A laboratory evaluation of the toxicity of four insecticides to a predacious mite found in Quebec vineyards and apple orchards

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A cosmopolitan predator feeding on many arthropod pests found on agricultural crops grown from temperate to sub-tropical regions. In Canada, it was first reported feeding on Panonychus ulmi (Koch) on peach trees in southern Ontario.1 Around Moscow, Russia, it was the most common predacious species feeding on phytophagous mites on blackcurrants.2 In northern Ireland, it was reported to be feeding on rust mite.3 On grapes, in Pennsylvania, Jubb et al.4 reported it feeding on leafhoppers. In French vineyards, the principal predacious feeding on phytophagous mites and other pests such as leafhoppers (Bostanian N.J., unpublished). Little is known of the toxicity of pesticides to AB. Bushkovskaya carried out laboratory studies and reported carbyl and dimethoate to be very toxic.5 A devastating impact on AB was also noted when multiple applications of azinphosmethyl, phosmet, chlorfenvinphos or a single application of cypermethrin was applied to kiwi trees in New Zealand.6 Field studies showed that multiple applications of mancozeb and captan/pentaconazole used to control scab in apples had a detrimental impact to AB.7

In this study we report the toxicity of azinphos-methyl, carbyl, imidacloprid, and thiamethoxam to AB collected from commercial Quebec vineyards.

Materials & Methods

Field collection

Specimens were collected on grapevines in an untreated vineyard in Durham, Quebec. The collection was made by gently tapping a vine leaf or a fruit cluster with an Anystis into a 30 ml Solo8 (Urbana, Illinois USA) plastic cup. The cups were placed in a cooler and brought to the laboratory within an hour following the termination of the collection.

Toxicological tests

Mites were exposed to a pesticide residue in plastic Petri dishes. The dishes were treated before the introduction of the mites. A thin coat of the test insecticides were applied to the interior of the Petri dishes, the side walls and the covers. A thin-layer chromatography sprayer set at 10.34 kPa was used to apply the insecticides. At that pressure the amount of insecticide residue on the Petri dish was 2.00 mg/m². The cages were stored in glass chambers set at 25°C and 70% RH for a period of two hours for drying. Only one specimen was introduced into the treated cages from the Solo cups to eliminate cannibalism among the treated specimens. The cages with the treated AB were stored in a growth chamber set at 25°C, 70% relative humidity and 16:8 light-dark photoperiod. The control was treated with tap water and mortality counts were made 24 hours after treatment. Whenever percent mortality was calculated according to Abbott.9 Specimens were considered dead when they were unable to move a distance equivalent to their own width when the cage was shaken. The following insecticides were evaluated: azinphos-methyl (Guthion® 50WP), carbaryl (Sevin® XLR), imidacloprid (Admire® 240FS), and thiamethoxam (Actara® 25WG). All four insecticides were provided by courtesy of Bayer Crop Science AB.

Field collection

Insecticides were used to estimate the LC50 of one organophosphate, one carbamate, and two neonicotinoids to Anystis baccaum collected at Durham, QC.

Table 1. Insecticide concentrations used to estimate the LC50 of one organophosphate, one carbamate, and two neonicotinoids to Anystis baccaum collected at Durham, QC.

<table>
<thead>
<tr>
<th>Insecticide designation</th>
<th>Rate used in orchard (g. A.I. litre⁻¹)</th>
<th>Percent mortality (%)</th>
<th>Range of concentration (g. A.I. litre⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azinphos-methyl</td>
<td>2.000</td>
<td>100</td>
<td>0.0078-0.0029</td>
</tr>
<tr>
<td>Carbaryl</td>
<td>1.325</td>
<td>100</td>
<td>0.0026-0.0013</td>
</tr>
<tr>
<td>Imidacloprid</td>
<td>1.169</td>
<td>0</td>
<td>0.0017-0.0005</td>
</tr>
<tr>
<td>Thiamethoxam</td>
<td>1.178</td>
<td>33</td>
<td>0.0009-0.0002</td>
</tr>
</tbody>
</table>

Table 2. Relative toxicity of two anticholinesterases to Anystis baccaum collected at Durham, QC.

<table>
<thead>
<tr>
<th>Insecticide designation</th>
<th>Slope (t50E)</th>
<th>LC50 (CI 95%) (g. A.I. litre⁻¹)</th>
<th>t²</th>
<th>g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azinphos-methyl</td>
<td>3.732 (0.471)</td>
<td>0.0176 (0.0014-0.0019)</td>
<td>3</td>
<td>0.002</td>
</tr>
<tr>
<td>Carbaryl</td>
<td>6.226 (1.012)</td>
<td>0.0117 (0.0010-0.0014)</td>
<td>5</td>
<td>0.094</td>
</tr>
</tbody>
</table>

References


Acknowledgements

The authors thank Bayer Crop Science and Syngenta Crop Protection for kindly providing the insecticides. Gaétan Racette and the team of 12 students are also thanked for their efforts to collect timely hundreds of specimens and participating in the bio-assays.