SURVEY OF THE OCCURRENCE OF HERBICIDE RESISTANT RYEGRASS IN VICTORIA

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Summary A survey of the occurrence of herbicide resistant annual ryegrass in the major cropping regions of Victoria was conducted over 1992 and 1993. Annual ryegrass seed was collected from randomly selected paddocks from 47 locations in the Wimmera and 65 locations in the Mallee. Plants grown from collected seed were treated with selective herbicides commonly used to control annual ryegrass in crops: chlorsulfuron, diclofop methyl, metribuzin and sethoxydim at 0, 0.5, 1.0, 2.0 and 4.0 times the recommended rate of application and assessed for herbicide resistance six weeks later. Herbicide resistance was present in only about 4% of the populations sampled. When populations developing resistance were included, however, 35% of paddocks had or were developing resistance to one or more of the herbicides tested. Five populations were developing cross resistance. The results indicate that herbicide resistant ryegrass is a growing and potentially serious problem in crops in Victoria.

INTRODUCTION

Annual ryegrass (*Lolium rigidum* Gaudin.) is a major crop weed of the cereal belt in southern Australia. In Victoria alone, losses in grain yield and control costs attributed to it have been estimated to exceed $37 million (Code 1990). The development of herbicide resistance will have appreciably increased these costs. Herbicide resistant biotypes of annual ryegrass have developed in response to the increased use of highly effective selective grass herbicides on which many 'conservation farming' systems rely (Walsh 1994). While it has been estimated that herbicide resistant ryegrass populations have developed on over 3000 farms across southern Australia (Walsh 1994), there is little published information on its prevalence in cropping land in Victoria. The principle aim of the work reported in this paper was to determine the prevalence of herbicide resistance in annual ryegrass to commonly used herbicides in the major crop growing regions of Victoria.

Table 1. Occurrence of herbicide resistant ryegrass populations in the major cropping zones of Victoria.

	Total	Wimmera	Mallee
Locations	112	47	65
HR present	4	3	1
Developing HR	36	19	17
HR + developing	39	22	18
Cross-HR	5	3	1

HR = herbicide resistance
Cross-HR = developing cross/multiple-resistance

MATERIALS AND METHODS

Survey technique Annual ryegrass seed was collected from randomly selected paddocks in the Wimmera in November 1992 and the Mallee in November 1993. Paddock selection was determined from road routes that covered an equal distance through each section of the regions. Seed was collected from paddocks adjacent to the road, at 10 km intervals along the routes. Green, immature seed was avoided where possible. In total, populations from 117 paddocks were sampled.

Growth conditions and resistance testing Plants were grown outside in 175 × 250 by 100 mm deep tubs filled with commercial topsoil. Seed from five samples failed to germinate, reducing the survey to 112 populations. When about 80% of the plants were at the 2–3 leaf stage, plants were counted and tubs divided into 17 groups which were treated with: chlorsulfuron, diclofop methyl, metribuzin or sethoxydim at 0, 0.5, 1.0, 2.0 or 4.0 at times the recommended rate of application. There were three replicates. Six weeks after herbicide application the numbers of surviving plants in each tub were counted to assess mortality. Mortalities of 0–40% at the recommended label rate of herbicide were taken to indicate the presence of herbicide resistance. Mortalities of 40–70% indicated resistance may be developing, those with more than 70% mortality were probably susceptible. The number of populations that fell within each class are tabulated in the results.

RESULTS AND DISCUSSION

Herbicide resistance was detected in 3.6% of the annual ryegrass populations surveyed (from Table 1). This is low compared to other states. In a survey of crops in southern NSW, resistance was present in 34% of the populations sampled (Pratley *et al.* 1995). In Victoria, however, resistance appeared to be developing in an additional 36 populations. In total, 39 (about 35%) populations either

had developed or were developing resistance to commonly used herbicides (Table 1). Thus, while herbicide resistant annual ryegrass was not common in crops in the Wimmera and Mallee at the time of the survey, herbicide resistance is developing throughout these areas. Consequently, herbicide resistance has the potential to become a major problem as commonly used selective herbicides become less effective at controlling annual ryegrass, increasing weed associated costs and reducing management options.

Three of the four herbicide resistant annual ryegrass populations were resistant to the group A herbicide diclofop methyl (Table 2). Full resistance was only detected for two herbicides, diclofop methyl and the sulfonylurea (SU), chlorsulfuron. These results are not surprising, given the high incidence of diclofop methyl resistance in crops in NSW and that resistance to group A and B herbicides has been documented in all southern mainland states of Australia (Pratley *et al.* 1995). In Victoria, as in other states, herbicide resistance in annual ryegrass was not restricted to group A and B herbicides and some degree of resistance, appeared to be developing to all four herbicides tested (Table 2).

Amongst the populations developing herbicide resistance, reduced responses to the group B herbicide, chlorosulfuron were prevalent. Reduced mortalities with this herbicide were detected in about 20% of the paddocks surveyed (from Table 2). Eleven populations were developing resistance to sethoxydim, only five to the other group A herbicide, diclofop methyl and only three to metribuzin. While these results may partially reflect patterns of herbicide usage, they demonstrate the rapidity with which annual ryegrass populations can develop resistance to SUs. Detectable resistance has been observed to develop after only three to four applications of SU herbicides (Gill *et al.* 1994). Consequently, if herbicide use strategies in Victoria are not changed the incidence of resistance to SUs and group A herbicides an be expected to increase dramatically in the near future.

The data also indicate that populations are developing multiple and cross herbicide resistance. Multiple resistance is the ability of a plant to survive normally lethal applications of more than one herbicide from the same chemical group, while cross resistance occurs between chemicals. These phenomena can drastically curtail effective herbicide-based weed control options. In the present study, four populations had or were developing resistance to more than one herbicide from more than one chemical group (Table 2). For example, a population that was highly resistant to diclofop methyl group A) was also developing resistance to chlorosulfuron (group B) and sethoxydim (group A). These results and those discussed above demonstrate that herbicide resistant ryegrass is a growing problem in Victorian cropping systems. Solutions to which will require a greater integration of weed management techniques, rather than sole reliance on a few selective herbicides

Table 2. Responses of annual ryegrass populations in Victoria to individual herbicides.

Herbicide	Metr	Chlor	Diclo	Sethox
Group	C	B	A	A
HR present	–	1	3	–
Developing HR	3[A]	22	5	11
Cross-HR	3	4	1	5

Metr = metribuzin, Chlor = chlorsulfuron,
Diclo = diclofop methyl, Sethox = sethoxydim
HR = herbicide resistance,
Cross-HR= developing cross/multiple-resistance
[A] all populations developing cross resistance

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