Effective resistance management for the neonicotinoids:

Industry's approach to ensure the continued efficacy of a key insecticide class

IRAC Symposium on Insecticide Sustainability: Neonicotinoids
ESA Annual Meeting, December 2005

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Syngenta, [1]Jealotts Hill, Bracknell, UK and [2]Stein, Switzerland

Outline

Why effective Resistance Management is essential

What industry is doing:

- **Company level**
  - **Resistance Management Strategy for a Neonicotinoid – A typical responsible company approach to IRM**
- **Inter-company level**
  - **Collaborative Industrial Approach to IRM for Neonicotinoids – An industry partnership to ensure sustainability**
- **All-industry level**
  - **Role of Insecticide Resistance Action Committee (IRAC)**





Why Effective Resistance Management is essential

- Sustaining effective commercial life of current insecticides requires intelligent use of presently available compounds
  - Insecticide Resistance Management (IRM)

- For any crop / pest situation, effective IRM requires the availability of a broad range of modes of action

- IRM is made much more difficult by loss of modes of action through resistance development caused by misuse or overuse of insecticides

- We can no longer rely on having a steady stream of new modes of action to circumvent resistance problems…….

Protecting current AIs from resistance is crucial !

- **Finding and developing new insecticides is extremely costly & difficult**
- **We cannot accept losing them to resistance!**

Cost of developing and registering a new chemical crop protection AI in year 2000 ($M) [Source: ECPA, 2003]

Category	Sub-category	Costs	Total Cost
Research	Chemistry	41	94
	Biology	44	
	Toxicology / Environmental Chemistry	9	
Development	Chemistry	20	79
	Field Trials	25	
	Toxicology	18	
	Environmental Chemistry	16	
Registration			11
Total			184

What industry is doing at a company level

Resistance Management Strategy for a Neonicotinoid

Responsible companies have clear guidelines to manage resistance to Neonicotinoids:

'To prevent the development and spread of resistance, applications of Thiamethoxam and other Neonicotinoid insecticides should be applied in 'block' applications where:

The total duration of the neo-nicotinoid 'blocks' <u>does not exceed more than half</u> of the crop cycle (vegetative period). The duration of a block application should be based on either:

- The generation time of the target pest (Where possible each block should treat a single generation of the target pest)
- The period of insect control that is provided by a single application of the insecticide (Applicable to insects with a short generation time).

Wherever possible it is recommended that the application of an insecticide 'block' should not immediately be followed by an application of an insecticide 'block' of the same chemical class.

Example of Whitefly RM Strategy

<u>Transplanting</u>

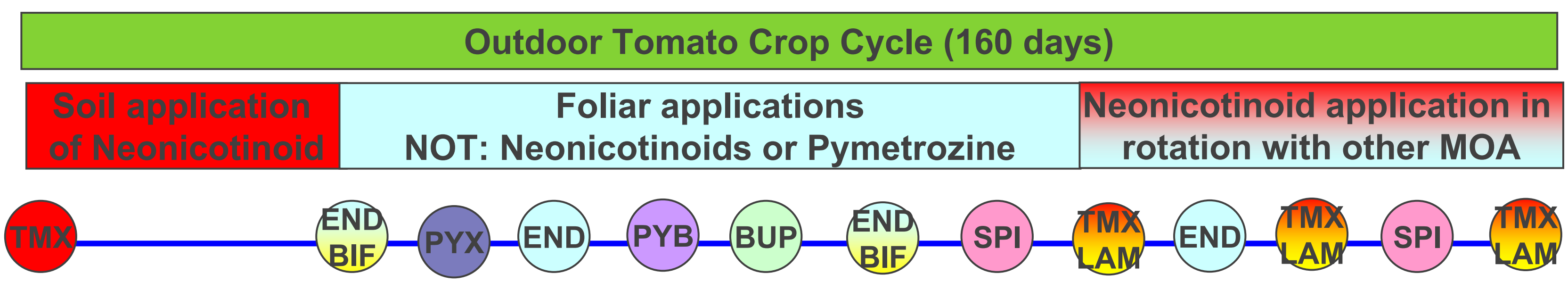
- Soil application of Neonicotinoid provides good control for an extended period - with limited selection for resistance

<u>First foliar applications made after soil application</u>

- Avoid applications of Neonicotinoids or Pymetrozine in this period
- Rotate other available AIs

<u>Foliar applications at end of crop cycle</u>

- Rotate available insecticides with different MoA including Neonicotinoids and Pymetrozine.
- <u>Avoid</u> consecutive applications of same chemical class
- Total number of Neonicotinoid and Pymetrozine applications should be < half crop cycle (based on 15d duration for foliar and 30day for soil)



Baselines and Resistance Monitoring

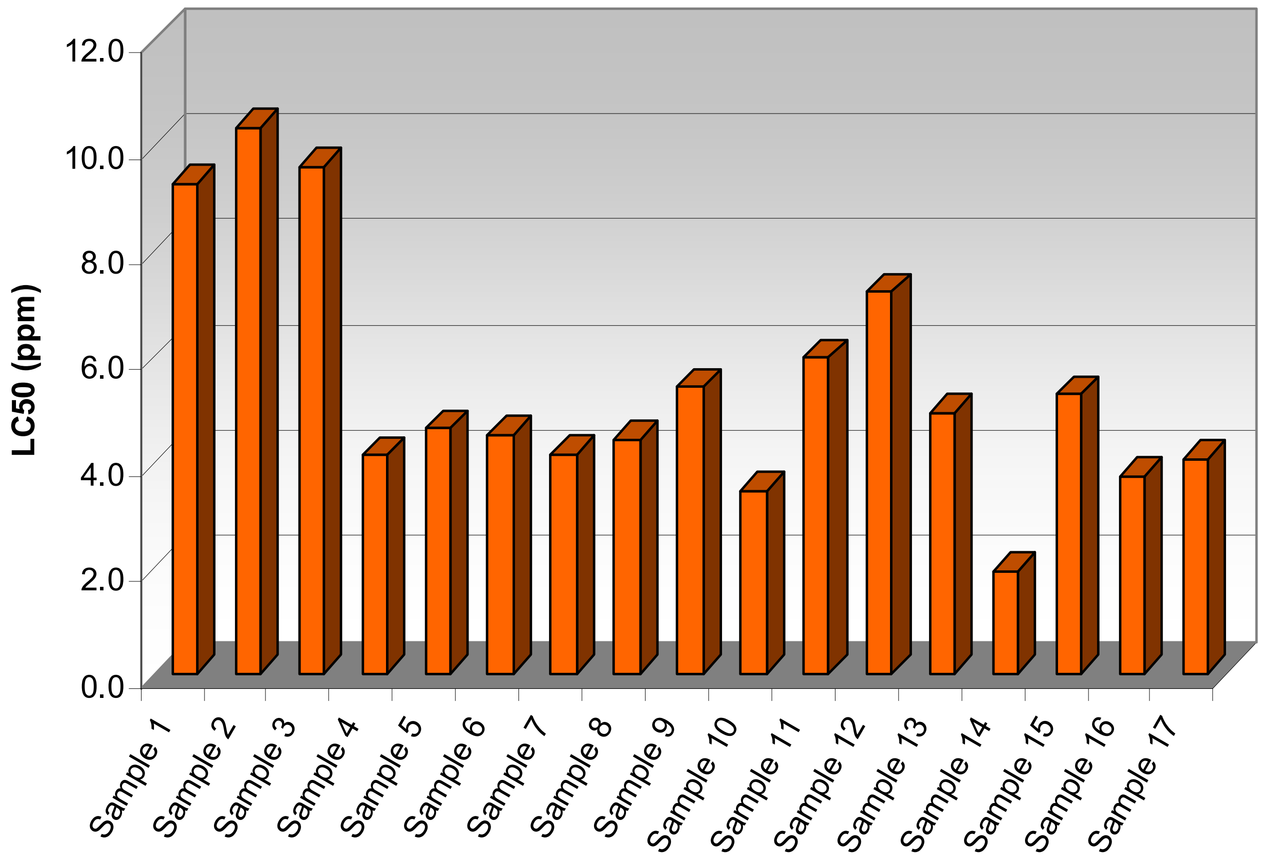
- Establishment of clear baselines followed by appropriate susceptibility monitoring ensures we know current status of susceptibility to key insecticides
  - Timely awareness of any emerging problems

- As indicated in Ralf Nauen's presentation each company establishes baselines for its products e.g. :
  - Thiamethoxam against Soybean Aphid
  - Emamectin benzoate against Grape Berry Moth

- And undertakes regular susceptibility monitoring for key at-risk pests e.g. :
  - Cotton Aphid, Peach Potato Aphid, Glasshouse Whitefly, etc
  - Diamondback Moth, Fall Armyworm, Cotton Bollworm, etc
  - Colorado Potato Beetle, Pollen Beetle, Spider Mites, etc

Example of Susceptibility Monitoring

- **Adult Western Corn Rootworm 'baseline' susceptibility to thiamethoxam**
- **Independent samples collected from USA Corn Belt.**



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Sponsorship of Resistance Research

- Sponsorship of various research projects on resistance to Neonicotinoids including:
- 'Characterisation and management of Neonicotinoid resistance in *Bemisia tabaci*'
- At Rothamsted Research, UK (Ian Denholm, Kevin Gorman)

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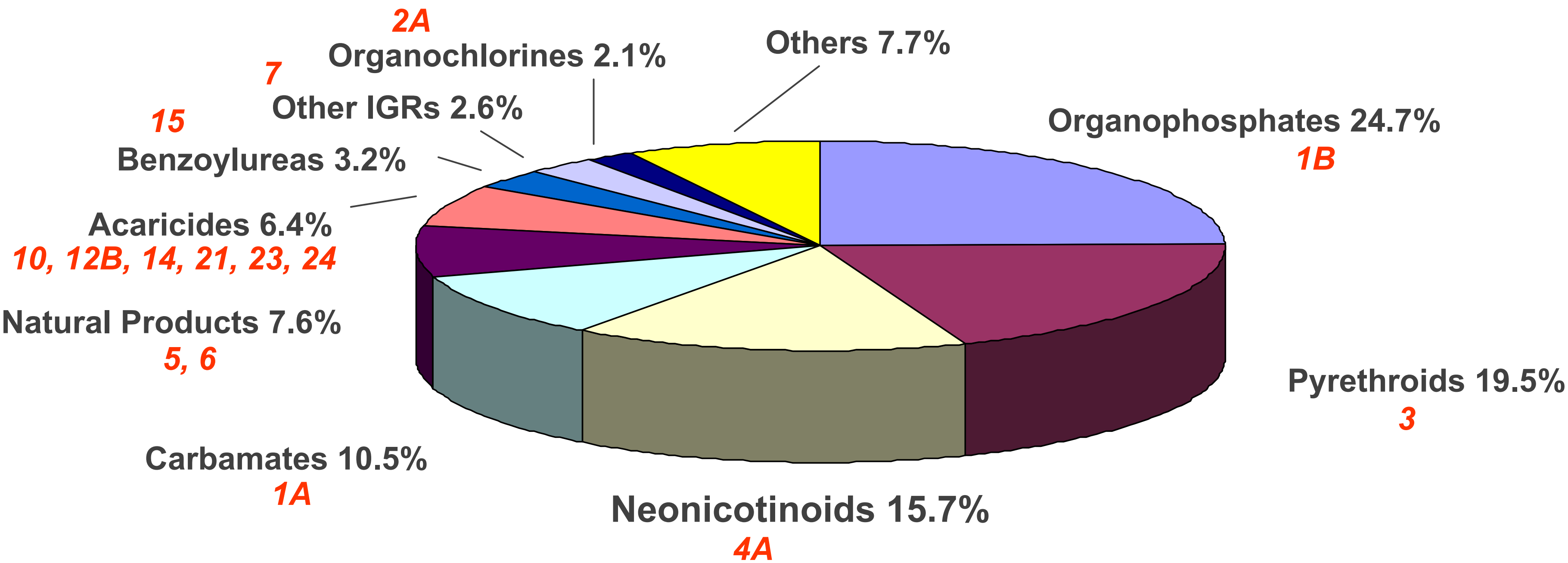
What industry is doing at an inter-company level

Global Insecticide sales



Total Global Insecticide Sales 2003 = $6,650 million

[Source Phillips McDougall, November 2004

[Natural products includes avermectins and spinosyns]

IRAC Mode of Action Classification Number

Neonicotinoids now 3rd largest group of insecticides based on global sales

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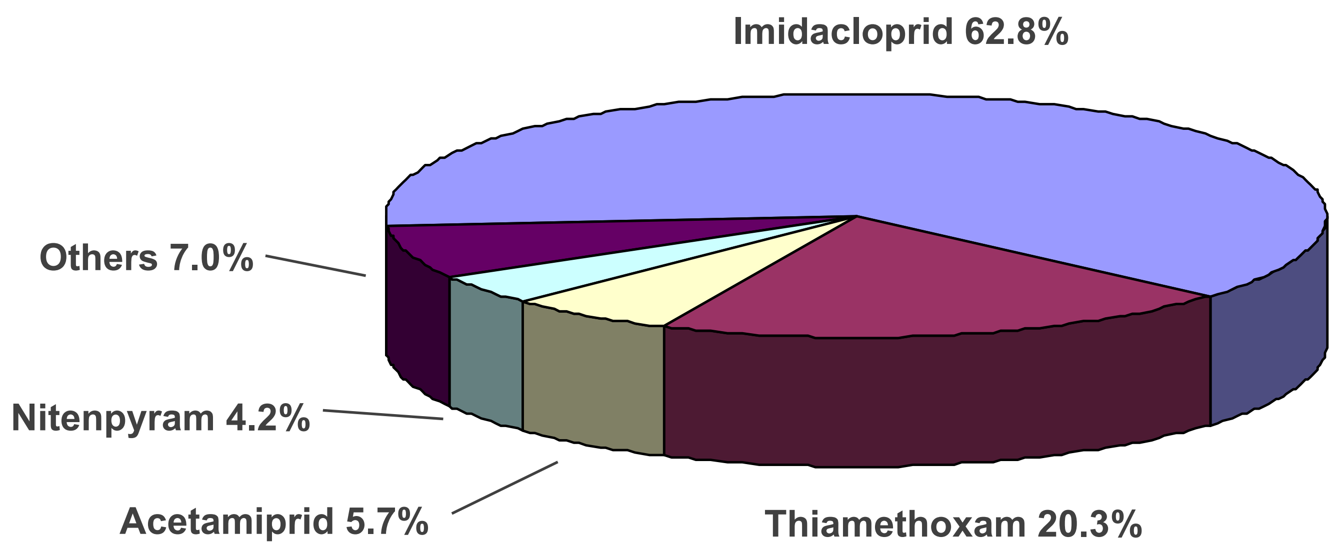
Global Neonicotinoid sales



Global Neonicotinoid Sales 2003 = $1,059 million

[Source Phillips McDougall, November 2004]

IRAC Mode of Action Classification Number 4A

Imidacloprid and Thiamethoxam account for >80% of market

Bayer CropScience and Syngenta – Collaborative Neonicotinoid Stewardship Project

- Together, sales of Bayer CropScience and Syngenta Neonicotinoid products total c. $930M – 88% of Neonicotinoids
  - Bayer CropScience: Imidacloprid, Thiacloprid, Clothianidin
  - Syngenta: Thiamethoxam
- Two companies uniquely placed to take a lead in developing and delivering coherent and effective IRM strategies at both a global and local level
- March 2005: Bayer CropScience and Syngenta agreed a joint global stewardship project to manage Neonicotinoids, focussing on key at-risk pests
- Other [Japanese] companies invited to join – but declined

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Bayer CropScience / Syngenta – Collaborative Neonicotinoid Stewardship Project

- Aim: To intensify the implementation of IRM by working together through contacts at country level
- Proposal to develop local IRM recommendations based on the two company global IRM recommendations for Neonicotinoids
  - Syngenta: Maximal exposure to Neonicotinoids is limited to 50% of the cropping cycle
  - Bayer CropScience: Neonicotinoids are limited to maximum of 3 applications per pest species and crop cycle
- Although slightly different, in practice expected in most situations that time periods covered by neonicotinoids are similar for both company recommendations
- Agreed that local guidelines can be stricter than the global guidelines, but should not be more flexible

Bayer CropScience and Syngenta - Collaborative Neonicotinoid Stewardship Project – Targets

Agreed first list of key at-risk targets for co-operation:

Country	Target	Crop
Mexico	Whitefly	Vegetables
Guatemala	Whitefly	Melons & Tomatoes
India	Brown planthopper	Rice
Brazil	Whitefly	Beans
Morocco	Whitefly	Covered vegetables
Italy	Whitefly	Covered vegetables
Turkey	Whitefly	Covered vegetables
Japan	Thrips	Vegetables

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Bayer CropScience and Syngenta - Collaborative Neonicotinoid Stewardship Project

Key actions:

- Establish local contacts between nominated persons from both companies and set up joint meetings
- Establish agreed local IRM Neonicotinoid strategies taking into account the general guidelines of both companies
  - Agree and adopt positioning in high risk crops
  - Adapt for local conditions, positioning and availability of products
- Involve local regulatory authorities and encourage them to take ownership
- Involve key local academic groups and influencers
- Involve local IRAC groups
- Approach other local neonicotinoid companies
- Check possibility of implementing a labelling scheme (similar to US)

BCS and Syngenta sponsor UK Neonicotinoid LINK project

- **Bayer CropScience and Syngenta are jointly sponsoring [with others] :**

  UK Department of Environment, Food and Rural Affairs, SA-LINK Project: Sustainability of Neonicotinoid Insecticides

  - **To assess and manage increasing risk of resistance to Neonicotinoids in *Myzus* persicae (and other aphids)**
  - **Risk arises from rapid recent increase in uses of neonicotinoids in multiple host crops for *M. persicae***
  - **Co-ordinating laboratory Rothamsted Research (Dr Ian Denholm et al)**

What industry is doing at an all-industry level

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Insecticide Resistance Action Committee - IRAC

- IRAC formed in 1984 to provide a co-ordinated industry response to the development of resistance in insect and mite pests

- Currently 6 IRAC International members:

BASF	Bayer CropScience
DuPont	Dow AgroSciences
FMC	Syngenta

IRAC Objectives:

- Facilitate communication and education on insecticide and acaricide resistance
- Promote the development of resistance management strategies in crop protection and vector control to maintain efficacy and support sustainable agriculture and improved public health

IRAC, US - Members

- AMVAC
- Arysta LifeScience
- BASF
- Bayer CropScience
- Cerexagri
- Chemtura
- Dow AgroSciences
- DuPont
- FMC
- Mitsui
- Monsanto
- Nisso America
- Syngenta
- Valent

www.irac-online.org

IRAC Country Groups

- IRAC Country groups deal with key resistance issues at local level – supported by IRAC International
  - Multi-company cooperation and coordinated IRM
  - IRAC Country groups often include additional companies not involved in IRAC International
  - Country groups may include or involve others from Academia and Research Institutes and Regulatory bodies (IRAG groups)

- Current IRAC Country groups:
  - IRAC Australia (AIRMG)
  - IRAC Brazil
  - IRAC India
  - IRAC South Africa
  - IRAC Spain
  - IRAC US
  - IRAC China (proposed)

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IRAC Mode of Action Classification

Insecticide Resistance Action Committee
www.irac-online.org

IRAC Mode of Action Classification

Fully revised & re-issued, September 2005

Version: 5.1

The IRAC Mode of Action (MoA) classification provides farmers, growers, advisors, extension staff, consultants and crop protection professionals with a guide to the selection of insecticides or acaricides for use in an effective and sustainable insecticide or acaricide resistance management (IRM) strategy. In addition to presenting the MoA classification, this document outlines the background to, and purposes of, the classification list and provides guidance on how it is used for IRM purposes. The list is reviewed and re-issued at intervals as required.

What is resistance

Resistance to insecticides may be defined as '*a heritable change in the sensitivity of a pest population that is reflected in the repeated failure of a product to achieve the expected level of control when used according to the label recommendation for that pest species*' (IRAC). This definition differs slightly from others in the literature, but IRAC believes it represents the most accurate, practical definition of relevance to farmers and growers. Resistance arises through the over-use or mis-use of an insecticide or acaricide against a pest species and results in the selection of resistant forms of the pest and the consequent evolution of populations that are resistant to that insecticide or acaricide.

MoA, Target-site resistance and Cross-resistance

In the majority of cases, not only does resistance render the selecting compound ineffective but it often also confers cross-resistance to other chemically related compounds. This is

- **Definitive scheme developed and endorsed by IRAC in consultation with key researchers**
- **Worldwide distribution**
- **All current insecticides allocated to a Mode of Action group or sub-group**
- **A key tool for selection of insecticides in effective IRM programs**
- **Updated as required**
- **Latest version Sept 2005**

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IRAC Mode of Action Classification

Example pages

IRAC Mode of Action Classification   *Version: 5.1*

IRAC Mode of Action Classification v5, September 2005 [1]

Main Group and Primary Site of Action	Chemical Sub-group or exemplifying Active Ingredient	Active Ingredients
1 Acetylcholine esterase inhibitors	1A Carbamates	Aldicarb, Alanycarb, Bendiocarb, Benfuracarb, Butocarboxim, Butoxycarboxim, Carbaryl, Carbofuran, Carbosulfan, Ethiofencarb, Fenobucarb, Formetanate, Furathiocarb, Isoprocarb, Methiocarb, Methomyl, Metolcarb, Oxamyl, Pirimicarb, Propoxur, Thiodicarb, Thiofanox, Trimethacarb, XMC, Xylylcarb
	Triazemate	Triazemate
	1B Organophosphates	Acephate, Azamethiphos, Azinphos-ethyl, Azinphos-methyl, Cadusafos, Chlorethoxyfos, Chlorfenvinphos, Chlormephos, Chlorpyrifos, Chlorpyrifos-methyl, Coumaphos, Cyanophos, Demeton-S-methyl, Diazinon, Dichlorvos/ DDVP, Dicrotophos, Dimethoate, Dimethylvinphos, Disulfoton, EPN, Ethion, Ethoprophos, Famphur, Fenamiphos, Fenitrothion, Fenthion, Fosthiazate, Heptenophos, Isofenphos, Isopropyl O-methoxyaminothio=phosphoryl) salicylate, Isoxathion, Malathion, Mecarbam, Methamidophos, Methidathion, Mevinphos, Monocrotophos, Naled, Omethoate, Oxydemeton-methyl, Parathion, Parathion-methyl, Phenthoate, Phorate, Phosalone, Phosmet, Phosphamidon, Phoxim, Pirimiphos-, ethyl, Profenofos, Propetamphos, Prothiofos, Pyraclofos, Pyridaphenthion, Quinalphos, Sulfotep, Tebupirimfos, Temephos, Terbufos, Tetrachlorvinphos, Thiometon, Triazophos, Trichlorfon, Vamidothion
2 GABA-gated chloride channel antagonists	2A Cyclodiene organochlorines	Chlordane, Endosulfan, gamma-HCH (Lindane)
	2B Phenylpyrazoles (Fiproles)	Ethiprole, Fipronil
3 Sodium channel modulators	DDT	DDT
	Methoxychlor	Methoxychlor
	Pyrethroids	Acrinathrin, Allethrin, d-cis-trans Allethrin, d-trans Allethrin,

...ain Group and ...nary Site of Action	Chemical Sub-group or exemplifying Active Ingredient	Active Ingredients
...tinic Acetylcholine ...ptor agonists / ...gonists	4A Neonicotinoids	Acetamiprid, Clothianidin, Dinotefuran, Imidacloprid, Nitenpyram, Thiacloprid, Thiamethoxam
	4B Nicotine	Nicotine
	4C Bensultap	Bensultap
	Cartap hydrochloride	Cartap hydrochloride
	Nereistoxin analogues	Thiocyclam, Thiosultap-sodium
...tinic Acetylcholine ...ptor agonists ...steric) (not group 4)	Spinosyns	Spinosad
...ride channel ...ators	Avermectins, Milbemycins	Abamectin, Emamectin benzoate, Milbemectin
...nile hormone mimics	7A Juvenile hormone analogues	Hydroprene, Kinoprene, Methoprene
	7B Fenoxycarb	Fenoxycarb
	7C Pyriproxyfen	Pyriproxyfen
8 Compounds of unknown or non-specific mode of action (fumigants)	8A Alkyl halides	Methyl bromide and other alkyl halides
	8B Chloropicrin	Chloropicrin

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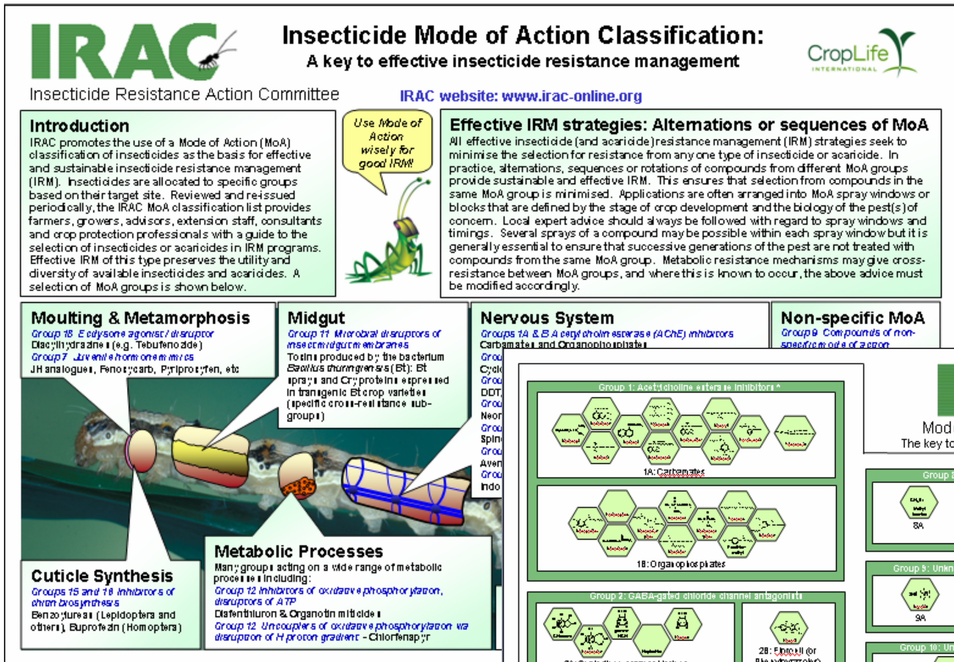
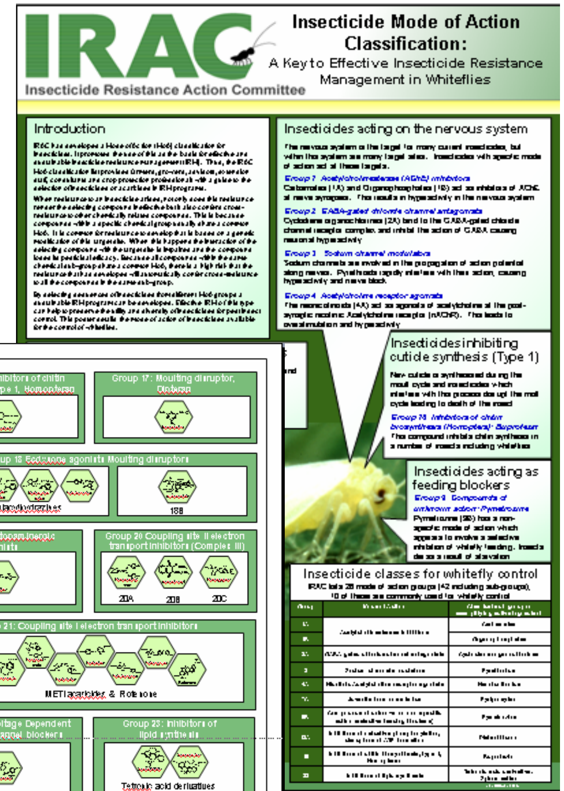
Using the IRAC MoA Classification

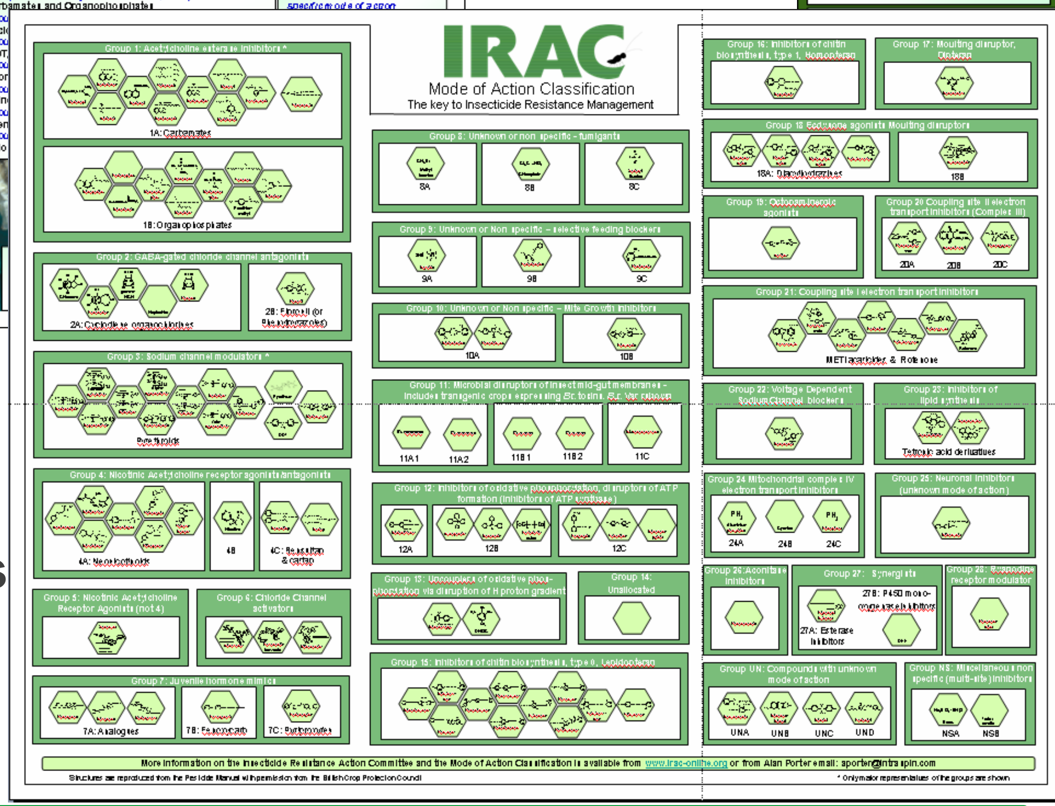
- The IRAC Mode of action scheme is central to developing effective IRM strategies
- Sequences, rotations or alternations of different MoA groups help prevent or delay resistance, or deal with existing resistance problems
- Modify locally to take account of known metabolic mechanisms conferring cross-resistance between MoA groups or insect populations with multiple resistances
- In the absence of any information, intelligent sequences of MoA groups will always reduce selection pressures and help prevent or delay resistance, and help regain susceptibility
- IRAC strongly supports MoA labeling schemes – e.g. US, Australia
  - And IRAC campaigns for wider use of such schemes
- Use of symbols and colors for MoA groups can help e.g. Brazil

IRAC MoA Posters and Wallchart



Conference Posters





IRAC Mode of Action Wallchart: MoA Classification Groups & Structures – A1 printed versions available

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eClassification – interactive MoA

New interactive online tool

www.irac-online.org

IRAC
Insecticide Resistance Action Committee
eClassification

Select a group to open... | Select a chemical class to open... | Select an active ingredient to open...

- 1 - Acetylcholine esterase inhibitor
- 2 - GABA-gated chloride channel antagonists
- 3 - Sodium channel modulators
- 4 - Nicotinic Acetylcholine receptor agonists / antagonists
  - Subgroup: A
    - Chemical Class: Neonicotinoids
      - Acetamiprid
      - Clothianidin
      - Dinotefuran
      - Imidacloprid
      - Nitenpyram
      - Thiacloprid
      - Thiamethoxam
  - Subgroup: B
  - Subgroup: C
- 5 - Nicotinic Acetylcholine receptor agonists (allosteric) (not group 4)
- 6 - Chloride channel activators
- 7 - Juvenile hormone mimics
- 8 - Compounds of unknown or non-specific mode of action (fumigants)
- 9 - Compounds of unknown or non-specific mode of action (selective feeding blockers)
- 10 - Compounds of unknown or non-specific mode of action (mite growth inhibitors)
- 11 - Microbial disruptors of insect midgut membranes (includes transgenic crops expressing B.t. toxins)
- 12 - Inhibitors of oxidative phosphorylation, disruptors of ATP formation (inhibitors of ATP synthase)
- 13 - Uncouplers of oxidative phosphorylation via disruption of proton gradient
- 14 - (vacant)
- 15 - Inhibitors of chitin biosynthesis, type 0, Lepidopteran
- 16 - Inhibitors of chitin biosynthesis, type 1, Homopteran
- 17 - Moulting disruptor, Dipteran
- 18 - Ecdysone agonists / moulting disruptors
- 19 - Octopaminergic agonists
- 20 - Mitochondrial complex III electron transport inhibitors (Coupling site II)
- 21 - Mitochondrial complex I electron transport inhibitors
- 22 - Voltage-dependent sodium channel blockers
- 23 - Inhibitors of lipid synthesis
- 24 - Mitochondrial complex IV electron transport inhibitors
- 25 - Neuronal inhibitors (unknown mode of action)
- 26 - Aconitase inhibitors
- 27 - Synergists
- 28 - Ryanodine receptor modulator
- UN - Synergists
- NS - Miscellaneous non-specific (multi-site) inhibitors3

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Select a group to open...

- (vacant)
- Acetylcholine esterase inhibitor
- Aconitase inhibitors
- Chloride channel activators
- Compounds of unknown or non-specific
- Compounds of unknown or non-specific
- Compounds of unknown or non-specific
- Ecdysone agonists / moulting disruptor
- GABA-gated chloride channel antagon
- Inhibitors of chitin biosynthesis, type 0, L
- Inhibitors of chitin biosynthesis, type 1, H
- Inhibitors of lipid synthesis
- Inhibitors of oxidative phosphorylation,
- Juvenile hormone mimics
- Microbial disruptors of insect midgut me
- Miscellaneous non-specific (multi-site)
- Mitochondrial complex I electron transp
- Mitochondrial complex III electron trans
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- Moulting disruptor, Dipteran
- Neuronal inhibitors (unknown mode of a
- Nicotinic Acetylcholine receptor agonis
- Nicotinic Acetylcholine receptor agonis
- Octopaminergic agonists
- Ryanodine receptor modulator
- Sodium channel modulators
- Synergists
- Synergists
- Uncouplers of oxidative phosphorylatic
- Voltage-dependent sodium channel bl

Select a chemical class to open...

- Select a chemical class to open...
- Avermectins, Milbemycins
- Benzoylureas
- Carbamates
- Cyclodiene organochlorines
- Esterase inhibitors
- Fipronil (or Phenylpyrazoles)
- Juvenile hormone analogues
- METI acaricides, Rotenone
- Methyl bromide
- Neonicotinoids
- Organophosphates
- Organotin miticides
- P450 monooxygenase inhibitors
- Pyrethroids
- Tetronic acid derivatives

Drop down menus >>options

Select an active ingredient to open...

- Select an active ingredient to open...
- Abamectin
- Acephate
- Acequinocyl
- Acetamiprid
- Acrinathrin
- Alanycarb
- Aldicarb
- Allethrin
- Aluminium phosphide
- Aminocarb
- Amitraz
- Azadirachtin
- Azamethiphos
- Azinphos-ethyl
- Azinphos-methyl
- Azocyclotin
- B.t. var. aizawai
- B.t. var. israelensis
- B.t. var. kurstaki
- B.t. var. sphaericus
- B.t. var. tenebrionensis
- Bendiocarb
- Benfuracarb
- Bensultap
- Benzoximate
- Bifenazate
- Bifenthrin
- Bioallethrin
- Bioallethrin S-cylclopentenyl

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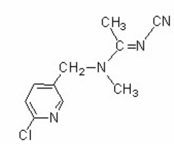
eClassification

Back to Group Index

Cas No	135410-20-7
Common Name	Acetamiprid
Chemical Class	Neonicotinoids
Primary Site of Action	Nicotinic Acetylcholine receptor agonists / antagonists
MOA Group Number	4A
Relevant Pests	Control of Hemiptera, especially aphids, Thysanoptera and Lepidoptera
Relevant Crops	Wide range of crops, especially vegetables, fruit and tea
Use Patterns	Soil or foliar
Comments	



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IRAC Website – www.irac-online.org

- IRAC's key communication vehicle
- Av. 150 hits, 30 visits a day (09.05)
- Accessed by over 80 countries
- Search terms - #1 'IRAC', #2 'Insecticide Resistance'
- 190 pages including public, protected & utility pages
- 160 docs. & 92 image files
- Information on IRAC, Mode of Action, advice on IRM
- Education modules
- Resources incl. key papers, documents, posters
- Links for growers
- IRAC Country group information

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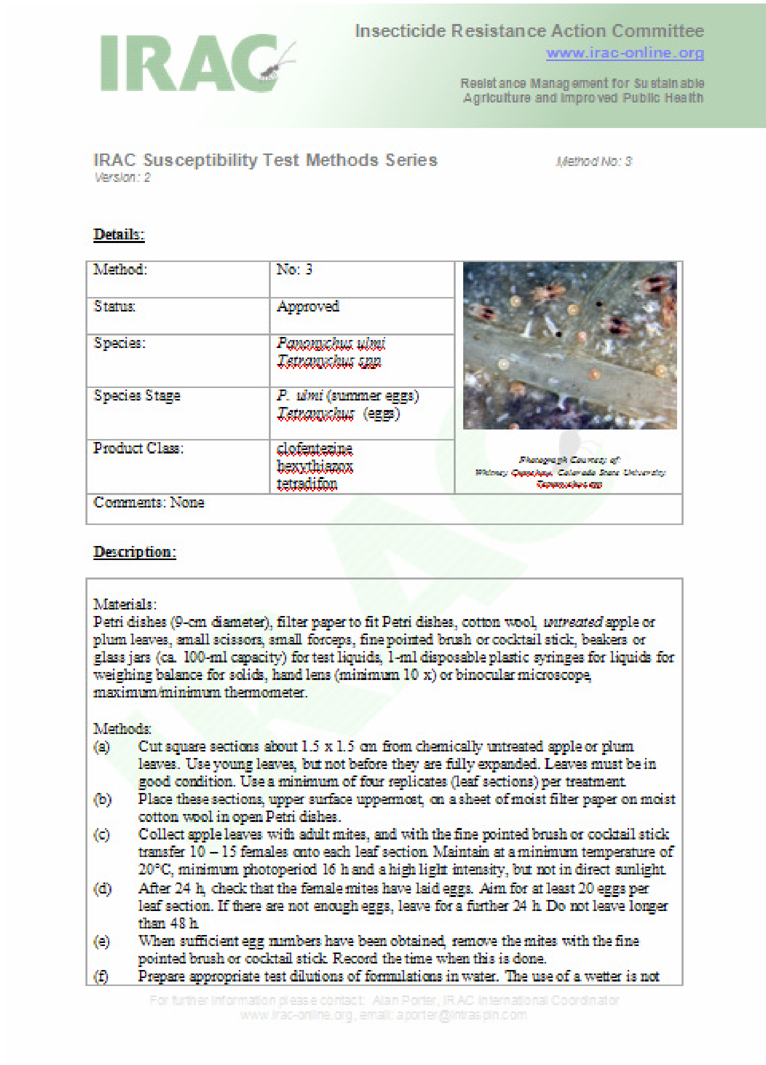
IRAC Susceptibility Test Methods



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Resistance Management for Sustainable Agriculture and Improved Public Health

IRAC Susceptibility Test Methods Series
Version: 2

Method No: 3

Details:

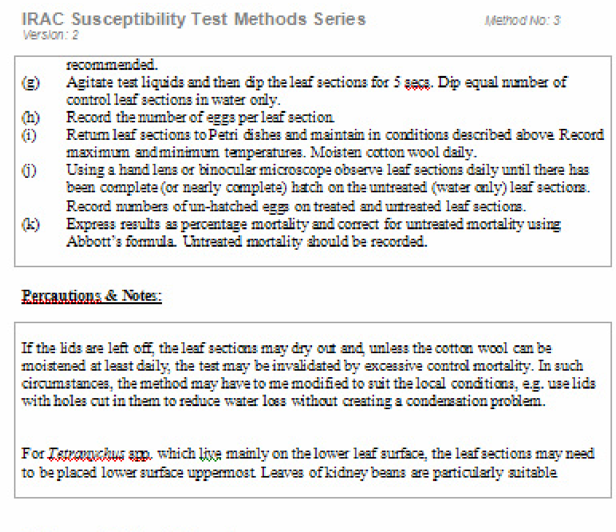
Method:	No: 3	
Status:	Approved	
Species:	*Panonychus ulmi* *Tetranychus spp*	
Species Stage	*P. ulmi* (summer eggs) *Tetranychus* (eggs)	
Product Class:	clofentezine hexythiazox tetradifon	Photograph Courtesy of:
Comments: None		

Description:

Materials:
Petri dishes (9-cm diameter), filter paper to fit Petri dishes, cotton wool, *untreated* apple or plum leaves, small scissors, small forceps, fine pointed brush or cocktail stick, beakers or glass jars (ca. 100-ml capacity) for test liquids, 1-ml disposable plastic syringes for liquids for weighing balance for solids, hand lens (minimum 10 x) or binocular microscope, maximum/minimum thermometer.

Methods:
(a) Cut square sections about 1.5 x 1.5 cm from chemically untreated apple or plum leaves. Use young leaves, but not before they are fully expanded. Leaves must be in good condition. Use a minimum of four replicates (leaf sections) per treatment.
(b) Place these sections, upper surface uppermost, on a sheet of moist filter paper on moist cotton wool in open Petri dishes.
(c) Collect apple leaves with adult mites, and with the fine pointed brush or cocktail stick transfer 10 – 15 females onto each leaf section. Maintain at a minimum temperature of 20°C, minimum photoperiod 16 h and a high light intensity, but not in direct sunlight.
(d) After 24 h, check that the female mites have laid eggs. Aim for at least 20 eggs per leaf section. If there are not enough eggs, leave for a further 24 h. Do not leave longer than 48 h.
(e) When sufficient egg numbers have been obtained, remove the mites with the fine pointed brush or cocktail stick. Record the time when this is done.
(f) Prepare appropriate test dilutions of formulations in water. The use of a wetter is not

For further information please contact: Alan Porter, IRAC International Coordinator
www.irac-online.org, email: aporter@intraspin.com



IRAC Susceptibility Test Methods Series
Version: 2

Method No: 3

recommended.
(g) Agitate test liquids and then dip the leaf sections for 5 secs. Dip equal number of control leaf sections in water only.
(h) Record the number of eggs per leaf section.
(i) Return leaf sections to Petri dishes and maintain in conditions described above. Record maximum and minimum temperatures. Moisten cotton wool daily.
(j) Using a hand lens or binocular microscope observe leaf sections daily until there has been complete (or nearly complete) hatch on the untreated (water only) leaf sections. Record numbers of un-hatched eggs on treated and untreated leaf sections.
(k) Express results as percentage mortality and correct for untreated mortality using Abbott's formula. Untreated mortality should be recorded.

Percautions & Notes:

If the lids are left off, the leaf sections may dry out and, unless the cotton wool can be moistened at least daily, the test may be invalidated by excessive control mortality. In such circumstances, the method may have to me modified to suit the local conditions, e.g. use lids with holes cut in them to reduce water loss without creating a condensation problem.

For *Tetranychus spp.* which live mainly on the lower leaf surface, the leaf sections may need to be placed lower surface uppermost. Leaves of kidney beans are particularly suitable.

- IRAC provides validated test methods of proven ability to detect changes in susceptibility
- IRAC currently has a program to update the methods
- Intention to include methods for all pests in new EPPO guidelines
- New methods will include biochemical and molecular methods

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Communication & Education IRAC Activities

- **eConnection** – Free electronic IRAC newsletter raises awareness of resistance issues, existence of country groups, raises profile of IRAC
- **eLearning** - extensive, interactive web-based education and training modules being developed


IRAC
Insecticide Resistance Action Committee
eConnection

Issue 8
September, 2005
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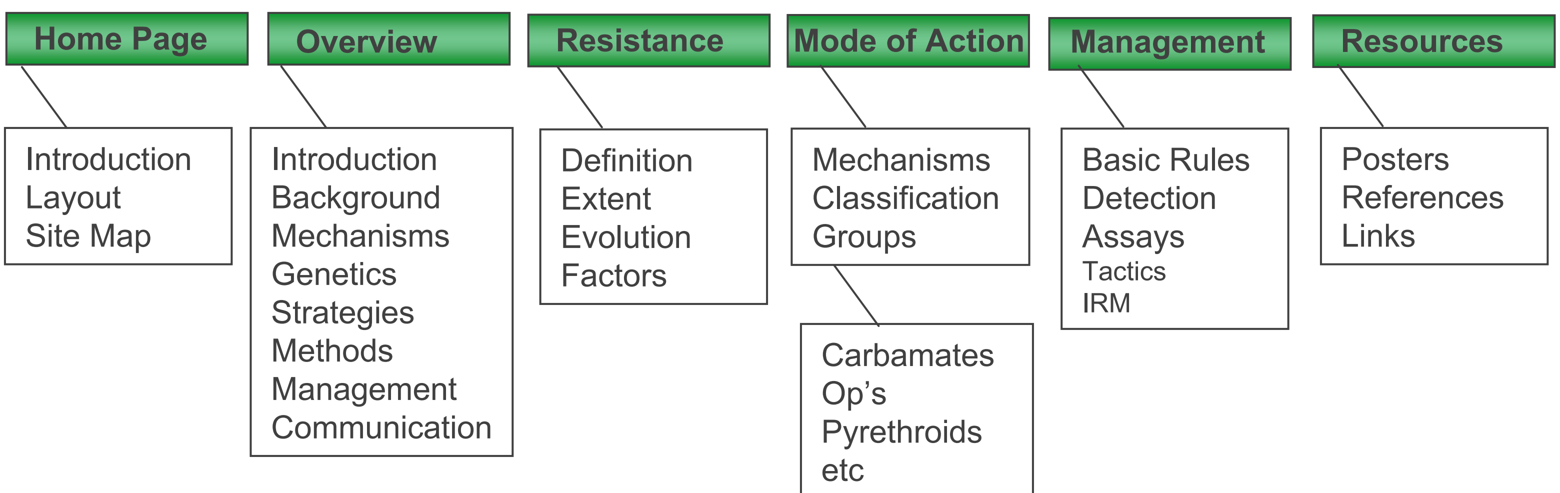
- eConnection and Website update
- IRAC News
- Conferences and Symposia

eConnection Update

- **Issue 8 of eConnection**
  Welcome to the latest eConnection, a free newsletter prepared in conjunction with the IRAC website. In this issue we report on the response from the IRAC International Regulatory Team to a recent ECPA release outlining the impact of reduced numbers of products for the treatment of minor crops. Also included is an article on the control of the brown plant hopper with neonicotinoids describing initiatives such as those being taken by IRAC India to monitor the resistance status. Finally there is a brief report on the recent IRAC International Meeting at CropLife International in Brussels and advance notice of an IRAC Symposium in the US on Neonicotinoid Sustainability. We hope you find the information interesting.



syngenta

Conclusions

- The major Neonicotinoid companies undertake extensive research to understand factors influencing the effectiveness of their compounds
- There is a large body of ongoing work to maintain awareness of susceptibility in key at-risk pests
- Key companies like Bayer CropScience and Syngenta are collaborating at a local level to harmonise their guidelines for IRM for the neonicotinoids
- IRAC works for the industry to promote awareness of and solutions to resistance
  - Communication and education on IRM are vital
  - IRAC provides key resources such as the MoA scheme, methodologies, IRM advice to help manage resistance
  - IRAC country groups work to tackle local problems