Beneficials Chemical Toxicity Table - Impact of insecticides on beneficial insects in Australian grain crops

Beneficial insects play an important role in keeping pests in check. Supporting local populations of beneficials is a cornerstone of Integrated Pest Management (IPM) and is increasingly being adopted by leading farmers aiming to reduce pest pressure in the long term.

However, insecticides and miticides can harm beneficial insect populations. This disruption may reduce the natural control they provide, making some pest problems more difficult and costly to manage.

The Beneficials Chemical Toxicity Table (Table 1) helps grain growers and advisors make informed choices about insecticide use. It summarises the toxicity of foliar chemical sprays on key beneficials relevant to the Australian grains industry.

How to Read the Table

Toxicity ratings are based on protocols for laboratory studies published by the International Organisation for Biological Control (IOBC). Ratings reflect the percentage mortality of insects within a particular group of beneficials exposed to each chemical.

- Low (L): < 30% mortality
- Moderate (M): 30-79%
- High (H): 80-99%
- Very High (VH): > 99% mortality.

Cells with a diagonal slash indicate variable results among beneficial species or chemicals within a group. This may occur when different species within a beneficial group respond differently to the same chemical, or when chemicals within a Mode of Action group have varying effects. In these cases, consider this variability when interpreting potential impacts.

How to Use the Table

Use this table to support spray decisions that help preserve beneficial insect populations.

- Select insecticides with the lowest toxicity to the beneficial species that are important in your system.
- Compare chemical options to identify those that are both effective against the target pest and cause the least overall harm to beneficials.

Data Sources

Cesar Australia conducted independent laboratory assessments and compiled this data with existing research to produce this table. These values represent mortality under controlled laboratory conditions – impacts may vary in the field, especially with repeated applications of a chemical.

In addition to predators and parasitoids, the table includes honey bee toxicity data from publicly available studies conducted under OECD laboratory protocols. Note: this data should be interpreted separately from the main beneficials ratings.

For further details about the underlying toxicity data, contact Cesar Australia at info@cesaraustralia.com.

This work represents a collaboration between Cesar Australia and the University of Melbourne, with investment from the Grains Research and Development Corporation.

Table 1: Beneficials Chemical Toxicity Table

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Active ingredient	Mode of Action 1	Toxicity to honey bees 2	Rate (g ai/ha) 3	Aphid parasitoids 4	Egg parasitoids 5	Lepidopteran larval parasitoids 6	Predatory bugs 7	Ladybird beetles 8	Predatory mites 9	Lacewings 10	Hoverflies 11	Spiders 12	Rove beetles 13
Nucleopolyhedrovirus 14	31		100	L	L	L	L	L	L	L	L	L	L
Bacillus thuringiensis 14	11A		3286	L	L	L	L	L	L	L	M	L	L
Chlorantraniliprole	28		24.5	L	L	M	L	L	L	L	L	L	L
Flonicamid	29		50	L	M	L	L	L	L	L	L	L	L
Afidopyropen	9D		5	L	L	L	L	L-M	L-M	L	L	L	L
Paraffinic oil	-		1584	L-VH	L	L	L-M	M	L	L	L	L	L
Cyantraniliprole	28		15	M-H	L-M	M	M	M	L	L	L	L	L
Pirimicarb Low 15	1A		75	M-VH	VH	L	L	L	L-M	L	L	L	L
Indoxacarb	22A		60	L-VH	L	VH	L	M-H	L	L	L	L	L
Emamectin benzoate	6		5.1	M-H	VH	VH	M	L	M	L	L	L	L
Primicarb High 15	1A		500	M-VH	VH	M	M	L-M	M	L	L	M	L
Abamectin	6		5.4	M-H	VH	L	M	M	M	M	H	L	L
Sulfoxaflor	4C		50	H-VH	VH	VH	VH	L	L	L	L	L	L
Spinetoram	5		36	H-VH	H	VH	M	M	L-H	M	M	L	L
Gamma-cyhalothrin 16	3A		4.5	L-M	VH	VH	VH	VH	L-VH	VH	L	L	L
Diafenthiuron	12A		300	M-VH	L	VH	VH	M-VH	M-VH	L	L	L	L
Thiodicarb	1A		281.25	M-VH	VH	M	M	H-VH	H	L	VH	L	M
Synthetic Pyrethroids (excl. Gamma-cyhalothrin) 17	3A		Variable	L-VH	VH	VH	VH	VH	L-VH	VH	H	VH	M
Methomyl	1A		450	VH	VH	M	H	VH	VH	VH	H	VH	VH
Organophosphates 18	1B		Variable	VH	VH	VH	VH	VH	VH	M-VH	H-VH	H	VH

Mortality							
L	<30%	M	30-79%	H	80-99%	VH	>99%

Toxicity to honey bees 19					
	Low		Moderate		High

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Footnotes

1 The Mode of Action of each active ingredient follows the Insecticide Resistance Action Committee classification (https://irac-online.org/modes-of-action/).

2 Data for honey bees (*Apis* spp.) based on studies conducted under OECD laboratory protocols, and sourced from the Pesticide Properties DataBase (https://sitem.herts.ac.uk/aeru/ppdb/) and Biopesticides DataBase (https://sitem.herts.ac.uk/aeru/bpdb/). Toxicity values reflect the worst-case LD_{50} (µg a.i./adult honey bee) at 24, 48, and 72 hours. Data for omethoate and nucleopolyhedrovirus are oral acute LD_{50} values; for all other active ingredients, data are contact acute LD_{50} values. Data sourced: July 2025.

3 Active Ingredients were typically tested at their Maximum Registered Field Rates (MRFR) per hectare in Australian grain crops. Data from previous research trials were included if those studies tested rates within 35% of the MRFR.

4 Data based on *Aphelinus abdominalis, Aphidius colemani* and *Diaeretiella rapae*.

5 Data based on *Trichogramma pretiosum* and *Telenomus remus* (international species).

6 Data based on *Diadegma semiclausum* and *Microplitis croceipes* (international species).

7 Data based on *Nabis kinbergii*, *Orius insidiosus* (international species), *Orius laevigatus* (international species), *Orius tantillus* and *Pristhesancus plagipennis*.

8 Data based on *Adalia bipunctata, Coccinella septempunctata, Coccinella transversalis*, *Harmonia axyridis, Harmonia conformis, Hippodamia convergens* (international species) and *Hippodamia variegata*.

9 Data based on *Hypoaspis aculeifer*, *Odontoscirus lapidaria, Phytoseiulus persimilis, Typhlodromus montdorensis* and *Typhlodromus pyri*.

10 Data based on *Mallada signatus* and *Micromus tasmaniae*.

11 Data based on *Melangyna* spp.

12 Data based on *Venatrix* spp and *Theridion impressum* (international species).

13 Data based on *Dalotia coriaria*.

14 Rates listed for biologicals are the amount of product per hectare rather than amount of active ingredient. The listed rate for nucleopolyhedrovirus is applicable to Vivus Armigen™ (mL) and the listed rate for *Bacillus thuringiensis* is applicable to Dipel™ (g). Rates for other products may vary.

15 Pirimicarb is shown at two rates due to its variation in application rates in Australian grain crops.

16 Gamma-cyhalothrin is listed separately to other synthetic pyrethroids due to lower mortality rates for some beneficial insects compared to other active ingredients in this Mode of Action group.

17 Synthetic pyrethroids included here are alpha-cypermethrin, bifenthrin, cypermethrin and lambda-cyhalothrin.

18 Organophosphates included here are chlorpyrifos, dimethoate, omethoate and phosmet.

19 Classifications based on UK guidelines, whereby: LD_{50} > 100 µg a.i./bee = Low; LD_{50} = 1-100 µg a.i./bee = Moderate; and LD_{50} < 1 µg a.i./bee = High. For guidance on how to minimise the impact of pesticides on honey bees, visit BeeAware: https://beeaware.org.au/pollination/pollination-and-pesticides/.

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