IRAC eConnection

Insecticide Resistance Action Committee

FEATURED IRAC MEMBER:

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About This Issue

Welcome to another IRAC eConnection newsletter. As always, we try to bring you interesting and informative articles about the work of IRAC and keep you updated on developing insecticide resistance problems around the world.

In this issue we report on the latest update to the IRAC MoA Classification, highlighting new actives added and the revision of Group 11, the *Bacillus thuringiensis* products. In addition we publish for the first time the IRAC Position Statement on the use of mixtures and caveats when considering resistance management and two new IRAC posters, one reporting the results of the pollen beetle monitoring in Europe during 2011 and the other covering strategies for sustainable control of of *Spodoptera exigua*. The final article is our regular spotlight feature, picking out some of the key insecticide resistance articles that have appeared in journals over the past few months and we conclude with some IRAC News Snippets and details of upcoming meetings and conferences.

47th Meeting of IRAC International

Dow AgroSciences kindly hosted the 47th IRAC International meeting at their research facility in Indianapolis last week in March, 2012. The meeting was held in conjunction with the IRAC US group and there was a useful exchange of information with around 40 participants representing 10 of the IRAC member companies along with some invited guests. The meeting consisted of a mixture of concurrent IRAC working group sessions, a meeting of the Executive Committee, the IRAC US group and an International resistance review day.

IRAC Mode of Action (MoA) Classification Update

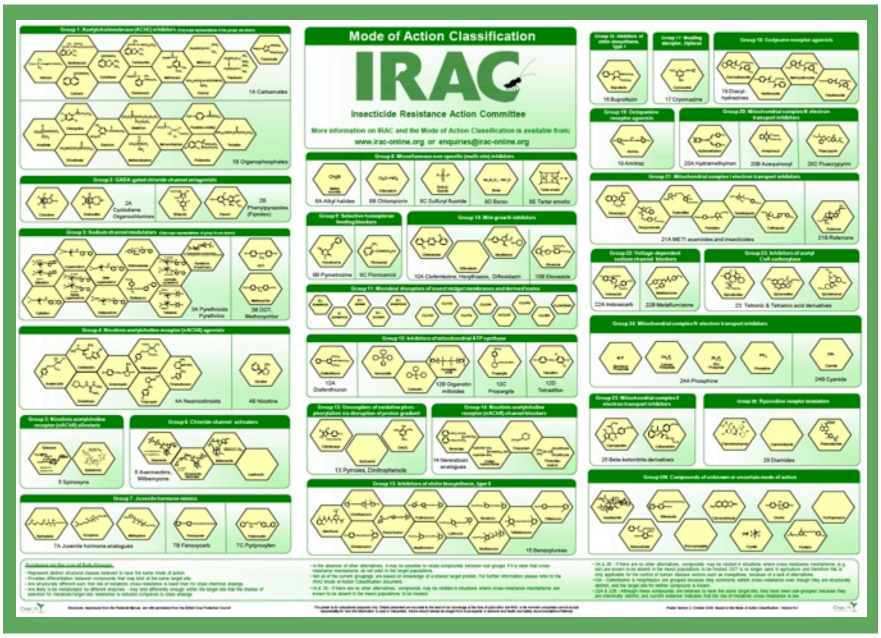
A number of changes have recently been made to the MoA Classification scheme resulting in publication of Version 7.2. The main updates are listed below, but the full MoA Classification Scheme can be downloaded from the IRAC website.

Some background information for the active ingredients included in the scheme:

- Cyantriliprole – Soon to be registered insecticide that is effective on a broad spectrum of sucking and chewing insect pests. Group 28
- Cyflumetofen – Registered in Japan as an acaricide for use on tree fruit, vegetables and ornamentals, and under development with BASF for use outside of Japan. Group 25
- Pyrifluquinazon – Registered in Japan and in development for the US for use on a wide variety of sucking insect pests and thrips. Group UN
- Sulfoxaflor – Registered in Korea and anticipating a registration in the US this year. It is effective on a wide spectrum of sap-feeding insect pests. Group 4C
- Group 11 revised – Following much discussion, the Biotech Team has revised the classification for Group 11 to provide more meaningful information.

Other MoA updates:

e-Classification: The e-Classification on the IRAC website, used to search for MoA by Group or active ingredient, has been updated to reflect all the accumulated changes and is now in line with Version 7.2 of the Classification Scheme.



MoA Posters: The MoA pest specific posters (sucking insects, mites, Lepidoptera and mosquito) have all been updated to reflect the most recent changes in the MoA Classification Scheme. Likewise, the MoA Structures poster has been updated and many of the structures have been redrawn / reformatted to make them easier to read. This has been issued and printed as a third edition of the poster with a different colour scheme to differentiate it from the earlier versions. In addition a Japanese version of the MoA Structure poster has been developed and the Spanish version updated. The MoA Working Group is currently updating the Chinese and Portuguese versions of the poster. All the MoA posters are available on the IRAC website.

MoA Booklet: The IRAC MoA booklet has been updated and is now in its third edition. Four thousand copies were printed this spring and are currently being distributed. Copies have already been provided for several meetings and conferences. Notably, the third edition of the MoA booklet along with English and Japanese versions of the MoA Structures poster were distributed at the Meeting of the Japanese Society of Applied Entomology and Zoology in March of 2012.

Book Chapter on IRAC MoA Classification: Earlier this year, an updated book chapter was published as part of the second edition of the Modern Crop Protection Compound book set; Nauen et al., 2012, IRAC, insecticide resistance and mode of action classification of insecticides. In Modern Crop Protection Compounds. Vol. 3, 2nd ed. (W. Kramer, U. Schirmer, P. Jeschke, M. Witschel, eds.), Wiley-VCH, New York, pp. 935-955.

IRAC Position on the use of Mixtures and their Role in Insect Resistance Management

Globally, there is an increased tendency and interest in developing insecticide mixtures. Whereas mixtures are common place for both herbicides and fungicides, insecticide mixtures are often a matter of debate, which mainly reflect differences in requirements for control, with insecticides usually controlling one target as opposed to a complex of targets, with the notable exception of insecticide seed (and soil) treatments. The considerations for any proposed mixture will vary depending on the actives and intended uses involved.

In order to provide some guidance when considering the use of insecticide mixtures a few basic principles have been drawn together from a series of considerations over the benefits and disadvantages of mixtures, and basically applying for crop, public health and biotech applications. These considerations regarding the potential justification for using insecticide mixtures, and their resistance management implications, are part of a fairly general insecticide mixture statement recently developed by the IRAC Executive member companies.

IRAC International Insecticide Mixture Statement

As with applying single active ingredient products, insecticide mixture products should be used with careful consideration of the characteristics of the individual active substances, use pattern and pest complex targeted. The primary intention for the use of an insecticide mixture (tank-mix or pre-formulated mixture) is, in most cases, not resistance management, but pest[1] management. The following should be considered before using insecticide mixtures for insect pest control:

1) Mixtures of insecticides provide technical advantages for controlling pests in a broad range of settings, typically by increasing the level of target pest control and/or broadening the range of pests controlled.

2) Most mixtures are not primarily used for purposes of insect resistance management (IRM).

3) In the majority of settings, the rotation of insecticide modes of action is considered the most effective IRM approach. Insecticide mixtures may offer benefits for IRM when appropriately incorporated into rotation strategies with additional mode(s) of action, but generally a single mixture should not be relied upon alone.

4) All of the following should be considered when using mixtures for IRM:

    a) Individual insecticides selected for use in mixtures should be highly effective and be applied at the rates at which they are individually registered for use against the target species.

    b) Mixtures with components having the same IRAC mode of action classification are not recommended for IRM.

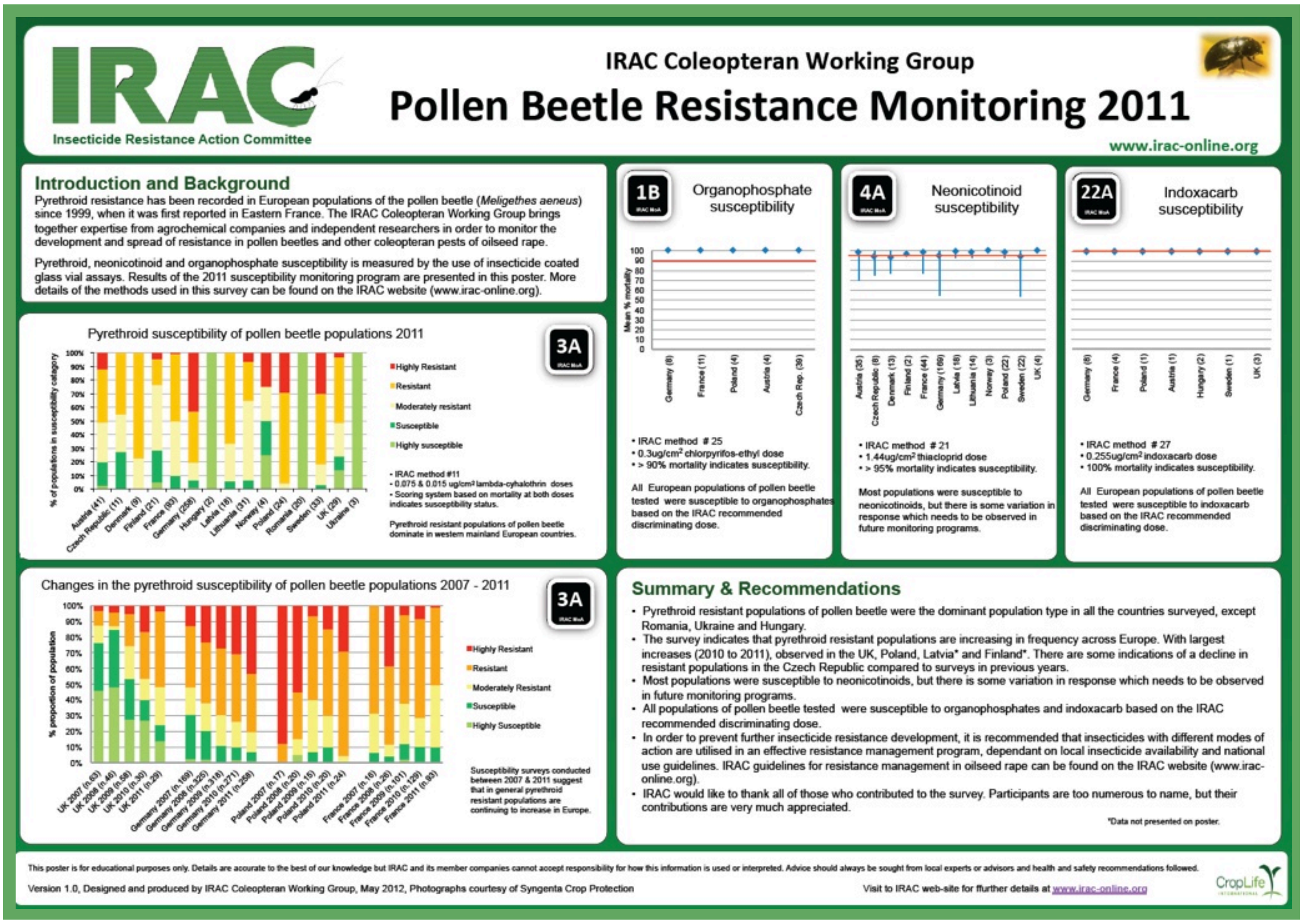
    c) When using mixtures, consider any known cross-resistance issues between the individual components for the targeted pest/s.

    d) Mixtures become less effective if resistance is already developing to one or both active ingredients, but they may still provide pest management benefits.

    e) The IRM benefits of an insecticide mixture are greatest if the two components have similar periods of residual insecticidal activity. Mixtures of insecticides with unequal periods of residual insecticide activity may offer an IRM benefit for the period where both insecticides are active.

[1] Pests include species relevant to both crop protection and public health

New Posters from the IRAC Coleoptera and IRAC Lepidoptera Working Groups



Spotlight on recent Insecticide Resistance Articles in Publications

The first half of 2012 has provided some excellent publications from insecticide resistance scientists, with reports of new cases of field derived resistance, characterization of new resistance mechanisms and several reviews which collate key learning.

Will it make the top 20 resistant pests?

Many of the reported cases of resistance are often attributed to the 'prime suspects' so when cases of resistance occur in new species it often peaks the interest of researchers. Early in the year it was reported that UK populations of the cabbage whitefly (*Aleyrodes proletella*) had evolved resistance to pyrethroid insecticides[1]. Although resistance to pyrethroids is far from a new discovery, this is the first case of resistance to insecticides recorded for this species. As reported in the last review, the Asian citrus psyllid (*Diaphorina citri*) is a hot topic for researchers, after the first reports of resistance were recorded in the USA last year. Neonicotinoid resistant strains are now also reported in China[2,] where cross-resistance was observed amongst all the neonicotinoids tested.

How do insects do that?

Molecular and biochemical techniques continue to advance our knowledge in the ways insects are responding to the chemical and biological techniques that we apply to control them. An interesting report on the gene up-regulation response of the diamondback moth (*Plutella xylostella*) to selection pressure with diamide insecticides was published in April[3]. Ryanodine receptor mRNA expression was increased in individuals exposed to diamide insecticides, but not other classes of insecticide chemistry. The over-expression of the receptor mRNA is linked to a reduced susceptibility to diamide insecticides and it is speculated that the upregulation is reason for the difference in susceptibility. A new mechanism of resistance was also reported for the tetronic acid class of insecticides, which target the acetyl-coenzyme A carboxylase enzyme (ACCase). A single point mutation (E645K) in the ACCase gene of the glasshouse whitefly (*Trialeurodes vaporariorum*) was associated with a reduction in the activity of at least one tetronic acid derivative[4]. This is the first recorded case of a target site resistance associated with this class of insecticide chemistry. Discovering mechanisms of resistance is not only restricted to new insecticide chemistry. A stimulating review of ligand gated ion channels in the two-spotted spider mite (*Tetranychus urticae*)[5] reveals novel mutations associated with abamectin resistance in glutamate-gated chloride channels.

Transgenic turnover

The first two quarters of 2012 have seen a number of publications related to field evolved resistance to transgenic *Bacillus thuringiensis* (Bt) crops. Programs established to monitor fall armyworm (*Spodoptera frugiperda*) susceptibility to the Cry1F toxin in Puerto Rico, continue to show widespread resistance in the country, however resistant populations have not spread to surrounding countries[6]. Summaries of resistance situations in Chinese pink bollworm (*Pectinophora gossypiella*) and cotton bollworm (*Helicoverpa armigera*) were also provided in early 2012[7,8], as well as an evaluation of the resistance risk associated with Cry3Bb1 resistant western corn rootworm (*Diabrotica virgifera*)[9].

And finally…..

Two additional papers of note: An excellent review of spinosyn resistance is provided in Pesticide Biochemistry & Physiology[10] and details of all too rare field scale studies investigating the practicalities of non-treated host plant refuges and insecticide resistance management were provided in the Proceedings of the National Academy of Sciences of the United States of America[11].

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IRAC News Snippets

- ★ Following agreement at the IRAC International Meeting, Ralf Nauen (Bayer CropScience) will continue as IRAC Chairman for a further year, Russell Slater (Syngenta) continues as Vice-Chair now joined by Tatjana Sikuljak (BASF) who takes over from Jonathan Henen (Makhteshim Agan) and Lixin Mao (BASF) takes over from Nigel Armes (BASF) as IRAC Treasurer.
- ★ As reported previously the IRAC Test Methods WG have developed two methods videos (*Tuta absoluta & Myzus persicae)* which are available on YouTube via links on the IRAC website. A third video describing the test method for brown planthoppers is under development. Details will be available in future eConnection issues.
- ★ The IRAC Diamide WG continues to develop a network of country groups around the globe who are working on implementing IRM strategies for the Diamide group of compounds. There are currently over 20 active groups established and a number of other countries are in the process of establishing teams.

Conferences & Symposia

- ★ National Pest Management Assoc., Pestworld, Boston, October 17-20, 2012
- ★ 60th ESA Meeting, Knoxville, Tennessee, November 11-14, 2012
- ★ 61st ASTMH Meeting, Atlanta, Georgia, November 11-15, 2012
- ★ Beltwide Cotton Conferences, San Antonio, Texas, January 7-10, 2013
- ★ NAICC Meeting, Hyatt, Jacksonville, Florida, January 23-26, 2013
- ★ 79th AMCA Annual Meeting, Atlantic City, February 24-28, 2013
- ★ 1st Intl. Whitefly Symposium, Kolymbari, Crete, May 20-24, 2013

Feedback
The eConnection is prepared by the IRAC International Communication & Education Working Group and supported by the 14 member companies of the IRAC Executive. If you have information for inclusion in the next issue of eConnection or feedback on this issue please email aporter@intraspin.com

Disclaimer
The Insecticide Resistance Action Committee (IRAC) is a specialist technical group of CropLife. Information presented in this newsletter is accurate to the best of our knowledge but IRAC and its member companies cannot accept responsibility for how this information is used or interpreted. Advice should always be sought from local experts or advisors and health and safety recommendations followed.

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