FUNGICIDE RESISTANCE ACTION COMMITTEE (FRAC): A RESISTANCE ACTIVITY UPDATE

P E Russell

Changes in Committee Structure.

The activities of FRAC are managed by the Steering Committee. Since the last report on FRAC in *Outlooks on Pest Management* (**17**(3), June 2006, 119-21) there have been several changes due to the retirement of members and the generation of a new Working Group. Professor Dr Ulrich Gisi retired from Syngenta and FRAC in 2008. Ulrich had served on the FRAC Steering Committee as FRAC Vice-Chairman, Chairman of the Phenylamide (PA) Working Group and then the PA Expert Forum. He was also largely responsible for the compilation of the FRAC Code list with all its attendant detail. His expertise will be sadly missed. Dr Dietrich Hermann replaces Ulrich on the Steering Committee as Chairman of the PA Expert forum and becomes responsible for the FRAC Code List. Dr Klaus Stenzel becomes FRAC Vice-Chairman. Dr Kristin Klappach is welcomed back to the Steering Committee as the first Chairlady of the newly formed Succinate Dehydrogenase Inhibitors (SDHI) Working Group (see below). The FRAC Banana Working Group operates a system in which the Chairmanship rotates between companies. Dr Helge Sierotzki (Syngenta) held the chair for 2007/2008 and the new Chairman for 2009/2010 is Dr Andreas Mehl (Bayer CropScience). The current FRAC committee structure is shown below.

A New Working Group

When new areas of chemistry are introduced to the market with two or more companies responsible for sales in the same market areas the work of FRAC expands to encompass this new chemistry by the formation of a new Working Group. The most recent example of this is the generation of the SDHI (Succinate Dehydrogenase Inhibitors) Working Group. The area of chemistry is not new and was previously known as 'carboximides' in FRAC Mode of Action Group C2. As the FRAC Code list is based on mode of action it was appropriate to name the Working Group and rename the chemical group to take this into account. The Code has not changed. The group includes such established molecules as carboxin, oxycarboxin, benodanil, flutolanil and mepronil, along with newer molecules e.g. boscalid, penthiopyrad, fenfuram showing a wider activity spectrum. The mode of action of the group is now well established: inhibition of Complex II, succinate dehydrogenase with all SDHIs binding in a similar way in the ubiquinone-binding site. Several mutations are known to be responsible for resistance and cross resistance studies have confirmed that all SDHIs are affected by them.

The first meeting of the new Working Group took place in December 2008 with representatives from DuPont, Bayer CropScience, LKC, Syngenta and BASF. Their first resistance management guidelines are expected later in 2009.

Name	Position	Company
Andy Leadbeater	FRAC Chairman and Chairman of the QoI WG*	Syngenta
Klaus Stenzel	FRAC Vice-Chairman and Chairman of the SBI WG	Bayer CropScience
Phil Russell	Secretary/Treasurer	Consultant
Michael Merk	Chairman, Carboxylic acid amide (CAA) WG	BASF
Helene Lachaise	Chairlady, Anilinopyrimidine (AP) WG and Dicarboximides Expert Forum	Bayer CropScience
Kristin Klappach	Chairlady, SDHI WG	BASF
Randy Gold	Communications and webpage manager	BASF
Andreas Mehl	Chairman, Banana WG	Bayer CropScience
Dietrich Hermann	Chairman, PA Expert Forum	Syngenta
Jean-Luc Genet	Chairman, Benzimidazole Expert Forum	DuPont
Greg Kemmitt	Ordinary member	Dow Agrochemicals
Kantaro Tanabe	Chairman, FRAC Japan	Nippon Soda
Gilberto Olaya	Chairman, North America FRAC	Syngenta
Nilceli Fernandes-Buzzerio	Chairlady, FRAC Brazil	Syngenta
*Working Group		

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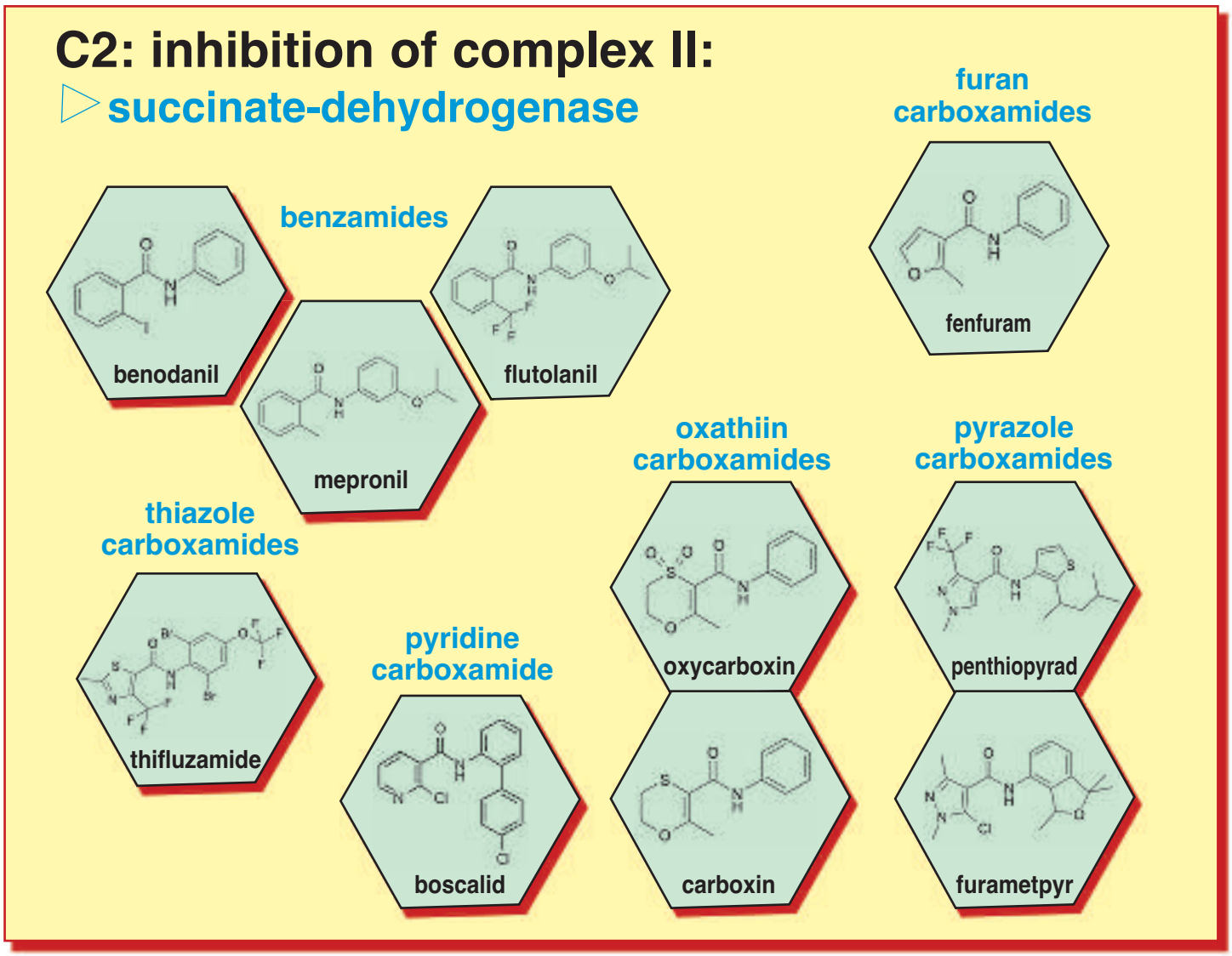

Resistance Management at Regional Level

The FRAC Working Groups produce the core resistance management guidelines which form the basis for resistance management worldwide. The Guidelines are crop and pathogen specific for all major crops, but due to the wide variety of crops treated with some areas of chemistry, the Working Groups also produce general guidelines applicable to these extra crops. The Guidelines are communicated to all FRAC member companies and their subsidiaries and are available for consultation from the FRAC website. However, it is quite possible that some adaptation of these guidelines may be required to suit local conditions. Responsibility for such adaptation is increasingly being taken by local organizations in consultation with the FRAC Working Groups. The two key organization types acting at the local level are the local FRAC groups which are industry based, and the local Resistance Action Groups (RAGs) which include members from industry, research institutes, advisory services, universities and the regulatory authorities.

Regional FRAC Groups

The Regional FRAC groups in Japan, North America and Brazil are key components of the FRAC structure, the chairperson of each being a member of the FRAC Steering Committee. They are self governing and self financing organizations and act to co-ordinate the gathering and dissemination of resistance management information at the local level. As the member companies may not have the research facilities available to their international parents, the local FRAC groups may sponsor research studies with local organizations. Such studies can include generation of local fungicide sensitivity baselines and fungicide sensitivity monitoring campaigns. An excellent example of this activity recently came from FRAC Brazil where there were some fears of resistance of cereal rusts to DMI fungicides, based on less than expected disease control. FRAC Brazil acted quickly to establish a research monitoring campaign and showed that, as expected, there was no evidence of resistance development and the poor product performance had been due to extreme disease pressure combined with inappropriate spray timing. Another project is still in progress to investigate the sensitivity of *Ramularia areola* from cotton to QoIs, triazoles and benzimidazoles. The project started in the 2006-2007 season when thirty six populations were collected. Samples from the 2007-2008 season were collected and resistance found to QoI based products. An *Outlooks on Pest Management* article detailing resistance management in Brazil is expected later in 2009.

FRAC North America is organized in a similar way to the parent FRAC with Working Groups for QoI, SBI, AP and CAA group fungicides. They have excellent working relationships with the American Phytopathological Society (APS) and FRAC members are frequent contributors to the annual APS meetings. A specialist symposium on the CAA fungicides is being planned for inclusion in the 2009 meeting and there is talk of a repeat of the very successful 'Fungicide Resistance in North America' meeting for 2010.

FRAC Japan is very successful in bringing together the Japanese companies to discuss common challenges. Regular meetings are held of the full committee plus some specialist meetings for individual areas of chemistry. An article covering resistance management in Japan is expected to be published in this journal in 2009.

Regional Resistance Action Groups

Very active groups exist in the UK (FRAG-UK) and The Netherlands (FRAG-NL) while a new group has just been formed to cover the Nordic and Baltic regions, NORBARAG, with Dr Lise Nistrup-Jorgensen as the first Chairlady of the Fungicide section. FRAC enjoys very good contact with the Groups and information is freely exchanged between all parties. The work of FRAG-UK is particularly appreciated and their series of fungicide use guidelines for individual crop areas is very useful. (www.pesticides.gov.uk/rags.asp?id=64)

FRAC and the 91-414 Revision

The proposed introduction by the European Commission of new criteria governing which pesticides can be authorized for use has been extensively covered in a previous edition of *Outlooks on Pest Management* (Copping L, **19(6)**, December 2008, 244-6). While most concerns were aimed at the direct consequences of a potential loss of crop protection products on the viability of growing various crops, the loss of these same ingredients would also have an effect on the implementation of resistance management strategies, potentially leading to a rise in resistance to the products surviving the new regulatory proposals. Such a situation would, of course, only make the effects of new legislation on crop viability worse. FRAC and its partner committee IRAC (Insecticide Resistance Action Committee) together with resistance experts of other organizations met in April 2008 to discuss these consequences; a meeting which resulted in 'The Declaration of Ljubljana' (Bielza *et al*., *Outlooks on Pest Management* **19(6)**, December 2008, 246-9) outlining the consequences of a reduction in the number of active ingredients on resistance management.

Vine downy mildew *Plasmopara viticola*. Courtesy of Bayer CropScience

More recently (January 13 2009) the proposals were voted on again by the European Parliament and agreed, with a few revisions. The general consensus is, however, that even with the revisions, which could result in fewer than expected active ingredients being withdrawn from the market, there will still be a serious issue concerning sustainability of resistance management. This concern will extend beyond Europe as the new proposals will also apply to crops treated outside the EU, but intended for import into the EU. FRAC will continue to collaborate with all interested parties in reaching a satisfactory conclusion to the matter.

As an aside, the possible consequences of new legislation were featured on the UK television news (14 January 2009).

South African vineyard. Courtesy of Thys Lombaard.

Potato blight lesion. Courtesy of BASF

I was surprised, and disappointed, to hear one supporter of the new legislation declare that the result would be to 'force industry to produce newer, safer products …'. The implications being, of course, that industry can produce such new molecules overnight and in time to avoid the calamitous consequences of the proposed new legislation and that current discovery practice does not seek to find safe products.

FRAC Publications

The FRAC publications pages contain much information relevant to all those interested in fungicide resistance and its management, including advisors, teachers and students.

The Mode of Action Code List

The FRAC MOA Code List is the most popular of all FRAC documents accessed from the FRAC webpages. It includes full details of the Mode of Action codes, the group name and code, chemical group names for individual molecules and their common names and comments on resistance risk. This code list is now the accepted international standard and is reviewed at regular intervals. There has been some discussion by Austria, Belgium and the UK regulatory authorities about the inclusion of the codes on product labels, but it has been decided not to make this compulsory. Codes are included on product labels in the USA.

A new addition to the 2009 list will be the first entry for a biological. After very careful consideration of information provided by AgraQuest, the FRAC Steering Committee has approved inclusion of *Bacillus subtilis* strain QST 713, sold as the product Serenade and Rhapsody, as a new Group, Code F6 (mode of action affecting lipids and membrane synthesis).

The FRAC List of Plant Pathogenic Organisms Resistant to Disease Control Agents

Have you ever wondered which organisms have shown resistance to a particular area of chemistry? This document should give you the answer. Its aim is to list confirmed cases of resistance by plant pathogens to modes of action covered by the FRAC Code List, together with references. Wherever possible, the case recorded is the first case published, but additional references are frequently added to cover key information on, for example, mode of action and resistance mechanism. Distinctions are made between instances of field resistance, mutation studies and resistance generated by forced laboratory selection. The list is updated regularly and information on new cases is always welcome for inclusion; but note that only verified cases (published in a refereed journal) are considered.

FRAC Methods Folder

Having a correct, verified, method for monitoring fungicide sensitivity is crucial for any fungicide resistance monitoring programme. The FRAC Working Groups have collated the methods used within their own member companies, together with methods used by recognized experts in academia and research institutes to produce a library of recommended methods. As well as being valuable for fungicide resistance research, the methods are also suitable for plant pathology teaching purposes. The library currently contains 32 methods, organized for individual pathogens. More methods are added regularly.

The FRAC Monographs

Monograph 1: Fungicide resistance in crop pathogens: How can it be managed? 2nd revised edition. K J Brent and D W Hollomon

Monograph 2: Fungicide resistance: The assessment of risk. 2nd revised edition. K J Brent and D W Hollomon

Monograph 3: Sensitivity baselines in fungicide resistance research and management. P E Russell

Copies of all Monographs are available as free downloads from the FRAC Website. Hardcopies of Monographs 1 and 2 and a CD containing all three monographs are available free of charge on request to the FRAC Secretary.

For further information on the resistance status of individual Working Group areas, on FRAC and its activities and regional groups please go to: www.frac.info

For local FRAC groups:

FRAC Brazil: www.frac-brasil.org.br

North America FRAC: www.nafrac.com

FRAC Japan see FRAC website.

Similar articles that appeared in *Outlooks on Pest Management* include – 1997 **8(3)** 34; 1999 **10(5)** 213; 2006 **17(2)** 90