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FarmLink Research Report 2017

Harvest Weed Seed Control in the Southern Region

Trial Site Location

Greenethorpe NSW

Report Author

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Introduction

Can harvest weed seed practices be adopted to reduce soil weed seed banks in high yielding high rainfall zone (HRZ) areas of the Southern region to address herbicide resistance issues?

This project looks at a range of different harvest weed seed capture and pre-sowing stubble management practices for growers in the HRZ in the Southern region of Australia. Capturing weed seeds during harvest is becoming an increasingly valuable tool in the fight against high weed populations and herbicide resistance.

An important focus of this experiment is to test and demonstrate the practical implications for growers adopting harvest weed seed control practices in the high rainfall zone. The trials give a reliable demonstration of the potential benefits and problems that growers might encounter when adopting certain harvest weed seed control methods.

SFS (Southern Farming Systems), AHRI (Australian Herbicide Resistance Initiative), along with FarmLink, Riverine Plains and McKillop Farm Management Group have been tasked with implementing innovative trials aimed at delivering key herbicide resistant management messages to growers and advisors to facilitate the adoption of weed management tool and encourage crop sustainability.

Project Partners

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MFMG
www.mackillopgroup.com.au
MacKillop Farm Management Group Inc

SFS
Southern Farming Systems

AHRI
AUSTRALIAN HERBICIDE RESISTANCE INITIATIVE

RiverinePlains

Funding Partners

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

GRDC project code - SFS00032

Objectives

To analyse and investigate various innovative harvest weed seed control methods suitable for the FarmLink HRZ and demonstrate the potential benefits or problems growers might face when adopting these methods.

Method

2015 – Replicated Experiment Treatments

In November 2015, a farm scale experiment was established in Greenethorpe, NSW, to compare various methods of dealing weed seed during harvest. The experiment layout consisted of three treatments, replicated four times, which gave a total of twelve strips 200 metres long by 12 metres wide.

Table 1. 2015 harvest weed seed replicated trial treatments

Treatment	Code	Description
1	CH	Conventional Harvest – harvested with the spreaders on at 30cm, stubble was meant to be burnt as a blanket burn prior to sowing. However, the location of the trial is a mixed farming enterprise, the paddock was grazed and there was not enough stubble to get a good burn.
2	WSM	Weed Seed Mill – harvested at 15cm using a prototype integrated harvest weed seed mill (PIM).
3	WB	Windrow Burn – harvested at 15cm, windrow strip to be burnt prior to sowing.

2016 – Un-replicated Demonstration Treatments

In 2016 an un-replicated demonstration was established over the 2015 site, the three treatments from 2015 were kept in the same location, while two new treatments were added alongside. The five un-replicated strips were 12 metres wide by 200 metres long, giving a total of five strips.

Table 2. 2016 harvest weeds seed demonstration treatments

Treatment	Code	Description
1	CH	Conventional Harvest – harvested with the spreaders on at 25-30cm, stubble to be burnt as a blanket burn prior to sowing.
2	WSM	The weed seed mill was unavailable for this year, the strip was harvested at 10-15cm and placed in a windrow, to be burnt prior to sowing in 2017
3	WB	Windrow Burn – harvested at 10cm, windrow strip to be burnt prior to sowing.
4	CC	Chaff Cart – cut at 10-15cm, chaff dumped at the end of the strip. To be burnt prior to sowing in 2017
5	HH	High Harvest – Harvested at 35-40cm, windrow strip to be burnt prior to sowing.

Assessments

Soil cores (10cm) were taken pre-harvest in the first year (2015 and 2016) of the trial and pre-sowing each year to determine the weed seed bank numbers, this was completed using a foot corer. The soil samples were grown out in trays and each germinated seed counted. Weed plant and inflorescence counts were taken pre and post-harvest to assess the amount of ryegrass inflorescence cut and sent through the header and how much remained intact in the paddock.

Its important to remember that the inflorescence that were cut by the header were not removed from the paddock, but taken in through the front of the header and sent out the back as chaff. An inflorescence is the flowering stem of a rye-grass plant (image 1). Spikelets on 10 inflorescence collected at random were counted for each strip to get an average of spikelets per square metre. Each spikelet has between three to nine seeds (GRDC 2014).

Data including yield, speed, fuel usage, engine capacity and engine speed was recorded during harvest using a commercial harvester. This was to highlight the practical implications of adopting harvest weed seed control methods. The trial was set up to give a reliable demonstration of the potential benefits or problems growers may encounter using these approaches.

Results

Inflorescence counts were taken pre and post-harvest in 2015 (Table 4), the conventional harvest treatment had the lowest amount of inflorescence cut at harvest, with a sum of 59.5%. While the weed seed mill and windrow burn treatments had a higher inflorescence cutting percentage of 65.4% and 64.1%.

The 2016 pre-harvest inflorescence counts (Table 5) were performed for all five of the treatments. Comparisons were made for the first three treatments using data from the previous year. There are no comparisons for the chaff cart and the high harvest treatments, as they were only introduced to the trial at the end of 2016. Counts will be taken again at rye grass flowering in 2017 for the comparison of all treatments. According to inflorescence counts (Table 5), the conventional harvest treatment had the greatest reduction in inflorescence numbers during 2015 and 2016, with a reduction of 31.3%. The weed seed mill treatment had a reduction of 8% and the windrow burn treatment had a 4.3% increase of inflorescence numbers.

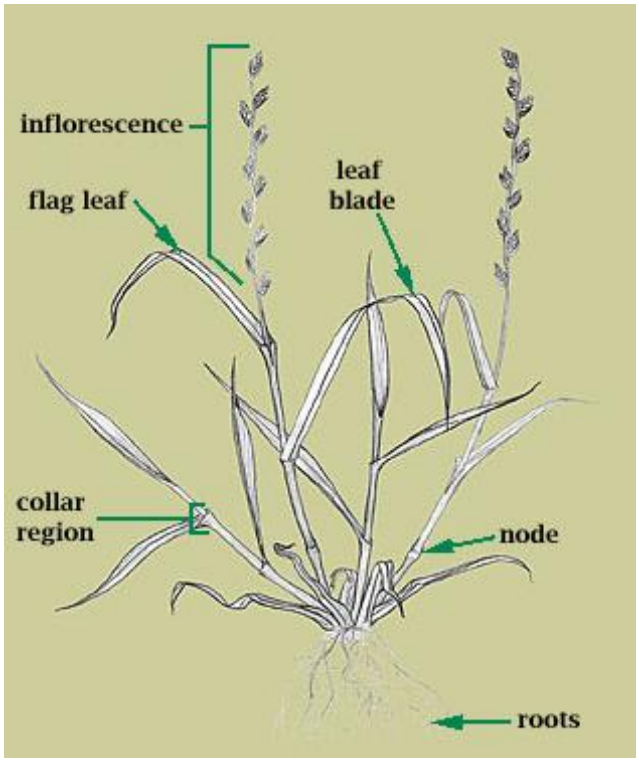

Image 1. Anatomy of annual ryegrass (Hannaway 2017)

Table 3. Treatment average weed seedbank results from the 2015 replicated trial.

Treatment	Pre-Harvest Weed Seed Bank (2015) (seeds/m²)
Conventional Harvest	1989
Weed Seed Mill	1910
Windrow Burn	2706

Table 4. Annual rye grass inflorescence counts pre and post-harvest 2015.

Treatment	Pre-harvest Inflorescence Count (2015) (inflorescence/m²)	Post-harvest Inflorescence Count (2015) (inflorescence/m²)	Inflorescences cut at harvest
Conventional Harvest	178.1	72.2	59.5%
Weed Seed Mill	143.0	49.5	65.4%
Windrow Burn	181.7	65.2	64.1%

*Table 5. Pre-harvest inflorescence counts, 2015 vs 2016, taken at annual rye grass flowering. * No 2015 Pre-harvest inflorescence counts for these treatments because they were not introduced until 2016.*

Treatment	Pre-harvest Inflorescence Count (2015) (inflorescence/m²)	Pre-harvest Inflorescence Counts (2016) (inflorescence/m²)	Inflorescence Change (%)
Conventional Harvest	178.1	122.4	-31.3%
Weed Seed Mill	143.0	131.5	-8.0%
Windrow Burn	181.7	189.6	4.3%
Chaff Cart	NA*	176.2	NA*
Harvest High	NA*	87.0	NA*

Spikelet numbers per square metre dropped between 2015 and 2016 (table 6). Information such as yield, speed, fuel usage, engine capacity and engine speed was recorded during harvest for both 2015 and 2016 for each treatment. That data is currently being analysed and will be available once completed.
*not implemented in 2015

Table 6. Pre-harvest seed counts, 2015 vs 2016, taken at annual rye grass flowering.

Treatment	Spikelet Counts (2015) (spikelet/m^2)	Spikelet Counts (2016) (spikelet/m^2)	Spikelet Change (%)
Conventional Harvest	3597.6	1814.0	-49.6%
Weed Seed Mill	3024.5	1934.4	-36.0%
Windrow Burn	3924.7	3183.4	-18.9%
Chaff Cart	NA*	2796.3	NA*
Harvest High	NA*	1263.0	NA*

Discussion

The conventional harvest treatment had 59.5% of inflorescence cut during harvest (Table 4), while the other two treatments, weed seed mill and windrow burn, had 65.4% and 64.1% cut. The difference in the treatments can be explained by the cutting height of the harvester. The conventional harvest treatment was cut at 30cm off the ground, the other two treatments were harvested at 15cm. Adjusting the height of the cutter bar of the header from 30cm to 15cm, only improved the collection of ryegrass by 5% and there were still many inflorescences lying flat below 15cm. No harvester is 100% efficient at picking up all weed seeds, and no matter which harvest weed seed method is used, none are 100% efficient at destroying them. The goal is to manage and bring down weed seed numbers over time using the most efficient method for your farming system.

The difference in pre-harvest inflorescence counts from 2015 and 2016 (Table 5) produced an unexpected result. The conventional harvest treatment had the greatest decline when compared to the other treatments. This was unexpected for a few reasons. Firstly, this treatment was cut at 30cm, our results show that harvesting at 30cm instead of 15cm leaves approximately 5% more inflorescences intact (Table 4). Secondly, the conventional harvest treatment was harvested with the spreaders on and was grazed rather than blanket burned. This treatment should have had the least difference in inflorescence counts from one season to the next. Another unexpected outcome was that the windrow burn treatment increased inflorescence numbers by 4.3%. It is likely that sampling variation is the cause of this unusual result. Lateral spatial variability across the paddock plays a big role in some of the inconsistent data. Further years of this trial are needed to get a clearer view of the impact of treatments.

We observed spikelets/m^2 reduce between 2015 and 2016 for all three treatments (Table 6). The 2016 crop was canola, canola is more competitive and has better herbicide options for grass weeds than wheat, which was the crop in 2015. The paddock received a spray of Roundup on July 31. These two strategies combined have the potential to limit weed vigour, resulting in less spikelets per inflorescence. Even though there was an increase in inflorescence numbers between 2015 and 2016 for the windrow burn treatment, the reduction in spikelets number per inflorescence in 2016 meant there was still an overall reduction of 18.0% in spikelets/m^2.

Other aspects growers could consider when deciding which weed seed management strategy to employ on their farm is how readily these practices can be adopted while using existing machinery, fuel usage, terrain and wear and tear on harvesters when harvesting low.

References

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Hannaway D. B. (2017). 'Grass growth and regrowth for Improvement management'. Forage Information System.