Pests find new ways around natural toxins

By the year 2000, three-quarters of U.S. cropland should be put on a low-chemical diet, according to the Clinton administration. A staple of that regimen, technically known as integrated pest management, are the toxins produced by the soil bacterium *Bacillus thuringiensis* and collectively dubbed Bt.

For decades, organic farmers have relied on the environmentally friendly Bt sprays to help control destructive caterpillars. Resistance to Bt began showing up in one caterpillar species in 1989.

In 1996, farmers planted the first crops engineered with toxin-producing genes from the bacterium. With this increased use comes the threat of hastened pest resistance to Bt, spurring a flurry of research to understand just how insects dodge Bt's lethal effects.

Within the last year or so, researchers have described what appears to be the most common genetic strategy—a recessive trait—that allows caterpillars to survive the Bt toxins. The closer the scientists look, however, the more they find differences in how insects evade Bt.

In caterpillars of the diamondback moth, a pest of cabbages and related crops, a single recessive trait confers resistance to four Bt toxins. In comparing resistance among caterpillar strains from Bt-sprayed fields in Hawaii, Pennsylvania, and the Philippines, entomologist Bruce E. Tabashnik of the University of Arizona in Tucson and his colleagues uncovered a nonrecessive trait that plays by a different set of resistance rules.

Such variations within the same insect species "profoundly affect the choice of resistance management strategies," the researchers report in the Nov. 25 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

They found the new trait through the same kind of mating experiments that Gregor Mendel used with peas. In the classic experiment where resistance is recessive, the offspring of a resistant moth and a susceptible moth should be susceptible.

Yet in some such crosses involving Philippine moths, none or fewer than 10 percent of the offspring were killed by Bt. This result indicates that "there is at least one dominant mutation in that population" conferring resistance, says Tabashnik.

Fred Gould's group at North Carolina State University in Raleigh has found genetic variation in resistance to Bt among strains of another pest, the tobacco budworm, grown in the laboratory. Moreover, in the Sept. 19 JOURNAL OF BIOLOGICAL CHEMISTRY, Brenda Oppert of the Department of Agriculture in Manhattan, Kan., and her colleagues reported physiological differences in how Indian meal moths resist Bt toxins.

Together, the results point out that a single plan for resistance management will not work, the researchers say.

Their work has a sense of urgency about it. "Since transgenic plants are in the field, we're under the gun," says Oppert. In addition, the Environmental Protection Agency is slated to review early next year its policy for managing Bt resistance. A recent legal action against EPA's stance on Bt transgenic crops has raised the stakes for any new policy (SN: 9/27/97, p. 199).

Oppert and others say that emergence of resistance to a pesticide can only be delayed, given the high population diversity among insects. Consequently, the hunt is on for new biological pesticides (SN: 7/26/97, p. 58).

"Susceptibility to a pesticide can be considered a natural resource," says Tabashnik. "And we will deplete it by using Bt or any other insecticide. The question is, how much benefit can you gain before you deplete the susceptibility?" —*C. Mlot*

Diamondback moth caterpillars dine on a cabbage leaf. A strain from the Philippines employs a newly uncovered means of resistance to Bt, which may pose problems for managing crops where the biological pesticide is used.

Hubble eyes springtime on Uranus

What a difference a season makes.

For 2 decades, winter has reigned in the northern hemisphere of Uranus, shrouding it in darkness. The return of spring, which occurs once every 84 Earth years, has wrought great changes in the region. This false-color, near-infrared image, taken by the Hubble Space Telescope, reveals five clouds, each nearly as large as Europe, along the right edge of the planet. Another Hubble image, in visible light, shows a pattern of dark and light bands representing variations in the atmosphere.

Such high-contrast features have never before been seen on Uranus. Moreover, astronomers had never observed the northern hemisphere with modern detectors, notes Heidi B. Hammel of the Massachusetts Institute of Technology. By tracking the clouds, her team hopes to measure wind speed. Only the region up to 30° north latitude (right edge of image) is now visible, and more features may become apparent as the rest of the hemisphere comes into view, says Hammel.

The near-infrared picture, analyzed by Erich Karkoschka of the University of Arizona in Tucson and his colleagues, is a composite of three images taken at different wavelengths. Blue corresponds to a wavelength of 1.1 micrometers and depicts regions deep in the atmosphere; green (1.6 μm) indicates absorption by methane gas as well as light reflected from haze; and red (1.9 μm) indicates absorption by hydrogen high in the atmosphere. Released by NASA last week, the image shows some of the 10 small moons of Uranus and several icy rings. —R. Cowen