The Day of the Locusts Is Near

A combination of a protozoan and low levels of insecticide makes control of grasshoppers economically feasible

Grasshopper plagues have been a bane to humanity throughout history. Swarms 100 miles long, 15 miles wide, and 3 miles deep have been reported. When these swarms touch down, they devour everything from crops to fences to wooden tool handles—leaving behind only famine and pestilence. In the past two summers parts of the western United States have been hit hard. For India and many of the poorer developing countries in Africa, however, grasshopper attacks are an annual event.

Grasshopper swarms can be destroyed with high concentrations of pesticides, but those chemicals also kill beneficial insects and the grasshoppers' own predators, removing natural controls on grasshopper expansion. But new research indicates that a combination of a natural parasite of grasshoppers with low levels of an insecticide may offer an ecologically sound way to control infestations. Field tests last summer showed that the combination can reduce infestations quickly and at the same time provide long-term control. The U.S. Environmental Protection Agency has recently granted registration of the combination for use against rangeland insects. Several other registrations are also pending. This summer should mark the first commercial use of the product.

The parasite is *Nosema locustae*, which translates roughly to "grasshopper sickness." It is a protozoan (technically a microsporidia) that infects the fat on grasshopper bodies and competes with the host for the energy reserves. It has been studied in the laboratory for more than 17 years and in the field for about 5 years by John E. Henry and his colleagues at the U.S. Department of Agriculture's Rangeland Insect Laboratory in Bozeman, Montana. Among other things, they have demonstrated that *N. locustae* infects at least 58 different species of grasshoppers, including the five or so that are of greatest importance economically. It also infects several species of crickets and the pygmy locust, but not the other insect species tested. It appears to be completely unable to infect plants or warm-blooded animals.

The parasite can be mass-produced relatively easily by feeding grasshopper nymphs with lettuce sprayed with *N. locustae* spores. After 32 days, the adult grasshoppers contain an average of about 3.9 billion spores apiece; at this time, the insects are frozen and stored. For use, the grasshoppers are thawed and crushed, and the spores are suspended in distilled water. The spores are then concentrated and sprayed onto wheat bran, which is the form in which they are applied. Repeated studies have shown

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that application of about 1 billion spores per acre will reduce the density of grasshoppers by about 50 percent within 4 weeks; the spores in one grasshopper are thus enough to treat nearly 4 acres. The protozoan persists in the treated area for several years until the concentration of grasshoppers becomes too low (about one grasshopper per square yard) to support continued reproduction of the parasite.

Application in this manner is more than adequate if *N. locustae* is applied preventively, says Henry, "but people won't invest in protection very readily." The annual average gross return on rangeland in the United States, he says, is less than $5 per acre, and land operators are reluctant to control grasshoppers even under cost-sharing arrangements with the state and federal governments. There is some evidence that applying the parasite to roadsides, waste areas, and the like might protect crops, and this would reduce the cost greatly. But once an infestation has begun, *N. locustae* does not act fast enough to prevent loss of crops or forage.

Henry and his colleagues have shown that the protozoan is compatible with low concentrations of several pesticides, such as carbaryl. In recent large experiments carbaryl was sprayed onto bran at a rate equivalent to 20 grams of pesticide per acre (much lower than the amount normally used), and this material was combined with an equal amount of bran containing *N. locustae*. When the mixture was applied to large acreages near Sheridan, Wyoming, a 50 percent reduction in grasshopper density was achieved within 48 hours and another 50 percent reduction within 4 weeks. Most of the survivors were also infected and there was evidence of impaired reproduction. Similar results were achieved in a cooperative trial in Argentina. The parasite is now being marketed by Reuter Laboratories of Haymarket, Virginia, and La Porte Insectories of Fort Collins, Colorado, and other companies may also start selling it, since USDA does not have a patent.

For the future, Henry is looking at two other parasites, *N. acridophagus* and *N. cuneatum*. The problem with these is that they infect grasshoppers so quickly that it is virtually impossible to raise significant quantities in the laboratory. Henry has found, however, that their spores can be grown in the corn earworm in the laboratory under carefully controlled conditions. That process is still tedious and inefficient, however, and must be improved substantially before large enough quantities of the parasites are available for field trials.

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