# Herbicide efficacy in retained stubble systems

RESEARCH

**Amanda Cook and Ian Richter**
SARDI, Minnipa Agricultural Centre

**Searching for answers**

**Location:**
Minnipa Agricultural Centre, paddock S3N
**Rainfall**
Av. Annual: 325 mm
Av. GSR: 241 mm
2016 Total: 391 mm
2016 GSR: 268 mm
**Yield:**
Potential: 3.6 t/ha (W)
Actual: 2.2 t/ha
**Paddock History**
2016: Mace wheat
2015: Grenade wheat
2014: Spray topped medic pasture
**Soil Type**
Red loam
**Plot Size**
20 m x 2 m x 3 reps

## Key messages

- **Herbicides which may be influenced by high stubble loads include trifluralin, triallate, pyroxasulfone, prosulfocarb and metalochor products. If grass weeds are an issue in paddocks with high stubble loads (greater than 50% stubble cover), removal of some stubble may maximize the herbicide activity and grass weed control.**
- **In-crop germination patterns are later for barley grass than for other grass weeds in MAC paddocks, which is limiting early control with pre-emergence herbicides.**
- **If you expect most of your grass weeds to emerge straight after sowing maybe 2 L/ha trifluralin (plus an added herbicide depending on cost and risk factors such as seasonal conditions, soil type, rotation etc.) is the best value for your system.**
- **If you have a later germinating population, and aim to reduce the seed bank, you may be better investing in some of the more expensive herbicide mixes even though they may cost more in the first season.**

## Why do the trial?

The GRDC project 'Maintaining profitable farming systems with retained stubble - upper Eyre Peninsula' aims to improve farm profitability while retaining stubble in farming systems on upper Eyre Peninsula (EP). Weed control in stubble retained systems can be compromised when stubbles and organic residues intercept the herbicide and prevent it from reaching the desired target, or the herbicide is tightly bound to organic matter. Reduced herbicide efficacy in the presence of higher stubble loads is a particular issue for pre-emergence herbicides. Current farming practices have also changed weed dormancy in barley grass genotypes in many paddocks on Minnipa Agricultural Centre (MAC).

As a part of the stubble project this trial was undertaken to assess herbicide efficacy (effectiveness) in different stubble management systems. To understand how herbicides perform it is important to know the properties of the herbicide, the soil type and how the herbicide is broken down in the environment. The availability of a herbicide is an interaction between the solubility of a herbicide, how tightly it is bound to soil particles and organic matter, soil structure, cation exchange capacity and pH, herbicide volatility, soil water content and the rate of herbicide applied (EPFS Summary 2015, p132).

This article reports on the results of the second year of the trial, with a third year of the trial to be conducted in 2017.

## How was it done?

The 2016 trial was sown into paddock S3N, a CL Grenade wheat stubble which yielded 2.4 t/ha in 2015, and was grazed before the trial site was selected in February 2016. The trial was sown on 30 May into good moisture conditions with Mace wheat @ 60 kg/ha and DAP (18:20:0:0) @ 60 kg/ha. Stubble treatments were standing stubble with burnt windrows (burnt on 31 March) and slashed stubble also with a burnt windrow (slashed on 8 April).

The trial area received a knockdown of 1.2 L/ha of Roundup Attack on 29 May. The herbicide treatments listed in Table 2 were individually mixed in small pressure containers and applied on 11 and 12 May using a shrouded boomspray at 100 L/ha of water. The trial was sown at 3-4 cm depth with an Atom-Jet spread row seeding system with press wheels.

Measurements taken were stubble load pre-seeding, plant emergence counts, early, in- crop and late grass weed counts and dry matter production, grain yield and grain quality. Soil was collected on 26 February for weed seed bank germination, with monthly assessments on emergence over the next 12 months.

Soil moisture and soil nutrition were sampled on 18 April. Stubble load was measured on 30 May. Plant establishment and weed counts were taken on 22 June. Late weed counts were taken on 11 October. The trial was harvested on 4 November.

Data were analysed using Analysis of Variance in GENSTAT version 16.

## What happened?

At seeding the stubble load was 1.48 t/ha of standing stubble and 1.28 t/ha of slashed stubble. The 2016 trial site had both barley grass and ryegrass present (Figure 1). The slashed stubble treatment had lower grass weed numbers and the only difference between the blocks was that the standing stubble was closer to the fence line. The 2016 grass weed germination shows in-crop weeds are emerging late in the cropping season, with greater numbers in August than June, despite good seeding and early germination conditions.

The barley grass germination pattern from in-crop soil samples in 2015 (Figure 2) showed differences from the 'fenceline' barley grass, indicating cropping with pre-emergent herbicides has selected for later germinating genotypes. This has resulted in moving the barley grass population to a type which has dormancy, supporting previous germination timing results collected at MAC (Ben Fleet, University of Adelaide).

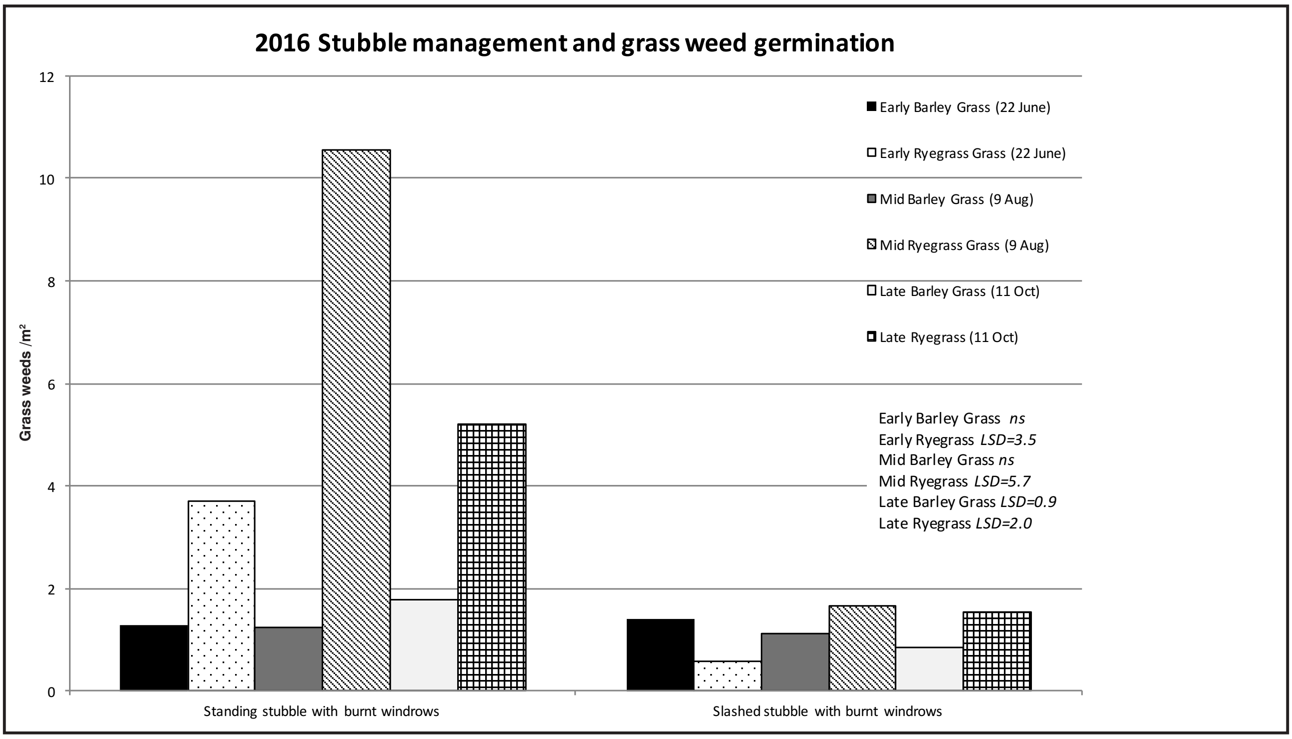


***Figure 1 Stubble management and grass weeds/m² at different timings during the 2016 season (LSDs in the graph are comparing between stubble treatments for the same weed species at the same time at P=0.05)***

### *Stubble treatments*

Plant establishment was the same with either standing stubble or slashed, but there were differences in dry matter and crop yield (Table 1). Slashed stubble resulted in higher yields than standing stubble which may be due to extra grass weed competition, especially ryegrass numbers, which were higher with standing stubble (Figure 1). There were no differences in grain quality due to stubble treatments with averages being; test weight of 80.6 kg/hL, protein of 10.8% and screenings of 1.3% (data not presented).

Ryegrass during the growing season was more dense than barley grass (Figure 1). There was more ryegrass in standing stubble than in the slashed stubble trial block (which was further from the fence line, 60 metres into the paddock).

### *Herbicide treatments*

There were no impacts of stubble management on the performance of individual herbicide treatments so results presented in this section are averaged over the two stubble management treatments.

Wheat establishment was between 88 and 109 plants/m², with several herbicide treatments causing significantly less establishment than the untreated control (Table 2). All herbicide treatments reduced early dry matter compared to the untreated control (Table 2), but only the pyroxasulfone treatments reduced late dry matter and yield of Mace wheat.

Due to the low grass weed densities, no herbicide treatment was more profitable than the control (Table 2).

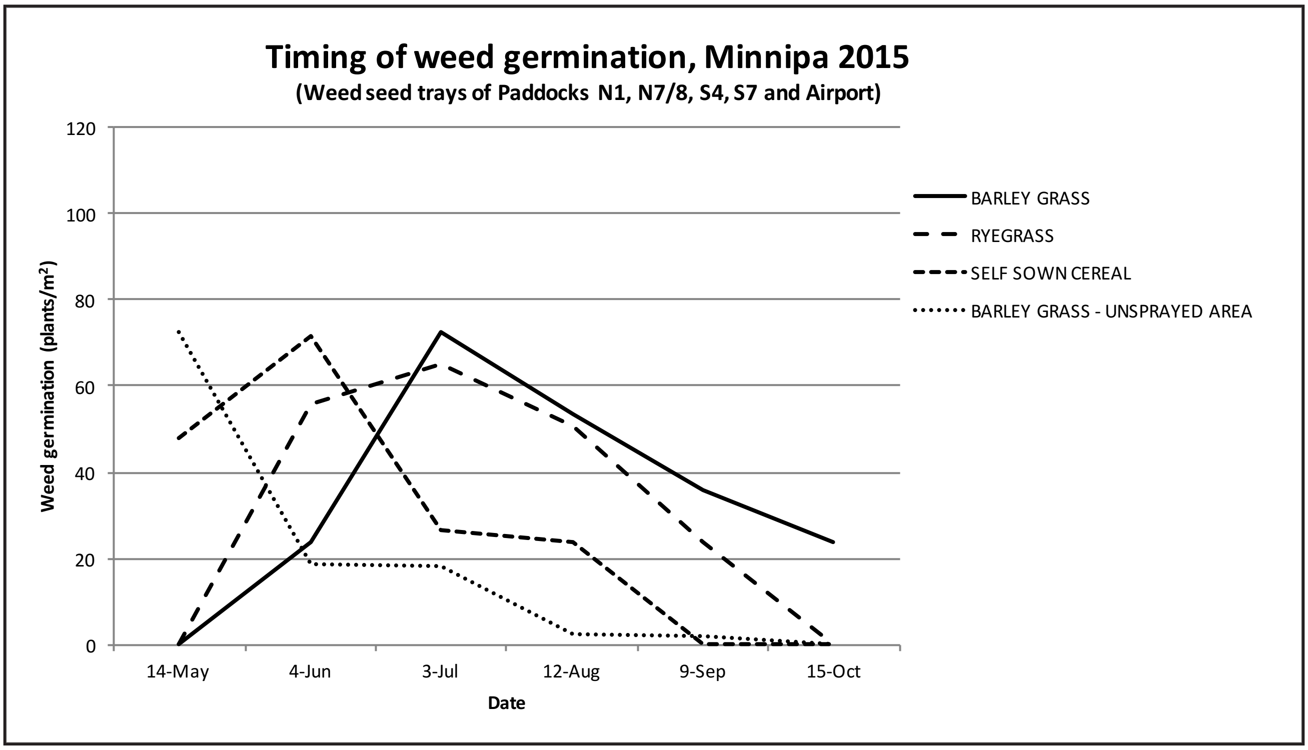


***Figure 2 Weed germination patterns from in-crop soil samples taken from harvest 2014 to early 2015***

***Table 1 Effect of stubble management on crop establishment, dry matter and yield of wheat in 2016***

| | Establishment (plants/m²) | Early crop dry matter (t/ha) | Late dry matter (t/ha) | Yield (t/ha) |
|---|---|---|---|---|
| Standing stubble with burnt windrows | 94.6 | 0.38 | 4.35 | 2.17 |
| Slashed stubble with burnt windrows | 98.0 | 0.41 | 4.67 | 2.25 |
| *LSD (P=0.05)* | *ns* | *0.03* | *0.20* | *0.04* |

Most herbicide treatments were providing better weed management than the untreated control (Figure 3). Some of the newer herbicides with greater residual activity were showing better in-crop grass weed control.

## What does this mean?

In both seasons of this work most herbicide treatments have lowered all grass weed types compared to the untreated control. The 2015 and 2016 results suggest that under the production regimes of upper EP, stubble management; standing stubble, burnt windrows, slashed stubbles and stubble removal by whole paddock burning, is unlikely to impact on the performance of pre-emergent herbicides targeting grassy weed control, with adequate water rates. However, this trial did not place the herbicide packages “under pressure” because grassy weed populations were quite low. Under low populations of barley grass weaker herbicide options may perform adequately compared to high weed population situations.

If grassy weeds are an issue in paddocks with high stubble loads (greater than 50% stubble cover), removal of some stubble may be a benefit to maximize the herbicide activity and grass weed control. Other research has shown the herbicides which may be influenced by high stubble loads include trifluralin, triallate, pyroxasulfone, prosulfocarb and metalochor products.

*Table 2 Effect of herbicide treatments on crop establishment, dry matter and yield in 2016*

| Herbicide treatment | Group | Establishment (plants/m²) | Early dry matter (t/ha) | Late dry matter (t/ha) | Yield (t/ha) | Herbicide cost ($/ha) | Income# less herbicide cost ($/ha) |
|---|---|---|---|---|---|---|---|
| Control Untreated | | 109 a | 0.54 a | 4.79 a | 2.22 a | 0 | 428 |
| Trifluralin (1.5 L/ha) | D | 92 c | 0.35 efg | 4.80 a | 2.23 a | 9 | 421 |
| Trifluralin (2 L/ha) | D | 88 cd | 0.39 cde | 4.64 abc | 2.28 a | 12 | 428 |
| Trifluralin (1.5 L/ha) + Lexone (Metribuzin) 180 g (post) | D+C | 107 ab | 0.44 bcd | 4.71 ab | 2.26 a | 15 | 421 |
| Trifluralin (1.5 L/ha) + Diuron 900 (400 g/ha) (pre-emergent) | D+C | 102 abc | 0.45 bc | 4.61 abcd | 2.21 a | 14 | 413 |
| Trifluralin (1.5 L/ha) + Diuron 900 (high rate) (pre-emergent) | D+C | 91 c | 0.36 ef | 4.22 bcdef | 2.28 a | 19 | 421 |
| Trifluralin (1.5 L/ha) + Avadex (Tri-allate) (1.6 L/ha) (pre-emergent) | D+J | 76 d | 0.26 h | 4.30 abcde | 2.16 a | 25 | 392 |
| Trifluralin (1.5 L/ha) (pre) + Monza (sulfosulfuron) (25 g/ha) (post) | D+B | 95 bc | 0.44 bcd | 4.83 a | 2.24 a | 35 | 397 |
| Monza (sulfosulfuron) 25 g (pre-emergent) | B | 101 abc | 0.37 def | 4.43 abcde | 2.17 a | 26 | 393 |
| Sakura (118 g) (pre-emergent) | K | 96 abc | 0.33 efg | 4.21 cdef | 2.21 a | 40 | 387 |
| Monza (sulfosulfuron) (25 g) + Sakura (118 g) (pre-emergent) | B+K | 89 cd | 0.28 gh | 3.84 f | 1.99 b | 66 | 318 |
| Sakura (118 g)+ Avadex (Tri-allate) 3 L (pre-emergent) | K+J | 97 abc | 0.36 ef | 4.03 ef | 2.20 a | 70 | 355 |
| Boxer Gold (2.5 L/ha) (pre-emergent) | K+J | 97 abc | 0.45 bc | 4.82 a | 2.29 a | 37 | 405 |
| Boxer Gold (2.5 L/ha) (post) | K+J | 99 abc | 0.47 b | 4.79 a | 2.19 a | 37 | 386 |
| Sakura (118g)+ Avadex (Tri-allate) 3 L (pre-emergent) + Boxer Gold 2.5 L (post) | K+J | 91 c | 0.30 fgh | 4.14 def | 2.18 a | 107 | 314 |
| *LSD (P=0.05)* | | *13.4* | *0.07* | *0.50* | *0.12* | | |

*# Wheat price of $193/t used for ASW on 1 December 2016 at Port Lincoln, less herbicide cost.*
**some treatments in the trial are for research purposes only*

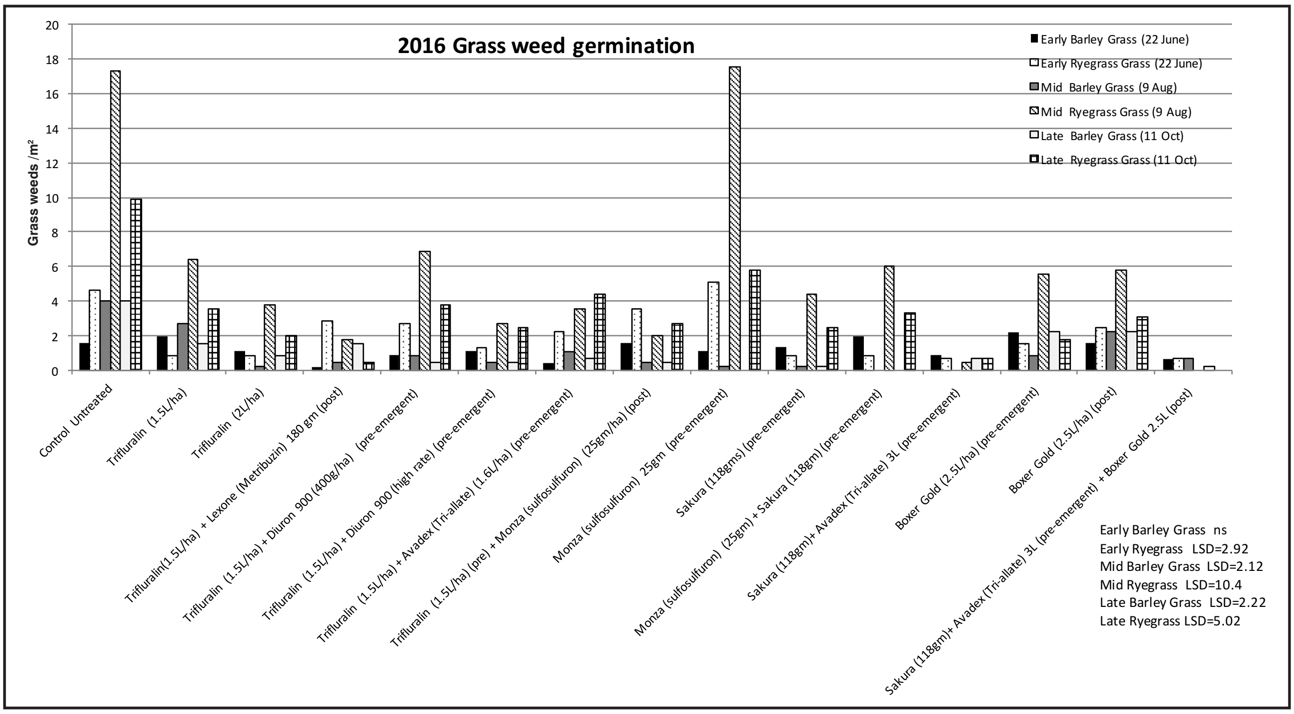


***Figure 3 Effect of herbicide treatments on grass weed control during the season (LSDs in the graph are comparing between stubble treatments for the same weed species at the same time at P=0.05)***
**some treatments in the trial are for research purposes only*

In-crop germination patterns are later for barley grass in MAC paddocks, which is limiting early grass control with pre-emergent herbicides. Check paddocks before crop anthesis (flowering) for late germinating grass numbers. Keep records at harvest of what grass is the biggest issue in paddocks, barley grass, ryegrass or both and have short and long term management plans. If you expect most of your grass weeds to emerge straight after sowing maybe 2 L/ha trifluralin (plus an added herbicide) is the best value for your system. If you have a dormant/later germinating population, and aim to reduce the seed bank, you may be better investing in some of the more expensive herbicide mixes with greater longevity even though they may cost more in the first season for longer term grass control. Two year breaks during the pasture/ break crop phase can also be effective in reducing the grass weed seed bank.

The differences in a herbicide's ability to bind to organic matter and move through the soil profile with soil water influences the uptake of the herbicide by the target weeds, the crop, and the impact on both. Soil texture and soil chemical properties can affect herbicide movement and availability in the soil profile. Some herbicides will have greater activity and mobility and be "hotter" in lighter sandier soils than the MAC loam in this trial. The dry seeding conditions and lack of post sowing rainfall at the start of the 2015 season resulted in less damage to the crop than expected with some herbicides (e.g. the diuron mixes) due to lower soil mobility. Seeding systems and speed at sowing may also influence soil throw and hence herbicide movement in soil water.

## Acknowledgements

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Registered products: see chemical trademark list.