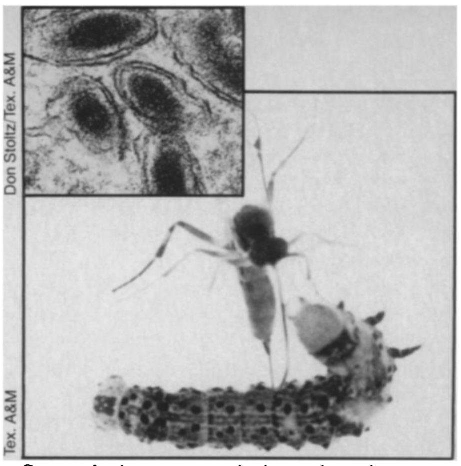
Virus allows wasps to kill crop pests

Parasitic wasps are gaining renown among gardeners and farmers as premier insecticidal agents because of their ability to selectively attack only targeted plant pests, not beneficial insects. Wasps use the pests as both hosts and a food source for their young. But the key to the parasites' success, new research at Texas A&M University in College Station shows, is a virus left behind with each of the eggs they inject into a host.

"Most of the parasitic wasps that lay their eggs inside a host have viruses," says entomologist Brad Vinson. Each of the egg-harbored viruses that he's found appears to be genetically complex and specific to a particular wasp. Since there are several thousand species of such wasps, he says, "we may be talking about many thousands of kinds of viruses."

The best characterized of these newly discovered polydnaviruses is one associated with *Campoletis sonorensis,* a less than half-inch long wasp that attacks two larvae — the tobacco budworm and another that's variously known as the cotton bollworm, tomato fruitworm or corn earworm. Once in a larva, this virus appears to move into the insect's "fat body" — a structure with a function somewhat analogous to that of the human liver.

"We know the virus affects the immune system," Vinson says, apparently by altering hemocytes, a blood cell similar to the human white blood cell. Moreover, the virus appears to cause endocrine system changes that can curb a larva's appetite, keep it from molting or prevent its pupation (passage into that dormant stage when it would metamorphose into an adult, capable of reproduction). Right now, Vinson is working with virologist Max Summers to pin down biochemically how the virus achieves these functions.



Don Stoltz/Tex. A&M
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Campoletis sonorensis *inserting virus-coated eggs into tobacco budworm. Inset: Viruses, shown here, are about 0.4 micrometers long.*

Since they have to be injected, it appears polydnaviruses can't infect larvae except with the wasp's help, Vinson notes. But, he says, "If we understood its genes enough to know how [the virus] affects immunity or prevents pupation, these genes might be cloned and inserted into other viruses" that are virulent in the field — making them more effective natural insect-control agents. —*J. Raloff*

Pests unexpectedly resist biocontrol

Because there have been few solid reports of insect resistance to microbial insecticides, a presumption has developed that bugs are less likely to become resistant to them than to chemical pesticides, explains William McGaughey, an entomologist at the U.S. Grain Marketing Research Laboratory in Manhattan, Kan. But that presumption is ill founded, his research now indicates. Working with the bacterium *Bacillus thuringiensis* (BT), the most widely used and intensively studied microbial pesticide, he found that high rates of resistance could develop in less than a year.

He was tipped off to the potential problem last year. As a final stage in research to get BT registered as an approved pesticide for stored grains, McGaughey and his colleagues examined field test results. They found a small but statistically significant decrease in the pesticide's efficacy among populations of Indian meal moth larvae collected from grain stores where BT had been applied.

McGaughey confirmed the finding in the lab: Increased resistance to BT developed in the larvae in just two or three generations — roughly two or three months. Succeeding generations became increasingly tolerant until resistance hit a plateau of about 100 times the original level at about the 15th generation.

That's about the same magnitude of resistance one might expect to see develop in insects exposed to a chemical pesticide, McGaughey told SCIENCE NEWS, "although similar experiments with chemicals typically take 30 or 40 generations."

Resistance normally develops only after an insect population has continuous contact with a pesticide for many generations, McGaughey says. Since neither BT nor the toxins it produces are stable in sunlight, field pests have, to date, received only intermittent exposure to BT. But with BT use increasing and with genetic engineers attempting to transfer BT's insecticidal traits into plants and field-stable microbes (SN: 12/15/84, p. 373), McGaughey believes a similar resistance to the one he uncovered in dark storage bins could begin surfacing outdoors. —*J. Raloff*

Zapping DNA into plant cells

A jolt of electrical current is what it may take to get plant genetic engineering off the ground. Scientists at Boyce Thompson Institute for Plant Research (BTI) in Ithaca, N.Y., report the first success in plant cells of the technique called electrotransformation, or electroporation. In the experiments, high voltage electrical pulses opened pores of carrot cell membranes, allowing foreign DNA to enter the cells, to become incorporated into chromosomes and to be expressed. This technique has already been used in a few instances for DNA uptake by animal cells.

"The introduction of foreign genetic material in the form of 'naked' or free DNA is the fundamental requirement for genetic engineering of plants," says Aladar A. Szalay of BTI. Most current plant gene-splicing employs a more elaborate procedure — foreign genes are inserted into the plasmid, called Ti, of the bacterium, *Agrobacterium tumefaciens.* The bacterium is used to deliver its elaborately engineered payload and then must be destroyed. "It's a long process," says William Langridge of BTI. This procedure is limited to those plants, mostly dicotyledons (thus not the major cereal crops), that the bacterium can infect.

In contrast, electroporation could enable any gene to be directly introduced into plant cells, Langridge predicts. For their initial experiments, Langridge and Bao-Jian Li, a visiting geneticist from Cungshan University in the People's Republic of China, used the Ti plasmid and a smaller plasmid as examples of foreign DNA. The recipient wild carrot cells were treated with enzymes to remove the cell wall and expose the cell membrane. Short pulses of 40-volt direct current were applied to a 0.4-milliliter mixture of plasmid molecules and about a million of the enzyme-treated carrot cells, called protoplasts.

About 2 percent of the carrot cells took up and expressed the foreign DNA, Langridge reports. Without electroporation, only one cell in a million takes up foreign DNA molecules. For the smaller plasmid, Langridge calculates about 10 copies go into each cell. In the case of the Ti plasmid, the cells containing the plasmid regenerated into plant embryos, but then grew aberrantly due to extra hormone encoded by genes carried on the Ti plasmid.

The electroporation technique works to introduce RNA, as well as DNA, into plant protoplasts. In experiments with tobacco mosaic virus RNA, almost 80 percent of the tobacco protoplasts were infected after electrical pulses, compared to less than 3 percent in an unshocked mixture of protoplasts and the RNA. The scientists are now working to improve and simplify this "exceptionally useful" tool for plant genetics. —*J.A. Miller*