It is now widely recognised that beneficial arthropods can play a very important role in the management of insect and mite pests of orchards and vineyards. Growers have become increasingly aware of the benefits of natural enemies of pest species and the assistance they can provide in reducing the overall cost of managing these pests. Many growers have adopted integrated pest management (IPM) programs, allowing them to move away from the use of broad-spectrum insecticides, which often have an adverse affect on predatory and parasitic insects and mites. One example of this is the introduction of the small black parasitic wasp Aphelinus mali, which has assisted in the management of woolly aphid in Australian apple orchards. Perhaps the best example of a successful IPM strategy in pome fruit has been the marked reduction in mite sprays required to control two spotted mite (TSM) and European red mites (ERM) in orchards. The introduction of predatory mites Typhlodromus pyri, Galendromus occidentalis (formerly T. occidentalis) and Phytoseiulus persimilis, and their preservation by the judicious use of pesticides that have minimum impact on their populations has been the driving force behind this success. There has also been much evidence that the predatory mites Euseius victoriensis (formerly Amblyseius victoriensis) and Typhlodromus doreenae play a similar role in assisting to manage rust mite and bud mites in grape vines (James and Rayner, 1994; James and Whitney, 1994; Bernard, Braybrook, Hurst, Hoffman and Glenn 2000). In the citrus industry a wide range of biological control agents are playing an important role in the management of scale and mealybug insect pests. Examples of this are the Aphytis wasps (Aphytis lingnanensis and A. melinus) for red scale, Cryptolaemus beetle (Cryptolaemus montrouzieri) for citrus mealybug and blue and red chilocorus ladybirds (Chilocorus baileyi and C. circumdatus) for various scale insect pests. In bananas, Stethorus beetles are an important predator of two spotted mite. Many of these beneficial insects and mites will occur naturally in orchards and vineyards while others may require regular introduction to maintain populations at levels that will allow integrated pest management to function. There is now a good network of commercial suppliers, (members of the Australasian Biological Control Association) of biological control organisms in Australia and New Zealand.
Measuring the Suitability of Fungicides for IPM in Orchards and Vineyards

Although the affects of most fungicides are usually less dramatic and slower than the affect of broad spectrum insecticides, they can nevertheless have a major negative impact on some of the beneficial species in orchards and vineyards. When measuring the affect of fungicides on predatory mites it has been shown that it is important to measure sublethal effects as well as acute toxicity. Measurement of the affect on the egg laying capacity of females has been shown to be very important in some cases (Bernard et al 2000). Two groups of fungicides that have been shown to have a negative impact on some predatory mites are the benzimidazoles (examples are benomyl and carbendazim) and dithiocarbamates (examples are mancozeb and metiram). However there are also differences within these broad groups of fungicides. In order to provide growers and advisers with some useful information to assist in making decisions about selection of fungicides that are suitable for use in Integrated Pest Management, Crop Care has conducted a review of available literature. Information obtained from this review is summarised in the table on the last page of this Technote. For each (or group of) beneficial insect or mite one of 4 ratings has been provided for each of Crop Care’s horticultural fungicides. Ratings have also been included for mancozeb and metiram. The ratings are as follows:

- **Little or no effect:** Products that can be used repeatedly without impact on the population.
- **Moderately harmful:** Products that have a damaging effect when used repeatedly through the season. Populations will generally recover provided applications cease.
- **Very harmful:** Products that have major negative effect on the population after only 1 or 2 applications. Populations will generally not recover during the current season. Reintroduction will be required.
- **Unknown:** No information is available on the interaction between the product and the insect/mite.

The methods used for testing toxicity of fungicides to beneficial insects and mites varied between the studies cited. In some cases, short term acute testing of fungicides will not provide a good indication of a products affect on a population of beneficial insects or mites. Products such as mancozeb and metiram have been shown to cause sterility of predatory mites and so the affect on populations will not be immediately obvious, although the medium term affect will be very damaging. Information in the table generally provides ratings based on a range of sources, which are referenced below the table. Where only one reference is provided the information may be regarded as less rigorous.
### Suitability of Crop Care’s Fungicides for IPM in Orchards and Vineyards

<table>
<thead>
<tr>
<th>Predator or Parasite</th>
<th>Pest</th>
<th>Crop</th>
<th>Captan</th>
<th>Delan</th>
<th>Barrack</th>
<th>Bavistin</th>
<th>Stroby</th>
<th>Ziragranz</th>
<th>Thiragranz</th>
<th>Nimrod</th>
<th>Sulphur</th>
<th>Cuprofix</th>
<th>Mancozeb</th>
<th>Metiram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typhlodromus pyri</td>
<td>TSM ERM</td>
<td>Fruit</td>
<td>2,5,10</td>
<td>10</td>
<td>8</td>
<td>10</td>
<td>8</td>
<td>10</td>
<td>3,9,10</td>
<td>10</td>
<td>1,2,5,8,10</td>
<td>1,2,5,8,10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Galendromus occidentalis</td>
<td>TSM ERM</td>
<td>Fruit</td>
<td>6,7,10</td>
<td>6,7,10</td>
<td>8</td>
<td>6,7</td>
<td>8</td>
<td>10</td>
<td>3,9,10</td>
<td>12</td>
<td>10</td>
<td>6,7,10</td>
<td>6,7,10</td>
<td></td>
</tr>
<tr>
<td>Phytoseiulus persimilis</td>
<td>TSM ERM</td>
<td>Fruit</td>
<td>6,7,10</td>
<td>6,7,10</td>
<td>12</td>
<td>12</td>
<td>6,7</td>
<td>8,10</td>
<td>10,12</td>
<td>3,9,10</td>
<td>12</td>
<td>10</td>
<td>6,7,8,10</td>
<td>6,7,8,10</td>
</tr>
<tr>
<td>Stethorus spp.</td>
<td>TSM ERM</td>
<td>Fruit</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3,9</td>
<td></td>
</tr>
<tr>
<td>Euseius victoriensis</td>
<td>Rust mite + bud mite</td>
<td>Grapes</td>
<td>6,7,12</td>
<td>4,6,7,12</td>
<td>4,7,11</td>
<td>11</td>
<td>6,7</td>
<td>11,12</td>
<td>11</td>
<td>7,11,12</td>
<td>4,8,7,8,11,12</td>
<td>6,7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typhlodromus doarenea</td>
<td>Rust mite + bud mite</td>
<td>Grapes</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
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<td></td>
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<tr>
<td>Ladybirds</td>
<td>Mealybug + Aphids</td>
<td>Various</td>
<td>3</td>
<td>7</td>
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<td></td>
<td>7</td>
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<tr>
<td>Lacewings</td>
<td>Aphids, Caterpillars, TSM</td>
<td>Various</td>
<td>3</td>
<td>3</td>
<td>12</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Parasitic wasps</td>
<td>Aphids + Caterpillars</td>
<td>Various</td>
<td>3,12</td>
<td>12</td>
<td>12</td>
<td>12*</td>
<td>12</td>
<td>3,9</td>
<td>12*</td>
<td>12*</td>
<td>12*</td>
<td>12*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Dependent on species of parasitic wasp.

As indicated in the table, Crop Care has a good range of horticultural fungicides that have little or no negative impact on most of the important beneficial insects and mites that are present or available for introduction in orchards and vineyards. Products that belong in this group for the different cropping segments are as follows:

**Pomefruit:** Captan WG, Delan® 750W, Stroby® WG and Nimrod®

**Stonefruit and Grapevines:** Captan WG, Barrack® 720, Delan® 750W, Cuprofix® Dispers® and Ziragranz.

**Citrus:** Cuprofix® Dispers®

Depending on the relevant beneficial insect or mite, caution is required when using Bavistin®, Thiragranz and our wettable sulphur products, Kumulus®, Top Wettable® and SulfoStar®.

References cited:

10. NZ Pomefruit Industry Advice.