

Residual herbicides—length of residual and efficacy: a summary of 18 trials across Queensland

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Key findings

1. Terbyne® Xtreme® and Valor® provided the best residual control of common sowthistle as stand-alone residual herbicides and as mix partners with 'grass active' herbicides.
2. Group K, Group D and Flame® provided the best residual control of grass weeds as stand-alone residual herbicides and as mix partners.
3. Herbicide mixtures provided improved control over individual products and are likely to provide more wide-spectrum control of a range of weed species.

Background

After many years of zero-till farming with chemical fallows, we are getting more pressure from weeds with resistance to the knock-down herbicides that were once effective. As such it is becoming more important to adopt other weed control tactics to stop seed set of our difficult to control weeds. Residual herbicides provide a range of different herbicide modes of action. When used in a rotation, residual herbicides can reduce the risk of herbicide resistance.

Many of these products are commonly used for in-crop weed control, but they can also offer an effective, alternative chemical approach for weed control in the fallow.

There are a range of environmental factors that affect the efficacy of residual herbicides. Therefore, residual herbicides should be applied in combination with other effective weed control tactics as part of an integrated approach, with the aim of zero weed seed set.

Recognising the increasing difficulty in effective fallow control of sowthistle and grasses and the potential role of residual herbicides, a series of field trials were established to compare efficacy of residual herbicide treatments across a range of environments and soil types.

NOTE: Products/combinations in this field experiment were tested FOR RESEARCH PURPOSES ONLY. Not all products used are registered for the purposes we have tested. Always read the label prior to use and only apply herbicides as approved in the label.

What we did

A series of nine fallow field trials were conducted across grain growing regions of Queensland (Border Rivers, Darling Downs and Central Queensland) (Table 1) during summer/autumn 2015/16 to evaluate the efficacy and persistence of a range of residual herbicides for the control of grass weeds (awnless barnyard grass (ABYG), feathertop Rhodes grass (FTR), sweet summer grass (SSG) and stink grass) or sowthistle in fallow (Table 2). The results from these trials were evaluated and treatment lists adjusted, for another nine field trials conducted in summer/autumn 2016/17 across the same geographic areas, but with a stronger emphasis on sowthistle.

In 2015/16, the trials targeted a range of difficult to control weeds, with treatments selected to target either grass weeds, broadleaf weeds, or a combination when both were expected. One site targeted sowthistle, one site targeted FTR and seven sites targeted mixed populations of sowthistle and grasses (one SSG, one FTR, one stink grass and four ABYG). After reviewing the 2015/16 results, 2016/17 treatments were determined, with a greater emphasis placed on evaluating mixtures of residual herbicides, and with a focus on establishing trial sites likely to grow sowthistle. One site (Callandoon) did not have any sowthistle emerge, and two sites (Mt McLaren and Gindie 1) had populations too low to measure significant differences. The site at Jondaryan 1 had additional split plots, with crop residue retained on half and removed from the other half of each plot.

Table 1. Location of trial sites and other details.

| Site location | Soil type | Treatments applied | Weeds present |
|-----------------------|-----------------------|--------------------|--------------------------------|
| South-west Queensland | | | |
| Boomi | Black Vertosol | 21 December 2015 | ABYG |
| Toobeah 1 | Brigalow | 22 December 2015 | ABYG |
| Toobeah 2 | Poplar box duplex | 22 December 2015 | FTR |
| Callandoon | Alluvial box | 27 October 2016 | ABYG |
| Yagaburne | Brigalow | 20 April 2017 | Sowthistle |
| Mungindi | Grey coolibah | 3 March 2017 | Sowthistle |
| Darling Downs | | | |
| Kingaroy | Ferrosol | 26 February 2016 | ABYG, sowthistle |
| Warwick | Black Vertosol | 25 February 2016 | ABYG |
| Pampas | Black Vertosol | 21 January 2016 | Sowthistle ns. |
| Jondaryan 1 | Black Vertosol | 9 November 2016 | Sowthistle (+/- stubble cover) |
| Jondaryan 2 | Black Vertosol | 27 April 2017 | Sowthistle |
| Jandowae | Grey Vertosol | 23 November 2016 | ABYG, FTR, sowthistle |
| Central Queensland | | | |
| Gindie | Open downs | 11 December 2015 | SSG |
| Gindie | Poplar box duplex | 10 December 2015 | FTR |
| Goovigen | Callide alluvial silt | 15 December 2015 | Stink grass |
| Mount McLaren | Open downs | 3 May 2017 | Sowthistle ns. |
| Gindie 1 | Open downs | 5 April 2017 | Sowthistle ns. |
| Gindie 2 | Brigalow | 27 April 2017 | Sowthistle, SSG |

Table 2. Residual herbicide treatments applied at up to 18 Queensland sites for the control of common sowthistle and difficult to control grasses.

| Product/s* | Mode of action (MOA) | Rate (/ha) | Number of sites | Effective rate (trials with >90% reduction in weeds / trials with weed present) | | Indicative price \$/ha |
|---------------------------------------|----------------------|-----------------|-----------------|--|-------|------------------------|
| | | | | sowthistle | grass | |
| Untreated control | - | | 18 | | | |
| Flame® | B | 200 mL | 17 | 3/8 | 9/11 | 4 |
| Terbyne® Xtreme® | C | 1.2 kg | 18 | 6/8 | 2/11 | 35 |
| Group C _{triazine} | C | 3.3 kg | 16 | 2/8 | 3/9 | 26 |
| Group C2 (urea) | C | 1 kg | 8 | 0/2 | 3/7 | 14 |
| Group D | D | 3.3 L | 18 | 0/8 | 9/11 | 53 |
| Balance® | H | 100 g | 18 | 2/8 | 8/11 | 16 |
| Group K | K | 2 L | 18 | 1/8 | 10/11 | 26 |
| Valor® | G | 280 g | 9 | 4/6 | 2/3 | 53 |
| Group B + Group H | B + H | 200 mL + 100 g | 17 | 6/8 | 10/11 | 20 |
| Group B + Group K | B + K | 200 mL + 2L | 17 | 5/8 | 11/11 | 30 |
| Group B + Group D | B + D | 200 mL + 3.3 L | 17 | 5/8 | 11/11 | 57 |
| Group D + Group H | D + H | 3.3 L + 100 g | 17 | 3/8 | 11/11 | 70 |
| Group C1 + Group D | C + D | 1.2 kg + 3.3 L | 9 | 5/6 | 2/3 | 88 |
| Group C1 + Group B | C + B | 1.2 kg + 200 mL | 9 | 5/6 | 3/3 | 39 |
| Group C1 + Group H | C + H | 1.2 kg + 100 g | 9 | 4/6 | 3/3 | 50 |
| Group C _{triazine} + Group K | C + K | 2 kg + 2 L | 9 | 2/5 | 3/3 | 42 |
| Group H + Group K | H + K | 100 g + 2 L | 9 | 1/6 | 3/3 | 42 |
| Group B + Group G | B + G | 200 mL + 280 g | 9 | 4/6 | 3/3 | 57 |
| Group G + Group K | G + K | 280 g + 2 L | 9 | 5/6 | 3/3 | 80 |

*Chemical groups are used in place of product name where the product is not registered for use in fallow. Please note: Not all products tested are registered for use in fallow. Please check labels for use patterns and only apply as per label.

Residual herbicides were applied to small plots (ranging in size from 3x12 m to 6x20 m) along with unsprayed controls (Table 2). Herbicides were applied using a quad-bike at 100 L/ha of water with an air-induced coarse (C) droplet size. Weed counts were made after each flush of emergence, following sufficient rain, and any emerged weeds were sprayed out with a knockdown herbicide to avoid double counting.

This report provides a summary of effective treatments across the 18 trial sites, with individual trial details previously reported in *Queensland grains research* 2016 and 2017/18. For the purpose of this report, a trial with effective control is defined as having one or more assessments where treatments were statistically different to the untreated control, and where greater than 90% reduction in weeds was achieved relative to the untreated control.

Results

Sowthistle

The efficacy of the residual herbicide treatments was variable across sites. However, there were some treatments that provided more consistent, effective suppression of sowthistle emergence (Table 2).

Terbyne® Xtreme® and Valor® provided the most consistent control of sowthistle when applied alone, being effective at six of eight and four of six trial sites respectively. Mixtures with these two herbicides also provided good control of sowthistle; when Terbyne® Xtreme® was mixed with Group B (5/6), Group D (5/6) or Group H (4/6) and when Valor was mixed with Group K (5/6) or Group B (4/6). Flame® provided less consistent control of sowthistle (3/8), but provided improved control as a mixture with Group H (6/8), Group K (5/8), or Group D (5/8). Interestingly, these three products provided poor control of sowthistle when applied alone (2/8, 0/8 and 1/8 respectively).

The duration of control differed between residual herbicide treatments. For example, at the Yagaburne site, all residual treatments initially provided a significant reduction in sowthistle emergence at 40 days after application (DAA). However, at 187 DAA, efficacy was greatly reduced in all but six of the treatments (Figure 1). These treatments maintained control with sowthistle emergence not significantly different to 0 plants/m².

The duration of persistence will impact on the efficacy of weed control but can also impact on the potential damage to subsequent susceptible crops. Dry years generally increase the persistence of many residual herbicides beyond the time frames stated on labels.

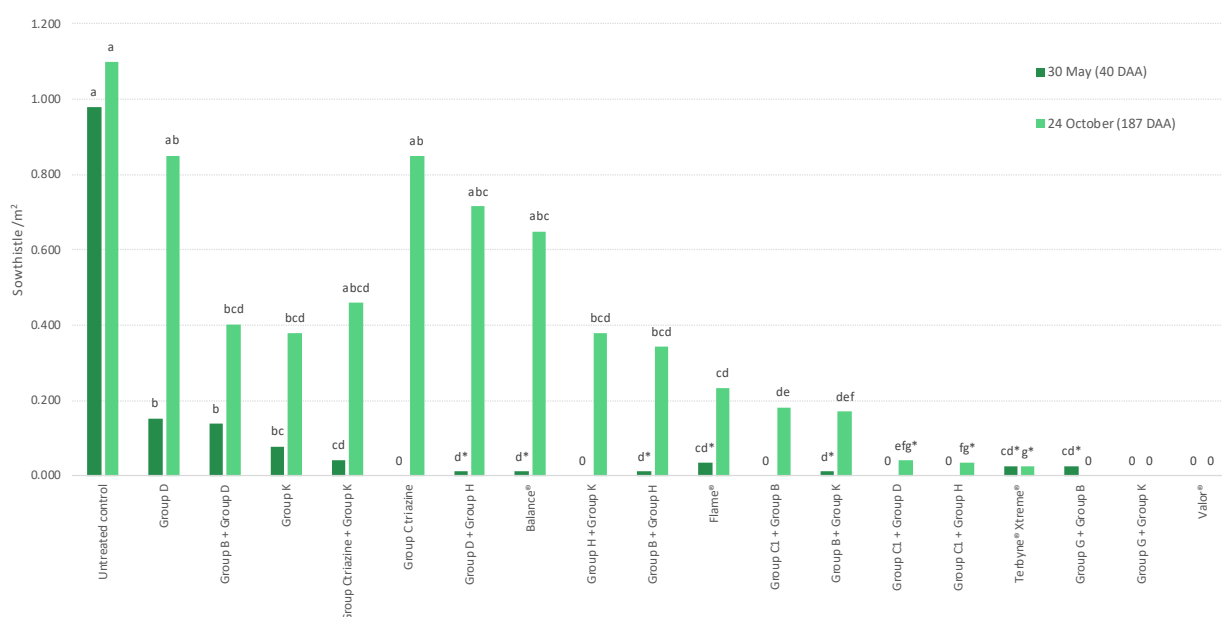


Figure 1. Sowthistle emergence (plants/m²) at Yagaburne following application of residual herbicides and counted 40 days after application (DAA) (30 May 2017) and 187 DAA (24 October 2017).
Columns within the same assessment date with similar letters are not significantly different. * = not significantly different to 0. P(0.05).

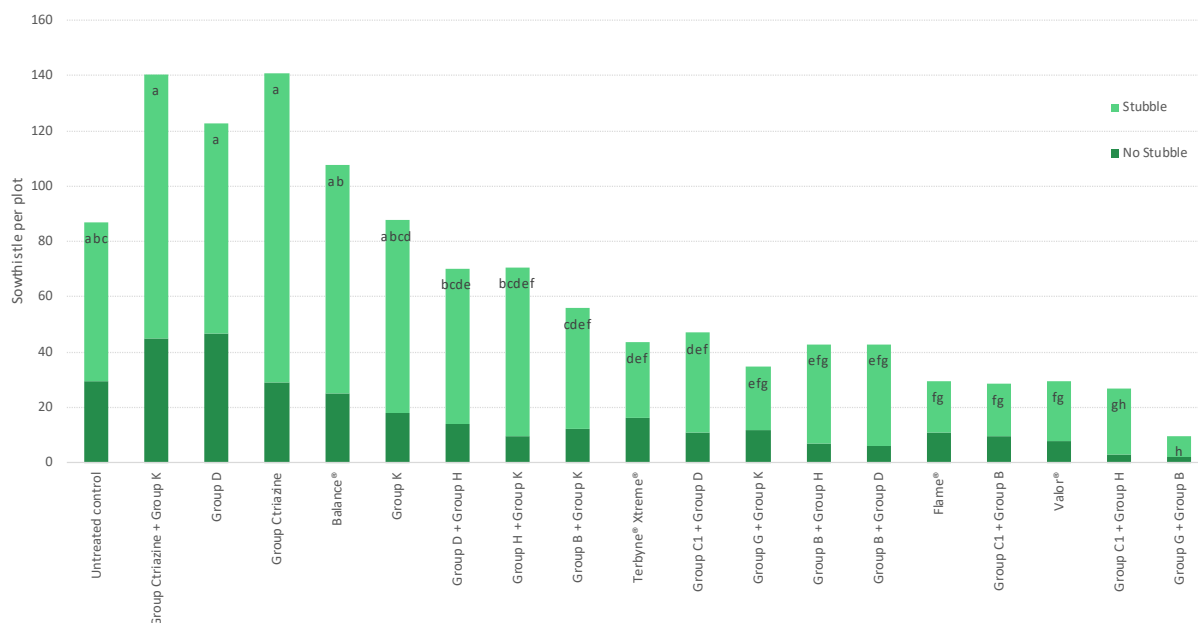


Figure 2. Sowthistle emergence (plants/m²) at Jondaryan 1 following application of residual herbicides in plots with crop stubble and without crop stubble. Counts were made 147 DAA (5 April 2017).
Columns with similar letters are not significantly different P(0.05).

Retaining crop stubble resulted in an increase in the emergence of sowthistle (Figure 2). Sowthistle requires an extended period (three days) of moisture to germinate and it is likely moisture was retained for longer under the crop stubble than in a bare fallow.

Previous research has shown crop residues can intercept a large proportion of residual herbicides, stopping them from getting to the soil target where they are activated. However, although the establishment of sowthistle was higher in the stubble plots, the presence of stubble did not reduce the efficacy of any herbicide treatments with a proportionate/equal reduction in emergence measured in both with and without stubble treatments (Figure 2).

Grasses

A range of grasses established over the 18 trials conducted over the two summers, with grass species varying between trials according to location and soil type. In 2015/16 eight sites measured significant herbicide treatment differences for grass weeds (four ABYG, two FTR, one SSG and one stink grass), as well as a further three sites with the revised treatments in 2016/17 (one SSG, one FTR and ABYG mixture and one ABYG).

Similar to sowthistle, these trials have demonstrated some treatments are able to provide more consistent reductions in grass weed establishment (Table 2). All three Group C products tested were not able to provide consistent control when applied alone (2/11, 3/9, 3/7), with effective grass control only achieved when rainfall was received within a few days of application. This is in spite of Terbyne® Xtreme® being the most consistently effective product applied alone for sowthistle control.

The other five mode of action groups (MOAs) performed well, (Group K 10/11, Group B 9/11, Group D 9/11, Group H 8/11 and Group G 2/3). Grass control was improved further by mixing multiple MOA. Nine of the eleven MOA combinations tested provided effective control of grasses at all of the sites, with the last two MOA combinations providing effective control at all but one site.

Similar to sowthistle control (Figure 1), herbicides varied in their ability to persist and provide continued control of multiple cohorts of grass weeds. Flame® and Valor® have demonstrated effective control beyond 180 days after application at a number of trials, with mixing partners often improving this control.

Implications for growers

Rotating weed control tactics is a key strategy in the management and prevention of herbicide resistance. Weed management shouldn't be prescriptive, but should take into account the environment (soil type, likely rainfall etc.) and future cropping aspirations. As such the results presented here are to help inform decision making and are not a recommendation for weed control.

Residual herbicides offer an opportunity for prolonged control of multiple flushes of weed emergence and for mode of action rotation. Our results show there are residual herbicide options for the effective suppression of sowthistle and grass emergence in fallows. Terbyne® Xtreme® and Valor® provided the best residual control of common sowthistle as stand-alone residual herbicides. Whereas Group K, Group D and Flame® provided the best stand-alone residual control of grass weeds.

Applying residual herbicides as a mixture, while more costly, has provided improved control compared to the individual products. Mixtures can also provide control of a broader spectrum of weeds, which is important when you consider 17 of the 18 trials in this series had both grass and broadleaf weeds germinating.



Sowthistle seedling.



Seedling leaf
pre- and post-spray.



As residual herbicides can be variable in their control and efficacy, it is important to use them in combination with other weed management tactics. For example, if applying a residual for fallow weed control, make sure any weed escapes are controlled (either with knockdown herbicides, targeted tillage or manual removal), and consider following with a competitive crop to provide added control.

Many herbicides require moisture to break down. With our recent run of hot, dry seasons, be mindful that some residual herbicides can persist for longer than described on their labels.

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Treatments with and without stubble.