Biology

First gene-engineered pesticide tested

Researchers from the U.S. Department of Agriculture (USDA) last week oversaw the inoculation of corn plants with genetically engineered bacteria designed to protect the plants from a crop-damaging caterpillar. The bacteria, developed by Hanover, Md.-based Crop Genetics International, is the first gene-altered microbial pesticide to undergo outdoor tests in the United States. It was injected into young corn plants at a federal agricultural research station in Beltsville, Md.

The USDA and the Environmental Protection Agency recently approved the test. It is the fifth gene-altered microbe to gain U.S. government approval for small-scale testing in the environment (SN: 5/2/87, p.277; 2/20/88, p.117).

The pesticide is made of a bacterium that can live in corn plants; into that bacterium, a gene from another bacterium has been inserted. The gene codes for the production of a protein, called Bt, which paralyzes the digestive systems of insects and caterpillars with nonacidic "stomachs." Bt has for decades been sprayed on vegetable crops and trees to protect them from insect pests; it appears to have no effect on humans or other animals with acidic digestive tracts.

Indoor tests show engineered, Bt-containing microbes multiply in the sap of corn plants as the plants grow, killing European corn borers that attempt to feed on the stalks. Researchers plan eventually to inoculate corn seed with the engineered organism, but the first tests call for one-month-old corn plants to be "vaccinated" directly.

Although the gene-spliced microbe is perfectly at home in corn stalks, it fails to migrate into the kernels, or seeds. That's good news not only for picky eaters, but for investors, too: With the high-tech corn plants producing old-fashioned kernels, says a Crop Genetics document, "the company can continue to enjoy repeat sales of its inoculated seeds."

Deaf chickens hear again

Scientists once presumed that when hearing was lost due to disease, loud noise, certain antibiotics or aging processes, the damage was permanent. This was because they believed the inner ear's hair cells, which convert sound into electrical activity, were produced in mammals and birds only during the first two-thirds of embryonic development.

In 1981, however, Jeffrey T. Corwin of the University of Hawaii found that certain fish and amphibians could produce hair cells throughout life. Now Corwin and Douglas A. Cotanche of Boston University report the regeneration of these cells in young chickens.

After exposing chicks to a loud noise for 48 hours, they administered radioactive thymidine as a tracer that is incorporated into replicating DNA, permitting detection of dividing cells. Shortly after exposing the chicks to the noise, Corwin and Cotanche examined tissue from the chicks' ears and found that hair cells were missing. Over the next 10 days, the damaged area gradually returned to normal, and the thymidine tracer turned up in the damaged area in the nuclei of both hair cells and supporting cells but not in undamaged regions of the chicks' cochleas — the affected inner-ear structure — or in chicks that received the tracer but were not subjected to loud noise.

At least in birds, some cochlear cells must retain the capacity to proliferate, Corwin and Cotanche conclude in the June 24 SCIENCE. They suspect the new hair cells originated from divisions of another cell type, then differentiated as hair cells.

Together with a report of hair-cell regeneration in adult quail that appears in the same issue, the discovery of replacement cells originating in progenitor cells carries implications for other species. "The possibility of self-repair," Corwin and Cotanche say, "should not be ruled out in mammalian ears."

Biomedicine

Free radicals in liberal amounts

When an arterial clot obstructs blood flow to the heart, doctors may dissolve it with enzymes, bypass it through surgery or stretch the artery with a balloon. But reentering blood may both rescue and damage the heart. The blood contains oxygen that is converted by certain cells into free radicals, highly reactive molecules that can disrupt DNA, cripple enzymes, poke holes in cell membranes and kill cells. Besides the heart, other organs — including the kidneys, lungs and brain — may become free-radical victims.

Although several studies have demonstrated free radicals' destructiveness (SN: 9/12/87, p.169), none has identified precisely which cells produce them. Scientists have proposed endothelial cells as one source. Now, in the June PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (Vol.85, No.11), Jay Zweier, Periannan Kuppusamy and Gerard Lutty of Johns Hopkins University School of Medicine in Baltimore confirm that theory by reporting they have detected oxygen free-radical production in endothelial cells from cow arteries.

To measure free radicals, Zweier irradiated the cells with microwaves while exposing them to a varying magnetic field, a technique called electron paramagnetic resonance. The strength of magnetic field at which the cells absorb the microwaves indicates the types of oxygen free radicals they contain. The researchers examined endothelial cells that had been deprived of oxygen for 45 minutes, then reoxygenated. "The free-radical concentration increased more than 100-fold" and killed the cells, says Zweier. In addition, when the scientists gave the cells the enzyme superoxide dismutase, it appeared to stop creation of the free radicals.

Although Zweier's group examined only animal cells, their work has clinical relevance since superoxide dismutase is thought to help prevent reoxygenation injury in humans.

The cocaine-AIDS connection

Bad news and good come from last week's 50th anniversary meeting of the Committee on Problems of Drug Dependence, held in North Falmouth, Mass. While the overall incidence of AIDS among intravenous drug users remains about the same, the use of injected cocaine is rising, as is exposure to the AIDS virus in those users, reports Don C. Des Jarlais of the New York State Division of Substance Abuse Services in New York City. "We don't fully understand the dynamics of this," he said prior to the meeting. "But one reason is the 'binge use,' with users sharing a needle for injection many times in a short period, unlike heroin addicts, who fall asleep after injection."

The potential for further spread of the virus by this route is worrisome, Des Jarlais told SCIENCE NEWS, because studies in New York City and San Francisco show that people who inject cocaine are the drug users most likely to test positive for infection by the AIDS virus. At the same time, he says, "We're starting to see a real reduction in the rate of new infections; drug users are changing their behavior — something it was widely believed would never happen."

On the darker side, no effective large-scale treatment of cocaine abuse exists, and relapses are common. But systematic trials of various therapies, begun four and five years ago, are now near completion, and other research is beginning to unravel the nature of cocaine withdrawal. Animal studies indicate cocaine use may produce a true physiological addiction and changes the brain's capacity to regulate mood. "The result in users is a diminution of the ability to experience pleasure — they feel bored," says Frank H. Gawin of Yale University. Gawin and his colleagues have treated addicts with an antidepressant, desipramine. Across the United States, researchers are conducting long-term trials of this and related drugs, which together with psychotherapy, he says, "may help."