Entomopathogenic nematodes can replace soil insecticides in western corn rootworm control

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The problem

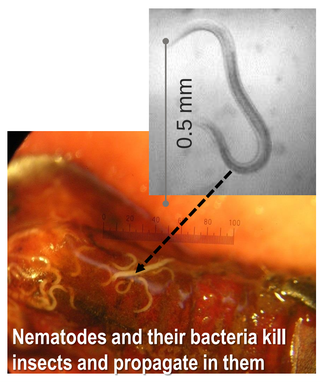
- Western corn rootworm (*Diabrotica v. virgifera*) damages maize.
- Many soil insecticides are either/or highly toxic to humans, have serious other non-target effects, or are banned from use.


Rootworm larvae feed on maize roots


Plant lodging due to root damage by rootworms

The solution

- Beneficial, entomopathogenic nematodes are well-adapted to the soil and non-toxic.
- To provide growers with more pest management options, and to reduce insecticide reliance, a biological control product has been developed that incorporates the entomopathogenic nematode *Heterorhabditis bacteriophora* (Nematoda: Rhabditida).



Nematodes and their bacteria kill insects and propagate in them

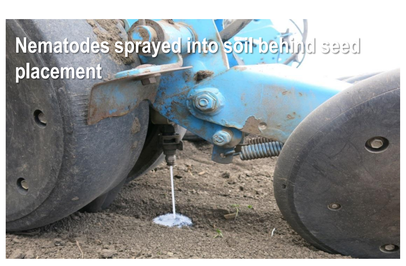
What we did

- The aim was to investigate whether fluid applications of the nematode can be an alternative to older as well a recently registered synthetic pesticides in the management of rootworms


Nematodes express –shipped in cool box to grower

- Five field trials implemented in southern Hungary between 2013 and 2015 using grower machinery
- Treatments
  - *Heterorhabditis bacteriophora* (Nematop TM = Dianem TM WP)
  - Tefluthrin (ForceTM 1.5G)
  - Cypermethrin 0.8% (Belem 0.8MGTM)
  - Chlorpyrifos 5% (Kentaur 5G)
  - Untreated infested control
- 4 plots per treatment per field
- Pest level, root damage, yield assessed


Nematodes diluted in water. Grower training is essential


Nematodes sprayed into soil behind seed placement

Results

Reducing rootworms

- Nematode treatments as well as soil insecticides were able to reduce adult emergence of rootworms
- Nematodes can, if applied at relatively high dosage, be as effective as commonly used synthetic soil insecticides in controlling the larvae.

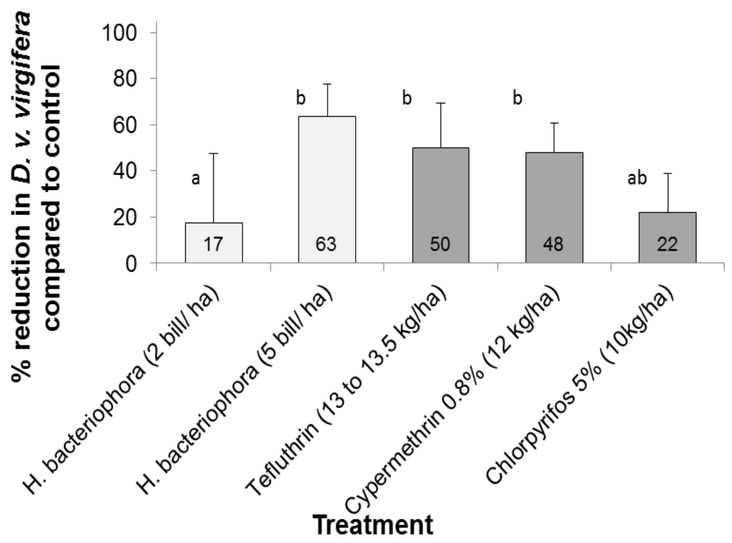


Figure. Efficacy of the entomopathogenic nematode *Heterorhabditis bacteriophora* and soil insecticides at reducing *Diabrotica v. virgifera* in five maize fields in southern Hungary. Plants infested with 300 eggs. Adult emergence assessed in 4 cages with 6 plants per treatment and field; error bars = SEM; letters above bars indicate differences according to Games Howell multiple comparison following GLM at $p < 0.05$

Preventing root damage

- Nematode treatments as well as soil insecticides were in most occasions able to significantly prevent at least some of the root damage caused by rootworm larvae

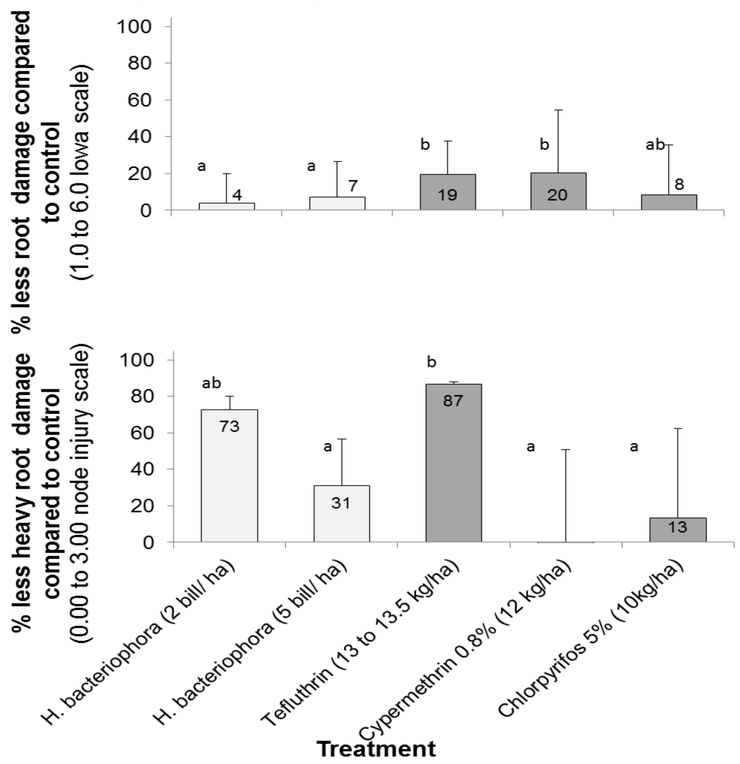


Figure. Efficacy of the entomopathogenic nematode *Heterorhabditis bacteriophora* and soil insecticides at preventing root damage by *Diabrotica v. virgifera* larvae in five maize in southern Hungary; plants infested with 300 eggs; 1.0 to 6.0 traditional Iowa scale = overall damage including minor damage; Oleson node-injury scale = heavy damage only; 6 plants assessed per plot per treatment and field; error bars = SEM; letters above bars indicate differences according to Tukey post hoc comparison following GLM at $p < 0.05$.

Preventing yield losses

- Nematode treatments as well as soil insecticides slightly increased yield on average across the five trials

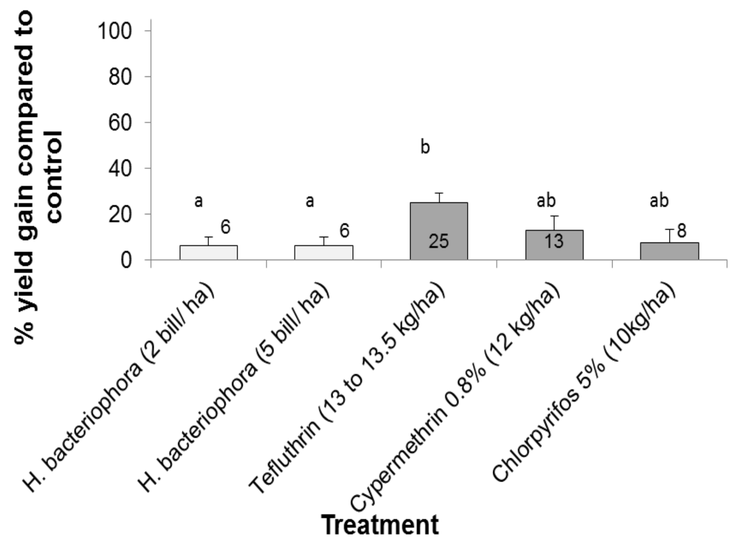


Figure. Efficacy of the entomopathogenic nematode *Heterorhabditis bacteriophora* and soil insecticides at preventing yield losses due to damage by *Diabrotica v. virgifera* larvae in five maize fields. Plants infested with 300 eggs. 6 plants assessed per plot per treatment and field; cob weight dried and standardized to 13% moisture; error bars = SEM; letters above bars indicate differences according to Tukey post hoc multiple comparison following GLM at $p < 0.05$. Southern Hungary with two fields in 2013 and 2014, and one field in 2015

Take home messages

- The recommended commercial dose of 2 billion nematodes per hectare appeared likely to be in most cases enough to keep damage below thresholds.
- To assure a higher security in treatment efficacy across locations, conditions, and different grower skill-levels, a higher dose might be applied.
- Findings support a nematode-based solution for the biological control of rootworms in maize fields in European regions as one among the alternative options to synthetic insecticides.

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