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**MICROBIAL INSECTICIDES CONTROL
FOREST TENT CATERPILLAR IN SOUTHWESTERN ALABAMA**L. P. Abrahamson¹ and J. D. Harper²

SOUTHERN FOREST EXPERIMENT STATION

One aerial application of a commercial formulation of Bacillus thuringiensis (Dipel or Thuricide HPC) protected water tupelo from defoliation by forest tent caterpillars. Dipel appeared to be superior to Thuricide when both were applied at the same rates with a molasses sticker.

Additional keywords: *Malacosoma disstria*, *Bacillus thuringiensis*, *Entomophthora megasperma*, polyhedrosis virus, trichlorfon, swamp forest.

Large areas in the predominately water tupelo (*Nyssa aquatica* L.) swamp forest between the Mobile and Tensaw Rivers in southwestern Alabama have been repeatedly defoliated by forest tent caterpillars (*Malacosoma disstria* Hubner) over the past 12 or more years. The area of infestation has varied from 11,000 to 800,000 acres; about 50,000 acres were defoli-

ated in 1972.³ Several chemical insecticides have been tested against the insects, and ultra low volumes (ULV) of trichlorfon have proved highly effective (Abrahamson and Morris, 1973). However, since the area provides recreation, marine and freshwater fishing, and water for urban use, microbial control of the insects may be preferable to chemical control.

This paper reports preliminary tests of a commercially available bacterium, *Bacillus thuringiensis* Berlinger, and of a virus and a fungus that are indigenous to the area. Results with *B. thuringiensis* formulations were highly encouraging.

In the area, defoliation by tent caterpillars occurs in the spring, normally from late March to early May. The caterpillars hatch during spring foliation, and heavy populations strip all leaves from host trees by early May. The

¹ Research Entomologist at the Southern Hardwoods Laboratory, which is maintained at Stoneville, Mississippi, by the Southern Forest Experiment Station in cooperation with the Mississippi Agricultural and Forestry Experiment Station and the Southern Hardwood Forest Research Group. Chemagro Corporation, Abbott Laboratories, International Minerals and Chemical Corporation, International Paper Company, and Scott Paper Company cooperated in the study described.

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³ Wilmore, D. H., and Hyland, J. R. Survey of forest tent caterpillar defoliation in southwest Alabama. USDA For. Serv., Southeast Area, State and Priv. For., For. Pest Manage. Group Rep. 72-2-17, 3 p. 1972.

trees seldom die and they usually refoliate in June, but research in progress indicates that their growth for the year may be cut almost in half.

METHODS AND MATERIALS

Twelve square plots of about 20 acres each (14×14 chains) were established in areas of high potential infestation, which was determined by shooting branch samples from tree tops and counting egg masses. Stands that had 2.5 or more egg masses per sample branch were selected. Experience has shown that this number of egg masses yields sufficient larvae to completely defoliate the stand.

Plot corners were marked by placing parachute sections between tree tops. Markers were put in position by shooting arrows with nylon strings attached over several trees. Parachute cords were then pulled over the trees, and a chute section was hauled up and tied securely in position at two ends. These markers remained visible from the air for at least a year. Trees along the plot borders were marked with flagging for easy location during later ground checks.

Four plots were sprayed with the insecticide trichlorfon, two each at rates of 0.75 and 0.50 lb./acre. Four were treated with Dipel,⁴ a wettable powder formulation of *B. thuringiensis*, two each at rates of 0.25 and 0.50 lb./acre. Two were sprayed with 1 qt./acre of Thuricide HPC,⁵ a liquid formulation of *B. thuringiensis*. Nuclear polyhedrosis virus, originally isolated from dead larvae in the host population and produced by the authors in the laboratory by infecting media-reared larvae, was applied to one plot at the rate of 2.5×10^{10} polyhedral inclusion bodies per acre. Resting spores of *Entomophthora megasperma* Cohn were processed from approximately 4,000 dead larvae which were collected in the swamp area during the previous year. A final concentration of 4.2×10^6 resting spores per acre was applied to one plot. Untreated control plots were not established, but areas adjacent to the treated plots were observed.

Water suspensions of all biological materials were prepared. Dipel, Thuricide HPC, and virus had 25 percent by volume CIB⁶ added. Biofilm spreader-sticker was added to the virus and fungus suspensions. Final volumes applied were 1 gal./acre of Dipel and Thuricide, 3 gal./acre of virus, and 5 gal./acre of fungus. Trichlorfon was applied at 16 ounces and 24 ounces per acre of a ULV formulation containing 4 pounds of active ingredient per gallon.

Materials were sprayed on April 5 and 6 by a Piper Pawnee airplane fitted with roto-spin nozzles. Wind speed was below 5 m.p.h. during all applications. Spraying was monitored on April 5 from a spotter plane. At this time, caterpillars were in third or early fourth instars, and defoliation was approximately 30 percent.

Defoliation by the forest tent caterpillar was assessed on May 10, 1972. Aerial photos were taken of the plots from an altitude of 4,000 feet on Ektachrome infrared aero film (type 8443) and Ektachrome aero film (type 8442) (Ciesla, et al., 1971)⁶. Plot boundaries were superimposed on the photos. Defoliation on plots was classed as complete, partial, or negligible (protected). The final evaluation of effectiveness of products was based largely on these photos. However, each week after application the plots treated with micro-organisms were observed from the ground; the caterpillar population was sampled by shooting branches from the tree tops.

RESULTS

Ground checks 1 day and 1 week after spraying indicated that trichlorfon killed nearly 100 percent of caterpillars at both 0.50 and 0.75 pound active ingredient per acre. In one of the plots treated with 0.50 pound, a few larvae were found in partially defoliated areas between the flight lines, but no larvae were found in most of the samples. Foliage protection by trichlorfon was similar to that found in past studies (Abrahamson and Morris, 1973).

Plots sprayed with *Bacillus thuringiensis* formulations were checked 6 to 24 hours after

⁴ Mention of trade names is solely to identify material used, and does not imply endorsement by the USDA.

⁵ Cargill Insecticide Base (molasses sticker with other additives).

⁶ We thank the Alexandria Forest Pest Management Zone Office, Southeastern Area, State and Private Forestry, for taking the aerial photographs.

spraying. Foliage samples revealed excellent coverage in most plots. Spray deposits were clearly visible on the leaves, and the water below was covered with fallen larvae. One plot treated with 0.5 pound Dipel 3 days before, contained an average of 1 larva per sample unit. Branch samples from adjacent untreated areas had populations of 50 to 200 larvae. After 6 days, very few larvae remained in the *B. thuringiensis* and trichlorfon-treated plots. A few paralyzed individuals were still on the water, indicating that the material was still active. There appeared to be more larvae remaining in plots treated with Thuricide than in those treated with Dipel. Most larvae remaining in the trees were scattered and did not congregate in masses as healthy larvae normally do. Trees in untreated areas were almost totally defoliated after 6 days, and larval masses were common.

Neither virus nor fungus provided detectable protection, although both caused significant mortality in natural populations. Larvae collected from these areas at varying intervals following spraying and maintained on artificial medium in the laboratory did not develop symptoms of the respective diseases. Only a few virus-infected larvae were recovered from bushes in the virus-treated plot, and incidence of the fungus disease in the fungus-treated plot was about the same as in the surrounding areas.

Twenty-seven days after treatment, average numbers of larvae per sample branch for individual treatments were 0.25 pound Dipel—3, 0.50 pound Dipel—1, Thuricide—17, and untreated—36.

Average foliage losses by treatment were:

Treatment	Percent loss
Trichlorfon	
(0.5 and 0.75 lb.)	30-35
Dipel	
(0.50 lb.)	30-35
Dipel	
(0.25 lb.)	35-40
Thuricide	40-50
Virus	95-100
Fungus	95-100
Untreated	95-100

At time of spraying, foliage loss was about 30 percent.

The aerial photographs showed negligible defoliation (no more than the 30 percent) in the four trichlorfon-treated plots and the 0.50 pound Dipel-treated plots. Defoliation surrounding these plots was complete. The break was sharply defined at boundaries on all plots. Areas treated with 0.25 pound of Dipel and Thuricide had narrow strips of complete to partial defoliation. Some of these areas were obviously between flight lines, an indication that the spray pilot had not accurately judged his position in treating adjacent swaths. However, some were due to lack of complete control. In one Thuricide plot, only trees that received dosages from overlapping swaths were protected. The larva population on this plot was particularly far advanced and defoliation was particularly heavy before treatment. Both factors may account for some of the apparent lack of control. The overall efficiency of the material may also have been lowered by a lack of leaves to receive the spray.

The late larval instars (third and early fourth) in most plots at time of treatment provided very rigorous test conditions, particularly for the virus and fungus, which do not kill rapidly. *Bacillus thuringiensis* at low rates, virus, and fungus may be better suited for control of first and second instar larvae. Better protection by these microbial insecticides might have been achieved and a better comparison between Dipel and Thuricide would have been possible had treatment been 7 to 10 days earlier. However, results of this test clearly show that one aerial application of *B. thuringiensis* can protect foliage from forest tent caterpillars. Dipel appeared superior to Thuricide at the same rate with CIB additives. These tests will be repeated with some modifications in 1973.

LITERATURE CITED

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PRECAUTION

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