

Narrow Windrow Burning

grass
roots
· agronomy ·

in southern NSW

...the good the bad
and the ugly



**with funding from GRDC through the
Southern Agribusiness Trial Extension Network
2014/15**

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back-ground

In 2014, Grassroots Agronomy received funding through the GRDC Agribusiness Trial Extension Network initiative to have a closer look at Narrow Windrow Burning (NWB) in southern NSW. There were already a few early adopters in the region, primarily due to the successes being achieved in Western Australia where NWB is commonly used to manage weed seeds at harvest. Although the data on weed reduction from WA was clear (99% control of annual ryegrass and wild radish seeds collected at harvest, AHRI 2007), there was still some hesitation regarding the practicalities of NWB in higher yielding systems of southern NSW.

We therefore set about gathering as much information as we could over a 1-year period from farmers who were prepared to 'give it a go'. From a 'Show & Tell' meeting focused on chute design, paddock-scale trials, Twitter discussions and debates, video case studies and a survey, the message about NWB in southern NSW has been made loud and clear... with rapid uptake.

Is it the answer to harvest weed seed management in southern NSW?

Growers have shown that it definitely works (although heavy cereal stubbles are risky) and apart from labour costs

it's inexpensive. However... time commitments to burn, fire restrictions, smoke levels and reduced ground cover are all conflicting factors.

What is clear is that harvest weed seed control deserves to be given priority status in a weed management program. Many growers in southern NSW are already looking closely at alternative techniques including chaff decks for controlled traffic systems, chaff carts, seed destructors integrated into headers and even strategic hay cutting. There's a lot happening in this space and certainly something we'll be following closely, particularly via the great information being generated through AHRI (Australian Herbicide Resistance Initiative) and the WeedSmart program.

Meanwhile, we've highlighted some of our experiences with NWB in southern NSW in this booklet; don't forget to click on the links for video case studies and additional information.

Regards,

Kirrily & Greg Condon
Grassroots Agronomy



@grassrootsag

www.grassrootsag.com.au



NWB

survey snapshot

A brief survey of NWB practices was distributed via Twitter in March 2015. There were 26 respondents, with the majority from NSW, but a few were from Vic, SA and WA. Here's what they had to say:

- **77% of respondents said they had narrow windrow burnt canola;** 42% wheat, 27% lupins, 23% barley, 4% field peas, faba beans and lentils.
- **50% of respondents were narrow windrow burning for the first time;** 15% had been NWB'ing for 2 years and 35% for 3 or more years.
- **48% of narrow windrow chutes were for John Deere headers,** 36% Case, 12%, Claas and 8% New Holland.
- **69% had narrow windrow chutes with openings between 500 and 600mm;** 23% were less than 500mm, 1 was greater than 600mm and 1 had an adjustable width.
- 31% said they harvested at beer can height (~15cm) for narrow windrowing; **58% harvested higher than 15cm,** 12% harvested lower.
- **96% of respondents were targeting annual ryegrass** and 35% wild radish; other target weeds included brome grass, wild oats and volunteer canola or wheat.
- **73% of respondents were able to burn windrows in March,** 23% in April and 1 in February.
- **58% of respondents used a drip torch to light windrows;** 30% used a ute-mounted Accufire, 3 made their own lighters.
- **96% of respondents said they would do NWB again.**

chute shape

One of the main advantages of NWB is that it is cheap to set up, requiring just a bit of thought and some welding skills. The hardest part is getting the chute design right.

With many first time NWB-ers in the region, a 'Show & Tell' day was held for growers in August 2014 to bring along their narrow windrow chutes, explaining the reasoning behind their designs and experiences with windrow burning. Hear what they had to say by clicking the yellow dot below.

click to hear these growers talk about chute designs in 'Show & Tell' on YouTube

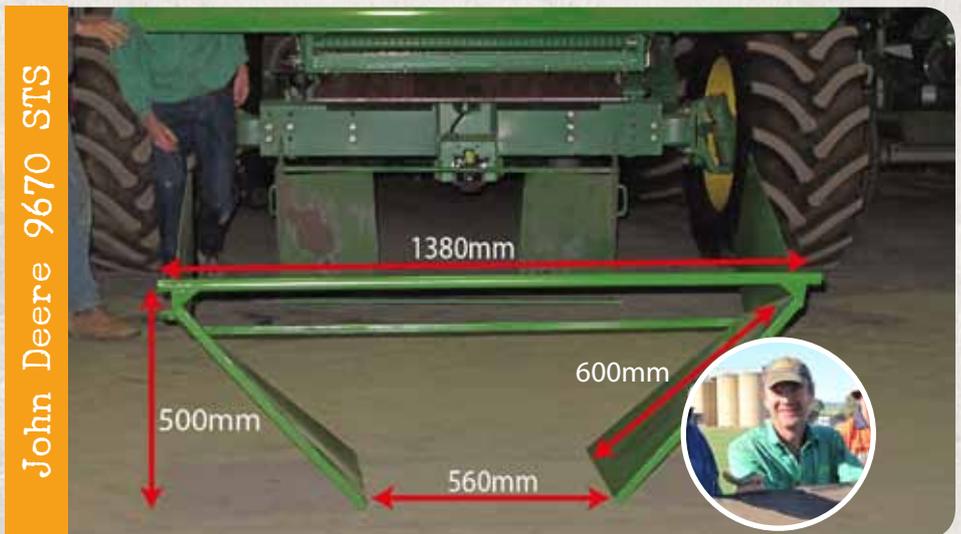
As growers have gained more confidence with NWB, chute modifications have been made. Many have been successfully reduced to around 500mm to create a tighter windrow without creating blockages. Some growers are on their 2nd or 3rd model to produce a lighter chute that is quick and easy to get on and off. Several have added rubber strips either side of the chute to capture more material, but many of these have since been removed.

Rod Messina and Doug Smith from WA are pioneers of NWB and their designs and experiences can be found on the AHRI website (click here).



John Deere 9750

Murray Scholz, Culcairn [@ScholzFarming](#)



John Deere 9670 STS

Warwick Holding, Yerong Creek [@Pontaragrain](#)



Claas 740

Rob Gollasch, Wallacetown [@RobertGollasch](#)

go low

Harvest height is a critical component of the NWB system. The rule of thumb is 'beer can' height, or approximately 15cm, to ensure the majority of ryegrass or wild radish seed heads are captured.

Unfortunately this can reduce harvest efficiency, with low cutting height reducing harvest speed and in some cases, increasing fuel use compared with standard straw spreaders (see 'NWB in wheat paddock demonstration trial pg. 8).

Cutting low is relatively easy in pulses, but can be difficult in bulkier crops such as hybrid canola. Regardless of crop type, it is VERY important to back the header up immediately after stopping to prevent blockages!

Harvesting low also reduces the chance of fire escapes when burning the windrows, particularly if the harvest height is less than the row spacing.

Remember to harvest two or three laps around the outside of the paddock for a firebreak.

Research from AHRI has shown NWB can capture 70% of annual ryegrass and wild radish seeds, with 99% of these killed when burnt. (Walsh & Newman, 2007)



Alexander Ingold, Dirnaseer @AlexanderIngold



David Fox, Marrar Daniel: @dfox05



Simon & James Finlay, Holbrook

light it up

Burning efficiently and effectively is the hardest part of the NWB process. It is time consuming and the logistics need to be considered early on in the season. Choosing the right firelighter can make a big difference to the time involved, operator comfort and to the result achieved.

Most growers in the region have started out using a hand-held drip torch carried on a quad/motor bike (handy for sharp lupin stubbles) or out the ute window, but 'dead arm' syndrome soon sets in.

Many have now progressed to a ute-mounted firelighter (such as the Accu-fire) which can be controlled from inside the cab and allows large areas to be covered at speeds up to 40 kph.

However driving across windrows is not a comfortable experience, not to mention the random traffic issue for those on controlled traffic systems. Warwick Holding from Yerong Creek has engineered a 'CTF lighter' that has 3 burners mounted on a 36m bar, allowing 3 windrows to be lit at once while staying on permanent tracks. Controlled from the tractor cab, the rows are ignited every 100m, covering about 60 ha/hr.

Weather conditions are critical to a good burn. The PocketFire app for smart phones is a handy tool to assess fire conditions based on wind speed, direction, temperature and humidity.

While March conditions are generally ideal for burning, fire restrictions in some areas mean burning can't start until April.

hand-held drip torch



ute-mounted lighter



'CTF lighter'



let it burn

This not only reduces the time available to have the windrows burnt before sowing, but they are also less likely to dry out after rain events. Fire restrictions need to be taken into account when deciding how much area to windrow.

When burning, the outside laps are lit first as a firebreak. These can usually be lit continuously along the row, but several growers have commented this results in a rapid burn which doesn't get hot enough to kill the weed seeds. Lighting them approximately every 20m may produce a slower, hotter burn.

The rest of the paddock can then be lit by 'zig-zagging' between windrows. The distance between ignition points along the same row can be shortened depending on the time of day. So the distance could be greater (200-400m) when burning commences in the afternoon, but reduced in the evening to give the rows time to burn out before moisture sets in.

There have also been issues with torches dripping after they have been shut off, lighting up stubble between the windrows. If this is the case, it may help to drive up the row for 3-4m after it's lit to get rid of the drips, before driving across to the next row.

Wind plays an important role in the success of the burn, with 'still' days often resulting in an incomplete burn. A **light** cross wind helps to move the fire along the windrow, but slowly enough to burn to the soil surface. Too much wind causes the fire to move quickly without getting hot enough to kill weed seeds.

NWB in wheat at Marrar



The outside rows are lit first. Some growers have commented that lighting these rows with the burner on continuously can make them burn too fast.

NWB in wheat at Marrar



The rest of the paddock can be lit by driving at right angles to the windrows or in a zigzag pattern.

NWB in wheat at Marrar



This wheat windrow (from the outside lap in the top photo) was lit on the opposite side and was still burning right through 40 minutes later.

a few tips

- Lighting the windrow on the side facing downwind helps to produce a slower, hotter burn back over the top. Lighting on the upwind side can result in the fire burning too quickly across the top, leaving the middle unburnt. You can see this in the 'NWB experiences in southern NSW' video on YouTube.
- For higher yielding cereal crops, burn in the morning when the straw is still damp (March/April).
- If windrows get wet, wait at least two weeks before burning and make sure summer weeds have been controlled.
- If possible, avoid stubble grazing in paddocks that have been narrow windrowed. Stock tend to kick the windrows around, increasing the risk of fire escape, but also creating tracks which can act as annoying firebreaks in the middle of a windrow.
- With closer settlement in southern NSW, health risks associated with smoke inhalation need to be considered.

a hot, slow burn is important:
 above 400 deg.C for 10 secs kills ryegrass;
 above 500 deg.C kills wild radish

lighting windrow on downwind side



With a light cross wind, this wheat windrow was lit on the side facing downwind in the foreground, but on the upwind side at the back. Lighting downwind resulted in a slower, hotter burn.

raking firebreaks in heavy stubble



Firebreaks were created either side of the windrow in this CTF system using hay rake wheels mounted on an old linkage tiller frame. (Alex Ingold, Dirnaseer NSW @AlexanderIngold)

sheep tracks making firebreaks



Sheep tracks in this lupin paddock created mini firebreaks which meant the windrows had to be re-lit.

paddock demonstration trials

NWB in wheat

Canola and pulses are the preferred crops for NWB, but experiences in southern NSW show it can be done in wheat crops above 3 t/ha. What impact does it have on harvest efficiency?

Two paddock-scale demonstration trials were established in wheat crops at Yerong Creek and Marrar in 2014. Both sites had two paddock length strips harvested at 15cm and 30cm, comparing the narrow windrow chute and straw spreaders at each height. The sites were followed through to burning in autumn 2015.

So what effect did narrow windrowing have on harvest efficiency?

Narrow windrowing at 15cm slowed harvest speed on both headers (see below), compared with harvesting at 30cm and spreading the straw.

This was particularly evident on the Case, where speed decreased by 40% and fuel use increased by 30% when narrow windrowing, primarily due to the low cutting height and increased through-put of material.

The John Deere recorded a 20% speed decrease while narrow windrowing compared with spreading at 30cm, although fuel use remained unaffected. The power requirements of the straw chopper and PowerCast spreaders meant the same fuel use was

required to harvest low with the chute on as to harvest high with the PowerCast in operation.

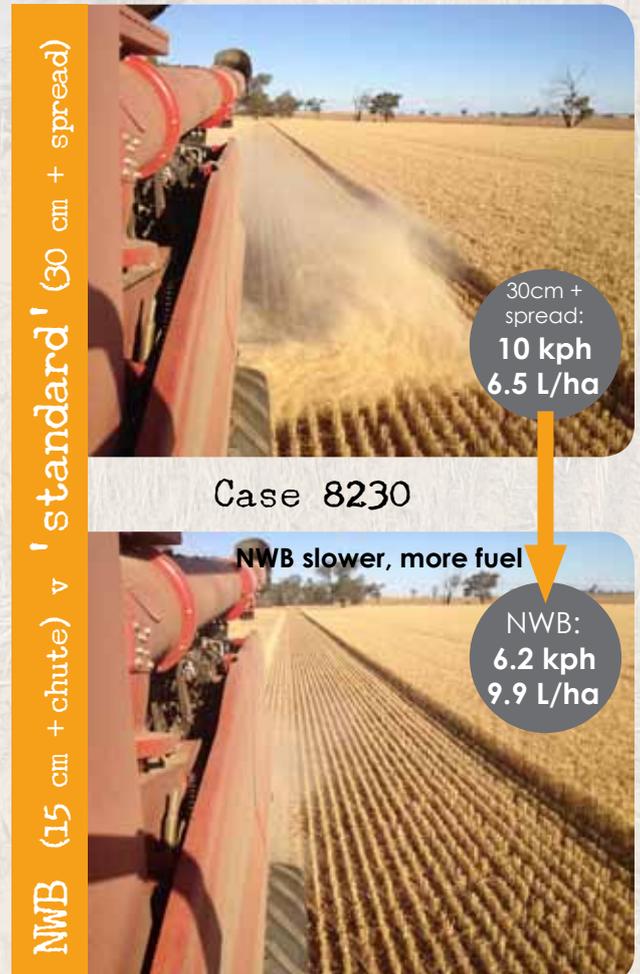
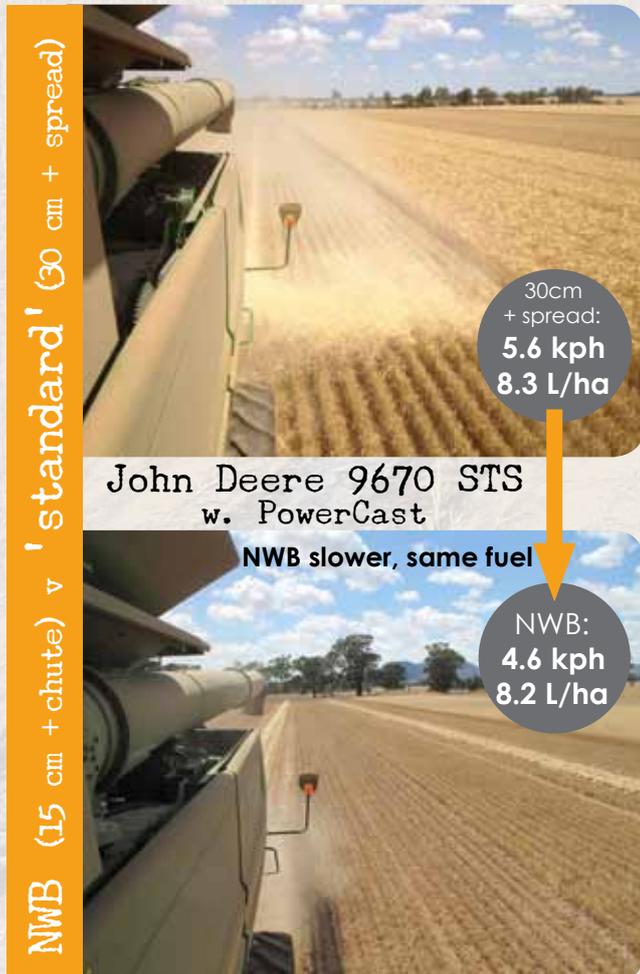
Narrow windrowing at 15cm v straw spreaders at 15cm:

Harvesting at 15cm, the Case used slightly less fuel with the (standard) spreaders on compared with the chute. On the John Deere, fuel use was 15% higher with the Powercast spreaders on compared with the chute.

Harvesting high with straw spreaders:

With the spreaders on, increasing harvest height improved harvest efficiency by reducing fuel use and increasing speed, as follows:

- **Case** 15cm to 30cm: 35% less fuel, 3.7 kph faster
- **JD** 15cm to 30cm: 15% less fuel, 1.2 kph faster
- **JD** 15cm to 40cm: 45% less fuel, 2.2 kph faster



NWB in wheat cont.

How difficult was the wheat to windrow and burn?

Wheat was windrowed through both chutes (560 mm and 650 mm wide) without any blockages. The whole paddock was successfully windrow burnt at the Marrar site, while only the two demonstration windrows were burnt at the Yerong Creek site:

Gregory wheat 3.3 t/ha

Warwick & Di Holding
Yerong Creek

click to see this paddock in NWB in southern NSW on YouTube

- 1. Narrow windrowed** through a 560mm wide chute on a John Deere 9670 without blockages.
- 2. Windrows were burnt** 1-April. The trial strips were the only narrow windrows in the paddock so were lit along the row with a drip torch. Bare CTF tramlines provided an effective firebreak.



With a light cross-wind, rows were lit on the downwind side and burnt back slowly over the top. For comparison, a section of the row was lit on the upwind side which burnt too quickly back across the top - this can be seen on the 'NWB experiences' video ([click yellow dot above](#)).

The video also shows what happened when the windrow harvested at 30cm was lit - as expected the fire burnt too quickly and spread outside the windrow.

- 3. Ryegrass** numbers 3 weeks after burning ranged from 2-9 plants/m².
- 4. Lupins** were sown in 2015, with pre-emergent applications of simazine and trifluralin. Clethodim and butoxydim were applied post-emergence. Ryegrass survivors will be crop-topped at maturity.

Carinya wheat 3.7 t/ha

David, Cathie
& Daniel Fox, Marrar

click to hear David in Chute design Show & Tell on YouTube

- 1. Narrow windrowed** through a 650mm wide chute on a Case 8230 without blockages.
- 2. Windrows were burnt** 31-March. With a light wind blowing along the windrows, the two outside laps were lit first, followed by each windrow starting from the downwind end of the paddock. The fire travelled slowly back along the windrows against the wind direction, with only a few minor escapes.
- 3. Ryegrass** numbers 3 weeks after burning were negligible across the paddock.
- 4. Barley** was sown in 2015 at 225 mm row spacing and 150 plants/m² for crop competition.



The Fox family have been successfully narrow windrow burning cereal crops for a few years, but say it's important to cut short and avoid free filling varieties such as Whistler and Wedgetail.

While underlying stubble increases the risk of fire escape, they have been able to windrow burn a wheat paddock on barley stubble by lighting it up the morning after 2mm of rain, when the stubble was still 'doughy'.

NWB in canola and lupins

paddock demonstration trials

Canola and pulses present excellent opportunities to manage ryegrass numbers through a combination of NWB, crop-topping and a wider range of pre and post-emergent herbicides. Where ryegrass pressure is high, double-breaks crops (pulse followed by canola) provide double the opportunity to reduce ryegrass numbers.

The following demonstration trials - canola at Yerong Creek and narrowleaf lupins at Marrar, were monitored through the 'weed management cycle' in 2014-15.

The paddock at Yerong Creek which Warwick & Di Holding share-farm had been a problem ryegrass paddock, but numbers have been steadily decreasing over time with careful management.

The paddock was sown to TT canola in 2014 and an area was used for a demonstration trial, comparing narrow windrow burning with crop-topping for weed seed management. Using 12m CTF runs, four paddock length strips were included in the demonstration:

- crop topping
- NWB
- crop topping + NWB
- nil (no weed seed control)

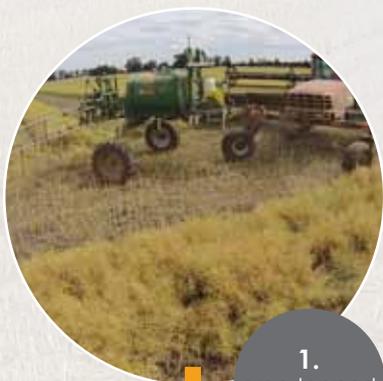
The trial is summarised below, but has also been included in the 'NWB Experiences in Southern NSW' video (click on yellow dot).

With minimal ryegrass numbers, the paddock was sown to wheat in 2015.

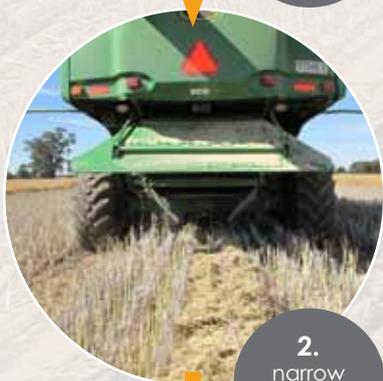
click to see this paddock in 'NWB experiences in southern NSW' on YouTube



Crop-top + NWB in canola, Yerong Creek



1. crop-topped 31-Oct



2. narrow windrowed 11-Nov



3. windrow burnt 1-Apr



4. windrows 3 weeks later 23-Apr



5. wheat 2015

1. **Crop-topped** with Weedmaster DST* using a 12m boom towed behind a self-propelled Macdon windrower.
2. **Narrow windrowed at harvest** with a 560mm wide chute.
3. **Windrows burnt** on 1-April, lit with a drip torch and successfully burnt to the ground (photo 4).
4. **Weed counts** -ryegrass numbers prior to sowing wheat were very low (2-5 plants/m²), even where there was no weed seed control, but were lowest in the strips that had been crop-topped. Summer weeds were also smaller and less prevalent in these areas, suggesting crop topping had controlled the first germination of summer weeds.
5. **Wheat 2015** - ryegrass numbers are now at minimal levels.

*Weedmaster DST is the only glyphosate product registered for pre-harvest weed control in canola and can be applied to standing crop or under the windrow. NWB following glyphosate crop-topping will help control any survivors and prolong the efficacy of glyphosate in the rotation.

paddock demonstration trials

NWB in canola and lupins cont.

The paddock at Marrar has a long history of continuous cropping. It was sown to narrow-leaf lupins in 2014 to better manage ryegrass numbers through:

- a wider range of in-crop herbicide options, including trifluralin + simazine pre-emergence; clethodim + butoxydim post-emergence
- strategic crop-topping with paraquat along one fenceline, adjacent to a laneway where ryegrass numbers were particularly high
- narrow windrow burning

Four paddock length strips (NWB +/- crop topping) were included in the demonstration trial, as described below.

Despite crop-topping and NWB, the fenceline effect was still obvious, with ryegrass numbers up to 20 plants/m² closest to the laneway. Numbers further into the paddock were low at 3-5 plants/m².

To continue to manage ryegrass numbers, the paddock was sown to TT canola in 2015 as a double break with the ability to use effective grass weed herbicides. The canola will be narrow windrowed again this harvest to manage ryegrass survivors.

click to see this paddock in 'NWB experiences in southern NSW' on YouTube



1. Crop-topped with paraquat along the fenceline where ryegrass pressure was particularly high.
2. Narrow windrowed at harvest with a 650mm wide chute, cutting at 150mm high.
3. Windrows burnt on 31-March, lit with a drip torch and successfully burnt to the ground (photo 4).
4. Weed counts - 4 weeks later (prior to sowing canola), ryegrass numbers* ranged from 3-20 plants/m², with numbers still higher closer to the fenceline despite crop-topping. Fumitory germination was stimulated by windrow burning (fire can increase seed-coat permeability).
5. Canola 2015 - TT canola grown for a double-break to control ryegrass survivors. Numbers are managed with propyzamide + atrazine pre-emergence, then clethodim and atrazine early post-emergence in a split application. NWB this harvest to manage survivors.

Paraquat is the preferred option for crop-topping in pulses, particularly if glyphosate (Weedmaster DST) has already been used in canola in the rotation.

*Although ryegrass numbers were recorded post burning in each trial, treatment effects would be more reliably determined at ryegrass maturity, which is outside the 1-year time-frame of this project. Instead, the project focused more specifically on the practical implementation of NWB in southern NSW.

Crop-top + NWB in lupins, Marrar



1. crop-topped 29-Oct



2. narrow windrowed 17-Nov



3. windrow burnt 31-Mar



4. windrows 4 weeks later 27-Apr



5. canola 2015

other HWSC options

Narrow windrow burning is effective, it's cheap, but it does involve compromises. Reduced stubble cover, moisture loss, wind erosion, dust and staggered crop germination are some of the downsides, which can be particularly hard for those in stubble retained systems to tolerate. The time, labour and stress associated with burning also make it a challenging task.

Re-distribution of stubble nutrients can be a problem when narrow windrow burning, particularly in CTF systems where the windrows are placed in the same location each time. Potassium deficiency between windrows is common on the lighter soils in WA.

Smoke, and its effect on those in the surrounding community, is an issue not to be taken lightly and several growers choose not to narrow windrow burn for this reason.

Many growers we have spoken to in southern NSW have said they will continue to narrow windrow burn in strategic paddocks, but are looking at other options that could overcome some of the issues described above.

For those with mixed farming systems, cutting high pressure paddocks for hay, or parts of paddocks, remains an effective weed management tool. **Chaff carts** and the **Harrington Seed Destructor** are viable options but relatively expensive, although there is a lot of interest in the **prototype seed mill** integrated into the back of the header, but this is not yet commercially available.

For those in CTF systems, **chaff decks** are creating the most interest as a relatively cost effective option, allowing straw to be retained but funnelling the chaff fraction (containing weed seeds) onto permanent wheel tracks. **Chaff lining** follows a similar theory, with a chaff row created behind the header and left to rot.

As usual, farmers have been the innovators in this area and it's worth following their progress on Twitter (click on their Twitter handles below). Researchers from AHRI (Australian Herbicide Resistance Initiative) believe there is definitely merit in the chaff deck and chaff line systems and plan to evaluate them in the near future.

1

Trevor Syme has bought an Emar Chaff Deck for his 12.2m CTF system



Trevor Syme, Bolgart WA [@WaddiPark](#)

2

Warwick Holding built nozzle shields out of 20L drums for spraying wheel tracks



Warwick Holding, Yerong Ck NSW [@Pontaragrain](#)

Chaff decks

1. Esperance grower Mark Wandel (@MarkwandelMark) developed a chaff deck system that channels chaff and weed seeds onto a single CTF wheel track, while still being able to spread the straw. Mark has observed that the combination of wheel compaction and chaff rotting in damp conditions restricts weed germination.

In drier years, weed germination from the chaff rows can increase, but growth is limited by competition for moisture, nutrients and light. Shielded sprayers can be used to control weed growth along the wheel tracks if necessary (see photo 2).

Mark's chaff deck system delivers chaff onto a single wheel track where weed seeds are concentrated and easier to manage. The Emar Chaff Deck, now manufactured under licence by Primary Sales, can deliver chaff to both wheel tracks, costing around \$10K-\$14K.

(see weedsmart.org.au for further information)

3. A non-herbicide option for controlling weeds germinating in chaff deck rows is being trialled by Esperance agronomist Quenten Knight (@QuentenKnight). He's using LPG burners under shrouds over the wheel tracks, reaching temperatures above 400 deg.C to kill weeds.

Early trials have worked well on 1-3 leaf grasses and broadleaf weeds. Quenten plans to make further modifications, including changes to the shroud design and length, and is considering different types of gas. He found that the chaff itself didn't catch alight because it was moist and partially composted.

4. Chaff lining (or windrow rotting) has been developed by Esperance grower Mic Fels (@ipaddockapps) and is a variation on the chaff deck concept.

Chaff lining

While still being able to spread the straw, the chaff fraction is diverted through a chute into a narrow row behind the header (in the same location each year in CTF systems), rather than on wheel tracks.

The chaff and weed seeds are then left to rot away or compete with each other in the confined environment. Mic says narrow windrowing burning over the chaff line is an option if it gets weedy or starts to spread out over time.

To avoid disturbing weeds seeds in the chaff line (or creating blockages), Mic says the system suits disc seeders or tynes on wider row spacings (eg. 305 mm) that can straddle the row.

5. Leigh Bryan (@leighjbryan) built a 25cm wide chafflining kit to fit his narrow windrow chute. He trialled chaff lining on 250ha of barley last harvest as an alternative to NWB and is pleased with the results so far. After 7mm rain he found moisture had only just penetrated the top of the chaff row.

3

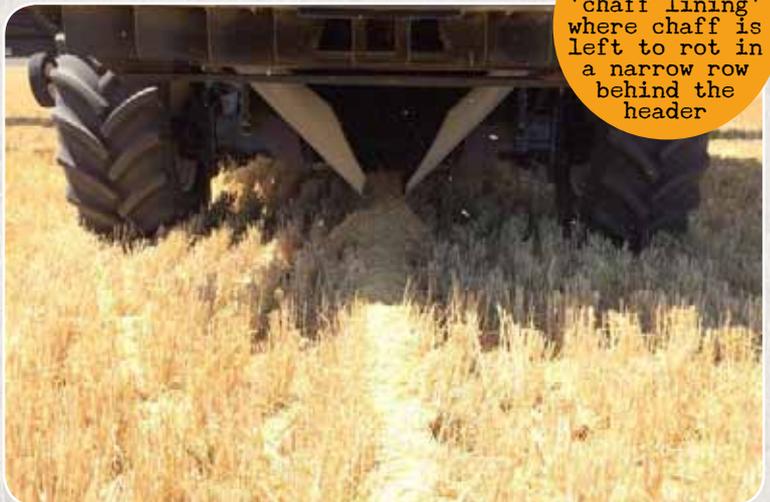
Quenten Knight is trialling a weed burner for resistant weeds in chaff deck rows



Quenten Knight, Esperance WA [@QuentenKnight](#)

4

Mic Fels developed 'chaff lining' where chaff is left to rot in a narrow row behind the header



Mic Fels, Esperance WA [@ipaddockapps](#)

5

Leigh Bryan built a 25cm chaff line kit to fit his NWB chute



Leigh Bryan, Swan Hill Vic [@leighjbryan](#)

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Written and produced by Kirily Condon,
Grassroots Agronomy

for the project

Adapting narrow windrow
burning to higher yielding
no-till systems in SNSW



with funding from GRDC through the
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**Many thanks to the Pontara Grain team (Warwick, Di & Ryan)
and the Fox family (David, Cathie & Dan) for helping out with
the demonstration trials.**

Disclaimer: The information contained in this publication is based on information available at the time of writing (September 2015). While all due care has been taken in compiling the information, Grassroots Agronomy Pty Ltd and its employees accept no liability resulting from its interpretation or use. Information contained in this document is subject to change without notice.