Application techniques for beneficial nematodes against soil insect pests in maize

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The problem
Soil insects such as wireworms, grubs, cutworms or rootworms cause major crop losses as they are difficult to control. Many soil insecticides are either very highly toxic to humans, have serious other non-target effects, or are banned from use.

The potential solution
Beneficial, entomopathogenic nematodes are well-adapted to the soil and non-toxic. They kill insects and can proliferate in them. Many nematode products are available, but their use at field scale is still limited.

What we did
During 5 years, application techniques for beneficial nematodes were developed for field crops like maize; being practical and using grower machinery, as well as being effective at such a scale at reasonable costs.

Application techniques

<table>
<thead>
<tr>
<th>Nematode fluid into soil</th>
<th>Nematode fluid onto soil</th>
<th>Nematode granules into soil</th>
<th>Nematode seed coating</th>
</tr>
</thead>
<tbody>
<tr>
<td>into soil together with sowing or with chemical weed control</td>
<td>into soil usually prior period when pest larvae start to damage roots</td>
<td>into soil together with sowing</td>
<td>into soil together with sowing</td>
</tr>
<tr>
<td>most used and validated technique in field crops</td>
<td>stream spray instead of flat spray needed to allow well-moisturising soil surface so that nematodes can move into deeper moist soil</td>
<td>normal granule applicators used</td>
<td>no water needed</td>
</tr>
<tr>
<td>all-in-one drive approach</td>
<td>extra drive needed</td>
<td>all-in-one drive approach</td>
<td>all-in-one drive approach</td>
</tr>
<tr>
<td>nematodes placed into moist areas of soil, thus only 200 to 500 litre water /ha needed</td>
<td>1000 to 2000 litre water /ha</td>
<td>nematodes placed into moist areas of soil; no water needed</td>
<td>coating with living nematodes only possible directly prior seeding</td>
</tr>
</tbody>
</table>

Take home message
The easiest and currently most promising technique against soil pests in maize is the fluid stream spray of a nematode-water suspension into soil at the moment of sowing or during mechanical weed control. Sowing machines are used that have simple fluid applicators that spray nematodes behind the sowing or press wheel into the furrow prior the soil-closing wheels. Farmers may adapt their equipment for fluid soil insecticides, or may use nematode-specific application tools. This allows reducing the nematode dose to between 2 and $3 \times 10^5$ nematodes per hectare, and thus the costs of this control technique.

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Knowledge for Life

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