Nematodes vanquish billion dollar pest

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The larvae of *Diabrotica virgifera virgifera* beetles wreak havoc on maize. Feasting on the plants' roots, they are estimated to cause $1 billion of damage every year in the US. Ted Turlings from the University of Neuchatel, Switzerland, explains that the pest, known as western corn rootworm, only arrived in Serbia in the 1990s, but since then it has marched through at least 11 European countries.

'Pesticides work to control the pest, but they are not environmentally friendly,' explains Turlings and adds, 'When it arrived in Germany in 2007 they wanted to eradicate it but the pesticide that they used killed millions of bees.' Looking for an alternative, more ecological, form of pest control, Turlings wondered whether predatory nematodes (microscopic worms) that munch on insects could defeat the pest. Knowing that *Heterorhabditis bacteriophora*, which kills western corn rootworm larvae, is relatively unresponsive to an alarm signal ((E)-beta-caryophyllene, which is released by the infested roots) Turlings has successfully improve *H. bacteriophora*'s response to caryophyllene by selective breeding of the nematodes.

He publishes the results of his bid to produce an effective biopesticide in The Journal of Experimental Biology on 25th June 2010.

Using an 'olfactometer' (six tubes radiating out from a central point) packed with damp sand for the nematodes to crawl through, Ivan Hiltpold inserted capillaries into the sand, which released different odours at the end of three of the olfactometer's arms. Then he released *H. bacteriophora* nematodes at the centre of the olfactometer and

allowed the nematodes to choose which odour they tracked. Timing how long it took 500 nematodes to reach the end of the trail in the caryophyllene arm of the olfactometer, Hiltpod collected the worms and allowed them to breed. Gathering the offspring 10 days later, he tested their responses to the three odours and again selected the 500 nematodes that reached the end of the caryophyllene trail first for breeding. Repeating the selection process 6 times, Hiltpold improved the nematode's performance significantly, decreasing the time it took 500 worms to reach the end of the caryophyllene trail from 10h to 2h.

Next Hiltpold tested how improving the nematode's response to caryophyllene had impacted on their potency. Sprinkling the selected nematodes directly on the pest larvae and waiting to see how many larvae died, he was relieved to find that the selected nematodes were only slightly less infectious than their forebears. This loss of potency could be overcome easily by the worm's increased response to caryophyllene, but how would the selected nematodes perform in a field?

'We couldn't test the nematodes in Switzerland because the western corn rootworm is not present yet, so we had to travel to Hungary,' says Turlings. Teaming up with Stefan Toepfer and Ulrich Kuhlmann from CABI Europe-Switzerland who had access to western corn rootworm infected fields sown with two varieties of maize (one that produced caryophyllene and another that did not), Turlings' colleague, Mariane Baroni, sprayed solutions of the selected nematodes between the rows of maize in some plots and sprayed solutions of the unselected nematodes on other plots in the same fields. Then the team waited to see whether the selected nematodes offered any protection against the pest.

They did. The variety of maize that released caryophyllene was healthier than the variety that did not release caryophyllene after treatment with the selected nematodes; and the selected nematodes killed more pest larvae near the caryophyllene releasing maize than the unselected

nematodes did.

Turlings says that this result is encouraging, but admits that there is more to be done before the nematodes can be used commercially. For instance, US varieties of maize have lost the caryophyllene alarm signal and application of the biopesticide is costly and problematic, but Turlings is optimistic that his team can crack both of these problems to add the nematodes to the maize farmer's arsenal.

More information: Hiltpold, I., Baroni, M., Toepfer, S., Kuhlmann, U. and Turlings, T. C. J. (2010). Selection of entomopathogenic nematodes for enhanced responsiveness to a volatile root signal helps to control a major root pest. J. Exp. Biol. 213, 2417-2423. jeb.biologists.org

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