Autumn 2015

giving a RATS

GRDC
Grains Research & Development Corporation

INTRODUCTION

Newsletter of :
"GRDC Project UA00124 – Understanding and management of resistance to Group M, Group L and Group I herbicides"

Do Australians believe in science?

It depends…….. appears to be the answer. While over the past decade various Universities and organisations have tried to get to the bottom of this question the results largely depended on how the question was asked and what questions preceded it. However a 2014 analysis of attitudinal studies by Craig McCormick of CSIRO Education came up with five major findings:

1. When information is complex, people make decisions based on their values and beliefs.
2. People seek affirmation of their attitudes (or beliefs) – no matter how fringe – and will reject any information or evidence that are counter to their attitudes (or beliefs).
3. Attitudes that were not formed by logic (nor facts) are not influenced by logical (nor factual) arguments.
4. Public concerns about contentious science or technologies are almost never about the science – and scientific information therefore does little to influence those concerns.
5. People most trust those whose values mirror their own.

OK, so facts will rarely produce behaviour change or win an argument but this work shows that better knowledge of the values different segments of the population hold are essential for targeting messages to these different groups. Also knowing the preferred media types of different groups will define how best to reach them.

Check this YouTube to get more information why people make illogical decisions such as not vaccinating their children.

In this edition of Giving a RATS we find that there is now have 2,4-D resistant sowthistle in South Australia and feathertop Rhodes grass has made a giant leap along southern Western Australian roads in the past three years. This is how fleabane managed to get such a rapid hold on farmland across the country. The Critch Brothers from Mullewa, WA, tell us how they keep ahead of the resistant weed game by using long fallow. The permit for optically activated sprayers has now been updated and Team Tony from NSW share results from residual herbicide trials for the management of glyphosate resistant annual ryegrass, windmill grass and sowthistle. Tony "Captain's Pick" Cook also presents a report on a weed society meeting in Lexington, Kentucky. Despite resistance being the main topic, herbicides appear to be the answer. This mirrors on what is happening with glyphosate resistant weeds in California tree crops, where the answer to herbicide resistance is more herbicides.

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> ***Always back the horse named self-interest, son. It'll be the only one trying.***
>
> ***John 'Jack' Lang - 1876-1975***

SOWTHISTLE DOES IT AGAIN – NOW RESISTANT TO 2,4-D

After evolving resistance to the Group B herbicides and glyphosate Sowthistle (*Sonchus oleraceus*) has now evolved resistance to 2,4-D.

Samples from five irrigated fields in the south-east of SA were submitted for testing with suspected resistance to 2,4-D. These samples were tested for resistance to chlorsulfuron (Group B), glyphosate (Group M) or 2,4-D (Group M).

The rates used were 15 g a.e. ha^{-1} chlorsulfuron, 360 g a.e. ha^{-1} glyphosate and 1100 g a.e. ha^{-1} 2,4-D. The results are provided in Table 1. Three of the five populations had resistance to 2,4-D, three had resistance to chlorsulfuron and none had resistance to glyphosate.

Figure 1. Resistant (left) and susceptible (right) populations of sowthistle following treatment with 1100 g a.e. ha^{-1} 2,4-D. – C. Preston

The three populations with resistance to 2,4-D showed typical 2,4-D symptoms within days of herbicide application and were severely damaged by 2,4-D, but within 2 weeks of treatment grew new leaves that were normal in shape (Figure 1). More than 50% of the plants survived treatment.

These plants were treated at the 4-6 leaf stage and were quite small. As sowthistle grows larger it can be more difficult to control with 2,4-D. 2,4-D would be even less effective on large plants from the resistant populations. Mixtures with 2,4-D and other Group I herbicides are still likely to be effective at controlling these populations, provided there is a robust rate of the mixing partner and the herbicide is applied to small seedlings. Otherwise alternative herbicides will have to be used to control the resistant populations.

Figure 2. Sowthistle post harvest 2014 – AGRONOMO

Table 1. Survival of five suspected resistant (R1-R5) and 2 susceptible (S1, S2) populations of sowthistle to three herbicides.

Population	2,4-D (1100 g a.e. ha^{-1})	Chlorsulfuron (15 g a.i. ha^{-1}) Survival (%)	Glyphosate (360 g a.e. ha^{-1})
S1	0	0	0
S2	0	0	0
R1	69	0	0
R2	0	100	0
R3	0	100	0
R4	58	0	14
R5	60	0	0

Christopher Preston, Jenna Malone and Peter Boutsalis

University of Adelaide

FEATHERTOP RHODES GRASS (FTR) - AN INCREASINGLY PREVALENT ROADSIDE SUMMER WEED, COMING TO A PADDOCK NEAR YOU?

In a national GRDC-funded project, Improving Integrated Weed Management Practice of Emerging Weeds in the Southern and Western Regions, a roadside survey is underway to determine what's out there. Feathertop Rhodes grass (*Chloris virgata*) is a major weed of fallows and roadsides in central Queensland and is becoming increasingly common in southern Queensland, NSW, Victoria and South Australia. In the southern region of Western Australia (from Katanning to Esperance), is also in the moove. In fact, around Gnowerangerup, there was little roadside that did not have large patches of plants merrily setting seed.

There are a number of reasons why FTR has become prevalent along roadsides.

- ➔ It is tolerant of glyphosate, especially after the early tillering stage (glyphosate is the herbicide of choice for most roadsides)
- ➔ It likes minimal soil disturbance for germination
- ➔ It prefers light textured soils

These are the reasons why we need to be vigilant and stop it from entering our paddocks; the predominant use of glyphosate and the widespread use of minimum tillage. Also add that it is number 3 on the risk of evolving herbicide resistance with a ranking of 7.0 (see Weeds to watch out for!).

What does it look like?

Feathertop Rhodes grass is a tufted annual grass up to 1 m tall with erect and semi-prostrate branched stems capable of rooting at the joints. Leaf blades are bluish green, 5 to 25 cm long and 3 to 6 mm wide. The seed-heads or panicles have seven to 19 feathery, white-silver spikes that are 3 to 9 mm long. The feathery appearance comes from the stiff white hairs and awns arising from the seeds.

Figure 3. Feathertop Rhodes grass along roadside at Gnowangerup, WA. Image. S. Peltzer

What to do if it is on your paddock

- ➔ Stop seed set. FTR seed persistence is relatively short (less than 12 months), so if you limit seed production you can achieve effective control.
- ➔ Keep your fences clean, particularly if fronting a major road
- ➔ Use Double knock on small weeds
- ➔ There are Group A herbicide options for wheat and barley
- ➔ As FTR germinates at or near the soil surface, strategic tillage can be effective
- ➔ Increased crop competition can suppress FTR growth and seed production

For more information see the profile of feathertop Rhodes grass on the GRDC hub and the GRDC factsheet

Sally Peltzer

DAFWA Albany

Figure 4. FT Rhodes grass head showing shattering. Image AGRONOMO

DOES LONG FALLOW HAVE A PLACE IN WESTERN AUSTRALIA'S CROPPING BELT? – YES ACCORDING TO DANIEL AND TIM CRITCH OF MULLEWA

Figure 5. Tim Critch with Weedseeker® boom. Image P. Newman.

Long Fallow Tips:

- Follow a fallow after wheat and retain the stubble straight after harvest. It needs to sit there for over 12 months so do not want wind erosion. Protect the stubble so do not graze or cultivate the paddock.
- The first application after the season break is the most important – always spray small weeds.
- In the first few years of fallowing, you may need to do multiple herbicide applications. This is especially true for wild radish control as it keeps germinating due to the soil staying wetter. Once you have the weeds under control, you need fewer applications.

Brothers Daniel and Tim Critch farm 13 000 ha at Mullewa in WA's north east with their wives, Penny and Jen and parents Tony and Judy. The property gets 325 mm average annual rainfall and 250-280 mm growing season rainfall, although in last 10 years it has decreased to 200 mm.

One third of the farm is fallowed each year and can sometimes seem wrong, especially when there is a good start to the season, but according to the Critch brothers there are many associated benefits. "You need to be disciplined and keep to the paddock plan".

Fallow was originally used to reduce the number of lupin rotations. Growing lupins often caused a major blowout in weed numbers leading to a need for expensive chemicals in the subsequent crops. "While lupins were fixing nitrogen, they were also fixing weeds" says Daniel. The brothers also did not want to grow continuous wheat due to diseases such as crown rot and associated yield reductions. They also stopped running sheep about the same time. Introducing fallow was used to fill the void of these other rotation options.

Experience has shown fallow reduces weed numbers and retains soil moisture with the following benefits:

- the weed numbers are going down on the Critch farm and crops can now be dry sown
- they have noticed that the wheat after fallow has higher yields than wheat after canola due to stored soil water
- there is less cereal root disease
- there is a possible increase in mineralisation of soil nitrogen and phosphorous due to the increased soil moisture. Soil test results after fallow came back the same as after lupins
- it is simpler to monitor herbicide resistance development. In fallow, it is easy to see a green patch in the bare paddock and be aware of what's working and what's not.

DOES LONG FALLOW HAVE A PLACE IN WESTERN AUSTRALIA'S CROPPING BELT? – YES ACCORDING TO DANIEL AND TIM CRITCH OF MULLEWA

Figure 6. Spraying weeds when small is the key to effective long fallow. Image AGRONOMO

How does a fallow work on the Critch farm?

The Critch brothers grow wheat and canola (Roundup Ready® and triazine tolerant). Their rotation is fallow/wheat/canola/wheat and approximately one third of the farm (4000 ha) goes into fallow each year. Fallow weed control consists of:

1. First flush of weeds is sprayed when they are still small.
2. A second spray goes on once the post-emergent sprays have been completed on the cropping paddocks.
   - ➔ The timing is critical here as it is imperative to hit the weeds when they are small, easy to kill. This means controlling wild radish at the small rosette stage before it forms a stem and before the annual ryegrass and brome grass have tillered.
   - ➔ The timing is so critical that the brothers will employ a contractor to do the spraying if their cropping program is not finished.
   - ➔ This spray usually occurs in early June with a mixture of glyphosate plus 2,4-D ester and metsulfuron with high water rates (80 L/ha). This also kills any volunteer Roundup Ready® canola
   - ➔ This spray is usually a blanket spray but the WeedSeeker® can be used if the weed numbers are low.
3. A third spray is usually done using the Weedseeker® in mid-July with a mixture of glyphosate, 2,4-D ester and Ecopar® in 100 L/ha and coarse droplets. Another similar spray may be done later if needed.
4. There are also two spray times over summer for melons, caltrop and tar vine to protect moisture. "If you have saved all that moisture over winter, you do not want it used up by the summer weeds".

What about protecting glyphosate?

Glyphosate is the main herbicide on the Critch farm and they are extremely dependent on it. Any short-term cost and control measure will be considered to keep glyphosate in the system.

As 90 per cent of the crops are dry sown there is little glyphosate used in the triazine-tolerant canola and wheat rotations. The sowing window has got narrower, so the time to use glyphosate has also reduced. Their biggest worry is glyphosate resistant wild radish and annual ryegrass in the Roundup Ready® canola rotation.

To protect glyphosate they are looking at using different chemicals over the farm, using the fallow to stop any seed from setting and using harvest weed seed management. More expensive herbicides can be used in the fallow through the Weedseeker® and because only 5 to 10 per cent of the paddock is sprayed it is still economical. (See next article about new Permit – Ed.)

The brothers narrow windrow burn most of their cropping paddocks to decrease weed numbers and reduce the pressure on the herbicides.

Sally Peltzer

DAFWA Albany

PERMIT FOR OPTICALLY ACTIVATED SPRAYERS UPDATED!

The APVMA has just updated Permit PER11163 for optically activated sprayers including the Weedseeker® optically activated sprayer.

This technology has revolutionised fallow spraying and reduced the cost of controlling difficult weeds including those with glyphosate resistance.

Nufarm Australia has registered this application technology on a range of their herbicides (see Giving a RATS Edition 11) so their products containing paraquat, 2,4-D, 2,4-D + picloram ,amitrole, Alliance® and fluroxypyr have been removed.

Application must still occur using 65° even fan nozzles (no double overlap required) using a minimum of 100 L/ha of water applying a coarse or greater spray quality.

Tony Cook

NSW DPI Tamworth

Figure 7. 2,4-D applied to large fleabane using Weedseeker® (left) compare with the untreated control. Image F. Taylor, Nufarm.

PATCH MANAGEMENT OF ANNUAL RYEGRASS IN NON-CROP AREAS

One serious weed issue emerging in the Central West region of NSW is the presence of glyphosate resistant annual ryegrass (*Lolium rigidum*). These infestations are usually seen as patchy clumps emerging either from irrigation channels, fence lines, crop verges or within paddocks. Some of these infestations maybe very small and easily eradicated whereas others have spread from crop verges to light infestations within crops/fallows.

The eradicating or at the very least containing all patches should be a high priority for growers. There is much to lose if nothing is done. Annual ryegrass in non-crop areas can spread rapidly with vehicles and water and plants within these non-crop areas are capable of huge seed production due to lack of competition from crops.

The National Project team from NSW has commenced developing treatments to successfully control glyphosate resistant annual ryegrass along crop verges. Our trial site, which commenced in August, 2014 at Narromine is a crop verge (canola) with a patchy infestation. Ryegrass plants were between 3 leaf (Z13) and 40 tillers, a little late for optimal performance of some residual based treatments. Nonetheless, results suggest otherwise, most of the treatments containing residual herbicides were the standout treatments with some assistance with a knockdown desiccant.

Table 2. Control of ryegrass, windmill grass and sowthistle along a crop edge at Narromine (plot size 40 m^2) 3 months after treatment timing 1.

Treatment (rate/ha)	ARG seed heads per plot	Windmill grass plants per plot	Common sowthistle plants per plot
untreated	1430	30	14
glyphosate 450 2L	1300	15	5
clethodim 500 mL	7500	0	5
clethodim 500 mL fb* paraquat 2.4 L	740	33	1
paraquat 2.4 L/ha	1300	32	3
paraquat 2.4 L/ha fb* paraquat 2.4 L	22	140	6
amitrole + paraquat 4 L	220	68	7
amitrole 4 L	520	22	11
Handweed	0	0	0
bromacil 1 kg + imazapyr 1 L fb* paraquat 2.4 L	170	0	2
bromacil 2 kg + imazapyr 1L fb* paraquat 2.4 L	13	0	0
bromacil 1 kg + imazapyr 2 L fb* paraquat 2.4 L	1	10	0
bromacil 2 kg + imazapyr 2 L fb* paraquat 2.4 L	0	0	0
atrazine 10 L + paraquat 2.4 L	0	0	0
* - Second knock applied 20 days after treatment time 1.			

Figure 8. Area treated with 2 L/ha glyphosate (450 g/L). Source: T. Cook

It is possible to nearly stop seed of annual ryegrass either by using combinations of bromacil and imazapyr followed up with a "double knock" of paraquat, atrazine + paraquat tank mixed or using regular cultivation, in this case hand chipping. For this demonstration the site was hand weeded three times.

The effectiveness of bromacil managing glyphosate resistant ryegrass has been demonstrated by Chris Preston's team in South Australia and Sally Peltzer in Western Australia (see last issue). They have successfully used bromacil at between 2 and 3 kg/ha along with paraquat or paraquat + diquat for pre- and post emergent control.

Figure 9. Clethodim resistance – ryegrass treated with 500 mL/ha. Image: T. Cook

The data from this trial shows bromacil and imazapyr also gave excellent control of windmill grass (*Chloris truncata*) and common sowthistle (*Sonchus oleraceus*). Other fence line weed management experiments from NSW DPI have also demonstrated excellent control of fleabane with bromacil.

This ryegrass population also shows a high level of clethodim resistance along with glyphosate resistance and it is likely to have Group B resistance as there were scattered annual ryegrass plants growing in the Group B resistant canola. One option in this situation is to use a TT canola, a manure crop or fallow the paddock and use combinations cultivation and paraquat on small plants.

The site will be inspected in autumn/winter this year to see how these residual treatments have affected ryegrass seed-bank carryover.

Tony Cook, NSW DPI

Tamworth

Figure 10. Excellent control of all weeds with bromacil + imazapyr. Image: T. Cook

ANOTHER AUSSIE ABROAD – HERBICIDE RESISTANCE THE MAIN FOCUS AT WEED SCIENCE SOCIETY OF AMERICA MEETING

UA00124 Project member Tony Cook recently attended the Weed Science Society of America annual meeting at Lexington, Kentucky, to get the low-down on resistance issues from an American perspective. Tony also presented this projects' research on the initial investigations on glyphosate resistant common sowthistle.

More than 300 oral presentations, and 105 posters, offered the 400 delegates a good range of topics with herbicide resistance, once again a dominant topic. Session intermission breaks allowed ample time to meet new researchers and discuss related issues.

Running three concurrent sessions made for some difficult decisions as to which talks to hear. A herbicide resistance symposium titled "Are We Going to do the Same Thing and Expect a Different Result?" was held. The symposium examined economic and sociologic factors affecting weed management decisions. It also covered potential incentives or regulatory actions that might influence weed management decisions to help mitigate herbicide resistance issues.

Tony listened to approximately 25 talks with a bias towards resistance management. Although Palmer Amaranth and Horseweed (Fleabane) the favored weeds, wild radish, ryegrass and Chloris species did get some coverage.

Many chemical companies had an opportunity to highlight their new herbicide tolerant crop traits, such as Dow Agroscience Enlist™ (2,4-D choline resistant) and BASF Engenia™ (dicamba resistant) http://agproducts.basf.us/campaigns/ingenious/ .

However, most talks that discussed solutions to herbicide resistance focused on herbicide solutions. Only a few talks mentioned cover crops, weed seed harvest management or microwave technology to control weeds.

Figure 11. Lexington suburban street – a bit cold! Image T. Cook

Figure 12. Central business district of Lexington, Kentucky. Everyone keeps indoors. Image T. Cook

GLYPHOSATE RESISTANCE IN COMMON WEEDS IN CALIFORNIA'S TREE CROPS CAUSES HEAVY RELIANCE ON PRE-EMERGENT HERBICIDES.

The top challenges facing California's tree nut growers in controlling weeds aren't new weed species but new problems with long-standing weed threats.

"The biggest difficulty continues to be expansion of herbicide-resistant biotypes of existing weed species," says Brad Hanson, University of California Cooperative Extension weed specialist.

Much of that resistance involves glyphosate, and some other herbicides. Because it offers relatively inexpensive control of a wide range of weeds, glyphosate has long been the go-to choice of many growers for controlling broadleaf and grass weeds in their orchards.

However, heavy reliance on this one mode of action has selected for some species or populations that are able to survive glyphosate treatment.

Glyphosate resistance

State-wide the most wide-spread of these resistant weed types is probably hairy fleabane, Hanson notes. However, some growers in the Sacramento Valley and northern areas of the San Joaquin Valley, might disagree, he adds. They also rank ryegrass as among their greatest glyphosate-resistant weed problems.

Canadian fleabane is another species found in California orchards that has developed resistance to glyphosate, Hanson points out.

So has Awnless barnyard grass (*Echinochloa colona*). In the past few years, glyphosate-resistant stands have been confirmed in more and more areas of the Central Valley.

The build-up of glyphosate resistance in barnyard grass has attracted special attention from weed scientists. Barnyard grass is the first summer annual weed discovered to do so in California, he notes.

Figure 13. Tree crops like this California almond orchard are still heavily reliant on herbicides for weed control. Image: UC Agriculture

"That makes for a difficult control challenge," Hanson says. "Barnyard grass begins germinating and emerging in May just as the residual activity of pre-emergent herbicides applied the previous December and January is beginning to run out."

Weed scientists are also keeping their eye on two other annual weeds found in California orchards. One of them is winter grass (*Poa annua*) with cases of glyphosate-resistance confirmed, Hanson reports.

Another is three-spike goose grass (*Eleusine tristachya*), a short-lived perennial. Some hot spots of suspected glyphosate-resistance of this weed have also been found.

Three-spike goosegrass germinates from seed or starts re-growing from existing clumps in the spring before barnyard grass emerges," Hanson notes.

"Three-spike goosegrass is particularly challenging," he says. "Once it starts tillering, it's difficult to control with glyphosate and other available post-emergence herbicides."

The key to controlling this and other summer annual weeds in California's tree nut orchards is a good pre-emergence herbicide program, Hanson says.

Primary drawback

The primary drawback to pre-emergence herbicides is the need to incorporate them into the top layer of soil where weed seed germinate, usually by rain or irrigation. For most commonly used pre-emergence herbicides, 5 to 10 mm of water is recommended within a few weeks of application for best results.

"However," Hanson adds, "even in last year's drought conditions, many pre-emergence herbicides still worked surprisingly well, despite less than ideal conditions. This included several weeks on the soil surface with minimal incorporation."

As with conventional practices, Hanson advises starting with a December or January application of a pre-emergence product targeted against the winter annual weed spectrum.

However, if summer annual weeds are also a problem, growers may want to consider a sequential application of two pre-emergence herbicides – one applied early enough to control the winter annuals and one applied in late winter or early spring to target the summer grasses.

"Growers continue to find a lot of value in glyphosate," he says. However, to broaden the weed control spectrum and reduce selection for weed populations resistant to glyphosate, I'm seeing a number of growers tank-mixing it with different modes of action for broadleaf weeds."

The October-December, 2014, issue of California Agriculture, published by UC Agriculture and Natural Resources, features several articles on herbicide-resistant weeds. (http://californiaagriculture.ucanr.edu/issue.cfm?volume=68&issue=4)

Adapted from Greg Northcutt, Western Farm Press Daily Feb 20, 2015

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CONTACT

Andrew Storrie
givearats@agronomo.com.au
Telephone: +61 89842 3598

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