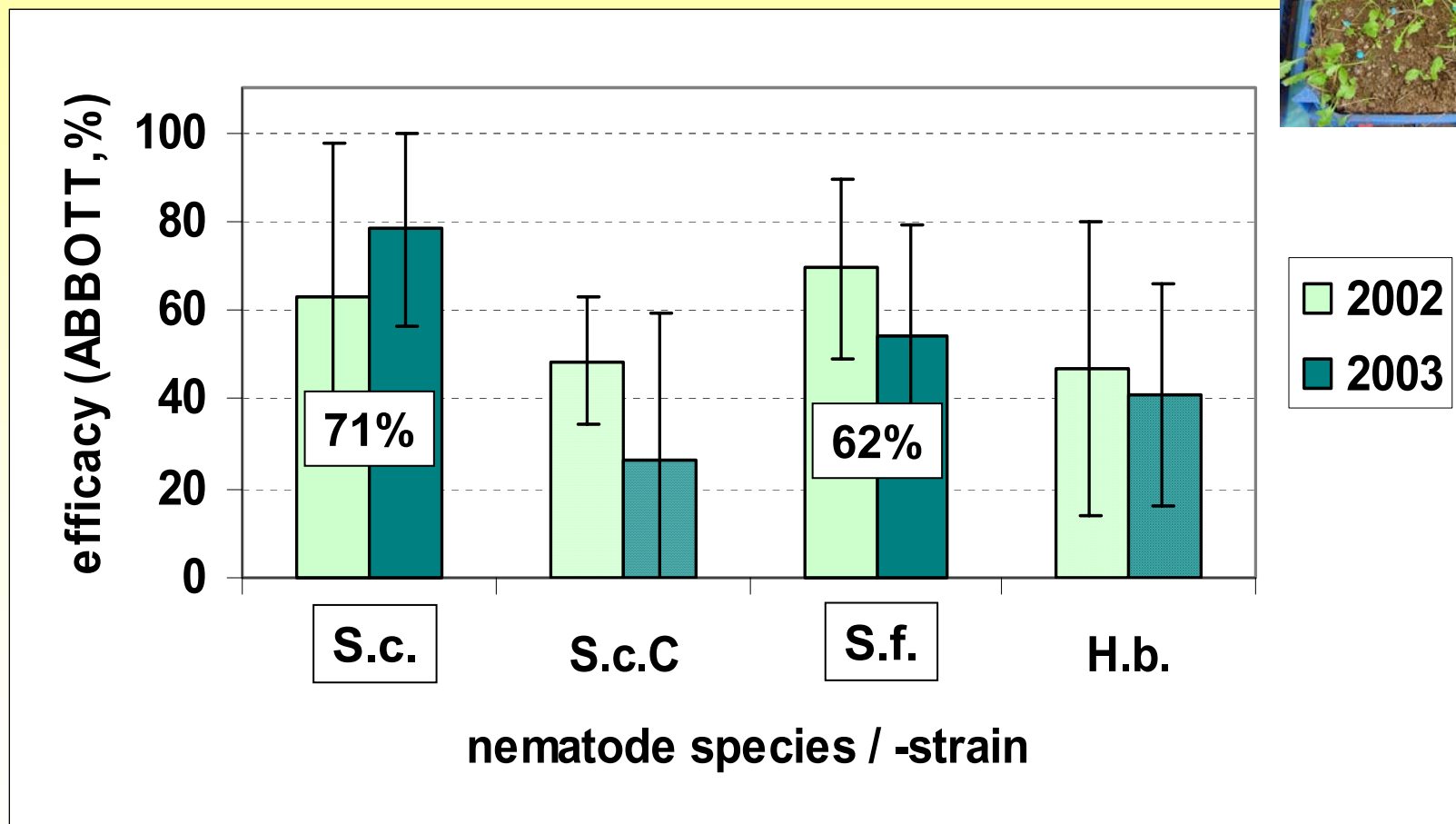


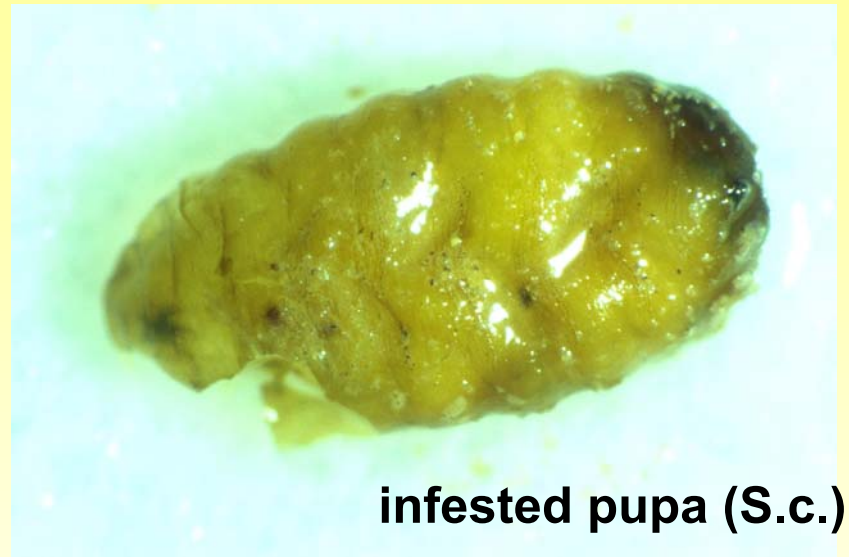
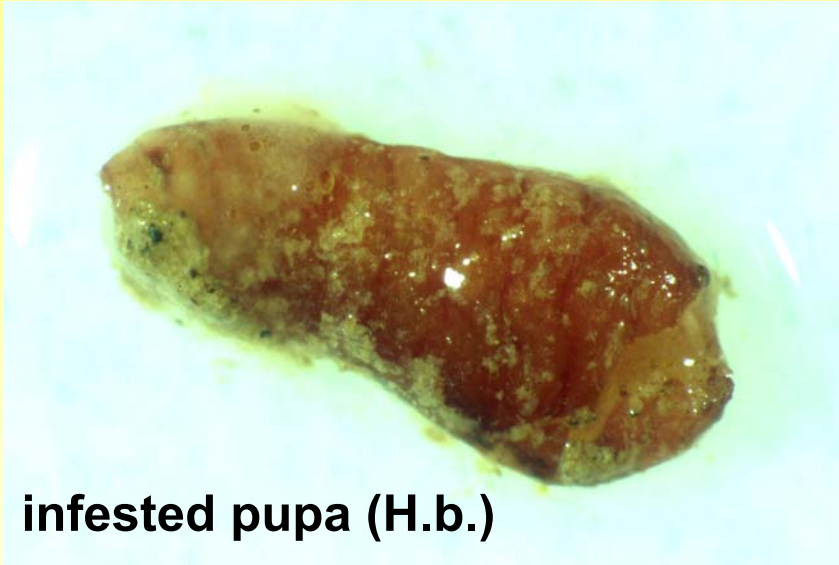
## Semi Field Test

- in plastic fruit boxes: 29 x 29 x 10 cm
- filled with clods, including vegetation
- 10 *R. cerasi* - larvae per box, each placed in a little bag made of gauze and filled with soil (for better finding at the end of the test)
- 50 IJs/cm<sup>2</sup>
- 5 replicates
- exposure in an open vegetation hall



## Mean Efficacy (ABBOTT) in the Semi Field Tests, 2002 & 2003 (50 IJs/cm<sup>2</sup>)





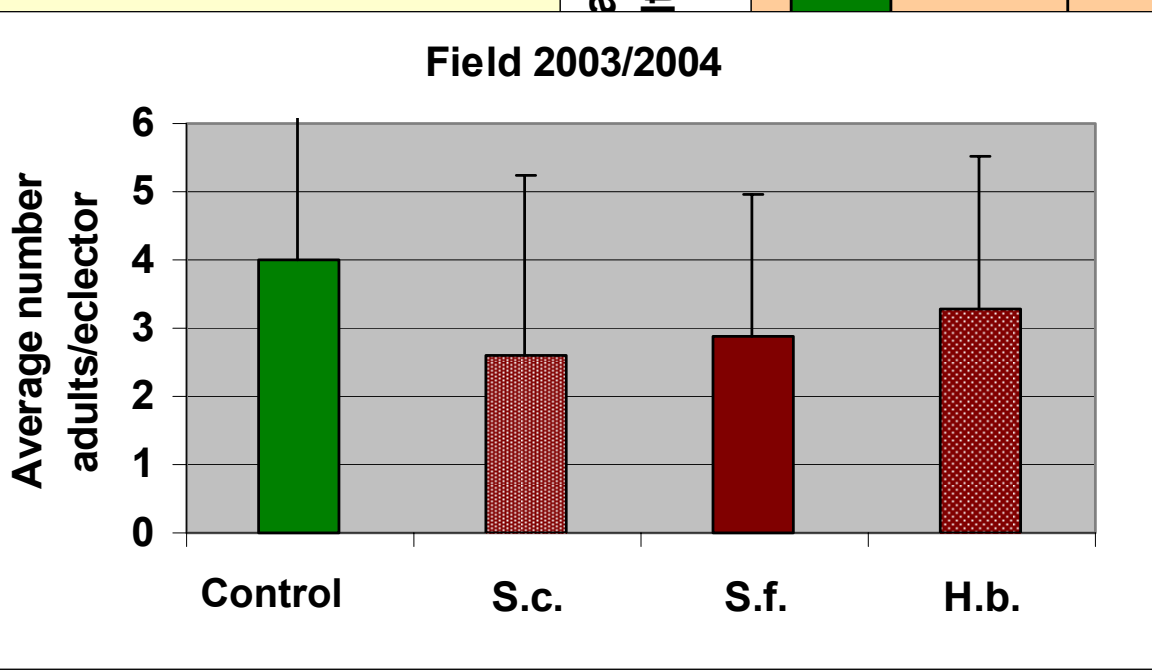
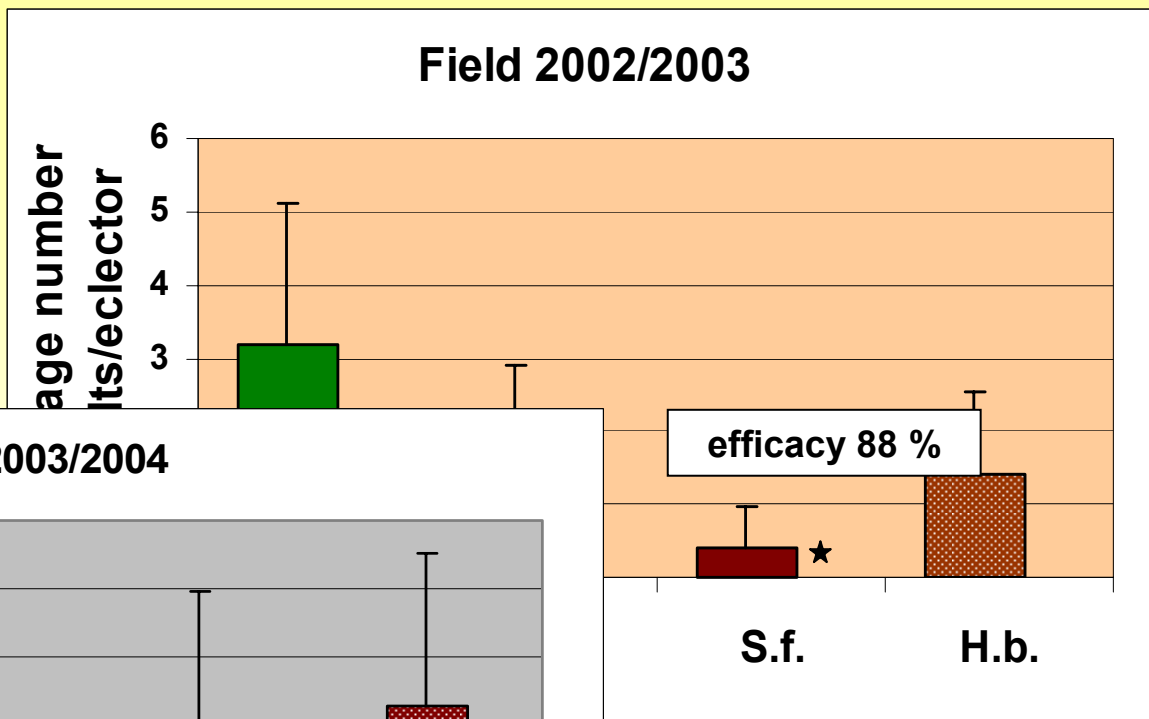
## Field approach

- treatment of 20 m<sup>2</sup> area around a cherry tree with nematodes; 50 IJs/cm<sup>2</sup>
- after nematode application rinsing with 5 l water /m<sup>2</sup>
- release of 30 (2002) and 50 (2003) *R. cerasi* larvae in marked sections of 1/4 m<sup>2</sup> within the area of 20m<sup>2</sup>
- 5 (2002), 10 (2003) sections with *R. cerasi* larvae per nematode species and control
- evaluation by trapping of emerging adults with photo-electors in the following year





### Field approach



★ P < 0,05, U-test

Recapture control 8,0 %

## Summary

- ➡ EPNs have a considerable potential to control *Rhagoletis cerasi* - larvae
  
- ➡ Most succesful nematodes:  
***Steinernema carpocapsae*** and ***Steinernema feltiae***  
Efficacy (50 IJs/cm<sup>2</sup>) on average:

<b>Laboratory:</b>	<b>88 %</b>
<b>Semi Field:</b>	<b>71 %</b>
<b>Field:</b>	<b>88 %</b>
  
- ➡ Temperatures and soil types tested in the lab did not influence the infestation potential of nematodes
  
- ➡ Dosage below 25 IJ/cm<sup>2</sup> was insufficient



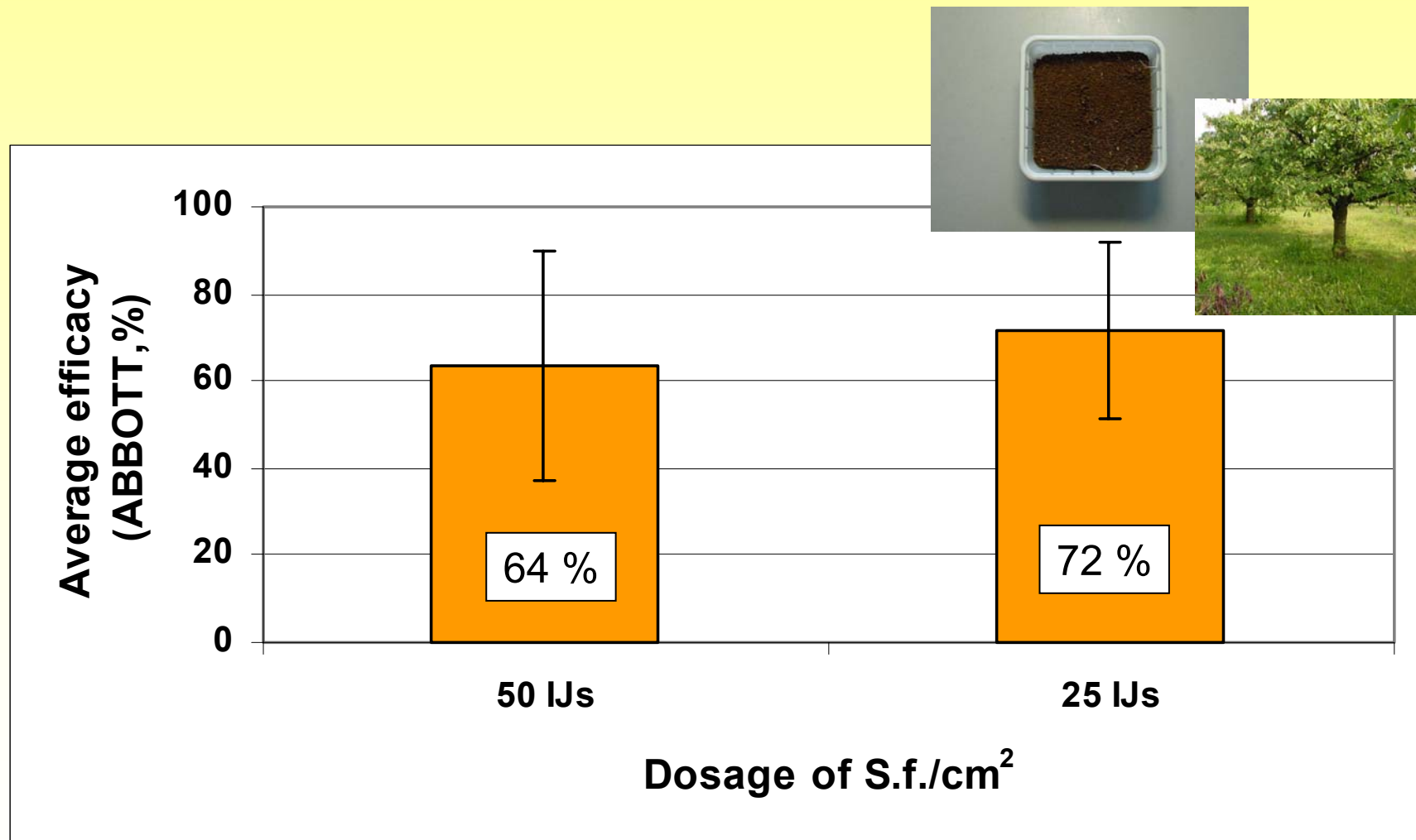
**Origin of CFF larvae: manual isolation of instar larvae from infested cherries**



**is not the natural situation for nematode infestation**

- variable age of larvae**
- time to pupation probably prolonged by isolation of big, but younger larvae, which are not ready for emigration**

Laboratory - field trial in 2004 with *S. feltiae* and naturally emigrated larvae



U-test:  $p > 0,05$

## Outlook



### **Field tests with natural CFF population in cherry orchards**

considering:

Determination and adjustment of factors, which can influence the nematodes' activity: soil humidity, persistence of the nematodes in relation to the period of larval emergence from the cherries, ground cover in the orchards, management of the orchards



### **Investigations on the population biology of the CFF:**

Estimation of the population density and evaluation of the damage before and after the application of EPNs; natural mortality, immigration of CFF from adjacent host trees



**Economic aspects:** further laboratory and field tests with doses  $< 50$  IJs/cm<sup>2</sup>



**Infestation of CFF adults:** Clarification if and to which extent CFF can get infested by EPNs during they emerge from the soil

