Farmer perceptions on herbicide resistance and proposed herbicide use to control annual ryegrass in South Australia

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Summary The relationship between the use of herbicides to control *Lolium rigidum* Gaud. and herbicide resistance was investigated by surveying 62 growers with properties located in major South Australian grain growing regions. These growers have relied heavily on a variety of herbicides with different modes of action for weed management. A high percentage of growers reported resistance to ACCase-inhibiting herbicides and consequently relatively few growers proposed to use aryloxyphenoxypropanoate herbicides in 2003. A high percentage of growers also perceived resistance to chlorsulfuron or triasulfuron and trifluralin. Growers planned to use herbicides with modes of action other than ACCase for the control of *L. rigidum*. The perceived high resistance status of *L. rigidum* to ACCase-inhibiting herbicides and ALS-inhibiting herbicides is not unexpected; however, the perceived resistance status of trifluralin is controversial. Perception of trifluralin resistance is apparently influencing weed management. Therefore, further investigation of trifluralin resistance is required.

Keywords *Lolium rigidum*, annual ryegrass, herbicide resistance, farmer survey, grower perceptions.

INTRODUCTION

Annual ryegrass (*Lolium rigidum* Gaud.) is a widespread weed in the southern Australian wheatbelt. Since the 1970s herbicides have been used extensively to control *L. rigidum* and other weeds in crops. The over-reliance on herbicides has resulted in the evolution of herbicide resistance in many *L. rigidum* populations (Gill 1995, Lewellyn and Powles 2001). The evolution of herbicide resistance significantly complicates weed management in cropping systems, as those herbicides are no longer useful for weed control.

A survey of grain growers was conducted in South Australia to determine herbicide use patterns, perceptions of herbicide resistance among growers and strategies used to manage herbicide resistance. This paper describes the relationship between past herbicide use on South Australian farms, grower perceptions of herbicide resistance in *L. rigidum* and some current strategies to manage herbicide-resistant *L. rigidum*.

MATERIALS AND METHODS

The data presented in this study are part of a survey completed by 62 grain-growers during March and April 2003 in a workshop setting. Growers attended one of several workshops, which were organised in conjunction with their agronomy consultants. Only growers who employed independent farm consultants attended the workshops. These growers are more likely to be early adopters of technology and hence the growers surveyed in this study probably contain a higher proportion of innovative grain growers than likely in a random sample from the general farming population.

Growers were asked questions pertaining to herbicides used up to 2003, current resistance status of *L. rigidum* on their farm, proposed herbicide use for 2003 and other non chemical management strategies used to control *L. rigidum*. Bootstrap analysis (Manly 1997) was used to examine the relationship between perceived trifluralin resistance by growers and the use of a range of chemical and non-chemical practices for management of *L. rigidum*.

RESULTS

Most growers surveyed (82%) reported they had *L. rigidum* on their property and 81% perceived they had herbicide resistant *L. rigidum*. Growers reported 82% of all their paddocks contained *L. rigidum* and 48% were perceived to have herbicide-resistant *L. rigidum*. While 50% of growers reported using commercial herbicide resistance testing in the past, only 24% of paddocks with perceived resistance had been tested.

A high percentage of growers reported using ACCase-inhibiting herbicides prior to 2003 (Figure 1). In addition, the growers reported extensive resistance in *L. rigidum* to the aryloxyphenoxypropanoate (APP) and cyclohexanedione (CHD) herbicides. The proposed herbicide use pattern for 2003 indicated that few growers intended to use any of the APP herbicides or the CHD herbicides tralkoxydim and sethoxydim to control *L. rigidum*. However, many growers proposed to use the CHD herbicides clethodim and butroxydim+fluazifop-P.

Apart from the ACCase-inhibiting herbicides, growers reported use of a number of herbicides with other modes of action (Figure 2). Many growers proposed to continue to rely on these herbicides in 2003. However, relatively high rates of resistance were reported for some herbicides such as the ALS inhibitors (chlorsulfuron or triasulfuron – 23%) and the tubulin formation inhibitor trifluralin (39%) (Figure 2).

The bootstrap analysis indicated a relationship between perceived trifluralin resistance and the adoption of other management strategies such as double knock, crop topping, and delayed seeding ($P < 0.05$) and stubble burning and autumn tickle ($P < 0.1$), compared to growers without trifluralin resistance.

DISCUSSION

Only a small percentage of the paddocks have been tested for resistance to herbicides, yet growers perceived high resistance status in *L. rigidum* for many of the ACCase-inhibiting herbicides. Therefore, the herbicide resistance status for many paddocks is clearly based on a subjective interpretation by individual growers or their consultants. It is reasonable to assume that growers and/or consultants used their knowledge of the resistance status of paddocks that had been tested and applied this to other paddocks with similar herbicide histories and failures. Llewellyn *et al*. (2002) reported complementary findings from a survey of 132 grain-growers in Western Australia. Of the farmers surveyed by Llewellyn *et al*. (2002), 37% had employed herbicide resistance testing, but only 6% of all cropping land had been tested.

Many growers indicated they would not be using any of the APP herbicides or the CHD herbicides tralkoxydim and sethoxydim in 2003, probably because of high levels of resistance to these herbicides. In contrast, growers and their consultants have recognised that limited cross-resistance occurs between the APP herbicides and the CHD herbicides clethodim and butroxydim+fluazifop-P. Therefore, growers were intending to use more of these herbicides.

The decisions by growers to use non-ACCase-inhibiting herbicides in 2003 may be influenced by a number of factors including a reduction in the efficacy of ACCase-inhibiting herbicides as a result of resistance, the perceived effectiveness of each herbicide, the need to use a range of herbicides for different purposes, the cropping system, other management strategies adopted and the susceptibility of other weeds on the paddocks to the herbicides. Further investigation will be required to determine the relative importance of each factor.

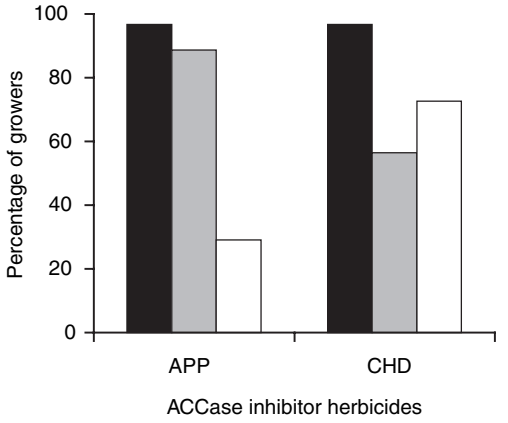

Figure 1. Past use, perceived resistance and proposed 2003 use for the ACCase-inhibiting herbicides on farms in South Australia. APP = Ayloxyphenoxypropanoate herbicides and CHD = Cyclohexanedione herbicides. ■ Growers using herbicide before 2003, ■ Growers reporting resistance, □ Growers intending to use herbicide in 2003.

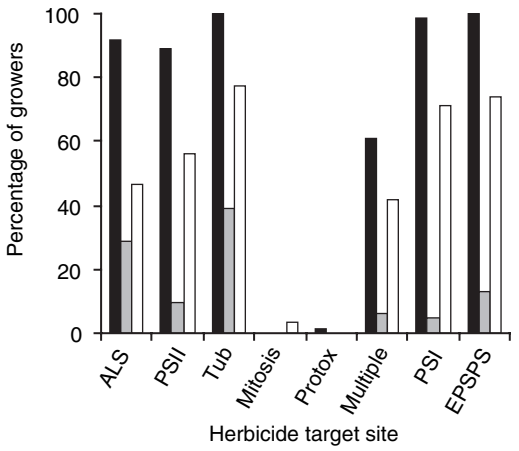

Figure 2. Past use, perceived resistance and proposed 2003 use for non-ACCase-inhibiting herbicides. ALS = Acetolactate synthase inhibitors, Tub = Tubulin formation inhibitors, Protox = Protoporphyrinogen oxidase inhibitors, PSI = Photosystem 1 inhibitors and EPSPS = EPSP synthase inhibitors. ■ Growers using herbicide before 2003, ■ Growers reporting resistance, □ Growers intending to use herbicide in 2003.

The high resistance status of *L. rigidum* to ALS-inhibiting herbicides is not unexpected and complements findings in Western Australia by Gill (1995),

Llewellyn and Powles (2001) and South Australian physical surveys (Preston unpublished data). However, the perception of extensive resistance to trifluralin is interesting. Researchers and some agronomists do not share this perception and suggest problems pertaining to the incorporation and efficacy of trifluralin are influencing farmer perceptions about resistance (Dr. A. Mayfield, pers. comm.). Efficacy of control of *L. rigidum* in South Australia varies considerably between sites and usually ranges from 50 to 90% (Kleeman and Gill 2002). However, trifluralin use has also increased in South Australia in recent times and there is concern that this herbicide is failing to control some *L. rigidum* populations (Kleeman and Gill 2002). Growers are responding to perceived trifluralin resistance by adopting a range of other weed management tactics. Of these, double knock, crop topping, stubble burning, autumn tickle and delayed seeding are management strategies that are also used by growers to manage large *L. rigidum* populations (Preston 2003). Thus, growers with trifluralin resistance may simply have more *L. rigidum* and are therefore more likely to encounter poor performance of trifluralin. Alternatively, there may be significant undetected trifluralin resistance in fields in South Australia. The extent and importance of trifluralin resistance in *L. rigidum* needs further investigation.

In conclusion, grain growers in South Australia continue to perceive high levels of resistance to some ACCase and ALS inhibiting herbicides in *L. rigidum* populations on their farms. As a consequence, few growers proposed to use the APP herbicides or the CHD herbicides tralkoxydim and sethoxydim to control *L. rigidum* in 2003. In contrast, many growers proposed to use non-ACCase-inhibiting herbicides in 2003 as growers continue to perceive herbicide use as an important *L. rigidum* control strategy. Whilst the resistance status of ACCase herbicides in *L. rigidum* populations is generally recognised and accepted by grain growers, researchers and consultants, the perceived resistance status of trifluralin is controversial and requires further investigation. This is particularly important as perception of trifluralin resistance is apparently influencing farm management.

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