Grass weed management in retained stubble systems - farm demonstrations

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DEMO

Searching for answers

Location:
Minnipa
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm

Location:
Yeelanna
Rainfall
Av. Annual: 395 mm
Av. GSR: 314 mm

Key messages

- **The ability to capture barley grass seeds at harvest is limited.**
- **If seed can be captured and placed in windrows, windrow burning can reduce grass weeds.**
- **Seed capture at harvest is higher with annual ryegrass than with barley grass.**
- **Burnt narrow windrows sustained temperatures above 400°C for longer than 10 seconds, which is sufficient to sterilise annual ryegrass seed.**
- **Snail numbers were reduced with windrow burning.**
- **Barley grass germinates later in Minnipa Agricultural Centre cropped paddocks than in non-cropped areas.**

Why do the demonstration?

The GRDC 'Maintaining profitable farming systems with retained stubble' projects on upper and lower Eyre Peninsula (EP) aim to improve farm profitability while retaining stubble in farming systems. Grass weed management is one of the key issues of current cropping systems with annual ryegrass and barley grass being of most importance on lower EP (LEP) and upper EP (UEP) respectively. Herbicides continue to be the main strategy for weed control, and on LEP the intensification of cropping rotations and the decrease in livestock from farming systems has resulted in even further pressure on herbicides, resulting in the accelerated development of herbicide resistance in ryegrass.

An integrated approach to weed management (IWM) is required to slow the development of herbicide resistance and improve the sustainability of our farming systems. IWM aims to lower the weed seed bank with the use of herbicides as well as non-chemical techniques such as cultivation, higher sowing rates, and harvest weed seed management such as burning stubble, narrow windrow and chaff cart dumps. Demonstration paddocks were monitored to assess grass weed management strategies in current farming systems. This information will be used to improve the Ryegrass Integrated Management (RIM) model for EP systems, and potentially produce other grass weed management models (barley grass).

How was it done?

In 2016 monitoring of farm paddocks was undertaken to assess grass weed management strategies by;

- Monitoring grass weed numbers in narrow windrows from harvest 2015 in MAC paddocks 'Airport', 'S3N' and 'N6W' (canola).
- Monitoring grass weed numbers, narrow windrows and chaff dumps in grower's paddocks 'CE42' (lentils) and 'Carina' (canola).
- Monitoring weed seed banks of ryegrass in narrow windrows from harvest 2015 on a property south east of Cummins. Two paddocks, '80 Acre' and 'Salt Lake' were monitored. See EPFS Summary 2015 p155-158 for more detail regarding this property.

Only broad conclusions from the farmer demonstrations can be made in regards to weed seed capture, as there was a large amount of variation in the weed population in the paddocks being monitored which clouds management effects.

Paddock monitoring for grass weed populations

Grass weed density was assessed in crop at 10 GPS points along a transect before grass weed spraying. Six crop and weed counts were taken at each of the 10 locations. The same transect was assessed again before harvest.

Assessing weed seed capture and burning in narrow windrows

Soil samples for weed seed banks were collected in February and March 2015 along a transect across the paddock comprising 10 GPS-located sampling points. The soil sampling method was described by Kleemann et al. (2014). Prior to narrow windrows being burnt a 5 m section of chaff was removed (non-burnt area) within each paddock (see EPFS Summary 2015, p150-151 for further details) and weed seeds in soil or chaff were germinated in 2015. Germinating trays, 35 cm x 29 cm, were partially filled with sterilised soil mix and the collected weed seed bank soil or chaff was then spread over the top to 1-2 cm depth, with another light coating of the sterilised soil mix spread over the soil or chaff. The trays were placed in a rabbit proof open area and watered if required during the season. Trays were assessed for weed germination approximately every four weeks. Counted weeds were removed from the trays. Control plots with barley grass seed collected from MAC oil mallee area (sprinkled into trays) were located across the germination area to assess timing of barley grass germination relative to a non-cropped population.

Percent reduction in seed by burning is the reduction of weed seeds within the windrow due to burning. This was calculated by (number of weeds in row burnt)/(number of weeds in row before burning (soil)) as a percentage (S Kleemann, per comm. 2015). This only explains the fate of weeds that end up in windrows.

In the paddocks sampled, approximately 10 m of crop and weeds was collected by the header front and the chaff and weed seed were deposited into a 0.7-1.0 m wide row resulting in a concentration of crop material (including weed seeds) by a factor of 10 – 14 times, depending on the actual size of the header front and the windrow width (Figure 1). To calculate the actual weed control efficacy of burning windrows we need to consider both the amount of weed seed in the row controlled by fire as well as the proportion of the seed that was captured by the header and placed into the windrow for burning. To calculate the proportion of the weed seeds collected at harvest the following calculations were used:

> Weed seed captured in the windrow can be calculated before burning by [(weed seeds in windrow) – (weed seeds from inter row) / (windrow concentration factor)]. This will give the amount of seeds/m^2 entering the windrow. This can be converted to a % of total weed seed capture by [(seeds removed to windrow) / (seeds removed to windrow + seeds in inter row)]*100. The final efficacy is the % of weed seed captured in the windrow multiplied by the % reduction by burning the seeds in the windrow (B Fleet, per comm. 2016).

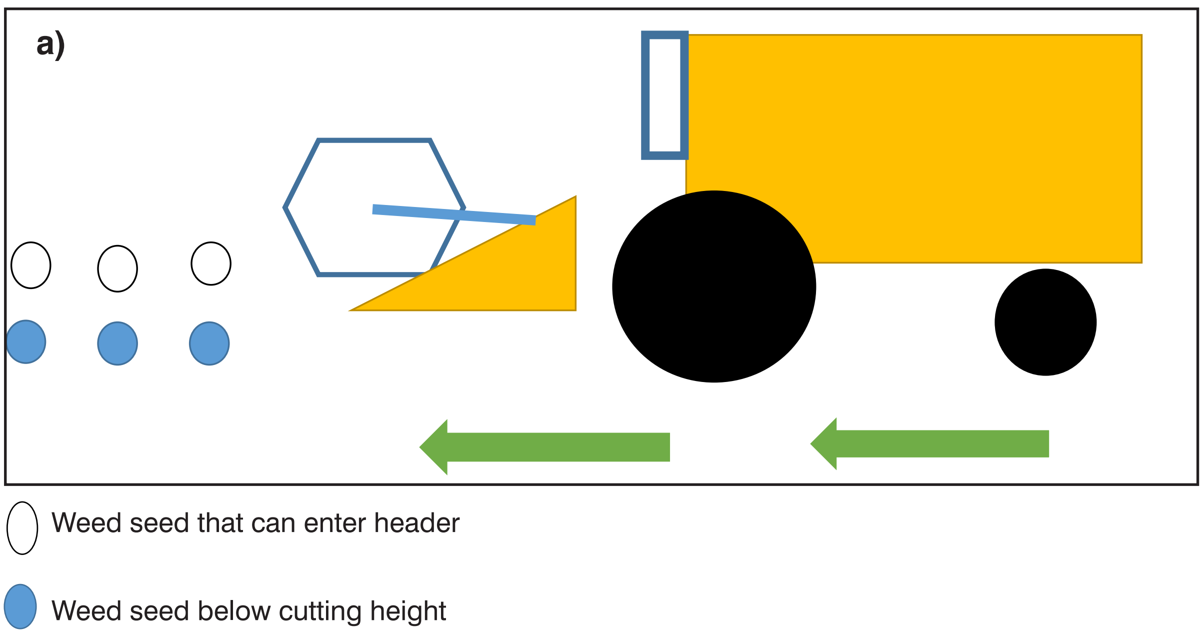
Snail numbers were recorded after windrow burning to asses live and dead snails across the paddock.

Assessing weed seed capture in chaff dumps after harvesting

Chaff was collected from 10 chaff dumps with 10 samples per dump, taken approximately 40 cm into the dump (which were approximately 1 m high), to determine the weed seed species being collected at harvest. Fifty grams of chaff were added to each germination tray with three replications (30 samples per chaff dump, 300 samples per paddock monitored).

Recording windrow burning temperatures

Temperatures of the burning windrow were recorded with a temperature gun (as used for recording machinery bearing temperatures). Temperatures were recorded every 10 seconds for 240 seconds, and then separately recorded at 300 and 360 seconds. This was repeated on 10 windrows.



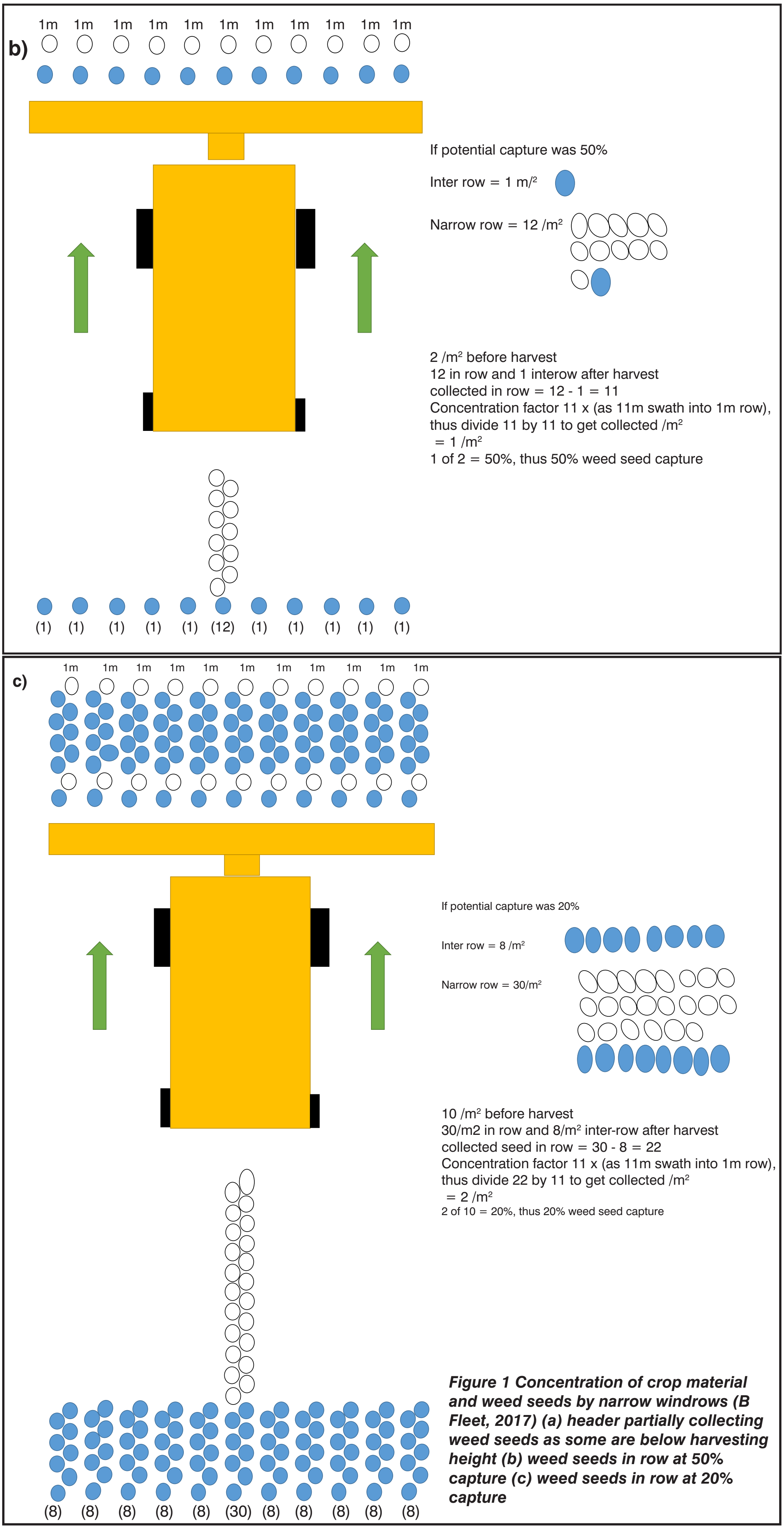


Figure 1 Concentration of crop material and weed seeds by narrow windrows (B Fleet, 2017) (a) header partially collecting weed seeds as some are below harvesting height (b) weed seeds in row at 50% capture (c) weed seeds in row at 20% capture

What happened?

Barley grass germination from in-crop paddock samples in 2015 differed from barley grass collected in a non-cropped area of the oil mallee paddock, which has not been sprayed since 2007 (Figure 2). The germination patterns indicate that by removing early germinating genotypes from the population, cropping has strongly selected for later germinating barley grass (Figure 2).

Paddocks MAC Airport and MAC S3N were windrow burnt on 31 March 2016 with 19 km/h winds in a west to north westerly direction, temperature of 25°C and relative humidity of 24%. MAC N6W canola windrows were burnt on 1 April 2016 with 15 km/h winds in a northerly direction, temperature of 27°C and relative humidity of 20%. Burning temperature remained higher than 400°C for longer than 10 seconds (Figure 3), which is the temperature required to sterilise or kill ryegrass seed (Walsh, 2007).

In the MAC Airport paddock, the crop was harvested at 25.2 cm (higher than desirable for weed seed collection) and snails were an issue. The snails moved into the windrow stubble over summer. After burning, there were 3.3 dead snails/m^2 in burnt windrows and 0.5 snails/m^2 surviving snails in nearby stubble counts.

The rotation of the paddock monitored at Carina has been; 2012 Clearfield wheat, 2013 Clearfield wheat with burnt windrows, 2014 medic brown manured for grass control, 2015 Emu Rock wheat and in 2016 ATR Stingray canola. Monitoring of grass weed numbers within windrow paddocks on EP has shown large variation in grass weed numbers (Table 1 and 2). A proportion of the weed seeds are captured by the harvester and placed into the windrow, resulting in higher weed numbers in-row than in the inter-row. A greater proportion of ryegrass seed is captured by the harvester and placed into windrows than for barley grass seed, as barley grass tends to shed prior to harvest. The initial data from chaff dumps show a greater numbers of ryegrass are being captured than barley grass (Table 1).

Weeds

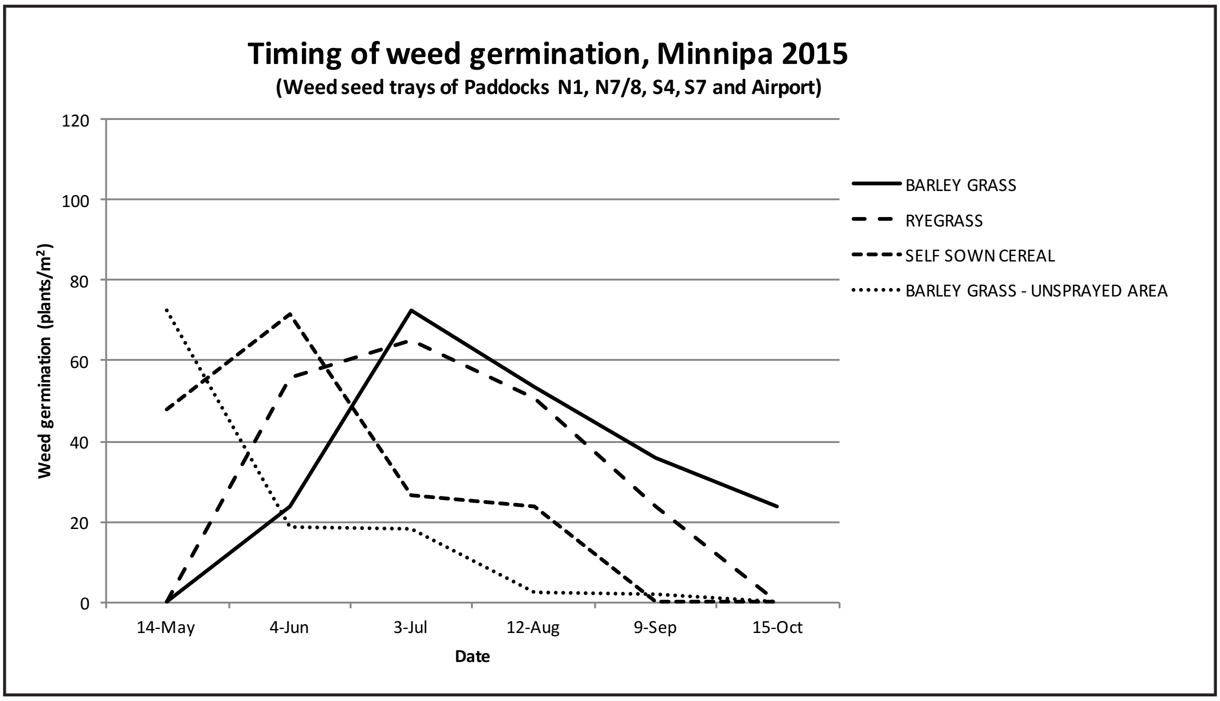


Figure 2 Weed germination patterns from in-crop soil samples taken from harvest 2014 to early 2015

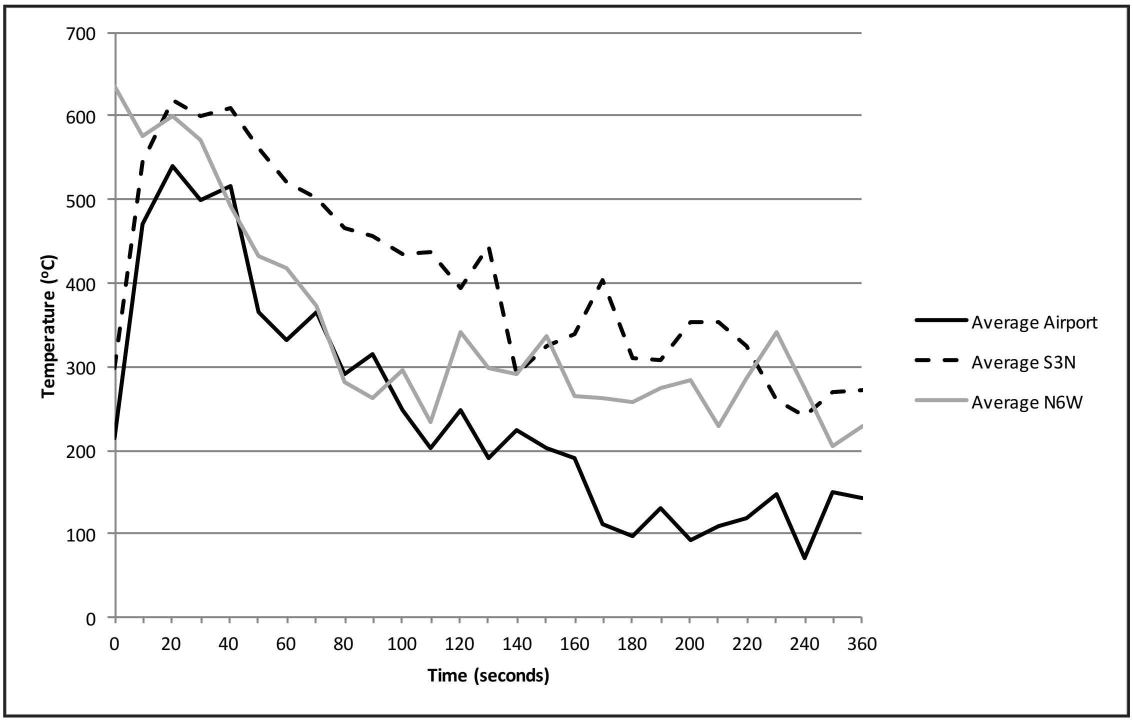


Figure 3 Burning temperatures (°C) over time (seconds) of windrows (wheat and canola), at Minnipa in March 2016

Table 1 Weed seed counts (plants/m²) from weed seed banks of harvest 2015 from upper Eyre Peninsula (Bruce Heddle's Carina paddock) (SE=standard error of sample)

Seeds/m²	Barley grass	SE	Rye grass	SE	Self-sown cereal	SE
Inter row (before burning)	28	7	83	22	4.8	2
In row before burning (soil collected before burning)	18	6	111	27	45	10
In row burnt (soil collected after burning)	6.4	2	73	22	2.4	1.3
% Reduction of weed seeds in windrow by burning	*64%*		*34%*		*95%*	
Final efficacy or overall % paddock seedbank reduction (with concentration effect of windrowing)	*0*		*1.1%*		*43%*	
Seeds/t chaff						
Windrow chaff (30 samples)	42,667	9,400	830,667	151,500	790,000	98,300
Chaff dumps (92 samples)	38,478	5,800	8,537,609	521,700	941,957	600,000

Table 2 Weed seed counts (plants/m²) from weed seed banks of harvest 2015 from lower Eyre Peninsula (SE=standard error of sample)

Paddock	2015 Rotation	Treatment	Barley grass	SE	Ryegrass	SE	Self-sown cereal	SE
80 Acre	Beans	Inter row (before burning)	0		22	7	48	9
		In row before burning (soil)	0		110	41	30	10
		In row non burnt (straw removed from 5 m row - soil collected after burning)	0		32	18	9	3
		% Reduction of seed in windrow by burning	*0*		*71%*		*70%*	
		Final efficacy or overall % paddock seedbank reduction (concentration effect of windrowing)	*0*		*20%*		*0*	
Salt Lake	Canola	Inter row (before burning)	2.4	1.8	41	12	61	16
		In row before burning (soil)	0		94	25	54	12
		In row non burnt (straw removed from 5 m row - soil collected after burning)	0		18	6	26	8
		% Reduction in windrow by burning	*0*		*81%*		*52%*	
		Final efficacy or overall % paddock seedbank reduction (concentration effect of windrowing)	*0*		*9.3%*		*0*	
N5	Canola	Paddock sample	0		17	7	40	9
Airstrip	Wheat	Paddock sample	0		14	6	129	58
Shearing Shed	Barley	Paddock sample	0		2	1	96	30
West well	Barley	Paddock sample	0		60	19	149	24

There was very little barley grass in windrows on LEP and ryegrass was the dominant grass weed. On LEP ryegrass weed seed capture was greater than upper EP (Table 2). The reduction in weed seed numbers by burning the windrow was similar on upper EP and lower EP.

What does this mean?

Continuous cropping has resulted in paddock populations of barley grass which are germinating later in the cropping season compared to the oil mallee non-cropped area at Minnipa. Be aware of grass weed germination patterns in paddocks; monitor a crop free area during the growing season to see when grass weeds are germinating.

High temperatures during narrow windrow burning are being achieved, over 400°C for longer than 50 seconds, which should provide temperatures to sterilise most weed species. Burning temperatures required to sterilise or kill other weed seeds including barley grass will be determined as part of a SAGIT-funded project with the University of Adelaide.

There is good control of weed seed achieved by narrow windrow burning when it is captured at harvest and burnt, however the inter row weed seed numbers or background weed seed population is often as high as in the windrow, especially for barley grass. Ryegrass on lower EP showed a greater reduction in overall seed bank in paddock with narrow windrows. Narrow windrow burning also reduced snail numbers.

In 2017 paddock monitoring of alternative methods to manage grass weed numbers will continue, especially for barley grass. This will include early swathing of wheat with high barley grass numbers to capture barley grass seed within the windrow.

Acknowledgements

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