

TOOLS AND TIPS SETTING UP FOR CHAFF LINING

AUGUST 2019



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Title: Tools and tips – setting up for chaff lining

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ISBN:

978-1-921779-89-3 (online)

978-1-921779-90-9 (print)

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Design and production: Coretext, www.coretext.com.au

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COVER: The Mic Fels-designed New Holland chaff line chute in action.

PHOTO: Mic Fels

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INTRODUCTION

The chaff lining technique is the cheapest harvest weed seed control tool, both in terms of capital cost and overall cost, including nutrient concentration. Chaff lining involves making a simple chute to divert the weed seed-bearing chaff fraction (from the sieves) into a narrow windrow, which is left to rot or mulch while the straw is chopped and spread. Chaff lines are placed in the same place each year. Full controlled-traffic farming (CTF) is good but not essential, as long as the harvester runs on the same track each year. Commercial chutes are now available and many grain growers make their own. This booklet is a collection of ideas from growers and industry about setting up a harvester for chaff lining.

There are four stages of harvest weed seed control (HWSC) and they all apply to chaff lining.

1. Getting weed seeds into the front of the harvester.
2. Getting weed seeds out of the rotor.
3. Keeping weed seeds in the chaff fraction (for HWSC tools that focus only on the chaff).
4. Delivering weed seeds into the HWSC tool (chaff line, chaff tramline, seed impact mill, chaff cart, narrow windrow or bale direct).

This booklet will cover these aspects of HWSC, with a focus on the third and fourth points.

It is also recommended that growers view the *Chaff Lining Explained* video featuring Peter Newman from the Weedsmart Know More Series <https://www.youtube.com/watch?v=XFkGfb9WGVE&t=44s>

1. GETTING THE WEED SEEDS INTO THE FRONT OF THE HARVESTER

The first step is to harvest low. The ideal harvest height for HWSC is generally accepted as 13 centimetres – or beer can height (Figure 1). To harvest at this height the paddock needs to be relatively clean of rocks and stumps. Harvesting low increases the cost of harvest compared with a higher height; however, low stubble height is also considered important at seeding.



FIGURE 1 Low harvest height to maximise weed seed capture.

PHOTO: PETER NEWMAN



FIGURE 2 Primary sales knife extensions used to improve crop and weed seed capture.

PHOTO: DANI WHYTE

Front modifications

Some grain growers are modifying the front of the harvester to improve weed seed capture, particularly in low rainfall environments where weeds often lodge in low biomass crops before harvest (Figures 2–4). There is no research to confirm if these modifications are effective; however, grower observations suggest that it is worthwhile.

Some growers are now looking to adopt a flex front to ‘shave’ the ground to a harvest height of approximately 5cm when harvesting weedy areas.



FIGURE 3 Coreflute attached to the finger tyne reel to sweep crop and weed seed heads into the harvester front. This is particularly useful in low-yielding crops (1 t/ha or less).

PHOTO: DANI WHYTE



FIGURE 4 John Deere HydraFlex®.

2. GETTING WEED SEEDS OUT OF THE ROTOR

Once the weed seeds are in the harvester they need to be delivered into the HWSC tools. This is a simple process for narrow windrow burning or bale direct as all of the residue is captured and little attention to detail is required. However, for all of the other HWSC tools that focus on the chaff only, all of the weed seeds need to enter the chaff fraction and stay there. The first step in this process is to ensure that the weed seeds exit the rotor.

There are several schools of thought here and this is not an exact science; however, one rule of thumb should stand:

If you are not losing grain out of the rotor (spread with the straw), weed seed loss from the rotor should also be minimal.

In general terms, if the harvester is set up to minimise grain rotor losses, the weed seeds should also be threshed from their seed heads and exit the rotor, landing on the sieves.



FIGURE 5 A standard John Deere 31 wire concave. Manufacturers recommend all three concave sections to be 31 wire for normal cereal harvesting.

PHOTO: PETER NEWMAN

To open the rotor or not?

This is a slightly controversial area with a range of opinions. It has been suggested that growers have concave sections quite open, often with wires removed in the second half of the concave, to enable the grain and weed seeds to fall out of the rotor (Figures 6 and 8).

On the other hand, machinery dealers and manufacturers will argue that your rotor should be set up according to the manual for ideal threshing of the grain. They suggest that if the concave is too open the grain may not be threshed hard enough (Figures 5 and 7).



FIGURE 6 The first section of concave is a standard 31 wire for aggressive threshing, leading into the next section where every second wire is removed to allow grain and weed seeds to exit the rotor.

PHOTO: PETER NEWMAN



FIGURE 7 The rear grates of John Deere harvesters are more 'closed up' than other makes of harvester.

PHOTO: PETER NEWMAN

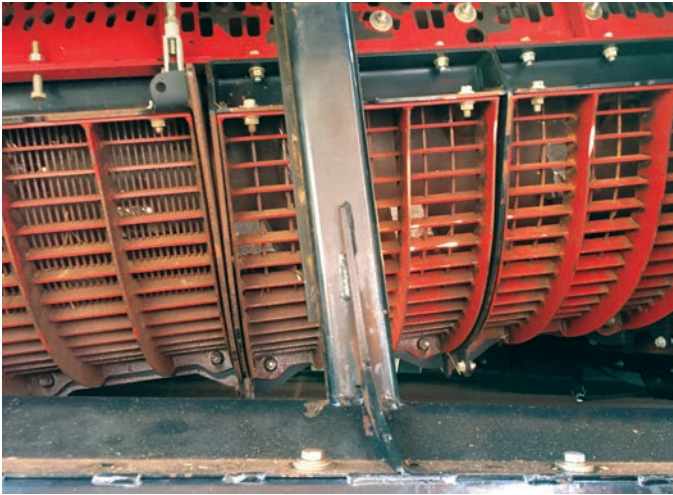


FIGURE 8 Case rotor with a small wire concave leading into a very open grate. New Holland harvesters have similar rotors with very open (golf ball-sized) grates in the rear section of the rotor.

PHOTO: PETER NEWMAN

Rotor speed

This is another area with a wide range of opinions. Some growers operate a faster-than-normal rotor speed (some say they run the rotor at full speed), working on the theory that this increases the centrifugal force to improve getting weed seeds out of the rotor. Others just set their rotor speed “as it says in the book” for normal grain harvest. There are no hard and fast rules about what rotor speed is ideal, and in most circumstances setting rotor speed for optimal grain quality will be best.

Summary

It will take some detailed measuring to help decide which rotor set-up is best for grain and weed seed harvest. The best option is to work with your dealer and colleagues to fine-tune your set-up to ensure that your grain rotor loss is minimal. The only way to ensure that you have achieved this is to measure your losses with drop trays. If you minimise grain loss from the rotor you will maximise weed seed capture.

3. KEEPING WEED SEEDS IN THE CHAFF STREAM

The schematic diagram in Figure 9 gives the best illustration of the concept of keeping weed seeds in the chaff fraction. Weed seeds and grain exit the rotor (separator) and fall onto the sieves. The heavy grain falls through the sieve and the wind from the fan floats the weed seed-bearing chaff above the sieve until it exits at the rear.

For John Deere and Case harvesters, a separator baffle is inserted behind the sieve to direct the chaff into the HWSC tool. This baffle is not necessary in Claas or modern Massey Ferguson harvesters and may not be needed in a modern New Holland harvester that is fitted with a Positive Straw Discharge (PSD) belt. You will see in the diagram the reference to high terminal velocity components (for example, heavy weed seeds) and low terminal velocity components (light material). This describes how the wind can blow material over the separator baffle, particularly the lighter components, so it is important to keep the wind to a level at which weed seeds will not be blown over the separator baffle and then exit with the straw. Long-term HWSC advocate Andrew Messina comments, "The days of a very clean sample are gone. We back the wind off until the sample is just a little bit dirty, this way we are sure that we are not blowing weed seeds over the baffle and into the straw stream, but we don't risk having the sample so dirty that we get downgraded." Brothers Andrew and Rod Messina operate three Case 8230 harvesters with chaff carts.

In some cases, inserting a baffle into a harvester can change the wind movement through the machine and can lead to increased grain losses. It is important to measure grain losses using a tray or drop pan to ensure that grain losses have not increased.

Separator baffles

There are a range of baffle designs for the many different makes and models of harvester on the market, as well as custom-built designs. The following are a few of these.



FIGURE 10 Separator baffle inside a John Deere harvester leading into a chaff line chute made by Westoz Boilermaking.

PHOTO: PETER NEWMAN

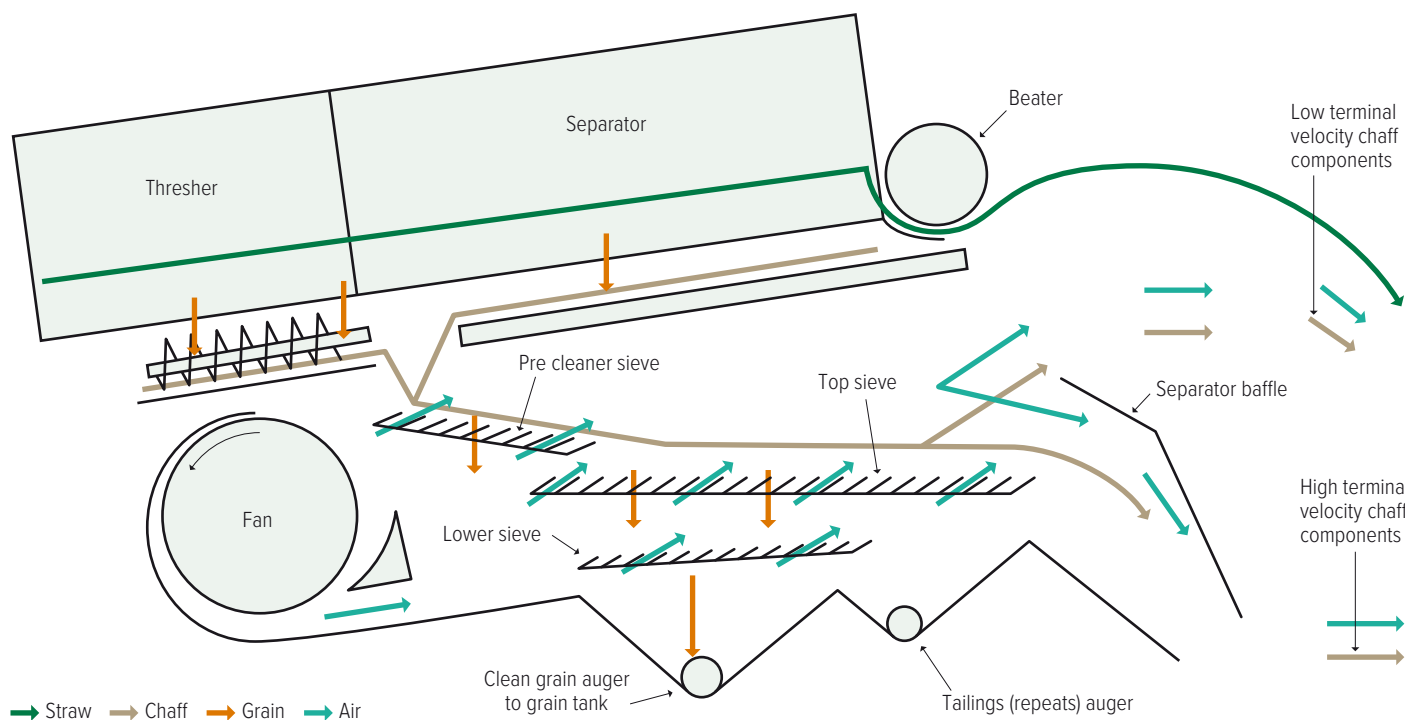


FIGURE 9 Schematic drawing of the internals of a modern harvester.

SOURCE: NICK BERRY

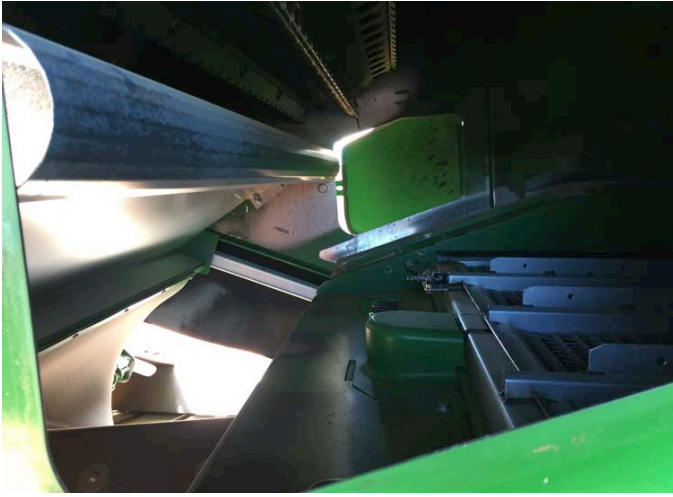


FIGURE 11 Separator baffle inside a John Deere S680 with overshot beater fitted with chaff decks. Note the curved leading edge of the baffle to minimise straw catching on the front of it. Harvester owned by Warwick Holding. Chaff deck and baffle supplied by Primary Sales.

PHOTO: PETER NEWMAN



FIGURE 12 Separator baffle in a Case 2388 sitting approximately 300mm above the rear of the sieve.

PHOTO: PETER NEWMAN



FIGURE 13 Separator baffle inside a Case 7230 fitted with a Mav chopper. Designed by farmer Leigh Bryan to work with his 'Tarpliner' chaff lining chute made from PVC tarpaulin.

PHOTO: LEIGH BRYAN



FIGURE 14 Straw spreader cover fitted to a Case 7230 owned by Craig Thompson, north-eastern wheatbelt of WA. Commonly known as the 'Rod and Andrew Messina' design, as this is what they used as a baffle with chaff carts fitted. This is designed to cover the front of the straw spreader so that the weed seed-bearing chaff is not sucked into the straw spreaders.

PHOTO: PETER NEWMAN



FIGURE 15 Another 'Rod and Andrew Messina' straw spreader cover fitted to a Case 8230 owned by Craig Simkin from Binu. The height of this baffle is adjustable with slotted holes, allowing for 100mm of height adjustment.

PHOTO: PETER NEWMAN

New Holland – Mic Fels, Esperance, WA

Mic Fels was an early adopter of chaff lining for HWSC and has been a great help providing ideas and insight for people setting up for the first time. Mr Fels owns two New Holland CR9070s (without a PSD belt) and one CR9090 (with a PSD belt). A PSD belt is a short conveyor belt designed to carry straw from the rotor to the chopper (Figure 16). Mr Fels does not use separator baffles in any of these machines and he believes that there is no need for a baffle on modern New Holland machines, as the chaff and straw are quite separate (Figure 16).

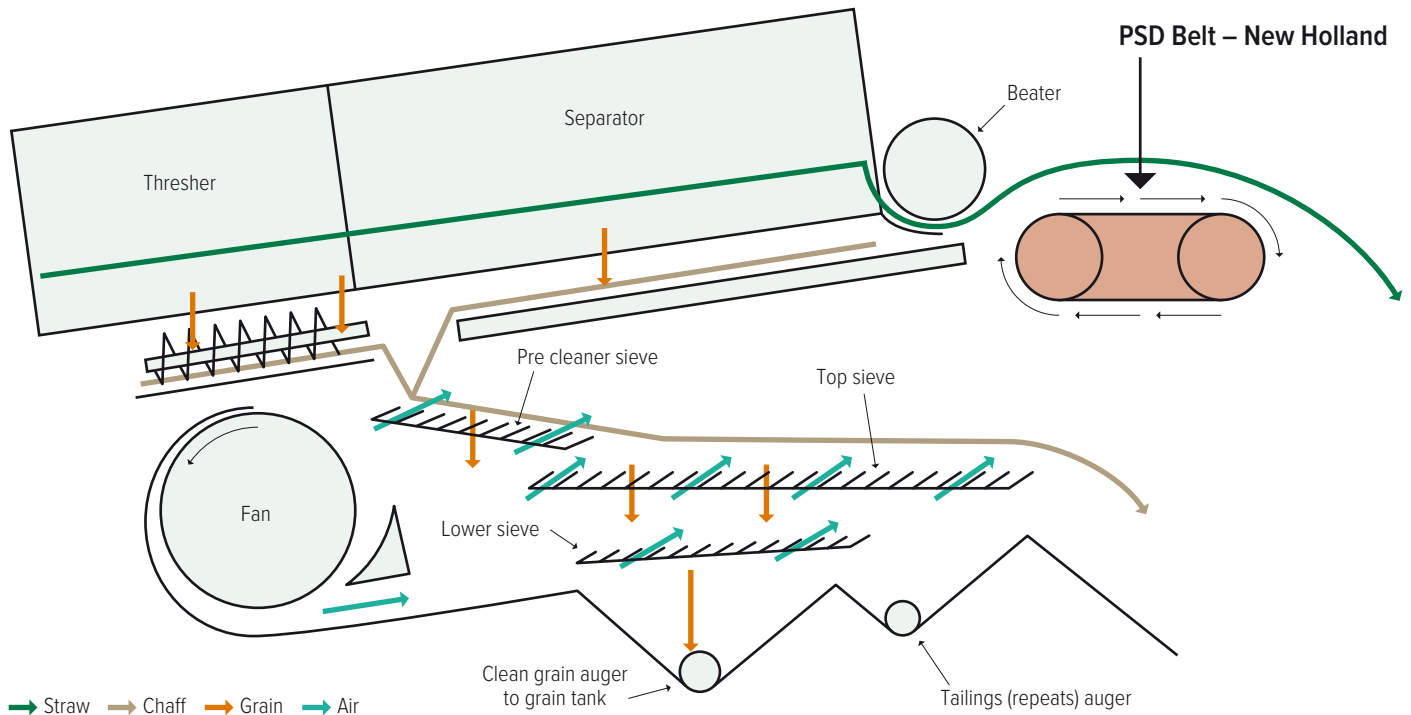


FIGURE 16 New Holland harvesters fitted with a PSD generally do not require a baffle. The PSD belt carries straw from the rotor to the chopper, keeping the straw and chaff quite separate.

SOURCE: NICK BERRY (MODIFIED BY PETER NEWMAN)

Claas

Claas harvesters are designed such that chaff and straw are very well separated (Figure 17). They also have a threshing drum prior to material entering the rotors, so threshing weed seeds from the plant is also very efficient. Mr Fels owns one Claas harvester, as well as the three New Holland harvesters, and chaff lines with all of them. Mr Fels says that the Claas is also very good for keeping the chaff and straw separate; however, he has noticed that the chaff lines from the Claas machine are much bigger than those from the New Holland – possibly due to the Claas having a more aggressive threshing system, which creates more chaff. Large chaff lines can be advantageous to suppress weed seed germination, but they can cause issues at seeding and affect crop establishment.

Claas harvesters generally do not require a separator baffle because the chaff and straw are separated by a 'floor' below the rotors. Also, the long rotors deliver straw directly into the chopper.



FIGURE 17 Cross-section of a Claas harvester.

SOURCE: CLAAS

Internal chopper or beater?

Many growers have commented that an internal chopper, such as the option in the Case harvester (Figure 18), is superior to an internal beater to improve weed seed separation. The internal chopper is preferred over the beater as it does a better job of throwing the straw further to the rear of the machine, making chaff and straw separation easier. The chopped straw also feeds easier into a spreader that has a 'Rod and Andrew Messina' spreader cover.

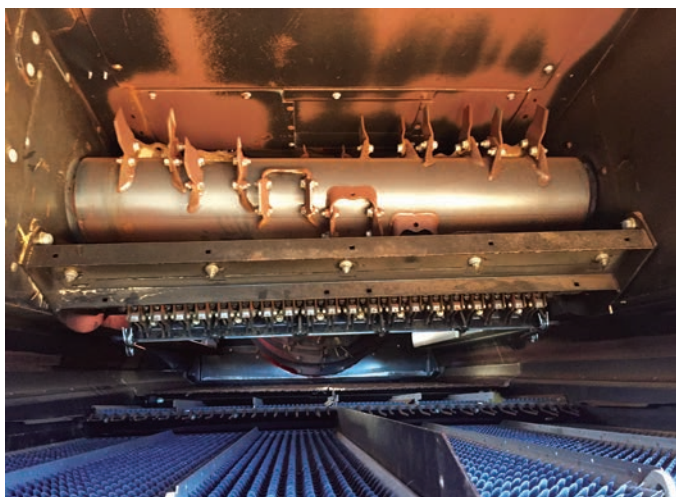


FIGURE 18 Internal chopper in a Case harvester.

PHOTO: PETER NEWMAN

Green residue is the enemy of HWSC

Green residue causes problems with HWSC in several ways. One of these is the build-up of this residue on the separator baffle, which can be extremely frustrating for the operator. There are some solutions, such as a powered roller at the leading edge or having a curved leading edge of the baffle. Often the simplest solution is removing the baffle for a period of time to allow harvest to continue, although this may compromise the HWSC job – but the show must go on. This often occurs when harvesting canola. In some situations, growers could change HWSC options to make narrow windrows for windrow burning. Baffles and chutes can sometimes be designed in such a way to facilitate this temporary change.

4. DELIVER WEED SEEDS INTO THE HWSC TOOL – CHAFF LINE CHUTES

One of the great things about chaff lining is that growers can build their own chute. This has led to a plethora of different chute designs for a range of harvesters. The following are descriptions and images for a few of these, as well as commercially available products.

How wide should the chute be?

The opening at the bottom of most chaff line chutes should be approximately 350 to 400 millimetres wide. This creates a chaff line approximately 200 to 250mm wide, as the chaff follows the trajectory that it is on as it exits the chute.

Commercial chaff line kits

Westoz Boilermaking has been building and supplying chaff line kits to farmers for several years. It started with the John Deere kit (Figure 19) and now has kits for Case, New Holland and Claas harvesters. The latest kits are fitted with quick-release pins to enable easy access to the rear of the harvester. You can find Westoz Boilermaking on Twitter (@tristan_westoz) or Facebook.



FIGURE 20 Side view of the S-series John Deere chute – Westoz Boilermaking. The chopper slides back on the rails. The chopper sensor is moved to allow the chopper to continue to operate when in this position. An overshoot beater is a good idea to help throw straw further back into the chopper.

PHOTO: PETER NEWMAN



FIGURE 19 S-series John Deere chaff line chute – Westoz Boilermaking.

PHOTO: PETER NEWMAN



FIGURE 21 STS John Deere chaff line chute – Westoz Boilermaking. A wedge has been inserted at the front of the chopper so it can move it back a little.

PHOTO: TRISTAN FRIEND



FIGURE 22 Rear view of the STS John Deere – Westoz Boilermaking.

PHOTO: TRISTAN FRIEND



FIGURE 23 Case harvester chaff line chute – Westoz Boilermaking.

PHOTO: TRISTAN FRIEND



FIGURE 24 Case harvester chute – Westoz Boilermaking. The straw spreaders close down on the back of the chute. The spreader is fitted with a cover to minimise weed seeds being sucked in.

PHOTO: TRISTAN FRIEND



FIGURE 25 New Holland chaff line chute – Westoz Boilermaking.

PHOTO: TRISTAN FRIEND



FIGURE 26 New Holland chute – Westoz Boilermaking.

PHOTO: TRISTAN FRIEND



FIGURE 27 Claas Lexion chaff line chute – Westoz Boilermaking.

PHOTO: TRISTAN FRIEND



FIGURE 28 Rear view of the Claas Lexion – Westoz Boilermaking.

PHOTO: TRISTAN FRIEND



FIGURE 30 Side view of Matt Johnson's chute.

PHOTO: PETER NEWMAN

John Deere S680 – Matt Johnson, Ogilvie, WA northern wheatbelt

This DIY design utilises the universal building product of intermediate bulk container (IBC) bladder plastic. The IBC chute is attached to the sieve and the shaking motion ensures that it does not block. Given that only a small piece of IBC is attached, no damage is done to the sieve. Chaff then falls into a fixed steel chute.



FIGURE 29 Rear view of Matt Johnson's chaff line chute, showing the shaking plastic IBC chute feeding into the fixed steel chute. Rubber sides on the bottom of the chute reduce crosswind effects.

PHOTO: PETER NEWMAN

John Deere S670 with standard spinners – Malcolm, Des and Adrian Kohlhagen, Collingullie, NSW

The standard spinners (no straw chopper) on the Kohlhagens' harvester presented a problem, as there was limited room at the rear of the harvester. This was overcome by removing the tray at the rear of the sieves, leaving enough room for the chaff to drop into the chaff line chute.



FIGURE 31 The Kohlhagens' chaff line chute on a John Deere S670. The straw spreaders are in the 'up' position for the photo, but while harvesting they operate in the normal 'down' position.

PHOTO: KIRRILY CONDON, GRASSROOTS AGRONOMY



FIGURE 32 The Kohlhagens' chaff line chute on a John Deere S670. This photo shows how the tray behind the sieve was removed to create some room between the sieve and the straw spreaders. The baffle is curved with a rounded leading edge, and a new cover has been made for the sieve controlling mechanism.

PHOTO: KIRRILY CONDON, GRASSROOTS AGRONOMY



FIGURE 33 The Kohlhagens' chaff line chute in action on a John Deere S670. The straw spreaders are in the normal 'down' position.

PHOTO: GREG CONDON, GRASSROOTS AGRONOMY

Case 7230 – Craig Thompson, Balla, WA northern wheatbelt

A simple DIY chaff line chute can be made for modern Case harvesters, very similar to windrow burning chutes that growers have used in the past. This chute is made from a steel frame lined with 3mm polycarbonate plastic. The straw spreader, with a 'Rod and Andrew Messina' cover, closes hard against this chute. The IBC plastic at the bottom reduces crosswind effects and helps make a very narrow chaff line (Figure 34).



FIGURE 34 Craig Thompson's chaff line chute fitted to a Case 7230. This design works with most 7200, 8200 and 9200 models.

PHOTO: PETER NEWMAN



FIGURE 35 Another view of Craig Thompson's chaff line chute with straw spreaders in the 'up' position. The straw spreader cover closes hard against the chaff line chute to make the back of the chute.

PHOTO: PETER NEWMAN

Case 2388 – Rowan Astbury, Harrismith, WA

Rowan Astbury modified his Case 2388 to fit a chaff line chute after discussions with Doug Harrington. Doug Harrington is the brother of Ray, and is well known for his skills in setting and modifying harvesters for efficiency and harvest weed seed control. The addition of the chute required creating more room for it to fit. To do this, and to facilitate separating the chaff from the straw, it is necessary to move the straw spinners back and up. To achieve this, Mr Astbury flipped the spreader mounts to face backwards so the holes line up, and he then fabricated a new top mount.

This required the spinners to move back by 150mm and up by about 100mm. Mr Astbury achieved this by shortening the spreader drive shaft, to allow for more clearance for the chaff, and by purchasing a new longer drive belt. To change to windrow burning, all Mr Astbury needs to do is drop the spinners off. He has not fitted a baffle. After these modifications the ladder no longer worked so he replaced it with a ladder from a silo.

After further discussion with the Harringtons, Mr Astbury removed a small steel insert from the back wall to redirect material from the beater down to the new spinner location – otherwise material lands on the front edge of spinner. He has found that it does help to land material onto the spinners, but he puts this plate back in when windrow burning so that the straw lands in the chute.



FIGURE 37 Rear view Case 2388.

PHOTO: ROWAN ASTBURY



FIGURE 36 Chaff line set-up on Rowan Astbury's Case 2388 with straw spreaders moved back 150mm and up 100mm.

PHOTO: ROWAN ASTBURY



FIGURE 38 Close up of the brackets.

PHOTO: ROWAN ASTBURY



FIGURE 39 Residue delivery onto the spinners.

PHOTO: ROWAN ASTBURY

Case 7230 ‘Tarpliner’ – Leigh Bryan, Swan Hill, Victoria

Leigh Bryan started out with a steel chaff line chute and then came up with his design made from a PVC tarpaulin, which he calls the ‘Tarpliner’. The flexible nature of this chute means that it continuously shakes, keeping it free from blockages. Mr Bryan fitted a solid plastic chute to the bottom of the Tarpliner to keep the chaff line narrow and to provide some weight on the base.



FIGURE 40 Tarpliner by Leigh Bryan.

PHOTO: LEIGH BRYAN

New Holland – Mic Fels, Esperance, WA

To create chaff line chutes for his New Holland harvesters, Mic Fels has used 3mm polycarbonate sheets and a heat gun to bend the sheets (through trial and error) to get them to fit right. To fit the chutes, the chaff spinners need to be dropped and the plastic chute clips under the sieve and onto the chaff spinners.



FIGURE 41 The Mic Fels-designed New Holland chaff line chute in action.

PHOTO: MIC FELS



FIGURE 42 Mic Fels’s chaff line chute attachments.

PHOTO: LEIGH BRYAN

Claas – Mic Fels, Esperance, WA

Mr Fels also runs a Claas harvester, which requires a slightly different set up for chaff lining. With this model harvester, to fit the plastic chute (similar in design to the New Holland harvesters) the chaff spinners need to be moved to the rear position. Mr Fels also removed the ringfeeder and made a short hitch to fit the chaff line chute. He says, “The chutes are best designed as closed at the sides – to ensure all weed seeds enter the chaff line – and open at the back – to let the air out.”

Mr Fels removed the Ringfeeder and made a short hitch to fit the chaff line chute. Removing the ringfeeder created a steeper angle for the chaff line chute to help avoid blockages. An interesting side note is that some growers have set these machines up for chaff tramlining (chaff placed on permanent wheel tracks) with a simple modification to these chaff spinners.



FIGURE 43 Mic Fels’s chaff line chute for New Holland harvesters.

PHOTO: MIC FELS



FIGURE 44 Chaff lining set up on Claas harvester of Mic Fels, Esperance.

PHOTO: MIC FELS

COMPARISON OF CHAFF LINING AND CHAFF TRAMLINING

Table 1 was prepared by Planfarm agronomist Nick McKenna, based on his observations while compiling 10 case studies in the Esperance region of WA. These are useful observations and are based on anecdotal evidence.

TABLE 1 A comparison between chaff lines and chaff tramlines.		
Factor	Chaff lines (1 band)	Chaff tramlines (2 bands)
Weediness	Does not get driven over, no seed soil contact, does not germinate	Gets driven over, including multiple times before seeding, so get lots of seed soil contact leading to frequent germinations
Chaff breakdown	Slower. Can hold onto moisture from below, but due to its low density it stays relatively dry, so it tends to persist through the year	Much faster, as the frequent passes with sprayer ensure it gets a little moist and therefore mulches down faster
Seeding through	No reports of it being difficult to seed through, but it would be slightly harder, as it has twice the concentration of material than chaff tramline	No reported problems, even with poor trash flow machines
Ease of fit	Easy – an afternoon in the workshop. Even easier on machines that already have chaff and straw separated such as Claas and New Holland	A bit harder. Kits available for \$12,000 to \$20,000. Again, easier on machines that have a pre-installed separation of chaff and straw such as Claas and New Holland
Wheel slip in difficult conditions	None	Scattered reports of wheel slip, mainly on very heavy soils in moist conditions
Dust suppression at spraying	None	Good. Having less dust could also lead to other benefits, such as cleaner air filters
Fit for sheep	Strong. Having the chaff, weed seeds and grain losses concentrated in the one line improves feeding efficiency	Strong, as with a chaff line

SUMMARY

Chaff lining is being rapidly adopted by Australian grain growers, with nearly one-third suggesting that they are planning to adopt this practice. Chaff lining chutes are available from commercial manufacturers or can be created on-farm to fit individual harvesters. To ensure the chaff lining system works well, further modifications to the harvester may also need to be made. The new system may require the addition of a baffle, moving the spinners, or fitting new longer driver belts, to mention a few. There are more chaff line designs that have not been featured in this booklet.

All that is left to do now is get to work in the workshop.



Chaff lining in action on Doug and Vanessa McGinnis' property at Merredin, WA.

PHOTO: DANI WHYTE, PLANFARM

