FIGHTING THE WAR AGAINST WEEDS: WILD RADISH CONTROL IN WHEAT

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TAKE HOME MESSAGES

- 2013 was a year of multiple germinations of radish and products with good residual were required.
- Velocity + MCPA, Precept + Lexone and Flight EC are currently the best performing products on the market to control radish in situations of multiple germination.
- Wild radish with group B and I resistance was found in 50% of surveyed paddocks.

KEY WORDS

Herbicides, mode of action (MOA), resistance, wild radish.

BACKGROUND

In 2012, BCG began trialling different herbicides for the control of wild radish in the Corack region. The results from that trial showed products containing bromoxynil such as Velocity®, Flight EC® and Jaguar® were the best performers. The trial site was believed to have group I resistant radish, which was confirmed following testing. Wild radish is recognised as a major problem weed and BCG is working with farmers to ensure that Victoria does not develop widespread herbicide-resistant populations, as has occurred in Western Australia.

In WA (low and medium rainfall zones), radish populations have exploded and there is now widespread resistance to group B, C, F and I herbicides. Tight wheat-lupin-wheat-lupin rotations and limited alternatives to controlling wild radish with herbicides with a different mode of action have contributed significantly to the problem. While there is greater crop diversity in Victorian cropping regions, most of the rotation options have been chosen for control of grass weeds such as ryegrass or brome. This has not, in some instances, enabled broadleaf herbicides to be rotated to reduce the potential of resistance developing in weeds such as wild radish, Indian hedge mustard and turnip.

The overuse of imi-based herbicides (group B) for the control of radish is a concern because in other regions such as in WA, resistance has already developed to this group of herbicides. In addition, the use of low application rates in the Mallee, increases the probability that resistance will develop in radish.

Due to the limited broadleaf herbicide options to control radish in crops such as lentils and field peas, it is likely that resistance to a wide range of herbicides will continue to develop, to the extent that it could limit crop options in future years. For example, greater pressure has been placed on diflufenican (active ingredient in Brodal®) and there are now confirmed resistant populations to Brodal and phenoxy herbicides (MCPA LVE) in Victoria. During the cereal phase (wheat and barley), there are more

options with different modes of action for the control of wild radish. The use of herbicides with different modes of action, provided they are effective, will delay the onset of resistance. It is highly advisable for growers to record which herbicides they use from year to year, because only then can they make informed decisions when selecting options that reduce the development of herbicide resistance.

Wild radish is a major problem weed: it is very hard to eradicate because it is able to germinate all year round if moisture is available, it grows at a relatively fast rate and produces and an abundance of hard seeds. Most wild radish plants will have shed their seeds before harvest so mechanical control methods such as windrow burning, chaff carts and the Harrington seed destructor are limited. The other problem with wild radish is that it persists in the soil for up to six years: as a result, rotating herbicide groups every year may not be the answer as farmers could be spraying the same herbicide on the same seed as four years ago. Instead, using herbicides with as many different Modes of Action (MOA) as possible in combination will help delay the onset of resistance.

With increasing levels of herbicide resistant wild radish on Victorian farms, it is important to identify problem paddocks and implement the best management practices to improve the control of resistant wild radish well into the future.

AIM

To raise awareness about the increasing occurrence of herbicide resistant wild radish populations in the Wimmera and Mallee and to determine the best management practices for farmers to combat it and reduce its spread.

TRIAL 1: WILD RADISH RESISTANT PADDOCK SURVEY

METHOD

In 2013 different Mode of Action herbicides were applied to wild radish populations in 20 paddocks across north west Victoria. The aim was to gain a better understanding about the spread and type of herbicide resistance in wild radish populations (Table 1).

Spraying was performed using the BCG Goldacres custom built 12-line tow behind sprayer. The herbicides were applied using a two metre wide boom in single strips depending on the consistency of radish in the paddock. Counts and photos of a 50x50cm quadrat were taken from a fixed point marker. Spray treatments were replicated two to three times. Large radish and crop were removed from the quadrat before spraying to minimise shading effects and maximise efficacy.

When assessing herbicide efficacy, new germinations were excluded from the counts (only the plants that were sprayed were judged to be alive or dead). The majority of the paddocks surveyed were sandy loam with dense radish populations. At one site there was more than 200 plants/m^2 measured across the trial.

Locations:	20 sites across North West Victoria
Spraying date:	July 30 to August 20
Assessment timing:	14, 28, 52 Days After Application (DAA)
Weed growth stage:	dicot to 8-leaf (larger radish plants were removed from the quadrat before spraying)

Table 1. Wild radish survey herbicide treatment list.

Treatment description	Group MOA
LVE Agritone 600 (420ml/ha)	I
Ester 680 (800ml/ha)	I
Eclipse® (50ml/ha) + Hasten™ (0.5% v/v)	B
Ester 680 (800ml/ha) + Eclipse® (50ml/ha) + Hasten (0.5% v/v)	I, B
Tigrex® (1L/ha)	I, F
Jaguar® (1L/ha)	C, F
Flight® EC (720ml/ha)	C, F, I
Precept® 300 (1L/ha) + Liaise (1% v/v)	H, I
Velocity® (680ml/ha) + Hasten™ (0.5% v/v)	H, C
Cobber 475 (526ml/ha) + Affinity® force (85ml/ha)	I, G
Precept® 300 (1L/ha) + Lexone® (100g/ha) + Liaise (1% v/v)	H, I, C

RESULTS AND INTERPRETATION

Precept + Lexone, Velocity and Flight EC were superior products for controlling radish in all of the surveyed paddocks (Figure 1). Data for five out of the 20 paddocks is not shown here as results were inconsistent due to likely application issues and these are still under further investigation. The individual data points for each paddock illustrate the consistency of each product. At some sites, Ester and group I chemistry worked extremely well, while at some it was poor. With the resistance tests still pending, it cannot be concluded whether these populations are resistant or whether something else has led to those herbicides not working as well as they did at other sites. It was evident that for reliability, Flight EC, Precept + Lexone and Velocity were more effective than the rest of the products.

At 50 days after spraying (DAA), there was still radish germinating across the trials at most of the sites. To try and quantify what level of radish was present in these paddocks, seed bank cores were taken at the completion of each trial. These results were not available at the time of writing this publication.

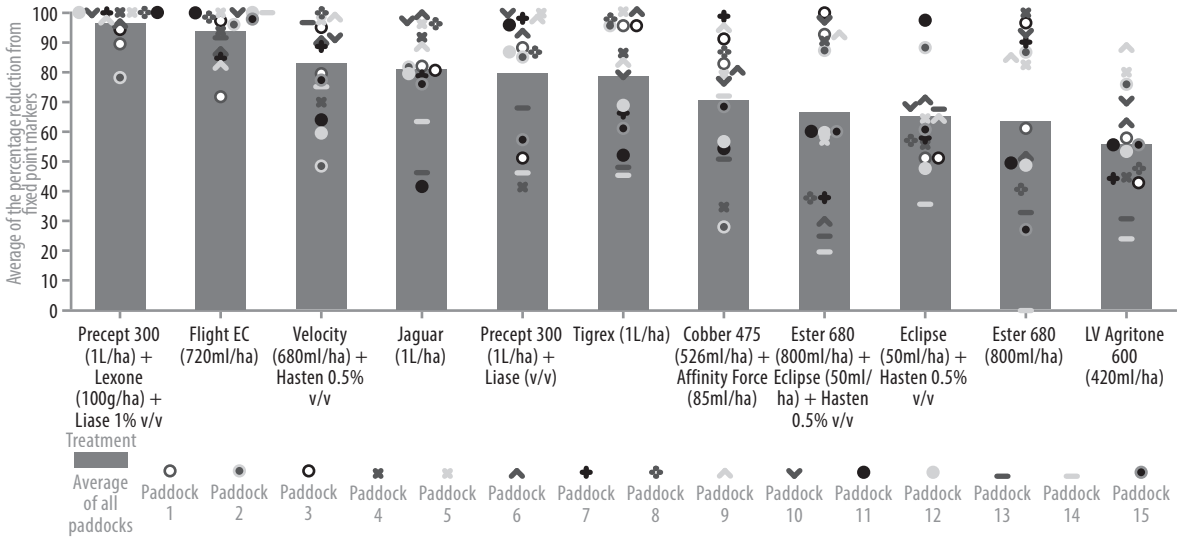

Figure 1. Wild radish survey results. The points on the graph represent the variation of the surveyed paddocks across North-West Victoria. We can see the treatments with lots of variation have expected resistance (awaiting on resistance test).

TRIAL 2: WILD RADISH TIMING

METHOD

A replicated field trial was undertaken at Corack in 2013 (Tables 2 and 3). Herbicides were applied using BCG's three-point linkage shielded sprayer. The soil type at the trial site was a sandy loam, and it had a dense population of wild radish (>10 plants/m^2). Photos and EWRC (European Weed Research Council) scores of herbicide damage were taken at fixed point markers within a 50x50cm quadrat.

Location: Corack
Replicates: Four
Crop: Yitpi wheat
Seeding equipment: BCG cone seeder (knife points, press wheels, 30cm spacings)

Table 2. Wild radish timing trial (spraying details).

Spray timing	1	2	3
Application date	7 June	26 June	24 July
Crop growth stage	1.5 leaf	3.5 leaf	6 leaf
Radish growth stage	Dicot to 2 leaf	Dicot to 6 leaf (up to 10cm in diameter)	Dicot to 8 leaf (up to 30cm in diameter)
Temperature (°C)	14.2	16.5	16
Humidity (%)	60	48	60
Wind speed (km/hr)	15 (shielded)	4.5 (shielded)	3 (shielded)
Cloud cover (%)	20	0	0
Water rate (L/ha)	100	100	100
Nozzle type	TT-02	TT-02	TT-02
Pressure (bar)	2	2	2
Soil moisture	moist	moist	moist

Table 3. Wild radish timing trial herbicide treatment details.

Treatment description	Group MOA
Control (untreated)	
Brodal® (150ml/ha)	F
MCPA LVE 600 (1.25L/ha)*	I
Affinity force (85ml/ha) + MCPA Amine 750g/L (330ml/ha)	G, I
Eclipse (50ml/ha) + MCPA LVE (500ml/ha)	B
Tigrex (750ml/ha)	F, I
Jaguar (500ml/ha)	C, F
Jaguar (500ml/ha) + MCPA LVE (300ml/ha)	C, F, I
Flight EC (540ml/ha)	C, F, I
Flight EC (720ml/ha)	C, F, I
Velocity (670ml/ha) + Hasten (1% v/v)	H, C
Velocity (670ml/ha) + MCPA LVE (300ml/ha) + Hasten (1% v/v)*	H, C, I
Precept 150 EC (1L/ha) + Hasten (1% v/v)	H, I

*Note some of these herbicide applications at these growth stages and rates are not registered

RESULTS AND INTERPRETATION

All herbicides were more effective when applied when the radish plants were young (Figure 2). The differences between older and newer chemistry became more apparent at the second and third spray timings. Commonly used products such as Brodal, Eclipse and Tigrex were the least effective at controlling radish at the two later timings. Three 'premier' products (Precept, Velocity and Flight EC) were less affected by time of spraying.

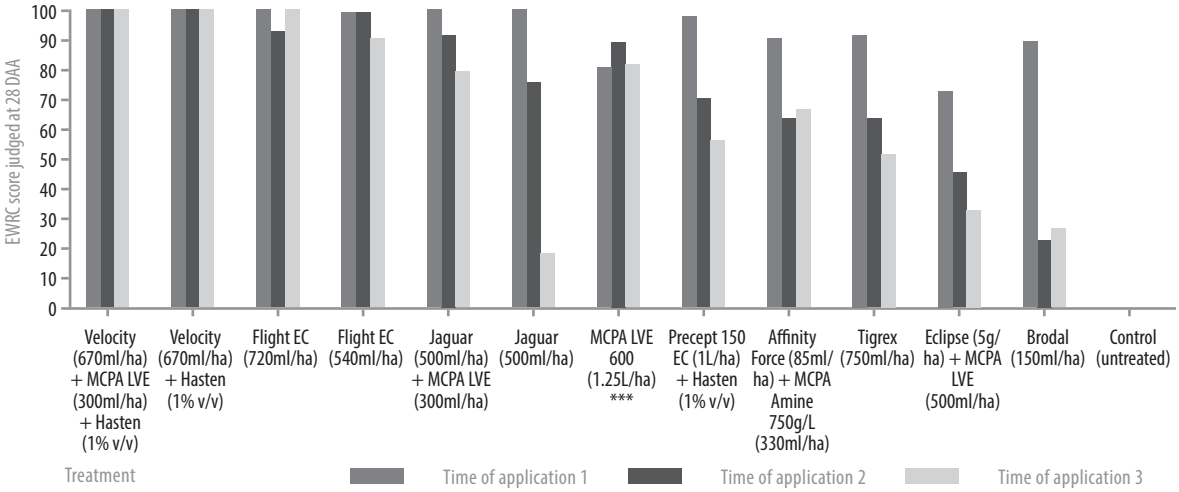

Figure 2. EWRC scores are comparing the different treatments and spray application timing scored at 28 DAA.

The results of the radish survey and the timing trial gave insight into effective control of wild radish with herbicides in wheat. The radish survey showed that products such as Velocity, Precept + Lexone and Flight EC were the best performers.

Velocity was the fastest acting product. It has a rapid brown out effect, but has no residual. Being a contact product, it requires very good coverage to achieve effective control. Best management practices require Velocity to be used at a high water rate and it should be applied when radish plants are actively growing. In the timing trial, Velocity performed well at all three timings, even on very large radish indicating there were no coverage issues. However in commercial situations where lower water rates may be used, the addition of MCPA LVE could account for any potential coverage problems. The addition of MCPA LVE to Velocity provides the systemic effect and an additional mode of action. However, it too has no residual to control the next wild radish germinations. This would count as another use of that mode of action and would not control any phenoxy resistant populations.

In the radish survey trial, treatments were designed to test the resistance status of radish in different locations. Failure to control a radish plant did not necessarily mean that it was resistant. Spray coverage, weather conditions at spraying and weed size are all factors that could account for less than 100% control. The addition of MCPA LVE to Velocity would have seen much greater control in the paddock survey trials however it was not used in this work.

The Precept + Lexone treatment performed best in the radish survey. Precept on its own worked quite slowly and rarely achieved 100% control. In the timing trial, as the radish plants grew, the effectiveness of Precept dropped away rapidly. The addition of Lexone (group C), with the active ingredient metribuzin, helped achieve better radish control by adding another MOA which resulted in faster control. Adding Lexone also added a residual to the herbicide mix which was helpful in reducing further germinations of radish. Though not included in these trials, in WA the addition of Lexone to

Velocity has also been successful in providing some residual control of later germinations.

Flight EC has three modes of action (C, F and I) which helps in combating stacked resistance (when a weed has resistance to multiple herbicide modes of action). Flight EC is a fast acting product which works well on larger radish. If the paddock has group F and I resistance, using Flight EC will put pressure on the bromoxynil (group C) component of the herbicide. Bromoxynil is an excellent herbicide for controlling wild radish. Resistance to this herbicide would make control of radish more difficult. Flight EC worked well in both the survey and the timing trial.

In the Corack spray timing trial, Brodal had good residual and reasonable control on very small radish (dicot-to-2 leaves). As soon as the plant grew to over 4-to-6 leaf it was very hard to control with Brodal and most of the plants survived.

Jaguar is a good product on small radish, having bromoxynil and diflufenican (Brodal) active ingredients. If the radish plants were larger than 6-leaf, the addition of MCPA LVE (group I) helped greatly with control. This involves putting additional pressure on the group I herbicide (Figure 2), which on its own, is not sufficiently effective in controlling wild radish.

Tigrex worked well in some situations but, with increasing resistance to groups I and F herbicides, it is losing efficacy. It also works best on smaller radish.

Amine and MCPA LVE used on their own were very slow to work and not very effective. If group I use is to continue into the future, the chemicals need to be used with other herbicides with a different mode of action to ensure 100% control.

Wild radish resistance to group B herbicides has been developing for some time. From the radish survey, it is clear that Eclipse is working well in paddocks with a low group B history. Farmers who use group B herbicides are experiencing more resistance to this group of herbicides in wild radish. This is a problem for farmers who would like to have residual control of later germinations of wild radish. At the Corack site, it appeared that there was some group B resistance, with the first application timing achieving only 70% control; the second and third timings achieved less than 50% control (unacceptable). The plants were suppressed, but leaves stayed green and continued to grow after herbicide application.

If radish is large (>8 leaves) at the time of spraying, using products like Velocity, Flight EC or Precept achieves better results.

In 2013 there were multiple wild radish germinations due to frequent rainfall events throughout the year. The need for residual control is very important for later germinating wild radish. Herbicides with residual control are in herbicide mode of action groups B, F and C. Their overuse can cause resistance to develop and limit options for the use of residual herbicides.

COMMERCIAL PRACTICE

To delay the onset of the resistance, robust herbicide rates are required to ensure that there are few, if any, survivors. Achieving the right timing for herbicide application is also very important. With only two herbicide groups growers can use later in the season (I-amine and B), it will be important to protect these groups; using the products such as Flight EC and Velocity (Precept + Lexone) will take the pressure off those group I and B applications later in the season. Precept will still have a reliance on group I: therefore the addition of Lexone should be considered.

In the two spray approach to controlling wild radish, the efficacy of herbicides at different crop growth

stages, their residual effects and their costs must be considered. If a paddock has no resistance to any of the listed herbicides, then products such as Jaguar + MCPA LVE and Tigrex will be effective for controlling young radish and following up with a late application of Precept + Lexone, or Velocity + MCPA LVE, or Flight EC will control escapes and reduce the likelihood of resistance development.

Eclipse is a good product for the control of wild radish in situations with limited group B history. If used in rotation with other herbicides with different modes of action, the onset of resistance should be delayed. If group B resistance is present, then it is likely that herbicides from this group will be ineffective.

ACKNOWLEDGMENTS

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