Root and Tuber

A guide to pesticide effects on beneficials

2020

About this guide

This guide provides information on the effects of pesticides on key beneficial insects and mites that are important in root and tuber crops. The results presented in the guide below have been compiled from several sources which include scientific literature, international pesticide data bases, the results of testing that has been conducted for project VG16067 'Impact of pesticides on beneficial arthropods of importance in Australian vegetable production' and field observations. The intended use of this guide is to provide growers and agronomists with a better understanding of how best to use pesticides in an IPM program to maximize the impact of beneficial species.

The products included were selected because they are currently registered (in 2019) for use in root and tuber crops and because of their potential to be incorporated into IPM programs. Some products that are not considered to be IPM compatible have also been included as a comparison of relative toxicity.

About the testing

The information in this guide is based on the results of laboratory-based tests and not field tests. Laboratory tests are designed to be the worst-case scenario. In these tests the product is applied at the highest label rate to the most vulnerable life stage. This means that products with low toxicity are most likely to be very safe when applied to a crop and products that show medium to high toxicity have the potential to disrupt beneficial species. How disruptive a product is will depend on the frequency of use, application rate, the age of the crop, how well established the beneficials are at the time of application and if the crop is grown in the field or in a glasshouse.

Acute and sublethal testing.

We used two levels of testing and the first is acute which aims to measure the impact of direct exposure to the product. In these tests beneficial species were exposed to the product for 24 or 48 hours and then the level of mortality was assessed. If mortality was less than 30%, they were then tested for sublethal effects. For the development of this guide sublethal tests were designed to answer two questions 1. For predators only - do the juveniles that survive the acute test develop into adults? 2. For predators and parasites – are adults that have been exposed to the product able to reproduce? The results of sub-lethal testing are only shown in this guide if the results differ from the acute toxicity. A blue triangle ▼ indicates that the results are a combination of both acute and sub-lethal. A white triangle ▽ means acute results only.

*The protocols for testing and the references for results that were not developed as part of this project are available in a separate document.

Table 1: Codes for beneficial species used in the guide

code		code		code	
D	**Diadegma** *(Diadegma semiclausum)* DBM parasite	B	**Brown lacewing** *(Micromus tasmaniae).* Aphid predator	N	**Damsel bug** *(Nabis kinbergii)* Caterpillar predator
A	**Aphidius** *(Aphidius colemani)* Aphid parasite	L	**Ladybird** *(Hippodamia variegata)* Aphid predator	E	**Encarsia** *(Encarsia formosa)* Whitefly parasite

About the beneficial species

The beneficials tested are species that are naturally occurring and commercially available and are considered important for IPM in root and tuber crops. For the acute tests the juvenile stage of the predatory species was used and for the parasitoids the adult wasps were used.

How to interpret this guide

The relative toxicity for each species is indicated on a scale from 0% to 100% mortality as shown in the example below.

This example shows that Spirotetramat (Movento) is safe to ladybirds (**L**) Encarsia (**E**) Diadegma (**D**) brown lacewing larvae (**B**) and Aphidius (**A**) but is harmful to predatory mites Persimilis (**P**).

Active/Trade name	**L**-ladybird, **D**-Diadegma, **B**-Brown lacewing, **E**- Encarsia, **A**-Aphidius, **P**-Persimilis **Mortality** **0%** Harmless **30%** Slightly harmful **80%** harmful **100%**	**Chem. Group**
Spirotetramat /Movento		23

When deciding to use this product things to consider are:

- How many other products have been used on the crop and what impact did they have on predatory mites?
- Will two-spotted mite flare if predatory mites are disrupted? And if so, can the flare be managed?
- Will there be an economic loss if this product is not applied?
- Is there another product that that could be used that is less disruptive?

Pesticides and IPM

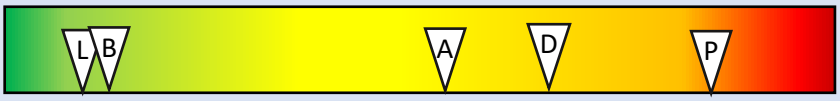
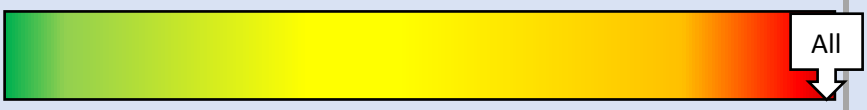
The results presented here are based on worse-case scenario laboratory testing. In the field it is likely that the effects will be less toxic for some of the products shown in this guide. However, the impact of pesticides on beneficial species is cumulative which means that the impact is the combined effects of all pesticides used. This is particularly relevant for growers wanting to maintain healthy populations of beneficial species on their farms and for growers investing in commercially available biological control.

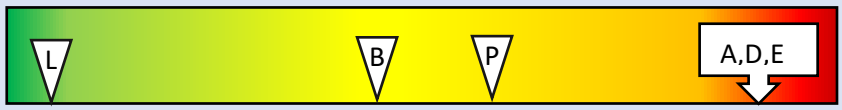
The guide for Root and Tuber vegetables

The information presented in the guide below is intended to be used as a support tool for IPM decision making and not to be interpreted as a list of “good and bad” or “safe and not safe” products.

*Information is currently not available for all the beneficial species listed in this guide which is why some of the products only show results for a few species.

Pesticides in order by active ingredient

Active/Trade name	**L**-ladybird, **D**-Diadegma, **B**-Brown lacewing, **E**- Encarsia, **A**-Aphidius, **P**-Persimilis ▽ Acute results only ▽ Acute and sub-lethal results **Mortality** **0%** Harmless **30%** Slightly harmful **80%** harmful **100%**	**Chem. Group**
Abamectin /Vertimec		6
Bacillus thuringiensis /Dipel and Xentari		11A
Chlorantraniliprole /Coragen		28
Chlorpyrifos /Lorsban		1B
Emmamectin Benzoate /Proclaim		6A
Fipronil /Regent		2B
Flubendiamide /Belt		28
Imidaclopoprid /Confidor		4A

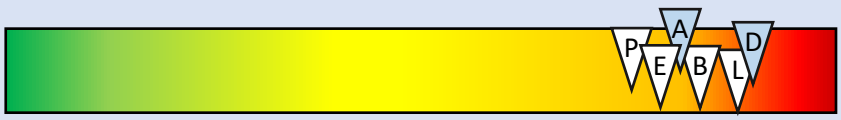
Pirimicarb /Pirimor		1A
Pyriproxifen /Admiral Advance		1A
Spinetoram /Success Neo		5
Spirotetramat /Movento		23
Sulfoxaflor /Transform		4C

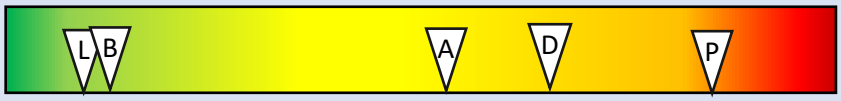
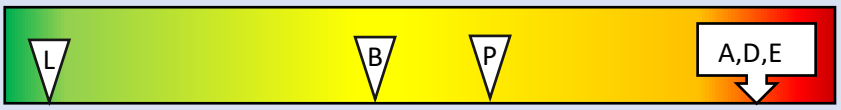
Fungicides in order by active ingredient

Active/trade name	**L**-ladybird, **G**-Green lacewing, **O**-Orius, **T**- Trichogramma, **A**-Aphidius, **C**-Californicus **P**-Persimilis Acute results only / Acute and sub-lethal results **Mortality** **0%** Harmless **30%** Slightly harmful **80%** harmful **100%**	**Chem. Group**
Azoxystrobin /Amistar		11
Boscalid /Filan		7
Chlorothalonil		M5
Mancozeb		M3
Metalaxyl /Ridomil Gold		4

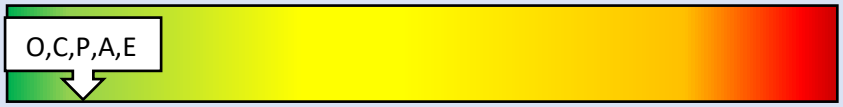
Penthiopyrad /Fontelis		7
Triadimenol /Bayfidan		3

Pesticides in order by trade name

Trade name /Active	**L**-ladybird, **D**-Diadegma, **B**-Brown lacewing, **E**- Encarsia, **A**-Aphidius, **P**-Persimilis Acute results only Acute and sub-lethal results **Mortality** **0%** Harmless **30%** Slightly harmful **80%** harmful **100%**	**Chem. Group**
Admiral Advance /Pyriproxifen		1A
Belt /Flubendiamide		28
Confidor /Imidaclopropid		4A
Coragen /Chlorantraniliprole		28
Dipel and **Xentari** /Bacillus thuringiensis		11A
Lorsban /Chlorpyrifos		1B
Movento /Spirotetramat		23
Pirimor /Pirimicarb		1A

Proclaim /Emmamectin Benzoate		6A
Regent /Fipronil		2B
Success Neo /Spinetoram		5
Success Neo /Sulfoxaflor		4C
Vertimec /Abamectin		6

Fungicides in order by Trade name

Trade name /Active	**L**-ladybird, **G**-Green lacewing, **O**-Orius, **T**- Trichogramma, **A**-Aphidius, **C**-Californicus **P**-Persimilis Acute results only — Acute and sub-lethal results **Mortality** **0%** Harmless **30%** Slightly harmful **80%** harmful **100%**	**Chem. Group**
Amistar /Azoxystrobin		11
Bayfidan /Triadimenol		3
Chlorothalonil		M5
Filan /Boscalid		7
Fontelis /Penthiopyrad		7

Mancozeb		M3
Ridomil Gold /Metalaxyl		4

Project acknowledgement: This project has been funded by Hort Innovation, using the Vegetable research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

Horticulture Innovation Australia Limited (Hort Innovation) makes no representations and expressly disclaims all warranties (to the extent permitted by law) about the accuracy, completeness, or currency of information in *VG16067 Impact of pesticides on beneficial arthropods of importance in Australian vegetable production.* Reliance on any information provided by Hort Innovation is entirely at your own risk. Hort Innovation is not responsible for, and will not be liable for, any loss, damage, claim, expense, cost (including legal costs) or other liability arising in any way, including from any Hort Innovation or other person's negligence or otherwise from your use or non-use of *VG16067 Impact of pesticides on beneficial arthropods of importance in Australian vegetable production*, or from reliance on information contained in the material or that Hort Innovation provides to you by any other means.

Copyright © Horticulture Innovation Australia Limited 2019
Copyright subsists in *Root and Tuber vegetables- A guide to pesticide effects on beneficials 2019*
Horticulture Innovation Australia Limited (Hort Innovation) owns the copyright, other than as permitted under the Copyright ACT 1968 (Cth). *Root and Tuber vegetables -A guide to pesticide effects on beneficials 2019* (in part or as a whole) cannot be reproduced, published, communicated or adapted without the prior written consent of Hort Innovation. Any request or enquiry to use the *Root and Tuber vegetables - A guide to pesticide effects on beneficials 2019* should be addressed to
Communications Manager
Hort Innovation
Level 7, 141 Walker Street
North Sydney NSW 2060
Australia
Email: communications@horticulture.com.au
Phone: 02 8295 2300