A population of wild oats (*Avena ludoviciana* Durieu) resistant to flamprop-m-methyl

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Summary Wild oats (*Avena* spp.) are major weeds of the Australian cropping industry and herbicide resistance has developed to many of the herbicides used for their control. Until recently there has been limited opportunity for the rotation of herbicide groups in the post-emergent control of wild oats. Flamprop-m-methyl has been used by farmers to either delay the onset of resistance or to manage resistant populations.

Flamprop-m-methyl has been considered as a herbicide with a low resistance risk developing due to its mode of action. Previous surveys of southern New South Wales in both 1991 and 1994 found no populations resistant to this herbicide. In 2001 a sample of wild oats suspected of being resistant to flamprop-m-methyl was sent to Charles Sturt University. Testing of the sample in both 2002 and 2003 resulted in greater than 80% survival at the recommended rate.

Prior to 2001 this population had no exposure to flamprop-m-methyl. This finding has major implications for the management of wild oats in cropping situations.
Keywords Resistance, wild oats, flamprop-methyl.

INTRODUCTION

Flamprop methyl (Mataven®) or flamprop-m-methyl (Mataven® L) is a significant herbicide for control of wild oats (*Avena* spp.). Until recently there has been limited options other than Group A herbicides for the post-emergent control of wild oats in cereal crops.

One of the reasons that wild oats are major weeds is their persistence. However, the persistence of wild oats may be the result of input of new seed rather than seed longevity (Medd *et al*. 1992). The use of early post-emergent herbicides cannot be relied upon to prevent seed set due to the staggered germination of wild oats (Medd 1996).

Flamprop-methyl allows for the control of the later germinating plants but can also be used to prevent wild oat seed set through selective spray topping. This practice can reduce seed set by over 90% (Nietschke and Medd 1996).

This ability to limit wild oat seed set has become more important with the emergence of herbicide resistance in wild oats. Resistance to diclofop-methyl was assessed at 6% in north-eastern Victoria in 1995 (Walsh 1995), 4% in South Australia in 1993 (Nietschke *et al*. 1996) and 5% in southern New South Wales in 1994 (Broster *et al*. 1998).

Until now resistance has been limited to Group A herbicides in Australia although in Canada populations of wild oats (*A. fatua* L.) have been found resistant to flamprop-methyl (Friesen *et al*. 2000). In Australia no populations have been reported as resistant to flamprop-methyl although a single resistant plant was found in 1991 (Broster *et al*. 1998).

MATERIALS AND METHODS

In November 2001 a sample of wild oats (*A. ludoviciana* Durieu) was supplied to Charles Sturt University's herbicide resistance testing service for screening to flamprop-m-methyl. This sample (020038) was from plants that had survived the application of flamprop-m-methyl that growing season.

The seed sample was cleaned and then stored until late February 2002 when seeds were sown into large trays of a standard peat and sand mix. After germination seedlings were transplanted at the one leaf stage to smaller trays containing the same peat and sand mix, ten to a tray. These trays were sprayed when the plants were at the four leaf to early tillering growth stage with the trays arranged in a completely randomised design.

The experiment was repeated in 2003 using accessions that survived the herbicide application in addition to the original accession as poor germination in 2002 limited the herbicide rates that could be tested. In all experiments a susceptible (S) and resistant (V09M) biotype were included as controls. The resistant biotype had been grown out from the single plant found to be resistant in 1991.

Surviving plants from the 2002 experiment were grown out and the seed harvested giving four accessions for testing in 2003:

1. 020038-Original, the original accession;
2. 020038-0R, survivors of the 2002 controls;
3. 020038-1R, survivors of 2002 1R; and
4. 020038-2R, survivors of 2002 2R.

In addition, two resistant controls were also sown, V09M-0R (survivors of 2002 controls) and V09M-1R (survivors of 2002 1R) as was the susceptible control.

Herbicides were applied at half (05R), one (1R) and two (2R) times the recommended label rate using an automated cabinet pot sprayer fitted with a TeeJet nozzle moving at 6.6 km h^{-1} applying 83.8 L ha^{-1} total spray volume at a pressure of 300 kPa.

Seedlings were assessed between 16 and 32 days after application for survival.

RESULTS

In 2002 limited germination of 020038 resulted in it not being screened at 05R. There was no difference between the two rates of herbicide in the survival percentage of 020038. Survival was greater than 80% at both rates compared with 0% for the susceptible control and 55% for the resistant control.

There were differences between the three biotypes across the mean of all rates ($P < 0.001$, LSD = 8.37).

In 2003 there were also no differences in the survival percentages between the three herbicide rates, however there was a difference in the mean of all rates among the four 020038 accessions ($P < 0.001$, LSD = 7.67). The survivors of the 2002 controls (020038-0R) had a lower survival percentage than the other three 020038 and the two V09M accessions (Figure 1).

DISCUSSION

The fact that this sample had no prior exposure to flamprop-m-methyl before the herbicide failure is a major concern as it suggests the development of cross or multiple resistance. There was a history of high group A use in this paddock prior to the use of flamprop-m-methyl with both 'fops' and 'dims' being used and a 'fop' failure observed in 2000. This is a similar history to the paddock from which the single plant resistant to flamprop-m-methyl was obtained in 1991.

If more populations are found to be resistant to flamprop-m-methyl there are major implications for wild oat management. A large number of wild oat populations are resistant to Group A herbicides. Fifty percent of wild oat samples sent to CSU's testing service are resistant to the 'fops' with 7% resistant to 'dim' herbicides (J. Broster unpublished data).

The decrease in the percentage of survivors recorded in 2003 for survivors of the 2002 controls (020038-0R) compared with the other accessions of 020038 raise questions regarding the fitness and heritability of the resistance and may warrant further investigation.

The lack of alternative herbicides for late post-emergent control and/or selective spray topping would place increased pressure on other methods to prevent seed set and importation of seed into the seed bank. Additionally if resistance is present to both Group A and K (flamprop-m-methyl) herbicides, increased selection pressure will be placed on the newly available Group B wild oat herbicides. This has implications for resistance management as Group B herbicides are considered to be of high risk for the development of resistance.

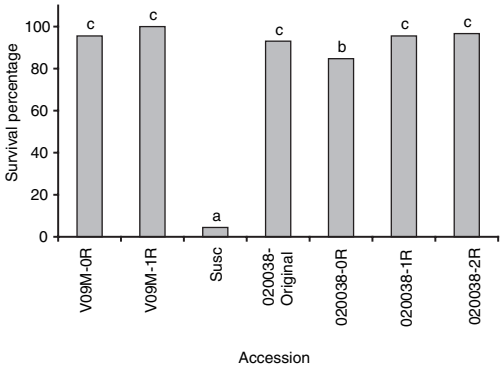

Figure 1. Mean survival percentage of accessions tested in 2003 (LSD = 7.67). Bars topped with different letters are significantly different.

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