POPULATION SUPPRESSION OF MAHOGANY WEBWORM, *MACALLA THYSRISALIS* (LEPIDOPTERA: PYRALIDAE), WITH NATURAL PRODUCTS

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ABSTRACT

In laboratory tests, both Margosan-O, diluted to 20 ppm azadirachtin in water, and Dipel 2X, which contains the entomopathogenic bacterium, *Bacillus thuringiensis* var. *kurstaki* Berliner, at 9,600,000 international units (i.u.)/liter H₂O, applied to foliage of West Indies mahogany, *Swietenia mahagoni* Jacquin, inhibited feeding by young mahogany webworms, *Macalla thyrsisalis* Walker, as measured by differences in growth and in the production of fecal pellets (P < 0.05). No clear effect was observed on older larvae. In a field test, the mean number of larvae per tree was reduced 10-fold (P < 0.05) ten days after treatments with either 20 ppm azadirachtin in H₂O or *B. t.* at 19,200,000 i.u./liter H₂O applied to the foliage of West Indies mahogany. One or more treatments with either of these materials during the spring when mahogany webworms are active on foliage is a suitable method of controlling this pest.

RESUMEN

En pruebas de laboratorio, Margosan-O, diluido a 20 ppm azadirachtin en agua, y Dipel 2X, lo cual contiene el bacterium entomopatogénico, *Bacillus thuringiensis* var. *kurstaki* Berliner, a 9,600,000 unidades internacionales (u.i.)/litro H₂O, aplicado al foliajo de caoba antillana, *Swietenia mahagoni* Jacquin, inhibieron la alimentación de larvas de primeros estadios de *Macalla thyrsisalis* Walker, medida por diferencias en crecimiento y en la producción de pelotillas fecales (P < 0.05). No se observó un efecto claro sobre las larvas más crecidas. En un ensayo de campo, el promedio de larvas por árbol fue reducido diez veces (P < 0.05) diez días después de tratamientos con azadirachtin a 20 ppm/litro H₂O, o *B. t.* a 19,200,000 u.i./litro H₂O aplicado al foliajo de caoba antillana. Uno o más tratamientos con cualquier de estos materiales durante la primavera cuando *M. thyrsisalis* es activo sobre el foliajo es un método satisfactorio para controlar esta plaga.
Larvae of the mahogany webworm, *Macalla thyrsalis* Walker (Lepidoptera: Pyralidae), attack foliage of mahoganies, *Swietenia* spp. (Meliaceae). In southern Florida, where the West Indies mahogany, *S. mahagoni* Jacquin, is native and an important ornamental, mahogany webworms usually occur on foliage beginning in April of each year and become abundant during about five weeks when new leaves are expanding. After June, larval populations become greatly reduced, apparently due at least partly to the impact of parasitoids, including *Apanteles* sp., *Habrobracon* sp. (Hymenoptera: Braconidae) and *Lepesta* sp. (Diptera: Tachinidae) (Howard & Solis 1989). The effects of defoliation on growth of mahoganies by mahogany webworms are not known, but shrouding of the foliage in webbing and defoliation by the insect constitute aesthetic damage to these ornamentals. Larval populations often become very dense, and as the larvae mature, they drop onto cars, sidewalks, etc., causing a nuisance. Each year during this period, the Cooperative Extension Service receives numerous requests for information on how to control this insect.

Environmentally compatible methods of suppressing larval populations of the mahogany webworm are needed. Two natural products appeared to be good candidates for this use.

Azadirachtin, and other compounds contained in the seed of the margosa, or neem tree, *Azadirachta indica* A. Jussieu (Meliaceae), have antibiotic, insect antifeedant, and insecticidal properties (Jacobson 1986, 1989, Warthen 1989, Pradhan & Jotwani 1968). The neem tree is native to India and Burma and is planted as an ornamental or shade tree in many tropical countries. Neem seed extracts have been shown to affect more than 80 species of insects (Warthen 1989), but the toxicity of these substances to higher animals is apparently extremely low. The oral LD$_{50}$ of azadirachtin for mice was reported as 13,000 mg/kg (Jacobson 1989).

Entomopathogenic bacteria of the *Bacillus thuringiensis* group (*B. t.*) are specific to lepidopterous and certain other larvae, and formulations using these bacteria are recognized as among the safest and environmentally benign of natural pesticides (Coppel & Mertins 1977).

The present paper reports results of laboratory tests and a field trial using azadirachtin or *B. t.* to suppress mahogany webworm populations.

**Materials and Methods**

The laboratory test included four different treatments: (1) Margosan-O (W. R. Grace & Co., Cambridge, Massachusetts) diluted in water to 20 ppm azadirachtin, (2) Dipel 2X (Abbott Laboratories, North Chicago, Illinois), which contains the HD-1 isolate of *B. thuringiensis* var. *kurstaki* (Berliner) diluted with water to 9,000,000 international units (i.u.) per liter, (3) Plyac (Hopkins Agricultural Chemical Company, Madison, Wisconsin 53707), which is a non-ionic spreader-sticker suitable for use with the above materials, at the rate of 1 ml per liter H$_2$O, and (4) untreated controls. Plyac at 1 ml per liter was added to the azadirachtin and *B. t.* mixtures to insure coverage of the foliage. The *B. t.* was obtained from the manufacturers a few days prior to this study. The azadirachtin was obtained 9 months earlier and stored in a laboratory at about 25$^\circ$ C. Materials were applied with a compressed air hand-held sprayer to young foliage of new shoots selected at random on a West Indies mahogany tree. When almost dry, sprayed foliage was clipped from the tree. One leaf was placed per Petri dish, with five replications for each treatment. An early instar mahogany webworm 5-12 mm long was placed on the leaf in each Petri dish. After three days, the number of fecal pellets was determined for each larva as an indication of feeding activity. After one week, the larvae were examined and measured. A similar experiment was conducted with nearly fully grown larvae about 30 mm long.
A field trial was conducted on West Indies mahogany of about 3 to 4 m in height at the Fort Lauderdale Research and Education Center. These were infested with mahogany webworms which were mostly in early instars. The treatments were (1) azadirachtin at the above rate, (2) B. t. at double the above rate, and (3) untreated control. Phyac at 1 ml per liter was added to these mixtures. Treatments were assigned at random to four trees per treatment. On May 10, 1989 and again 15 days later, the materials were applied with a compressed air hand-held sprayer so as to fully cover the foliage. Precipitation was recorded at a rain gauge about 200 m from the mahogany trees. The numbers of webworms were determined just prior to spraying. The day after application of the treatments, 30 medium to full-grown mahogany webworms were placed on each tree to supplement the natural populations. The numbers of webworms on each mahogany tree were determined two, ten, 15 and 20 days after spraying. Results were analyzed with the Analysis of Variance and the Waller-Duncan Bayesian k-ratio t-test (SAS Institute 1985).

RESULTS AND DISCUSSION

No mortality was observed in treatments or control in the laboratory test with nearly full grown larvae. There were no significant differences in the numbers of fecal pellets produced by larvae on foliage treated with azadirachtin or B. t., compared to the controls. These larvae increased only slightly in length and pupated within 7 days of the commencement of the experiment.

There were significantly fewer fecal pellets produced by younger larvae over a 3 day period on foliage treated with B. t. and with azadirachtin, compared with the controls (P < 0.05). The mean increase in length of mahogany webworms on foliage treated with either azadirachtin or B. t. was less than 1/4 of that of webworms in the controls (P < 0.05) (Table 1). These results indicate that both B. t. and azadirachtin curtailed feeding of younger mahogany webworms. There was no significant difference in mean numbers of pellets or mean increase in length between the spreader-sticker treatment and the control.

Three days after the application of the materials there was no mortality of young larvae in any treatment including the control. At the end of seven days, three of the five larvae on foliage treated with azadirachtin and one on foliage treated with spreader-sticker were dead. All larvae in the other treatments were alive. In an earlier study, Reinert & Howard (1982) observed that mahogany webworms were alive after 24 hours exposure to B. t., but that study did not reveal that this treatment curtailed feeding.

**TABLE 1. EFFECTS OF AZADIRACHTIN AND BACILLUS THURINGIENSI S ON EARLY INSTAR MAHOGANY WEBWORM, MACALLA THYRSISALIS. MEAN NUMBER OF FECAL PELLETS PRODUCED PER LARVA (N = 5) IN 3 DAYS AND MEAN INCREASE IN LARVAL LENGTH (MM) IN 7 DAYS.**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean number of fecal pellets (3 days)</th>
<th>Mean growth of SD larvae (7 days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>144.3a</td>
<td>11.6a</td>
</tr>
<tr>
<td>Spreader-sticker</td>
<td>114.7ab</td>
<td>8.4a</td>
</tr>
<tr>
<td>Azadirachtin</td>
<td>84.8bc</td>
<td>1.5b</td>
</tr>
<tr>
<td>B. t.</td>
<td>62.4c</td>
<td>3.2b</td>
</tr>
</tbody>
</table>

<sup>a,b</sup>Means within the column not followed by the same letter are significantly different. [* F = 10.06, df = 16, P < 0.05, & k ratio = 100; & F = 8.06, df = 10, P < 0.05, & k ratio = 100 (Waller-Duncan Bayesian k-ratio t-test, SAS Institute 1985)].
In the field test, on the second day after application of the materials to West Indies mahogany trees, populations of this insect had increased about equally in all treatments including controls, probably partly due to the placement of 30 medium to full-grown larvae per tree, but also due to natural infestation as evidenced by an apparent increase in the numbers of early instar larvae. Ten days after the first treatment application, the populations of mahogany webworms per tree in both azadirachtin and B. t. treatment groups were reduced ten-fold or more compared to the control group (P < 0.05, F = 9.50, df = 9). Mean webworms per tree by treatments were as follows: azadirachtin, 2.3 (SD = 3.86); B. t., 3.0 (SD = 1.14); and control, 34.3 (SD = 20.1) (Fig. 1). Larvae on treated and untreated trees were of mixed instars. Since the larval stage of mahogany webworms lasts about ten days in the field (Howard & Solis 1989), it is unlikely that later instar larvae placed on the trees the day after the application of treatments were still present in the population ten days after treatment applications. At this point, the webworm populations presumably included full-grown webworms that were in early instars and naturally established on the trees before spraying and younger webworms that became established naturally since the application of treatments. Since the laboratory tests showed that the treatments curtail feeding and are most effective against younger larvae, it is presumed that most of the younger larvae attempting to feed on foliage treated with either azadirachtin or B. t. probably dropped off after a few days. There was noticeably more webbing and feeding damage on untreated trees than on trees treated with either material. Populations in both azadirachtin and B. t. treatment groups remained low 15 days after the initiation of treatments. Populations had also declined in the control group, but since some early instar larvae were observed in all treatment groups, and both materials are generally not persistent under field conditions, the treatments were repeated at this time to prevent re-establishment of webworm populations. On 31 May, twenty days after the first treatment application, mahogany webworm populations on trees in the control group had diminished as predicted from studies of their population dynamics (Howard

![Graph](image)

Fig. 1. Mean numbers of mahogany webworms per West Indies mahogany tree treated with azadirachtin, *Bacillus thuringiensis*, and control, Fort Lauderdale, Florida, May 1989.
Howard: Natural Products Against Mahogany Webworm  229

& Solis 1989) and were about equal to those on trees treated with either of the two materials.

The azadirachtin and B. t. treatments were effective in spite of rainfalls that occurred during the field test. There was a heavy rainfall (40.1 mm) five days after the first treatment applications. In addition, there were seven days each with a mean of 0.35 mm of rainfall during the period of the test. Based on the results of this study, both azadirachtin and B. t. are promising materials for the management of mahogany webworms. One or more applications in the spring “webworm” season would be adequate for controlling this pest in Florida. The first application should be made at the beginning of the leaf flushing period of mahogany when mahogany webworms are first observed on foliage. In Florida, mahogany webworms are objectionable to the public when they occur in dense populations or cause aesthetic damage to mahogany trees. Thus, the need for additional applications should be based on a subjective analysis of field observations. Both materials, because of their low environmental persistence and low level of toxicity to higher animals (Jacobson 1989) are highly suitable for protecting mahoganies in urban environments. These products would also have advantages for use on timber trees. However, although the mahogany webworm is widely distributed on mahoganies in Tropical America (Howard & Solis 1989), it has thus far not been reported as a pest of mahoganies under forest conditions.

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REFERENCES CITED