# Pesticides and insect pest control in vegetables

Hort Innovation

ahr applied horticultural research

RMCG

IPM TECHNOLOGIES

cesar

Integrated Crop Protection

PROTECTING CROPS

# Pesticides & Chemical Groups

Integrated Crop Protection
PROTECTING CROPS

| 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

Integrated Crop Protection
PROTECTING CROPS

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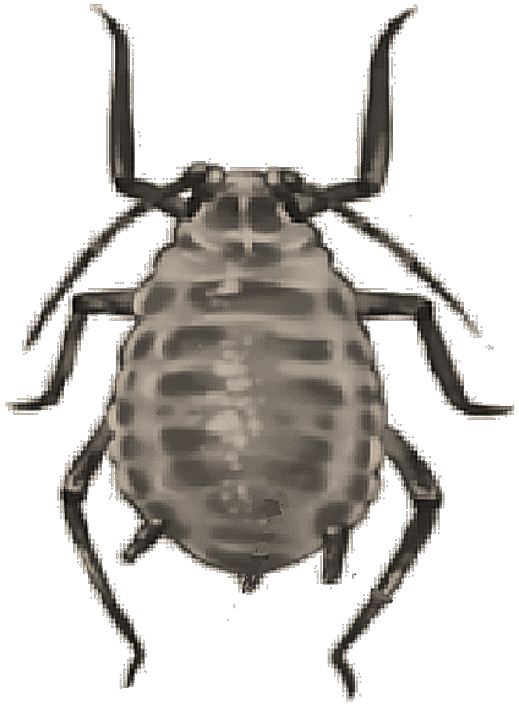
# Pesticides & Chemical Groups

Integrated Crop Protection
PROTECTING CROPS

*Alpha-cypermethrin*

*Bifenthrin*

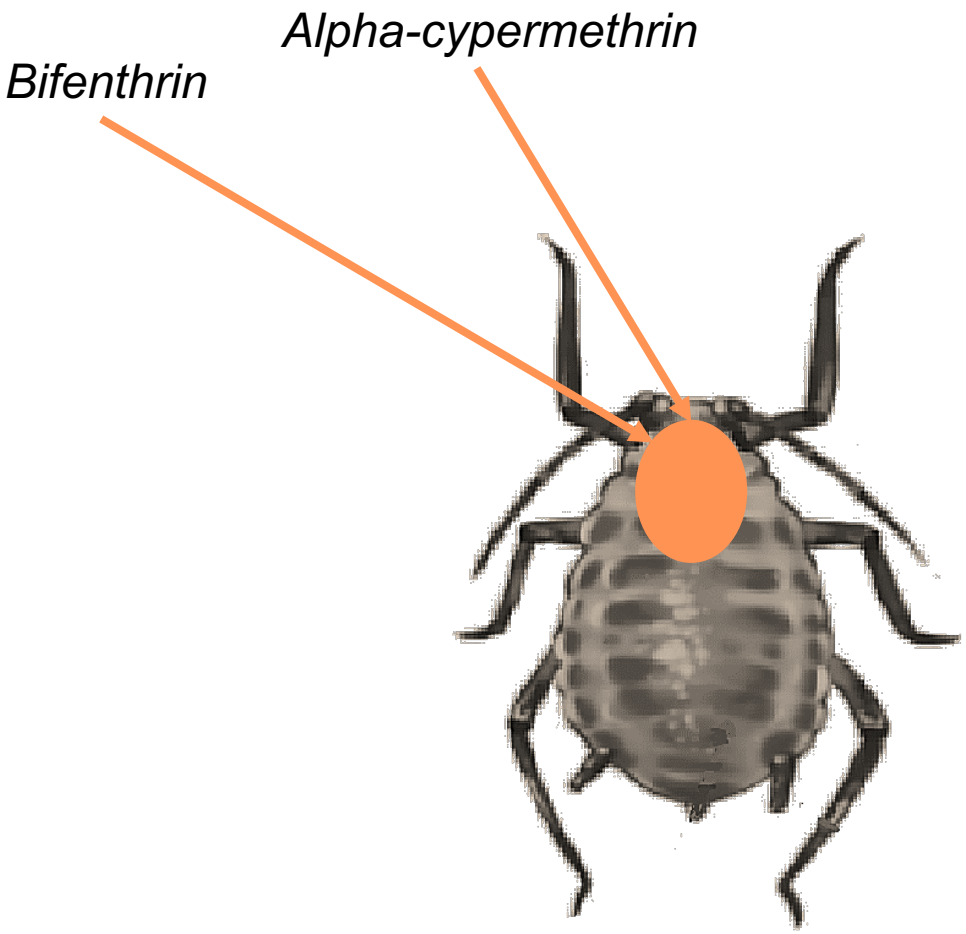


*Spinetoram*

*Spinosad*

# Pesticides & Chemical Groups

Integrated Crop Protection
PROTECTING CROPS

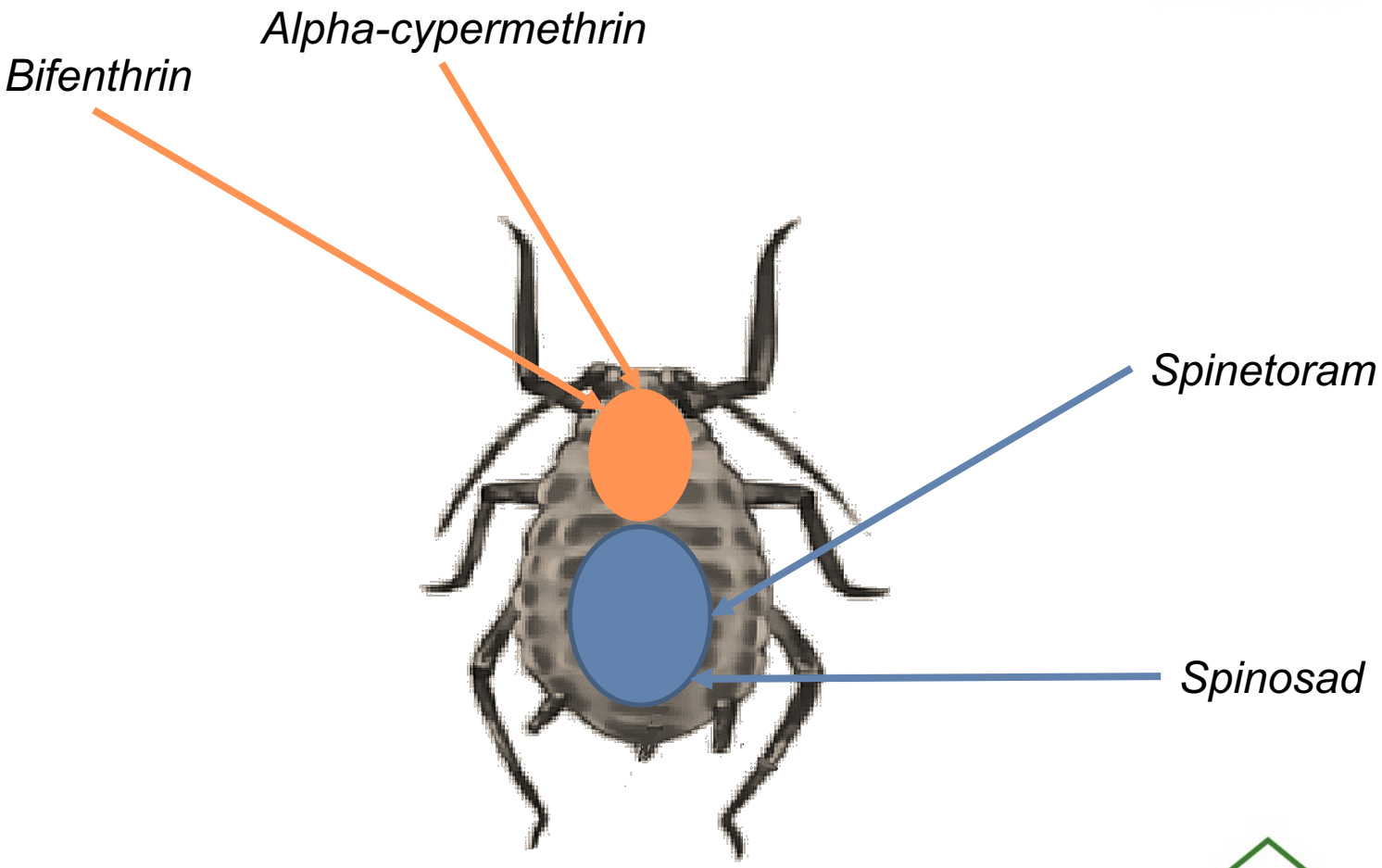



*Spinetoram*

*Spinosad*

# Pesticides & Chemical Groups

Integrated Crop Protection
PROTECTING CROPS



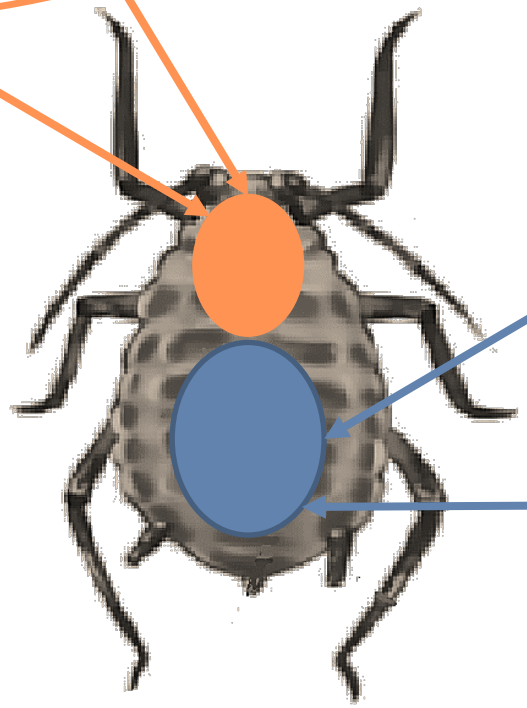
# Pesticides & Chemical Groups

Integrated Crop Protection
PROTECTING CROPS

**Group 3a**

*Alpha-cypermethrin*

*Bifenthrin*



*Spinetoram*

**Group 5**

*Spinosad*

IRAC
Insecticide Resistance Action Committee

# Pesticides & Chemical Groups

IRAC
Insecticide Resistance Action Committee

Integrated Crop Protection
PROTECTING CROPS

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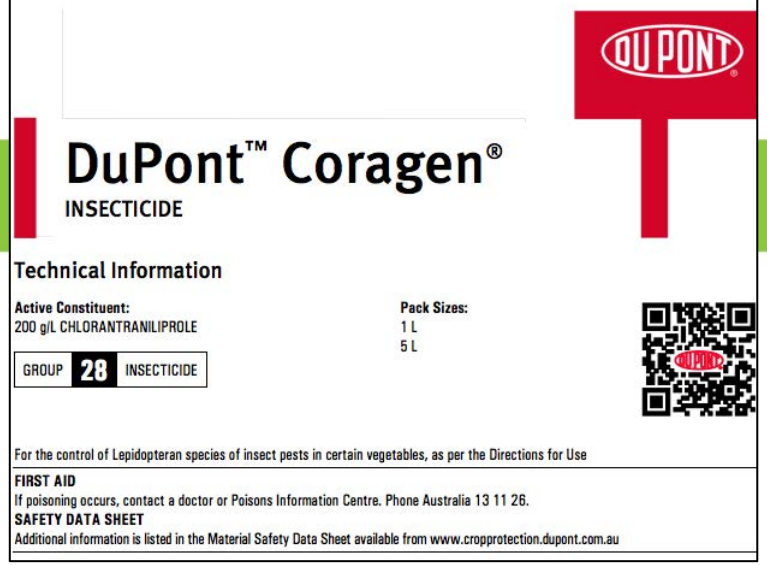
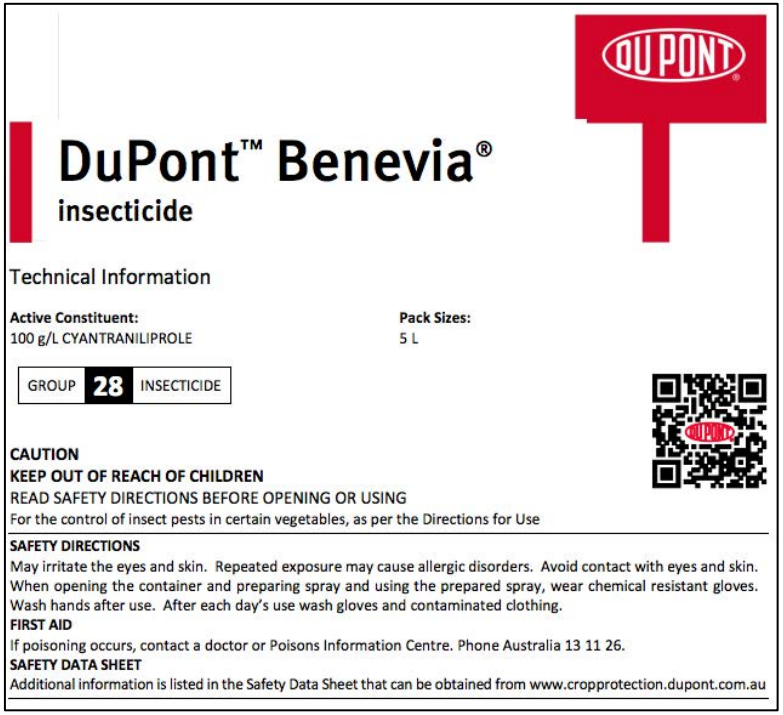

DuPont™ Coragen®
INSECTICIDE
Technical Information
Active Constituent:
200 g/L CHLORANTRANILIPROLE
Pack Sizes:
1 L
5 L
GROUP 28 INSECTICIDE
For the control of Lepidopteran species of insect pests in certain vegetables, as per the Directions for Use
FIRST AID
If poisoning occurs, contact a doctor or Poisons 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™ Benevia®
insecticide
Technical Information
Active Constituent:
100 g/L CYANTRANILIPROLE
Pack Sizes:
5 L
GROUP 28 INSECTICIDE
CAUTION
KEEP OUT OF REACH OF CHILDREN
READ SAFETY DIRECTIONS BEFORE OPENING OR USING
For the control of insect pests in certain vegetables, as per the Directions for Use
SAFETY DIRECTIONS
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.
FIRST AID
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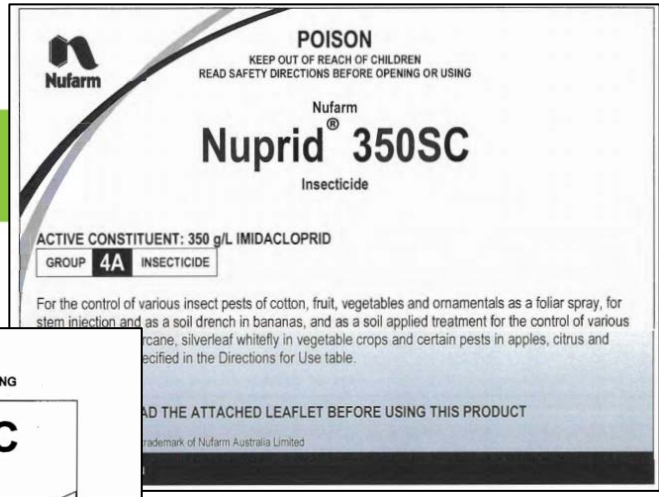
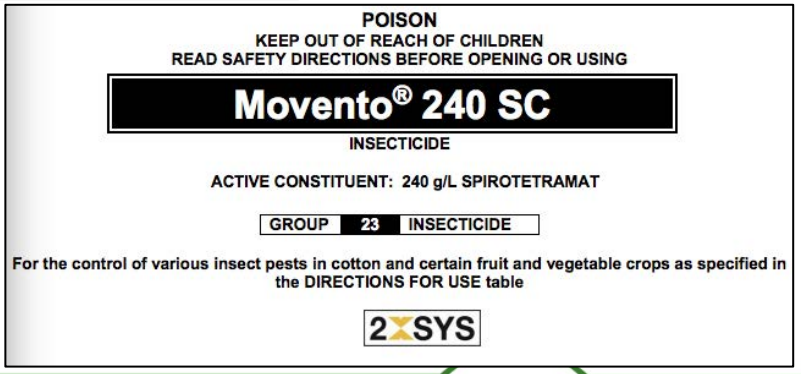

Nufarm
POISON
KEEP OUT OF REACH OF CHILDREN
READ SAFETY DIRECTIONS BEFORE OPENING OR USING
Nufarm
Nuprid® 350SC
Insecticide
ACTIVE CONSTITUENT: 350 g/L IMIDACLOPRID
GROUP 4A INSECTICIDE
For the control of various insect pests of cotton, fruit, vegetables and ornamentals as a foliar spray, for
as a soil 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
ecified in the Directions for Use table.
AD THE ATTACHED LEAFLET BEFORE USING THIS PRODUCT
rademark of Nufarm Australia Limited


CAUTION
KEEP OUT OF REACH OF CHILDREN
READ SAFETY DIRECTIONS BEFORE OPENING OR USING
Confidor® 200 SC
Insecticide
RLP Approved
DISPLAYED
INFOPEST
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
KEEP OUT OF REACH OF CHILDREN
READ SAFETY DIRECTIONS BEFORE OPENING OR USING
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
2XSYS

# 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™ Benevia®

insecticide

## Technical Information

**Active Constituent:**
100 g/L CYANTRANILIPROLE

**Pack Sizes:**
5 L

GROUP 28 INSECTICIDE

**CAUTION**
**KEEP OUT OF REACH OF CHILDREN**
READ SAFETY DIRECTIONS BEFORE OPENING OR USING
For the control of insect pests in certain vegetables, as per the Directions for Use

**SAFETY DIRECTIONS**
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.
**FIRST AID**
If poisoning occurs, contact a doctor or Poisons Information Centre. Phone Australia 13 11 26.
**SAFETY DATA SHEET**
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**CAUTION**
KEEP OUT OF REACH OF CHILDREN
READ SAFETY DIRECTIONS BEFORE OPENING OR USING

# 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**
KEEP OUT OF REACH OF CHILDREN
READ SAFETY DIRECTIONS BEFORE OPENING OR USING

Nufarm

# 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 [illegible]rcane, silverleaf whitefly in vegetable crops and certain pests in apples, citrus and [illegible]ecified in the Directions for Use table.

[illegible]AD THE ATTACHED LEAFLET BEFORE USING THIS PRODUCT

[illegible]rademark of Nufarm Australia Limited

**POISON**
**KEEP OUT OF REACH OF CHILDREN**
**READ SAFETY DIRECTIONS BEFORE OPENING OR USING**

# Movento® 240 SC

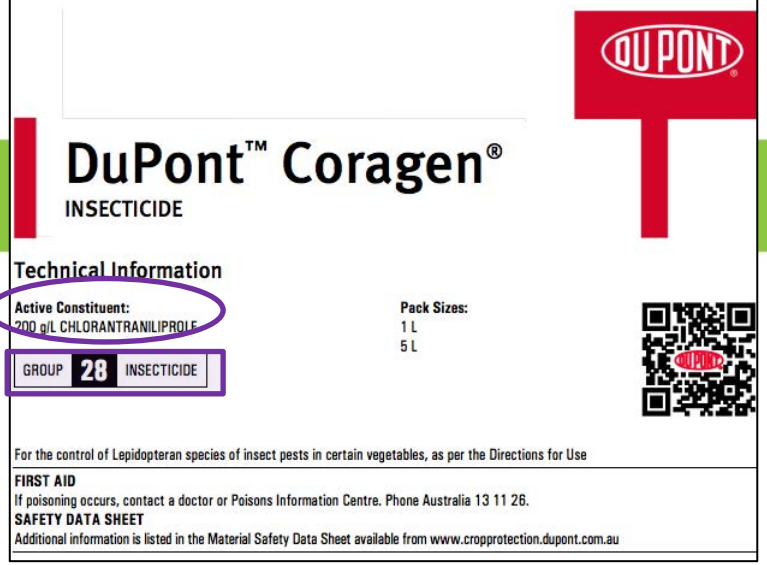
**INSECTICIDE**

**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**

2XSYS



DuPont™ Coragen®
INSECTICIDE

Technical Information

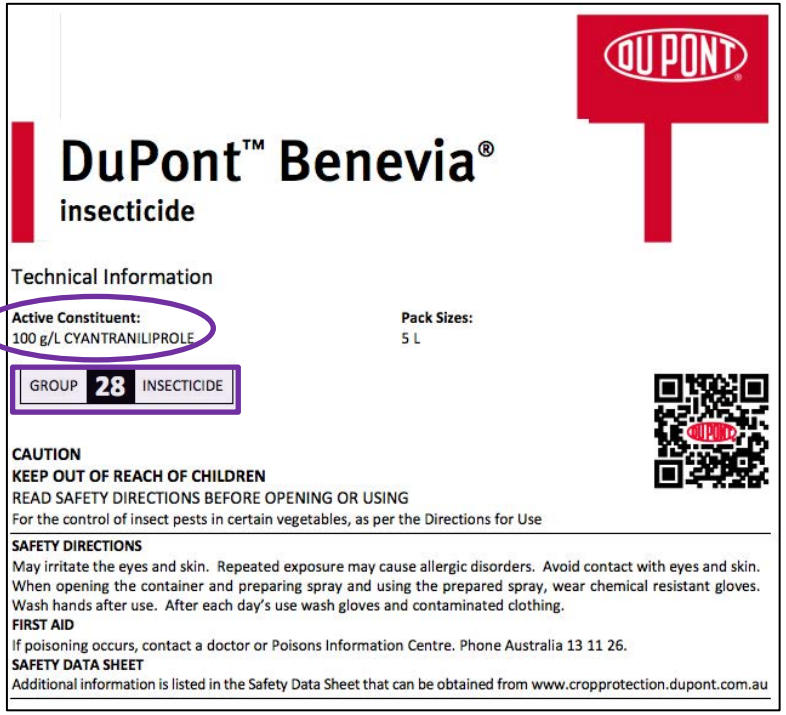
Active Constituent:
200 g/L CHLORANTRANILIPROLE

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™ Benevia®
insecticide

Technical Information

Active Constituent:
100 g/L CYANTRANILIPROLE

Pack Sizes:
5 L

GROUP 28 INSECTICIDE

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

SAFETY DIRECTIONS
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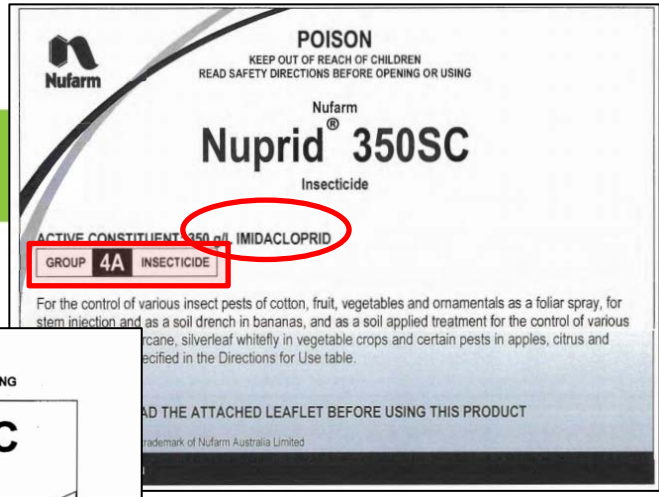


POISON
KEEP OUT OF REACH OF CHILDREN
READ SAFETY DIRECTIONS BEFORE OPENING OR USING

Nufarm

Nufarm
Nuprid® 350SC
Insecticide

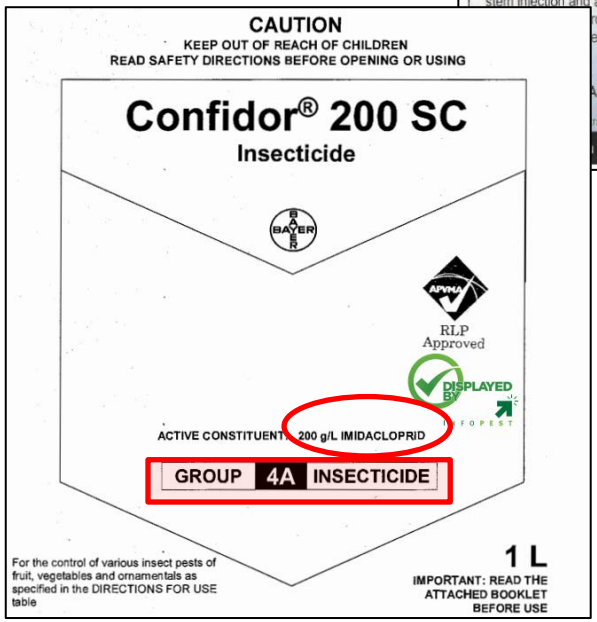
ACTIVE CONSTITUENT: 350 g/L IMIDACLOPRID

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 ...rcane, silverleaf whitefly in vegetable crops and certain pests in apples, citrus and ...ecified in the Directions for Use table.

...AD THE ATTACHED LEAFLET BEFORE USING THIS PRODUCT

...rademark of Nufarm Australia Limited



CAUTION
KEEP OUT OF REACH OF CHILDREN
READ SAFETY DIRECTIONS BEFORE OPENING OR USING

Confidor® 200 SC
Insecticide

BAYER

APVMA
RLP Approved

DISPLAYED BY INFOPEST

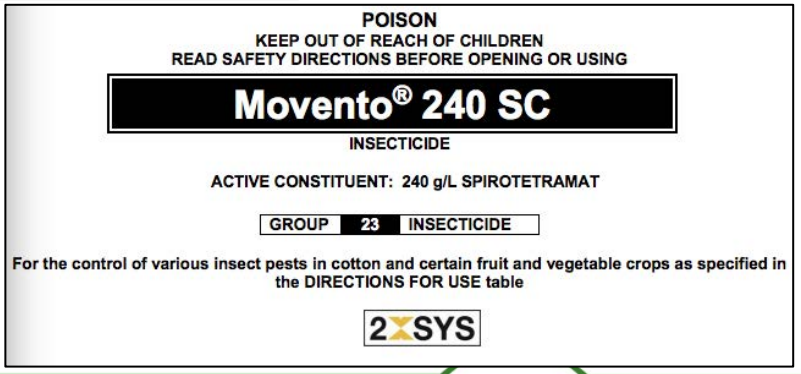
ACTIVE CONSTITUENT: 200 g/L IMIDACLOPRID

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
KEEP OUT OF REACH OF CHILDREN
READ SAFETY DIRECTIONS BEFORE OPENING OR USING

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

2XSYS

# 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™ Benevia®

insecticide

## Technical Information

**Active Constituent:**
100 g/L CYANTRANILIPROLE

**Pack Sizes:**
5 L

GROUP 28 INSECTICIDE

**CAUTION**
**KEEP OUT OF REACH OF CHILDREN**
READ SAFETY DIRECTIONS BEFORE OPENING OR USING
For the control of insect pests in certain vegetables, as per the Directions for Use

**SAFETY DIRECTIONS**
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**POISON**
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Nufarm

# 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 ...rcane, silverleaf whitefly in vegetable crops and certain pests in apples, citrus and ...ecified in the Directions for Use table.

...AD THE ATTACHED LEAFLET BEFORE USING THIS PRODUCT

...rademark of Nufarm Australia Limited

**CAUTION**
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READ SAFETY DIRECTIONS BEFORE OPENING OR USING

# Confidor® 200 SC

Insecticide

RLP Approved

DISPLAYED BY INFOPEST

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**
KEEP OUT OF REACH OF CHILDREN
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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

2XSYS

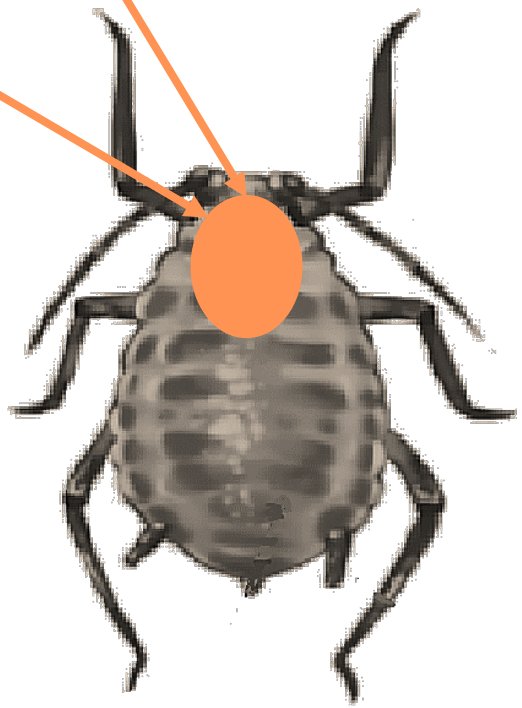
# Evolution of pesticide resistance

Integrated Crop Protection
PROTECTING CROPS

## Group 3a

*Alpha-cypermethrin*

*Bifenthrin*



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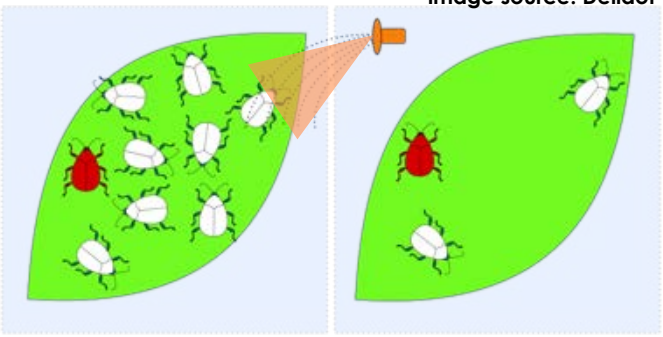


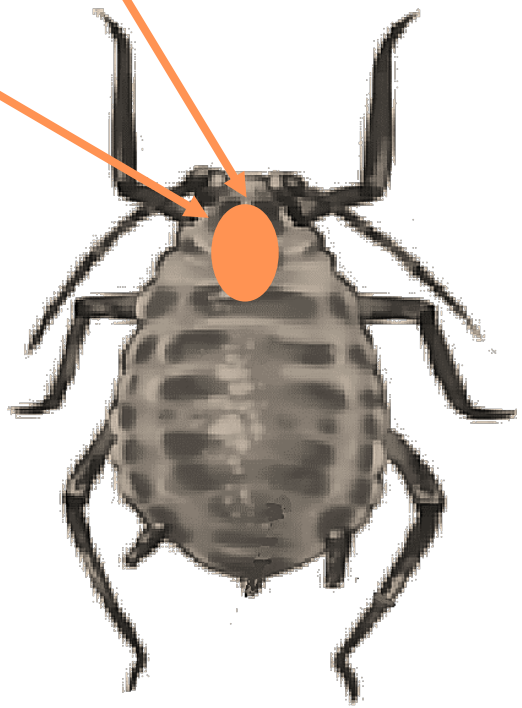
# Evolution of pesticide resistance

Integrated Crop Protection
PROTECTING CROPS

## Group 3a

*Alpha-cypermethrin*

*Bifenthrin*



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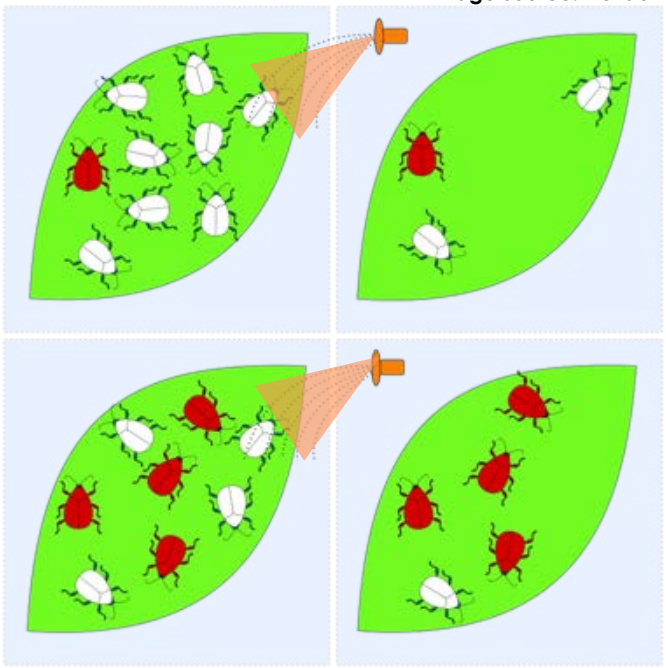


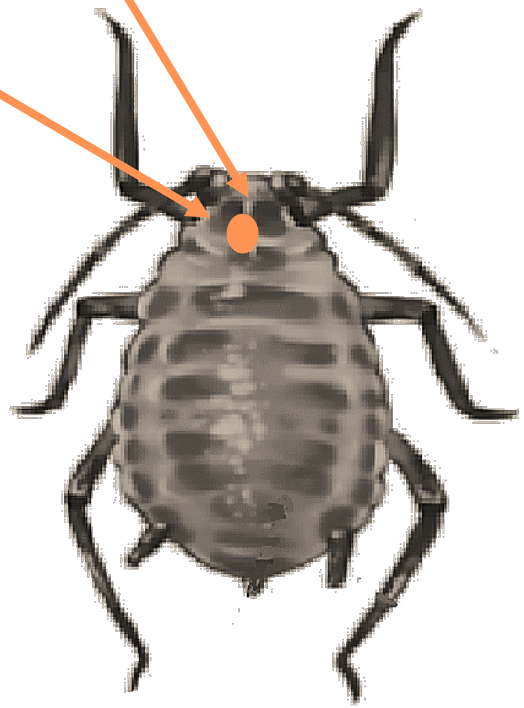
# Evolution of pesticide resistance

Integrated Crop Protection
PROTECTING CROPS

## Group 3a

*Alpha-cypermethrin*

*Bifenthrin*



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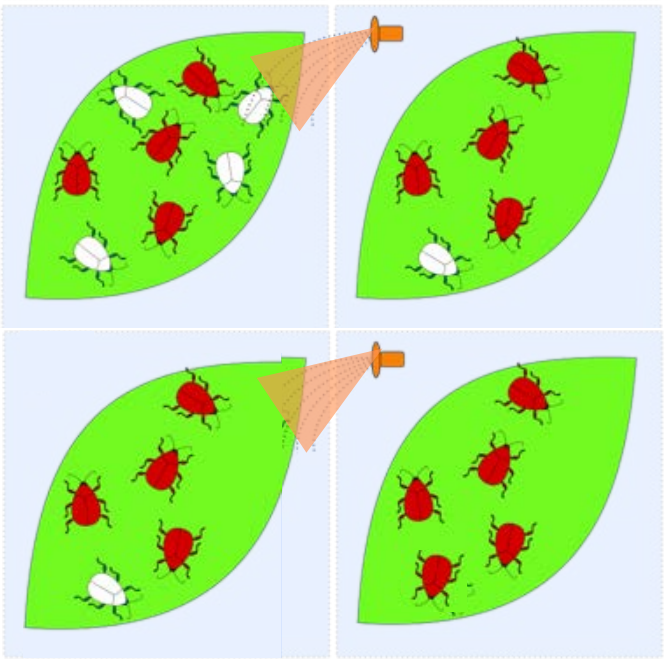
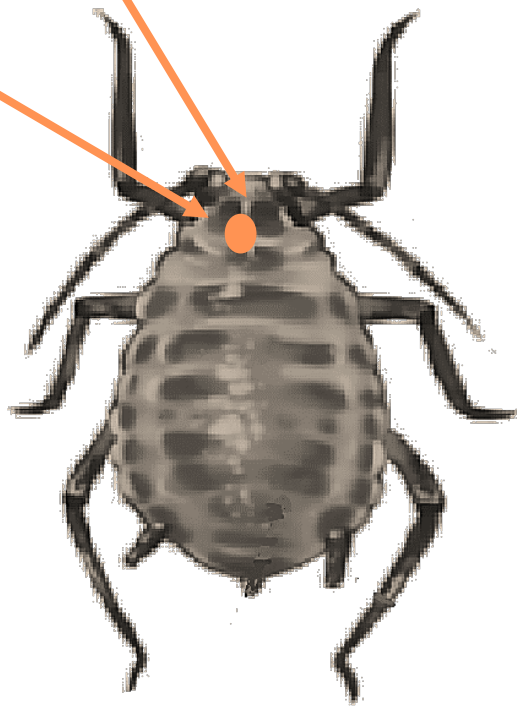


# Evolution of pesticide resistance

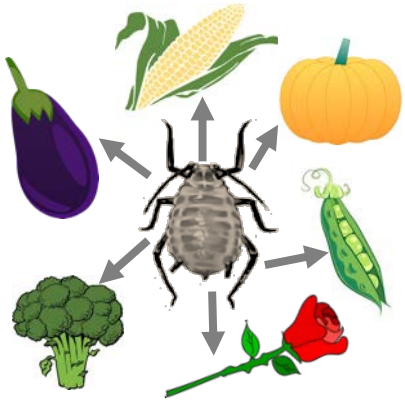
## Group 3a

*Bifenthrin*

*Alpha-cypermethrin*



Integrated Crop Protection
PROTECTING CROPS



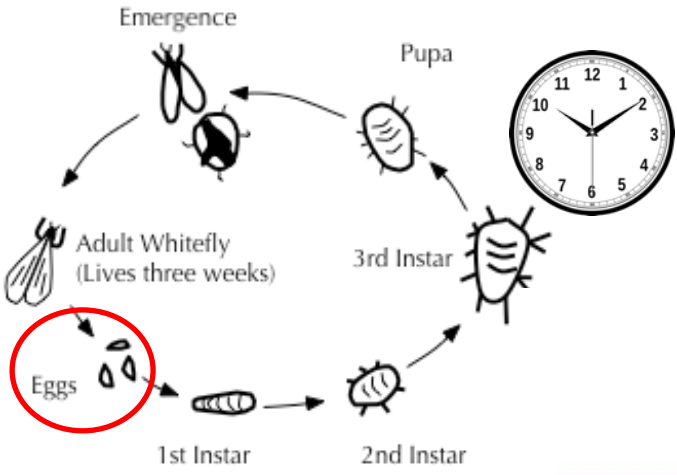



image source: Quercusrobor

# Resistant pests in vegetable crops




# Green peach aphid control in veg

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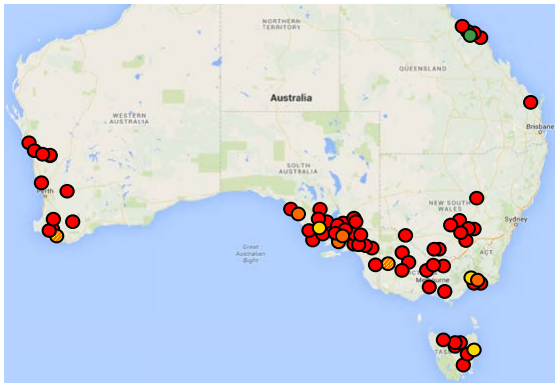
| MoA | Active ingredients | Resistance |
|---|---|---|
| Group 1A | Pirimicarb | yes |
| Group 1B | Chlorpyrifos, Diazinon, Dimethoate, Maldison, Omethoate, Phorate | yes |
| Group 3A | Permethrin, Tau-fluvalinate, Pyrethrins, Piperonyl butoxide | yes |
| Group 4A | Thiamethoxam, Imidacloprid, Acetimiprid | 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

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| 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 | *Bacillus thuringiensis* | - |
| 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

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| 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 | - |



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 | - |


Source: Rasbak


Source: Gilles San Martin

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

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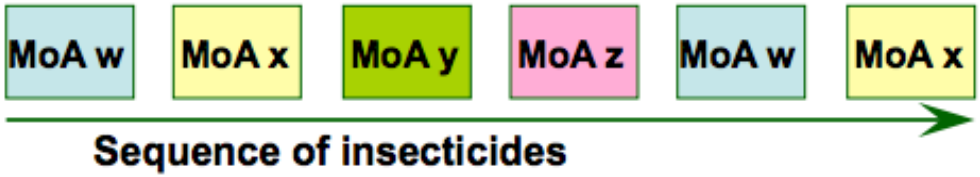
Resistance Management strategies are available for most pests.

Key message (if chemical control is needed):

**Rotate between different IRAC MoA groups**







**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:**

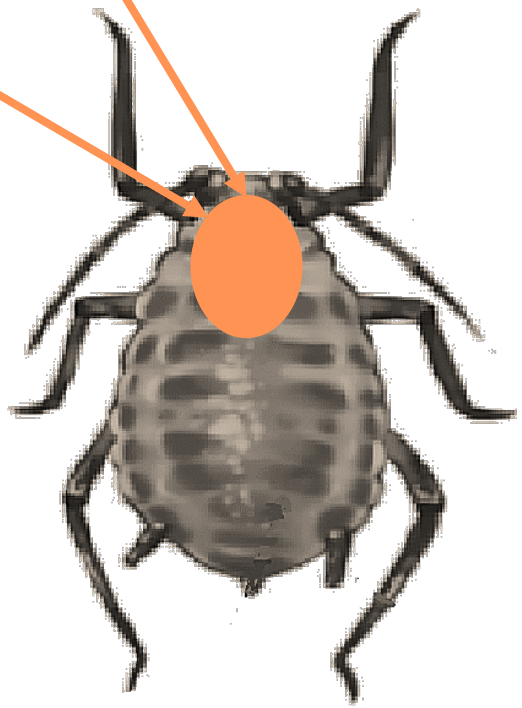
1. Monitor pest numbers and apply control measures before adult populations reach high levels.
2. Select registered insecticide control measures accordingto the primary growth stage of the pest, the infestation level and the age and type of crop.
3. In cotton, spray decisions should be based on the Silverleaf 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

*Alpha-cypermethrin*

*Bifenthrin*



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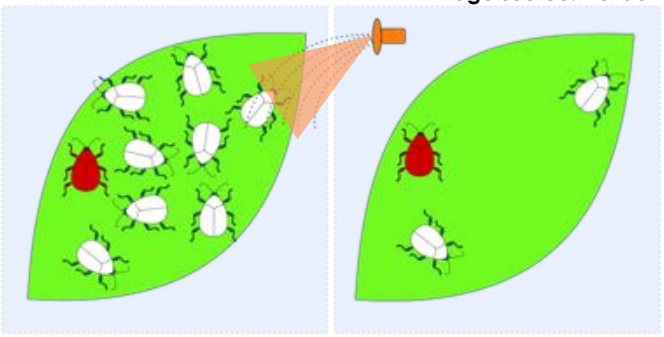
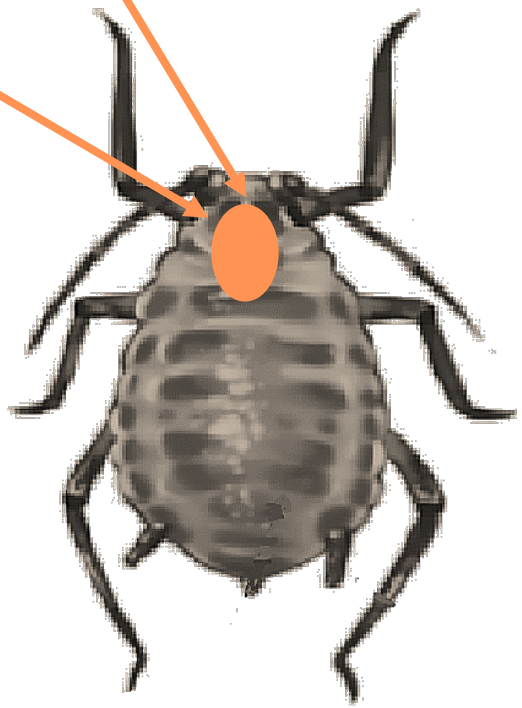


# Rotation of MoA groups

## Group 3a

*Alpha-cypermethrin*

*Bifenthrin*



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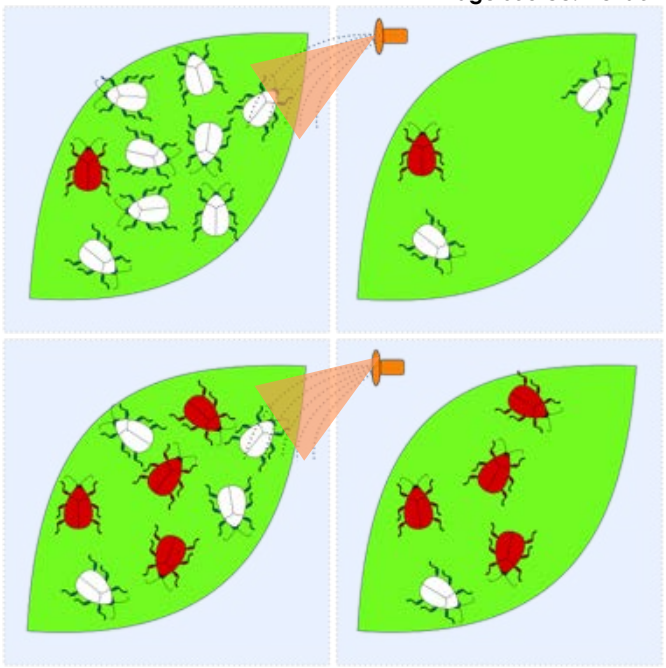

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*Alpha-cypermethrin*

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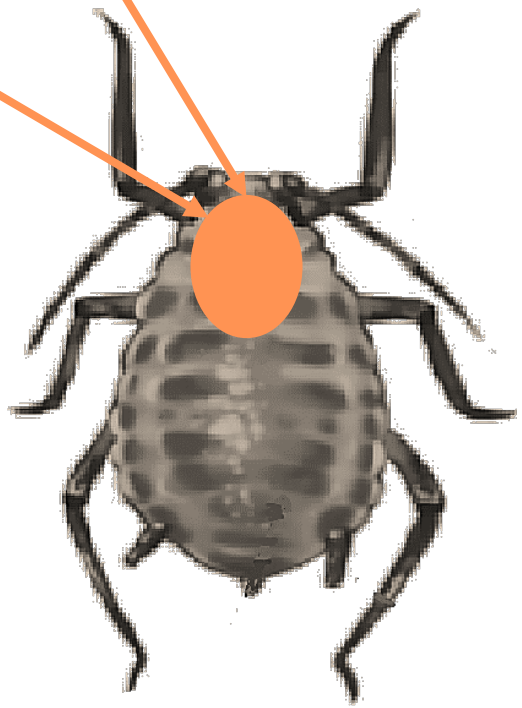

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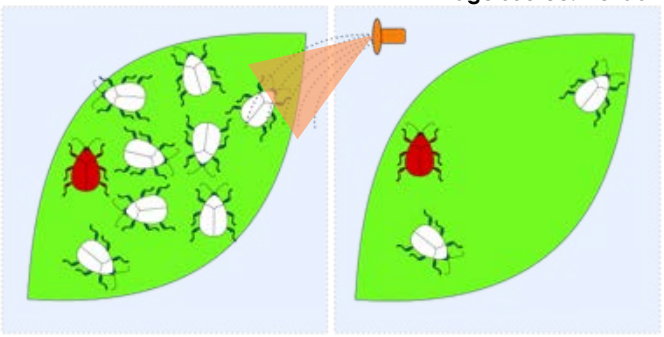

# Rotation of MoA groups

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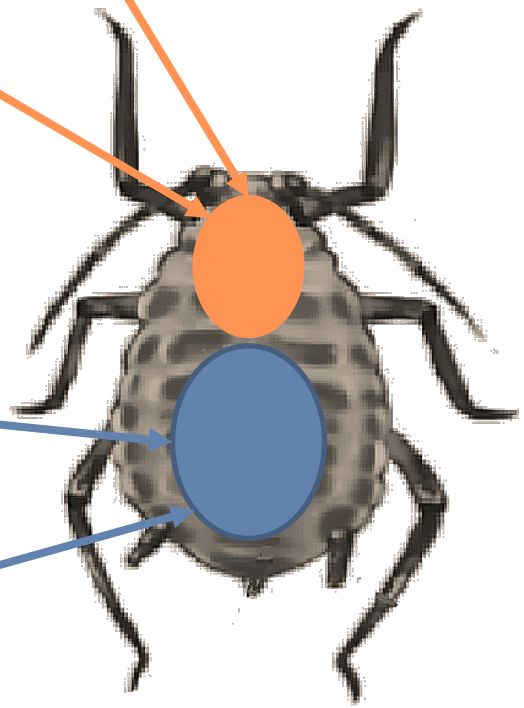
**Group 3a**

*Alpha-cypermethrin*

*Bifenthrin*



*Spinetoram*

**Group 5**

*Spinosad*

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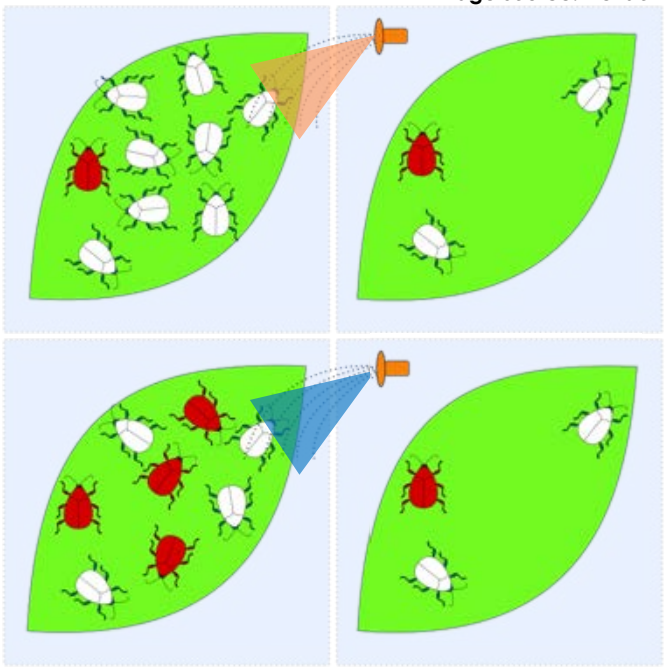

# Beneficial insects in your crop

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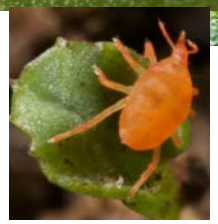
Integrated Crop Protection
PROTECTING CROPS



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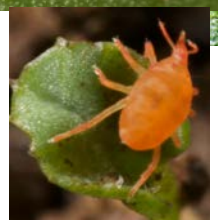
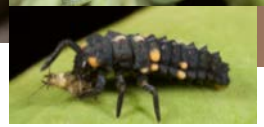
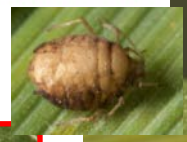
PROTECTING CROPS











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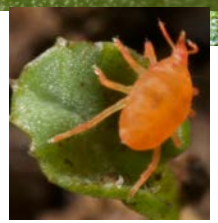



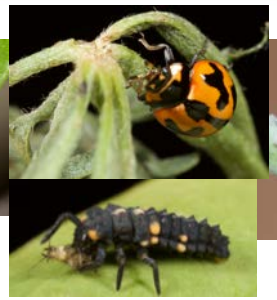

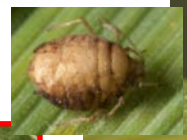









# Pest vs beneficial sensitivity

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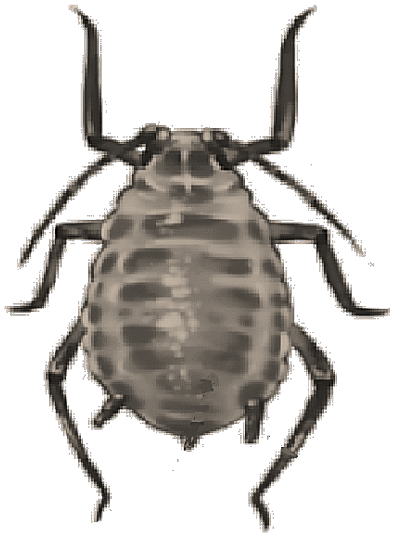
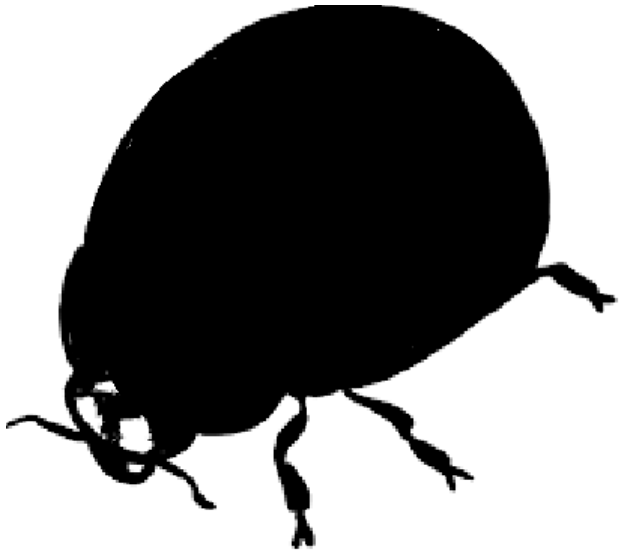
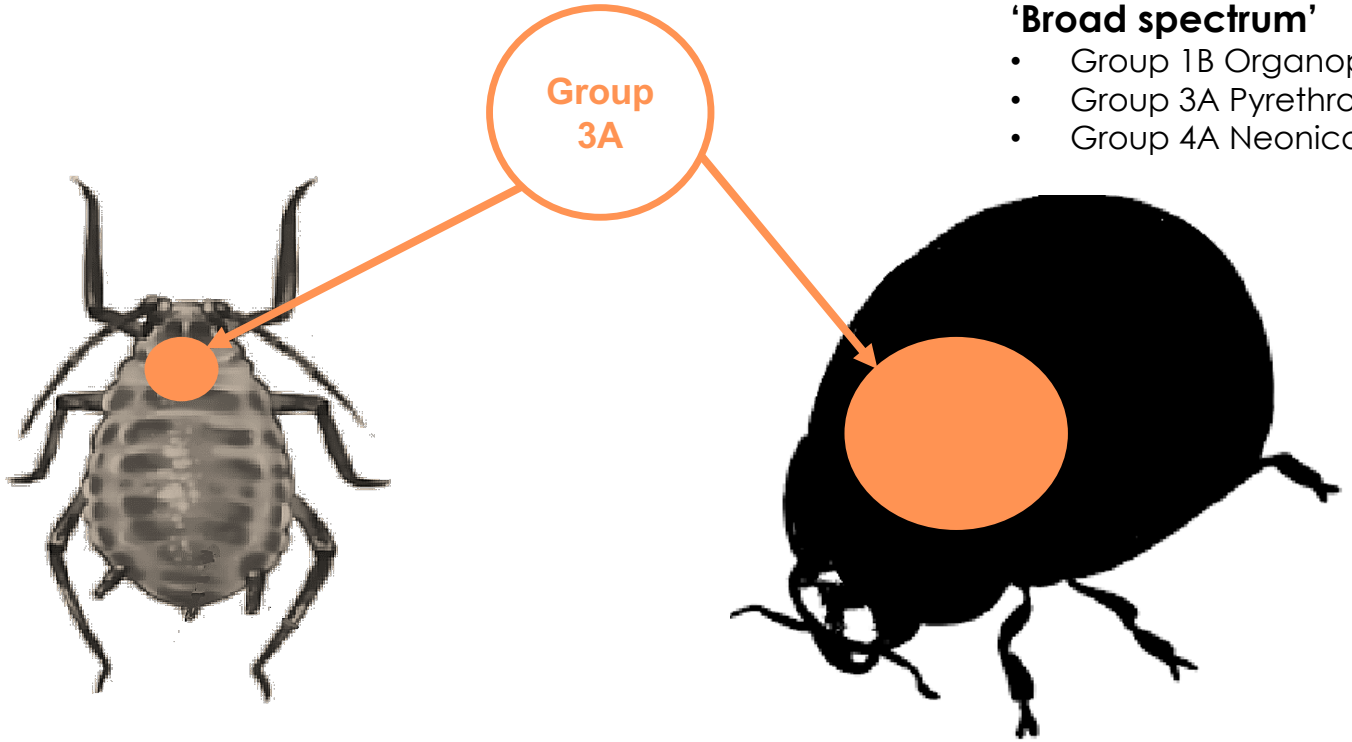




# Pest vs beneficial sensitivity

**'Broad spectrum'**

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



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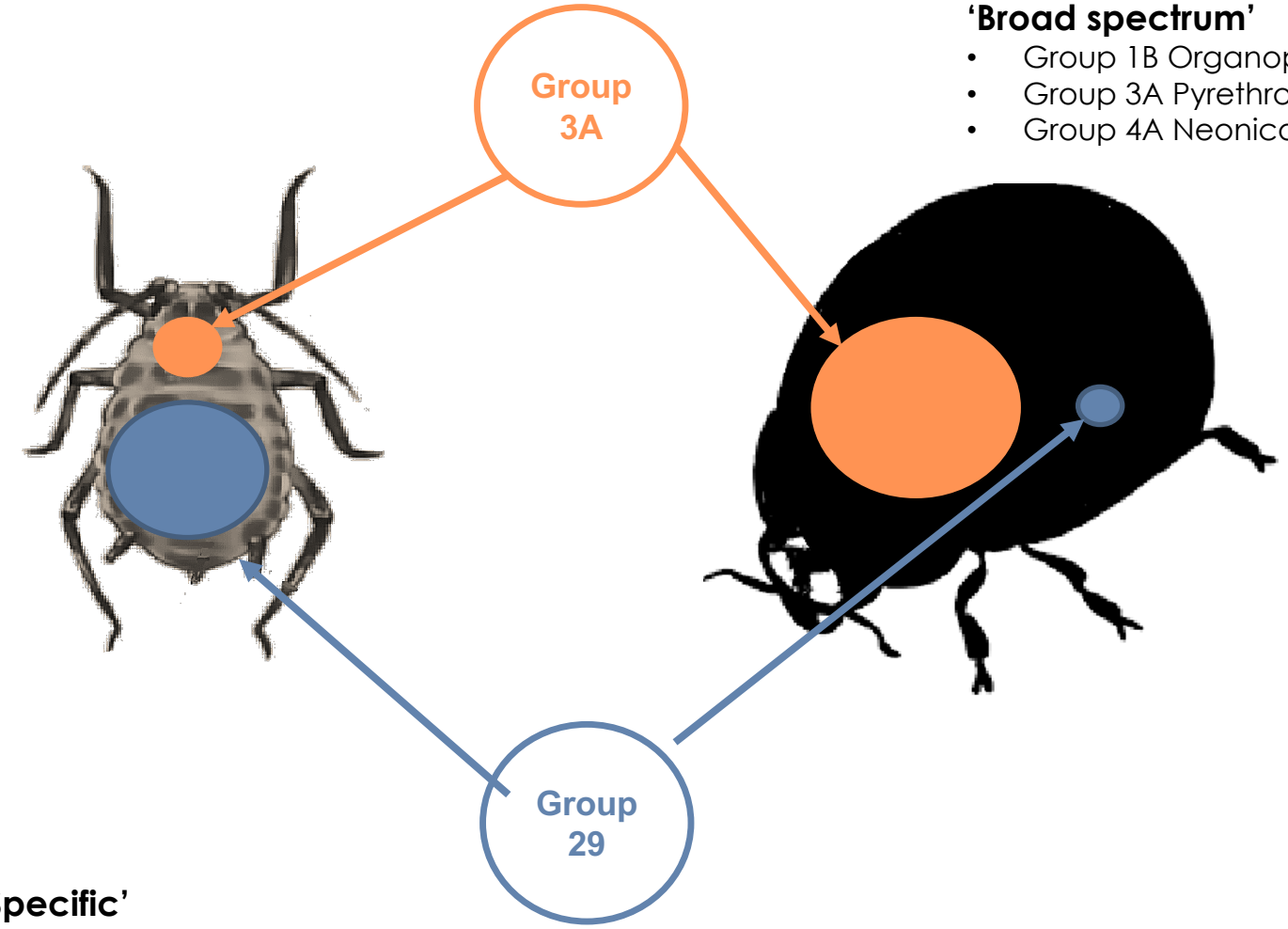


**'Selective/Specific'**
e.g. pirimicarb for aphids

# Beneficial Insects and chemicals

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| 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) | *Eretmocerus*[7] | *Encarsia formosa* | *Trichogramma* | *Aphytis* | *Aphidius* | | | |
| 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 |
| Flonicamid | 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!

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## 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

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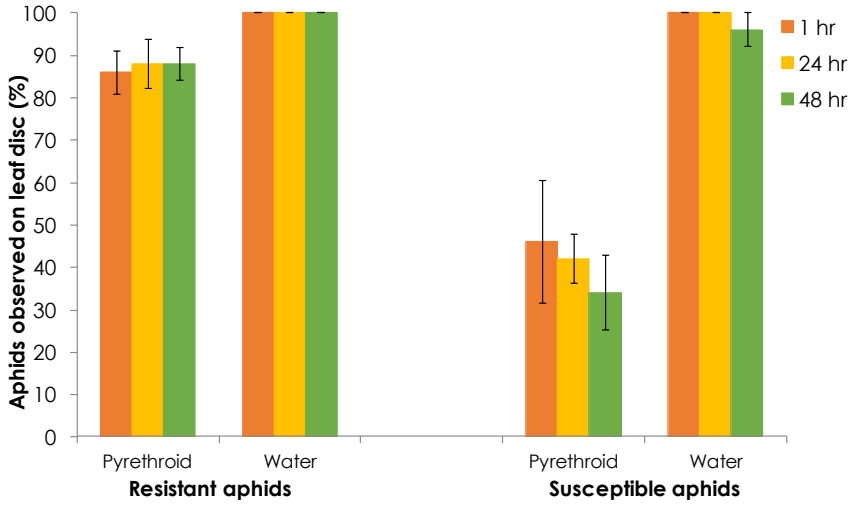
- Do not use 'insurance' sprays.
- Plant wind-barriers between crops to avoid wind-assisted pest movement
- Eliminate weed virus hosts
- Change the microclimate – watering & nutrition management

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## Resources

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

**IRAC website (www.irac-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**



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