

Pest Control by Bacteria

alfalfa caterpillar in field reduced to sub-economic levels within two days by bacillus applied as spray

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A spore-forming bacterium—*Bacillus thuringiensis* Berliner—successfully reduced populations of the alfalfa caterpillar to below the economic level in field tests near Dos Palos.

The bacillus is produced easily in large quantity, stored in powder form, and applied to infested fields by any sprayer used for the application of insecticides.

The bacterium acts relatively fast, killing the pest within two days, and leaves the alfalfa clean.

Application

The spore material was grown in nutrient agar, washed off, filtered, poured into flat enameled pans, and allowed to dry. The dry, brittle deposit of spores was scraped from the pans, and ground into fine powder. Tests indicate that the dried spores retain their viability and virulence, when stored properly, for at least one year, and probably much longer.

The concentrated spore powder was placed in suspension in an ordinary five-gallon back-pack hand sprayer, and diluted with water to make the final spray solution. Aircraft spraying and the use of spore dusts instead of sprays also seem feasible.

Two series of test plots were set up, each in a separate alfalfa field. The first series consisted of six test plots and three control plots, and ran from August 1 to August 4, 1950. The second series consisted of three test plots and three control plots, and ran from August 29 through September 1, 1950.

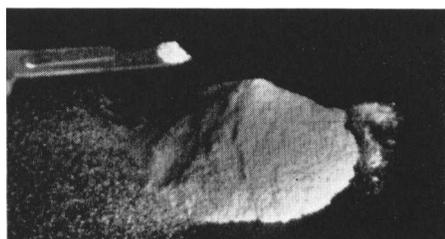
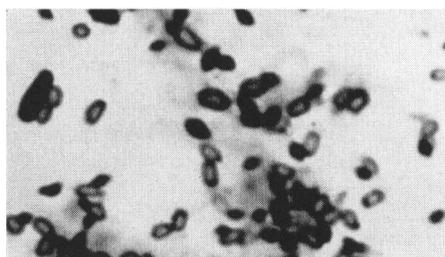
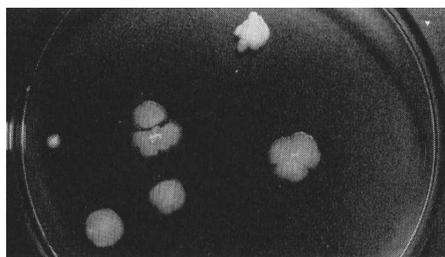
The approximate total concentration of spores—or clumps of spores—applied to each plot varied from six to 13 billion.

The age of the spores varied from one to 12 months.

Results of Tests

Within 24 to 48 hours following the spray applications, microscopic and cultural examinations of the dead and dying caterpillars showed symptoms of sluggishness, diarrhea, discoloration, and flaccidity typical of most bacterial infections. After death the bodies of the pest darkened, softened, and developed a putrefying odor.

In at least seven of the nine test plots the caterpillar population was brought



Top. Colony of *Bacillus thuringiensis* growing on nutrient agar. Center. Microscopic picture of the spores from a three-day culture. Bottom. Powder made from spores can be stored for a year without losing its virulence.

below an economic level—about 20 larvae per two sweeps of net—while in each of the untreated check plots the population remained at a destructive level—from 61 to 90 larvae per two sweeps. In the two remaining test plots the count was brought down to just slightly above 20, and would very probably have been reduced further in another day or two. The plots were cut for hay before the tests could be run to their desired completion.

Control of the alfalfa caterpillar by *Bacillus thuringiensis* was compared with that by the polyhedrosis virus, another promising biological control agent. The virus method appears to be at least slightly more thorough in its effectiveness, but there are at least two possible advantages of the bacillus over the virus: the bacterium is more quickly effective, and the infection leaves the integument of the insect intact.

Because of its longer incubation pe-

riod the virus usually does not begin effectively to reduce the alfalfa caterpillar population until five or six days after application. In the case of the bacillus, marked reduction in the number of insects occurred by the second day.

When the alfalfa caterpillar is killed by the virus, the integument usually disintegrates and breaks open, permitting the liquefied body contents to run out over the host plant. When this occurs on a large scale, the palatability of the hay for cattle is sometimes adversely affected. When the bacillus was used, the integument of the insect ordinarily remained intact. Most of the dead larvae dropped to the ground without smearing the alfalfa plant.

A combination of the bacillus and the virus might constitute a more highly efficient means of control of the alfalfa caterpillar than use of either agent alone.

Such a bivalent product would be simple to make up in the field prior to application. It also could be prepared in advance if the virus material as well as the spore material were in the form of a powder or dust.

Following the application of the combined materials one could expect to have an initial rapid drop—within 48 hours—in the caterpillar population as a result of infection by the bacillus, followed three or four days later by a further reduction in the remaining population as a result of the virus infection. Whether such desirable results would actually occur can only be ascertained by further experimentation.

Additional tests are needed to come to definite conclusions about the efficacy and practicability of the method using bacterial control of the alfalfa caterpillar. The fact that the bacillus is pathogenic for some insects under certain conditions, and that it retains its virulence when cultivated repeatedly on artificial media or when stored in a dried condition makes it an inviting organism with which to work, especially since it is a potential control agent not only against the alfalfa caterpillar but against certain other insects as well.

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