Harvest weed seed control for the southern high-rainfall zone

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Key points

- Herbicide-resistant annual ryegrass (*Lolium rigidum*) is increasingly becoming a challenge for growers across southern Australia.
- Harvest weed seed control (HWSC) — the collection and/or destruction of weed seeds at harvest — is a non-chemical control method, which can be used to reduce the seedbank of weeds such as annual ryegrass.
- A major premise of HWSC is that the targeted weed species retain a high proportion of their total seed production at crop maturity.
- Where pre-emergent or in-crop herbicides have not been applied, ryegrass weeds are shedding before wheat is harvested.

Aim

The aim of this work is to understand if growers can reduce soil weed seedbanks in high-yielding high-rainfall zones by adopting harvest weed seed control (HWSC) practices.

Background:

The four-year project (2015–18), aims to investigate the efficacy of HWSC practices across southern Australia through partnerships with Southern Farming Systems, Mackillop Farm Management Group, Riverine Plains Inc and Farmlink. The project includes four small plot trials and six on-farm demonstration sites across the different regions.

The small plot trials are investigating the impact of harvest height on weed seedbanks. The height of the weed seed within the crop determines the harvest height required to collect most weed seeds.

The on-farm demonstration sites are investigating the impact on weed seedbanks of narrow windrow burning (harvest low 15cm), using a weed seed mill (harvest 15cm) and a grower treatment involving the separation of chaff and straw, with the chaff dropped on top of the straw and then baled. These treatments will be compared against a traditional blanket burn.

Method

The Riverine Plains Inc small plot trial was established at Yarrawonga, Victoria during 2016.

Soil weed seedbanks were measured before sowing, and annual ryegrass was sown to reflect commercial grower experiences of: nil (no ryegrass sown), 25 plants/m^2, 50 plants/m^2 and 75 plants/m^2. This was done to offset the spatial variability in weed seed across a paddock, ensuring a relatively even distribution of weed seeds across the various treatments.

The site was sown to wheat (cv Corack) on 28 April 2016. No pre-emergent or in-crop herbicides were applied.

The crop was sown into a wheat stubble with 75kg MAP at sowing and 100kg of urea applied by plane on 10 August 2016 at first node (GS31).

The trial was a split plot randomised design with the main plot being harvest height with residue removed (15cm and 30cm) and the split plot being ryegrass density.

The plots were replicated five times and were 2m wide and 15m long.

Residue was collected by attaching a fertiliser bulk bag to the back of the plot harvester and regularly unloading straw and chaff away from the plots. The straw and chaff was burnt after harvest. The removal of residue replicates weed seed capture using a broadacre HWSC technique, such as a chaff cart.

Annual ryegrass plant numbers were measured when the wheat was at the two leaf stage (GS12) and again when the wheat had three tillers (GS23). Ryegrass seed shedding was measured weekly from 11 November 2016, which was when the ryegrass was mid-flowering (GS65), until the wheat was harvested on 11 December 2016. Seed shedding was measured by counting the number of seeds that fell into two small trays placed in each plot.

Data were analysed with an analysis of variance (ANOVA), where data were log transformed for normality if needed and 95% confidence intervals were estimated from the statistical analysis.

Results

Soil seedbank tests on the site prior to sowing indicated ryegrass populations of 3.42 plants/m^2. Actual ryegrass emergence in nil ryegrass sown plots indicated a much higher seedbank (an average of 46.9 plants/m^2 when the wheat was at the two leaf stage (GS12)).

Ryegrass plant densities averaged 57 plants/m^2 when the wheat was at the two-leaf stage (GS12) and 77 plants/m^2 when the wheat had three tillers (GS23) (Table 1). When measured again at the wheat hard dough stage (GS87), the number of ryegrass spikelets averaged 804 spikelets/m^2. This equates to approximately 4824 seeds/m^2, based on an average number of six seeds per spikelet.

The weekly number of seeds shed by the ryegrass prior to harvest commenced with an average of 506 seeds/m^2 during the second week of November and increased to an average of 1355.22 seeds/m^2 by the first week in December (Table 2).

The wheat yielded 3.03t/ha with protein of 8.16% and screenings of 1.94% (Table 3). There were high numbers of ryegrass seeds in the harvest sample.

Observations and comments

The decile 9 growing season rainfall (GSR) of 604mm experienced during 2016 significantly impacted yield due to waterlogging at the trial site. The extremely wet season also made it difficult to apply adequate nitrogen to the crop.

TABLE 1 Ryegrass density measured at wheat two-leaf stage (GS12) on 20 May, wheat three-tiller stage (GS23) on 27 June, and wheat hard-dough stage (GS87) on 24 November 2016 at Yarrawonga.

Measurement	Ryegrass plants/m^2	Ryegrass plants/m^2	Ryegrass spikelets/m^2
Assessment timing (wheat growth stage)	GS12	GS23	GS87
Mean	56.57	76.52	803.93
Confidence interval (95%)*	33.00 – 96.94	49.38 – 118.59	266.34 – 2426.59

* The confidence interval shows the range of measurements around the mean and gives an indication of the variability of the measure, in this case, ryegrass numbers.

TABLE 3 Wheat density, yield, protein and screenings Yarrawonga, 11 December 2016

	Density (plants/m^2)	Yield (t/ha)	Protein (%)	Screenings (%)
Mean	130.56	3.03	8.16	1.94
Confidence interval (95%)*	75.18 – 185.93	2.75 – 3.32	7.40 – 8.92	1.25 – 2.63

*The confidence interval shows the range of measurements around the mean and gives an indication of the variability of the measure, in this case, ryegrass numbers.

Sowing the HWSC plot trials, May 2017.

TABLE 2 Ryegrass weekly seed shedding measurements at Yarrawonga during November and December 2016

Measurement	Ryegrass seed shed/m^2	Ryegrass seed shed/m^2	Ryegrass seed shed/m^2	Ryegrass seed shed/m^2
Assessment timing	11/11/2016	18/11/2016	24/11/2016	2/12/2016
Mean	506.00	427.10	1359.24	1355.22
Confidence interval (95%)*	339.67–753.79	246.41–740.27	983.02–1879.43	955.28–1922.60

*The confidence interval shows the range of measurements around the mean and gives an indication of the variability of the measure, in this case, ryegrass numbers.

Weeds (mainly ryegrass, with some Paterson's curse, brome grass and volunteer canola) thrived at the site. Many of the ryegrass weed seed heads lodged on the ground, making them difficult to pick up with the header.

As there were no other weed control treatments besides harvest removal of residue, any inferences as to the efficacy of weed seed control through variable harvest height cannot be made until the end of 2017. However, the data collected indicates that when there are high populations of ryegrass (>20 plants/m^2), the large amount of ryegrass seed shed prior to harvest limits the amount that can be collected during the harvesting process. This means where ryegrass weed populations are high, harvest weed seed control cannot be used as the only weed control strategy, but needs to be integrated with other strategies for effective control.

Much of the data on ryegrass weed populations has been collected in the low-to-medium rainfall zones. This project is collecting information to understand the most cost-effective ways to manage ryegrass populations in the high-rainfall zone.

Sponsors

This project is funded by GRDC project SFS00032 *Harvest weed seed control for the southern high rainfall zone and led by Southern Farming Systems*. Thanks also go to Baker Seed Co, the Trevethan family and the Inchbold family as farmer co-operators during 2015 and 2016.

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