New studies clarify monarch worries

A study of Bt corn supports the contention that pollen concentrations drifting in a cornfield can kill caterpillars of monarch butterflies, but the risks diminish quickly beyond the field's edge.

Bring-your-own-pesticide corn plants, genetically engineered to make a toxin discovered in the bacterium *Bacillus thuringiensis*, covered some 16 million of the 80 million acres of U.S. cornfields in 1998.

Within 5 days of feeding for 48 hours on leaves dusted with 135 grains of Bt corn pollen per square centimeter, 38 percent of young monarch caterpillars died, reports Laura C. Hansen of Iowa State University in Ames. That pollen dose lies at the upper end of the range she found measuring pollen on leaves in Iowa fields, Hansen told the annual meeting of the Entomological Society of America in Atlanta this week.

Hansen's results echo a Cornell University monarch study that ignited an international furor over the potential for transgenic crops to hurt monarch butterflies (SN: 5/22/99, p. 324). One of that study's coauthors, John E. Losey, and four other researchers also provided summaries of their most recent data, presented at a meeting in November.

They found hints that monarchs in the wild may not face a serious threat. Female butterflies seem to avoid laying eggs on milkweed surrounded by corn plants, and corn pollen builds up less on upper leaves of milkweed, the preferred egg-laying site, than on lower leaves.

In the study published last spring, Losey and his Cornell colleagues dusted Bt corn pollen onto milkweed leaves in amounts that roughly reproduced the appearance of leaves around cornfields. About half their caterpillars died after 4 days of feeding.

Hansen checked some two dozen milkweed plants in or near Iowa cornfields. Plants sprouting between corn rows accumulated an average of 50 pollen grains/cm^2, but 10 meters away from the field, she found only 1 grain/cm^2.

That dovetails with a survey of milkweed in 80 Maryland cornfields, notes Galen Dively of the University of Maryland in College Park. Milkweed plants growing amid corn averaged 75 grains of pollen/cm^2, but only 15 grains/cm^2 at 6 to 10 meters beyond the field.

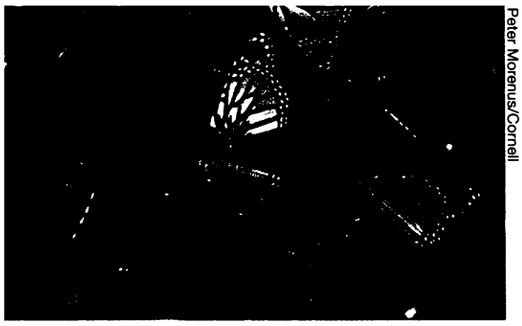
To test the effects of pollen-speckled milkweed, Hansen dripped a measured pollen solution onto snippets of leaves and fed them to caterpillars. The deep drop in survival that she found among young caterpillars surprises Dively, he says, because U.S. Department of Agriculture and Canadian studies last summer didn't show die-offs at pollen dustings sparser than 150 grains/cm^2.

What portion of milkweed falls within the high-pollen zone is not clear, Dively notes.

The public fuss over butterflies is obscuring more serious issues, comments Tom Turpin, a corn entomologist at Purdue University in West Lafayette, Ind. He wonders whether Bt toxins could build up and disrupt the teeming soil ecosystem. Or could reckless use of Bt corn trigger so much resistance among insects that Bt insecticide becomes useless?

In widespread Bt corn planting, "we're not saving that much pesticide," Losey argues. He says that only 3 percent of cornfields in Iowa had been sprayed for the European corn borer, the pest that Bt corn is marketed to fight. Other scientists at the meeting hotly debated whether Bt corn will cause pesticide use to shrink.

"We're taking a hard look at the risk," Losey says. "We need to take a hard look at the benefits as well." —*S. Milius*



Peter Morenus/Cornell

Monarch butterflies: At risk from Bt corn?

A sign of healing appears in stratosphere

Satellite measurements indicate that the amount of harmful chlorine pollution in Earth's stratosphere has started to decline—a sign that the ozone layer will soon begin its slow recovery from 70 years of chemical assault.

The observation, reported this week at a meeting of the American Geophysical Union in San Francisco, demonstrates the success of the Montreal Protocol, a 1987 treaty that forced countries to curb their use of chlorofluorocarbons (CFCs) and other ozone-destroying compounds. "What we were able to conclude is that, yes, the protocol is working. This is significant because it brings closure," says James M. Russell of Hampton (Va.) University.

Soon after the invention of CFCs in 1928, companies started mass-producing these nontoxic, nonflammable compounds for use as refrigerants and then for myriad other purposes. It took nearly 50 years before scientists recognized that these extremely stable chemicals could survive long enough to drift up to the stratosphere, where they would then display a nasty side. At that height, above 10 kilometers, CFCs and some other gases split apart and loose their destructive chlorine or bromine in the midst of the ozone layer—the shield that protects Earth's surface by absorbing harmful ultraviolet light.

Scientists detected the first step toward global recovery from chlorine pollution in 1996. Measurements made in the troposphere—the lowermost layer of the atmosphere—indicated that chlorine concentrations there had peaked between 1992 and 1994 and were slowly starting to decline (SN: 3/9/96, p. 151).

Yet chlorine was still increasing in the most important place, the stratospheric layer where ozone resides. The reason is that it takes several years for air from the troposphere to leak up into the stratosphere. Researchers were unclear when stratospheric chlorine would start to decline.

Russell's team monitored the situation with a satellite instrument called the Halogen Occultation Experiment, which stares at the sun's rays as they pass through the atmosphere. The sensor measures how much light gets absorbed by hydrogen chloride, which contains more than 90 percent of the chlorine at the stratosphere's top. The data showed chlorine concentrations peaking in 1997.

Confirmation of this observation comes from measurements made high in the Swiss Alps. Spectrometers there record the concentration of hydrogen chloride and chlorine nitrate, which together account for 95 percent of the total chlorine in the stratosphere. The data from that site also reveals stratospheric chlorine topping out in 1997, says Rodolphe Zander of the University of Liège in Belgium, leader of the alpine team.

The stratosphere's chlorine concentration rises and falls naturally, so scientists had to wait sufficient time to be sure that it had truly peaked. "You always need a few more years to convince yourself that you have seen the maximum," says Zander.

The main factor contributing to the chlorine turnaround was a reduction in the emissions of methyl chloroform, a cleaning solvent. This compound breaks down in the atmosphere far faster than CFCs, so the amount of chlorine in the air responds quickly to changes in the solvent's usage, which developed countries curtailed in 1995.

Many ozone-harming compounds—such as bromine-rich chemicals—continue to increase in the atmosphere, some faster than scientists had expected. Still, when scientists total up all the pollutants and account for their potency, they conclude that the tide has turned for ozone destruction, says Zander.

It may take another decade before the first signs of ozone recovery begin to surface. Convalescence will last beyond 2050, according to computer calculations. —*R. Monastersky*