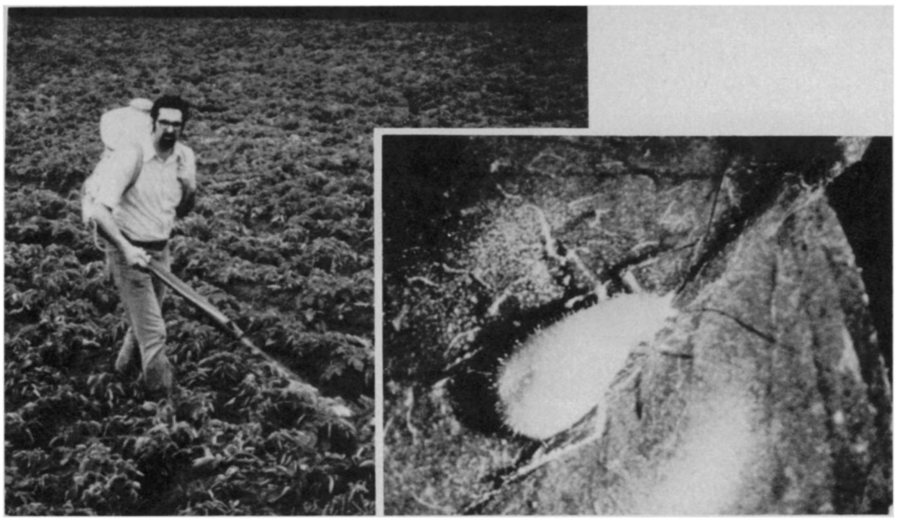
Biological contr
Better a cent

by Joan Arehart-Treichel



Holbrook et al.

Holbrook sprays fungi on potato plants. Aphid surrounded by halo of fungi.

In 1872, a scale insect that feeds on the sap of orange trees appeared in California. During the next 15 years it became a horribly destructive pest, threatening California's orange groves with extinction. Then a parasite of the insect was imported from Australia. Within two years the insect was under complete control. One could comb California's groves for days without finding a single scale insect.

This was one of America's first efforts to control insects by natural rather than by manmade means. But in spite of its spectacular success, we have had to wait a century for biological controls of insects to come into their own.

A primary reason for this delay is the astonishing success chemical insecticides enjoyed for many years. Only when insects started to build resistance to these chemicals and when wildlife started to be poisoned by cumulative insecticides in the environment were biological controls again seriously considered.

The about-face came largely during the past decade, in response to Rachel Carson's dire predictions about insecticides, as the nightmares portrayed in *Silent Spring* became a grim reality. There was a burst of research into biological controls. This research is beginning to bear fruit.

Some biological controls are already commercially available. A bacterial agent for the Japanese beetle is being marketed by Fairfax Biological Laboratories. It is being sold on the Eastern Seaboard to protect grass on airfields. Abbott Laboratories markets a bacterial agent called Dipel; Sandoz, a bacterial agent called Thuricide; Nutrialite Products, a bacterial agent called Biotrol. In June, the Environmental Protection Agency cleared the way for the first commercial virus control of insects (SN: 6/23/73, p. 405). Viron/H, marketed by International Minerals and Chemical Corporation, can be used on the cotton bollworm and on the tobacco bollworm.

More biological controls are in the hopper. The insect receiving the most attention is the gypsy moth. Its sex attractant has been identified and synthesized by Morton Baroza and his staff at the U.S. Department of Agriculture in Beltsville, Md. The USDA is now exploring the possibility of using the synthetic attractant, called Dispalure, to snuff out gypsy moths when they spread to new areas and to keep the moths from spreading in the first place. The USDA is investigating the chemical that male boll weevils make to attract female boll weevils for mating. The chemical is being put in traps to destroy the insects and also to concentrate them in cotton fields for killing with chemical pesticides.

The sex attractant of the codling moth, a serious pest of apples and pears, is being explored as a biological control in the state of Washington. Field tests are under way to see whether traps baited with the synthetic sex attractant can control the moth. The synthetic attractant is also being sprayed in the air to confuse the male moths so they cannot find the female moths and mate.

Scientists working in the U.S. Forest Service and in state forest institutions have discovered and synthesized the sex attractant of bark beetles.

John Stoffolano of the University of Massachusetts and Anthony Nappi of the State University of New York at Oswego have found a parasitic worm that has potential for controlling the face fly. This fly causes $90 million damage annually to livestock. The worm gets into the ovaries of the female fly, filling the ovaries with thousands of larval worms. Then the ovaries rupture and the larval worms spill out. The worm may help kill houseflies as well.

Donald W. Roberts of the Boyce Thompson Institute for Plant Research in Yonkers, N.Y., is working with a fungus that is effective against mosquito larvae. Roberts, an insect pathologist, hopes to try it in field tests in the near future. The World Health Organization has approached him about trying the fungus on mosquitoes in Africa. Frederick Holbrook and Richard Soper of the USDA and the University of Maine, and Irena Majchrowicz, a visiting scientist from Poland, have found that a powder of fungus spores can kill potato plant aphids within two days. Once the spores infect aphids, the spores make more infectious spores. Those spores infect more aphids, and so on. Holbrook calls the powder "a little bag of infectiousness."

USDA scientists have found that a bacterium that causes milky spore disease in the Japanese beetle can be used as a biological control. Roberts has found that certain poxviruses can kill the salt marsh caterpillar. Sandoz is developing a virus that affects the cotton bollworm and cornworm. The USDA is working on a broad-spectrum virus that kills several insects.

The roster of biological controls is growing rapidly. It is unlikely, though, that natural controls will prove to be a panacea, at least not for some years to come. First some problems have to be dealt with.

For one, the effectiveness of biological controls on a massive scale has not yet been proven. As E. F. Knipling of the USDA, a pioneer in insect sterilization, says, "At present there is no clear-cut information about any control."

Nor has the long-range effectiveness of biological controls been sufficiently documented. There is evidence that insects may build immunity to biological controls just as they do to chemical insecticides. Nappi has found that blood cells in the face fly can encapsu-

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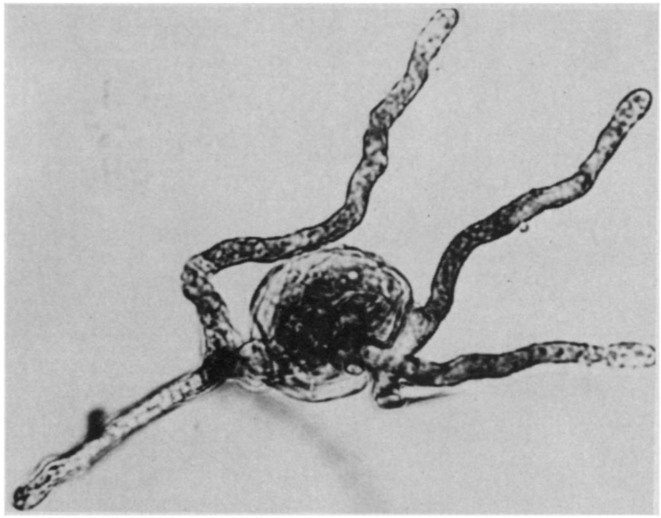

Holbrook et al.

Fungus spore sends out branches that infect insects.

late the fly's worm predator. Blood-cell encapsulation in insects roughly corresponds to cellular immunity in mammals. Nappi hopes that the fly cannot build up enough immunity to keep the worm from being effective as a biological control.

The danger of biological controls to animals other than insects, and to people, must also be considered. If controls are not target-specific or at least limited to insect pests, they will hardly be better than chemical insecticides.

Insect juvenile hormones keep insects in a state of immaturity. The synthetic hormones have shown promise in arresting sexual development of insects or in actually killing them. However, evidence that insect juvenile hormones are not insect-specific and react with mammalian tissue is reported by Richard T. Mayer of the USDA at College Station, Texas, and by Adelbert Wade and Magdi Soliman of the University of Georgia. Roberts says that insect poxviruses will not attack humans, mice or rabbits. But A. M. Heimpel of the USDA is doubtful whether insect poxviruses will be cleared for commerical use because of their possible danger to people.

Holbrook and his colleagues report that their fungus attacks aphids only. But this fungus and other fungi with potential for biological control must be exonerated from causing cancer. Some fungi are known to produce toxins that can cause stomach cancer in humans. One scientist is afraid that insect viruses used near estuaries might hurt the billion dollar shrimp industry. Says he, "I am not willing to sacrifice all the shrimp in order to make the farmers happy."

Says Heimpel, "Our responsibility is to make sure we are not going to do any more damage with biological controls than with chemical pesticides, and hopefully less or nothing at all."

Test requirements for biological controls must also be firmed up. Research and regulation, Heimpel says, are almost "totally unrelated." The Environmental Protection Agency is only now getting interested in registering biological controls. Heimpel estimates that massive doses of potential controls as well as subacute doses over a period of time will probably have to be given to two mammals. Potential controls will probably also have to be tested on birds, fish, bees and other animals that would come into close contact with biological controls. Even after a control is registered by the EPA, its manufacturer will probably have to conduct tests to make sure the agent does not hurt persons who make it.

Finally, industry must be given more incentive to develop natural insect controls. Says Heimpel, "We had tremendous industrial output at the first part of this game. But there has been a lot of delay from the regulatory area. I do not know whether it is valid. But we have cost industry so much money they have been forced to get out of development. This is serious. It puts the onus of research on Government's shoulders."

Actually Heimpel sees a role for both Government and industry in the research and development of insect controls. "Government," he says, "has the time and funds to go deep into research. It can do the basic work and take out public patents that companies can build on. Then, when industry takes on an agent, it can run with it."

In spite of all these problems, "a lot of progress has been made and more will be made in the future," Knipling declares. At last, Rachael Carson's advice is being heeded:

"Through all these new, imaginative and creative approaches to the problem of sharing our earth with other creatures there runs a constant theme, the awareness that we are dealing with life —with living populations and all their pressures and counterpressures, their surges and recessions. Only by taking account of such life forces and by cautiously seeking to guide them into favorable channels can we hope to achieve a reasonable accommodation between the insect hordes and ourselves." □

Normal face fly ovaries (left). Worm - infested ovaries erupt, spilling out thousands of larval worms (right).

Stoffolano and Nappi