Harvest weed seed control – narrow windrow burning paddock case studies

Sam Kleemann[1], Sarah Noack[2], Peter Hooper[2], Gurjeet Gill[1] & Chris Preston[1]
School of Agriculture, Food & Wine, The University of Adelaide[1], Hart Field-Site Group[2]

Key findings

- Narrow windrow burning can be an effective tactic against ryegrass provided:
  1) weed seeds are captured and concentrated at swathing & harvest
  2) the burn heat and duration are enough to kill weed seeds.
- Annual ryegrass control in canola was more variable than last season with 37-86% control of the seed captured and concentration in the windrow. Higher control (86-93%) was achieved for wheat residues concentrated into narrow windrows.

Background

Narrow windrow burning is a practice being adopted by growers across the Mid North to assist in the management of herbicide resistant ryegrass. It is a simple and low cost approach, which involves concentrating chaff and straw residues into a 50-100 cm windrow. If implemented correctly, this technique can provide high levels of ryegrass seed control (>95%). Research from Western Australia (Walsh & Newman 2007) has shown that a minimum temperature of 400°C is required for at least 10 seconds to kill ryegrass seed. To achieve this, appropriate conditions (temperature, wind speeds, humidity etc.) and fuel load is required.

The aim of this study was to assess the effectiveness of narrow windrow burning practices in the Mid North as a late weed seed control tactic against ryegrass in canola and wheat.

How was it done?

The study involved sampling several field sites of canola (n=5) and wheat (n=2) in the Mid North of SA where growers had concentrated stubble and chaff residues at harvest into narrow windrows for burning. Prior the windrows being burnt, stubble cutting height and windrow width (cm) were determined. Information was also collected to include: variety, swath & harvest date, herbicide management, swath width and burn date.

A 5 m section of chaff was protected from burning by removing a small section of windrow at either end to represent an unburnt area. After the narrow windrows were burnt, 10 soil samples (7 cm diameter core x depth 10 cm) were taken from four replicates per site in the following three locations:

1) Burnt section of windrow (centre & edge of windrow)
2) Sample within 5 m on the unburnt section
3) Inter-row

These 10 soil samples were combined to make one bulk sample per treatment. The soil samples were then transferred to shallow trays and germinating ryegrass assessed at regular intervals. Census of ryegrass ceased when no new seedlings emerged over a 3-week period. Ryegrass seed number was determined by the total number of ryegrass seedlings to germinate, and the total area sampled. Sampling from the inter-row (i.e. area between windrows) was undertaken to provide an estimate of the amount of ryegrass seed accumulation in the narrow windrow.

Table 1. Cutting height of canola and wheat stubble, and estimated ryegrass accumulation into narrow windrows at field sites across the Mid North of SA.

Crop phase (Site)	Stubble cutting height (cm)	Estimated ryegrass accumulation
Canola		
NWB_01	30	Low
NWB_02	44	Low
NWB_03	50	Low
NWB_06	27	High
NWB_07	50	High
Wheat		
NWB_04	11	High
NWB_05	21	Low

Low = less than 8-fold increase in ryegrass in windrow compared to the inter-row.

Results and discussion

The effectiveness of narrow windrow burning is governed by the amount of weed seed captured by swathing or harvest. Often collection of ryegrass seed is better compared to other weed species. (eg. brome grass, barley grass & wild oats) which have a tendency to shed seeds early, well before harvest. However, ryegrass seed capture can be compromised, particularly with lodging (more difficult to feed into the machine front) or delays to swathing and harvest, by which time much of the ryegrass seed has shed onto the soil surface.

The capture and accumulation of ryegrass seed in narrow windrows appeared to be far more variable this season than last. Of the 7 sites assessed, only at 3 sites (2 canola, 1 wheat) was sufficient seed concentrated (>8-fold increase) into the windrow (Table 1). Stubble cutting height or timing of swathing/harvest (data not shown) did not consistently influence seed capture. This is in contrast to results from last season, where there appeared to be a direct correlation between cutting height and the amount of seed captured. There are a number of factors which effect the height and maturity of ryegrass in the crop canopy (eg. crop competition, lodging). The results from this season highlights the need to look at the position and maturity of ryegrass before swathing, otherwise a lot of time can be placed on burning windrows which have low levels of seed.

Table 2. Ryegrass (seeds/m^2 & % control) following burning of canola and wheat residue concentrated into narrow windrows at field sites across the Mid North of SA.

Crop phase (Site)	Windrow treatment			*Ryegrass control (captured seed only)
	Unburnt	Burnt centre	Burnt edge	
	ryegrass seeds (no./m^2)			(%)
Canola				
NWB_01	546	221	279	54
NWB_02	857	312	611	47
NWB_03	1344	927	766	37
NWB_06	36225	5897	4858	86
NWB_07	63274	21563	-	66
Wheat				
NWB_04	63227	6408	11080	86
NWB_05	9041	253	961	93

*Percent control across entire windrow (i.e. average of burnt centre & burnt edge).

Of the ryegrass seed captured and concentrated into narrow windrows in canola, only at 1 of the 5 sites was a high level of seed control achieved (86%; Table 2). Control was variable in canola (37-86%) indicating that temperatures at the soil surface during burning were generally insufficient and did not reach the required 400°C for at least 10 seconds to kill seeds (Walsh & Newman 2007). This was much lower than the levels observed in 2014 where control was greater than 90%. In contrast, burning was far more effective on ryegrass (86-93% control) in wheat, which can be attributed to the higher fuel loads (40 versus 20 t/ha).

Often overlooked is the amount of seed left behind after burning, creating concentrated strips of ryegrass (Figure 1) on the edge of burnt rows. This was clearly evident in a number of paddocks sampled in this study where even though 80% of seed had been killed in the middle of the windrow a large amount of viable seed remained in the windrow (>5000 seed/m^2) or on the windrow edge (>10,000 seeds/m^2; Table 2.). Achieving effective control in these areas can be difficult and often lead to high weed infestations if not managed correctly. Generally, these sites occurred where growers had waited for fire ban to end (rather than gaining a permit) and burnt at the beginning of May after many areas received >20 mm rainfall. There was insufficient time for the windrow to dry before seeding and these moist conditions led to a poorer quality burns.

Figure 1. Ryegrass germination (>1000 plants/m^2) on the unburnt edge of a narrow windrow of canola.

Photo (above): Soil cores from paddock surveys are spread in trays and germinating ryegrass plants counted over six weeks.

There are other disadvantages to narrow windrow burning which can include unburnt residue and associated trash flow issues at sowing, risk of burning the entire field leading to increased erosion (less of a problem with narrow than conventional windrows), redistribution of nutrients such as potassium in windrow area, and loss of important nutrients such as nitrogen and sulphur lost in smoke.

Summary / implications

Narrow windrow burning can be an effective tactic for late seed set control of ryegrass provided weeds seeds can be captured and concentrated into narrow windrow at swathing or harvest. Cutting lower and earlier before the seeds have had a chance to shed is likely to improve collection. However, concentrating seeds in a narrow windrow does not automatically guarantee control; equally important is to ensure that a hot and long burn is attained to provide best chance of killing most ryegrass seed.

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References

Walsh, M. and Newman, P. (2007) Burning narrow windrows for weed seed destruction. Field Crops Research 104, 24-30

Photo (left): Narrow windrow burning in wheat case study.

Photo (left): Narrow windrow burning in canola.