Agriculture

Making genes disappear . . .

Many researchers are inserting foreign genes into crop plants to make them grow bigger and better. Others are developing methods for destroying foreign genes that have done their job, to ensure that they don't spread to wild plants.

One new way of performing this deletion trick involves putting segments of DNA, called flip recombinase targets (FRTs), on either side of the foreign gene, explains Thomas K. Hodges of Purdue University in West Lafayette, Ind. The plant also gets a *flp* gene, which controls an enzyme that attaches to FRTs and excises the gene between them.

In the October NUCLEIC ACIDS RESEARCH, Hodges, L. Alexander Lyznik, and K.V. Rao describe using the technique to remove a marker gene from corn cells. Marker genes signal the successful insertion of other genes; once having done so, they are no longer needed. The researchers have since removed a marker gene from mature plants, not just isolated cells, says Hodges.

The *flp*/FRT approach resembles one described in 1991 by David W. Ow of the U.S. Department of Agriculture's Agricultural Research Service in Albany, Calif., and his colleagues. They used an enzyme called Cre and DNA sequences called lox to excise genes. DuPont Co. in Wilmington, Del., has an exclusive license on the Cre/lox system but has not developed it commercially, notes Ow.

The Purdue team is also trying to use the *flp*/FRT system to make hybrid crops that have a higher yield than their parent plants. To make hybrids, companies must first sterilize plants' male parts so the plants won't self-pollinate. In the case of corn, this often involves a costly detasseling effort.

Hodges' team has inserted in corn plants a gene that sterilizes the male parts and has flanked that gene with FRTs. The group plans to fertilize the plants with male pollen from another cultivar containing *flp*. The plants' zygotes, or fertilized eggs, should then contain *flp*, along with a male sterility gene between the FRTs. The flp enzyme will excise the sterility gene, and the seeds will grow into fertile hybrids, the team expects.

— *T.A.*

. . . and virus-resistant genes appear

Scientists have boosted the ability of plants to ward off single viruses by giving them powerful foreign genes. Now, researchers say they are engineering plants to resist multiple viruses.

A Japanese team has inserted into tobacco plants human genes that express two enzymes that together kill common crop viruses and their host cells, report Toshiya Ogawa and his colleagues at Kirin Brewery's Central Laboratory for Key Technology in Yokohama.

The enzymes, 2',5'-oligoadenylate synthetase and ribonuclease L, target RNA viruses (SN: 6/15/96, p. 381), plants' main viral enemies, the scientists report in the November NATURE BIOTECHNOLOGY. These enzymes also guard against viral infections in mammals.

Earlier this year, a team at the Cleveland Clinic Research Institute in Ohio carried out a similar experiment. Together, the groups have demonstrated that the enzymes have "a substantial impact on the replication and accumulation of viruses that belong to four different taxonomic groups and likely will have similar effects on other viruses," Roger N. Beachy of the Scripps Research Institute in La Jolla, Calif., notes in an accompanying article. The viruses commonly attack cucumbers, tomatoes, tobacco, and other crops.

The engineered plants aren't immune to infection, but they resist it well enough to control the spread of the virus, Ogawa and his colleagues assert. They plan to test the technique on chrysanthemums and carnations in the field in the near future, says coauthor Isao Ishida. The researchers plan to use similar enzymes obtained from cows, not humans. —*T.A.*

Astronomy

More evidence of ice on the moon

It's too patchy to skate on, and the soil it's mixed with is likely to make it look like dirt, but the lunar ice field suggested by data from the Clementine spacecraft could serve as a major resource for space voyagers. An analysis of radar signals bounced off the moon during Clementine's 2-month visit in 1994 suggests that the ice field, located in a basin near the south pole, measures 5 to 10 meters thick and some 16,000 square kilometers in area.

The field could serve as a filling station for craft en route to other locales in the solar system, providing an abundant source of hydrogen and oxygen for rocket fuel.

The notion that the moon contains water-ice dates to 1961, when researchers proposed that parts of the lunar surface in perpetual darkness would be cold enough to retain frozen water. In the late 1970s, scientists proposed that comets and asteroids bombarding the moon deliver a significant amount of water to the surface. These ideas came to the fore 2 years ago, when images taken by Clementine revealed a depression in the moon's South Pole-Aitken Basin that never receives sunlight (SN: 6/11/94, p. 383).

Researchers recently analyzed radar data collected during the Clementine flight. The team concluded that only the region in perpetual darkness reflected the signals coherently, just as ice would. In contrast, a surface of ground-up rock, such as that of Mercury, Venus, and most of the moon, scatters radio waves randomly in all directions.

Although the study doesn't prove the case for ice, Paul D. Spudis of the Lunar and Planetary Science Institute in Houston says he and his colleagues have no other explanation for their finding. They report their study in the Nov. 29 SCIENCE. Spudis adds that an instrument designed to measure hydrogen abundance, part of the Lunar Prospector mission scheduled for launch next October, should settle the question. — *R.C.*

Huge pulsars boosted by tiny neutrinos?

Born in the hearts of exploding supernovas, pulsars have confused astronomers since their discovery 30 years ago. These rapidly rotating, radiowave-emitting neutron stars often travel outside the galactic plane, where most stars congregate, and at greater speeds than their celestial brethren.

Theorists have argued that pulsars rocket out of a supernova at the moment of their creation (SN: 6/8/96, p. 358). How this happens has been a mystery. Now, two physicists suggest that an ejection of neutrinos, particles less massive than electrons, boots pulsars out of the galaxy.

When a star goes supernova, a secondary implosion of material takes place, squeezing stellar protons and electrons into neutrons, leaving behind a neutron star. "At its birth, we get a one-time kick," explains Gino Segrè of the University of Pennsylvania in Philadelphia. "And the reaction produces neutrinos—very tiny escaping particles." If the neutrinos escaped in all directions, their pulsar would stay in place. However, if the paths of only 1 percent favored a single direction, that asymmetry could accelerate the pulsar to a speed of 450 kilometers per second, according to a report by Segrè and Alexander Kusenko in the Dec. 9 PHYSICAL REVIEW LETTERS.

The physicists posit that as neutrinos flee from a newly created neutron star, their path is bent by the magnetic field of the nascent pulsar. Furthermore, transformations of the neutrinos from one type into another could create additional asymmetries (SN: 5/18/96, p. 319). Too small to be held by the star's gravity, neutrinos headed in any given direction would accelerate the star as if a rocket were strapped to its side.

"We're on the border between physics and astronomy," says Segrè. "Astronomers might says this is a cute but eccentric idea. But in physics, cute ideas sometimes turn out to really work." — *D.V.*