giving a RATS

GRDC
Grains Research & Development Corporation

CLICK CLACK FRONT AND BACK?

Quote
To improve is to change; to be perfect is to change often.
Winston Churchill 1874 - 1965

The confirmation of annual ryegrass which is resistant to both glyphosate and paraquat in a Western Australian vineyard certainly got people talking. Multiple resistance to these herbicides has already happened in the clover seed industry in South Australia and the vineyards of the Cape in South Africa.

It is likely this population has evolved from the use of both paraquat and glyhosate which raises the question of "Are farmers doing enough to prevent/manage resistance to these vital herbicides?"

The first port-of-call for most landholders is to rotate modes-of-action. While this is a useful tactic, when used alone, it delays, not prevents resistance. Rotating modes-of-action must be used in combination with a range of other strategies to prevent production of or kill any seed produced by survivors of the herbicide applications.

Jason Sabeeney, Syngenta Crop Protection Australia, contacted me about the issue of rotating modes-of-action to share a great analogy he has developed.

"I use the analogy of seatbelts in cars," said Jason. "Seatbelts significantly reduce the risk of serious injury and save many lives. However many people are killed even when using a seatbelt. This doesn't mean seatbelts are ineffective."

Seatbelts are one tool that is most effective when combined with a diverse range of other safety technologies such as airbags, stability control, crumple zone and driver training. Interestingly even when all of these technologies are combined, people are still injured and killed in crashes, although the risk significantly lowered.

"This is similar to managing herbicide resistance," he continued, "herbicide rotation is like seatbelts in that while it significantly reduces risk, it is not completely effective when used alone. They are most effective when utilized in combination with a diverse range of other options. We also know that even after employing all these tactics there is no 100 per cent guarantee resistance won't ever occur. We are however better able to manage resistance."

So there you have it. Jason is a keen car fancier and has come up with a great analogy for people to get their heads around managing herbicide resistance.

For what farmers should be doing go to WeedSmart and see the 10 Point Plan.

Click clack front and back..... and get some defensive driver training.

Also in this edition Tony Cook and team have been busy testing sowthistle for glyphosate resistance, leaving little room for doubt of its existence in northern NSW. He and his team have also been checking levels of glyphosate resistance in barnyard grass populations to see whether "the ducks can line up" and still get a good kill with glyphosate to take the pressure off other modes-of-action and non herbicide tactics.

We also look at the interesting situation of glyphosate resistance in the US south and mid-west and how the "next big gun" will be dicamba and 2,4-D resistant crops. Introduction of these technologies will be interesting to watch.

Team Preston from the University of Adelaide report on the potential use of the residual herbicide bromacil (Group C) on fencelines to control glyphosate resistant annual ryegrass. It looks as though one company is looking at extending its label to cover this use pattern.

Tony Cook also gets out his crystal ball and gives it a good hard rub to look into the future of herbicide resistance in central NSW.

A new app to help improve spray application, "SnapCard", has been released jointly by Department of Agriculture & Food Western Australia and the University of Western Australia. Effective herbicide application is a crucial part of herbicide resistance management so this is worth a look.

In the last edition of Giving a RATS it was highlighted that highly volatile formulations of 2,4-D were being phased out. This report failed to highlight that winter broadacre uses will still be registered in Western Australia.

INDEX FOR THIS ISSUE

Key Points

- ➔ Two populations of sowthistle from northern NSW suspected of being resistant to glyphosate are in the final stages of testing
- ➔ The populations are from north and south of Gunnedah
- ➔ Sowthistle is the most common weed of reduced-till farming systems in the northern grain region
- ➔ Regardless of resistance status many sowthistle plants are surviving herbicide applications in fallow and pre-planting so more attention needs to be paid to controlling and stopping seed set of these plants before they can spread.

In the last edition of 'Giving a RATS', it was suggested that some populations of sowthistle from northern NSW appear to be resistant to glyphosate. This will have major implications for northern reduced-till farming systems as surveys conducted over the past two years have shown sowthistle was the most common weed species in wheat, chickpea, sorghum and fallow.

Regardless of the resistance status a drive around reduced till fallows and newly planted crops will show sowthistle plants surviving all previous weed control treatments.

The progress of sowthistle plants in the test are rather slow and have been in a 'static' state for 3 weeks. This is in contrast to the reaction time for grasses such as annual ryegrass or awnless barnyard grass due to their rapid responses to glyphosate. Therefore the process of confirming resistance is much slower in broadleaf weeds.

The experiment investigates the response of sowthistle at two growth stages; the large rosette/early bolting stage and the late bolting/early flowering stage.

Anecdotal evidence indicates that growth stage has a major impact on expression of resistance/tolerance, that is, the larger and or older the plant the higher the dose required to kill them.

In figure 1, one population of plants (left) has survived 2 L/ha of glyphosate (500 g/L) whilst the 'susceptible' (right) has killed all but one plant. These plants were treated at the large rosette stage approximately 6 weeks before the photo. However, when applied at a larger early flowering growth stage (figure 2), the population under suspicion has already shown signs of 'growing away' from the herbicide damage by producing flower buds.

If glyphosate resistance is confirmed in this species it will have serious implications for reduced-till farming system such as:

- ➔ Spread of glyphosate resistant sowthistle will be rapid due to wind dispersal of seed and frequent use of glyphosate in fallows, crops and non-agricultural areas.
- ➔ Glyphosate resistance in sowthistle is likely to co-exist with other glyphosate resistance species in paddocks such as barnyard grass. Options to control one GR species may not be suitable for other species.
- ➔ Sowthistle has the ability to germinate and grow all year so efforts to control the weed will have to be spread over various seasons, crops and fallows.
- ➔ Complicating weed management glyphosate resistant crops, particularly in cotton systems that are sensitive to Group I herbicides that are often used to control sowthistle.
- ➔ Greater use of Group B or I herbicides to control these populations. Group B resistance is already confirmed in sowthistle so multiple resistance is a possibility.

Tony Cook, NSW DPI, Tamworth

Figure 1. Large sowthistle rosettes treated with 2 L/ha glyphosate (500 g/L) with suspected resistant biotype (left).

Figure 2. Sowthistle treated at early flowering with 2 L/ha glyphosate (500 g/L) with flowers developing on the suspected resistant biotype (left).

Figure 3. Chris Love, Dow Agrosciences doing his 'bit' to prevent spread of suspect glyphosate resistant sowthistle using integrated weed management.

Key Points

- ➔ Older barnyard grass plants are generally "more resistant" than younger plants
- ➔ New populations of barnyard grass have such high levels of resistance using glyphosate at any rate is ineffective
- ➔ The only way to know if your barnyard grass is "super-resistant" is to get it tested.

Previous research has suggested that glyphosate resistant awnless barnyard grass (BYG) plants can be controlled with glyphosate at the two to three leaf stage. The critical growth stage when resistance expresses itself starts at the early tillering stage.

Tony Cook and his team from NSW Department of Primary Industries have now identified populations with far higher levels of glyphosate resistance compared to the original population from Bellata in 2007.

The discovery of these new biotypes raised the question: Could these plants also be controlled at such early stages?

Research is currently underway to determine if some "super resistant" biotypes can be controlled with very high rates of glyphosate at early growth stages. Interim results show survival of some individuals at 7.2 L/ha of glyphosate (450 g/L) applied at the three leaf stage (Figure 4) while increasing the rate to 13 L/ha and applying herbicide at the larger and older three tiller stage increases survival (Figure 6).

These rates of herbicide are not registered and are unrealistic. The experiment did investigate however the registered rate of 1.6 L/ha at the three leaf stage. A highly resistant biotype was temporarily stunted but regrew rapidly (Figure 5). Any early application of glyphosate to control any portion of a GR population should clearly be followed up with an effective and alternative tactic to stop these survivors.

Although the technique of using glyphosate to control a large proportion of small glyphosate resistant barnyard grass was once possible, it appears this maybe a thing of the past. Some populations have such high levels of resistance that glyphosate rates required to kill a large proportion of small individuals becomes unrealistic. Registered rates of glyphosate have negligible effects when applied to these populations even when the plants are very small.

It is recommended that farmers have their barnyard grass populations tested to see how resistant they are and what herbicide modes of action are still effective.

Tony Cook

NSW DPI, Tamworth

Figure 4. 3 leaf BYG treated with 7.2 L/ha glyphosate 450. Left: highly resistant biotype with one HR biotype plant alive and likely to recover.

Figure 5. 3 leaf BYG treated with 1.6 L/ha glyphosate 450. Left: highly resistant biotypes Right: susceptible. Plants re-sprouting due to lower rate and no plant deaths!

Figure 6. 3 tillered BYG treated with 13 L/ha glyphosate 450. Left and centre: highly resistant biotypes. Note: handful of HR biotype plants alive.

Figure 7. Palmer amaranth choking out glyphosate resistant cotton in southern USA.

US LOOKING AT DICAMBA AND 2,4-D RESISTANT CROPS TO SOLVE GLYPHOSATE RESISTANCE?

Weed scientists at the University of Illinois have been studying crops engineered to tolerate dicamba and 2,4-D.

"We've been looking at how they respond to the herbicides they've been engineered to resist," says weed scientist Aaron Hager. "Also, we've looked at what opportunities these new technologies can offer with respect to controlling some of the weed species we're having difficulty dealing with."

While the most problematic resistant weed species in Arkansas is glyphosate-resistant Palmer amaranth, the biggest problem in Illinois is resistant waterhemp, although Palmer amaranth is increasing.

"We assume these Palmer amaranth populations have moved into the state via seed transport from areas where the species is already well-established. Much of the Palmer amaranth is resistant to glyphosate and many of the Group B herbicides."

"What we see as the most challenging scenario currently and in the future with waterhemp is 'multiple resistance' – resistance to more than one herbicide mode-of-action and up to 3. (see http://www.weedscience.org/Summary/Species.aspx?WeedID=219) Depending on what crop and variety an Illinois farmer grows, there may not be a chemical solution for waterhemp control."

2,4-D, dicamba and Group G resistant crops

"One of the things we try to remind people is that while these traits – whether resistance to 2,4-D or dicamba – are new, the herbicides themselves aren't. 2,4-D has been around for 70 years and dicamba has been around for 50 years. The ability to use these herbicides in soybean crops is new."

Weed populations have been exposed to these herbicides for years and resistance to 2,4-D and dicamba might already exist.

"The biology of Amaranth species will force us to use the new technologies, force us to grow more Liberty Link® (glufosinate resistant) crops in the Midwest. But there's no reason to assume that if we overuse these new technologies like we have glyphosate we won't compromise their effectiveness. Amaranths have evolved resistance to almost everything we've thrown at them over the years."

"We must steward these new technologies very carefully. Otherwise, we'll just add another mode-of-action of resistance to the weeds."

"The reason we have these very significant challenges now is that we've tried to simplify weed management for too long. In reality, farming is a biological system. We've tried to simplify that biological system for far too long. And the rule of nature does not like simplicity, nature is all about complexity."

For more information on 2,4-D & dicamba resistant crops - http://www.extension.purdue.edu/extmedia/ID/ID-453-W.pdf

Adapted from Delta Farm Press 29/8/2013
http://deltafarmpress.com/management/

Main points

- Residual herbicides tank-mixed with a knockdown offer improved control of glyphosate resistant ryegrass on fencelines
- Bromacil (Group C) has shown reliable control in past experiments
- These experiments show lower rates of bromacil are effective on glyphosate resistant weeds when mixed with a knockdown particularly when weeds are small
- One company is looking at adding fencelines to their product label

The evolution of glyphosate resistant weeds on fence lines leads to contamination in crop. Alternatives to glyphosate to control weeds on fence lines have been previously investigated. The most effective registered treatment for spring applications identified in previous South Australian trials has been two applications of Spray.Seed® at 3.2 L/ha, 14 days apart.

A double knock of Spray.Seed® in spring can be difficult to use as it is a busy time for farmers and other options have been investigated. Single applications of knockdown herbicides to dense populations of large glyphosate resistant annual ryegrass are not effective. Like trials in Western Australia, adding residual herbicides was explored. Residual herbicides that are not used in crops were investigated, so hopefully selection of resistance on the fence line will be less of an issue in crop.

Figure 8. Glyphosate resistant annual ryegrass at Kapunda trial after an application of Roundup® Attack at 2 L/ha.

Figure 9. Good control of large, dense glyphosate resistant annual ryegrass after an application of Spray.Seed® plus bromacil at 3.2 L + 3 kg /ha.

Table 1. Effect of herbicides on annual ryegrass seed production, South Australia, 2013

Treatment	Rate (/ha)	Clare		Kapunda	
		Seed heads (m^{-2})	Seed head reduction (%)	Seed heads (m^{-2})	Seed head reduction (%)
Nil		3553 a	0	4287 a	0
Roundup® Attack	2 L	1627 b	54	3253 ab	24
Spray.Seed®	2 L	1100 b	69	1580 bcd	63
Basta®	5 L	833 bc	77	1767 bcd	59
Spray.Seed® + bromacil	2 L + 2 kg	860 bc	76	107 f	98
Spray.Seed® + bromacil	2 L + 3 kg	7 f	100	73 f	98
Basta® + bromacil	5 L + 2 kg	47 ef	99	347 ef	92
Basta® + bromacil	5 L + 3 kg	113 def	97	67 f	98
Experimental 1		1627 b	54	2427 abc	43
Experimental 2		1273 b	66	2380 abc	44
Experimental 3		1293 b	64	2787 abc	35
Experimental 4		400 cde	89	727 de	83
Spray.Seed® + Experimental 4	2 L + X	187 def	95	400 ef	91
Basta® + Experimental 4	5 L + X	33 ef	99	60 f	99
Roundup® Attack + Exptal 4	2 L + X	473 cde	87	1227 cd	71

Note: numbers with the same letters are not statistically different.
Editor's note: Bromacil has good activity on a number of other species including broadleaf weeds like fleabane. Further research for this use pattern should be encouraged.

CONTROL OF GR RYEGRASS ON FENCE LINES WITH BROMACIL ... *cont*

Of the residual compounds tested previously, bromacil (800 g/kg) appears to have the greatest promise. Two fence line trials were conducted in South Australia in 2013 on ryegrass populations resistant to glyphosate to determine effective rates of bromacil tank-mixed with knockdown herbicides and to explore some alternative products.

The two trials were started on 27th August 2013 and assessed after 60 days by counting the number of seed heads.

Both trial sites had high populations of annual ryegrass resistant to glyphosate (Table 1). Spray.Seed® at 2 L/ha was insufficient to control the ryegrass while 3.2 L/ha was needed to control these larger weeds. Basta® (glufosinate) is weak on ryegrass during winter and the 5 L/ha rate was insufficient to control the weeds.

In previous experiments 5 kg/ha of bromacil was tank-mixed with knockdown herbicides. In 2013 the aim was to determine how little bromacil is needed to control glyphosate resistant ryegrass. In these trials, 3 kg/ha bromacil controlled all ryegrass when applied either Spray.Seed® or Basta®. At 2 kg/ha some ryegrass escaped control with each of the knockdown herbicides at each trial location. A rate of 2 kg/ha would be sufficient for fence lines where ryegrass populations were less dense or when applied earlier when plants were small, but is not effective on dense populations of large plants.

Currently a range of bromacil products are registered for rights of way, however a label change has been submitted by one company to use bromacil on fence lines.

All residual herbicides carry some risk for damage to wanted vegetation. Great care should be taken to follow label recommendations, particularly with respect to light soils, near waterways and near desirable trees. These herbicides should NOT be used within 2.5 times the mature height of non-target vegetation.

Sarah Morran, Peter Boutsalis and Christopher Preston | School of Agriculture, Food & Wine, University of Adelaide.

COULD CENTRAL WESTERN NSW BE THE FUTURE 'EPICENTRE' OF GLYPHOSATE RESISTANCE?

- Central western NSW currently has four species resistant to glyphosate
- Alternative management tactics can be limited due to fragile soils and unreliable rainfall
- Land managers in this area will need to use as many weed management tactics in the one season to kep ahead of developing herbicide resistance problems

What would make a region an 'epicentre' for herbicide resistance? One would imagine that it would include several weed species already with resistance to glyphosate and possibly other modes-of-action. Amplifying this problem, there could be both summer and winter growing species.

Evidence suggests that central west NSW could be such a region with an array of impending troubles. The region is bounded by the townships of Nyngan (west), Coonamble (north), Orange (south) and Coolah (east). The majority of cropping is in winter, however there is a significant area of irrigation along the Macquarie River and some parts of the north-east section have opportunity summer cropping.

Rainfall is non-seasonal; meaning summer storms require the use of glyphosate to keep fallow weeds controlled.

What issues are being faced?

Windmill grass: Currently three confirmed cases of glyphosate resistance in this region. Knowing that surveys under-estimate the problem along with the weeds' ability to spread by wind-blown seed it is very likely glyphosate resistant windmill grass spreading well beyond the Narromine region.

Fleabane: Only one confirmed case of glyphosate resistant fleabane (railway) here so far. As with windmill grass, this problem is likely to have spread due to abundant wind-blown seed.

Awnless barnyard grass: Barnyard grass is common on many summer fallows in the eastern parts of the region as well as on irrigated fields. Glyphosate resistance is confirmed at Warren and Wellington.

Figure 10. Greg Brook, NSW DPI, and Campbell Muldoon, MPAC, pleased with their weed control efforts for the day.

Annual ryegrass: Populations of ARG were identified as glyphosate resistant in a chemical fallow (Baradine) in the early 2000's. Since then the Australian Glyphosate Sustainability Working Group's register has it listed in the Central West on fence lines, an orchard and within an irrigation channel. In 2011 and 2012 a small 'spike' in the numbers of resistant individuals from the region. In addition to the glyphosate resistance, farmers are dealing with resistance to Groups A and B.

Crystal Ball Gazing: What might we have in 10 years?

One of the certainties in life, apart from death and taxes, is that resistance will never disappear. Eradication is only possible with newer small patches before they spread.

Management tactics for some of these weeds is currently limited to herbicides. Despite cultivation being an effective control for windmill grass it may not be an acceptable due to fragile soils. Herbicides can also give variable control due to moisture stress and spraying of large weeds. Annual ryegrass control is reduced by resistance to groups A and B.

Also glyphosate resistance might not be (or just appearing) on the radar for many farmers. While most farmers have some awareness of glyphosate resistance, it is usually seen as a future problem.

With this in mind, what will the central west look like 10 years from now.

Annual ryegrass: Due to the widespread distribution of ARG in the Central West it will be the greatest resistance problem. Already there are many un-confirmed cases of glyphosate resistance present small patches (Less than 100 per square m). With the increased use of glyphosate resistant canola, widespread resistance to herbicide groups A and B, and little use of non-herbicde control tactics, its spread is virtually guaranteed.

Windmill grass: Most farmers in the Central West are relying on glyphosate for summer fallows and are hesitant to cultivate. These two factors, along with wind dispersal of seed will ensure spread to new areas. Confirmed glyphosate resistance on roadsides will exacerbate the problem.

While a Pesticide Permit does allow the fallow use of quizalofop followed by paraquat, the risk of Group A resistance in this species is high.

Figure 11. Glyphosate resistant windmill grass ready to spread from an irrigation channel, Narromine, NSW.

Fleabane: Glyphosate resistance will spread due to wind dispersal. However, 'blow-outs' are not expected as excellent control is achieved with Group I herbicides. Currently there is no Group I resistance in fleabane but if over-used, it is a matter of when not if, resistance develops. Work is underway to register Group C and H herbicides that also give excellent control.

Awnless barnyard grass: The same prediction for windmill grass applies. Farmers are heavily reliant on glyphosate and as yet do not use Group A herbicides in fallow to specifically control this weed. A few wet summers will see glyphosate resistance dramatically increase. A low level of awareness and the high risk practice of glyphosate reliance is a concern.

What can the national resistance project offer?

While the Central West region of NSW is shaping up to be the 'epicentre' of glyphosate resistance in the medium to long term the National glyphosate, paraquat and 2,4-D Resistance Project is aiming to slow its progress through:

- ➔ Promotion of awareness of resistance threats such as glyphosate resistant annual ryegrass and awnless barnyard grass
- ➔ Use trials to demonstrate that alternative control tactics and use these sites for field days and farm walks
- ➔ Have resistance experts attend field days and farm walks to highlight resistance management strategies
- ➔ Conduct surveys to better understand the current spread of glyphosate resistance in key weed species
- ➔ Produce high quality extension materials that show how other farmers in the nation are successfully managing their glyphosate resistant weeds

Tony Cook | Tamworth

Figure 12. Variable control of awnless barnyard grass in a central west NSW irrigation channel.

USING SNAPCARD® TO IMPROVE SPRAY RESULTS?

A new smartphone App designed to help broadacre farmers maximise pesticide spray efficiency is now available.

SnapCard was developed by the Department of Agriculture and Food (DAFWA) and the University of Western Australia (UWA) to enable growers to predict spray coverage based on weather conditions and spray settings.

The free App is now available for iPhone, iPad and Android smartphones and tablets.

DAFWA senior entomologist Rob Emery said SnapCard was a valuable decision support tool which also allowed growers to assess the performance of pesticide spray applications.

"Spray applications are an important cost for growers and prior to SnapCard there were no quantitative procedures available to predict or measure efficacy and performance," Mr Emery said.

"The app predicts spray coverage based on tractor speed, size of spray nozzles, spray volume, and addition of adjuvant, and weather conditions including temperature, humidity and wind speed".

Figure 13. Snapcard app

Figure 14. Spray cards placed in crop checking setup of equipment.

"This allows growers to record, measure and archive actual spray treatments, providing better pest control, reduced risk of pesticide resistance development and minimise spray application costs."

SnapCard is the latest outcome of a strong research collaboration between DAFWA's entomology group and the Applied Entomology program at UWA, led by Associate Professor Christian Nansen. The development of the phone App is supported by the Council of Grain Grower Organisations.

Mr Emery said predicted coverage could be saved along with spray settings and additional details of treatment, equipment used and chemical rate.

Another key part of the App involves placement of water-sensitive spray cards that can be used in field locations with optional GPS co-ordinates and comments recorded so that a map view of whole paddock coverage can be considered.

"Following treatment, the spray cards can be photographed by SnapCard and the image cropped to the area of the card with droplets," Mr Emery said.

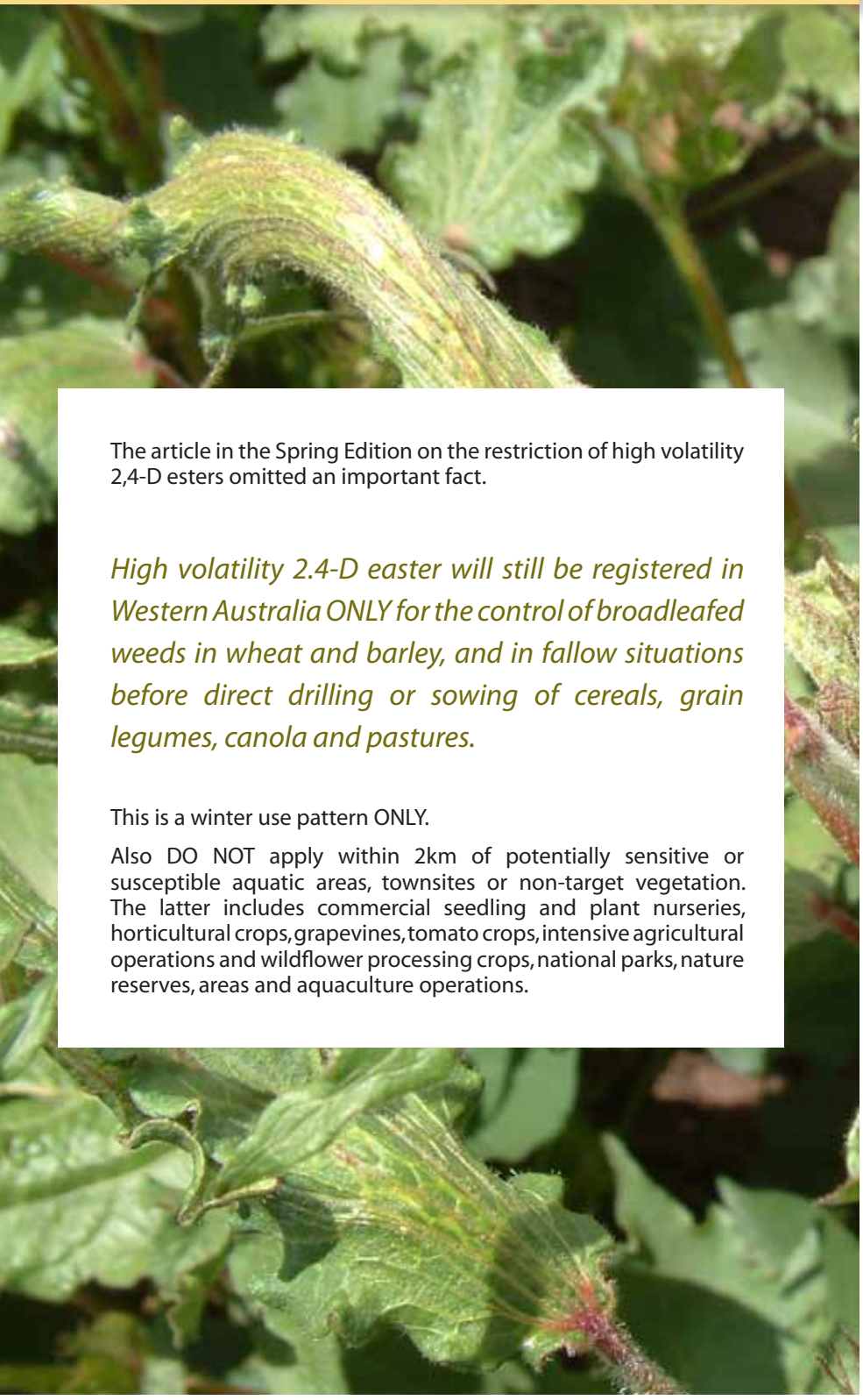
"Actual coverage is then calculated by SnapCard and compared with the predicted coverage. This allows farmers to assess actual spray coverage and refine how they use the predictive tool."

Users have the option to create an account and log into the SnapCard website on a DAFWA server where data can be synchronised and archived. This allows users to look back at long-forgotten treatment profiles for future seasons while satisfying Department of Health regulations.

SnapCard can be downloaded from Apple iTunes or the Google Play app stores.

For more information go to the Department of Agriculture and Food Western Australia Snapcard page.

CORRECTION FOR SPRING EDITION OF GIVING A RATS HIGH VOLATILITY 2,4-D PRODUCTS



The article in the Spring Edition on the restriction of high volatility 2,4-D esters omitted an important fact.

High volatility 2.4-D easter will still be registered in Western Australia ONLY for the control of broadleafed weeds in wheat and barley, and in fallow situations before direct drilling or sowing of cereals, grain legumes, canola and pastures.

This is a winter use pattern ONLY.

Also DO NOT apply within 2km of potentially sensitive or susceptible aquatic areas, townsites or non-target vegetation. The latter includes commercial seedling and plant nurseries, horticultural crops, grapevines, tomato crops, intensive agricultural operations and wildflower processing crops, national parks, nature reserves, areas and aquaculture operations.

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