Beneficial insects and the toxicity of pesticides

used on Australian summerfruit, table grapes and cherries

Version 1, August 2023

Summerfruit AUSTRALIA

ATGA Australian Table Grape Association Inc.

CHERRY GROWERS AUSTRALIA INC

Contents

Introduction

Beneficial insects are the natural enemies of crop pests. Many Australian native arthropods are useful in managing pests, such as light brown apple moth (LBAM), codling moth (CM), oriental fruit moth (OFM), aphids, mealybug, pest mites and other troublesome species.

Some beneficial insects, such as lacewings, ladybirds, parasitic wasps (*Trichogramma*), and predatory mites, are available commercially and can be bought from integrated pest management specialists to augment existing wild populations, or in response to an outbreak or flare.

Beneficial insects can be broadly defined as pollinators, predatory mites, predatory beetles and parasitoids. Agricultural chemicals can often have a negative impact on these beneficial species. The effects of these agrichemicals may be different for different insect groups.

Cherry Growers Australia, the Australian Table Grape Association, and Summerfruit Australia Limited have worked to create a guide for chemical selection which also considers the undesired impact of chemicals on beneficial populations.

The information collated examines the effect of a selection of chemicals on beneficials, with data gathered from a range of sources.

The guide sorts active ingredients by insecticides/miticides and fungicides. It provides a chemical toxicity rating for a range of common beneficial insects, based on aggregated data.

The project scope allowed for only a selection of chemicals.

As the data is adapted from existing work undertaken for the vegetable industry by Jessica Page in 2020, the guide contains data relating to not only table grape, cherry and summerfruit, but additional chemicals registered for use in other crops.

Inclusion in the guide does not imply registration, and users should consult their MRL app.

Only active ingredients are listed in the guide. Example trade names can be found on the industry posters, or by searching the APVMA Pubcris or Permit databases, https://apvma.gov.au/node/19146.

The project consortium (Cherry Growers of Australia, Summerfruit Australia Limited and Australian Table Grape Association) acknowledge the support Agriculture Victoria in developing the *Beneficial Insects and the Toxicity Effects of Chemicals* guide through funding from their *Food to Market* program.

Insecticide/ Miticide ratings

Toxicity rating of chemicals for common beneficial insects

INSECTICIDE/MITICIDE

CHEMICAL | Group	Common name	Species	Overall rating	Ratings' sources	Bibliography no.
ABAMECTIN					
Parasitoids	Aphidius wasp	*Aphidius colemani*	4	4 IOBC; 4 Koppert; 87% mortality Page	23, 30, 35
	Trichogramma wasp	*Trichogramma pretiosum*	3	3 IPM Tech	24
Predators	Damsel bug	*Nabis kinbergii*	3-4	3 IPM Tech; 80% mortality Page	24, 35
	Ladybird	*Hippodamia variegata*	3	3 IPM Tech; 73% mortality Page	24, 35
	Pirate bug	*Orius spp.*	4	4 Van de Veire & Tirry	44
Predatory mites	Californicus mite	*Neoseiulus californicus*	3	3 Van de Veirre et al.	45
	Persimilis mite	*Phytoseiulus persimilis*	3	3 Bluemel & Hausedorf	9
BACILLUS THURINGIENSIS					
Bees	European honey bee	*Apis melifera*	1	"low" Infopest	22
Parasitoids	Encarsia wasp	*Encarsia formosa*	1	3% mortality Page	35
	Aphidius wasp	*Aphidius colemani*	1	3% mortality Page	35
Predators	Lacewing (Brown)	*Micromus tasmaniae*	1	3% mortality Page	35
	Lacewing (Green)	*Mallada signatus*	1	3% mortality Page	35
	Ladybird	*Hippodamia variegata*	1	3% mortality Page	35
	Pirate bug	*Orius spp.*	1	3% mortality Page	35
Predatory mites	Californicus mite	*Neoseiulus californicus*	1	3% mortality Page	35
	Persimilis mite	*Phytoseiulus persimilis*	1	3% mortality Page	35

Least tox Low tox Medium tox High tox

INSECTICIDE/MITICIDE

CHEMICAL | Group	Common name	Species	Overall rating	Ratings' sources	Bibliography no.
BIFENTHRIN					
Parasitoids	Aphidius wasp	*Aphidius colemani*	4	4 Koppert; 99% mortality Page	30, 35
	Encarsia wasp	*Encarsia formosa*	4	99% mortality Page	35
Predators	Lacewing (Green)	*Mallada signatus*	4	99% mortality Page	35
	Ladybird	*Hippodamia variegata*	4	4 IOBC; 99% mortality Page	23, 35
	Pirate bug	*Orius spp.*	4	4 IOBC; 99% mortality Page	23, 35
Predatory mites	Californicus mite	*Neoseiulus californicus*	4	4 Koppert	30
	Persimilis mite	*Phytoseiulus persimilis*	4	4 Koppert; 99% mortality Page	30, 35
CARBARYL					
Predators	Mealybug ladybird	*Cryptolaemus montrouzieri*	4	4 MacGregor (adults & larvae)	33
CLOFENTAZINE					
Predatory mites	Victoriensis mite	*Amblyseius victoriensis*	1	"low" James	26
CLOTHIANADIN					
Bees	European honey bee	*Apis melifera*	4	"high" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	4	4 IOBC; 86% mortality Page	23, 35
Predators	Ladybird	*Hippodamia variegata*	4	86% mortality Page	35
	Mealybug ladybird	*Cryptolaemus montrouzieri*	4	4 (100%) Attia	5
Predatory mites	Californicus mite	*Neoseiulus californicus*	4	4 Koppert; 86% mortality Page	30, 35
	Persimilis mite	*Phytoseiulus persimilis*	4	4 Koppert; 86% mortality Page	30, 35
	Typhlodromus mite	*Typhlodromus occidentalis*	1	1 Duso (0% in field testing)	15

INSECTICIDE/MITICIDE

CHEMICAL | Group	Common name	Species	Overall rating	Ratings' sources	Bibliography no.
CHLORANTRANILIPROLE					
Parasitoids	Aphidius wasp	*Aphidius colemani*	1	1 Brugger et al.; 1 E-Phy; 36% mortality Page	12, 16, 35
	Diadegma wasp	*Diadegma semiclausum*	1	1 IPM Tech acute; 32% mortality Page	24, 35
	Encarsia wasp	*Encarsia formosa*	1	1 Brugger et al; 19% mortality Page	12, 35
	Trichogramma wasp	*Trichogramma achaeae*	1	1 Fontes	17
	Trichogramma wasp	*Trichogramma pretiosum*	1	1 Brugger et al.; 1 E-Phy; 2 IPM Tech (adults); 1 Kahn et al;	12, 16, 24, 29
Predators	Damsel bug	*Nabis kinbergii*	1	1 IPM Tech; 8% mortality Page	24, 35
	Lacewing (Brown)	*Micromus tasmaniae*	1	1 IPM Tech; 5% mortality Page	24, 35
	Ladybird	*Hippodamia variegata*	1	1 E-Phy acute; 1 IPM Tech; 2 Mills et al.; 3% mortality Page	16, 24, 34, 35
	Mealybug ladybird	*Cryptolaemus montrouzieri*	1	1 Bernard et al.(adults & larvae)	6
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	1	1 Koppert; 10% mortality Page	30, 35
CHLORPYRIFOS					
Bees	European honey bee	*Apis melifera*	4	"high" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	4	4 IOBC; 99% mortality Page	23, 35
	Encarsia wasp	*Encarsia formosa*	4	4 IOBC; 99% mortality Page	23, 35
	Trichogramma wasp	*Trichogramma achaeae*	4	4 Fontes	17
	Trichogramma wasp	*Trichogramma pretiosum*	4	4 Alano; 4 IOBC; 4 IPM Tech; 99% mortality Page	1, 23, 24, 35

INSECTICIDE/MITICIDE

CHEMICAL | Group	Common name	Species	Overall rating	Ratings' sources	Bibliography no.
Predators	Damsel bug	*Nabis kinbergii*	4	4 Cole et al.; 99% mortality Page	13, 35
	Lacewing (Brown)	*Micromus tasmaniae*	4	4 Cole et al.; 99% mortality Page	13, 35
	Lacewing (Green)	*Chrysopa carnea*	4	4 IOBC (adults & larvae)	23
	Lacewing (Green)	*Mallada signatus*	4	4 IOBC; 99% mortality Page	23, 35
	Ladybird	*Hippodamia variegata*	4	4 Cole et al.; 99% mortality Page	13, 35
	Mealybug ladybird	*Cryptolaemus montrouzieri*	2	2 & 3 Attia (fecundity & larvae survival); 1 MacGregor (adults & larvae)	5, 33
	Pirate bug	*Orius spp.*	4	2 (nymphs), 4 (adults) IOBC; 99% mortality Page	23, 35
Predatory mites	Californicus mite	*Neoseiulus californicus*	4	4 IOBC; 99% mortality Page	23, 35
	Cucumeris mite	*Amblyseius cucumeris*	4	4 IOBC	23
	Californicus mite	*Neoseiulus californicus*	3	3 IOBC	23
	Predatory mite	*Amblyseius degenerans*	4	4 IOBC	23
	Persimilis mite	*Phytoseiulus persimilis*	3	3 IOBC	23
	Typhlodromus mite	*Typhlodromus occidentalis*	4	4 Pozzebon	38
CYANTRANILIPROLE					
Parasitoids	Aphidius wasp	*Aphidius colemani*	1-2	1 & 2 Page	35
	Encarsia wasp	*Encarsia formosa*	2	2 Page	35
	Trichogramma wasp	*Trichogramma pretiosum*	1-2	1 & 2 Page	35
Predators	Damsel bug	*Nabis kinbergii*	1	1 Page	35
	Lacewing (Brown)	*Micromus tasmaniae*	1	1 Page	35
	Lacewing (Green)	*Mallada signatus*	1	1 Page	35
	Ladybird	*Hippodamia variegata*	1	1 Page	35
	Pirate bug	*Orius tantillus*	2	2 Page	35
Predatory mites	Californicus mite	*Neoseiulus californicus*	1	1 Koppert	30
	Persimilis mite	*Phytoseiulus persimilis*	2	1 & 3 Page	35

INSECTICIDE/MITICIDE

CHEMICAL | Group	Common name	Species	Overall rating	Ratings' sources	Bibliography no.
DIAZINON					
Bees	European honey bee	*Apis melifera*	4	"high" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	4	4 IOBC	23
	Encarsia wasp	*Encarsia formosa*	3	2 (larvae) 3 (adults) IOBC	23
	Parasitoids, other	*Other parasitoids*	4	3 & 4 IOBC	23
	Trichogramma wasp	*Trichogramma pretiosum*	4	4 IOBC	23
Predators	Beetles, other	Other beetles	3	3 IOBC	23
	Predatory fly	*Aphidoletes aphidimyza*	4	4 IOBC	23
	Lacewing (Green)	*Chrysopa carnea*	4	3 (larvae) 4 (adults) IOBC	23
	Pirate bug	*Orius spp.*	3	2 (nymphs) 3 (adults) IOBC	23
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	2	2 IOBC	23
	Californicus mite	*Neoseiulus californicus*	2	2 IOBC	23
	Predatory mite	*Amblyseius cucumeris*	4	4 IOBC	23
	Predatory mite	*Amblyseius degenerans*	4	4 IOBC	23
EMAMECTIN BENZOATE					
Parasitoids	Aphidius wasp	*Aphidius colemani*	2	1 E-Phy acute; 1 IOBC; 3 Koppert	23, 30
	Diadegma wasp	*Diadegma semiclausum*	4	3 Cordero et al.	14
Predators	Damsel bug	*Nabis kinbergii*	3	3 IPM Tech	24
	Lacewing (Brown)	*Micromus tasmaniae*	1	1 IPM Tech	24
	Ladybird	*Hippodamia variegata*	1	1 IPM Tech	24
	Pirate bug	*Orius spp.*	4	4 Koppert	30
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	4	4 Koppert	30

INSECTICIDE/MITICIDE

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
ETOXAZOLE					
Parasitoids	Aphidius wasp	*Aphidius colemani*	2	2 Koppert	30
Predators	Pirate bug	*Orius tantillus*	1	1 IOBC	23
Predatory mites	Californicus mite	*Neoseiulus californicus*	4	3 Koppert	30
	Persimilis mite	*Phytoseiulus persimilis*	4	3 Koppert	30
FIPRONIL/REGENT					
Bees	European honey bee	*Apis melifera*	4	"high" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	4	99% mortality Page	35
Predators	Damsel bug	*Nabis kinbergii*	4	99% mortality Page	35
	Lacewing (Brown)	*Micromus tasmaniae*	4	99% mortality Page	35
	Ladybird	*Hippodamia variegata*	4	99% mortality Page	35
FLONICAMID					
Parasitoids	Aphidius wasp	*Aphidius colemani*	1	1 Jansen et al.; 2 Koppert; 1 Page	27, 30, 35
	Encarsia wasp	*Encarsia formosa*	1	1 Koppert; 1 Page	30, 35
	Trichogramma wasp	*Trichogramma pretiosum*	3	1 Kahn et al.; 4 Page	29, 35
Predators	Pirate bug	*Orius tantillus*	1	13% mortality Page	35
Predatory mites	Californicus mite	*Neoseiulus californicus*	1	1 Koppert	30
	Persimilis mite	*Phytoseiulus persimilis*	2	1 Koppert; 57% mortality Page	30, 35
FLUBENDIAMIDE					
Parasitoids	Aphidius wasp	*Aphidius colemani*	1	1 Koppert; 4% mortality, Page	30, 35
	Diadegma wasp	*Diadegma semiclausum*	1	3% mortality Page	35
	Encarsia wasp	*Encarsia formosa*	1	1 Koppert	30
Predatory mites	Californicus mite	*Neoseiulus californicus*	1	1 Koppert	30
	Persimilis mite	*Phytoseiulus persimilis*	1	1 Koppert; 1% mortality Page	30, 35

INSECTICIDE/MITICIDE

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
HEXYTHIAZOX					
Bees	European honey bee	*Apis melifera*	1	"low" Infopest; 5% mortality Page	30, 35
Parasitoids	Aphidius wasp	*Aphidius colemani*	1	1 Koppert; 5% mortality Page	30, 35
	Encarsia wasp	*Encarsia formosa*	1	1 Koppert; 5% mortality Page	30, 35
	Trichogramma	*Trichogramma pretiosum*	1	1 Koppert	30
Predatory mites	Californicus mite	*Neoseiulus californicus*	1	1 Koppert	30
	Persimilis mite	*Phytoseiulus persimilis*	1	1 Koppert; 5% mortality Page	30, 35
	Victoriensis mite	*Amblyseius victoriensis*	3	3 James	25
IMIDACLOPRID					
Bees	European honey bee	*Apis melifera*	4	"high" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	3	3 IOBC; 3 Ketabi (adults); 81% mortality Page	23, 28, 35
	Encarsia wasp	*Encarsia formosa*	3	3 IOBC (acute); 73-84% mortality Page	23, 35
	Trichogramma wasp	*Trichogramma pretiosum*	3	3 IOBC	23
	Diadegma wasp	*Diadegma semiclausum*	4	98% mortality Page	35
Predators	Damsel bug	*Nabis kinbergii*	3-4	3 IPM Tech (acute nymphs); 95-98% mortality Page	24, 35
	Lacewing (Brown)	*Micromus tasmaniae*	2-3	2 IPM Tech (acute); 2 IPM Tech (survival to adult); 91-100% mortality Page	24, 35
	Lacewing (Green)	*Mallada signatus*	2-3	2 & 3 Page	35
	Ladybird	*Hippodamia variegata*	4	3 IPM Tech (acute larvae); 86-95% mortality Page	24, 35
	Pirate bug	*Orius spp.*	3-4	3 Angeli; 3 Van de Veire & Tirry; 88% mortality Page	4, 35, 44
Predatory mites	Californicus mite	*Neoseiulus californicus*	3	3 IOBC; 58-75% mortality Page	22, 35
	Persimilis mite	*Phytoseiulus persimilis*	3	2 Duso (acute adults); 3 Gentz; 3 IOBC; 77% mortality Page	15, 18, 23, 35

INSECTICIDE/MITICIDE

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
INDOXACARB					
Bees	European honey bee	*Apis melifera*	4	"high" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	2	2 Koppert (adults); 3 IOBC; 1 Stara et al.; 36-45% mortality Page	23, 30, 35, 42
	Diadegma wasp	*Diadegma semiclausum*	2	41% mortality Page	35
	Encarsia wasp	*Encarsia formosa*	1	3% mortality Page	35
	Trichogramma wasp	*Trichogramma pretiosum*	1	1 IPM Tech (acute adult)	24
Predators	Lacewing (Brown)	*Micromus tasmaniae*	2	1 IPM Tech (acute larvae); 63% mortality Page	24, 35
	Lacewing (Green)	*Mallada signatus*	3	53% mortality Page	35
	Ladybird	*Hippodamia variegata*	3	3 IPM Tech (acute larvae); 72-91% mortality Page	24, 35
	Chilocorus ladybird	*Chilocorus spp.*		Information pending	
	Mealybug ladybird	*Cryptolaemus montrouzieri*		Information pending	
	Pirate bug	*Orius spp.*	3	3 Angeli; 3 Van de Veire & Tirry; 78% mortality Page	4, 35, 44
Predatory mites	Californicus mite	*Neoseiulus californicus*	1	1 IOBC; 15% mortality Page	23, 35
	Perisimilis mite	*Phytoseiulus persimilis*	1	1 Bostanian; 1 IOBC; 10% mortality Page	10, 23, 35
	Typhlodromus mite	*Typhlodromus occidentalis*	1	1 Bernard et al. (mortality & fecundity); Pozzebon 2015; Pozzebon 2014	6, 37, 38
MALATHION					
Bees	European honey bee	*Apis melifera*	4	"high" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	4	4 IOBC (larvae, adults)	23
	Encarsia wasp	*Encarsia formosa*	4	4 IOBC (larvae, adults)	23
	Parasitoids, other	*Other parasitoids*	4	4 IOBC (larvae, adults)	23
	Trichogramma wasp	*Trichogramma pretiosum*	4	4 IOBC (larvae, adults)	23

INSECTICIDE/MITICIDE

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
Predators	Mealybug ladybird	*Cryptolaemus montrouzieri*	2-3	2 & 3 Rahmouni	40
	Pirate bug	*Orius spp.*	4	4 IOBC (larvae, adults)	23
	Persimilis mite	*Phytoseiulus persimilis*	2	2 IOBC	23
	Predatory mite	*Other predatory mites*	4	4 IOBC	23
Predatory mites	Typhlodromus mite	*Typhlodromus occidentalis*		Information pending	
	Victoriensis mite	*Amblyseius victoriensis*	4	4 James	26
MILBEMECTIN					
Bees	European honey bee	*Apis melifera*	4	"high" Infopest	22
Parasitoids	Encarsia wasp	*Encarsia formosa*	1	1 Koppert; 5-10% mortality Page	30, 35
Predators	Pirate bug	*Orius spp.*	2	2 Koppert; 27% mortality Page	30, 35
Predatory mites	Californicus mite	*Neoseiulus californicus*	3-4	4 Koppert; 73% mortality Page	30, 35
	Persimilis mite	*Phytoseiulus persimilis*	4	4 Koppert; 78% mortality Page	30, 35
METHOMYL					
Bees	European honey bee	*Apis melifera*	4	"high" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	4	4 IOBC; 98% mortality Page	23, 35
	Encarsia wasp	*Encarsia formosa*	4	4 IOBC	23
	Parasitoids, other	Other parasitoids	4	4 IOBC	23
	Trichogramma wasp	*Trichogramma pretiosum*	4	4 IOBC	23
Predators	Beetles, other	Other beetles	4	4 IOBC	23
	Damsel bug	*Nabis kinbergii*	4	98% mortality Page	35
	Lacewing (Brown)	*Micromus tasmaniae*	4	98% mortality Page	35
	Lacewing (Green)	*Mallada signatus*	4	98% mortality Page	35
	Mealybug ladybird	*Cryptolaemus montrouzieri*	4	4 MacGregor (adults & larvae)	33
	Pirate bug	*Orius spp.*	4	4 IOBC	23

INSECTICIDE/MITICIDE

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	4	4 IOBC	23
	Predatory mite	*Amblyseius cucumeris*	4	4 IOBC	23
	Typhlodromus mite	*Typhlodromus occidentalis*		Information pending	
PIRIMICARB					
Bees	European honey bee	*Apis melifera*	1	"low" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	3	1 IOBC; 3 Koppert (adult); 90% mortality Page	30, 35
	Encarsia wasp	*Encarsia formosa*	2	2 Koppert; 1 IOBC (larvae); 2 IOBC (adults); 38% mortality Page	23, 30, 35
	Trichogramma wasp	*Trichogramma pretiosum*	3	2 IPM Tech (acute adult); 1 IOBC (larvae); 4 IOBC (adults)	23
Predators	Damsel bug	*Nabis kinbergii*	1-2	2 (acute nymphs), 1 (survival to adult) IPM Tech; 8% mortality Page	23, 35
	Lacewing (Brown)	*Micromus tasmaniae*	1	1 IPM Tech (survival to adult); 2 Walker et al. (treated prey); 5% mortality Page	23, 35, 46
	Ladybird	*Hippodamia variegata*	1	1 IPM Tech (acute nymphs); 8% mortality Page	23, 35
	Pirate bug	*Orius spp.*	2	1 IOBC (adults); 2 IOBC (nymphs); 2 & 3 Koppert; 44% mortality Page	23, 30, 35
Predatory mites	Victoriensis mite	*Amblyseius victoriensis*	4	4 James	25
	Predatory mite	*Amblyseius cucumeris*	3	1 & 3 IOBC	23
	Californicus mite	*Neoseiulus californicus*	2	2 Koppert; 21% mortality Page	30, 35
	Persimilis mite	*Phytoseiulus persimilis*	2	2 IOBC; 2 Koppert; 27% mortality Page	23, 30, 35

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CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
PROPARGITE					
Predatory mites	Victoriensis mite	*Amblyseius victoriensis*	3	3 James	25
PYMETROZINE					
Bees	European honey bee	*Apis melifera*	1	"low" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	1	1 IOBC; 1 Jansen et al.	23, 27
	Diadegma wasp	*Diadegma semiclausum*	1-2	1 & 2 IPM Tech (acute adult)	30
	Encarsia wasp	*Encarsia formosa*	1-2	1 IOBC (pupa); 2 Koppert (acute nymphs)	23, 30
	Trichogramma wasp	*Trichogramma pretiosum*	1	1 IOBC; 1 Jansen et al.	23, 27
Predators	Lacewing (Brown)	*Micromus tasmaniae*	1	1 IPM Tech (acute larvae)	24
	Damsel bug	*Nabis kinbergii*	1	1 IPM Tech (acute nymphs)	24
	Pirate bug	*Orius spp.*	2	1 IOBC (acute); 1 Koppert; 2 Van de Veire & Tirry	23, 30, 45
Predatory mites	Californicus mite	*Neoseiulus californicus*	1-2	1 Koppert; 2 IOBC	23, 30
	Persilimis mite	*Phytoseiulus persimilis*	2	2 Duso et al.; 2 IOBC; 1 Koppert	15, 23, 30
PYRIROXIFEN					
Parasitoids	Aphidius wasp	*Aphidius colemani*	1-2	2 IOBC; 1 Koppert	23, 30
	Encarsia wasp	*Encarsia formosa*	2	2 Koppert	23
	Trichogramma wasp	*Trichogramma pretiosum*	1-2	2 IOBC; 1 Koppert	23, 30
Predatory mites	Pirate bug	*Orius spp.*	1	1 Koppert	23
	Californicus mite	*Neoseiulus californicus*	1	1 Koppert	23
	Persimilis mite	*Phytoseiulus persimilis*	2	2 IOBC; 2 Koppert	23, 30

INSECTICIDE/MITICIDE

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
SPINETORAM					
Bees	European honey bee	*Apis melifera*	4	"high" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	4	4 Koppert; 3 & 4 IOBC; 91-95% mortality Page	23, 30, 35
	Diadegma wasp	*Diadegma semiclausum*	4	100% mortality Page	35
	Encarsia wasp	*Encarsia formosa*	4	2 & 3 IOBC; 91% mortality Page	23, 35
	Trichogramma wasp	*Trichogramma pretiosum*	4	2 Alano; 4 IOBC; 4 Page	1, 21, 33
Predators	Lacewing (Brown)	*Micromus tasmaniae*	4	89% mortality Page	35
	Lacewing (Green)	*Mallada signatus*	2	45% mortality Page	35
	Ladybird	*Hippodamia variegata*	1	5-10% mortality Page	35
	Damsel bug	*Nabis kinbergii*	1	14% mortality Page	35
	Chilocorus ladybird	*Chilocorus spp.*		Information pending	
	Mealybug ladybird	*Cryptolaemus montrouzieri*		Information pending	
	Pirate bug	*Orius spp.*	4	3 Broughton et al.; 4 IOBC; 4 Koppert; 91% mortality Page	11, 30, 35
	Predatory bugs	Predatory bugs	4	4 Amarasekare & Shearer	3
Predatory mites	Californicus mite	*Neoseiulus californicus*	3-4	4 Koppert; 64% mortality Page	30, 35
	Predatory mite	Other predatory mites	4	4 Bostanian et al.; 4 Lefebvre	10, 31
	Persimilis mite	*Phytoseiulus persimilis*	3	3 IOBC; 59-63% mortality Page	23, 35
	Typhlodromus mite	*Typhlodromus spp.*		Information pending	
SPINOSAD					
Bees	European honey bee	*Apis melifera*	4	"high" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	3	3-4 IOBC; 3 Page	23, 35
	Encarsia wasp	*Encarsia formosa*	2	2 & 3 IOBC; 2 Page	23, 35
	Trichogramma wasp	*Trichogramma achaeae*	2	2 & 3 Fontes	17
	Trichogramma wasp	*Trichogramma pretiosum*	4	4 IOBC	23
	Parasitic wasps	*Hymenoptera*	4	4 Biondi	8

INSECTICIDE/MITICIDE

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
Predators	Lacewings, other	Other lacewings	1	1 IOBC	23
	Chilocorus ladybird	*Chilocorus spp.*		Information pending	
	Mealybug ladybird	*Cryptolaemus montrouzieri*	1	1 Rahmouni	40
	Pirate bug	*Orius spp.*	4	4 IOBC	23
Predatory mites	Predatory mite	*Amblyseius cucumeris*	1	1 IOBC	23
	Typhlodromus mite	*Typhlodromus spp.*	4	4 (100%) Bernard et al.; 3 Biondi; 4 Duso et al.; 4 Pozzebon	6, 8, 15, 38
	Perisimilis mite	*Phytoseiulus persimilis*	2	2 IOBC	23
SPIROTETRAMAT					
Bees	European honey bee	*Apis melifera*	1	"low" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	1	1 IOBC; 1 Koppert; 1 & 2 Page; 41% mortality Page	23, 30, 35
	Diadegma wasp	*Diadegma semiclausum*	1-2	20-32% mortality Page	35
	Encarsia wasp	*Encarsia formosa*	1	1 IOBC; 2 Koppert; 1 Page	23, 30, 35
	Trichogramma wasp	*Trichogramma pretiosum*	2	2 IPM Tech (acute adults)	24
Predators	Lacewing (Brown)	*Micromus tasmaniae*	1	1 IPM Tech acute larvae, 8% mortality Page	24, 35
	Lacewing (Green)	*Mallada signatus*	2	2 Page (adults)	35
	Ladybird	*Hippodamia variegata*	1	1 IPM Tech (acute larvae); 2% mortality Page	24, 35
	Chilocorus ladybird	*Chilocorus spp.*		Information pending	
	Mealybug ladybird	*Cryptolaemus montrouzieri*	1	1 Attia; 1 Planes (survival, longevity, fecundity)	5, 36
	Damsel bug	*Nabis kinbergii*	1	1 IPM Tech (acute nymphs); 5% mortality Page	24, 35
	Pirate bug	*Orius spp.*	1	1 IOBC; 2 Koppert; 1 Page	23, 30, 35
Predatory mites	Californicus mite	*Neoseiulus californicus*	3	3 Koppert	30
	Persimilis mite	*Phytoseiulus persimilis*	3	4 IOBC; 3 Koppert	23
	Typhlodromus mite	*Typhlodromus spp.*		Information pending	

INSECTICIDE/MITICIDE

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
SULFOXAFLOR					
Bees	European honey bee	*Apis melifera*	1	"high" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	4	4 Koppert; 4 Page; 74-77% mortality Page	30, 35
	Encarsia wasp	*Encarsia formosa*	4	4 Koppert; 77% mortality Page	30, 35
	Diadegma wasp	*Diadegma semiclausum*	4	4 Page; 80% mortality Page	35
	Trichogramma wasp	*Trichogramma spp.*		Information pending	
Predators	Chilocorus ladybird	*Chilocorus spp.*		Information pending	
	Mealybug ladybird	*Cryptolaemus montrouzieri*		Information pending	
	Damsel bug	*Nabis kinbergii*	2	2 Page; 31% mortality Page	35
	Lacewing (Brown)	*Micromus tasmaniae*	1	4 Page; 93% mortality Page	35
	Lacewing (Green)	*Mallada signatus*	3-4	4 Page; 77% mortality Page	35
	Ladybird	*Hippodamia variegata*	4	4 Page; 66-77% mortality Page	35
	Pirate bug	*Orius tantillus*	4	4 Page; 77% mortality Page	35
Predatory mites	Californicus mite	*Neoseiulus californicus*	1-2	1 Koppert; 25% mortality Page	30, 35
	Persimilis mite	*Phytoseiulus persimilis*	1	1 Koppert	30
	Typhlodromus mite	*Typhlodromus spp.*		Information pending	
SULPHUR / SULFUR (WETTABLE)					
Parasitoids	Trichogramma wasp	*Trichogramma achaeae*	1	1 Fontes	17
	Trichogramma wasp	*Trichogramma cacoeciae*	2	2 Hassan (90-100% reduction in parasitism of eggs)	20
	Trichogramma wasp	*Trichogramma carverae*	2	2 & 3 Thompson et al. (toxic @ >600g/100L)	43
Predators	Mealybug ladybird	*Cryptolaemus montrouzieri*	1	1 MacGregor	33
Predatory mites	Typhlodromus mite	*Typhlodromus occidentalis*	4	4 Bernard et al. (highly toxic @ >400g/100L)	6

INSECTICIDE/MITICIDE

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
TAU FLUVALINATE					
Bees	European honey bee	*Apis melifera*	1	"low" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	4	2 IOBC (larvae), 4 IOBC (adults)	23
	Encarsia wasp	*Encarsia formosa*	4	2 IOBC (larvae), 4 IOBC (adults)	23
	Trichogramma wasp	*Trichogramma*	4	2 IOBC (larvae), 4 IOBC (adults)	23
Predators	Predatory fly	*Aphidoletes aphidimyza*	4	2 IOBC (larvae), 4 IOBC (adults)	23
	Pirate bug	*Orius tantillus*	4	4 IOBC (nymphs & adults)	23
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	4	4 IOBC	23
	Predatory mite	*Other predatory mites*	4	4 IOBC	23
	Typhlodromus mite	*Typhlodromus occidentalis*	4	4 Duso et al (100% mortality)	15
THIACLOPRID					
Bees	European honey bee	*Apis melifera*	1	"low" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	3	3 IOBC	23
	Encarsia wasp	*Encarsia formosa*	4	1 IOBC (larvae); 3 IOBC (adults)	23
Predators	Lacewings, other	Other lacewings	3	4 IOBC (larvae); 2 IOBC (adults)	23
	Pirate bug	*Orius tantillus*	4	4 IOBC (adults & nymphs)	23
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	3	3 IOBC	23

Fungicide ratings

FUNGICIDES

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
AZOXYSTROBIN					
Parasitoids	Aphidius wasp	*Aphidius spp.*	1	1 IOBC; 1 Koppert	23, 30
	Encarsia wasp	*Encarsia formosa*	1	1 & 2 Koppert	30
	Trichogramma wasp	*Trichogramma*	1	1 & 2 IOBC	23
Predators	Ladybird	Coccinellidae family	1	1 IOBC	23
	Pirate bug	*Orius spp.*	1	1 IOBC	23
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	1	1 IOBC	23
BOSCALID + KRESOXIM-METHYL					
Parasitoids	Aphidius wasp	*Aphidius spp.*	1	1 IOBC	23
Predatory mites	Californicus mite	*Neoseiulus californicus*	1	1 Koppert	30
BUPIRIMATE					
Parasitoids	Aphidius wasp	*Aphidius spp.*	1	1 IOBC	23
	Encarsia wasp	*Encarsia formosa*	3	4 IOBC; 2 Koppert	23, 30
	Trichogramma wasp	*Trichogramma*	1	1 Koppert	30
predatory mites	Californicus mite	*Neoseiulus californicus*	1	1 Koppert	30
	Persimilis mite	*Phytoseiulus persimilis*	1	1 & 2 Koppert	30
	Pirate bug	*Orius spp.*	1	1 & 2 Koppert	30
CAPTAN					
Parasitoids	Aphidius wasp	*Aphidius spp.*	1	1 IOBC	23
	Encarsia wasp	*Encarsia Formosa*	1	1 IOBC	23
	Trichogramma wasp	*Trichogramma*	1	1 IOBC	23
	Trichogramma wasp	*Trichogramma cacoeciaei*	1	1 Hassan et al.	20
Predators	Lacewing (Green)	*Chrysopa carnea*	1	1 IOBC	23
	Pirate bug	*Orius spp.*	1	1 IOBC (larvae & adults)	23

Least tox Low tox Medium tox High tox

FUNGICIDES

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	1	1 IOBC	23
	Predatory mite	Other predatory mites	1	1 IOBC	23
	Typhlodromus mite	*Typhlodromus occidentalis*	1	1 Bernard et al. (mortality & fecundity)	6
CHLOROTHALONIL					
Bees	European honey bee	*Apis melifera*	1	"low" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius spp.*	1	2 IOBC; 1 & 2 Koppert; 5% mortality Page	23, 30, 35
	Encarsia wasp	*Encarsia formosa*	1	1 IOBC; 5% mortality Page	23, 35
	Trichogramma wasp	*Trichogramma atopovirilia*	2	2 Pratissoli, et al. (parasitism of sprayed eggs)	39
Predators	Pirate bug	*Orius spp.*	1	1 Koppert; 5% mortality Page	23, 35
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	1	1 IOBC; 1 Koppert; 5% mortality Page	23, 30, 35
	Typhlodromus mite	*Typhlodromus occidentalis*	1	1 Bernard et al. (mortality & fecundity)	6
	Victoriensis mite	*Amblyseius victoriensis*	1	"low" James	25
CYAZOFAMID					
Parasitoids	Aphidius wasp	*Aphidius spp.*	1	1 IOBC	23
Predators	Ladybird	Coccinellidae family	1	1 IOBC	23
CYFLUFENAMID					
Parasitoids	Aphidius wasp	*Aphidius spp.*	1	1 IOBC	23
	Trichogramma wasp	*Trichogramma*	1	1 IPM Tech	24
Predators	Lacewing (Green), larvae	*Mallada signatus*	1	1 IPM Tech	24
	Ladybird, larvae	Coccinellidae family	1	1 IPM Tech	24
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	1	1 IPM Tech	24
CYPRODINIL + FLUDIOXONIL					
Bees	European honey bee	*Apis melifera*	1	"low" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius spp.*	1	1 IOBC; 1 Koppert	23, 30
	Encarsia wasp	*Encarsia formosa*	1	1 IOBC; 1 Koppert	23, 30

FUNGICIDES

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
Predators	Ladybird, larvae	Coccinellidae family	2	2 IOBC	23
	Pirate bug	*Orius spp.*	2	2 IOBC	23
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	2	2 Koppert	30
	Typhlodromus mite	*Typhlodromus occidentalis*	1	1 Bernard et al.	6
DITHIANON					
Parasitoids	Encarsia wasp	*Encarsia formosa*	1	1 IOBC (larvae & adults)	23
	Trichogramma wasp	*Trichogramma pretiosum*	1	1 IOBC (larvae & adults)	23
Predatory mites	Predatory mite	Other predatory mites	1	1 IOBC	23
	Persimilis mite	*Phytoseiulus persimilis*	1	1 IOBC	23
	Typhlodromus mite	*Typhlodromus occidentalis*	1	1 Bernard et al. (mortality & fecundity)	6
	Victoriensis mite	*Amblyseius victoriensis*	1	"low" James	25
DIMETHOMORPH					
Parasitoids	Trichogramma wasp	*Trichogramma*	1	1 IOBC	23
Predators	Pirate bug	*Orius spp.*	3	3 Koppert	30
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	1	1 IOBC; 1 Koppert	23, 30
FLUOPYRAM					
Predators	Chilocorus ladybird	*Chilocorus spp.*		Information pending	
	Mealybug ladybird	*Cryptolaemus montrouzieri*		Information pending	
Predatory mites	Predatory mite	Other predatory mites	1	1 IOBC	23
	Typhlodromus mite	*Typhlodromus occidentalis*		Information pending	
FLUXAPYROXAD					
Parasitoids	Encarsia wasp	*Encarsia formosa*	1	1 IOBC (adults)	23
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	2	2 IOBC	23
	Predatory mite	Other predatory mites	1	1 IOBC	23

FUNGICIDES

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
FLUDIOXONIL					
Predators	Pirate bug	*Orius spp.*	4	4 IOBC	23
Predatory mites	Typhlodromus mite	*Typhlodromus occidentalis*	1	1 Bernard et al.	6
FENHEXAMID					
Bees	European honey bee	*Apis melifera*	1	"low" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	1	2 IOBC	23
	Trichogramma wasp	*Trichogramma spp.*		Information pending	
Predators	Pirate bug	*Orius spp.*	2	2 IOBC (nymphs & adults)	23
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	2	2 IOBC	23
	Typhlodromus mite	*Typhlodromus occidentalis*		Information pending	
IPRODIONE					
Bees	European honey bee	*Apis melifera*	1	"low" Infopest	22
Parasitoids	Encarsia wasp	*Encarsia formosa*	1	1 IOBC (larvae, adults)	23
	Trichogramma wasp	*Trichogramma pretiosum*	1	1 IOBC (larvae, adults)	23
Predators	Pirate bug	*Orius spp.*	1	1 IOBC (larvae, adults)	23
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	1	1 IOBC (larvae, adults)	23
	Predatory mite	Other predatory mites	1	1 IOBC (larvae, adults)	23
	Typhlodromus mite	*Typhlodromus occidentalis*	1	1 Bernard et al. (fecundity)	6
	Victoriensis mite	*Amblyseius victoriensis*	3	3 James	25

FUNGICIDES

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
MANCOZEB					
Bees	European honey bee	*Apis melifera*	1	"low" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius spp.*	1	1 IOBC; 1 Koppert; 14% mortality Page	23, 30, 35
	Encarsia wasp	*Encarsia formosa*	1	1 IOBC (larvae); 2 IOBC (adults); 1 & 2 Koppert; 18% mortality Page	23, 30, 35
	Trichogramma wasp	*Trichogramma cacoeciae*	3	3 Hassan (90-100% reduction in parasitism of eggs)	20
	Trichogramma wasp	*Trichogramma atopovirilia*	1	1 Pratissoli	39
	Trichogramma wasp	*Trichogramma pretiosum*	1	1 Manzoni (dried residue)	32
	Trichogramma wasp	*Trichogramma*	2	1 IOBC; 4 Koppert	23, 30
Predators	Pirate bug	*Orius spp.*	1-2	1 IOBC (nymphs, adults); 1 & 2 Koppert; 38% mortality Page	23, 30, 35
	Damsel bug	*Nabis kinbergii*	1	14% mortality Page	35
	Mealybug ladybird	*Cryptolaemus montrouzieri*	1	1 MacGregor (adults & larvae)	33
	Lacewing (Brown)	*Micromus tasmaniae*	1	14% mortality Page	35
	Ladybird	Coccinellidae family	1	14% mortality Page	35
Predatory mites	Californicus mite	*Neoseiulus californicus*	3	2 Koppert; 80% mortality Page	30, 35
	Predatory mite	Other predatory mites	1	1 IOBC	23
	Typhlodromus mite	*Typhlodromus occidentalis*	4	4 Bernard et al.	6
	Victoriensis mite	*Amblyseius victoriensis*	4	4 James	25, 26
	Persimilis mite	*Phytoseiulus persimilis*	3	2 IOBC; 2 Koppert; 85% mortality Page	23, 30, 35
MANDIPROPAMID					
Parasitoids	Aphidius wasp	*Aphidius spp.*	4	4 IOBC	23

FUNGICIDES

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
METALAXYL					
Parasitoids	Aphidius wasp	*Aphidius spp.*	2	2 IOBC	23
	Encarsia wasp	*Encarsia formosa*	1	1 Koppert	30
Predators	Pirate bug	*Orius spp.*	1	1 IOBC	23
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	4	3 Koppert	30
METIRAM					
Bees	European honey bee	*Apis melifera*	1	"low" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius spp.*	2	1-2 IOBC; 1 Koppert; 24% mortality Page	23, 30, 35
	Encarsia wasp	*Encarsia formosa*	2	1-4 Koppert; 40% mortality Page	30, 35
	Trichogramma wasp	*Trichogramma*	2	1-4 Koppert	30
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	3	1 & 2 IOBC; 4 Koppert; 79% mortality Page	23, 30, 35
OXATHIAPIPROLIN					
Parasitoids	Aphidius wasp	*Aphidius spp.*	1	1 IOBC	23
PENTHIOPYRAD					
Parasitoids	Encarsia wasp	*Encarsia formosa*	1	3% mortality Page	35
PROPICONAZOLE					
Parasitoids	Encarsia wasp	*Encarsia formosa*	1	1 IOBC	23
	Trichogramma wasp	*Trichogramma pretiosum*	1	1 IOBC	23
Predators	Lacewings, other	Other lacewings	1	1 IOBC	23
	Pirate bug	*Orius spp.*	1	1 IOBC	23
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	2	2 IOBC	23
	Predatory mite	Other predatory mites	1	1 IOBC	23
PYRACLOSTROBIN					
Predatory mites	Typhlodromus mite	*Typhlodromus occidentalis*	1	1 Bernard et al. (mortality & fecundity)	6

FUNGICIDES

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
TRIADIMENOL					
Parasitoids	Aphidius wasp	*Aphidius spp.*	1	1 IOBC; 1 Koppert	23, 30
	Encarsia wasp	*Encarsia formosa*	1	1 IOBC; 1 Koppert	23, 30
	Trichogramma wasp	*Trichogramma*	1	1 IOBC; 1 Koppert	23, 30
Predators	Pirate bug	*Orius spp.*	1	1 Koppert	30
Predatory mites	Californicus mite	*Neoseiulus californicus*	1	1 Koppert	30
	Persimilis mite	*Phytoseiulus persimilis*	1	1 IOBC; 1 Koppert	23, 30
TRIADIMEFON					
Parasitoids	Encarsia wasp	*Encarsia formosa*	1	1 Koppert	30
	Trichogramma wasp	*Trichogramma*	1	1 Koppert	30
Predators	Ladybird (larvae)	Coccinellidae family	2	1 & 2 IOBC	23
	Pirate bug	*Orius spp.*	1-2	1 & 2 Koppert	30
Predatory mites	Californicus mite	*Neoseiulus californicus*	1	1 Koppert	30
	Persimilis mite	*Phytoseiulus persimilis*	1	1 Koppert	30
TRIFLOXYSTROBIN					
Bees	European honey bee	*Apis melifera*	1	"low" Infopest	22
Parasitoids	Aphidius wasp	*Aphidius colemani*	1	1 IOBC (nymphs & adults)	23
	Encarsia wasp	*Encarsia formosa*	1	1 IOBC (nymphs & adults)	23
	Trichogramma wasp	*Trichogramma*		Information pending	

FUNGICIDES

CHEMICAL | Group	Common name	Species	Overall rating	Sources	Bibliography no.
Predators	Lacewing, other	Other lacewings	1	1 IOBC (nymphs & adults)	23
	Chilocorus ladybird	*Chilocorus spp.*		Information pending	
	Mealybug ladybird	*Cryptolaemus montrouzieri*		Information pending	
	Predatory mite	*Other predatory mites*	1	1 IOBC	23
	Pirate bug	*Orius spp.*	1	2 IOBC (nymphs); 1 IOBC (adults)	23
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	1	1 IOBC	23
	Typhlodromus mite	*Typhlodromus occidentalis*	1	1 Bernard et al. (mortality & fecundity)	6
ZINEB					
Parasitoids	Aphidius waso	*Aphidius spp.*	1	1 Koppert	30
	Encarsia wasp	*Encarsia formosa*	1	1 Koppert	30
	Trichogramma wasp	*Trichogramma*	1	1 Koppert	30
Predators	Chilocorus ladybird	*Chilocorus spp.*		Information pending	
	Mealybug ladybird	*Cryptolaemus montrouzieri*		Information pending	
	Pirate bug	*Orius spp.*	1	1 Koppert	30
Predatory mites	Persimilis mite	*Phytoseiulus persimilis*	1	1 Koppert	30
	Typhlodromus mite	*Typhlodromus occidentalis*		Information pending	

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