Roundworms to the Rescue!

Scientists at the Max Planck Institute for Chemical Ecology aim to transfer a defense mechanism of wild maize to agricultural plants

THE CORN ROOTWORM *(Diabrotica virgifera)* is one of the most serious insect pests of maize (corn) in the world. It was introduced into Europe 15 years ago and has spread to many parts of the continent. The costs of corn rootworm damage combined with the cost of the insecticides used to fight it amount to nearly USD 1 billion each year. The larvae of this beetle start their attack on the plant by eating the root hairs, and then tunnel into the roots. As a result, the maize plant absorbs less water and nutrients, causing the leaf blades to become stunted and bend.

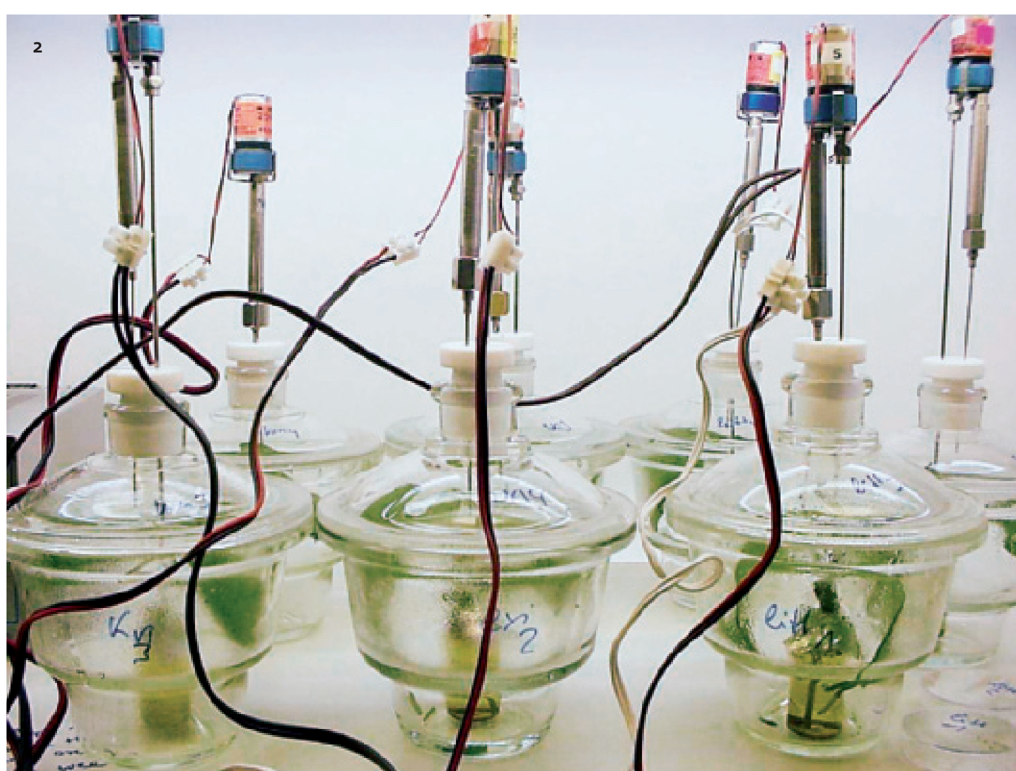
Researchers from the Max Planck Institute for Chemical Ecology in Jena, Martin Luther University in Halle and the University of Neuchâtel in Switzerland have now found that maize roots on which corn rootworm larvae have fed are attractive to microscopic enemies of the corn rootworm, soil organisms called roundworms or nematodes. The secret of this attraction is a volatile chemical released by the plant, known as (E)-ß-caryophyllene, which lures the roundworms to the damaged maize plant. Once there, they feed voraciously on the larvae of the rootworm, reducing their population significantly. The ability of maize plants to release this roundworm-attraction chemical has been lost over centuries of conventional crop breeding as plant breeders focused on other traits. Breeders usually develop crop plants for maximum yield or rapid growth. In doing so, however, they often lose sight of characteristics that increase resistance to pests, especially characteristics that increase plant resistance indirectly, by attracting enemies of the pest.

"Use of this indirect defense could be an attractive strategy for increasing the resistance of maize toward plant-eating insects and reducing the amount of pesticides needed," says Jörg Degenhardt. Together with traditional crop rotation, in which farmers alternate growing maize and wheat, the attraction of roundworms could help contain the corn rootworm plague. This would result in reduced damage to the plant and increased revenue from the crop. The Max Planck Institute for Chemical Ecology, together with colleagues from Neuchâtel, has now patented the idea of using (E)-ß-caryophyllene and similar chemicals to attract corn rootworm enemies. The use of such substances as plant protection agents could be a convincing example of biological plant protection that reduces the need for insecticides. Indeed, preliminary experiments conducted in maize fields in Missouri (USA) have been very promising, and could lead to widespread adoption of this strategy to reduce corn rootworm damage. BA | MI 1602-3590-LI

1 The adult beetles do not have nearly as devastating an effect on maize cultures as their greedy larvae.

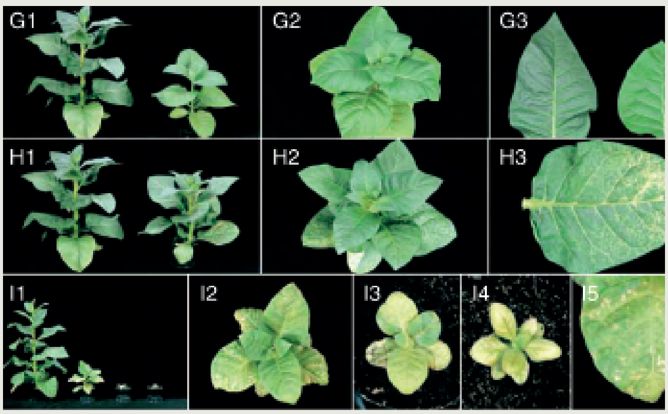
2 Scent as an SOS signal: Plants under attack from pests give off a scent and scientists can easily measure its concentration in the lab.

Photos: Baufeld, Julius Kühn Institute/MPI for Chemical Ecology – Löwe TextDesign



A New Generation of Herbicides

Genetic analysis from basic research delivers new targets



Little genetic activity: Tobacco plants that form fewer proteins stay small, the leaf veins turn yellow or the leaf tissue dies.

HERBICIDES that perturb carbohydrate or nitrogen metabolism are harmful to plants; the leaves either form less chlorophyll (chlorosis) or the leaf tissue dies (necrosis). As a result, the plants are no longer able to photosynthesize, and subsequently die. One of the agrochemical industry's main research objectives is to identify new classes of active substances that are not only effective at preventing the growth of weeds without harming the crop plants, but also safer for the environment than conventional herbicide products. With this goal in mind, results obtained by scientists engaged in basic research can be very informative to their colleagues working in industry.

Mark Stitt from the Max Planck Institute of Molecular Plant Physiology in Golm is particularly interested in identifying the factors that determine how well a plant grows in a given environment. Through a major scientific effort, involving collaboration with his colleagues from the Institute of Plant Genetics and Crop Plant Research (IPK) in Gatersleben, he has investigated more than 20,000 plant genes. "We used the antisense method because this procedure can be automated, and with this approach, we reduced gene activity on average by a factor of just two to four," says Professor Stitt. The scientists then tested the effects of the antisense on around two million plants.

They succeeded in identifying some 80 genes that have a significant impact on plant growth when partially inhibited. Detailed follow-up studies will help us understand the precise function of these genes, and will provide new insights into the regulation of plant growth. Some of these genes have already been patented as potential targets for new herbicides, as researchers have found that herbicides generally do not fully inhibit the activity of their target proteins, either on their way into the plant or at their site of action. Industry researchers are now using large chemical libraries to first test whether novel structural classes of chemicals are effective inhibitors of the newly identified targets, and then to optimize their potency. BA

Enhancing Rice – Less Is More

Researchers in Tübingen easily and efficiently inactivate genes that impart unwanted characteristics

A boost for rice cultivation: Artificial RNA snippets accelerate the breeding of varieties with new properties.

ACCORDING TO THE FOOD and Agriculture Organization (FAO), a total of 651.7 million tons of rice were harvested worldwide in 2007, mainly in China, India and Indonesia. The grain is the number one basic foodstuff for around half of the world's population. This makes it all the more important to continue research into the improvement of rice varieties through breeding – particularly with a view to speeding up this time-consuming process. This may be possible with the help of small snippets of RNA, known as microRNA.

MicroRNAs consist of between 20 and 22 base pairs. They play an important role in regulating genes in both plants and animals: In plants, they facilitate degradation of messenger RNAs with complementary base sequences and thus prevent the production of the corresponding protein. In this way, the gene is virtually silenced and the course of entire signal chains altered. With the help of artificial microRNAs, scientists can make use of this natural way of inactivating genes that are of particular interest to plant breeders – and the method offers an unprecedented level of specificity.

Detlef Weigel's research group at the Max Planck Institute for Developmental Biology first developed and implemented this technique on *Arabidopsis thaliana*. Norman Warthmann, together with colleagues from the International Rice Research Institute (IRRI) in the Philippines, then successfully applied the technique to rice plants. Using artificial microRNA, the researchers were able to transfer reduced genetic functions to two agriculturally significant rice varieties within a matter of weeks, thus creating plants with the desired characteristic.

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Photos: Max Planck Institute of Molecular Plant Physiology/pixelio.de – Gabi Huckelmann