

# Application considerations for entomopathogen nematodes in IPM systems

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Entomopathogenic Nematode Application

## General perception on nematodes as bio-pesticides

- the solution for a broad range soil related (larval) pests
- work against all soil pests
- easy to apply, almost fool proof
- very expensive compared to chemicals
- cannot see them, so they do not work
- if control fails, ALWAYS due to bad product/nematodes

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# Truth about nematodes as bio-pesticides

- they do work, but do not work against all insects (stages)
- often not applied in the right way
- failure often due to lack of knowledge
  - wrong application technique and timing
  - insect (stage) non-susceptible
  - culturing technique and watering regime not compatible with nematode application

→ application needs more attention

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# 'Standard' application of nematodes

- techniques:
  - watering can, overhead irrigation, sprinklers, drenching, spraying boom, etc.
- against:
  - sciarid flies/fungus gnats, grubs, vine weevil, mole crickets, Tipula, etc.
- Dose:
  - 0.5 M / m<sup>2</sup> , high volume (>1500L/ha)

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# Examples of different application techniques nematodes

Spraying boom application in  
ornamental nursery



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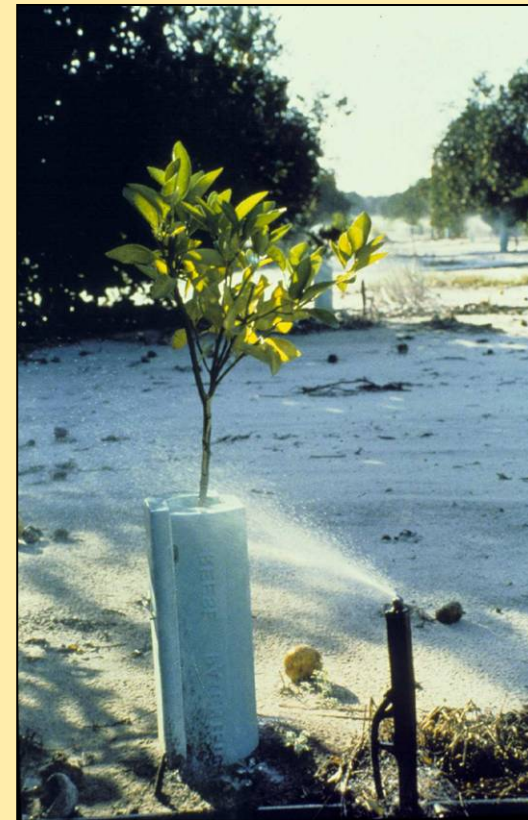
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Source: Koppert BV

## Examples of different application techniques nematodes



Tractor mounted spray boom application in turf grass



through irrigation sprinkler systems

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# The standard 'recommendations' how to apply nematodes

- pressure: max 5 bar on the nozzle
- nozzle opening: minimum 0.5 mm
- remove all sieves
- keep surface moist before and after application
- dosages 0.5 M nematodes per 1 m<sup>2</sup> or per 0.1 m<sup>3</sup>

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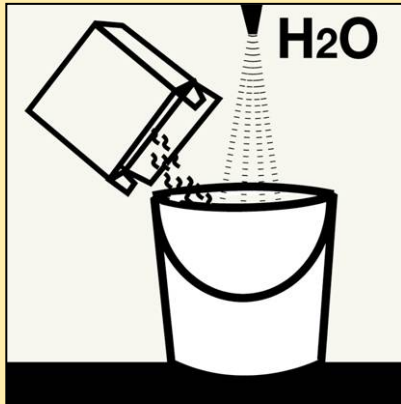
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## Preparation of a nematode solution

- 1 ■ Empty content of box in bucket water (~15-20°C)
- 2 ■ Stir well and transfer content in spraying device
- 3
- 4 ■ Use one package at once
- 5
- 6 ■ Immediately apply nematode solution after preparation
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## Points of attention when applying nematodes

- substrate type
- irrigation system (dripping, ebb and flow; overhead)
- substrate moisture content
- high temperatures  $>35^{\circ}\text{C}$
- UV radiation
- substrate temperatures

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# Forgotten attention points when applying nematodes

- biology of target insect
- culturing techniques: every crop and grower is different
- application/spraying has to fit in the normal watering management of the grower
- compatibility with chemicals and water quality

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# Constraints of standard application of nematodes

- entering new markets needs a different approach
  - new pest
  - known pest in new crop
  - foliar insects
- examples of a 'new' pest: *Orfelia*
- examples of an 'old' pest:
  - Sciarid larvae

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## Example of a new pest : 'pot-worms' (*Orfelia* sp.) in pot-orchids

- 'new' pest in pot-orchids: Cymbidium, Cambria and Phaleanopsis
- larvae puncture root tip → plant stops growing and diseases can be transmitted
- threshold: one larva can destroy a plant or gives growth reduction



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## *Orfelia* sp.

- family: Mycetophilidae > 40 species
- species not known
- closely related to sciarid flies
- biology not very well known
- brown instead of black head
- adult and larvae bigger than sciarid flies
- often not more than 1-2 larvae per plant
- larvae can stay in a pot for a long period
- sensitive to drought
- mainly eating decaying matter, but also cannibalistic and puncture in root tips



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# *Orfelia* sp.



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larva  
infected  
adult

Source: Koppert BV

## Control of *Orfelia*

- looks like sciariid: “so use of EPN’s should be easy”
- on closer look: everything is different
- research needed
- biology and crop management asks for adaptations to “general recommendations”

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## Control of *Orfelia*

- chemical (registered products):
  - teflubenzuron, deltamethrin
- mechanical/cultural:
  - blue lamps attracts adults
  - yellow sticky traps
  - keep pot as dry as possible
- biological:
  - rove beetles, predatory mites, Bti
  - EPN's

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# Constraints in controlling *Orfelia*

- chemical:
    - no or very little effect
  - mechanical:
    - almost not attracted by sticky traps
    - blue lamps must be very near to pots
    - drought helps, but not good for plant
  - biological:
    - no effect of beneficials; larvae too big, aggressive and deep in pot for predators
    - Bti, no effect seen so far
- very sensitive to nematodes, but environment not favourable

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# Application of nematodes against *Orfelia* through overhead sprinklers

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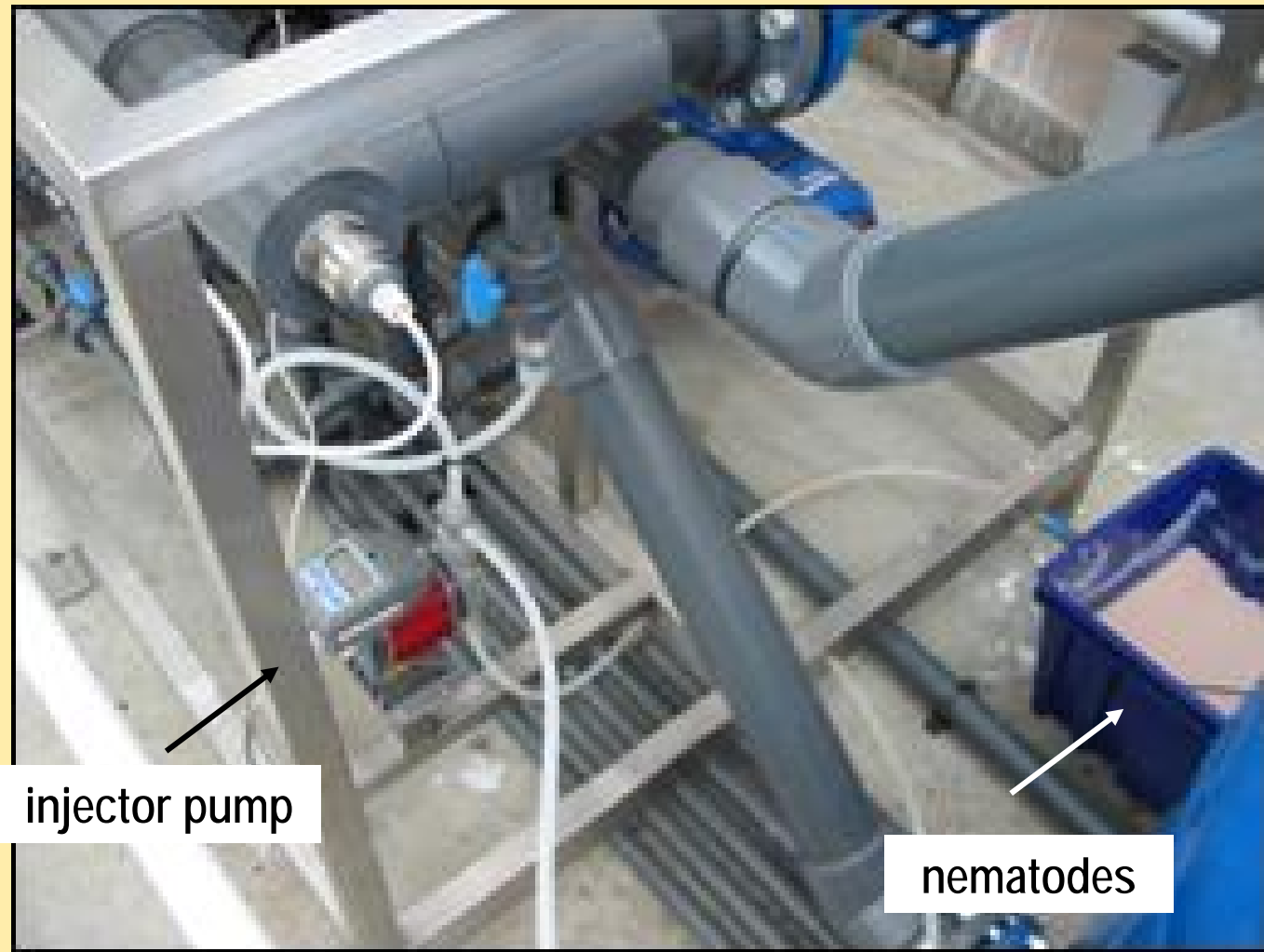
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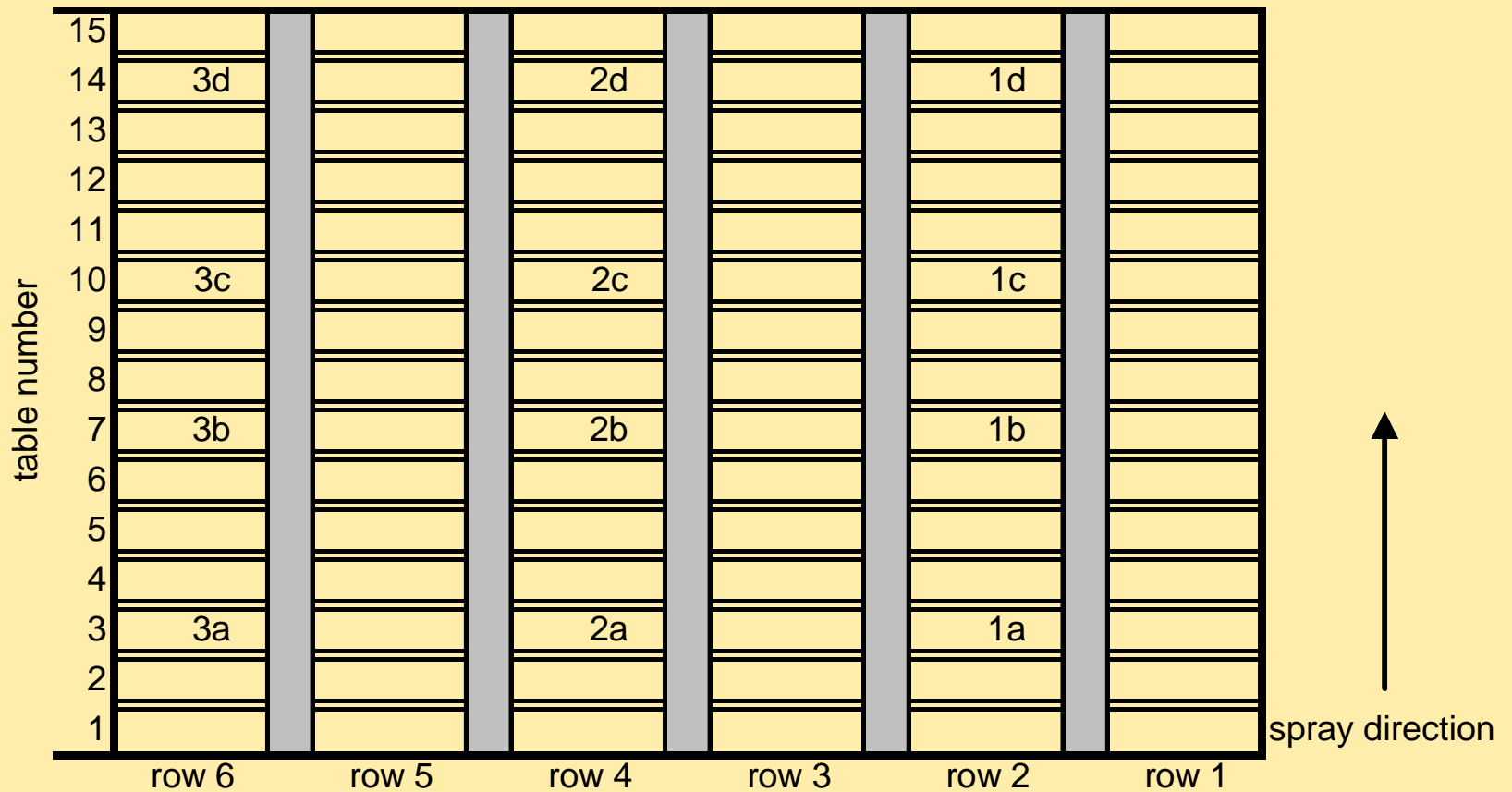
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# Overview of the sampling pots in the greenhouse



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## Average number of nematodes per pot (Ø 6.5 cm) after spraying

Pot #	nematodes	
	per pot	per m <sup>2</sup>
1a	1670	505909
1b	1737	526212
1c	1568	475152
1d	1903	576545
2a	33	9970
2b	1693	512970
2c	3202	970182
2d	2138	647758
3a	768	232727
3b	1247	378000
3c	562	170424
3d	1226	371364
average	1479 ± 814	448101 ± 246717

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# Damage in Cambria caused by *Orfelia* larvae



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# Experience controlling *Orfelia* with nematodes

- through overhead sprinklers
  - good, even distribution
  - easy to apply
  - pots stay relative dry after application
  - poor results, 30-40%
- knapsack sprayer very good results
  - labour intensive
  - good results, >75%

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# Constraints in controlling *Orfelia* with nematodes

- plants grown in bark/peat mixture
- plants cultured as dry as possible
- watering through overhead sprinklers:
  - couple of times day/week
  - relative small quantities at once
  - effect difficult to monitor
  - even with good larvae control, lots of adults can be caught
- nematodes regarded as very expensive
- growers want to see a direct effect

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## 'Standard' advice for controlling *Orfelia* with nematodes

- use only knapsack or hose-end sprayers
- before application pre-irrigate plants with sprinkler systems to moisten the bark
- apply nematodes
- post-irrigate plants with sprinkler systems to rinse nematodes from leaves and get them in the pots
- do not water the plants for 3-4 days
- low pest pressure: apply every other week half dose
- high pest pressure: apply weekly full dose, 3 times

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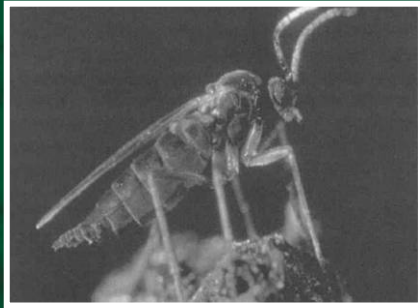
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Source: J.Scheepmaker

## Example of an “old pest”: Fungus gnat control in fresh herbs

- Sciariid flies and shore flies major pests in fresh herbs
- larvae feed on young seedlings, adults are nuisance and pollute leaves
- larvae can transmit diseases
- often due to bad sanitation, hygiene and an internal source of contamination

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# Control of fungus gnats

- chemical:
  - teflubenzuron, deltamethrin
- mechanical/cultural:
  - blue lamps attracts adults
  - yellow sticky traps
  - keep soil surface as dry as possible
- biological:
  - *Hypoaspis aculeifer*
  - *Steinernema feltiae*
  - Bio-soaps against adults

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# Constraints in controlling fungus gnats

- chemical:
  - teflubenzuron not effective, deltamethrin kills *Hypoaspis*
- biological:
  - often very wet so that mites can drown and nematodes are flushed out
- amount of water used in culturing herbs
- time of application differs per crop, grower and cropping system

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## Standard advise for controlling fungus gnats with nematodes

- With low pest pressure: apply 3-5 days after germinating
- With high pest pressure: repeat within 7-10 days after first application
- try to avoid watering just before and/or after applying nematodes

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# Conclusion

- nematodes can be effective biological alternatives for chemical pesticides
- nematodes can control a broad range of soil pests
- application of nematodes is easy
- nematodes survive all 'normal' watering and application methods
- even in standard situations there are failures in control
- every situation, new pest and grower is different and needs separate advise

→ each new case needs research

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