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AWARD 2020



**Biological Control of
Western Corn Root Worm**

dianem[®]

Patent
pending



**True alternative
to standard
chemical
pesticides**

Diabrotica v. virgifera* management using a genetically improved strain of *Heterorhabditis bacteriophora

**Ralf-Udo Ehlers
e-nema GmbH, Germany**

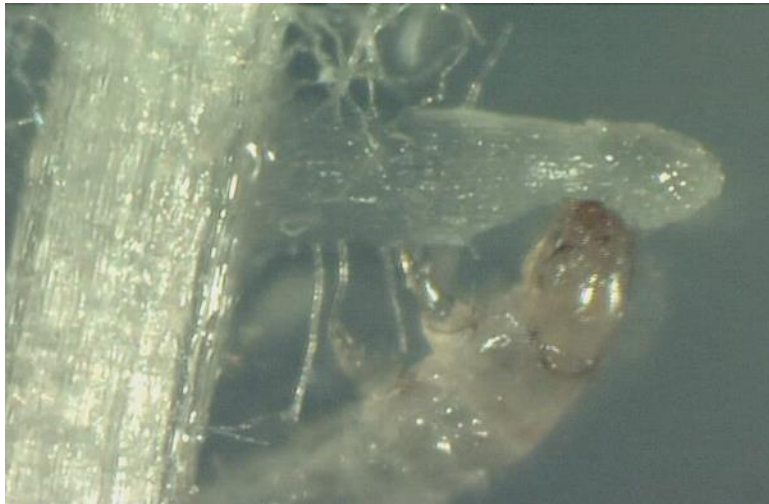
www.e-nema.de



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The Western Corn Rootworm *Diabrotica v. virgifera*



First instars feed on small roots. L2 and L3 tunnel into the roots



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The Western Corn Rootworm *Diabrotica v. virgifera*

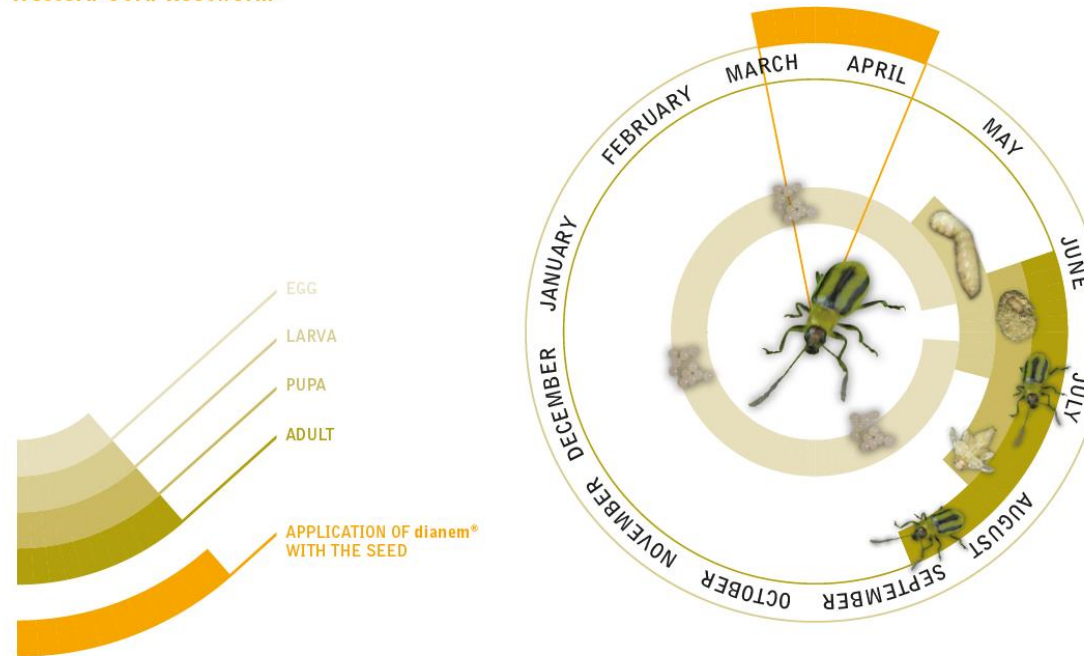


Styria 2014

The billion \$ insect: Damage and control costs estimated for USA

The Western Corn Rootworm *Diabrotica v. virgifera*

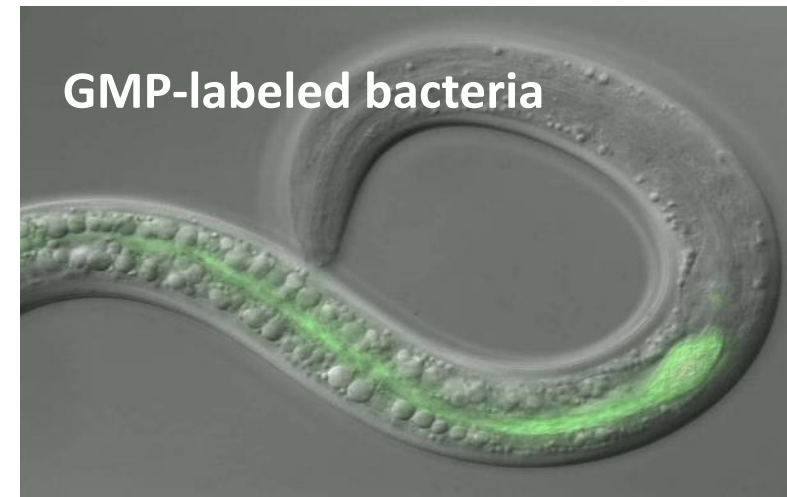
Western Corn Rootworm



**Rotation can solve problem but farmers loose 150-650 €/ha
(Kehlenbeck 2014: <https://doi.org/10.5073/jka.2014.444.046>)**

The biological control product **dianem[®]** contains:

Nematode	Bacterium
<i>Heterorhabditis bacteriophora</i>	<i>Photorhabdus luminescens</i>

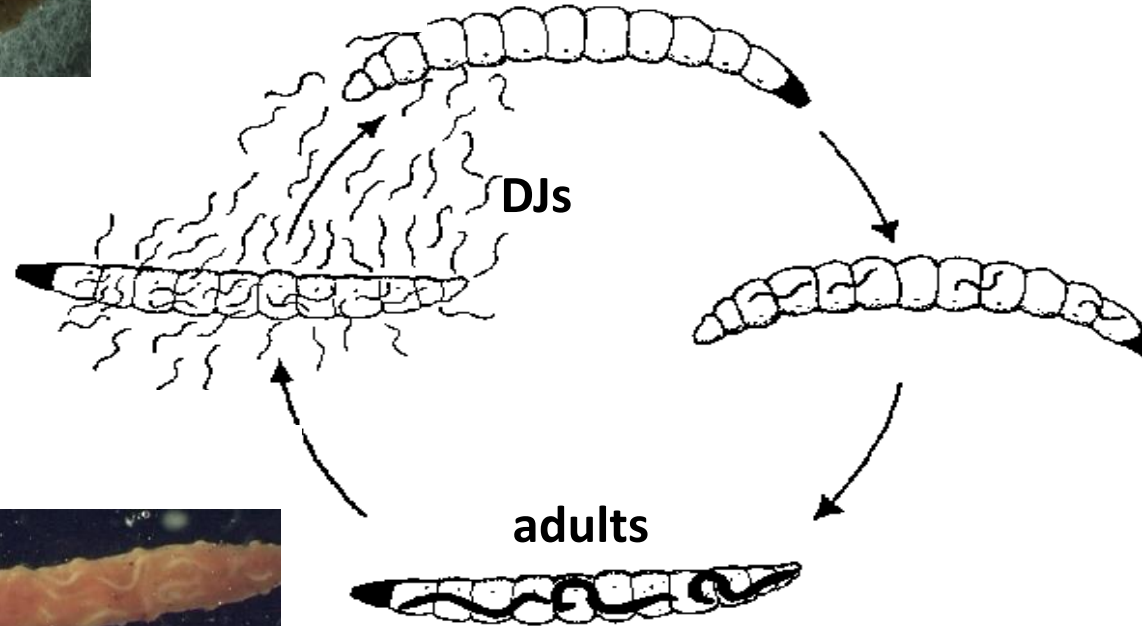


Detailed life cycle at: <https://www.youtube.com> search for [dianem](#)

DJ infest host and release bacteria



When host is consumed, DJs develop, which seek for surviving CRW larvae



Bacteria proliferate and kill larvae within 2 days




Nematodes feed on bacteria and reproduce

How to make it competitive?

**Biological Control of
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dianem[®]

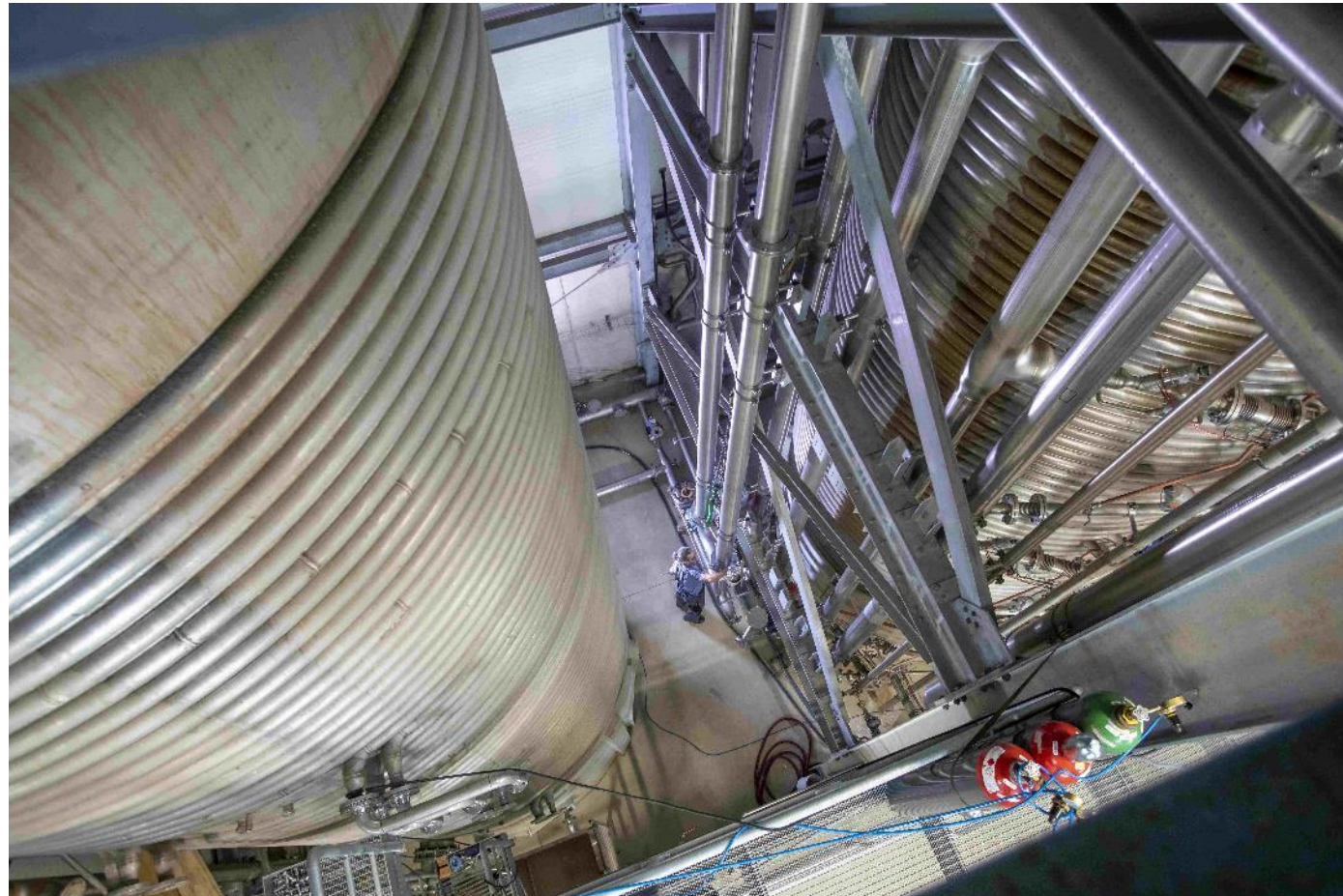
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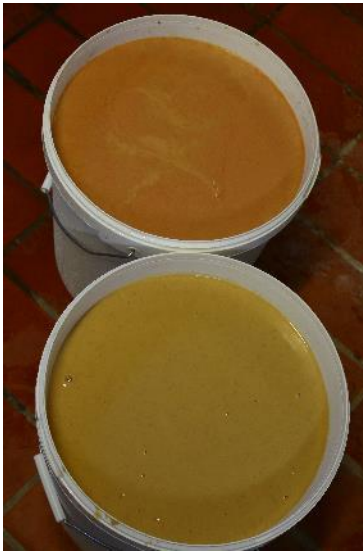
**True alternative
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chemical
pesticides**

- Use economies of scale: Produce at larger volumes

Nematodes are produced in liquid culture



Formulated in amorphous SiO₂



**Concentrated
nematodes for
appr. 100 ha**

+



Amorphous SiO₂

Packed in plastic bags of 500 million
Two bags for 1 ha



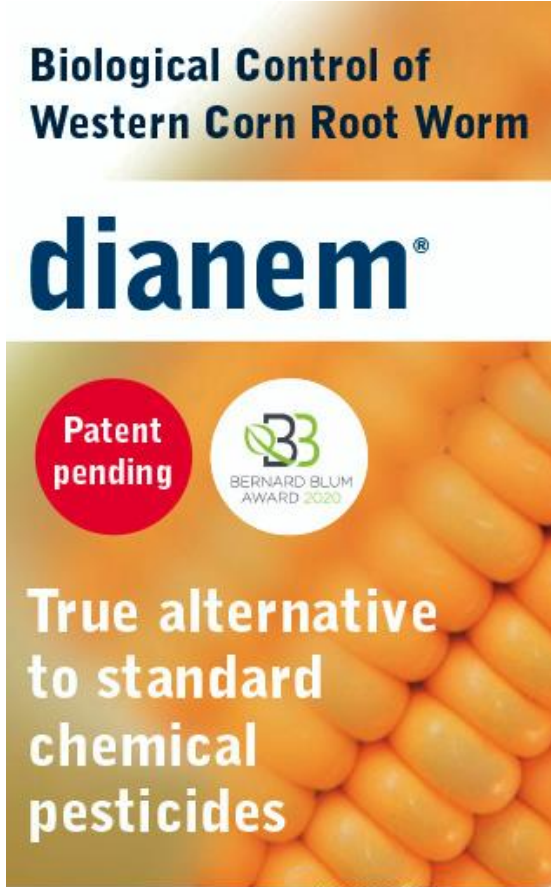
Packing machine



500 million Dauer Juveniles




How to make it competitive?



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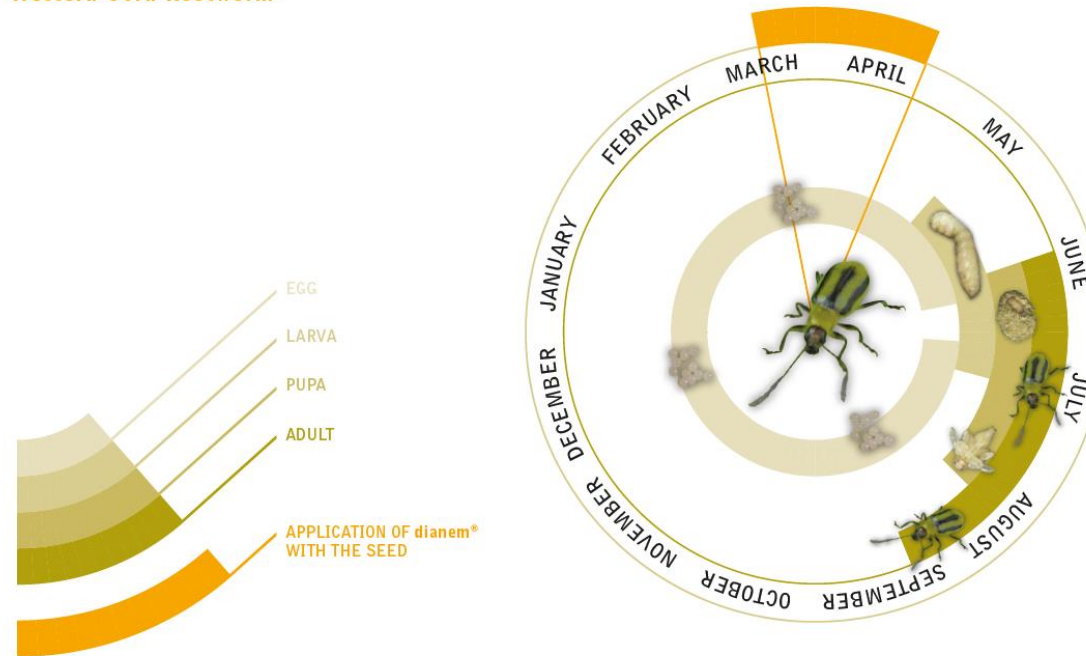
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**True alternative
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- Develop adapted application technology

When to apply?

Western Corn Rootworm



**Nematode application in June/July impossible (too much water needed)
Why not apply at seeding? Application in March/April tested successfully**

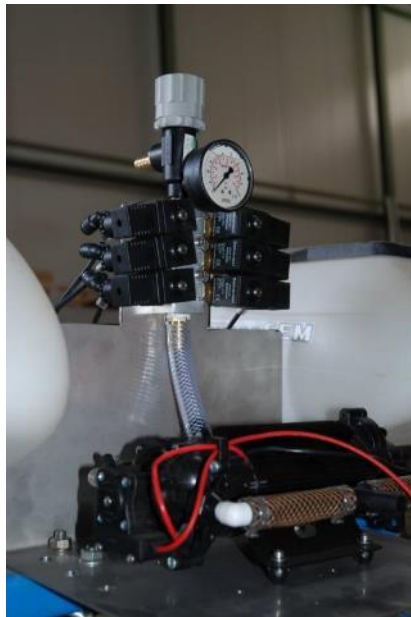
Application with seed drilling machine



Front tank with nematode suspension



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**Electric pump
25 L/Min.**



Liquid-Inject-Share



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Application into furrow onto the seed with 1 billion/ha and 200 L application water





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Liquid application systems now available

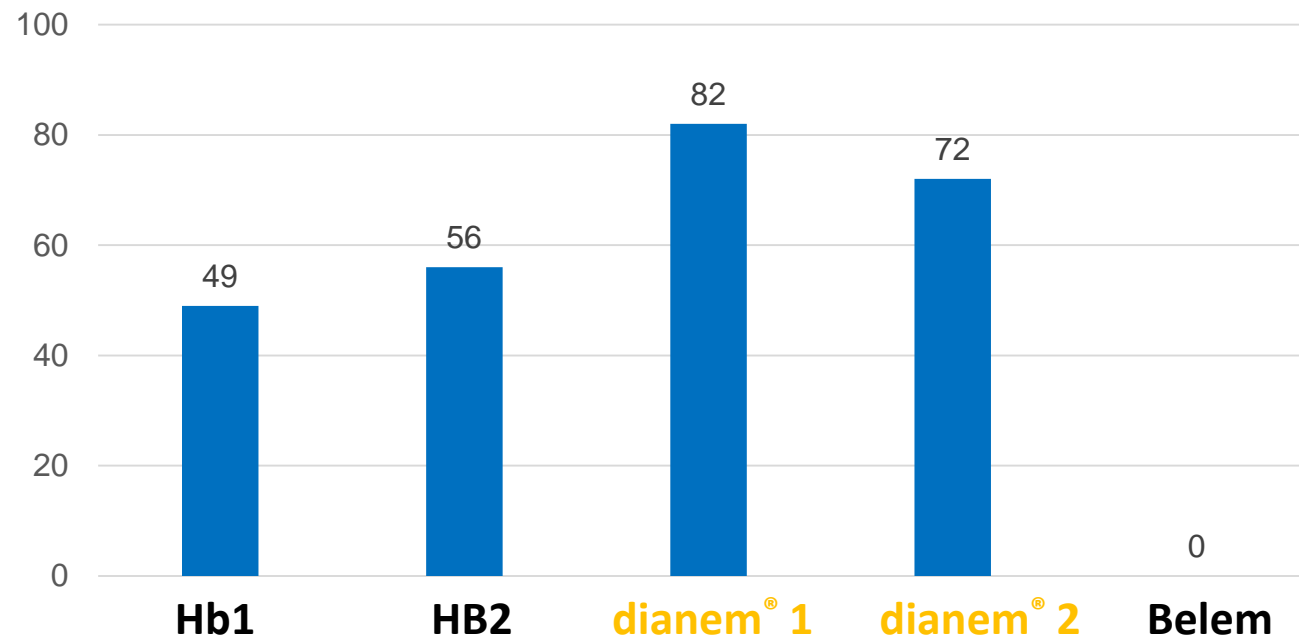


HORSCH

How to make it competitive?

- Reduce application density by genetically improving virulence and persistence
- Application of 1 billion/ha

CABI HU, 2018: % Control of Adults



dianem® and Hb at 1 and 2 x 10⁹/ha, Cypermethrin 12 kg/ha

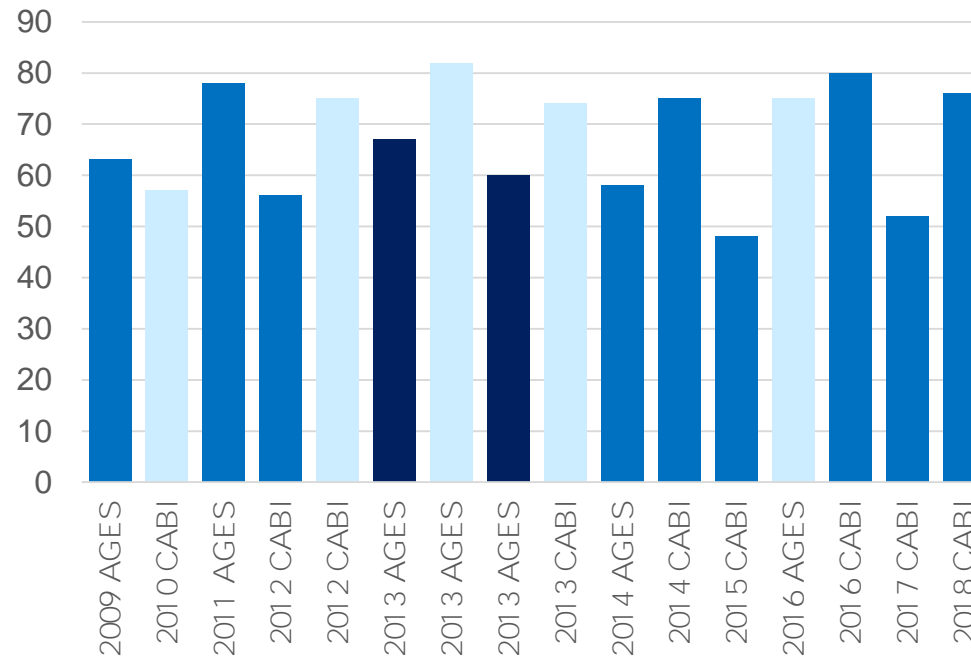


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Reduction of adult population (%)

Mean = 68%



Dianem®

■ better, ■ same or worse than chemical

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True alternative
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100-300 eggs/plant, 1-2 x 10⁹ DJ/ha

Summary

Biological Control of Western Corn Root Worm

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True alternative
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- **dianem[®]** is an effective and environmentally safe control product
- Provides sustainable control of Corn Rootworm larvae
- Investment into production capacity made possible the use of economies of scale
- Adapted application technology enabled transfer into agricultural practice
- A 6-years breeding programme resulted in a more virulent and persistent strain
- Application of 1 billion/ha with 200 ltr. water at sowing
- These achievements make **dianem[®]** a competitive product for control of Dv



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Thanks to:



BIOCOMES

New biological control products
for sustainable farming and forestry



Bundesministerium
für Bildung
und Forschung

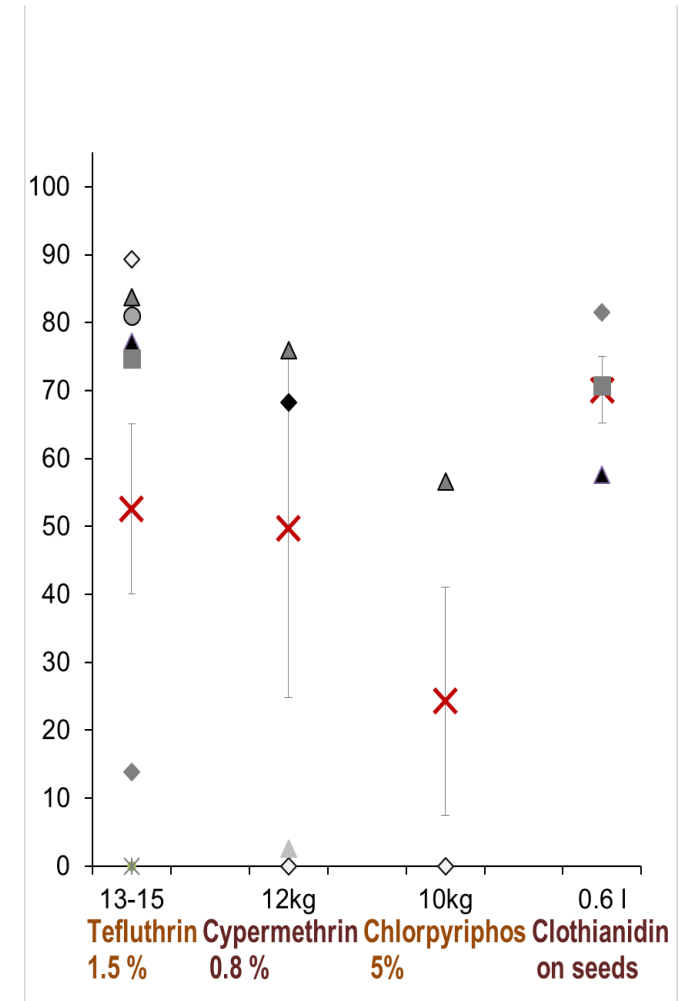
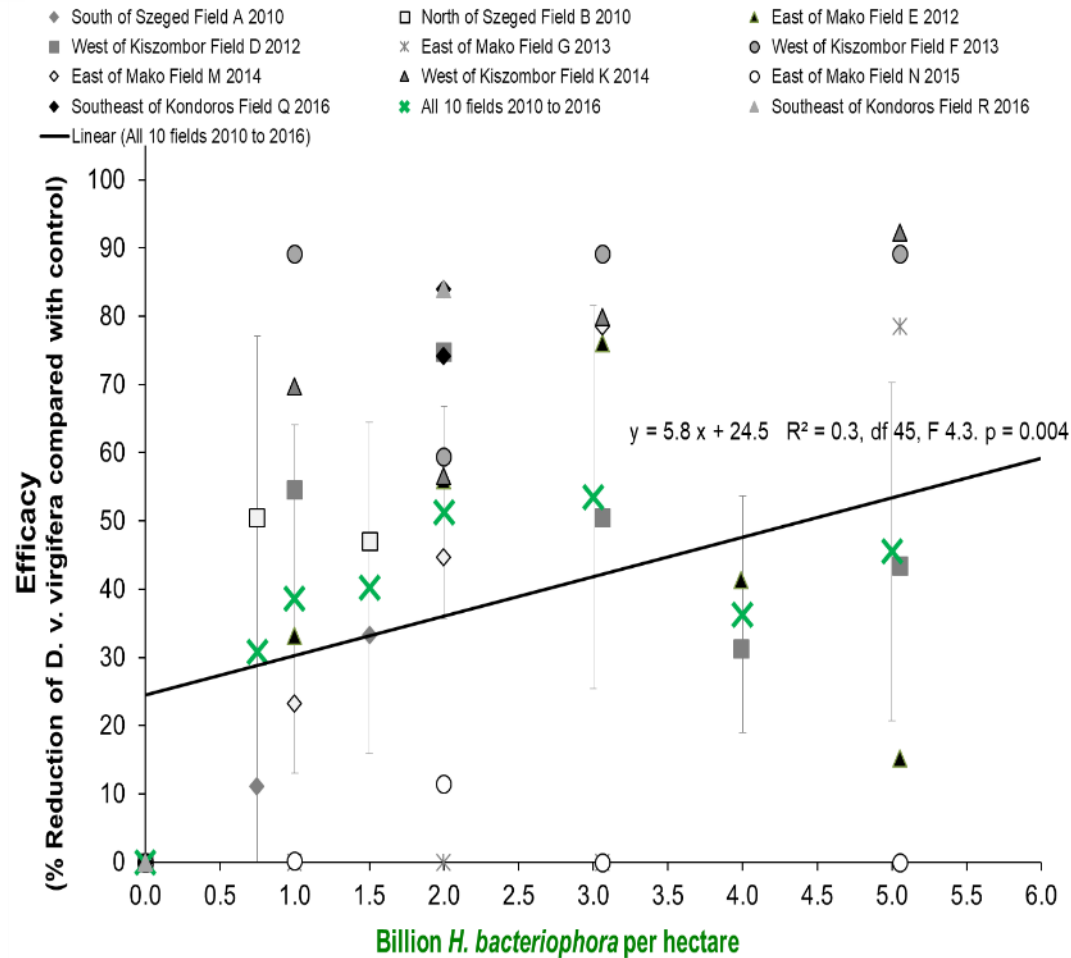




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Challenge: Variability



Control strategies

Leaves

- Against adults
- Damage to plants



λ-Cyhalothrin

Seed treatment

- Against larvae
- Bees affected
- Seed treatment prohibited



Insecticidal granulate

- Only Tefluthrin provides control
- At high temperature vaporisation

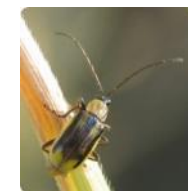


Tefluthrin

Cypermethrin

GMO-Maize

- Not used in EU
- Resistance against Bt-Cry 3



Plant protection

Breeding