

## Herbicide Resistance : The Stance of the Agrochemical Industry

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### Summary

Herbicide resistance in weeds was first identified in 1964 and now, less than thirty years later, there are over one hundred resistant biotypes in about forty countries. In the late eighties, in response to growing awareness, the agrochemical industry formed an international Herbicide Resistance Action Committee (HRAC). The objective of the committee is to delay and effectively manage herbicide resistance in weeds in order to minimise its impact on agricultural production. This paper describes the three technical working groups formed to focus on resistance to ALS-inhibitors, triazines and grass herbicides, and gives examples of the accomplishments of HRAC and its plans for the future.

### Introduction

The first case of herbicide resistance in weeds was identified in 1964, and less than thirty years later there are over one hundred resistant grass and broadleaved weed biotypes globally in about forty countries (1). Resistance is reported to a range of different herbicides believed to cover fifteen different modes of action (1). These include resistance to triazines, ALS (acetolactate synthase) inhibitors and ACCase (acetyl CoA carboxylase) inhibitors. However, one of the greatest concerns is the selection of multiple resistant biotypes of Lolium rigidum in Australia and Alopecurus myosuroides in England. The increase in herbicide resistant weed populations is of concern not only to academics and governmental personnel, but also to industry, and the agrochemical industry in particular must play a major role in developing and implementing effective weed management strategies.

### Formation and Role of the Herbicide Resistance Action Committee (HRAC)

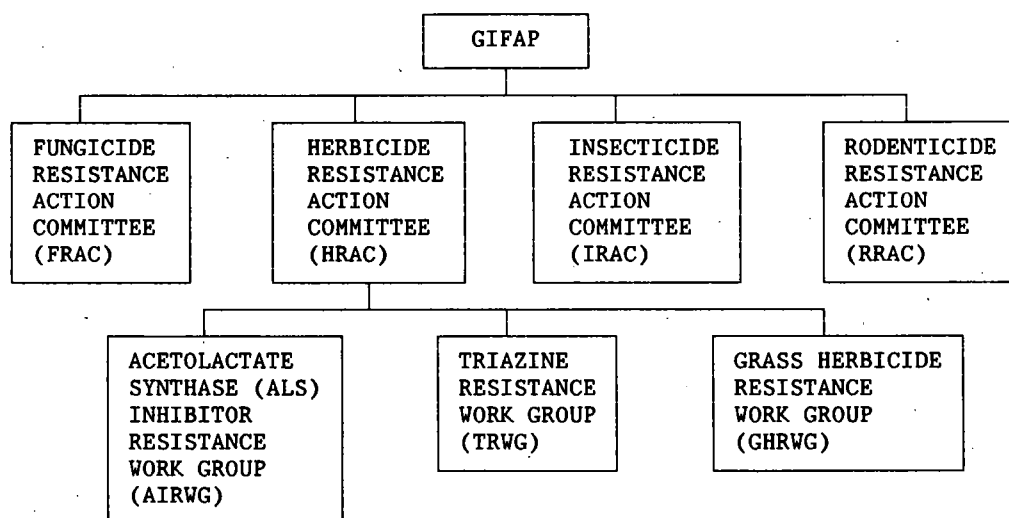
In September 1989, the agrochemical industry formed an international, industry-led Herbicide Resistance Action Committee to be led by Alan Jutsum of ICI. This committee consists of technical representatives from the main herbicide-producing Companies and, together with the Insecticide, Fungicide and Rodenticide Resistance Action Committees (IRAC, FRAC and RRAC), functions under the auspices of the International Group of National Associations of Agrochemical Manufacturers (GIFAP). The objective of HRAC is to delay and effectively manage herbicide resistance in weeds in order to minimise its impact on agricultural production.

HRAC, therefore, is an important forum for the discussion of herbicide resistance problems and for the formulation and communication of resistance management strategies. It liaises with universities, advisory and extension services, farmers, distributors and governments, and fulfils a valuable

educational role, through publications and open meetings, and by providing technical consultations.

HRAC has set up three technical working groups (see Figure 1) which focus on resistance in the priority areas of ALS inhibitors, triazines and grass herbicides (including multiple resistance). These groups recommend technical strategies to prevent, delay or manage herbicide resistance and monitor the subsequent implementation of these strategies. In addition, the groups establish and direct collaboration on monitoring programmes, research and education initiatives, verify reports of resistance, and monitor and guide the activities of various national sub-groups.

Figure 1 - Organisation of the GIFAP Resistance Action Committees and the Herbicide Resistance Work Groups



#### Accomplishments of HRAC

HRAC has made very good progress in a short period of time. A number of key resistance situations causing concern have been investigated and advice given. Open meetings with academic and governmental researchers have been held to develop effective interactions with non-industrial personnel, and collaborative research including monitoring programmes has been set up, funded in part or in total by HRAC.

In order to illustrate some of the accomplishments of HRAC, examples of recent progress made by the ALS Inhibitor Resistance Work Group (AIRWG) will be used. Resistance to ALS inhibitors has been confirmed in the USA, Canada and Australia, and the first case in Europe has just been reported, in Denmark. The AIRWG has taken the initiative to meet with researchers from the United States and Canada to discuss the selection of ALS-resistant weed populations in wheat producing areas and the potential for selecting ALS-resistant weeds in maize and soybean fields. Two areas that were identified as needing additional research in order to develop effective resistant weed management strategies were to measure the frequency of the ALS-resistance trait within natural weed populations and to clarify the role of pollen and seed dispersal in the spread of ALS-resistance from one population to another. This information is needed to further refine various models which have been used to predict the potential for a herbicide to select for resistance.

To gather this information, the member companies of HRAC/AIRWG are funding two research projects for two years. In the first project, Dr Donn Thill, Dr Phil Westra and Dr Peter Fay are collecting seed from Kochia scoparia populations which have not been previously treated with ALS inhibitors in Idaho, Colorado, and Montana, and are determining the frequency of resistance to chlorsulfuron in these populations. These data should measure the initial frequency of resistance to ALS inhibitors within Kochia scoparia populations. In the second project, Dr Carol Mallory-Smith and Dr Donn Thill are determining the spread of ALS-resistance through the pollen of the open pollinated Kochia scoparia and the closed pollinated Lactuca serriola and the movement of seed in Salsola iberica. ALS-resistance has been selected in all of these species. These data should help us understand what roles pollen and seed dispersal play in the spread of ALS-resistance.

In addition to funding and supervising these two research projects, AIRWG is also writing guidelines for weed control management to prevent or delay the selection of resistance to ALS inhibitors and for monitoring and managing any resistant populations before they become serious problems. These guidelines will be distributed to industrial and public personnel and will be used to help educate growers on effective weed management procedures and to implement these procedures.

### Plans for the Future

HRAC will continue to co-operate actively with industry and non-industry personnel to ensure a rapid and open disclosure of resistance information and proposals. It will also continue to support existing co-operative research programmes and identify new areas warranting sponsorship. The key objective of these approaches is to ensure that effective anti-resistance strategies are developed and implemented. This will evolve around the use of herbicides having different modes of action used either as tank mixes or sequential treatments, and incorporating herbicides with mechanical, cultural (eg crop rotation and tillage) and biological weed control practices. However, weed resistance management strategies may vary between countries or areas, due to differences in weed spectra, cropping and cultural practices, soil type and environmental conditions. For this reason, it is important for HRAC to work closely with national weed resistance groups to help them formulate specific strategies to overcome local problems. To supplement this approach, a series of resistance monographs will be issued by HRAC which review particular areas (starting with graminicide resistance), provide clear guidelines for confirming resistance, and outline agreed strategies for overcoming the threat of herbicide resistance.

### Acknowledgements

HRAC thanks the participating agrochemical companies for allowing staff to freely give of their time to HRAC matters, and acknowledges the vital role played by academic and government research institutes and advisory services throughout the world in the management of herbicide resistance.

### Reference

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