USING BENEFICIAL MAIZE-RHIZOSPHERE MICROBIALS AGAINST WESTERN CORN ROOTWORM

Locations	France, Hungary, United States
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Summary

The western corn rootworm is a major invasive maize pest in North America and Europe. The phase-out of certain pesticides means control options are increasingly limited. New technologies are being researched in collaboration with five French partners. Using field surveys and candidate gene searches through database-mining, we are investigating bacterial proteins for insecticidal effects. Promising strains are then screened in vitro to develop biopesticidial or biotechnological control options.

The problem

The western corn rootworm, *Diabrotica virgifera virgifera*, is one of the most destructive pests of maize in North America and Europe. This leaf beetle has one generation a year with eggs that overwinter in the soil. These hatch after the maize has germinated in spring, and the larvae feed on maize roots, often causing entire plants to bend (lodge). Adult beetles can reduce yields through intensive silk feeding, which interferes with maize pollination.

The pest has been managed through crop rotation, granular soil insecticides, insecticide seed coatings, and/ or by planting transgenic maize which produces *Bacillus thuringiensis* toxins which act as insecticides. But the western corn rootworm has been shown to be able to develop resistance against many of the control measures. Moreover, some soil insecticides are being phased out owing to their high toxicity, and others, such as the neonicotinoids, appear to be problematic to bees. Novel control measures are needed, preferably with multiple-ways-of acting on the insect which are environmentally friendly.

What we are doing

The project, officially called Utilisation de la DiversitE microbienne pour idenTifier des activités insEcTICides contre la larve de la chrysomèle du maïs (Diabrotica virgifera virgifera) (DIETETIC), is supported by the French Groupement National Interproffessionel des Semences et plants (GNIS), a service provider for farmers. The four-year project is being implemented by a consortium of five French partners (three science-based SMEs, two research institutions), as well as CABI.

We aim to identify new technologies to protect maize from corn rootworm larvae. We are using a bioinformatics-based candidate gene search approach followed by high-throughput screening to investigate a diversity of microbes (mainly bacteria), and identify those producing proteins with insecticidal effects on rootworms. The long-term goal is to develop biopesticidal or biotechnological control options against this major invader.

Objectives:

- Isolate and identify novel microbial strains from field surveys that may protect maize roots from corn rootworm larvae
- Screen microbial collections for bacteria with potential insecticidal properties
- Perform bacterial strain sequencing to select candidate genes with insecticidal potential
- Screen bacterial strains and their toxic proteins on rootworms to assess biocontrol/ biotechnological potential

Results so far

We have carried out a survey of rootworm-infested fields in central Europe to obtain samples of bacteria from the maize rhizosphere – the roots and surrounding soil.

More than 400 bacteria have been identified via 16S rRNA characterization by the project partners. Moreover, several microbial collections have been screened based on a bioinformatic approach. Genomes from about 2500 bacterial strains from the microbial collections and the rhizosphere survey have been sequenced by project partners.

More than 300 unique proteins have been produced as crude lysates and tested on larvae of western corn rootworms. Two entirely novel binary proteins and their homologs have been detected to inhibit the growth of larvae. The genome of 15 bacteria carrying genes for those proteins have been fully sequenced. Moreover, two more candidates have been detected that appear to have comparable modes of action to some known toxins to rootworms but originate from new bacteria.

	Follow up activities will focus on mass culturing the bacteria and understanding the conditions of optimal expression of the considered proteins. This lays the base for potential developments of novel microbial biopesticides urgently needed for the management of soil insect pests.
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Partners	Proteus, France, UMR 7265 CNRS-CEA-AMU CEA/DRF/BIAM/LEMiRE, CEA Cadarache, France, Genoscope UMR8030, CEA/DRF/IBFJ, France, Biogemma, France, Genective, France and USA
CABI Project Manager	Stefan Toepfer




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