SHORT COMMUNICATIONS

Control of Dendrolimus spectabilis with a Mixture of Cytoplasmic Polyhedrosis Virus and Bacillus thuringiensis

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For control of the Pine Moth, Dendrolimus spectabilis, a cytoplasmic polyhedrosis virus (CPV) has been successfully used (Katagiri, 1969). As the CPV infection develops slowly and larval death does not begin to occur until 2 or more weeks after infection, rapid control of the pest by the CPV cannot be expected. The CPV is a very useful agent for long-term control, however, as mortality from the virus increases gradually and finally reaches a very high percentage level. Moreover, effectiveness of the virus depends largely on the pest population density and developmental stage (Koyama and Katagiri, 1967).

On the other hand, Bacillus thuringiensis kills the larvae in a few days (Katagiri and Kushida, 1974). It also shows inhibitory effects on biting and stops feeding, resulting in good control for the short term.

To obtain an integrated effect in controlling the pest insect, these two agents were mixed and sprayed on a pine forest at the young larval stage. Krieg (1971) reviewed the interactions between pathogens and mentioned some positive and some negative cases of interaction between viruses and B. thuringiensis, but no case of a combination of CPV and B. thuringiensis has yet been reported.

In the study, three concentrations of B. thuringiensis (Bactospène; 2.5×10⁶, 5×10⁶, and 1×10⁷ spores/ml), two concentrations of CPV (10⁸ and 10⁹ polyhedral inclusion bodies/ml) were prepared and handsprayed on the pine forests at Hachioji, Tokyo, at the rate of 400 l/ha. After spraying, three branches were chosen at random from each treated forest plot. Each branch was enclosed with cheese cloth. Fifty 4th-instar larvae, which had been reared indoors, were reared on each branch. For the unsprayed control plot, five branches were used. Mortality and the amount of feces were investigated at 1-week intervals.

Results are summarized in Tables 1 and 2. The CPV of 10⁶/ml produced 13% mortality in 4 weeks after spraying. Death began at 2 weeks after spraying. That of 10⁷/ml produced 68% mortality in the same period. On the other hand, B. thuringiensis of 10⁸ spores/ml produced more than 66% mortality in a week and more than 85% in 4 weeks. That of 5×10⁷ spores/ml also killed about 60% of the larvae in a week and a little more than 70% in 4 weeks. The mixture of both agents produced 60% mortality in a week and more than

Table 1. Cumulative Mortality of D. spectabilis after Spraying of B. thuringiensis, CPV, and the Mixture

<table>
<thead>
<tr>
<th>Pathogen sprayed</th>
<th>Weeks after spraying</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Unsprayed control</td>
<td>0.1±0.4%</td>
</tr>
<tr>
<td>B. thuringiensis</td>
<td></td>
</tr>
<tr>
<td>2.5×10⁶ sp/ml</td>
<td>16.8±1.2</td>
</tr>
<tr>
<td>5.0×10⁶ sp/ml</td>
<td>58.6±3.6</td>
</tr>
<tr>
<td>1.0×10⁷ sp/ml</td>
<td>66.1±9.4</td>
</tr>
<tr>
<td>Mixtureb</td>
<td>60.4±0.4</td>
</tr>
<tr>
<td>10⁸ polyhedra/ml</td>
<td>0</td>
</tr>
<tr>
<td>10⁹ polyhedra/ml</td>
<td>0</td>
</tr>
</tbody>
</table>

a sp : spores.
b Mixture : 10⁸ polyhedra and 5×10⁷ spores/ml.

Table 2. Weekly Change in Feces Weight after Spraying (g per Initial 100 Larvae)

<table>
<thead>
<tr>
<th>Pathogen sprayed</th>
<th>Weeks after spraying</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Unsprayed control</td>
<td>5.2 ± 1.6 g</td>
</tr>
<tr>
<td>B. thuringiensis</td>
<td>2.2 ± 0.7</td>
</tr>
<tr>
<td>2.5 × 10⁷ sp/ml</td>
<td>0.9 ± 0.6</td>
</tr>
<tr>
<td>5.0 × 10⁷ sp/ml</td>
<td>0.7 ± 0.3</td>
</tr>
<tr>
<td>1.0 × 10⁸ sp/ml</td>
<td>1.2 ± 0.3</td>
</tr>
<tr>
<td>Mixtureᵇ</td>
<td>10⁷ polyhedra/ml</td>
</tr>
<tr>
<td>CPV</td>
<td>10⁸ polyhedra/ml</td>
</tr>
</tbody>
</table>

ᵃᵇ See notes in Table 1.

80% in 4 weeks. The mortality from a mixture exceeds that from B. thuringiensis or CPV alone. Moreover, the mixture killed the larvae rapidly, mainly due to B. thuringiensis.

Feces weight was also decreased significantly in the B. thuringiensis and mixture plots. At CPV 10⁷/ml plot, no reduction in feces weight was observed in 4 weeks, but at 10⁸/ml plot a significant reduction was observed after 2 weeks. In the mixture plot, a sharp reduction in feces weight occurred immediately after treatment, and a continuous reduction due to increasing mortality was observed.

In conclusion, for short-term control of the caterpillars an integration of CPV and B. thuringiensis was found to be very effective.

REFERENCES


Mating Suppression of Spodoptera litura F. (Lepidoptera: Noctuidae) in Greenhouses by a Component of Its Sex Pheromone

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The sex pheromone of Spodoptera litura F. has been identified as a mixture of (Z,E)-9, 11-tetradecadienyl acetate (compound A) and (Z,E)-9, 12-tetradecadienyl acetate (compound B) by Tama-ki et al. (1973). The ratio of these components in the mixture was 9:1 when extracted from female abdominal tips. When a large quantity of either compound or the mixture in the ratio of 10:1 was evaporated, the mating of this species was strongly suppressed under field conditions (Yushima et al., 1975).

The present experiment was designed to investigate the effect of a single component of the sex pheromone on the mating of S. litura in greenhouses.

The experiment schedule for 1973–1976 and summarized results are shown in Table 1. In each experiment, a definite number of tethered females (Oyama, 1974) and the test compounds