Bt-Corn Pollen Can Kill Monarchs

Eating pollen from corn plants genetically engineered to make their own pesticide can kill larvae of monarch butterflies, according to a Cornell University study.

The results raise doubts about a supposed smart bomb in the pesticide arsenal, the Bt toxin. Biotech companies sell corn carrying the toxin gene, designed to protect the crop from moth caterpillars with minimal collateral damage to bees and other beneficial insects.

In a laboratory test, about half of the monarch caterpillars died after 4 days of munching on leaves dusted with Bt-corn pollen, report Cornell's John E. Losey and his colleagues. All the caterpillars that ate regular corn pollen survived, the researchers note in the May 20 NATURE.

"We don't know how big the risk is," Losey cautions. More tests need to answer such questions as how much pollen coats leaves in the real world and whether wild caterpillars avoid coated leaves, he says.

The Bt toxin, discovered in the bacterium *Bacillus thuringiensis,* kills its victims by perforating their guts. In 1996, Novartis Seeds of Golden Valley, Minn., introduced corn souped up with the Bt gene to fight corn borers. By 1998, up to 16 million of the 80 million acres of corn harvested in the United States carried some form of the gene, according to Monsanto Co., a St. Louis firm that licenses the technology behind Bt corn.

Earlier tests did not explore Bt effects on monarchs, says Cornell's Linda S. Rayor, a coauthor of the new study. The caterpillars eat leaves only from milkweed, which thrives along roadsides and field edges. Rayor lives near a cornfield and can testify that corn, which is wind-pollinated, sheds pollen beyond field borders.

Other butterfly caterpillars feed near fields, too. "I think there's a really good chance the pollen affects less charismatic species," she says.

Losey points out that previous work had already raised questions about Bt's safety. Lacewings are not fazed by direct exposure to Bt, but they languish from indirect effects, say Angelica Hilbeck of the Swiss Federal Research Station in Zurich and her colleagues. In the April 1998 ENVIRONMENTAL ENTOMOLOGY, they reported that 1.5 times as many lacewings died when fed Bt-eating corn borers than when they dined on Bt-free caterpillars.

That study did not kick up the fuss now arising from the Cornell research. Monsanto spokesman Randy Krotz acknowledges that he's tied to the phone answering questions. "Remember where we're coming from," he urges. Earlier pesticides used to control corn borers killed a wider spectrum of creatures, he points out. Also, he emphasizes that the Losey team just estimated real-world pollen exposure by eye. "It's not very likely you're going to have mortality in the field," Krotz predicts.

Monarch specialist Karen S. Oberhauser of the University of Minnesota in St. Paul remains concerned. "[The study] certainly demonstrates there's a clear potential for harm," she says.

Biological control specialist John J. Obrycki of Iowa State University in Ames agrees. "John's work is real dramatic," he says of Losey's research. The results fit with preliminary data from Obrycki's student Laura C. Hansen. About a quarter of monarch larvae died after 1 day of munching on pollen-dusted leaves collected near Bt-corn fields.

Obrycki also questions the argument that Bt corn is a lesser evil than old pesticides. That may be true where farmers irrigate corn fields and create green paradises for pests. Iowans generally don't do that, he says, and only about 2 percent of the state's cornfields get sprayed for borers. If farmers plant Bt corn on more acres, he worries, "you've added a significant new risk to monarchs." —*S. Milius*

Kent Loeffler

A monarch caterpillar dines on a milkweed leaf dusted with corn pollen.

Elephants may have started out all wet

A study of tiny elephant fetuses, one no bigger than a pea, suggests that the wrinkly skinned giants originally evolved as seagoing mammals that used their trunks as snorkels.

"For the first time, we now have a rational explanation for the unusual anatomical features of the elephant," says Ann P. Gaeth of the University of Melbourne in Parkville, Australia.

Some paleontologists, however, argue that this idea doesn't hold water.

The evidence comes from an investigation of seven fetal elephants found inside females that were shot to reduce overpopulation in a South African park. Gaeth and her colleagues studied the growth of kidneys and other organs in these specimens, the smallest of which had developed for only 58 days. Elephant gestation typically lasts 22 months.

The researchers were surprised to find dozens of small, funnel-shaped tubes, called nephrostomes, in the kidneys of the elephant fetuses. These features had not been seen in any mammal that gives birth to live young, the researchers report in the May 11 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES. Nephrostomes appear briefly in the embryos of egg-laying mammals, such as the platypus, and function in adult fish and amphibians.

The elephant's fetal nephrostomes are a legacy that provides clues about the animal's origins, say the researchers. Aquatic animals have nephrostomes, so elephants may have inherited this feature from an aquatic ancestor, says Gaeth.

The same argument applies to the elephant's nose. The trunk appears early in fetal growth, suggesting that it has a more ancient origin than features popping up later during gestation, the Australian scientists say. The trunk may have evolved originally as a snorkel for early aquatic elephants, they speculate.

Other researchers don't discount the possibility that elephants arose from an aquatic mammal. Fossil bones, as well as genetic studies, suggest that elephants are closely related to manatees. Researchers have debated whether the ancestor of both groups lived on land or in the sea.

Paleontologists, however, argue that the fetal evidence doesn't provide much insight into elephant evolution. For instance, studies of the oldest elephant fossils indicate that these animals lacked trunks, an observation that contradicts the Australian researchers.

"I don't buy the argument about a trunk having first evolved in an aquatic environment," says Daryl P. Domning of Howard University in Washington, D.C., who studies fossil manatees.

"I'm not convinced by their arguments. I think they've overstated their case," agrees mammal paleontologist Andre Wyss of the University of California, Santa Barbara. —*R. Monastersky*