Effective and selective control of plant parasitic nematodes with *Paecilomyces lilacinus* 251

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Sustainable food production

- Consumers expect **safe** and **sustainably-produced** food
- Global retailers and the **food chain** have more stringent **quality targets**
- Farmers need **Integrated Crop Management (ICM)** programs

This has led to an increasing demand for biologicals within integrated crop solutions
BioAct – one example of several well developed biologicals

The Bayer CropScience portfolio of biologicals
Threat of plant parasitic nematodes

- Nematodes or eelworms are major soil pests affecting horticultural and agricultural crops. They cause severe damage and crop losses, if they are not controlled.

- Harmful soil nematodes infect the roots of plants. They impede the take-up of water and nutrients and weaken the standability of affected plants.

- The nematode species involved are world-wide in their distribution and collectively cause billions of dollars of crop damage every year.
Paecilomyces lilacinus

- *Paecilomyces lilacinus* 251 very efficient egg parasitizer
- It attacks all stages of nematodes (juveniles and adults)
- No genotoxicity (absence or insufficient conc. of genotoxic mycotoxins)
- Intensely developed by R. Holland, A. Khan, G. T. Garcia, S. Kiewnick and uncountable others, incl. own team

Mode of action is parasitism in which no toxins are involved

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Intense Research & Development

**The Active**
- Mode of action
- Tox/Eco-tox/EnSa
- Relation with known other strains (features)
- Efficacy
- Reproduction

**Formulation**
- Shelf life
- Consistent quality
- Manageability
- Way of application
- Confirmatory efficacy trials

**Competitiveness**
- Target market
- Regulatory data package
- Ability to produce
- Price/volume
- Farmers support
The Active

<table>
<thead>
<tr>
<th>Item</th>
<th>Method</th>
<th>Result</th>
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<tbody>
<tr>
<td>Mode of action on eggs of different stages</td>
<td>Scanning electron microscopy</td>
<td>Clear insight on the parasiting and proliferation process</td>
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<tr>
<td>Screening of 89 strains</td>
<td>Allozyme electrophoresis</td>
<td>Parasiting features; different P.I. can coexist in same soil</td>
</tr>
<tr>
<td>Genetic relation between strains of 47 strains</td>
<td>Long Primer - Random Amplified Polymorphic (LP-RAPD) analysis</td>
<td>Identification of strain; no correlation related to origin</td>
</tr>
<tr>
<td>Growth at 37 °</td>
<td>Plating at different temperatures</td>
<td>Limited growth at &gt; 32°C</td>
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The Active: well explored already before studies for registration were conducted
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<th>Item</th>
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<tr>
<td>Persistence in soil</td>
<td>Re-isolation from different soils</td>
<td>Rapid decline, after appl. back to background level after crop</td>
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<tr>
<td>Non establishment of PL in roots?</td>
<td>Plating of stained root tips</td>
<td>Non establishment of PL in and on roots!</td>
</tr>
<tr>
<td>Paecilotoxin present?</td>
<td>HPLC comparison (high performance liquid chromatography)</td>
<td>Paecilotoxin not present!</td>
</tr>
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Range

- Awl nematode (*Dolichodorus heterocephalus* species)
- Burrowing nematode (*Radopholus similis*)
- Citrus nematode (*Tylenchulus semipenetrans*)
- Cyst nematodes (*Heterodera* and *Globodera* species)
- False root knot nematodes (*Nacobus* species)
- Lance nematode (*Hoplolaimus columbusspecies*)
- Lesion nematodes (*Pratylenchus* species)
- Reniform nematode (*Rotylenchulus reniformis*)
- Ring nematodes (*Criconemoides, Criconemella* and *Mesocriconema* spp.)
- Root knot nematodes (*Meloidogyne* species)
- Spiral nematodes (*Helicotylenchus* and *Rotylenchus* species)
- Stem nematodes (*Ditylenchus dipsaci*)
- Sting nematode (*Belonolaimus longicaudatus*)
- Stunt nematodes (*Tylenchorhynchus* species)

No side effects on beneficial insect parasitic nematodes
Paecilomyces lilacinus 251 – Consistent efficacy in all kind of crops

Numerous trials conducted
- Tomatoes
- Cucumbers
- Bananas
- Potatoes
- Grape vine
- Tobacco
- …

Average yield increase (in %)

Average result of a series of 14 comparable GEP efficacy trials (8 tomato and 6 cucumber) conducted in Spain, Italy and Greece

Application 14 days prior to planting, at planting and every 6 weeks after planting
Trial was conducted by GAB Technology GmbH
Experiences with BioAct – Proved efficacy

Effect of BioAct WG controlling *Meloidogyne incognita* on cucumber in Greece 2004 (GEP trial); application 14 days prior to transplanting, at transplanting and 6 weeks after planting; last harvest was made 92 days after planting; Trial was conducted by GAB Technology GmbH.
Control of Nematodes in bananas (BioAct WG – $4 \times 10^9$ spores/gram)

Efficacy of BioAct WG in the control of nematodes in Bananas (ECA, 2002)

Average: 102 days after 1st application

- Untreated
- 30 g/pl Standard A
- 30 g/pl Standard B
- 30 g/pl Standard A & 30 g/pl Standard B
- 4 g/pl BioAct WG (150ml/pl)
- 6 g/pl BioAct WG (300ml/pl)

Area under curve

Radophulus similis Population
Control of Nematodes in bananas
(BioAct WG – 4 x 10⁹ spores/gram)

Efficacy of BioAct WG in the control of nematodes in Bananas (ECA, 2002)

Average: 102 days after 1st application

![Graph showing the efficacy of BioAct WG in controlling nematodes in bananas. The graph displays the area under the curve for different treatments including Untreated, 30 g/pl Nemacur 10 GR, 30 g/pl Counter 10 GR, 30 g/pl Nenacur 10 GR & 30 g/pl Counter 10 GR, 4 g/pl BioAct WG (150ml/pl), and 6 g/pl BioAct WG (300ml/pl).]
BioAct – an example of ideal successful product development

Intensive research efforts for a safe and reliable product

- Strain 251 isolated amongst other strains in the Philippines
- No correlation of genetic specifics to the region
- Not harmful for beneficial (entomopathogenic) nematodes
- No toxin involved in the parasitizing process
- No growth at >37 °C
- No contamination, no metabolites due to state of the art production
- Formulation of consistent quality; transparent quality control
- Screened for efficacy for commercial use
- Consistent efficacy proven for diverse crops
- Well suited for integrated pest management programs