WEED CONTROL USING NARROW WINDROWS VS EMAR CHAFF DECK

GRDC project CWF00020 – Overdependence on Agrochemicals

KEY MESSAGES

- Concentrating the header trash into rows prevents spreading of weed seeds across the paddock. Additionally, it allows for site specific weed management and weed seed destruction through strategic burning.
- A low cutting height (10cm) can allow greater than 95% weed seed capture and placement into rows. However this harvest height can impact harvest cost, speed and efficiency.

Background

CWFS undertook a trial at Northparkes Mine that investigated the impact that two different harvest weed seed control (HWSC) methods – narrow windrowing of header trash and the Esperance Mobile Ag Repairs (EMAR) chaff deck – have on reducing the weed burden in the following crop.

Narrow windrow burning is the process where a chute is mounted to the rear of the harvester and concentrates the trash into a narrow windrow of approx. 500-600 mm wide (Walsh 2014) (Figure 2). The trash rows are then burnt when weather conditions are suitable to destroy the weed seeds.

EMAR chaff deck (designed in WA) is set-up to drop the chaff onto the tramlines of a controlled traffic farming system, where it is left to rot. The concept behind this process is that the compacted wheel tracks make a hostile growing environment for the germinating weeds. This is achieved by increased competition for light and nutrients, increased waterlogging, and in wet years an increase in trash decomposition rotting the weed seeds within the rows. It also allows for shielded spraying of the trash piles should the weeds germinate which is considered a saving in chemical compared to spraying the entire paddock.

Agronomic issues

Weeds cost Australian agriculture more than $4 billion per year in loss of income and cost of control (DAFF 2012). The overall cost of weeds to Australian grain growers is estimated to be $3,300 million p.a. attributing to 2.76 million tonnes of grain lost due to weeds (Llewellyn et al 2016).

Herbicide resistant ryegrass (Lolium rigidum) has been ranked 1st nationally as the most costly to manage herbicide resistant weed with $103.2 million spent in extra herbicide (Llewellyn et al 2016). The rise of herbicide resistance to a number of modes of action mean that farmers are now required to use increasingly more expensive herbicides, or alternative methods such as HWSC to manage weeds.

The simultaneous maturity of crops and the weeds that infest them can result in effective harvest then redistribution of weed seeds across the paddock (Walsh and Powles 2014). Collection of these weed seeds and then their subsequent destruction has been identified as providing a cost effective means of controlling weeds by reducing the weed seed bank and addressing herbicide resistance, resulting in a reduction of grower reliance upon agrochemicals. Weeds such as annual ryegrass (ARG) (Lolium rigidum), wild radish (Raphanus raphanistrum), brome grass (Bromus spp.) and wild oats (Avena spp.) have been found to have high seed retention levels at time of crop harvest (Walsh and Powles 2014) which makes them suitable for HWSC. Options for HWSC include; windrow burning, chaff carts, bale direct, the Harrington Seed Destructor (Weedsmart 2013) and chaff tramlining with an EMAR chaff deck.

The GRDC undertook a national review in 2014 into weeds which was able to gauge the adoption of HWSC in Central NSW (Bogan, Cobar, Lachlan, Carrathool, Murray, Wakool, Balranald, Wentworth, Berrigan, Deniliquin and Jerilderie districts) (Llewellyn et al 2016). It found that technologies such as chaff tramlining, chaff carts, bale direct and Harrington Seed Destructor were very low in potential uptake in the next 5 years (2-14%) (Llewellyn et al 2016). Windrow burning was identified as the highest potential HWSC adoption with 29% of growers feeling they would adopt the technology in the next 5 years (Llewellyn et al 2016). This response is lower than the Southern region average of 47% of growers looking to adopt windrow burning in the next 5 years, but similar in response to the other 4 technologies stated above (6-15%) (Llewellyn et al 2016).

Within the CWFS region of NSW, HWSC may be considered to be in its "infancy" with limited numbers of producers identified as using chaff carts or the Harrington Seed Destructor due to either their initial cost of purchase or the use of contractors who do not provide these options at harvest. In comparison, windrow burning has been widely adopted by growers in the Central West to manage herbicide resistant ARG. The EMAR chaff deck is an emerging product which has the potential to provide a similar HWSC to windrow burning but without the risk that fire holds. With HWSC being proven to be highly successful in Western Australia in reducing the weed pressure and reliance on herbicides (Walsh and Powles 2014) (Walsh, Newman and Powles 2013) these methods of weed control are becoming more common place in the Eastern states.

Trial design

Three paddocks were identified, one harvested with the EMAR chaff deck, one with narrow windrows and a control which was also narrow windrowed (2016 results not published).

Prior to harvest 2015, data was collected to determine the degree of weed seed capture at harvest and to gauge weed populations in the trial paddocks prior to treatment applications. This was measured by collecting weed seed above and below a low harvesting cutting height (10cm) and weed seeds already shed on the ground. Trash treatments were imposed during harvest in 2015. Post-harvest the narrow windrow and EMAR chaff deck trash lines were sampled at 15 random sites per paddock. This was to determine the bulk density of the trash and total crop residue (results not shown). Moisture under the trash lines and in the standing stubble was measured at 15 random points per paddock post-harvest (7/12/15), pre-trash line burning (23/2/16) and post trash burning pre-sowing (4/4/16). Trash lines were burnt by the farm manager when conditions were suitable in late March/early April. Due to very high stubble loads the fires got away and burnt most of the stubble within the paddocks. Weed counts were undertaken at 10 random points per paddock post-autumn rains in May and later on in the season in August.

Note: Due to previous work undertaken by Northparkes Mines, they identified that conventional trash management was increasing weed pressure in their paddocks. For this reason they no-longer use this method at harvest and all paddocks in 2015 were either harvested with the addition of narrow windrows or using the EMAR chaff deck. The control paddock was narrow windrowed in 2015 and burnt 2016 and for this reason weed data will not be reported for 2016. For weed control Northparkes Mine include a field pea crop in their rotation that is brown manured prior to weed seed set. Trial paddocks were sown to Morgan field peas in 2016 preventing the collection of harvest data from those paddocks. Alternative paddocks that were harvested with the EMAR chaff deck and narrow windrowed in 2015 were identified as replacement paddocks and 2016 harvest data was collected from them. Sampling will continue in 2017 in the original trial paddocks to measure the success of HWSC and brown manuring on weed control.

TABLE 1 Weed seeds above 10cm harvest height (seeds/m^2)

Paddock treatments	Weed	Count
Control	ARG	1049
	Black Oats	225
	Wheat	807
EMAR chaff deck	ARG	653
	Barrel Medic	33
	Black Oats	277
	Phalaris	375
Narrow windrow	ARG	1374
	Black Oats	256

TABLE 2 Weed seeds below 10cm harvest height and on the ground (seeds/m^2)

Paddock treatments	Weed	Count
Control	ARG	43
EMAR chaff deck	Black Oats	3
	ARG	33
Narrow windrow	Black Oats	3
	ARG	51

FIGURE 1· EMAR chaff deck in action harvest 2015

FIGURE 2· Setup for narrow windrows harvest 2015

FIGURE 3· Narrow windrows post-harvest 2015

FIGURE 4· Narrow windrows pre-burn 2016

Weed seed collection pre-harvest 2015

The degree of HWSC was measured by collecting weed seeds retained in the plant heads above 10cm harvest height (Table 1) and those still retained in the plant heads below 10cm harvest height plus those already shed on the ground (Table 2). These seed numbers represent the weed seed numbers in the trial paddocks prior to treatment application. Annual ryegrass (ARG) had the highest weed seed numbers across all paddocks, with phalaris and black oats having the second highest weed seed numbers. Whilst there were some ARG and black oat seeds escaping harvest (Table 2), more than 95% of weed seeds were being captured to allow destruction by burning or decomposition (Table 1).

Soil moisture

Figure 5 shows the difference in moisture under the trash lines compared to the standing stubble of the control paddock post-harvest, pre-trash burning and post- trash burning. Any difference in soil moisture between the EMAR chaff deck and narrow windrows that were seen post-harvest and pre-burning are almost equal post-burn pre-sow. This difference in soil moisture has had an effect on the 2016 field pea crop with clear growth responses from the crop growing on stored moisture under the 2015 trash lines (Figure 6 and Figure 7).

Weed counts 2016

Weed counts were undertaken in the trial paddocks in May (Figure 8) and August (Figure 9) to determine the effect of narrow windrows and EMAR chaff deck on weed populations. The sample points in the paddocks were random and included a mix of on and off the trash lines. The control paddock was sampled, however it had also been narrow windrowed at harvest 2015 and will not be reported at this time. Small broadleaf weeds and ARG were the most prominent weeds at the time of the May sampling with all weeds having a population of more than 50 plants/m^2 (Figure 8). At the second weed sampling in August, all weeds averaged fewer than 10 plants/m2 (Figure 9).

Weed seed collection prior to 2016 harvest

Due to the field pea crop being sown in the original trial paddocks two alternative paddocks were identified to enable the continuation of the data collection. Both alternative paddocks have had similar treatments with the only difference being the use of the EMAR chaff deck or narrow windrows at 2015 harvest. The most prominent weeds were toad rush (Juncus bufonius), phalaris (Phalaris aquatic), ARG and black oats and all were still green apart from the toadrush. Toad rush had the highest weed seed count with almost all of the seed existing below 10cm avoiding harvest capture (Table 4). The wet conditions that were experienced during 2016 would have favoured toad rush which thrive in waterlogged soils. In drier years this weed may not be a problem. Due to planned harvest of those paddocks approx. 1 week post our weed sampling it would be expected that weed seeds above 10cm would be captured by harvest to allow for subsequent destruction. The two paddocks used for 2016 harvest data were harvested with the aid of the EMAR chaff deck and will be sown to field peas 2017.

Paddock assessment post brown-manuring

Use of double spraying in both directions and the use of a follow up spray has provided a good weed control to the paddock. Upon assessment of weed seed heads the herbicide has been well timed preventing the successful seed establishment of the ARG and black oats. Monitoring of these paddocks will commence post-autumn rains 2017.

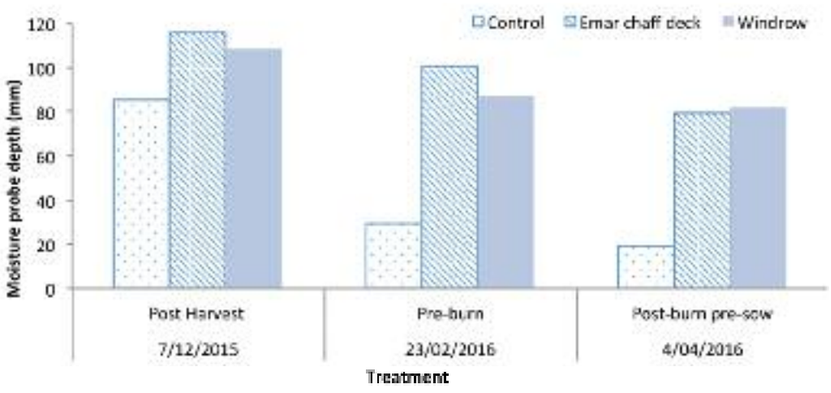

FIGURE 5 Moisture probe depth under trash lines and off trash lines (control) post-harvest, pre-trash burning and post-burning pre-sowing.

FIGURE 6 Field pea growth response to moisture 18/5/16

FIGURE 7 Field pea growth response to moisture 15/6/16

Discussion

The trial demonstrated some key points regarding weed seed capture as a component of integrated weed management.

- HWSC methods are a useful strategy to reduce the spread of weeds across the paddock where weeds have escaped herbicide control during the growing season and have made it to maturity.
- A short harvesting height (10cm) allowed for greater than 95% weed seed capture during 2015 harvest. Other work undertaken by Walsh and Powles (2014) found that 80% or more ARG, wild radish, brome grass and black oats seeds were retained at 15cm harvest height at time of wheat crop maturity.
- The strong growth response in the field peas, thought to be a response to higher soil moisture under the trash lines, led to greater crop competition and increased weed suppression, resulting in fewer than 10 ARG and black oat plants/m2 at the August 2016 assessment.
- Implementing an HWSC method such as placing the chaff into the wheel tracks using a chaff deck allows for the benefits of weed seed capture without the risk of fire that narrow windrow burning can cause.
- Care must be taken so that one weed control tool is not relied on too heavily, allowing weeds to form a resistance to control. Effective weed management revolves around using multiple control tools that have different modes of action such as rotating herbicide groups, using strategic cultivation or stubble burning, seed removal such as bailing or seed destruction such as the Integrated Harrington Seed Destructor (iHSD) and narrow windrow burning etc. that slow the weeds ability to form resistance to control.
- 2016 harvest for Northparkes Mine was planned to include both narrow windrow burning in the canola and chaff tramlining in most of the cereal crops to reduce the fire risk.

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TABLE 3 Weed seeds above 10cm harvest height (seeds/m^2)

Paddock treatments	Weed	Count
EMAR chaff deck	Phalaris	5 (seed heads)
	Toad Rush	64
Narrow windrow	Black Oats	116
	Toad Rush	222

TABLE 4 Weed seeds below 10cm harvest height and on the ground (seeds/m^2)

Paddock treatments	Weed	Count
EMAR chaff deck	Toad Rush	410
Narrow windrow	Toad Rush	1001

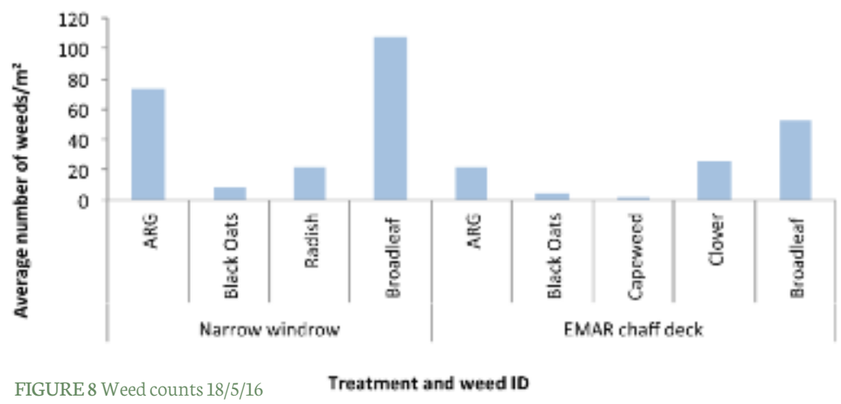

FIGURE 8 Weed counts 18/5/16

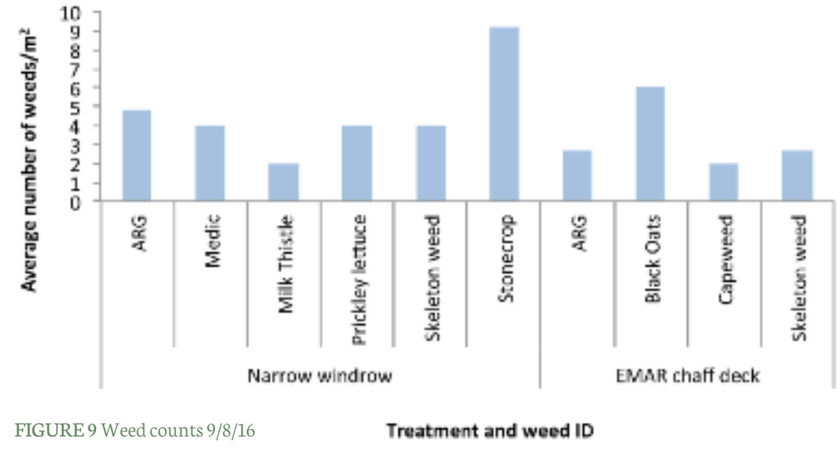

FIGURE 9 Weed counts 9/8/16