Insecticide Resistance Action Committee: What does it do?

Joint RAC & RAG Open Forum
Combating Pesticide Resistance
BCPC International Congress
Crop Science & Technology 2005

Alan McCaffery

IRAC and its Mission

- 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
Dow AgroSciences	DuPont
FMC	Syngenta

- Industry changes led to changing priorities
- IRAC Coordinator – Alan Porter

IRAC Mission:

- 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

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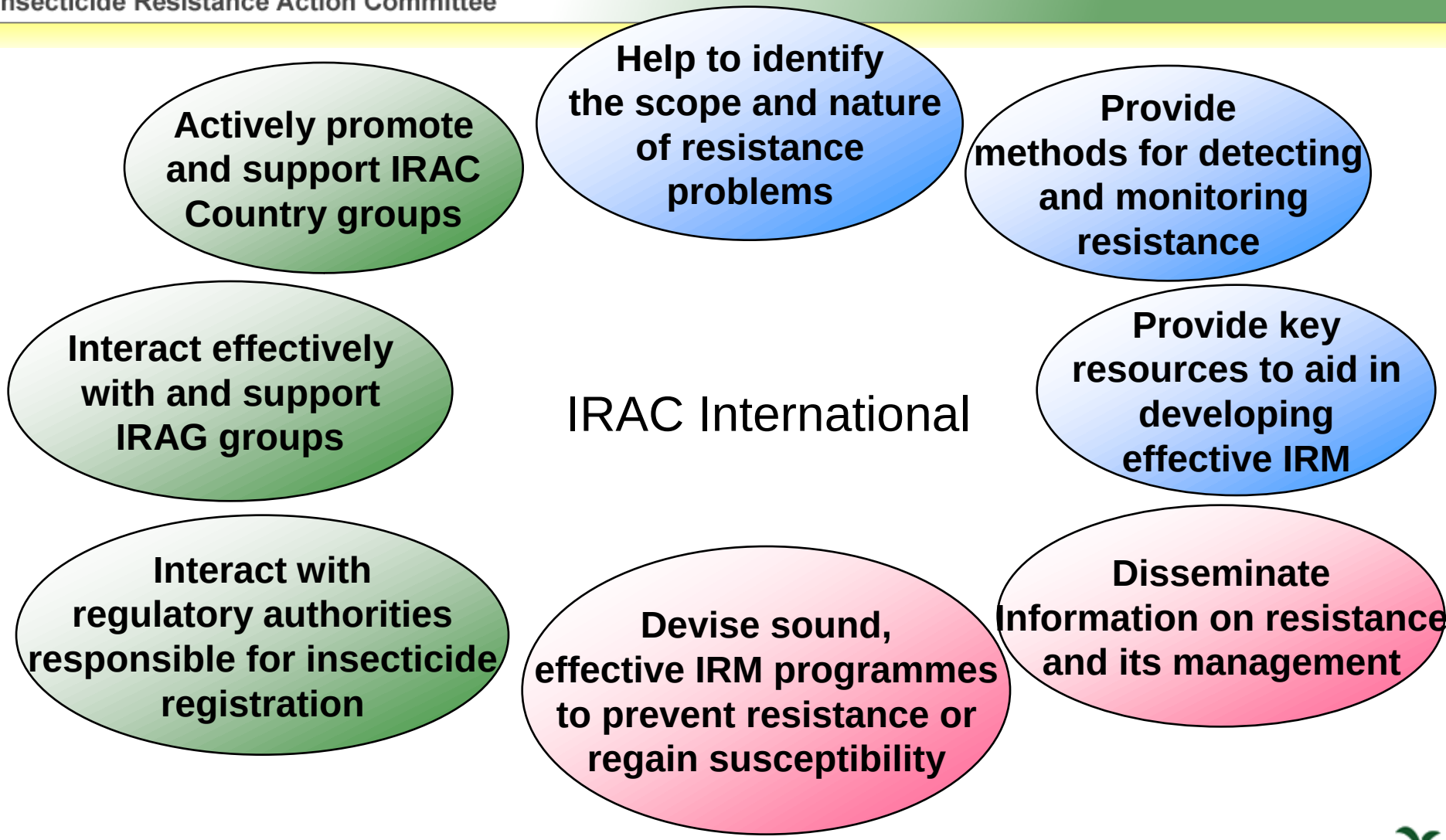
Role of IRAC

Insecticide Resistance Action Committee



A comprehensive approach to tackling resistance

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Key IRAC teams

Teams within IRAC International tackle specific areas of IRAC's current work:

- Communication and Education team (Nigel Armes)
- Regulatory Team
- Neonicotinoid Team (Ralf Nauen)
- Codling Moth Team (Max Angst)
- Methods Team (Nigel Armes)
- Biotech Team (being formed) (Nick Storer)

Individual responsibilities within IRAC

- Vice-chairman and Treasurer (Ralf Nauen)
- IRAC Mode of Action Classification (Alan McC)
- MSU Database and *Resistant Rest Management Newsletter* (Gary Thompson)

IRAC Country groups

- IRAC Country groups deal with key resistance issues at local level – supported by IRAC International
- IRAC Country groups often include additional companies not involved in IRAC International
- Country groups may include or involve others from Academia and Research Institutes
- Current IRAC Country groups:
  - IRAC Australia (AIRMG)
  - IRAC Brazil
  - IRAC India
  - IRAC South Africa
  - IRAC Spain
  - IRAC US
  - IRAC China (proposed)
- Country projects – e.g. BPH in India

Communication and Education is vital !
A key role of IRAC

Website: www.irac-online.org

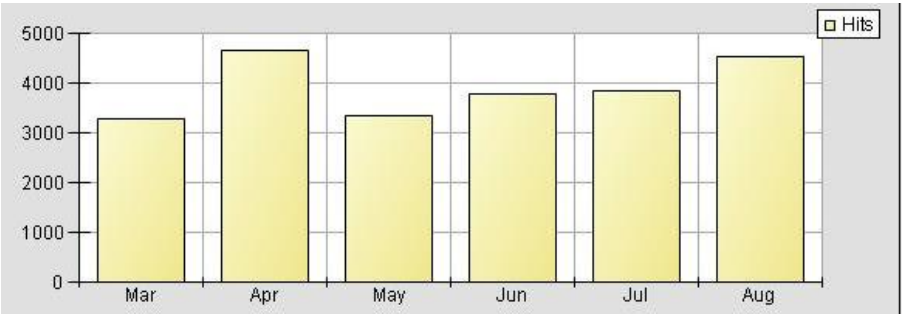
Accessed by over 80 countries

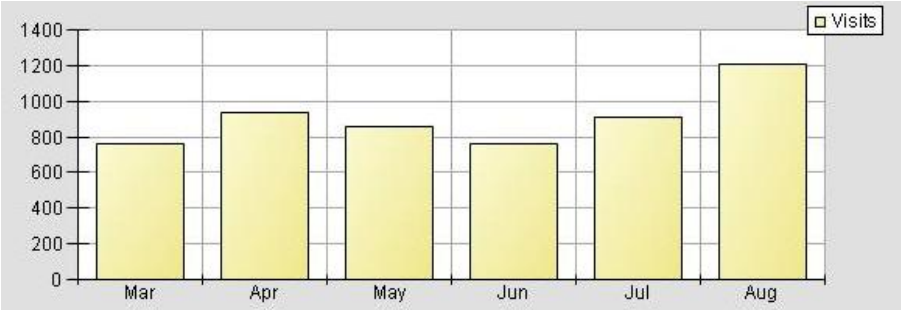
- IRAC's key communication vehicle
- Designed and managed by Alan Porter
- 190 pages including public, protected & utility pages
- 160 docs. & 92 image files
- Information on IRAC, Mode of Action, advice on IRM
- Education modules
- Resources incl. key papers, documents, posters
- Links for growers
- IRAC Country group information

Latest IRAC Website Statistics (Sept 05)

Insecticide Resistance Action Committee

- **Averages 150 hits, 30 visits / day**





- **No 1 in Google & Yahoo for Key Terms**

Top SE

Rank	Engine	% Visits
1	Google	70.5
2	Yahoo!	15.9
3	Microsoft Network	6.7
4	AOL NetFind	2.2
5	Netscape	1.6

Top Docs

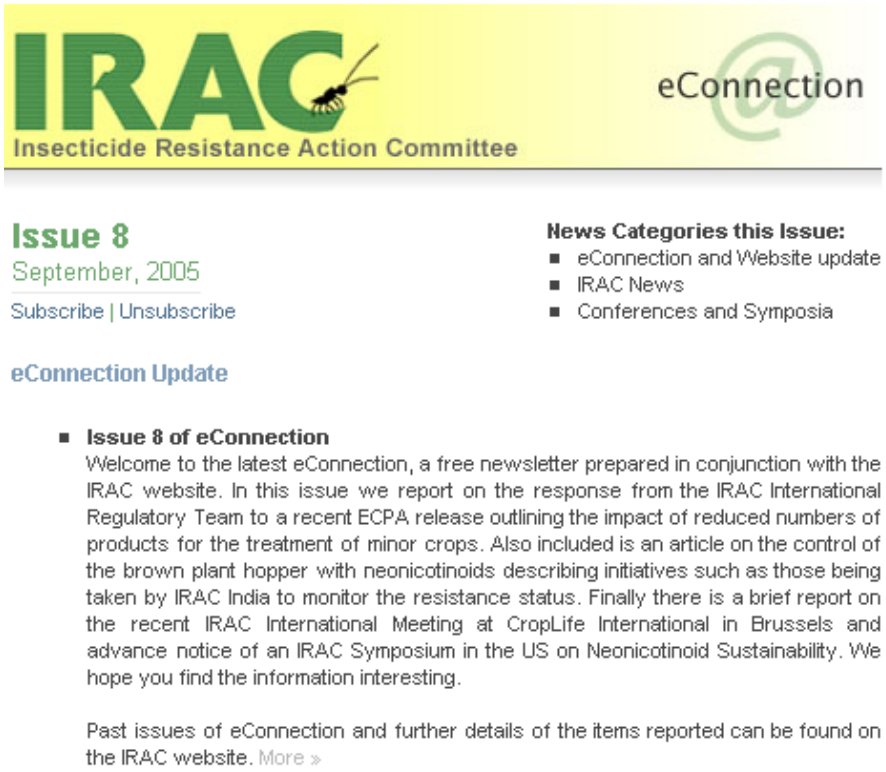
Rank	Page Name	% Visits
1	/documents/moa/moa.doc	31.7
2	/documents/moa/icepaper2004.doc	25.0
3	/documents/info/rmarticle2.pdf	8.6
4	/documents/info/rmarticle2.doc	8.4
5	/documents/posters/moaposter.pdf	7.5

Top Search Terms

Rank	Phrases	% Visits
1	irac	52.3
2	insecticide resistance	16.3
3	insecticide	8.0
4	insecticide mode of action	5.8
5	thiamethoxam	4.3

eConnection

IRAC
Insecticide Resistance Action Committee



IRAC
Insecticide Resistance Action Committee
eConnection

Issue 8
September, 2005
Subscribe | Unsubscribe

News Categories this Issue:
- 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.

  Past issues of eConnection and further details of the items reported can be found on the IRAC website. More »

- Free IRAC Newsletter
- Distributed by e-mail
- ~4 issues a year
- Distribution list 500+ and growing
- Raises awareness of IRM
- Raises awareness of country groups & topical resistance issues
- Improves profile of IRAC
- Positive effects on website traffic

eConnection #8 September 2005

Welcome	Website Update
Spread the Word	MoA New Version
Comment on ECPA Release	BPH India
IRAC Meeting, Brussels	Diary

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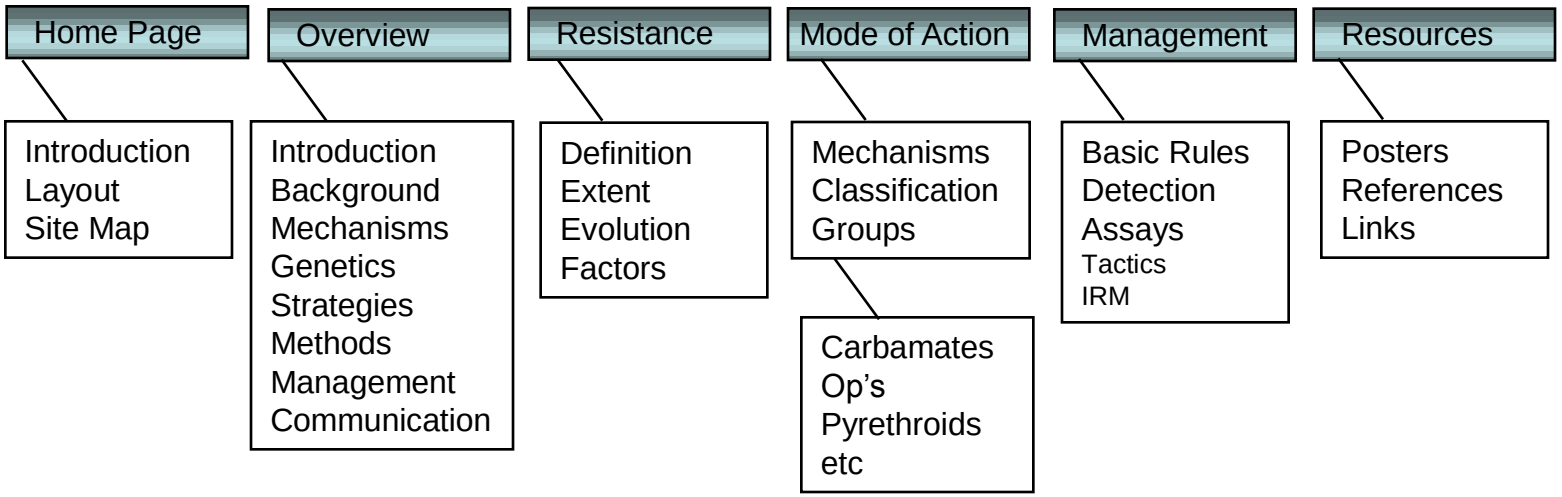
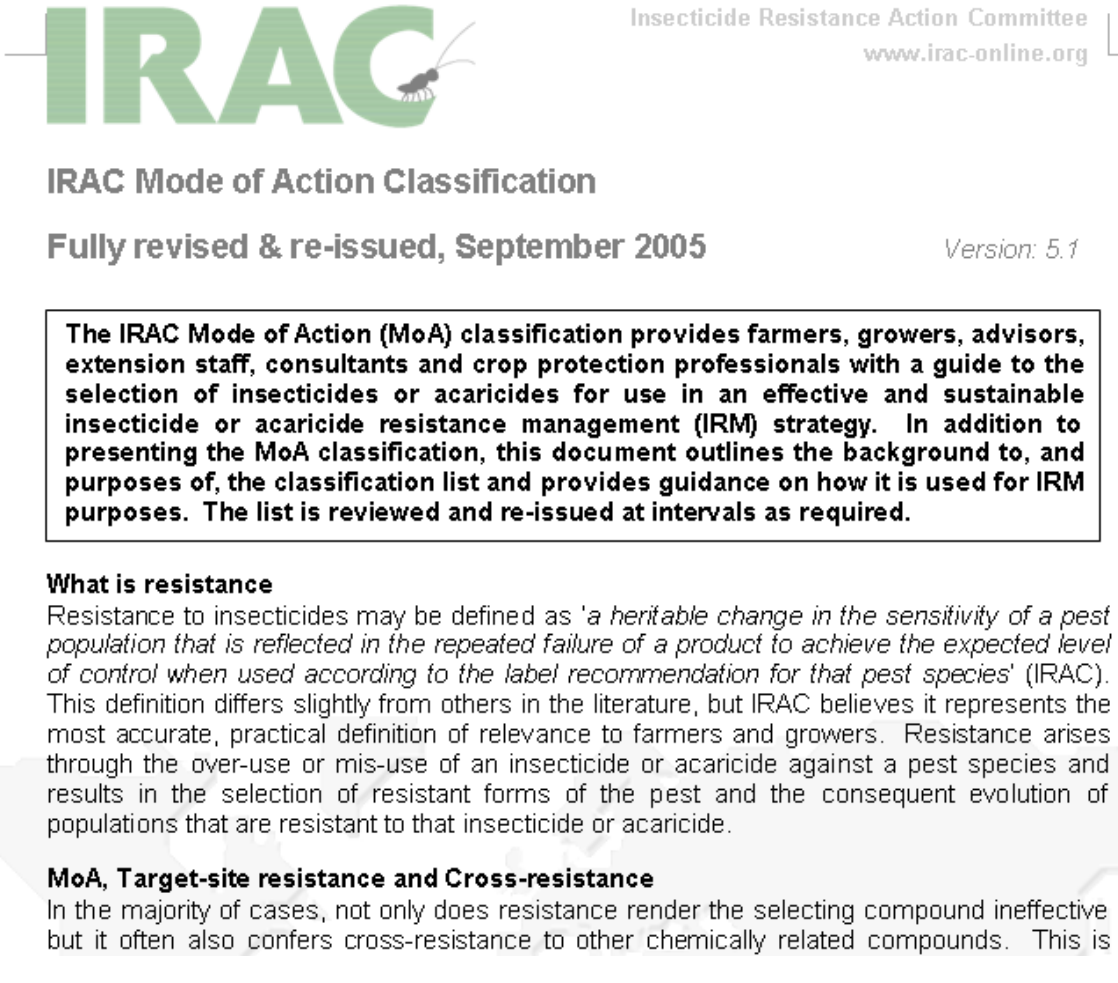
eLearning

- New IRAC resource still under development
- Education and Training modules on resistance & IRM
- Graphic provides a diagrammatic representation of layout and content
- Currently education material is available on the website under the "Resources" section



Mode of Action Classification



IRAC

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

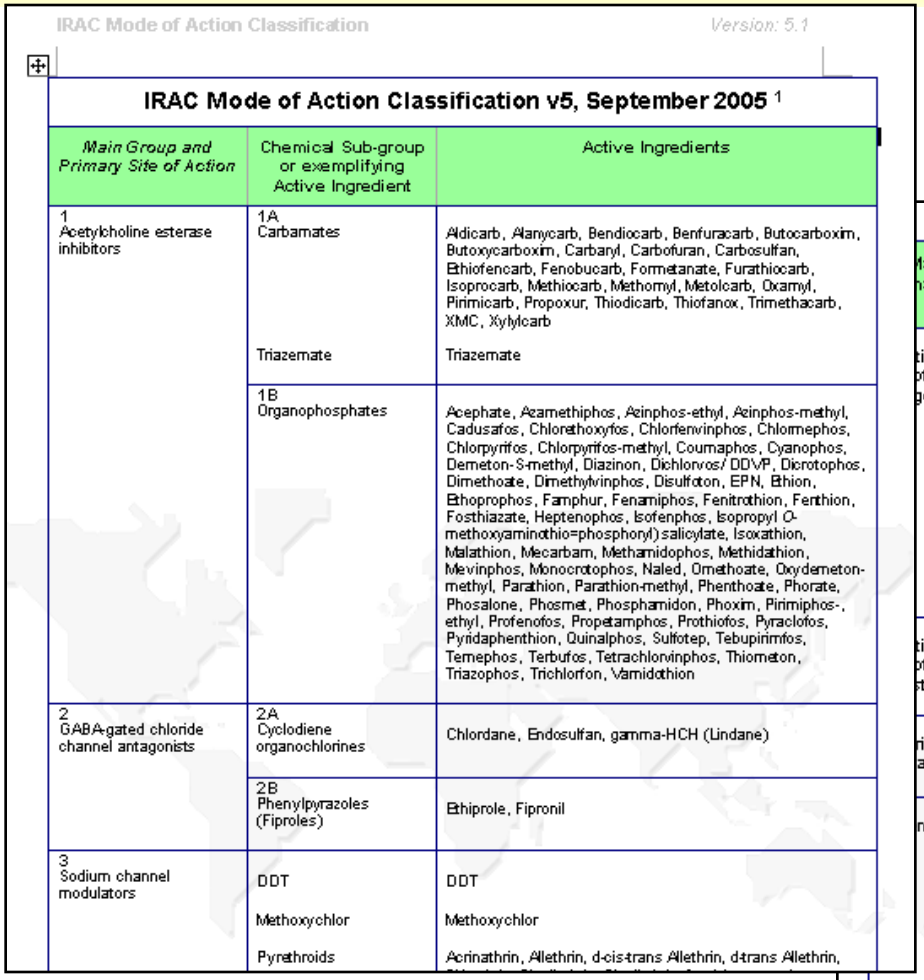
In the majority of cases, not only does resistance render the selecting compound ineffective but it often also confers cross-resistance to other chemically related compounds. This is

- 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
  - MoA groups 1-28
- A key tool for selection of insecticides in effective IRM programs
- Updated as required
- Latest version Sept 2005

Mode of Action Classification

Insecticide Resistance Action Committee

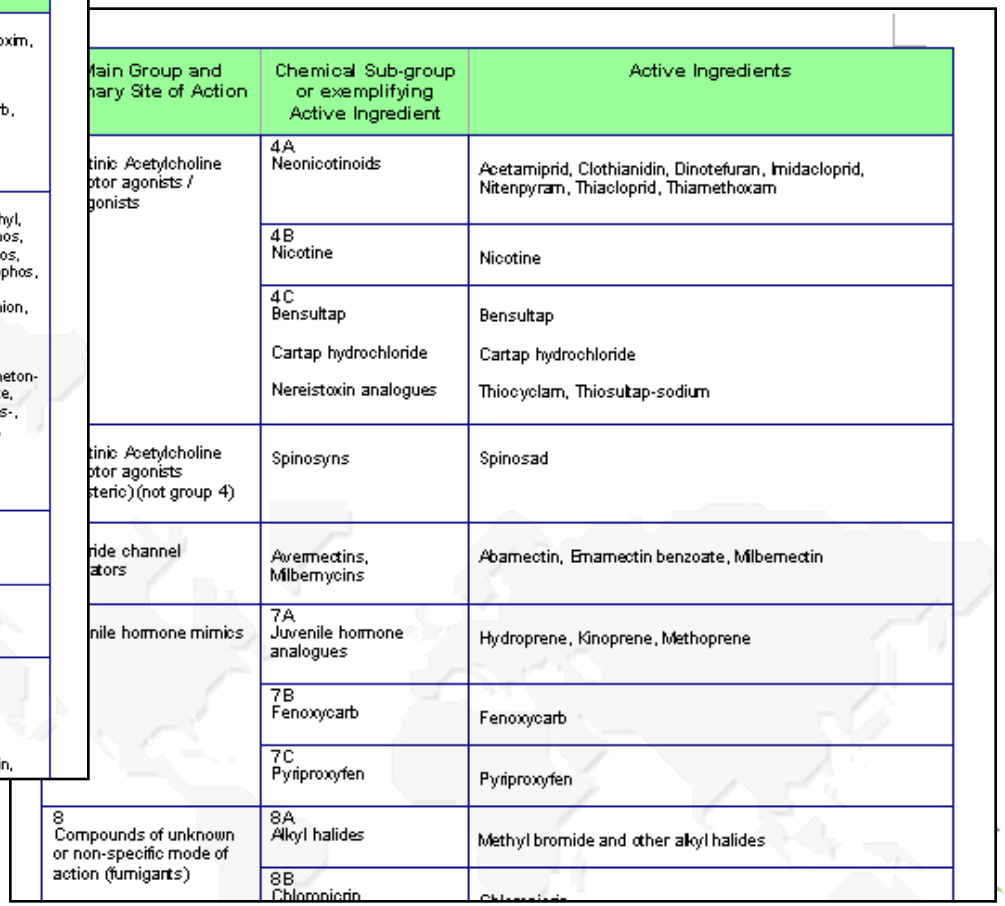
Example pages



IRAC Mode of Action Classification Version: 5.1

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

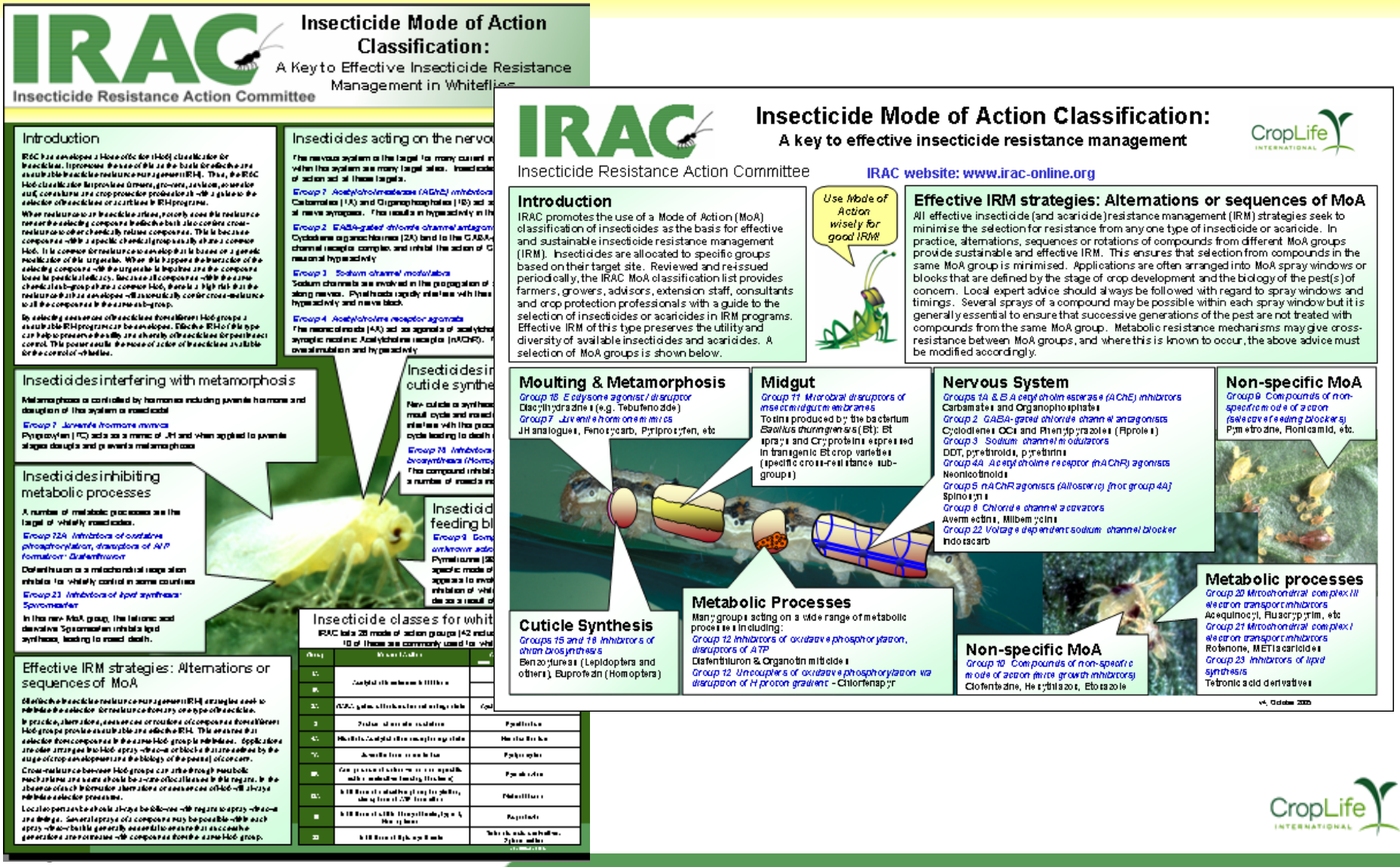
Main Group and Primary Site of Action	Chemical Sub-group or exemplifying Active Ingredient	Active Ingredients
1 Acetylcholine esterase inhibitors	1A Carbamates	Aldicarb, Alanycarb, Bendiocarb, Benfuracarb, Butocarboxim, Butoxycarboxim, Carbaryl, Carbofuran, Carbosulfan, Ethiofencarb, Fenobucarb, Formetanate, Furathiocarb, Isoprocarb, Methiocarb, Methomyl, Metolcarb, Oxamyl, Pirimicarb, Propoxur, Thiodicarb, Thiofanox, Trimethacarb, XMC, Xylylcarb
	Triazamate	Triazamate
	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 ary Site of Action	Chemical Sub-group or exemplifying Active Ingredient	Active Ingredients
tinic Acetylcholine otor 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 otor 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	

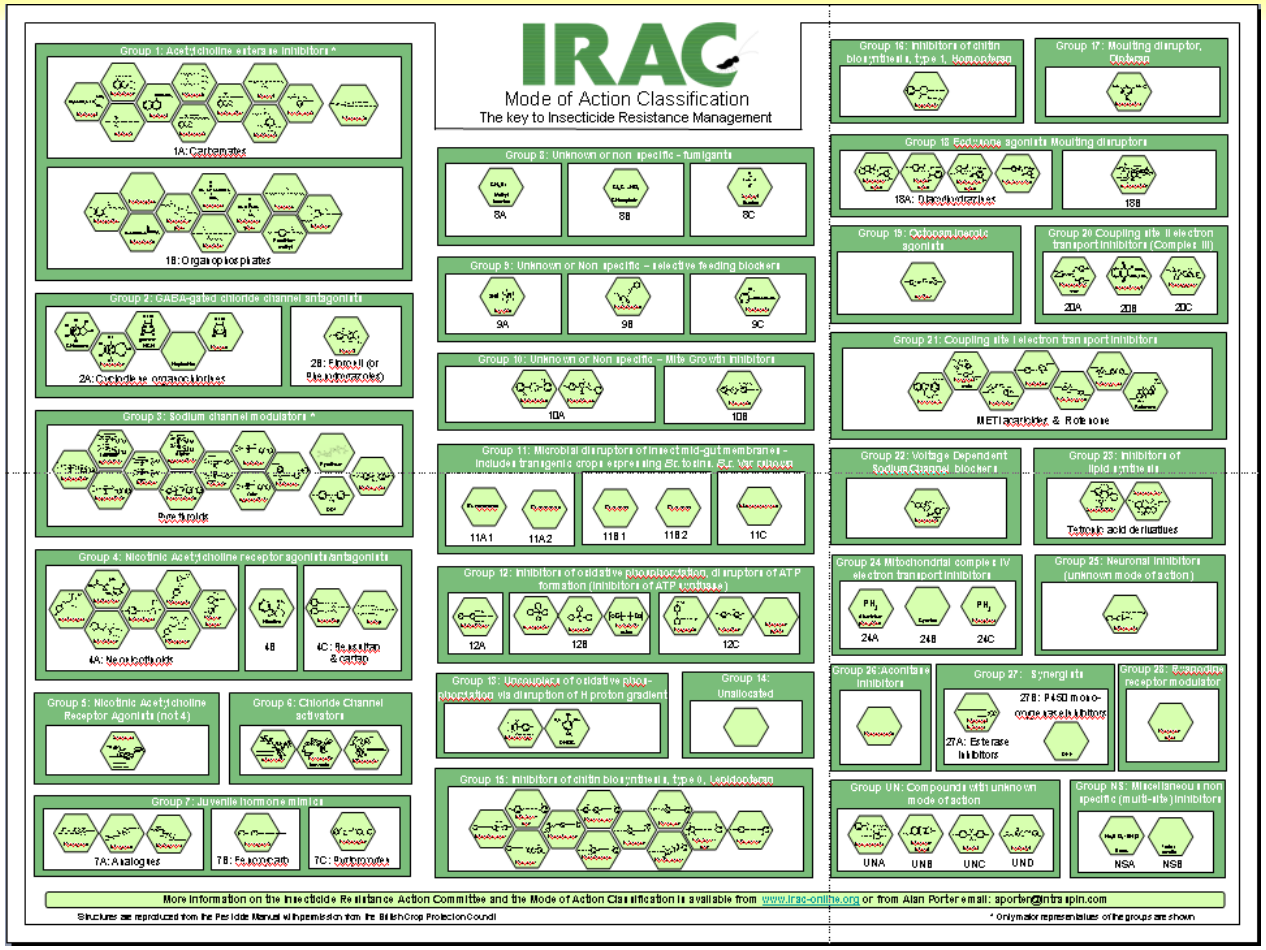
MoA Posters

Insecticide Resistance Action Committee



MoA Classification Poster

Insecticide Resistance Action Committee

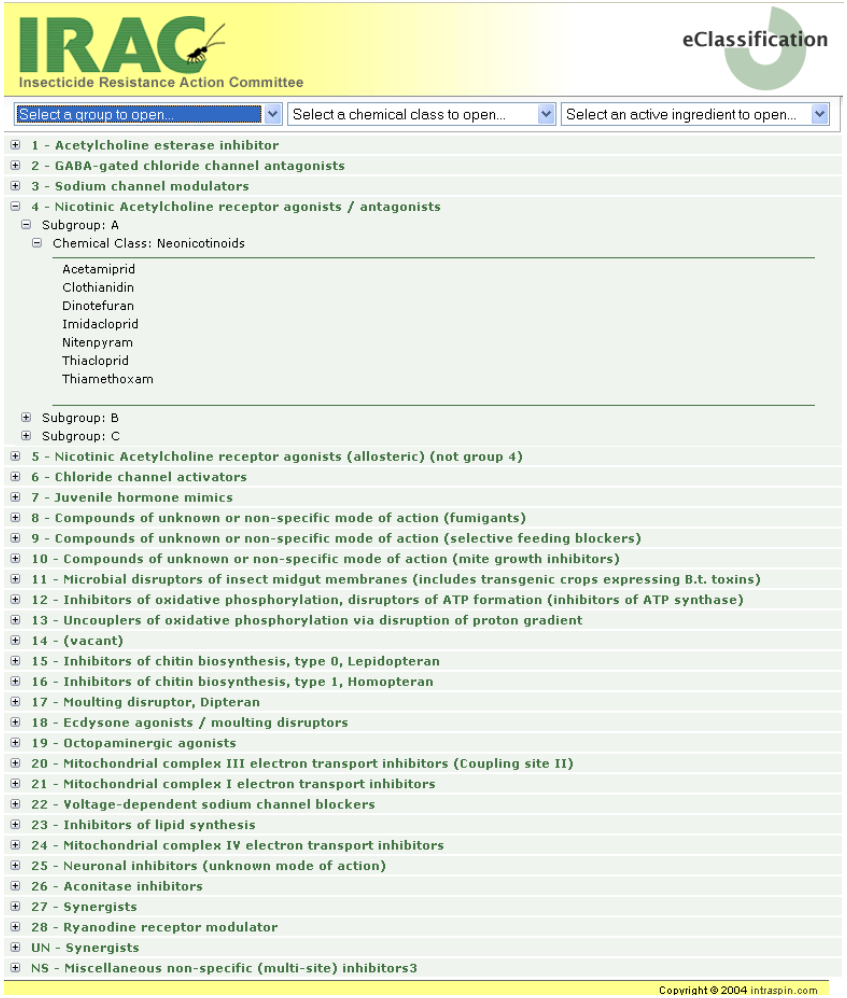


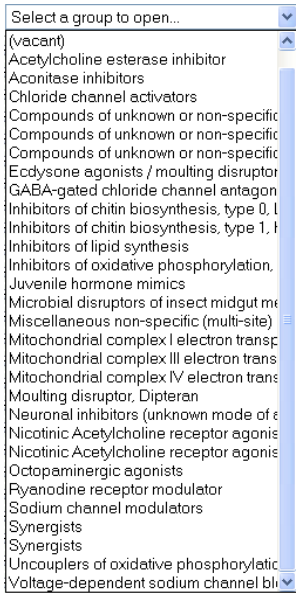
IRAC Mode of Action Classification Groups and Structures
A1 printed versions available soon!

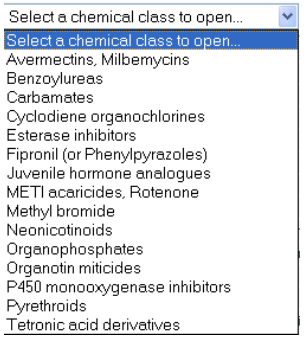
eClassification – interactive MoA

Insecticide Resistance Action Committee

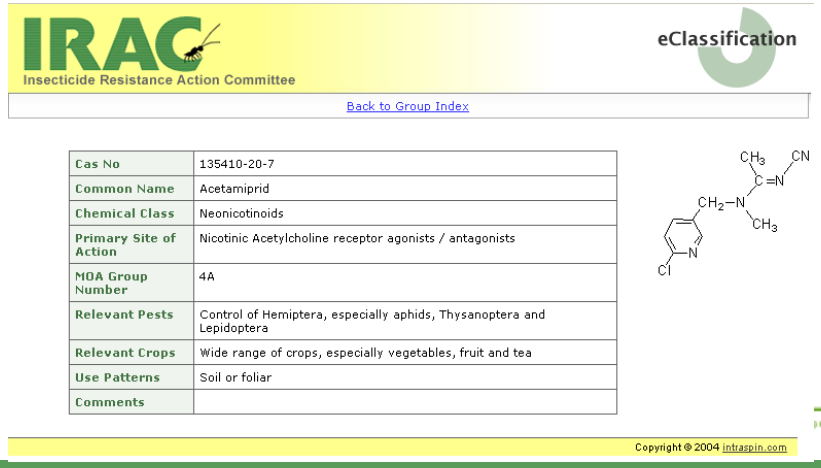
New MoA interactive online tool







Drop down menu options



IRAC Susceptibility Test Methods

Insecticide Resistance Action Committee

Insecticide Resistance Action Committee
www.irac-online.org
Resistance Management for Sustainable Agriculture and Improved Public Health

IRAC Susceptibility Test Methods Series *Method No: 3*
Version: 2

Details:

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

Photograph Courtesy of Whitney Cranshaw, Colorado State University, Tetranychus spp

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@mtras.pin.com

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.

Precautions & 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.

References & Acknowledgements:

None

New methods will include biochemical and molecular methods – additions for validated methods welcome

To finish

- IRAC has a key focus on Communication and Education – a major effort in recent years
- The completely updated and redesigned IRAC website is central to this effort – resources, education, advice
- IRAC is supporting the Country group network with appropriate resources to tackle local resistance problems
- IRAC is working with regulatory bodies to represent and champion effective IRM
- IRAC has key projects to support worldwide IRM for major MoA groups like Neonicotinoids
- IRAC will become more involved in IRM in insect-control transgenic crops