the northern
HERBICIDE RESISTANCE Reporter

A Newsletter keeping you up to date with research and development in herbicide resistance in the Northern Region

Herbicide Resistance – a North American Perspective

Herbicides are the mainstay of weed control in American agriculture. The loss or reduction in the utility of herbicides is a concern to researchers, agronomists, agribusiness, and farmers alike. Crop production in the United States is quite diverse due to geographical differences and cropping systems.

Of the land planted to crops in the US, 24% of the land is planted to maize and 18% is planted to soybean. Over ninety percent of these two crops are treated with a herbicide. Winter wheat and spring wheat are planted on 11% and 4% of the crop land, respectively. Less than 50% of the winter wheat is treated with a herbicide while over 90% of the spring wheat receives at least one herbicide application. Cotton is planted on 3% of the hectares and 95% of the cotton is treated with a herbicide. Thus, when herbicide resistance management is discussed in the USA, it can not focus on a single crop, it needs to consider the entire cropping system.

Herbicide resistance in the USA was first reported with a *Chenopodium album* biotype resistant to triazine herbicides in maize in the early 1970's. Soon after, *Amaranthus retroflexus* and *A. hybridus* were reported to be resistant to triazines. The development of herbicide resistant biotypes was very dramatic for triazines throughout the 1970's and 1980's. In the early 1980's, acetolactate synthase (ALS) resistant *Amaranthus* species were reported and since then selection for ALS-resistant biotypes has been very rapid. Resistance to ALS-inhibiting herbicides is the most common form of herbicide resistance in the USA.

Biotypes from seven weed species have been selected for resistance to glyphosate. The seven species are *Lolium rigidum* identified in 1998, *Conyza canadensis* (2000), *Ambrosia artemisiifolia*, *Ambrosia trifida*, and *Lolium multiflorum* (2004) and *Amaranthus palmeri* and *Amaranthus rudis* (2005). Currently,

Mark VanGessell from the University of Delaware gives his presentation to Tamworth agronomists

multiple resistance to glyphosate and ALS-inhibiting herbicides are reported for bioptyes of *Amaranthus rudis* in Missouri, *Conyza canadensis* in Ohio, and *Amaranthus palmeri* in North Carolina and Georgia.

The increase in glyphosate resistance can be attributed to wide-spread use of Roundup Ready (RR) varieties of soybean, maize, and cotton. In 2006, over 40% of the maize was planted with the RR trait. Over 95% of the soybeans, over 60% of the cotton and 50% of the canola was planted with the RR trait. In addition, the number of glyphosate applications in the crops increased. Concurrently, the percent of no-till hectares has increased, which has resulted in additional glyphosate use as the non-selective pre-plant herbicide.

As farmers have adopted RR crops, they have reduced the number of herbicide mode of actions as well. In 2005, only 4 different modes of actions were used on at least 10% of the cotton hectares, compared to 8 modes of action in 1997 when RR cotton was first released. The decline has been more dramatic in soybeans. Eight herbicide modes of action were used in 1996 when RR soybeans were introduced while today only glyphosate is used on more than 5% of the soybean hectares. The most dramatic decline in herbicide use for RR crops has been the reduction in soil-applied herbicides.

A survey of University extension personnel in the US revealed that herbicide resistance in weeds is an increasing focus in educational programs for farmers. Over 80% of those responding said they are spending more effort on herbicide resistance than they were ten years ago. The two main issues they are addressing are management of a specific resistant biotype and resistance management to avoid the development of herbicide resistant biotypes. Glyphosate and ALS-resistance are the two modes of action

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Editorial

This issue of the 'Reporter' provides you with highlights from two recent agronomist workshops, which were held in Tamworth and Toowoomba on the 4th and 6th September. The workshops provided up-to-date information on herbicide resistance in Australia and overseas to over 150 agronomists.

The workshops were opened by Rohan Rainbow from GRDC, who fund the northern region herbicide resistance project. In addition, the event was sponsored by Syngenta, Monsanto, Nufarm and Bayer. Many thanks to GRDC and these chemical companies for their support.

We were very fortunate to have an excellent group of presenters that included our overseas guest speaker Dr Mark Van Gessel from Deleware in the USA. Other presentations were made on:

- *understanding resistance,*
- *resistance R, D and E in Western Australia,*
- *recent chemical advances from chemical companies,*
- *practical tactics for herbicide resistance prevention and management, and*
- *first-hand agronomist experiences with resistance and weed management.*

On the following pages you will find snap shots of the papers prepared by some of our presenters from the workshops. If you would like to receive the full workshop proceedings, please e-mail through your request and I will send an electronic version to you once all the papers have been compiled.

Additional happenings since our last issue include a farmer workshop at Dalby (southern Queensland) and discussions with GRDC regarding a follow-on resistance project. With the current project wrapping up in June 2008, the next months will be busy compiling experimental data and reporting results and implications. In addition, a further 2 farmer workshops are planned for Goondiwindi and Roma.

Michael Widderick

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that university extension specialists are targeting for education on herbicide resistance management. ACCase resistance was also mentioned consistently by extension specialists in the northern states where ACCase resistance in small grains is a concern. Most of the extension specialists responding said alternate modes of action were the most common method of resistance management and weeds with few herbicide options were the species they were most concerned about for resistance management.

Of the university extension specialists who responded, about 50% of the farmers they work with are implementing some type of resistance management program. For those growers who are not implementing resistance management the reasons they gave include:

- Farmers have the attitude of "Why implement resistance management now, will deal with herbicide-resistant weeds if/when they show up";
- No effective alternative approaches;
- Herbicide mode of action is too confusing to understand (particularly with pre-mixes);
- Too management intensive;
- Believe new modes of action will become available to manage herbicide-resistant biotypes;
- High percentage of rental land (why invest if you may not reap the benefits); and
- Resistance management is too costly.

Resistance is likely to increase in the United States. Weed management approaches need to change in order to limit further development and spread of herbicide-resistant weeds. A determined and long-term effort is needed by all involved in agriculture for successful resistance management.

Mark VanGessel,
University of Delaware

Are You at Risk of Glyphosate Resistance?

Barnyard grass is one of the most significant weeds of cropping throughout the NR, and glyphosate resistant barnyard grass has the potential to reduce farming profitability significantly in both NNSW and Queensland.

In estimating the effects of the northern regions (NR's) variable farming systems and practices, climate, and soil types on the rate of evolution of glyphosate resistance in barnyard grass, we elected to take a modelling approach as has been done successfully for other regions of Australia. We developed a model of barnyard grass populations in NR farming systems and have used the model to assess a variety of different NR farming systems and weed control tactics. We have also evaluated the effects of the double knock tactic as a preventative measure.

Results from the simulations show that typical NR farming systems have a range of levels of risk of glyphosate resistance. Rapid selection for glyphosate resistance can occur where glyphosate is heavily relied upon in every year without the complementary use of alternative weed control tactics and where weeds that survive glyphosate applications are allowed to set seed. The lowest risk systems are ones that include tillage, frequent summer cropping with good efficacy from residual herbicides, and control of the survivors of glyphosate applications. Double knock applications have been shown to be effective in extending the useful lifespan of glyphosate. Preventing glyphosate resistance altogether appears to depend on relatively frequent use of non-glyphosate tactics and controlling glyphosate survivors before they set seed, where possible. Combining frequent, good quality summer cropping with occasional double knock that affects all flushes of barnyard grass is likely to provide the best chance of preventing glyphosate resistance in NR farming systems.

Inspection of the glyphosate resistant barnyard grass site near Bellata, NSW

Our predictions of risk for various farming practices will be used to assist growers in determining their own risk level, allowing them to make practical but worthwhile changes to avoid glyphosate resistance.

David Thornby

Glyphosate Resistance – Evolution, Mechanisms and What of the Future?

The world's first case of glyphosate resistance was first reported from annual ryegrass *(Lolium rigidum)* **in Australia in 1996. Since then resistance has appeared in 5 grass species and 8 broadleaf species.**

In Australia, there are 64 populations of annual ryegrass with resistance to glyphosate. There is also one population of barnyard grass with confirmed resistance to glyphosate. The main situations with resistance are chemical fallows, horticultural systems and non-cropped areas around the farm. Resistant populations are known from all states of Australia except Queensland and Tasmania.

In Australia, and elsewhere in the world, glyphosate resistance occurs in situations where glyphosate is intensively used, no other effective herbicides are used and there is no tillage. In many situations, glyphosate was used continuously for 15 years or more before resistance evolved. However, in other circumstances where glyphosate was used many times in a season, resistance has evolved more quickly. Resistance has evolved in both grass and broadleaf weed species and in both out crossing and self-pollinated weed species.

There are two known mechanisms of resistance to glyphosate that have been identified in resistant weed populations. There may be additional mechanisms that we have not yet discovered.

One mechanism of glyphosate resistance is a mutation within the target enzyme EPSP synthase that reduces the ability of glyphosate to inhibit the enzyme. So far, there is only one known site within EPSP synthase where mutations giving resistance have occurred, but several different mutations at this site have been found. Target site resistance to glyphosate has typically provided weak resistance to glyphosate, usually about 3 to 5-fold compared to susceptible individuals. Target site resistance is inherited as a single gene.

The other known type of resistance is the result of a change in the way that glyphosate is moved around the plant. Resistant plants accumulate glyphosate in the leaf tips; whereas susceptible plants have a more even distribution of herbicide. In particular, resistant plants have less than half the amount of glyphosate in the meristematic zone compared to susceptible plants. This difference in translocation of glyphosate results in resistant plants being initially stunted, but then growing away from the damage. This mechanism typically provides 5 to 11-fold resistance. Like target site resistance, translocation-based resistance is inherited as a single gene.

Current understanding of the evolution of glyphosate resistance suggests that glyphosate resistance will continue to occur in situations where glyphosate is used almost exclusively for weed control. These will include situations with glyphosate-based chemical fallows, in tree and vine horticulture and in uncropped areas around the farm. The major weeds at risk are those that are widespread, occur in large populations, are more susceptible to glyphosate and which have short-lived seed banks. However, it is possible for glyphosate resistance to evolve in most weedy species. If heavy reliance on exclusive use of glyphosate for weed control continues, glyphosate resistant populations will continue to evolve.

Glyphosate resistance does not readily evolve in situations where glyphosate is not almost exclusively used for weed control. This property is quite different to our experience with resistance to the Group A and Group B herbicides. Two related factors appear to be important: glyphosate resistance alleles are a lot less common in weed populations and carry a significant fitness penalty. Therefore, any system that has diversity in weed control would appear to be significantly less at risk from glyphosate resistance evolution than those that rely heavily on glyphosate. Introducing diversity into weed management systems will reduce the risk of glyphosate resistance, possibly dramatically so.

Christopher Preston and Angela Wakelin
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Wild oats Herbicide Resistance – a National Perspective

The most common resistance in wild oats is to the Group A FOP herbicides: diclofop (eg. Hoegrass®), fenoxaprop (Wildcat®) and clodinafop (Topik®). In many cases DIM, DEN, Group B and Group K herbicides are effective in controlling FOP-resistant wild oats. However, several cases of cross resistance to these herbicides have been confirmed. This article summarises the current status of resistance in wild oats.

Random surveys in Victoria and Western Australia

In 2006 a random survey was conducted in Victoria, where 8% of the wild oat samples were resistant to diclofop-methyl with a further 4% developing resistance. As expected, improved control with Axial® and Atlantis® was observed.

A random survey across WA in 2005 identified that 16% of these paddocks contained diclofop-methyl resistant wild oats and a further 61% of wild oat samples were classified as developing resistance. Similar to the Victorian study, 2% of wild oat populations showed resistance to Axial®. Atlantis® was not tested in the WA study.

Resistance testing services

Since 2004, 80 wild oat samples suspected of being resistant have been sent for testing. In 25% of cases, no resistance was detected suggesting that factors other than herbicide resistance were responsible for poor herbicide efficacy.

A trial was conducted to determine the level of cross-resistance of 23 FOP-resistant wild oat samples from consultants or farmers across WA, SA, NSW and Qld as paddock failures requiring herbicide resistance confirmation. All these samples were confirmed as resistant to FOP herbicides.

In a subsequent trial, the 23 populations were tested with Wildcat®, Topik®, Axial®, Atlantis® and Mataven®, and confirmed some cross-resistance to the modern herbicides, Axial® (21%) and Atlantis® (4%). Continued selection with these herbicides will probably lead to elevated levels of resistance. Axial® has only been available for a limited time, and it is not likely that this period has been sufficient to select for resistance but that FOP herbicides have resulted in cross-resistance. The cause of resistance to Atlantis® can be due to cross-resistance by FOP herbicides and/or independent selection with Group B herbicides. The trial also showed that 43% of the FOP-resistant wild oats showed significant levels of resistance to Mataven®. Paddock histories were obtained for most of the samples, which revealed that Mataven® use was minimal in the majority of cases. Thus, the study revealed that resistance to Mataven® was unpredictable in FOP-resistant wild oats. Earlier random surveys in southern NSW in 1991 and 1994 did not detect any resistance to Mataven®.

The complexity and unpredictability of herbicide resistance in wild oats highlights the importance of herbicide resistance testing prior to the selection of alternative herbicides.

For further information on herbicide resistance testing, please visit the following website www.plantscienceconsulting.com .

Dr Peter Boutsalis,
The University of Adelaide & Plant Science Consulting

Mix it up - Alternatives to Group M and Group A Herbicides

Herbicide resistance has become a more serious management issue for farmers in the northern region in the last couple of years. With the increased incidence of wild oat resistance to Group A herbicides and the discovery of a population of barnyard grass resistant to glyphosate, the use of alternate weed management strategies has become very important. Alternate strategies for management of resistant weeds involve integrated weed management (IWM). An integrated approach may include double knock of glyphosate followed by paraquat or cultivation, the use of alternate chemistries, selective spray topping, crop rotation and crop competition and other cultural practices. The aim is to reduce the seed bank burden, and to maintain long term productivity.

So is there an alternate chemistry?

There is no "silver bullet" alternative to replace glyphosate for the control of barnyard grass in fallow. The management strategy may need to involve cultural and chemical control practices to reduce the soil seed burden. It may involve looking at some of the older chemistry, some of which may not have been traditionally used in fallow.

Some alternate products to glyphosate for control of the potential new resistant weeds are listed in Table 1. New products under development include NUL1254 (a mixture of Group F and Group L products) and Amitrole T (Group F). NUL1254 shows good activity against a wide range of seedling weeds as a knockdown herbicide prior to crop establishment, as well as in fallow. Amitrole T looks promising against some of the harder to kill weeds such as fleabane, bladder ketmia, and volunteer cotton and may prove to be a suitable alternative to glyphosate in some situations. It is also a product that would fit well in non-crop areas such as fence lines and around buildings, thus reducing the reliance on glyphosate.

What about wild oat management?

There has been a significant increase in the incidence of wild oat resistance to Group A herbicides in the northern region. The key to managing wild oat resistance is to prevent seed set. To do this more than one control strategy needs to be used throughout the season. Strategies for wild oat control should include delayed sowing, a light tickle to stimulate maximum wild oat germination, the use of soil residual herbicides Avadex (Group E) and Triflur Xcel (Group D) the use of post emergent herbicides (Group A, B & K) and selective spray topping with Mataven® 90 (Group K).

With the wide adoption of minimum tillage there has been less use of the soil residual herbicides due to the need for mechanical incorporation. However, recent research conducted by the QDPI&F, the Northern Grower Alliance (NGA) and Nufarm has indicated there is potential for Avadex and Triflur to be used in a wild oat management program in the northern region.

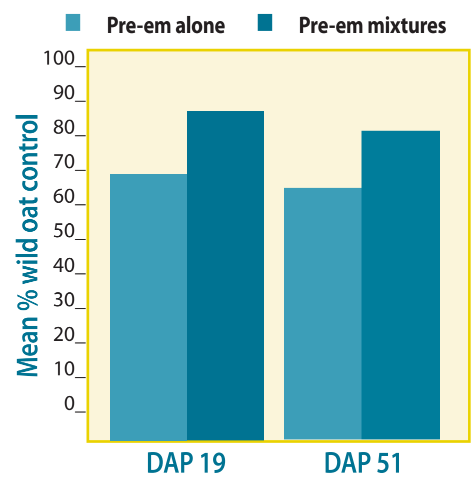


Figure 1 – Wild oat control with Triflur and Avadex (Northern Grower Alliance 2007).
DAP = Days after planting

Preliminary data from a series of trials conducted by NGA on Group A resistant wild oats indicated 84% control in wild oats was achieved 51 days after planting with a tank mix of Avadex and Triflur compared to 69% with Triflur and Avadex applied alone (Figure 1). Incorporation by sowing was with commercial planters (knifepoints and press wheel). The data indicates that the residual herbicides can provide good control of wild oats when used in minimum tillage situations, but may not be stand alone treatments. To maximise control a post emergent application of a Group B or Group K (Mataven®) may be required to reduce seed set.

Table 1. Some alternate products to glyphosate

Potential resistant weed	Alternate chemical options
Barnyard Grass & Liverseed grass	Nuquat®, NUL1254, Revolver® Flame®
Common sowthistle	Bromicide® 200, NUL1254, Nuquat Revolver
Wild oats	Avadex®, Triflur Xcel®, Nuquat, NUL1254, Revolver
Brassica weeds eg turnip weed, charlock, Indian Hedge mustard	NUL1254, Revolver
Fleabane	Atrazine, Amitrole® T, NUL1254
Black bindweed	Bromicide, Nuquat, Revolver
Bladder ketmia	Atrazine, Amitrole, NUL1254, Nuquat, Revolver

Frank Taylor,
Nufarm Australia Limited

Nozzle Type and Water Volumes - Key Factors in the Efficacy of Spray Seed®

Spray.Seed® is a non-selective knockdown herbicide which can be a very successful alternative for glyphosate products in some situations. However, the method of application of Spray. Seed® can greatly impact on its efficacy.

The aim of a series of trials was to evaluate the efficacy of Spray.Seed® on annual ryegrass when applied with a fine, medium and coarse spray quality at three water volumes (50, 75 and 100L/ha). Spray.Seed® was applied at 1.2 – 1.4 L/ha using the following nozzle types:

1. TeeJet extended range XR (fine),

2. Turbo TeeJet TT (medium),

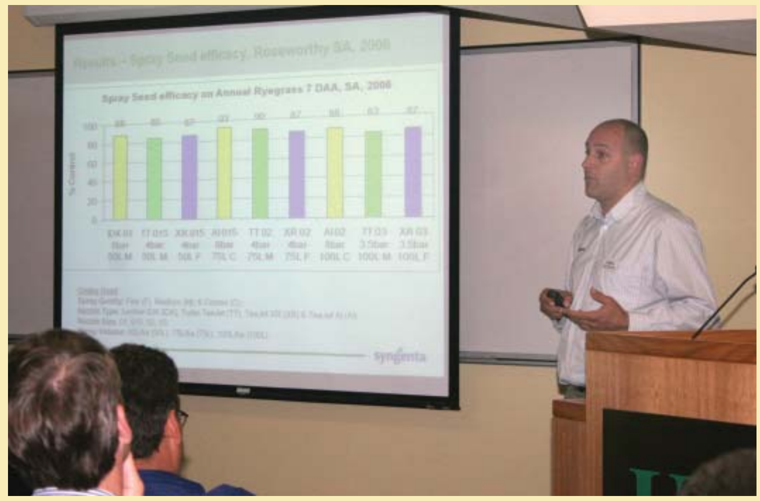
3. TeeJet Air Induction AI (coarse).

In general, the efficacy of Spray.Seed® was not compromised when applied with a coarse spray quality from a HARDI INJET or AI TeeJet® nozzle compared with a standard XR nozzle generating a fine spray quality or a Turbo TeeJet nozzle producing a medium spray quality.

However, if using air induction (AI) nozzles, it is important to make sure the pressure is adequate for the nozzle and that the water volume is sufficient to compensate for the lower number of droplets produced, especially if targeting grasses.

As a guide:

1. ***High pressure air induced nozzles (eg TeeJet AI, HARDI INJET, Agrotop Turbo Drop®, Lechler ID)***
   - ***Must use high pressures > 4 bar, generally 4-8 bar***
   - ***If targeting grass weeds, use > 75L/ha***
2. ***Low pressure air induced nozzles (eg TeeJet AIXR, HARDI MINIDRIFT, Agrotop Airmix®, Lechler IDK)***
   - ***Must use pressures > 2 bar, generally 3-5 bar***
   - ***If targeting grass weeds, use > 75L/ha***



Jason Sabeeney explaining how to achieve best results with Spray.Seed®

Further experimentation is required to confirm these findings.

Jason Sabeeney Syngenta Crop Protection Australia Pty. Ltd.
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The Australian Glyphosate Sustainability Working Group Meets

The Glyphosate Sustainability Working Group (GSWG) met on the 14th November to discuss glyphosate resistance issues in Australia. The GSWG is a collaborative initiative involving research, industry and extension representatives with the purpose of promoting the sustainable use of the herbicide glyphosate in Australian agriculture.

The recent meeting discussed topics including:

- The glyphosate resistance register (where glyphosate resistance cases are documented),
- Research updates from each state and industry
- Continuation of the network after June 2008, including maintenance of the website and communication
- Upgrading the website, in particular the Frequently asked question section, and
- Updating communications to encapsulate the local government and horticultural industries.

The meeting was the first national meeting to include a representative from the horticultural industry. Representation from this industry will ensure that horticultural systems such as orchards and vineyards, which are at high risk of getting glyphosate resistance, will be engaged.

For further information on the activities and priority goals of this group, please see their website on www.weeds.crc.org.au/glyphosate .

RESISTANCE is FUTILE

Double Knock is a Winner for Summer Weed Control

The use of sequential knockdown herbicide applications from different herbicide mode of action groups, known as the double knock technique, has been used successfully in southern Australia for the management of glyphosate resistant ryegrass. This method has been developed so that survivors of the first herbicide application are controlled by the second to prevent seed production. Prevention of seed set is critical for resistance prevention and management. This practice has also been adopted by some growers to control fleabane where tillage is not considered an option.

Glyphosate is an important herbicide in Australian agriculture due to its effectiveness on a broad spectrum of weeds, its low price, and its minimal impact on the environment. It has particular importance in management of weeds in conservation farming systems. The widespread use of glyphosate in the fallows of the northern grains region has increased the risk of resistance evolution and has resulted in a shift towards weed species favoured by its use.

The double knock technique was investigated for its effectiveness in controlling problem weeds fleabane, barnyard grass and sweet summer grass. Results (Table 1) showed that following glyphosate and glyphosate mixes with either Spray.Seed® or paraquat provided highly effective control (up to 100%) of these species. Fleabane control was reduced as the interval for the follow-up application increased beyond 14 days. The study showed that sequential knockdown treatments are effective in controlling glyphosate tolerant weeds, potentially preventing herbicide resistance evolution and thus prolonging the effectiveness of glyphosate.

There is a definite place for the double knock tactic in the northern grains region of Australia, in order to improve weed management and prolong the effectiveness of glyphosate, particularly in conservation farming systems. This tactic is also effective in reducing the risk of glyphosate resistance through stopping seed set.

Jeff Werth and Michael Widderick

Table1. Control of banyard grass, sweet summer grass and fleabane without and with the double knock tactic

Barnyard grass

First knock	Second knock	Timing of second knock after first (days)	Control (%)	Seed set (#/m^2)
Herbicide (Product rate/ha)				
nil			0	3292
glyphosate (0.8L)			98	0
glyphosate (1.6L)			100	0
paraquat (1.2L)			97	27
paraquat (2L)			99	0
glyphosate (0.8L)	paraquat (1.2L)	7	100	0
glyphosate (0.8L)	paraquat (2L)	7	100	0
glyphosate (1.6L)	paraquat (1.2L)	7	100	0
glyphosate (1.6L)	paraquat (2L)	7	100	0

Sweet summer grass

First knock	Second knock	Timing of second knock after first (days)	Control (%)	Seed set (#/m^2)
Herbicide (Product rate/ha)				
nil			0	243 832
glyphosate (0.5L)			99.3	32
glyphosate (1L)			97.7	25
paraquat (1L)			99.3	109
paraquat (1.5L)			98	485
paraquat (2L)			98.7	253
glyphosate (0.5L)	paraquat (1L)	13	98.7	4
glyphosate (1L)	paraquat (1L)	13	100	0
glyphosate (0.5L)	paraquat (1.5L)	13	97.7	18
glyphosate (1L)	paraquat (1.5L)	13	100	0
glyphosate (0.5L)	paraquat (2L)	13	99.3	0
glyphosate (1L)	paraquat (2L)	13	100	0

Fleabane

First knock	Second knock	Timing of second knock after first (days)	Control (%)	Seed set (#/m^2)
glyphosate (2L)			55	
gyphosate (2L)	paraquat+diquat (1.6L)	7	96	
glyphosate (2L)	paraquat+diquat (1.6L)	14	96	
glyphosate (2L)	paraquat+diquat (1.6L)	21	88	
glyphosate (2L)	paraquat+diquat (2.4L)	7	97	
glyphosate (2L) + 2,4-D (1.5L)	paraquat+diquat (1.6L)	7	98	
glyphosate (2L) + 2,4-D (1.5L)	paraquat+diquat (2.4L)	7	99	
glyphosate (2L) + 2,4-D (3 L)	paraquat+diquat (2.4L)	7	100	

Herbicide formulations: glyphosate, 450 g ae L-1; paraquat, 250 g ai L-1, 2,4-D, 300 g ai L-1; paraquat + diquat, 135 g ai paraquat L-1 + 115 g ai diquat L-1

A Consultant's Perspective on Double Knock

Hard to kill weeds like fleabane and barnyard grass can be controlled in our minimum tillage systems through the use of integrated management including double knock techniques.

Drew Penberthy (left) and Gary Onus providing a consultant's perspective

Our fleabane strategy starts with the previous crop. A lot of Tordon® 242 is used in our winter cereals due to its superior control of fleabane, especially on multiple germinations during the season. Balance® on chickpeas is a certainty, and an early application of Atrazine prior to planting sorghum crops is becoming common. Dual® in sorghum, Verdict®/ Select® in sunflowers and Flame® in fallows are all tools used to keep grass problems to a minimum. Inevitably problems arise especially where missed strips occur during planting. You're never going to eliminate weed problems altogether but management is the key. Fleabane can spread very easily on the wind and if anyone has seen a whirly wind during summer you know it can spread for miles. These issues are here to stay and we have to be able to manage them in our minimum till systems by reducing the populations as quickly as possible with different control practices. When you've finished harvest and the sunshine reaches fleabane plants that have been sitting under the canopy or multiple germinations of barnyard grass begin germinating, then the real double knock system starts.

Double knock using Sprayseed for fleabane and barnyard grass

We use 1.5-2.0 L/ha Glyphosate with 1.5L/ha Surpass® and Hotup® applied through 11002 Minidrift Nozzles or twin cap nozzles at 80 L water/ha. This is then followed up by Spray.Seed® at 1.6 L/ha using the same nozzles, but with 100 L water/ha 10-14 days later. It's all about coverage. Where people have skimped on water rates or used larger nozzles, then the control isn't nearly as effective. Double knock may take a few weeks to finally kill the plant but it does control very large fleabane. It is also very effective on barnyard grass when targeting small multiple germinations. It allows the first flush to be controlled with Glyphosate and the later ones with Spray.Seed®. It's not very effective on large barnyard grass, but hopefully we can get on top of the weeds prior to them getting too large.

Double knock using Amicide® 625 for fleabane

After a couple of summers attempting to control fleabane in one pass applications of herbicide mixtures, we only ended up with monster weeds. As we moved through various rates of Glyphosate and Surpass®, the control on other weeds was being compromised due to the increasing antagonism between the two products as the rates rose, especially for sowthistle. The decision was made to do two applications, usually 3 - 5 days apart. The rates of 24D Amine® (625gai) started at 1.5 L/ha and finished up at 2 L/ha. Oils and surfactants were tried but seemed to have little impact on the level of control. This high rate of 24D Amine® seems to give a good level of control on fleabane of all sizes, even up to old woody plants covered in seed. The rate of death is very slow, often taking 6 - 8 weeks to become crisp. Another benefit that has been observed is that there seems to be almost negligible viable seed shed by these plants, even if they have seeded when sprayed. This "double knock" technique for the control of fleabane is being used mainly to salvage fallows where the weed has come through previous sprays. It is used as a last resort.

To minimize the likely need for the above technique, we are now very focused on nailing the little critter very soon after it germinates with a good choice of in-crop herbicide including products such as Logran®, Glean®, Tordon® 242, Tordon® 75D and Hotshot® in winter cereals, Balance® and Simazine® in chickpeas, and Atrazine in sorghum and maize. Last summer we did some work with Tordon® 75D at 700 mL/ha in our first fallow spray after harvest and it gave very pleasing results.

The integrated approach including the above techniques and herbicides, as well as strategic cultivation has reduced the threat that fleabane posed to our farming systems. The secret is to be very vigilant, hit the weed very small if possible and hit it hard.

Future options

The secret to maintaining control over future weed populations and dynamics is to manage population numbers by the use of as many control measures as possible and utilizing different rotations and chemical groups to maintain the equilibrium. The ability to do this will require the use of integrated management techniques, including pre-emergent herbicides, in-crop control measures, crop competition, fence line hygiene, an excellent understanding of application methods and meteorological conditions, strategic full disturbance farming, good crop and herbicide group rotations and perhaps even growing millet as ground cover to increase competition for weed germinations on bare fallows. These are all strings in our bow to help maintain control over weed dynamics in our farming system.

Drew Penberthy and Garry Onus

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