TOXICITY OF IMIDACLOPRID TO SELECTED ARTHROPOD PREDATORS IN THE LABORATORY

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Imidacloprid, BAY NTN 33893, 1-[(Chloro-3-pyridinyl)methyl]-4,5-dihydro-N-nitro-1H-imidazol-2-amine, is an insecticide being developed worldwide by Bayer AG and in the U.S. by the Mobay Corporation (Anonymous 1990). This nitromethylene compound is a broad-spectrum, systemic insecticide which has shown activity against sucking insects such as Homoptera and some Coleoptera, Diptera and Lepidoptera. It also has shown excellent potential in seed and soil applications (Schmeer et al. 1990, Dewar & Read 1990). Imidacloprid has no known activity against phytophagous mites or nematodes (Elbert & Overbeck 1990). Mobay anticipates registration of imidacloprid on many commodities including vegetables, field crops, fruit, turf and ornamentals. Imidacloprid is a category 3 or 4 compound, depending upon formulation, and is relatively non-toxic to mammals (Elbert & Overbeck 1990).

The systemic properties of imidacloprid may be useful with respect to activity against pests and selectivity to beneficial species. However, control of many target pests will require foliar applications which may also affect beneficial arthropods. The objective of this study was to determine the toxicity of imidacloprid to selected beneficial arthropods commonly found in agroecosystems.

The 240 FS formulation (240 g ai/liter) of imidacloprid, obtained from Mobay Corporation, was used in the bioassays. Dilutions tested varied by predator response (Table 1), and 127.4 ppm active ingredient, the recommended concentration for foliar application, was used as the 1X rate.

Laboratory tests of the toxicity of imidacloprid residues to the following predatory species were conducted: adults of the mirid, Deracoris nebulosus (Uhler); larvae in the last instar and adults of the coccinellid, Olla v-nigrum (Mulsant); adults of the coccinellid, Hippodamia convergens (Guerrin-Meneville); adult females of the phytoseiid mites, Neoseiulus longae (De Leon), Phytoseiulus macropilis (Banks), and Propriostopis maculatus (Garman); eggs and adults of the chrysopid, Chrysoperla rufilabris (Burmeister) from a Georgia colony and adults from a Texas colony; and adults of the lygaeid, Geocoris punctipes (Say). Some of the predators were collected in the field; however, the predatory mites and C. rufilabris were obtained from laboratory cultures. The female mites were from a one-year-old colony and had been adults for approximately 5-10 days. The Georgia C. rufilabris were from a one-year-old colony and had been adults for 15-30 days when tested. C. rufilabris from Texas were from a 2- to 3-year-old colony and were approximately 5 days old when tested. Predators were provided water, a 1:1:1, honey:glycerin:water solution and/or wheat before and during the tests. All predators collected in the field were tested within 3 h of collection.

Tests were conducted by exposing the predators to plastic petri dishes or diet cups with lids (29.6 ml) dipped in solutions of water + imidacloprid + Triton X00 (0.1 ml/liter)
TABLE 1. Toxicity of imidacloprid to selected arthropod predators in the laboratory.

<table>
<thead>
<tr>
<th>Predator Species</th>
<th>N</th>
<th>Concentrations Tested(^1)</th>
<th>Control Mortality(%)</th>
<th>LC(_{50})</th>
<th>95% C.L.</th>
<th>Slope</th>
<th>S.E. Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deracoccianebulousus</td>
<td>350</td>
<td>0.0001-1, 5X</td>
<td>17.0</td>
<td>0.0163</td>
<td>0.001-0.0793</td>
<td>0.52</td>
<td>0.92</td>
</tr>
<tr>
<td>Olla v-vigrum (larva)</td>
<td>300</td>
<td>0.0001-1X</td>
<td>12.5</td>
<td>2.62</td>
<td>0.92-3.32</td>
<td>1.01</td>
<td>0.17</td>
</tr>
<tr>
<td>Olla v-vigrum (adult)</td>
<td>350</td>
<td>0.0001-1, 5X</td>
<td>4.0</td>
<td>3.07</td>
<td>0.45-4.4</td>
<td>0.69</td>
<td>0.93</td>
</tr>
<tr>
<td>Neoseiulus colesae</td>
<td>650</td>
<td>0.0001-1, 5, 10,</td>
<td>0</td>
<td>-(^\text{a})</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Phytoseiulus macropilis</td>
<td>400</td>
<td>0.0001-1, 5, 10,</td>
<td>5.3</td>
<td>3561.0</td>
<td>2778-4817</td>
<td>2.06</td>
<td>0.37</td>
</tr>
<tr>
<td>Proprioseiopsis oxacacans</td>
<td>200</td>
<td>0.01, 1, 10X</td>
<td>3.8</td>
<td>-(^\text{a})</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Chrysoperla rufilibriss (egg), Georgia</td>
<td>700</td>
<td>0.00001-1, 10X</td>
<td>10.6</td>
<td>20.2</td>
<td>9.7-31.9</td>
<td>1.3</td>
<td>0.28</td>
</tr>
<tr>
<td>Chrysoperla rufilibriss (adult), Georgia</td>
<td>400</td>
<td>0.00001-1, 2, 20X</td>
<td>9.6</td>
<td>190.0</td>
<td>102-367</td>
<td>1.04</td>
<td>0.14</td>
</tr>
<tr>
<td>Chrysoperla rufilibriss (adult), Texas</td>
<td>1130</td>
<td>0.01-1, 2, 3, 5, 10, 25, 50, 75, 100X</td>
<td>1.0</td>
<td>155.0</td>
<td>101-229</td>
<td>0.94</td>
<td>0.54</td>
</tr>
</tbody>
</table>

\(^{1}\)Concentrations tested are times the 1X rate of 127.44 ppm. Concentrations below 1X were done in log serial dilutions within the range specified.

\(^{a}\)Less than 5% mortality at 100X and LC\(_{50}\) was not developed.

\(^{a}\)Mortality observed did not differ from the control at concentrations tested.
for 10 sec and allowed to dry (Grafton-Cardwell & Hoy 1985). The dishes and cups were ventilated with holes in both the tops and bottoms and held for the duration of the bioassay under a hood with air flowing to prevent fumigation. The predators were held in the treated containers with water and food for 48-72 h and compared to an untreated control group held under similar conditions. Forty to 100 individuals in groups of 8-12 were tested at each concentration. The concentrations tested to estimate the LC$_{50}$ for each predator species (except G. punctipes and H. convergens) are provided in Table 1.

The POLO program (Russell et al. 1977) was used to estimate the LC$_{50}$ for each species. When it was not possible to collect enough insects to estimate an LC$_{50}$ (G. punctipes and H. convergens) or mortality was low at all concentrations tested (predatory mites), the percent mortality for the concentrations tested is presented.

Imidacloprid showed little toxicity to the three species of predatory mites at concentrations near the recommended field rate. However, at similar concentrations, imidacloprid was toxic to most of the insect predators tested (Table 1).

For adult Geocoris punctipes, we observed 7% control mortality, 84.2% mortality to 12.74 ppm and 84.6% mortality to 127.4 ppm. For adult H. convergens, we observed 0% control mortality while 73.3% mortality was observed to 127.4 ppm. Less than 4% mortality was observed for P. mexicanus adults to serial dilutions from 1.27-1274 ppm, and an LC$_{50}$ was not estimated.

The insect predator species tested represent four different families with widely different responses to other pesticides (Wilkinson et al. 1979, Mizell & Schiffauer 1990, Hassan et al. 1991). Imidacloprid represents new chemistry for an insecticide. It has little impact on predatory mites at the rates effective against phytophagous insects. However, as with most conventional insecticides, it will probably harm many beneficial insects if used as a foliar spray. Seed treatment or application as a systemic soil drench are methods that may allow growers to reduce the harmful effects to some biological control agents that may accompany foliar application of imidacloprid.

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REFERENCES CITED


FURIA CRUSTOSA, FUNGAL PATHOGEN OF FOREST TENT CATERPILLAR IN FLORIDA

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The forest tent caterpillar, Malacosoma disstria Hubner, can defoliate many tree species (Badger & Waters 1956, Futuyama & Wasserman 1981, Lorimer 1979). During spring 1987, epizootics were observed decimating forest tent caterpillars in Central Florida. Numerous cadavers were collected and the pathogen was identified as Furia crustosa MacLeod & Tyrell (1979). The purpose of this note is to report the first observed Florida occurrence of F. crustosa on the economically important M. disstria.

Cadavers were mounted within a few hours after collection and placed in humid chambers to induce the fungus to sporulate. Mycelium and sporulating structures were mounted in lactophenol-cotton blue for light microscopy. For scanning electron microscopy, pieces of diseased cadavers were fixed in 8% glutaraldehyde and critical point dried following the procedure of Samson et al. (1979).

Projected primary spores, mycelial fragments from the haemocoel and resting spores were transferred to various mycological media, including Sabouraud, soil extract and malt extract agars with additional antibiotics. In spite of numerous attempts and up to 10 days of observation, the fungus did not grow on the artificial media tested. Dried specimens are deposited at the Herbarium of the Centraalbureau voor Schimmelcultures (CBS).

Percent disease estimates were made by rapidly counting diseased and healthy larvae from 1-5 feet on three trees separated by 100 ft in each infestation.