

Pesticides and insect pest control in vegetables



**Integrated
Crop Protection**
PROTECTING CROPS

**Hort
Innovation**



RMCG



Pesticides & Chemical Groups



IRAC MoA group	Insecticide category	Active Ingredient(s)	Example trade names
GROUP 1A INSECTICIDE	Carbamates	pirimicarb	Pirimicarb, Pirimor
GROUP 1B INSECTICIDE	Organophosphates	chlorpyrifos, diazinon, dimethoate, maldison, omethoate, phorate	Strike Out, Danadim, Fyanon, Thimet, Fokus, Pyrinex Super ¹
GROUP 3A INSECTICIDE	Synthetic Pyrethroids	permethrin, piperonyl butoxide, pyrethrins, tau-fluvalinate	Ambush, Klartan, Pyrinex Super ¹
GROUP 4A INSECTICIDE	Neonicotinoids	acetamiprid, imidacloprid, thiamethoxam	Intruder, Confidor, Nuprid, Actara, Durivo ²
GROUP 4C INSECTICIDE	Sulfoximines	sulfoxaflor (Isoclast™ active)	Transform
GROUP 9B INSECTICIDE	Pymetrozine	pymetrozine	Chess, Endgame
GROUP 23 INSECTICIDE	Tetronic and Tetramic acid derivatives	spirotetramat (iso)	Movento
GROUP 28 INSECTICIDE	Diamides	cyantraniliprole, chlorantraniliprole	Benevia, Durivo ²
GROUP 29 INSECTICIDE	Flonicamid	flonicamid	Mainman

Pesticides & Chemical Groups



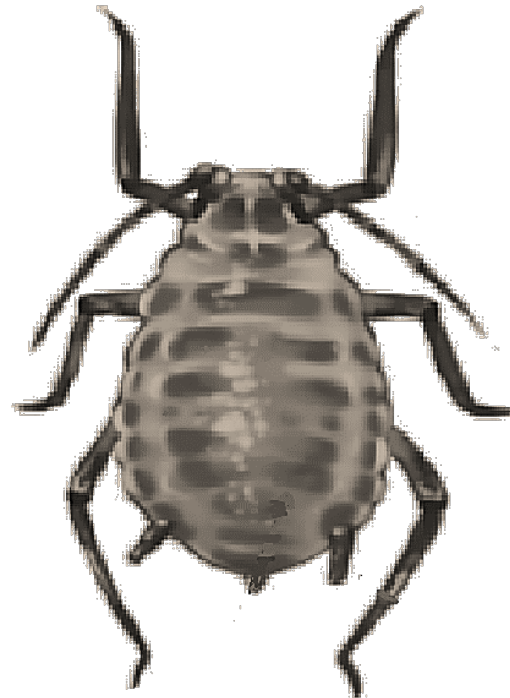
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Pesticides & Chemical Groups



Bifenthrin

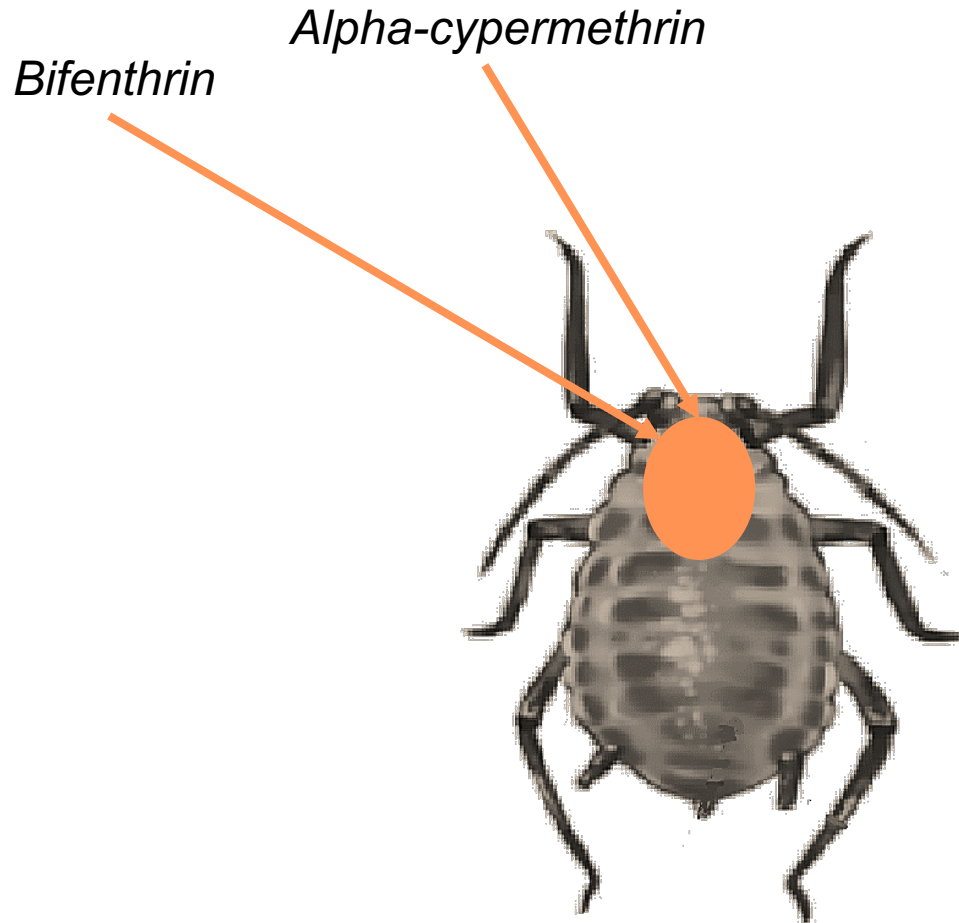
Alpha-cypermethrin



Spinetoram

Spinosad

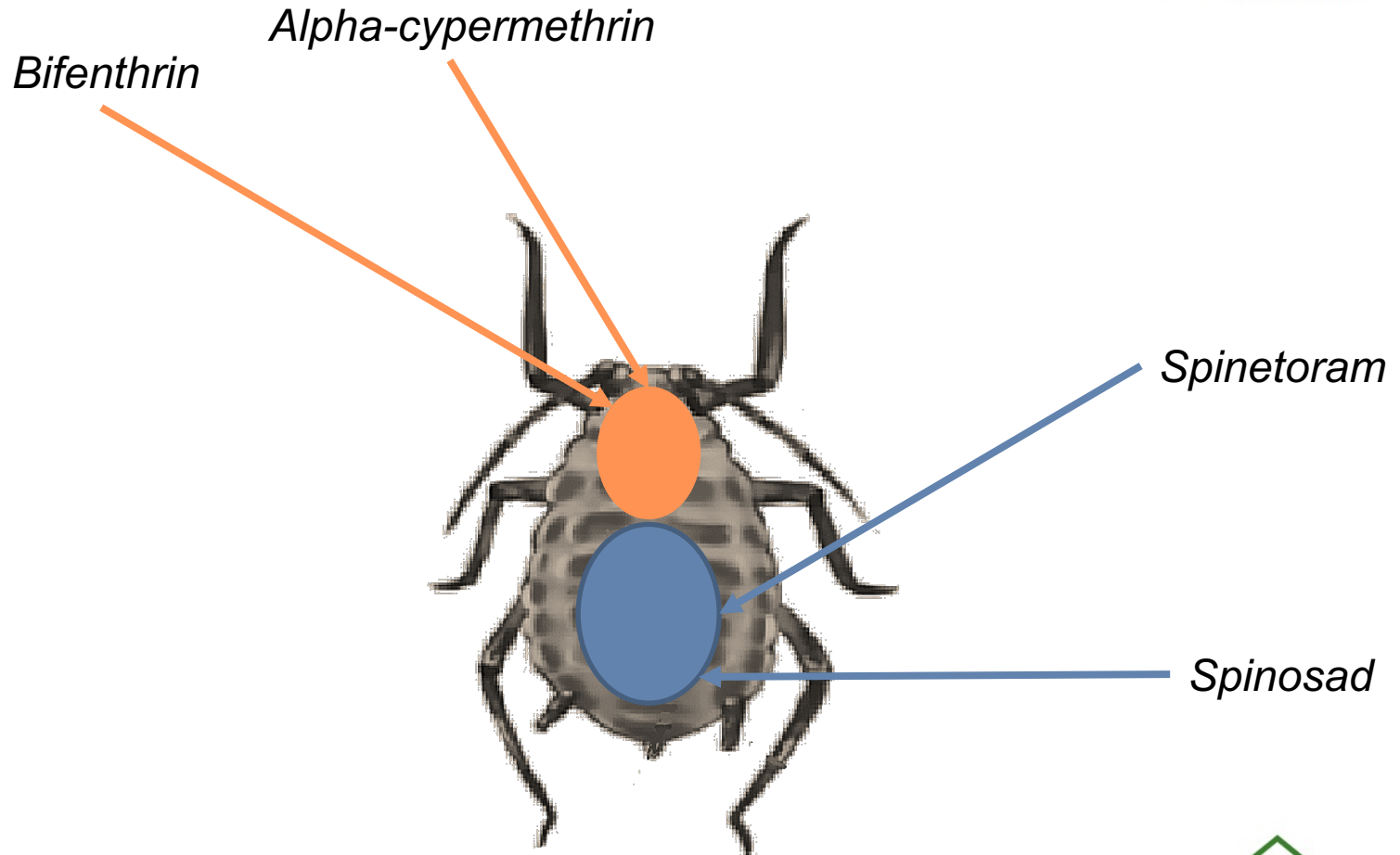
Pesticides & Chemical Groups



Spinetoram

Spinosad

Pesticides & Chemical Groups



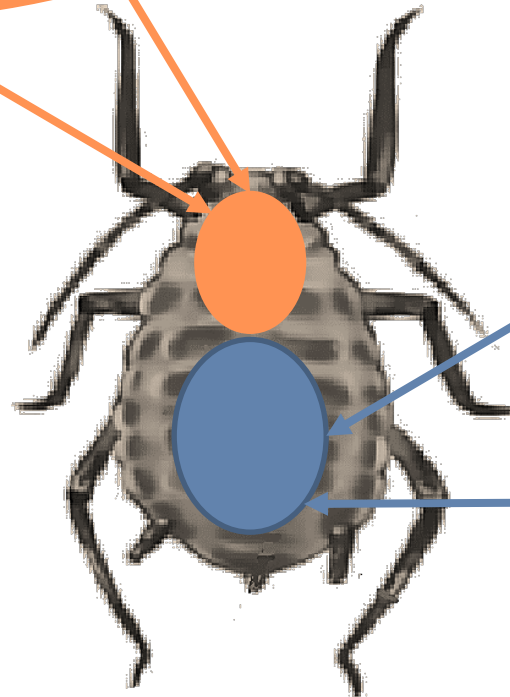
Pesticides & Chemical Groups



Group 3a

Bifenthrin

Alpha-cypermethrin



Spinetoram

Group 5

Spinosad



Insecticide Resistance Action Committee

Pesticides & Chemical Groups

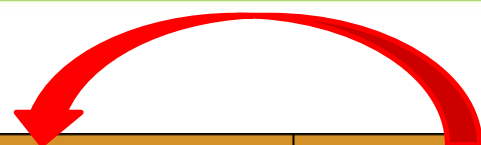


Insecticide Resistance Action Committee



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Crop Protection

PROTECTING CROPS



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DUPONT

DuPont™ Coragen®

INSECTICIDE

Technical Information

Active Constituent: 200 g/L CHLORANTRANILIPROLE
Pack Sizes: 1 L, 5 L

GROUP **28** INSECTICIDE



For the control of Lepidopteran species of insect pests in certain vegetables, as per the Directions for Use

FIRST AID

If poisoning occurs, contact a doctor or Poisons Information Centre. Phone Australia 13 11 26.

SAFETY DATA SHEET

Additional information is listed in the Material Safety Data Sheet available from www.cropprotection.dupont.com.au

DUPONT

DuPont™ Benevia®

insecticide

Technical Information

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Pack Sizes: 5 L

GROUP **28** INSECTICIDE



CAUTION

KEEP OUT OF REACH OF CHILDREN
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May irritate the eyes and skin. Repeated exposure may cause allergic disorders. Avoid contact with eyes and skin. When opening the container and preparing spray and using the prepared spray, wear chemical resistant gloves. Wash hands after use. After each day's use wash gloves and contaminated clothing.

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Nuprid® 350SC

Insecticide

ACTIVE CONSTITUENT: 350 g/L IMIDACLOPRID

GROUP **4A** INSECTICIDE

For the control of various insect pests of cotton, fruit, vegetables and ornamentals as a foliar spray, for stem injection and as a soil drench in bananas, and as a soil applied treatment for the control of various cane, silverleaf whitefly in vegetable crops and certain pests in apples, citrus and specified in the Directions for Use table.

READ THE ATTACHED LEAFLET BEFORE USING THIS PRODUCT

Trademark of Nufarm Australia Limited

CAUTION

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Confidor® 200 SC

Insecticide



RLP
Approved



ACTIVE CONSTITUENT: 200 g/L IMIDACLOPRID

GROUP **4A** INSECTICIDE

For the control of various insect pests of fruit, vegetables and ornamentals as specified in the DIRECTIONS FOR USE table

1 L

IMPORTANT: READ THE ATTACHED BOOKLET BEFORE USE

POISON
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Movento® 240 SC

INSECTICIDE

ACTIVE CONSTITUENT: 240 g/L SPIROTETRAMAT

GROUP **23** INSECTICIDE

For the control of various insect pests in cotton and certain fruit and vegetable crops as specified in the DIRECTIONS FOR USE table



DUPONT

DuPont™ Coragen® INSECTICIDE

Technical Information

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POISON KEEP OUT OF REACH OF CHILDREN READ SAFETY DIRECTIONS BEFORE OPENING OR USING Nufarm Nuprid® 350SC Insecticide

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Trademark of Nufarm Australia Limited

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ACTIVE CONSTITUENT: 240 g/L SPIROTETRAMAT

GROUP **23** INSECTICIDE

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DUPONT

DuPont™ Coragen® INSECTICIDE

Technical Information

Active Constituent:
200 g/L CHLORANTRANILIPROLE

Pack Sizes:
1 L
5 L

GROUP 28 INSECTICIDE



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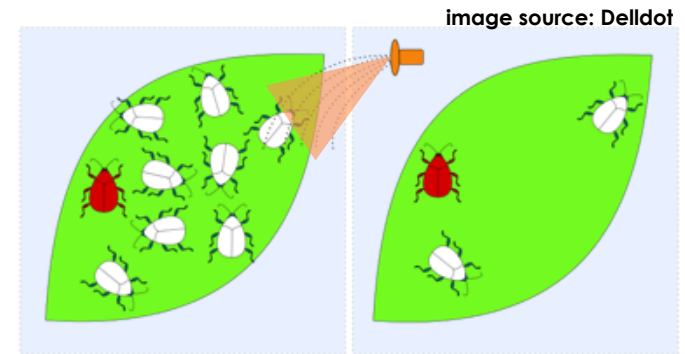
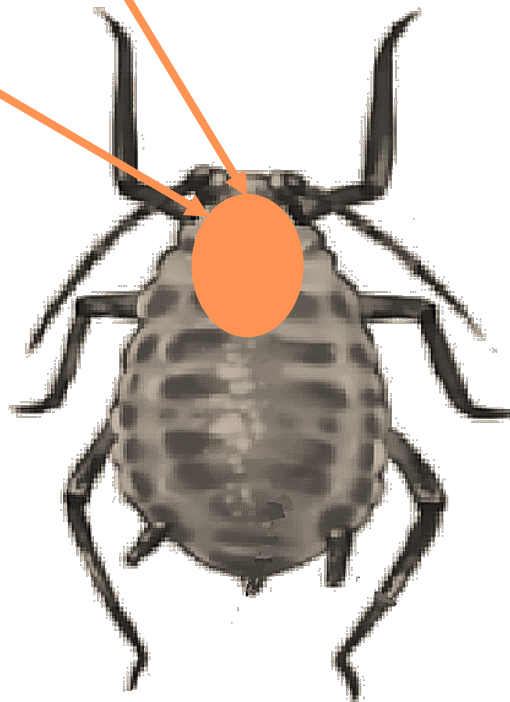
Evolution of pesticide resistance



Group 3a

Alpha-cypermethrin

Bifenthrin



Evolution of pesticide resistance



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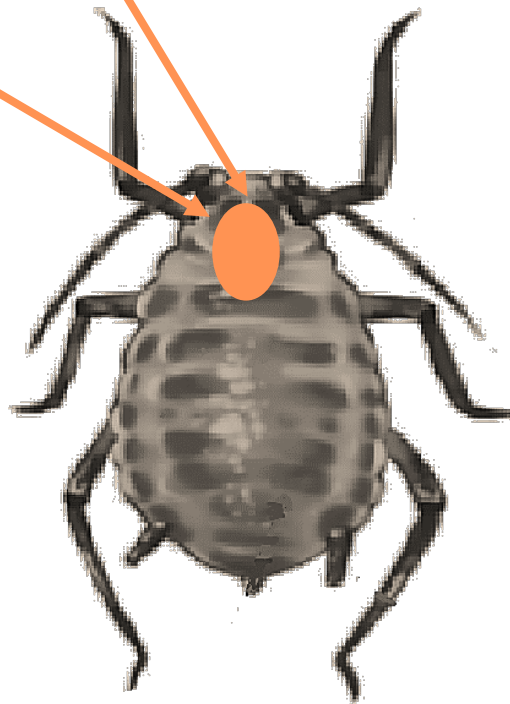
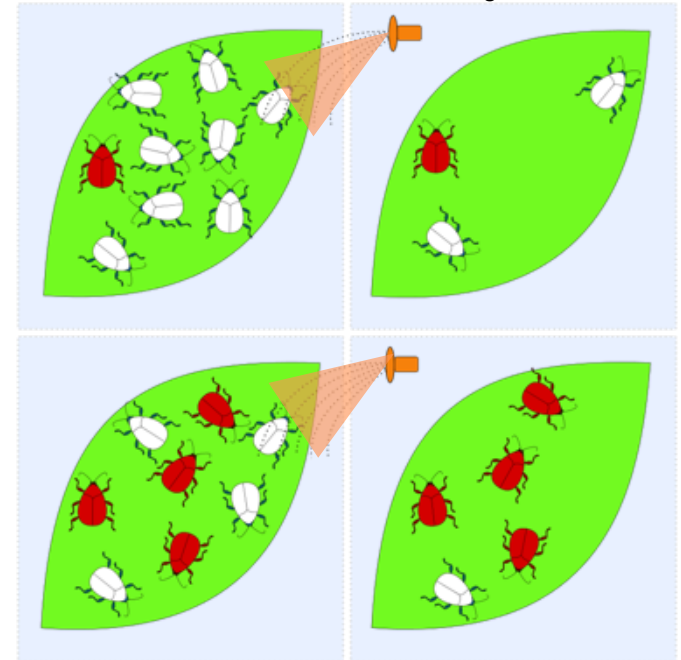


image source: Delldot



Evolution of pesticide resistance



Group 3a

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Alpha-cypermethrin

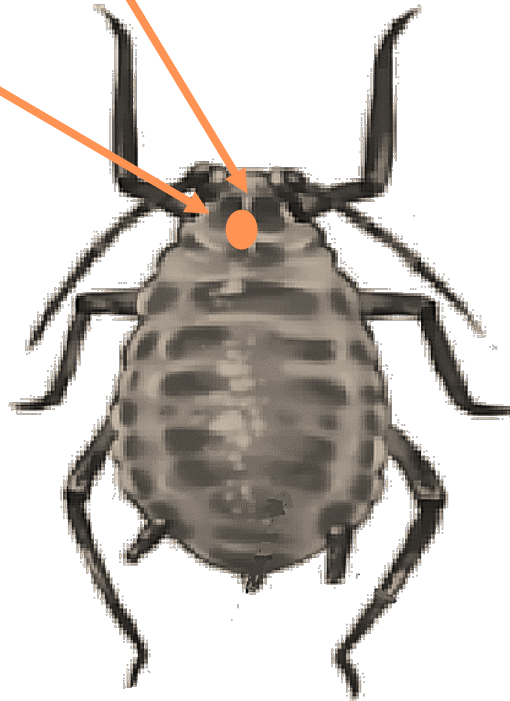
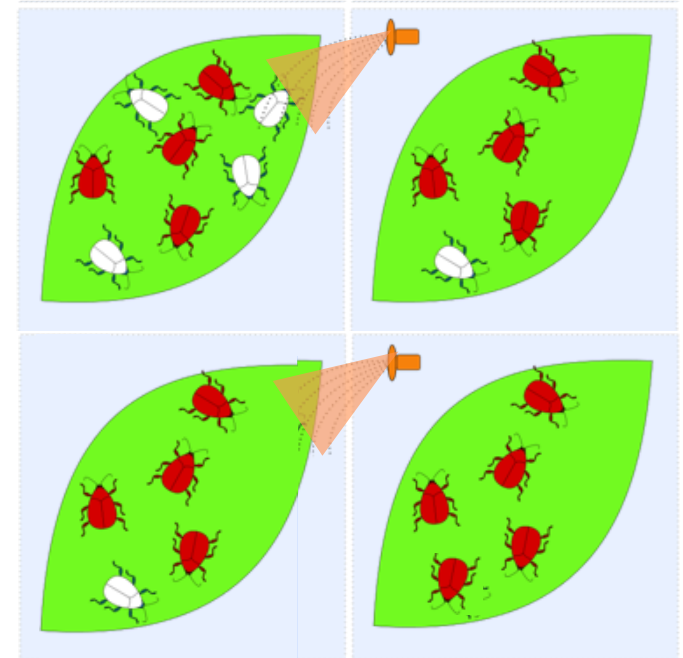


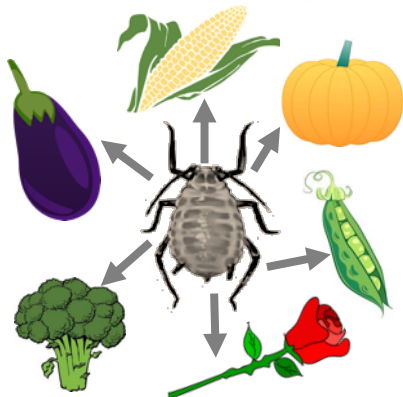
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Evolution of pesticide resistance



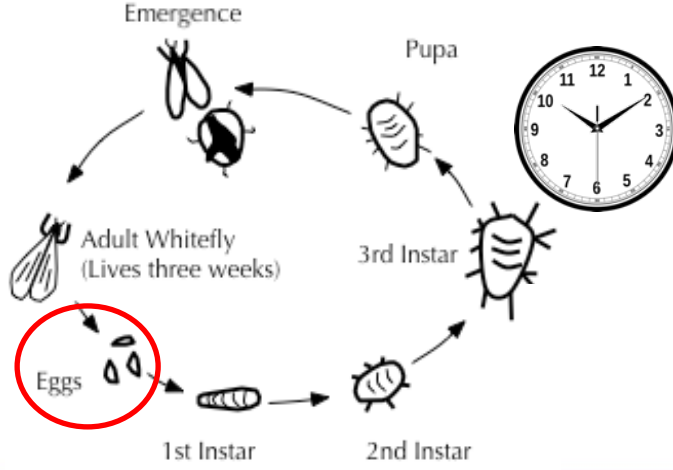
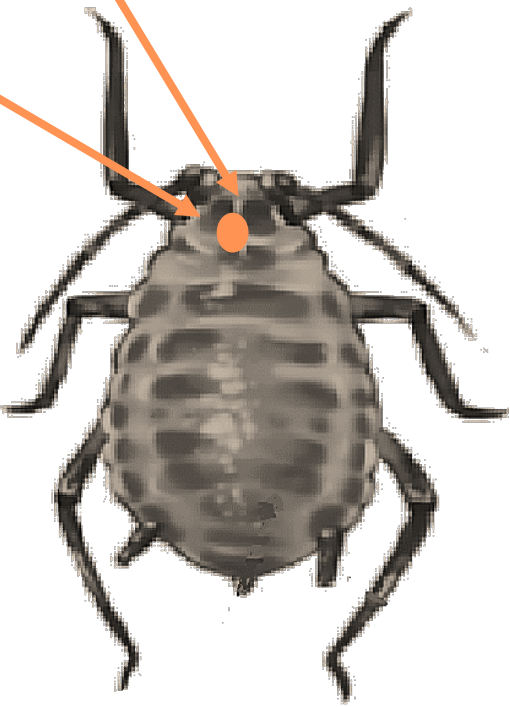
**Integrated
Crop Protection**
PROTECTING CROPS



Group 3a

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Alpha-cypermethrin



Resistant pests in vegetable crops



Source: CSIRO



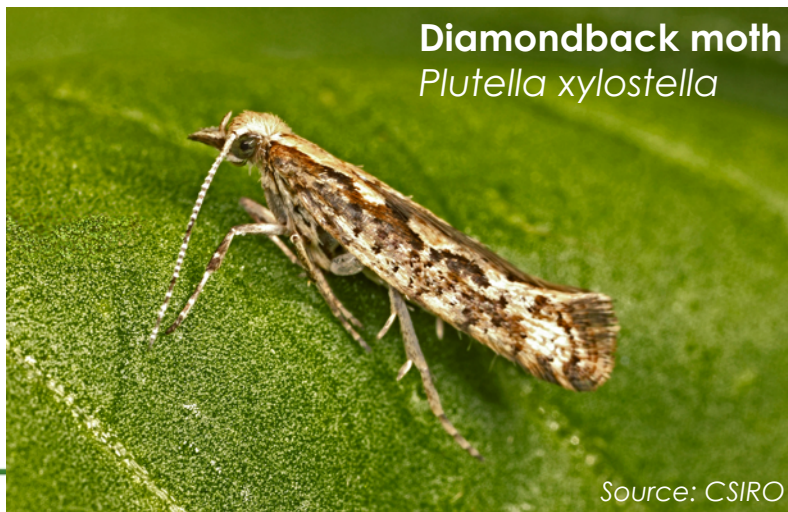
Silverleaf whitefly
Bemisia tabaci

Source: J. Holopainen



Two-spotted mite
Tetranychus urticae

Diamondback moth
Plutella xylostella

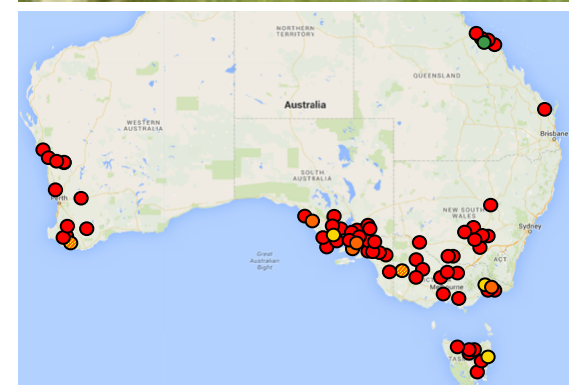


Source: CSIRO



Green peach aphid
Myzus persicae

Green peach aphid control in veg



MoA	Active ingredients	Resistance
Group 1A	Pirimicarb	yes
Group 1B	Chlorpyrifos, Diazinon, Dimethoate, Maldison, Omethoate, Phorate	yes
Group 3A	Permethrin, Tau-fluvalinate, Pyrethrins, Piperonyl butoxide	yes
Group 4A	Thiamethoxam, Imidacloprid, Acetimidiprid	yes
Group 4C	Sulfoxaflor	
Group 9B	Pymetrozine	-
Group 23	Spirotetramat	-
Group 28	Cyantraniliprole	-
Group 29	Flonicamid	-

Worldwide – reported resistance to more than 80 insecticides

Diamondback moth control in veg



MoA	Active ingredients	Resistance
Group 1A	Methomyl, Thiodicarb	-
Group 2B	Fipronil	-
Group 3A	Synthetic Pyrethroids (various)	yes
Group 5	Spinetoram	-
Group 6	Emamectin benzoate	yes
Group 11A	<i>Bacillus thuringiensis</i>	-
Group 13	Chlorfenapyr	-
Group 22A	Indoxacarb	-
Group 28	Chlorantraniliprole, Flubendiamide	-



Worldwide – reported resistance to more than 82 insecticides including Group 28 (Diamides) and *Bacillus thuringiensis*

Silverleaf whitefly control in veg



MoA	Active ingredients	Resistance
Group 1B	Chlorpyrifos	-
Group 3A	Bifenthrin	yes
Group 4A	Thiamethoxam, Imidacloprid	-
Group 7C	Pyriproxyfen	yes
Group 9B	Pymetrozine	-
Group 16	Buprofezin	-
Group 23	Spirotetramat	-
Group 28	Cyantraniliprole, Chlorantraniliprole	-
Group 29	Flonicamid	-



Source: CSIRO



Source: CSIRO

Worldwide – reported resistance to more than 50 insecticides

Two-spotted mite control in veg



MoA	Active ingredients	Resistance
Group 1B	Dimethoate, Omethoate, Phorate	yes
Group 3A	Bifenthrin, Pyrethrins, Tau-fluvalinate	yes
Group 6	Abamectin, Milbemectin	yes
Group 10B	Etoxazole	yes
Group 12C	Propargite	yes
Group 20D	Bifenazate	-



Worldwide – reported resistance to more than 90 insecticides

Insecticides are no longer recommended as a viable option for this pest as it develops resistance to almost all chemicals used to control it.

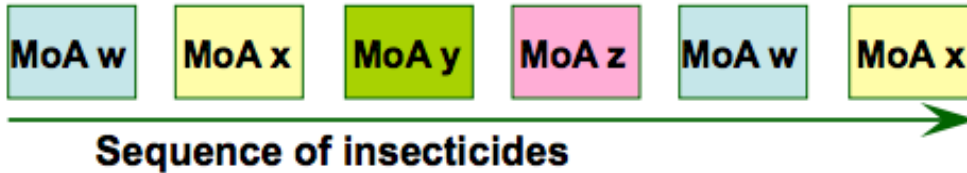
Resistance Management



Resistance Management strategies are available for most pests.

Key message (if chemical control is needed):

Rotate between different IRAC MoA groups



June 2016

Resistance Management Strategy for the green peach aphid in Bundaberg field vegetable crops

CSAR
sustainability through science and innovation

Green peach aphid and insecticide resistance

Key points

- Green peach aphid (GPA) are an important pest of vegetables, causing damage by feeding and transmitting viruses.
- Nine chemical groups are registered to control GPA in vegetables. Insecticides are also registered for GPA control, and parasitic wasps are registered for suppression.
- High levels of resistance to carbamates, pyrethroids and organophosphates are found across Queensland crops, often through the use of chemicals registered in other crops.
- Low levels of resistance to neonicotinoids have also been observed in some GMA populations.
- A strategy to manage insecticide resistance in GPA, populations is available for use by vegetable growers in Bundaberg, involving rotating different chemical groups, and using alternative IPM methods to reduce pest and virus loads.

Green peach aphid and insecticide resistance

Describe the factors that are most likely to contribute to the development of resistance in Bundaberg, involving rotating different chemical groups, and using alternative IPM methods to reduce pest and virus loads.

Colour morphs of green peach aphid (GPA) on leaf. A: White, B: Green

JUNE 2017

RESISTANCE MANAGEMENT STRATEGY FOR DIAMONDBACK MOTH IN AUSTRALIAN CANOLA

GRDC
GROWER RESEARCH DEVELOPMENT AND EDUCATION CORPORATION

When DDM larvae are disturbed they will wiggle, and may stop feeding for a while. However...

DDM pupae migrate through the grain to the bottom of the underside of a damaged canola leaf. Pupae start to grow in canola. First larva hatched before harvest of the adult crop.

KEY POINTS

Diamondback moth and insecticide resistance

The diamondback moth (Plutella maculipennis), DDM is a pest of canola, brassica vegetables and orange crops. DDM larvae feed on plant foliage, stems, flower heads and pods. The larvae can be found at any stage of canola development, with their numbers often increasing in the lead up to flowering. Canola can tolerate considerable leaf damage before causing yield loss. However severe infestations can cause complete defoliation and yield losses of up to 80 per cent in canola.

The use of pyrethroids in canola and vegetable crops continues to grow in Australia, placing strong selection pressure on the development of resistance. DDM has a high propensity to develop resistance and there are more than 80 insecticide compounds registered globally to which DDM has developed resistance. Because of the high observed levels of DDM control, resistant individuals can soon dominate a population if there is widespread use of the same insecticide group. With resistance to three key insecticide groups (pyrethroids, organophosphates and insecticides), already established, canola growers need to understand how to minimise the further development of resistance.

Resistance management and minimisation strategy

The aim of this strategy is to minimise the selection pressure for resistance to the same chemical groups across consecutive generations of DDM. The strategy includes three insecticide - insecticide DDMs (Group 6, 9, 10) and the insecticide DDMs (Group 18) products because resistance to these products is ubiquitous in Australia. DDM populations at levels that render them ineffective. Similarly, pyrethroids and organophosphates are not recommended for DDM control.



Insecticide Resistance Management Strategies
Developed by the CropLife Australia Insecticide Resistance Management Review Group
Valid as at 10 June 2017

Crop(s) : Various
Insect(s) : Silverleaf Whitefly

Guidelines:

1. Monitor pest numbers and apply control measures before adult populations reach high levels.
2. Select registered insecticide control measures according to the primary growth stage of the pest, the infestation level and the age and type of crop.
3. In cotton, spray decisions should be based on the Silverleaf Whitefly threshold matrix. Refer to the current [Cotton Pest Management Guide](#) for further details
4. Where possible, utilise selective insecticides during the early stages of crop development to minimise the impact on beneficial insects.

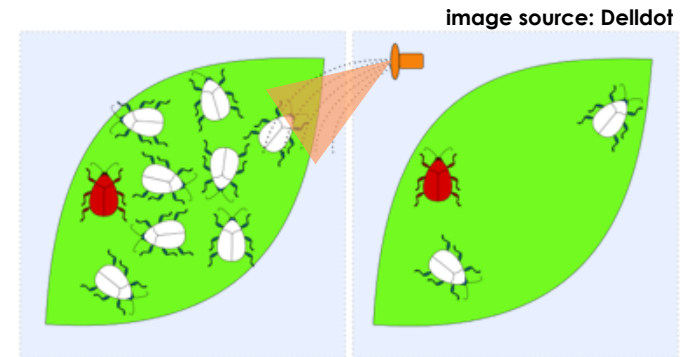
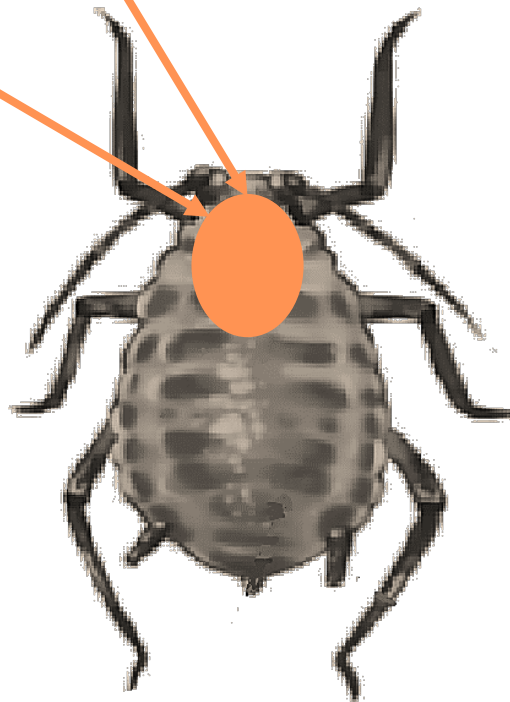
Rotation of MoA groups



Group 3a

Bifenthrin

Alpha-cypermethrin



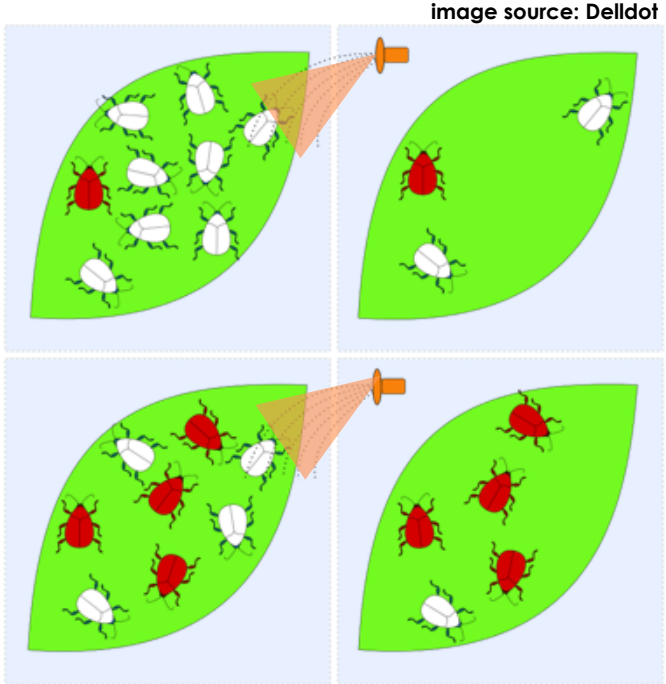
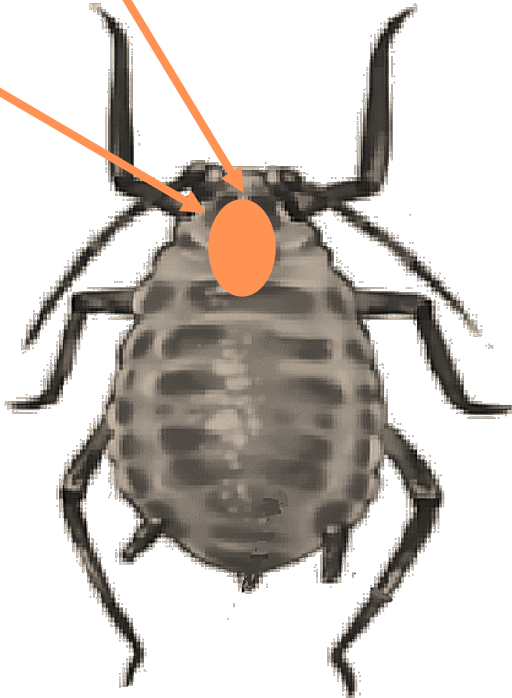
Rotation of MoA groups



Group 3a

Bifenthrin

Alpha-cypermethrin



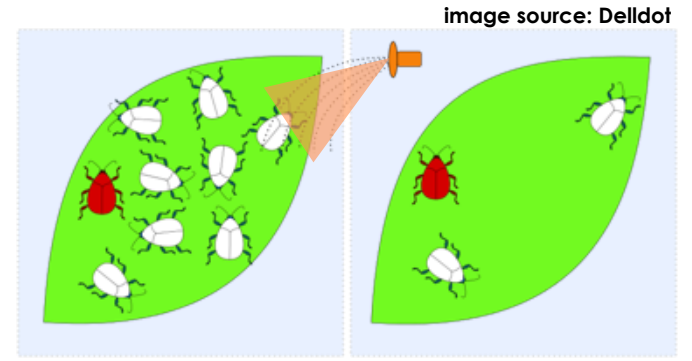
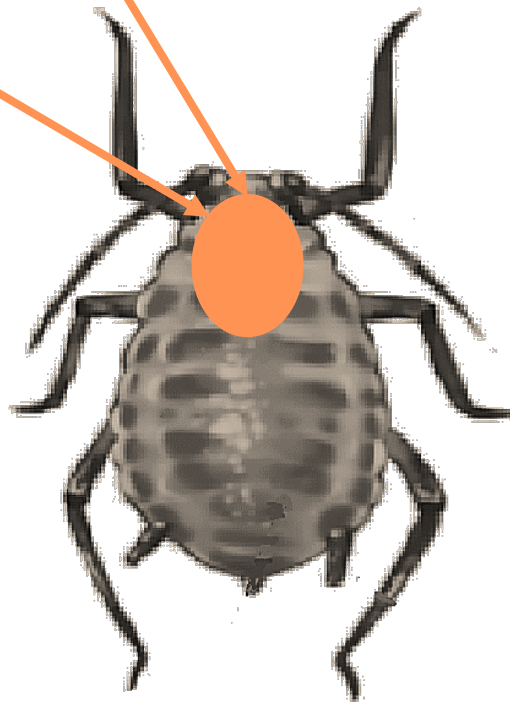
Rotation of MoA groups



Group 3a

Bifenthrin

Alpha-cypermethrin



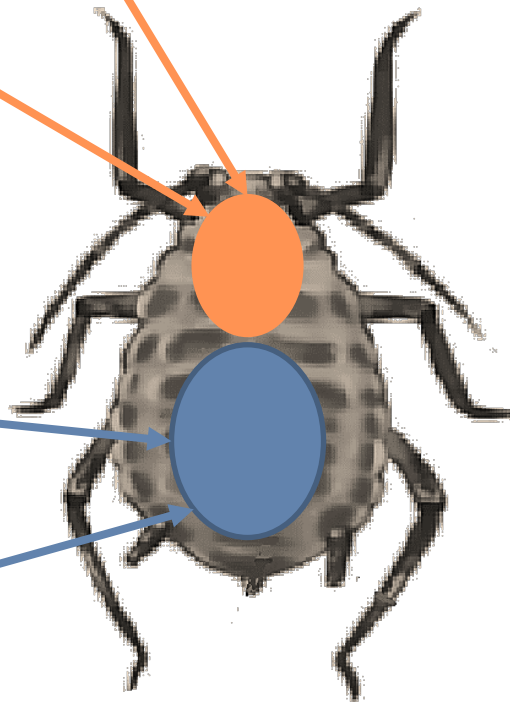
Rotation of MoA groups



Group 3a

Alpha-cypermethrin

Bifenthrin

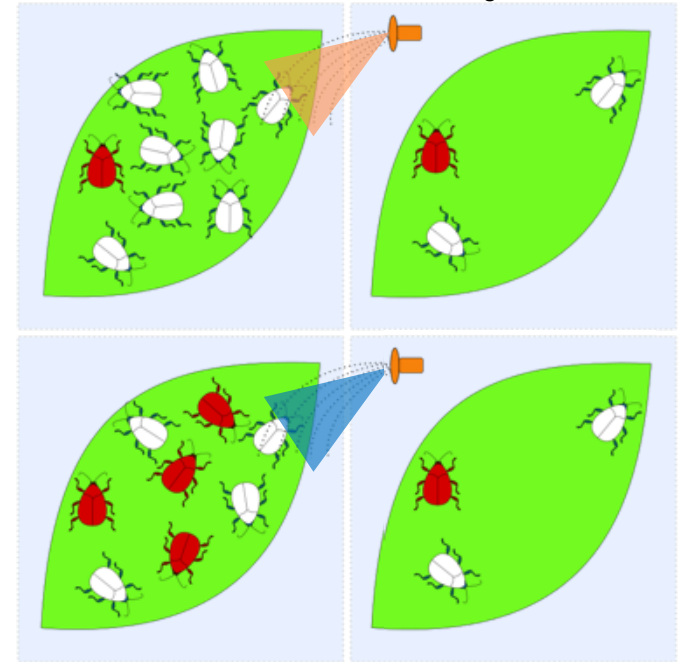


Spinetoram

Group 5

Spinosad

image source: Delldot



Beneficial insects in your crop



Source: J. Holopainen



Source: CSIRO



Source: CSIRO

Beneficial insects in your crop



Beneficial insects in your crop

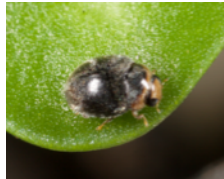


**Integrated
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PROTECTING CROPS

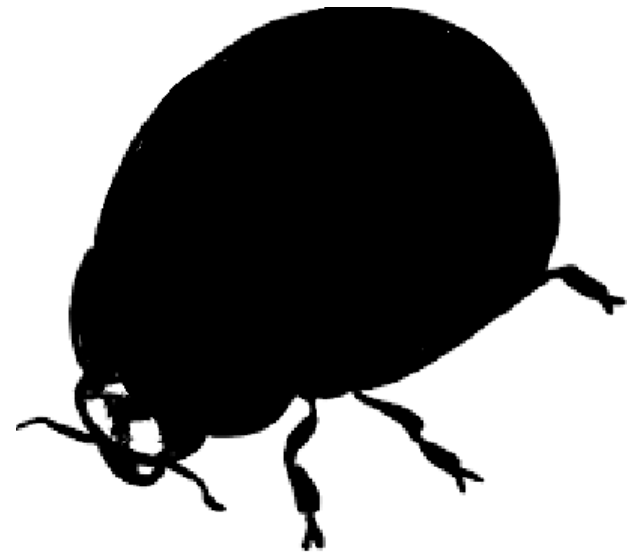
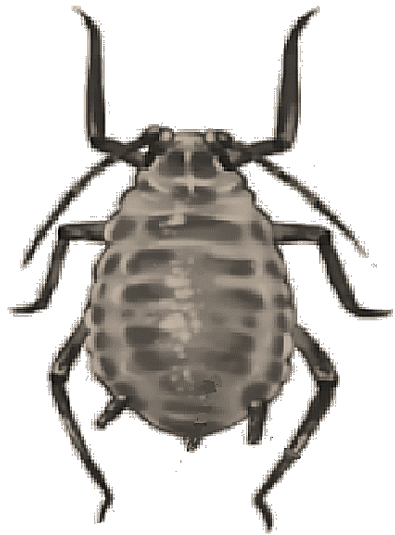


Beneficial insects in your crop

Integrated
Crop Protection
PROTECTING CROPS



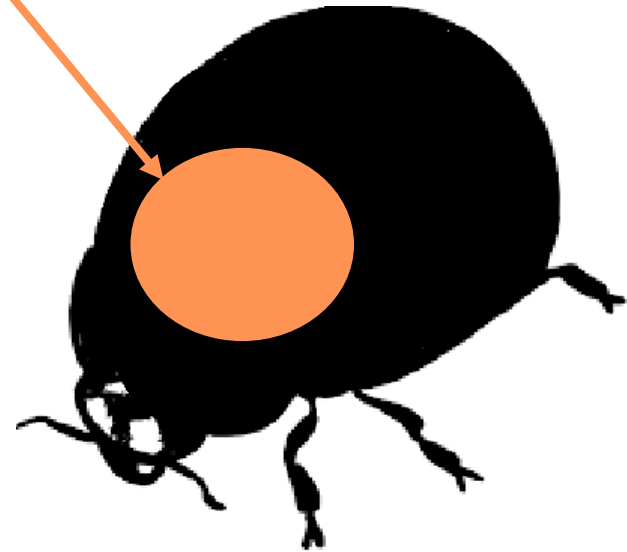
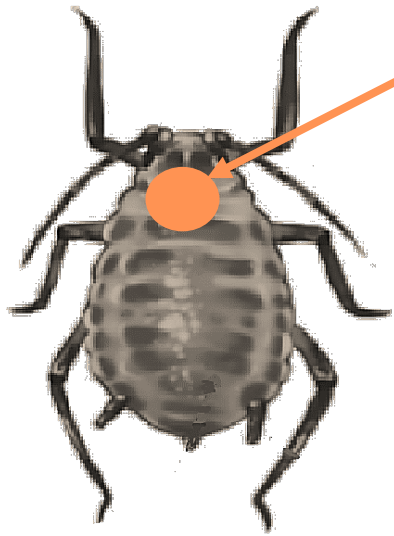
Pest vs beneficial sensitivity



Pest vs beneficial sensitivity



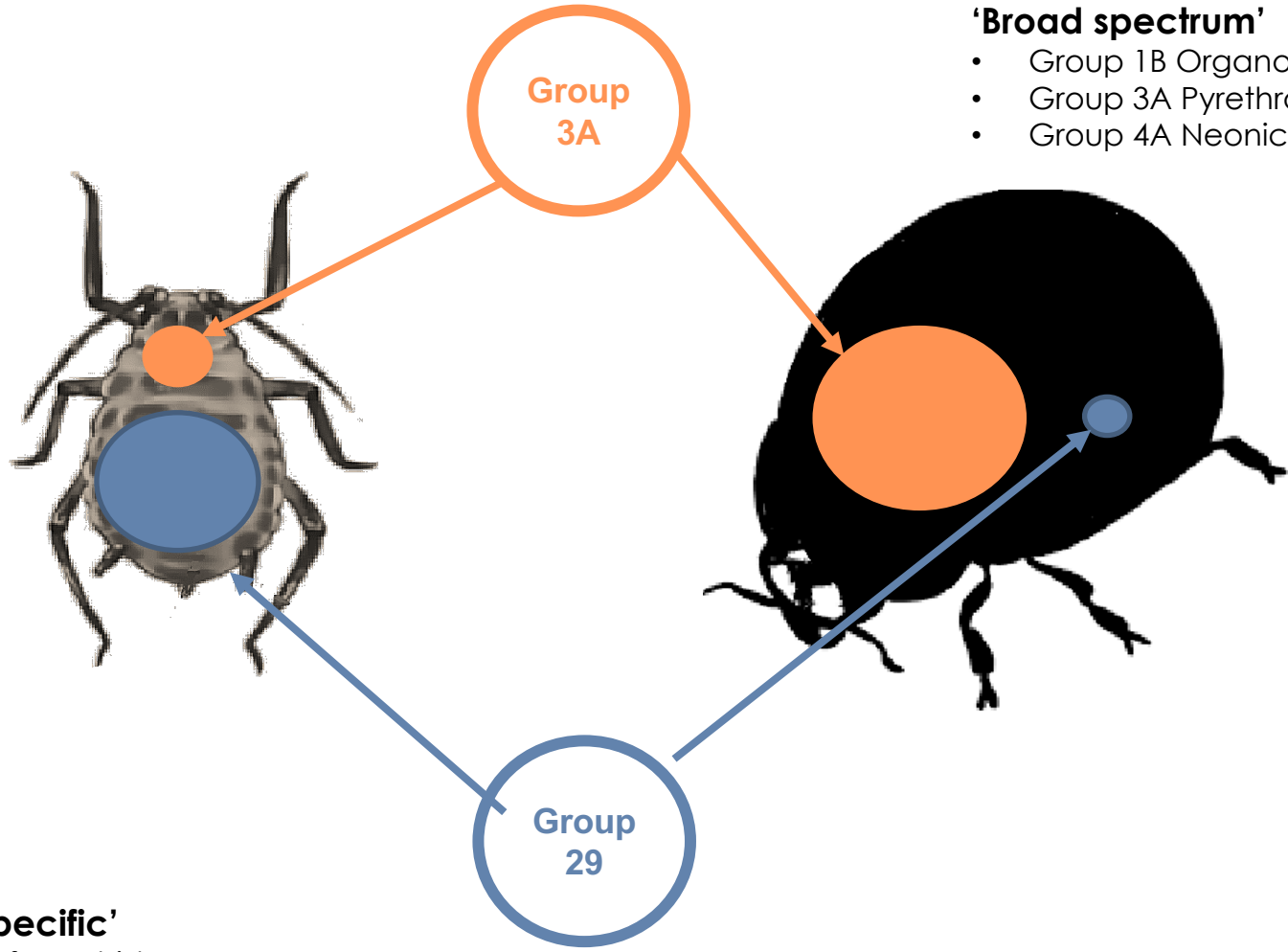
Group
3A



'Broad spectrum'

- Group 1B Organophosphates
- Group 3A Pyrethroids
- Group 4A Neonicotinoids

Pest vs beneficial sensitivity



- 'Broad spectrum'**
- Group 1B Organophosphates
 - Group 3A Pyrethroids
 - Group 4A Neonicotinoids

'Selective/Specific'
e.g. pirimicarb for aphids

Beneficial Insects and chemicals



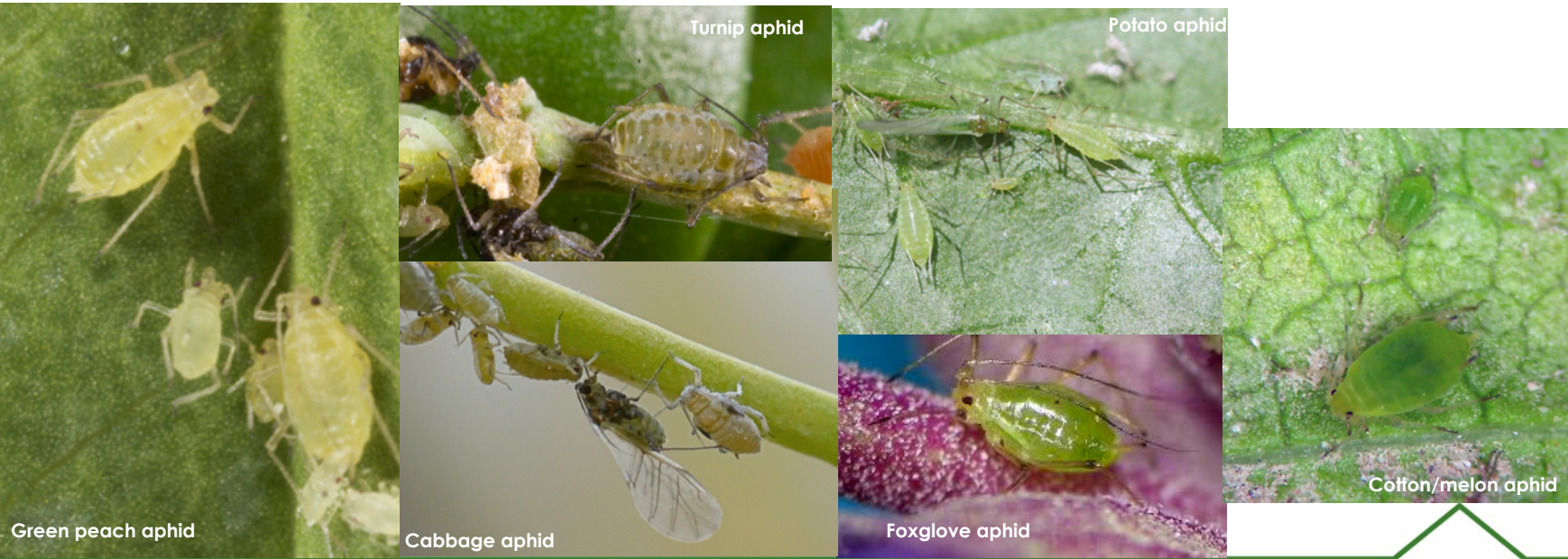
Insecticide	Predatory beetles ¹				Predatory bugs					Predatory mites	Spiders	Hymenoptera (small wasps) ⁶					Lacewing adults	Thrips ⁸	Toxicity to bees ⁹	
	Total ²	Red & Blue beetle	Minute 2-spotted lady beetle	Other lady beetles	Total ³	Damsel bugs	Big-eyed bugs	Other Predatory bugs	Apple Dimpling			Total (wasps)	<i>Eretmocerus</i> ⁷	<i>Encarsia formosa</i>	<i>Trichogramma</i>	<i>Aphytis</i>				<i>Aphidius</i>
Paraffinic Oil	VL	L	L	VL	VL	VL	VL	VL	VL	-	L	VL	-	-	VL	-	-	VL	VL	VL
Petroleum Oil	-	-	-	L	-	-	-	-	-	M	-	-	-	H	-	M	-	-	-	-
Cyantraniliprole	M	M	VL	L	M	M	M	H	L	-	M	VL	L	-	VL	-	-	VH	H	-
Spirotetramat	M	L	H	H	VL	VL	VL	VL	M	-	M	M	L	-	M	-	-	VH	M	-
Pirimicarb	H	VL	VL	L	M	L	M	VL	VL	L	VL	VL	M	H	H	L	L	L	L	VL
Fonicamid	L	VL	VL	VL	H	H	VH	H	H	-	M	M	L	-	H	-	M	L	H	-
Diafenthiuron	M	H	VL	M	L	M	VL	L	H	-	L	L	H	-	L	-	VH	L	L	M
Pymetrozine	M	M	M	M	M	L	L	VL	H	L	L	L	L	M	L	L	M	M	VL	VL
Sulfoxaflor	H	L	M	H	L	VL	L	M	VH	-	L	M	-	-	H	-	-	H	H	-
Chlorantraniliprole / Thiamethoxam	-	-	-	-	-	-	-	-	-	-	-	-	M	-	-	-	-	-	-	-
Imidacloprid (Irrigating)	H ⁴	-	-	-	VH	-	-	-	-	-	-	-	L	-	L	-	L	L	-	-
Acetamiprid	H	M	VH	H	H	M	H	M	VH	-	VL	L	H	-	H	-	H	L	VH	M ¹⁰
Imidacloprid (Spraying)	H	L	VH	H	H	M	H	L	VH	M	L	L	VH	VH	H	H	VH	M	H	M
Thiamethoxam	H	H	H	H	H	M	M	H	H	-	VL	M	M	-	H	-	VH	M	H	H
Organophosphates ⁵	H	M	H	H	H	M	H	H	VH	H	M	H	VH	VH	VH	H	VH	M	H	H
Tau-Fluvalinate	VH	-	-	-	VH	-	-	-	-	-	-	-	VH	-	VH	-	VH	M	-	-
Piperonyl Butoxide / Pyrethrins	VH	-	-	-	VH	-	-	-	VH	-	VH	VH	VH	-	VH	-	VH	H	VH	H
Bifenthrin / Chlorpyrifos	VH	-	-	-	VH	-	-	-	VH	-	VH	VH	VH	-	VH	-	VH	VH	VH	H
Permethrin	VH	-	-	H	VH	-	-	-	VH	H	VH	VH	VH	VH	VH	H	VH	VH	VH	H

Don't spray unless you need to!



Monitoring & Correct ID

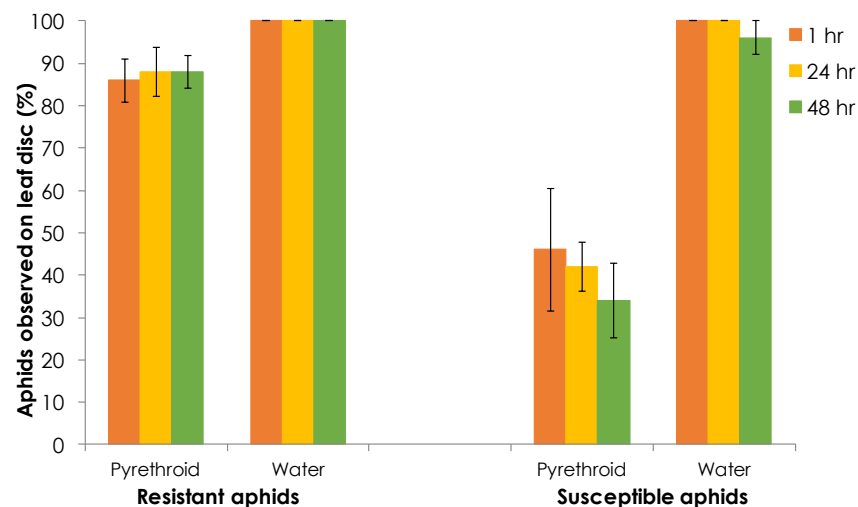
- What?** Do you have a resistant pest or another aphid species
- Where?** Know where to look for the pest in your crop
- When?** Seasonal abundance of the pest
- How?** Yellow sticky traps, hand lens
- Should I Spray?** Check economic thresholds



Non-chemical control methods



- Do not use 'insurance' sprays.
- Plant wind-barriers between crops to avoid wind-assisted pest movement
- Eliminate weed virus hosts
- Change the microclimate – watering & nutrition management



Resources

APVMA PubCRIS database search (<https://portal.apvma.gov.au/pubcris>)

IRAC website (www.iraac-online.org)

CropLife (www.croplife.org.au)

www.soilwealth.com.au

www.cesaraustralia.com

<http://horticulture.com.au/resistance-management-strategy-for-the-green-peach-aphid-in-bundaberg-field-vegetable-crops/>

@PestFactscesar 

Veg Pest ID app 



Key points

- Green peach aphid (GPA) are an important pest of vegetables, causing damage by feeding and transmitting viruses.
- Many chemical groups are registered to control GPA in vegetables. Insecticides are also registered for GPA control, and pyrethroids are registered for suppression.
- High levels of resistance to carbamates, pyrethroids and organophosphates are found across Australia. Low levels of resistance to neonicotinoids have also been observed in some GPA populations.
- A strategy to manage insecticide resistance in GPA populations is available for use by vegetable growers in Bundaberg involving rotating different chemical groups, and using alternative (GPA) methods to reduce pest and virus loads.

Green peach aphid and insecticide resistance

In Australia, the green peach aphid (GPA), *Myndus persicae*, primarily attacks Cruciferae, Solanaceae and Umbelliferae as well as being a common pest in broadcast crop (such as lettuce and broccoli). The aphid feeds by sucking sap from leaves and flower buds. When populations are large, the crop's ability to grow may be reduced, resulting in stunted growth of young plants. GPA can transmit more than 100 plant-infecting viruses, including cucumber mosaic virus (CMV) and lettuce etch virus (LEV).

Despite the name, GPA are not always green in colour, ranging from shades of light and dark green, yellow, pink and red. Scientific studies have shown that there is no difference in the level of insecticide resistance between different colour morphs of GPA. A single genetic group or clone of GPA can be made up of both green and red morphs, and these different colour morphs from a single clonal population respond in exactly the same way to insecticides.

The use of chemicals to control GPA in horticultural and vegetable crops continues to grow in Australia, placing strong selection pressure on the development of resistance. As a result, the effectiveness of the use of chemical control of GPA can be reduced. Growers are encouraged to use alternative methods to reduce the further development of resistance.

Colour morphs of green peach aphid
Photo: A. Wood, Cesar



High Priority Diseases

Disease	Type of control	Options
Bacterial wilt (<i>Bacterium</i> <i>tomato</i> sp.)	Currently registered fungicides	Copper (bioactive, PER1408, expires Sep 2022) - Group M1 - effective
	Currently permitted fungicides	Copper (bioactive, PER1408, expires Sep 2022) - Group M1 - effective
Phytophthora blight (<i>Phytophthora</i> <i>blight</i>)	Non-chemical options	Manage farm and crop hygiene Investigate waterlogging Other pest disease reduction chemicals for control (Bior)
	Currently registered fungicides	Hydrogen peroxide + prochloraz acid (PENTEC-FLUOR) - Group M Penflufenol (CONTULIO) - Group 7 Sulfur (broad) - Ineffective No use of fungicide - not used Trifluoromethyl (Group 3) - effective
Tomato yellow leaf curl virus (TYLCV)	Currently permitted fungicides	Supramite (PERMIDON, PER1484, expires Sep 2016) - Group 9 - effective Potassium bicarbonate (bioactive, PER3085, expires Aug 2017) - Group M2 - protected situations only Biquinone (BIOACT, PER1490, expires Jan 2020) - Group 11 - protected situations only
	Non-chemical options	None identified

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Thank You



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