HERBICIDE RESISTANCE EXTENSION STRATEGY FOR SOUTH-EASTERN AUSTRALIA

A. Bishop[A], R.S. Britton[B], J.J. Dellow[C] and M. Incerti[D]
[A] Department of Primary Industry and Fisheries, Rundle Road, Devonport, Tasmania 7310, Australia
[B] Primary Industries South Australia, GPO Box 1671, Adelaide, South Australia 5001, Australia
[C] NSW Agriculture, Agricultural Research and Veterinary Centre, Forest Road, Orange, New South Wales 2800, Australia
[D] Formerly with Agriculture Victoria, Institute of Sustainable Irrigated Agriculture, Tatura, Victoria 3616, Australia

Summary In the south-eastern grain belt of Australia, many farmers, although aware of herbicide resistance, are not prepared to take action in regard to herbicide resistance avoidance until the problem actually appears. To tackle this problem nationally a three year extension strategy was run funded by the Grains Research and Development Corporation. Many of the conventional extension methods were employed in this program. A unique, but effective strategy was the introduction of a national herbicide label code based on the mode of action of the different herbicides.

INTRODUCTION

In the southern Australian cropping belt herbicides have enabled farmers to develop extensive and more continuous cropping rotations based on minimum tillage. These practices have proved beneficial to soil structure, fertility and disease control and to the ability of farmers to sustain profitable crop production. Such cropping systems have had to rely heavily on the use of selective herbicides, particularly for grass weed control but also for the control of broadleaf weeds. This has resulted in the widespread appearance of herbicide-resistant weeds.

The first detection of herbicide-resistant annual ryegrass (*Lolium rigidum* Gaudin), in Australia occurred in 1982. Since this initial identification 13 other annual weeds have displayed resistance to herbicides. In the more favourable south-eastern wheat belt of New South Wales, annual ryegrass has been reported to occur in one third of the cultivated fields (Pratley, personal communication). Ryegrass is also a major weed across most of the cropping areas of Victoria and South Australia.

A national survey of annual ryegrass resistance in Australia in 1991 by the Agricultural and Veterinary Chemicals Association (AVCARE) found that 47% of farmers were aware of herbicide resistance. This figure varied greatly across the country, from a 72% awareness in Western Australia to only a 40% awareness in New South Wales and Victoria. These low awareness figures prompted the establishment in 1992 of a 'National Extension Strategy for Managing Herbicide Resistance'. This national three year program, funded by the Grains Research and Development Co-operation involved the establishment of three co-ordinating committees in: Western Australia, south-eastern Australia (South Australia, Victoria, Tasmania, southern and central New South Wales), northern New South Wales, and southern Queensland.

The aims of the program were to make farmers aware of the factors responsible for the development of herbicide resistance; the strategies for avoidance of herbicide resistance; and the options available for managing herbicide-resistant weed populations.

MATERIALS AND METHODS

In order to identify the perceptions and needs of farmers and chemical resellers associated with chemical use on farms, a series of 'focus discussion groups' was held in late 1993 in the south-eastern wheat belt of New South Wales (Pratley *et al.* 1994).

The main points to arise from the eight 'focus groups' (six held with farmers and two held with chemical resellers) were as follows:

- Farmers were not prepared to act until the problem appeared.
- Farmers had a strong distrust of chemical representatives.
- Farmers tend to blame the herbicide for the poor results.
- Retailers requested and needed technical updates and workshops.
- Retailers were worried about litigation problems.

On the basis of data collected from the eight 'focus group' meetings and input from farmers, resellers, and advisers in other states the following recommendations were made for the development of a herbicide resistance extension strategy:

- A basic awareness campaign should be maintained. All participants at the focus groups were aware of herbicide resistance but concluded most farmers had not yet acted to address the problem.
- Herbicides should be clearly and uniformly coded according to their modes of action on the label. This should be easily recognized.

- Information about herbicide resistance should be consistent throughout the country. Extension and resale information should be consistent and not give conflicting information.
- Farmers must be educated about the relationships between herbicide resistance and other management issues and strategies.
- Agricultural chemical companies must be encouraged to take more responsibility for the end use of their products by providing support and information about the use and effects of their products.
- Agricultural chemical resellers needed an education program to increase their understanding of the issues when dealing with farmer clients.

RESULTS

The three year national extension strategy has achieved the following outcomes matching the recommendations made by the focus groups.

Uniform coding of herbicides Registration of agricultural chemicals in Australia is regulated by the National Registration Authority. As from January 1995 it has been mandatory for all registered herbicide labels to include a statement regarding the mode of action group to which the particular herbicide belongs and a warning in regard to the likelihood of resistance appearing if repeated applications of the herbicide are made.

More importantly, the National Registration Authority has adopted a uniform alphabetical coding of all herbicides based on their mode of action. There are currently 14 mode of action groups (A to N) and these groups are arranged, in resistance management guides, according to the perceived risk of resistance (Table 1). Herbicides in Groups A and B are considered high risk. Group A includes most of the grass selective herbicides namely the aryloxyphenoxypropinates, and the cyclohexanediones. Group B includes some grass selective herbicides and a range of very effective broadleaf herbicides. Group B consists of three sub-groups, namely the sulfonylureas, imidazolinones and sulfonamides. Group C to Group H are perceived as moderate risk and Group I to Group N are perceived as low risk.

Prior to the alphabetical coding, herbicides were referenced by their complicated mode of action; for example Group A herbicides were listed as 'inhibitors of acetyl coA carboxylase [ACC]' which meant little to farmers and resellers and was considered too complicated and confusing.

Commencing in 1995 the National Registration Authority made it mandatory for all herbicide labels (nationally) to be coded prominently on the front label with the mode of action group. For example, 'GROUP A HERBICIDE' appears in large type in a box close to the position where the active constituents are listed. The distinguishing letter (e.g. 'A') is highlighted by using white relief on a dark background.

Table 1. Herbicide mode of action groups.

	High Risk
Group A	Inhibitors of lipid synthesis-ACCase inhibitors
Group B	Inhibitors of the enzyme acetolactate synthase-ALS inhibitors
	Moderate Risk
Group C	Inhibitors of photosynthesis at photosystem II
Group D	Inhibitors of tubulin formation
Group E	Inhibitors of mitosis
Group F	Inhibitors of carotenoid biosynthesis
Group G	Inhibitors of protoporphyrinogen oxidase
Group H	Inhibitors of protein synthesis
	Low Risk
Group I	Disrupters of plant cell growth
Group J	Inhibitors of fat synthesis
Group K	Herbicides with multiple sites of action
Group L	Inhibitors of photosynthesis at photosystem I
Group M	Inhibitors of EPSP synthase
Group N	Inhibitors of glutamine synthetase

With the national alphabetical coding, herbicide groups can now be easily recognized. This initiative is considered as one of the most important steps taken in assisting farmers and resellers to identifying the different mode of action groups and their herbicide resistance risk factor.

All weed control recommendation booklets published by the various state government agencies now clearly table the mode of action group to which the particular herbicide belongs, along with more detailed information on herbicide resistance, its avoidance and its management.

Awareness campaign An extension campaign was coordinated between the state government departments responsible for agriculture in New South Wales, Victoria, Tasmania and South Australia. The south-eastern committee oversaw this campaign. The respective coordinators designed and distributed extension materials such as extension leaflets and posters, slide and overhead projector packages and a audio-visual for use by extension and retail personnel. Field days and

demonstrations together with workshops and training sessions were conducted and/or supported. Government, industry and private advisers were targeted with the knowledge that such operators are in the best position to influence farmers.

Consistent information Prior to the establishment of the national extension strategy much of the information provided to farmers and resellers was considered to be inconsistent and consequently confusing. The south-eastern Australia committee worked to ensure that consistent messages where delivered via common leaflets and posters for distribution throughout its region. This consistent message has increased the awareness and understanding of herbicide resistance amongst farmers, resellers and advisers.

The south-eastern co-ordinators also worked closely with the co-ordinators covering northern New South Wales, southern Queensland and Western Australia. This co-operation across regional and state borders was a real strength of the program.

Chemical manufacturer responsibility Agricultural chemical companies have been extremely co-operative in providing extension material on herbicide resistance and in amending their labels consistent with the new national regulations. However, initially there was little effort directed towards advertising to which mode of action group a herbicide belonged to and why it was important to know this, or to the importance of rotating between different herbicide groups and other management options so as to avoid heavy reliance on the same herbicide or group of herbicides. The National Association for Crop Protection and Animal Health (AVCARE) through its herbicide resistance committee AHRAC undertook a major awareness and communication campaign in 1996, aimed at its own members, distributors of herbicides and the farming sector.

Integrated approach Considerable effort was expended by the co-ordinators in encouraging farmers, their advisers and the agricultural chemical industry to adopt an integrated approach to the management of weeds. This was seen as necessary to reduce the over reliance on the highly selective Group A and Group B herbicides and to consequently delay and/or reduce the impact of herbicide resistance. The relationship between an integrated approach to weed management and the other aspects of farming have been emphasised in an attempt to promote sustainable and profitable crop production. The co-ordinators have contributed material on integrated weed management to programs such as Topcrop, Right Rotations (SA) and Farmcare as well as industry and government training programs.

DISCUSSION

The three year extension strategy successfully addressed and implemented the 'focus group' recommendations. The uniform mode of action label coding is considered to be both a unique and a major breakthrough in enabling farmers, resellers and extension personnel to identify herbicides within their groups. This simple coding has proven most useful in helping herbicide users to easily recognize which groups of herbicides they are using and greatly assists in advising avoidance and management strategies.

It is now considered that the vast majority of farmers know about herbicide resistance, but there is still a major section of farmers who are not prepared to take action until the problem arises. Whilst funding for the project finished in July 1996 the extension strategy is continuing to address this growing problem via state agency programs and the newly formed Co-operative Research Centre for Weed Management Systems.

ACKNOWLEDGMENTS

The component projects were funded by the Grains Research and Development Corporation Southern Panel. The support and guidance of Dr. Stephen Powles, Director of the Co-operative research Centre for Weed Management is also acknowledged, together with the AVCARE herbicide resistance committee and the many researchers, farmers and advisory personnel who have contributed to the better understanding and management of this major threat to grain growers.

REFERENCES

Prately, J., Baines, P., van der Rijt, V. and Lockie, S. (1994). Chemical use on Farms – Focus Groups Reports. National Resistance Workshop 1994, pp. 118-19.