Altered Baculovirus Dooms Corn Earworms

A microscopic saboteur may deprive corn earworms of their greatest pleasure—feasting on corn plants at farmers' expense.

The saboteur is a natural insect pathogen called a baculovirus. In nature, the virus infects the earworm in order to multiply and spread. But the pest may not die right away, instead continuing to chew on plants, says Ashok K. Raina.

An entomologist with the Agricultural Research Service's Insect Biocontrol Laboratory in Beltsville, Maryland, Raina's solution is to genetically alter the baculovirus so it overwhelms the earworm with an overdose of an appetite-stopping hormone.

In the South, crop-hungry corn earworms cost farmers an estimated $1.5 billion annually in losses and chemical controls. Sweet corn growers loathe this pest and may spray up to 20 times a season to ensure unblemished ears. But this can endanger the environment and beneficial insects.

Raina's approach should offer a safer alternative. For one, the hormone-making baculovirus dooms the earworm from within. And outside the insect, the virus eventually breaks down under the sun's ultraviolet light. It's also harmless to humans, livestock, and plants.

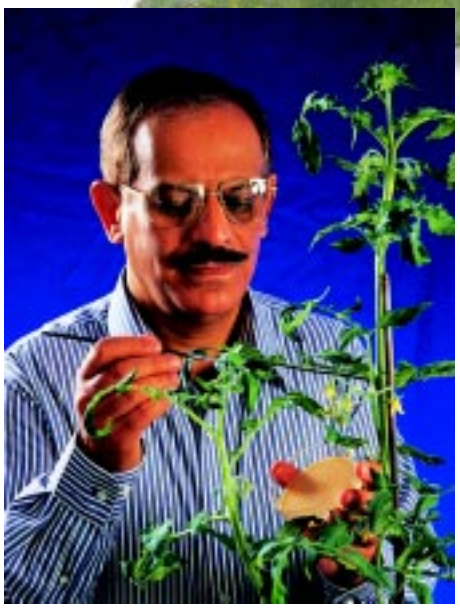
The hormone, called helicokinin-II (Hez-HK-II), actually comes from the corn earworm, not from the baculovirus. Raina discovered it in earlier studies of the pest's nervous system. He later pinpointed the specific gene responsible for making the hormone, cloned it, and inserted it into the baculovirus. He has filed for a patent on the gene.

In its natural owner—the corn earworm—the Hez-HK-II hormone helps regulate physiological processes, enabling the insect to grow from caterpillar to adult moth. But Raina showed that inserting the Hez-HK-II gene into the virus and then feeding or injecting the altered virus into the earworm leads to hormonal sabotage.

Once ingested, the virus quickly replicates inside the earworm's gut cells. In the process, it churns out the Hez-HK-II hormone, adding to that already present.

SCOTT BAUER (K8001-20)

A normal corn earworm larva (right) dwarfs one fed on a genetically altered baculovirus. Both larvae are 10 days old.



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Entomologist Ashok Raina places corn earworm larvae on a tomato plant after feeding them for 48 hours on a diet including a recombinant baculovirus.

"The hormone is naturally present in the insect, but only at certain times," Raina explains. "Here, we're flooding the insect with it." As a result, the pest soon stops eating and excretes much of its water.

But why not just spray the hormone directly onto plants?

Because, says Raina, the hormone is made of a type of small protein called a peptide. Peptides are expensive to produce, and they degrade quickly. Also, you can't spray them onto a crop like you do an insecticide, and they don't penetrate the insect.

But the baculovirus can get inside the earworm, making it an ideal delivery mechanism for the peptide hormone. Also, the technology exists for growing baculoviruses in special industrial vats. This could expedite the virus' development as a biopesticide product that growers could spray onto crops.

In lab studies, at a temperature of 23°C, hatchling corn earworms infected with the virus typically stopped eating after about 48 hours. By 20 days, only 3 percent had survived and pupated—compared to 100 percent of the virus-free worms.

The true test will come with field trials, Raina notes. There, the altered baculovirus will face wild corn earworms, which are more robust than those kept in captivity.

Raina is now conducting greenhouse experiments. "Within 6 months to a year," he says, "we should be able to pass the technology on to a commercial company interested in pursuing field studies."—By **Jan Suszkiw,** ARS.

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