

# Almond IPM: Impact of pesticides and fungicides on beneficial species

## INTRODUCTION

Almond production in Australia has traditionally featured a low level of pesticide use. This began to change around the 2012-2014 harvest seasons when carob moth and carpophilus beetle became serious pests, causing high levels of kernel damage. Since then, broadscale insecticide use has increased significantly in the absence of effective alternative management options for these major pests.

There is now a greater need for almond producers to be vigilant for undesirable consequences of pesticide use, namely the suppression of biological control agents (predators and parasites), which may lead to upsurges in what are usually considered minor pests. Pest mites in particular, often increase in response to the impact of broad-spectrum pesticides on their natural enemies.

The range of chemicals available for management of pests and diseases in almonds is growing, through direct registration or by emergency or minor-use permits. Globally, many of these chemicals have been assessed to some degree and rated for their impact on selections of agriculturally beneficial species such as parasites and predators of crop pests. This data may be used by producers who want to be more strategic in their selection of chemicals, by choosing options with lower off-target impacts. This is particularly important for producers who aim to develop integrated pest management programs on their farms, with potentially greater reliance on biological control options for management of their key pests.

The following table is a compilation of data from numerous sources that have rated chemicals for their effect on predatory mites, beetles, lacewings and bugs; and parasitic wasps and nematodes. Not all toxicity studies have been conducted on the exact species of beneficial organism found in almond orchards in Australia. However, where they are conducted on related species or functionally similar broad groups (e.g. predatory beetles or predatory bugs), the ratings provide a guide to the impact we can expect when the chemical is applied to agricultural systems including almond orchards.

### References for data in Table 1.

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Table 1. Ratings for off-target impacts of chemicals registered or permitted for use in almonds.

Active ingredient	Predatory mites	Predatory beetles	Lacewings	Parasitic wasps	Trichogramma spp.	Predatory bugs	Entomo-pathogenic nematodes	References
<b>INSECTICIDE</b>								
CHLORANTRANILIPROLE	Non-toxic	Harmful	Non-toxic	Slightly harmful	Non-toxic	Non-toxic	No data	1, 2, 4, 13
CLOTHIANIDIN	Moderately harmful	Slightly harmful to harmful	Harmful	Harmful	Harmful	Moderately toxic	No data	4
LIQUID PARAFFIN (HEAVY)	Harmless to harmful	Slightly harmful	Slightly harmful	Harmless	Harmless	Toxic	No data	4, 14
METHOXYFENOSIDIDE	Low toxicity	Low toxicity	Low toxicity	Low toxicity	Harmful		Low toxicity	4, 11, 12
PARAFINIC OIL							No data	4
PETROLEUM OIL	Low to Moderate toxicity	Low toxicity	Low toxicity	Low to moderate toxicity	Low to moderate toxicity		Low toxicity	4, 12
PIRIMICARB	Low to Moderate toxicity	Low toxicity	Low toxicity	Low to moderate toxicity	Toxic	Slightly toxic	No data	11, 12
PYMETROZINE	Low toxicity	Low toxicity	Low toxicity	Low to moderate toxicity	Low to moderate toxicity	Slightly toxic	No data	11, 12
SULFOXYFLOR	Harmless	Non-toxic	Non-toxic to slightly toxic	Harmless to harmful		Moderately toxic	No data	4, 6
<b>INSECTICIDE/MITICIDE</b>								
BIFENTHRIN	Toxic	Toxic	Toxic	Toxic	Toxic	Toxic	Low toxicity	11, 12
<b>MITICIDE</b>								
ABAMECTIN	Toxic	Slightly to moderately toxic	Toxic	Toxic	Toxic	Toxic	Low toxicity	11, 12
BIFENAZATE	Non-toxic to toxic	Non-toxic to larvae	Non-toxic	Non-toxic	Non-toxic	Non-toxic	No data	11
CLOFENTHIZINE	Non-toxic	Non-toxic	Non-toxic	Non-toxic	Non-toxic	Non-toxic	No data	11
ETOXAZOLE	Toxic to juveniles, slightly-moderately toxic to adults		Toxic to larvae		Low toxicity		Harmless to harmful	No data
<b>FUNGICIDE</b>								
AZOXYSTROBIN	Non-toxic	Non-toxic	Non-toxic	Non to low toxicity	Non-toxic	Non-toxic	Non-toxic	9, 11
TEBUCONAZOLE	Non-toxic	Non-toxic	Non-toxic	Non to slightly toxic	Moderately toxic (adults)	Non-toxic	Non-toxic	11, 15
CAPTAN	Non to slightly toxic	Non to low toxicity	Non to low toxicity	Non to low toxicity	Non-toxic	Non-toxic	Non-toxic	3, 11
CHLOROTHALONIL	Non to slightly toxic	Non-toxic	Non-toxic	Non to slightly toxic	Non-toxic	Non-toxic	Non-toxic	13
COPPER (TRIBASIC COPPER SULPHATE)	Harmless to slightly harmful	Harmless to slightly harmful	Moderately harmful	Harmless to moderately harmful	Harmless			4
COPPER (COPPER HYDROXIDE)	Low to high toxicity #							4, 5
COPPER (COPPER OXYCHLORIDE)	Non to moderately toxic	Slightly toxic	Slightly toxic	Non to moderately toxic	Non-toxic	Non-toxic	Non-toxic	11
COPPER (CUPROUS OXIDE)								11
CYPRODINIL	Slightly toxic a	Harmless to harmful	Harmless to slightly harmful	Non-toxic	Non-toxic	Non-toxic	Non-toxic	10
FLUOPYRAM   TRIFLOXYSTROBIN	Harmless-harmful	Harmless to moderately harmful	Harmless to slightly harmful	Harmless to harmful	Harmless to harmful	Harmless to harmful	Harmless to harmful	4, 11
IPRODIONE	Non-toxic	Non-toxic	Non-toxic	Non-toxic	Non-toxic	Non-toxic	Non-toxic	4, 11
MANCOZEB	Non-toxic to toxic	Slightly toxic	Slightly toxic	Non-toxic	Non-toxic	Moderately toxic	Non-toxic	11
PENTHIOPRAD	Non-toxic to toxic	Slightly toxic	Slightly toxic	Non-toxic	Non-toxic	Moderately toxic	Non-toxic	11
PROPICONAZOLE	Non-toxic	Slightly toxic	Non-toxic	Non-toxic	Non-toxic	Moderately toxic	Non-toxic	11
PYRACLOSTRBIN	Harmless to moderately harmful							4, 11
SULFUR (POLYSULFIDE SULFUR)	*		*					7

Key to toxicity ratings:

Blank cell = no data  
 Nil or low impact on beneficial insects OR < 25% mortality  
 Slightly toxic/Harmful  
 25- 50% mortality

Moderate toxicity/Moderately toxic/Moderately harmful  
 Beneficial activity significantly reduced but can recover in a week or so OR 50-75% mortality  
 High toxicity/Toxic/Harmful  
 A high proportion of the beneficial population is killed and re-establishment will not be possible for several weeks OR >75% mortality

Some toxicity ratings vary from harmless-harmful due to inconsistencies in experimental design or variation in toxicity among species within the same group.  
 \* Reduced population growth with increased concentrations # *Amblyseius cucumeris* ^ *Phytoseiulus persimilis*

Table 2. Chemicals for which no data was found for their impact on beneficial species.

Active ingredient
<b>FUNGICIDE</b>
COPPER (CUPRIC HYDROXIDE)
COPPER (COPPER AMMONIUM ACETATE)
COPPER (CUPRIC AMMONIUM COMPLEX)
COPPER (COPPER AMMONIUM COMPLEX)
SULFUR (CALCIUM POLYSULFIDE/CALCIUM THIOSULFATE)
PHOSPHOROUS (PHOSPHONIC) ACID AS MONO-DI-K PHOSPHONATE