Kondinin Group
Research Report
FEBRUARY 2018 No. 097 www.farmingahead.com.au

RESIDUE MANAGEMENT AT HARVEST

WEED SEED OPTIONS

Independent information for agriculture

Weed weapon: Destroying weed seeds at harvest is an important component of any integrated weed management plan and there are plenty of options available in the toolbox. In-fact, there are so many, deciding which to use can be tricky.

Straw and chaff management options

Harvest weed seed control is an important part of any integrated approach to weed control and farmers, research bodies and manufacturers have spent millions of dollars coming up with solutions. With this in mind the Kondinin Group research team has investigated the performance of a range of harvest weed seed control options including the more expensive of these; the integrated Harrington Seed Destructor (iHSD) and the competing Seed Terminator chaff mills.

By **Ben White**, **Josh Giumelli** and **Mark Saunders**

According to the 2017 National Agricultural Survey, more than two in three Kondinin Group members have experienced chemical resistance with one or more weeds. Of those, annual ryegrass resistance was experienced by 85 per cent nationally. Fleabane, wild oats and wild radish were the next most prevalent with 30%, 25% and 24% of farmers experiencing chemical resistance.

With levels of chemical resistance increasing, there has been a substantial focus on non-chemical approaches to weed control. In particular, harvest weed seed control which seizes the opportunity to collect all weed seeds processed through the harvester for treatment, removal or destruction.

Depending on the time of harvest and weed species, between 50 and 90% of weed seeds in a paddock make their way through the harvester.

A combination of herbicides, crop competition, and natural seed decay usually delivers around 98% total control of annual ryegrass and usually holds a weed seed bank numbers level. Assuming that 98% total control is achieved, adding a harvest weed seed control option can begin to erode the weed seed bank.

Even if harvest weed seed control only achieves 50% removal of any weed seeds standing in the paddock, (although 60 to 70% is common), the total weed seed control level is increased from 98 to 99%. 99% total control can be enough to start reducing numbers in the weed seed bank.

HARVEST OPTIONS IMPORTANT

An argument could be made that desiccated crops have had weeds sprayed out prior to harvest, but according to Peter Newman from AHRI, harvest weed seed control should be considered the "second knock". Newman says crop desiccation with glyphosate drives significant selection pressure for glyphosate resistance and therefore, harvest weed seed control is essential. Seeds from glyphosate resistant weeds can escape the first chemical knock, so a second, in the form of harvest weed seed control, is required.

SELECTIVE BREEDING?

On the question of whether harvest weed seed control will drive the selection of early

Chaff carts offer sheep and wool producers the option of extracting value out of weed seeds through grazing. And while sheep digestion will eliminate 97% of annual ryegrass seeds, cattle will only eliminate 66%.

CHAFF CARTS

Chaff carts rely on weed seeds being collected through the harvester before being transported off the back of the sieves via a hydraulically-driven conveyor belt in the cart.

Chaff is dumped when the cart is full and usually timed to be in a straight line to make fire breaks simpler when the dumps are and burnt.

Alternatively, with a portion of the chaff collected containing weed seeds along with portions of broken grain kernels, dumps can be effectively grazed.

With lambs, sheep and wool becoming increasingly profitable, the nutritional value of the chaff dump can provide a significant ration.

According to AHRI, less than 3% of annual ryegrass seeds will survive digestion through a sheep.

This proportion is as high as 33% in cattle.

Chaff carts are built in sizes between 30m^3 and 50m^3 and cost between $50,000 to $90,000 excluding GST to purchase new. Depending on the make, they can be purchased at a discounted price second-hand, but generally hold their value well.

Because they need to be hydraulically connected and set-up to capture the chaff, dropping the chaff-cart off is simple if going to, for example, chaff-lining. But to go back to standard specification may be more complex depending on the make of harvester.

Getting the mix of straw and chaff right for an efficient, hot and rapid burn can also require some refinement.

Options include in-cart cameras, automated dumping at pre-set programmed locations and configuration to adhere to 3m or 4m wheel centres to match Controlled Traffic Farming (CTF) operations.

Cost of operation in addition to nutrient removal depends on yield, but as an example, a figure of $14/ha including nutrient removal was quoted by WeedSmart in 2000ha of wheat averaging 2t/ha. Of this $14/ha, $8/ha is the cost of using the chaff cart.

If grazing the chaff dumps and not burning them as per the WeedSmart example, the feed value could reduce this to $8/ha.

Meals on wheels: For mixed farming operations, chaff dumps can provide useful sheep feed over summer, extracting significant value from a waste product that might otherwise be burnt.

Contact:

- TecFarm (WA)
  www.tecfarm.com.au
  08 9061 1808
- Hills Ag (WA)
  www.hillsag.com
  0428 310 398
- Trufab (WA)
  www.trufab.com.au
  08 9635 1401
- Springfield (NSW)
  www.springfieldgrenfell.com.au
  0428 422 066

maturing or prostrate weeds, Newman says there is a possibility that this could occur.

But in the context of an integrated approach, the diversity of control measures should remove selection pressure.

COMPARING THE OPTIONS

Narrabri-based Dr Michael Walsh, from the University of Sydney, a former AHRI team member, conducted over two dozen trials looking at the comparative efficacy of the HSD, chaff cart, and a windrow burn. All performed equally and resulted in a 60% reduction in an overall ryegrass germination the following year. Chaff-lining was not included in the study.

Importantly, getting weed seeds into the harvester and then into the chaff fraction is key to the success of any harvest weed seed control approach.

Keeping weed seeds in the chaff fraction may require concave adjustment and additional baffles in place to get weed seeds to fall onto the sieves and keep straw out of the chaff stream.

Getting in early is also important, as weed seeds will continue to shed after the crop ripens and is ready for harvest.

For example, research has demonstrated that at just two weeks past crop maturity, around 11% of annual ryegrass seeds and 21% of wild oat seeds will have already shed and therefore harvest weed seed control is reduced.

But while we are equally taking care of the weed seeds, each approach has an impact on the bottom line with nutrient removal varying between them all.

Broadly speaking each of the options can be categorised into; chaff removal, chaff and straw removal or full residue retention.

Full residue retention systems, for example, chaff mills, spread all straw and process the chaff before spreading, meaning no nutrients are lost.

Chaff removal, such as chaff carts, chaff-decks and chaff-lining removes only the nutrients from the chaff fraction of the residue. Chaff and straw removal options include narrow windrow burning and bale direct. These options, while equally effective, mean a significant amount of nutrient value is taken with the removal of both chaff and straw.

NARROW WINDROW BURNING

Confining the chaff and straw into a narrow windrow for burning is an alternative to chaff carts but where chaff carts remove between 10 and 30% of the crop residue, narrow windrows remove 50%, as more straw is taken and added to the windrow to aid burning.

This means that while the weed-seed kill outcome is superior to a full paddock burn thanks to a concentration of fuel and a resulting hotter burn, the cost is higher because more nutrients are removed. In a controlled traffic or permanent harvest run-line scenario, this is exacerbated because post-burn residual potassium becomes concentrated along a single path and is lost.

Concerns regarding nutrient removal in a windrow burn are less for lower rainfall environments with soils containing high levels of potassium.

Narrow windrows offer an alternative to a full paddock burn but with up to 50% more residue taken over chaff-only methods, the nutrient removal can be expensive.

Bale Direct: Baling straight off the harvester requires hydraulic plumbing to be fitted to drive the baler, but can be detached relatively easily back to conventional harvesting where required.

BALE DIRECT

Straw bales made with the Bale Direct system can be utilised as stock feed, bedding, strawboard or the cellulose component in fuel, but it does remove chaff and straw from the paddock which may have otherwise added significant nutrients.

Adapting the Bale Direct system to a harvester requires some minor modification to the harvester and baler. Drawing the power from the harvester, the Bale Direct method uses around 70kW of power from the engine, this is offset by around a 30kW power saving from no residue spreading.

The pick-up on the baler is removed and replaced with a belt-conveyor to carry chaff and straw into the baling chamber. The kit is typically fitted by a dealer and system manufacturer Primary Sales.

Removing the bale-direct system is less involved; unhitching, and re-fitting straw spreaders to take the harvester back to a regular configuration. Where a viable market for the straw exists, the bale direct system has merit and could generate additional income, but if not, the cost of removed nutrient may exceed the financial benefit gained. Bale direct is superior for weed-seed capture over conventional residue windrowing and secondary baling.

Contact:
Primary Sales
08 9250 3500
www.primarysales.com.au

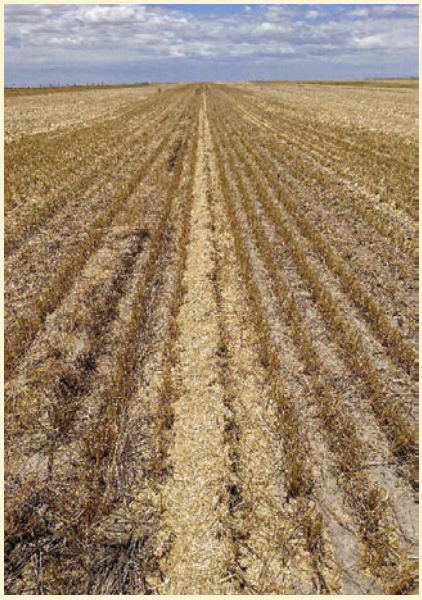
CHAFF-LINING

A chaff lining chute offers a low-cost approach to aggregating chaff in a narrow row. While some issues exist with harbouring or feeding pests with the chaff residue, and plant establishment in the chaff-line is not optimal, the system is simple to implement.

Essentially, the chute captures everything coming off the sieves to drop it in a narrow band behind the harvester. The chaff, including the weed seeds can then rot in the narrow row. Anecdotal evidence suggests the approach works well and provides adequate control. If weeds do spring up from the row, a narrowly-targeted chemical application can be used. Like chaff dumps, owners tell us that sheep forage the chaff-lines well.

AHRI recommends maintaining year-on-year consistent chaff-line placement to concentrate weed seeds. It also allows the option of dropping a canola windrow on the chaff-line and burning it as part of the rotation. If farming under a CTF system, an option like a chaff-deck may be an alternative. Numerous designs of chute have been fashioned using an array of materials, including cutup intermediate bulk containers (IBC's) and scrap sheet-metal. While many of these chutes have been home-made with varying levels of success, they can also be purchased as a professionally fabricated bolt-on product.

Although viable weed-seeds are dropped in the paddock to rot, chaff-lining is a low-cost and effective option for weed seed consolidation, drawing no additional power.



Chaff-lining is relatively inexpensive, and while not perfect is a good solution for those looking to minimise nutrient loss through burning. Note that straw is still spread across the working width.

Western Australian based, WestOz boilermakers have developed a range of bolt-on kits to fit most harvester brands. WestOz reportedly sold 8 chaff-lining kits in 2016 working with WA growers and 58 in 2017.

Prices start at $3500 and extend to $5000 (excluding GST) with kit availability for John Deere S-series, 50, 60 and 70 series STS and Case IH 120, 230 and 240 series. New Holland and Claas kits will be available for harvest in 2018.

CHAFF DECKS

A similar approach to chaff-lining, chaff decks drop the chaff portion of residue in the permanent wheel tracks of a controlled traffic farming system.

Consolidated in the wheel tracks, the seeds can rot as they do in chaff-lining, but if any survive, they have to penetrate the highly trafficked soil and then are likely to be driven over again. If substantial emergence occurs, the weeds can be sprayed out with a targeted application.

Kondinin Group engineers have seen a number of home-made units, but Primary Sales are the agents for the commercially-built Emar chaff-decks.

Five chaff-deck owners we spoke to reported the chaff decks to be both simple to use and reliable despite two indicating that fitment instructions could be improved.

As a side-benefit, one owner who used a chaff-deck in 2017 reported significantly reduced dust levels when conducting post-harvest summer sprays.

Contact:
Primary Sales
08 9250 3500
www.primarysales.com.au

Chaff Deck: Places weed seeds into permanent wheel tracks where crops are not grown. Chaff decks rely on the seed rotting or not germinating due to the compacted soil in the wheel track.

Chaff mills: The buzz-word in harvest weed seed control, but enthusiasm is tempered with high capital outlay requirements. Data gathered in 2017 by Kondinin Group engineers would also suggest high costs and complexity are a potential hurdle to their mainstream adoption.

CHAFF MILLS

Chaff mills capture the chaff portion of residue and subject it to intense physical damage before spreading it behind the harvester.

While credit must go to Darkan WA farmer Ray Harrington for persisting with the concept, and GRDC for funding the research and path to commercialisation behind it, the concept of chaff mills has been around for some time.

For members who have a lifetime legacy library of *Farming Ahead* magazines, look at Issue number 114 page 35 where a fresh-faced engineer, our very own Josh Giumelli, wrote about the Harvestaire Rotomill which had been successfully trialled in 2000.

Prior to the integration of the chaff mills, a tow-behind option with a separate engine was sold.

Today, 17 years later, two manufacturers currently offer a harvester-integrated chaff mill; DeBruin Engineering and Seed Terminator, both from South Australia.

The mill designs differ slightly to overcome patent infringement issues but both have stators and rotational components.

The iHSD has two mills with left and right hand sides counter-rotating. Mills and stators are fully welded with two stator sections and three rotor sections with a central fan. The fan and rotors are hydraulically driven via a stand-alone system, with a hydraulic pump coupled to the harvester's engine and a separate oil cooling system.

Two styles of mill are available, a high-flow and mid-flow which operate at 3000rpm and 2750rpm respectively. Kondinin Group engineers only inspected and gathered data from high-flow specification mills and understands DeBruin is working on a mechanical drive iHSD product for class 6, 7 and 8 machines.

The Seed Terminator also uses two mills, each with a centre-mounted set of flail-like hammers and rotary bar components. Three sets of stationary screens are fixed to a top plate and mount between the rotors. Screens are fabricated using laser-cut hardened steel sheet and rolled, perforated hardened steel sheet sections. Openings between the screens allow the chaff and weed seeds to pass through to the next mill section. Opening positions can be rotated to provide varying levels of "aggression".

The Seed Terminator is mechanically driven using the harvester jackshaft to drive the system via sets of pulleys and belts, and a 90-degree gearbox. Drive pulleys under the mills can be changed to deliver 2850rpm speed mills via 224mm diameter pulleys or 3000rpm with smaller 212mm diameter pulleys. Both mills rotate in the same direction, clockwise.

Deeper analysis of the respective performance of each make is detailed from p26. Having spoken to the owners of over 20 chaff mills, Kondinin Group engineers recommend farmers looking to adopt a chaff mill for harvest weed seed control thoroughly understand the economics relative to their operation.

The primary benefit offered by a chaff mills is the ability to return all of the nutrients to the paddock with none removed as is the case with other harvest weed seed control methods.

The financial benefit of a full residue return is difficult to quantify, but according to AHRI removing the chaff portion (15% of total residue) with a chaff cart or chaff-lining chute removes $2.25 in nutrient value per tonne of wheat grain harvested. Removing 50% of the total residue with narrow windrows or bale direct therefore removes $7.50 in nutrient value per tonne of wheat grain harvested.

Because about half of the residue nutrient value is in potassium (the other half is N), soils with high levels of potassium can see these nutrient benefit values halved.

EFFICACY

iHSD efficacy is quoted at between 96 and 99% reduction in viability of weed seeds going through the mill with the range related to the 11 weed species tested. In-field observations by Kondinin Group engineers suggest the Seed Terminator is at least equal to this. Stator screen position settings vary the aggressiveness of the Seed Terminator mill action, and we understand testing is currently being performed to quantify viability at various stator positions.

CAPACITY IMPACT

Chaff mills consume a considerable amount of power to drive the mills at around 3000 rpm. Early estimates put the power requirement of the iHSD at around the 60kW mark.

Comparable fuel use and capacity figures from 2017 would indicate that the Seed Terminator is consuming similar levels of power despite a more efficient driveline. Overall, this power draw has an impact on the capacity of the machine. Kondinin Group engineers observed two trials where maximum capacity was compared while maintaining all other variables. Both trials in wheat saw a reduction in harvester capacity of between 12 and 20% with the chaff mills operating. In all cases, the harvester's engine had been remapped to minimise the impact of capacity reduction.

Capacity reduction imposes a significant cost to the harvesting operation. Lower tonnages of throughput per separator hour ultimately cost growers money through machine depreciation with more hours required to harvest the same area of crop.

REMAP ESSENTIAL

To overcome the reduction in capacity through the use of a chaff mill, 71% of growers Kondinin Group engineers visited had either remapped or added an engine performance chip to their harvester to extract more power from the engine.

In an on-farm trial investigating the impact of remapping, a New Holland 8.90 fitted with a Seed Terminator in Sceptre wheat averaged just 20.5t/h without a remap and 23.2t/h after an engine remap.

Fuel efficiency was also improved by around 15%.

If considering a chaff mill, we recommend factoring in the purchase of an engine remap or chip to regain some of the reduction in machine capacity. An engine remap or chip will typically come at a cost of around $4,000 installed, but fuel savings will likely see it pay for itself in a single season.

Any resulting warranty implications for a new machine should also be considered with the installation of a chip or engine remap.

Tough nut: Wheat is the hardest crop on chaff mills for wear but green material including re-shot canola can see them block quickly.

CROP EFFECTS

Crop type and condition has a significant impact on capacity. In cereals, wheat delivers the highest flow rate of chaff so is the most difficult crop for chaff mills to handle.

Barley has a slightly higher harvest index (ratio of grain to residue) than wheat, but barley has a higher ratio of straw to chaff. This means the capacity impact through the use of chaff mills in barley is less pronounced than in wheat.

Canola and lupins have higher ratios of chaff to grain than cereals, but most notably, green material, particularly in canola, has a severe impact on mill performance and can cause mills to block quickly. Examples include areas where green wild radish plants are harvested and canola where patches of still-green material are prevalent, for example, near water courses. For this reason, genetically modified varieties and re-shot canola also proved to be more challenging. But pulse crops presented the biggest problem to operators of chaff mills, with the low-cut harvesting requirement pulling a lot of sand and soil through the harvester.

SAND AND SOIL THE ENEMY

Sand and soil picked up when harvesting pulse crops works its way back to the mills and causes premature wear. In one instance, outer mills on a Seed Terminator lasted less than 200 operating hours harvesting 400ha of canola, 320ha of faba beans and 400ha of wheat.
According to the operator, the faba beans carried a lot of soil which caused high levels of mill wear.

Owners of John Deere S-series machines said they expected to see the left hand mill wear more quickly than the right due to the S-series typical left-hand side loading bias over the sieves.

But when the right-hand Seed Terminator chaff mills on three S680 harvesters were wearing prematurely, further investigation revealed sand was being drawn though the cleaning fan intake behind the track.

While most prevalent on John Deere S-series on tracks, the same issue was noted, albeit to a lesser extent by owners of other S-series machines on tyres.

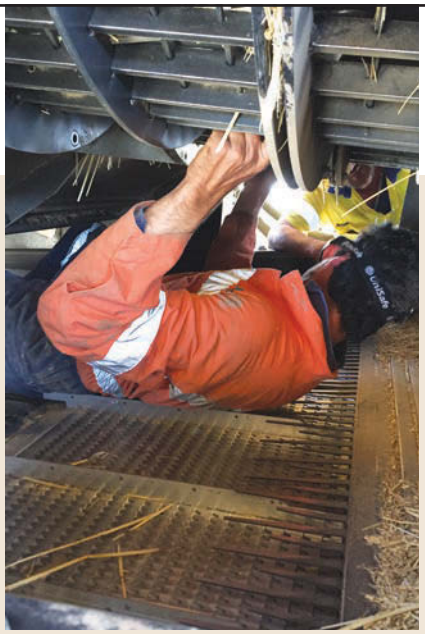
Blasted to bits: This Seed Terminator mill stator came from the right-hand-side of a John Deere S680 and shows considerable wear on the outer cage. Note the missing sections of perforated cage.

SEPARATION IMPACTS

Segregating chaff and straw streams effectively is essential in any of the chaff removal options, but in a chaff mill scenario, volumes of straw entering the mill can cause problems. Straw loading will reduce mill capacity, can overload or bridge the mill intakes and will ultimately prematurely wear the mill.

To prevent this from happening, baffle plates were fitted to most harvesters behind the beater. The beater acts as an accelerator for straw coming out of the rotor, with the assistance of the baffle for guidance, it throws straw over the top of the chaff mill intakes into the chopper at the back of the harvester. Achieving the optimal baffle plate positioning can be tricky with kill-stalls helpful in indicating the volume of straw potentially flowing through the mills.

A number of New Holland 10.90 owners had the optional Positive Straw Discharge (PSD) fitted which uses a belt conveyor behind the beater to deliver straw to the chopper. Potentially, this improves straw and chaff separation, but adds a level of complexity to the straw flow. There was no significant difference observed regarding mill life or capacity between machines using a baffle and those with a PSD. Where no baffle or PSD was used, premature mill wear was observed in an iHSD on a New Holland 10.90 after just 140 hours of operation covering 1000ha of wheat averaging 3.4t/ha.



Concaves and settings may need adjustment to minimise grain loss and the volume of small straw going through the mills.

CONCAVE SETTINGS

In the same way straw and chaff separation is important behind the rotor for chaff mill efficiency, concave settings are also important in getting the thresh right without over-threshing small sections of straw into the chaff stream. Some operators trialled soybean grates, closing up the open area at the back of the rotor, but no significant difference in capacity was measured.

INTAKE BRIDGING

Mill intake bridging becomes a problem when the bridge breaks and chaff floods the mills, potentially causing them to stall and requiring an unpleasant and time-consuming manual clean-out.

Both chaff mill systems had low mill-speed alarms but where a bridging issue occurs, there is little warning for the operator as the mills grind to a halt with the surge of chaff. One operator saw this as an opportunity for improvement, developing and commercialising a multi-beam bridging detector.

Called the ChaffSense, the system has an in-cabin alarm alerting the operator that a bridge has formed so the harvester can be immediately halted and the surge allowed to process through before resuming forward operation.

Dusty: The pulverising action of the chaff mills on these New Holland 10.90 harvesters significantly increase fine dust levels and reduce visibility for the operator.

Redirected: iHSD owner Roger Newman modified the outlet deflectors on his mills to divert dust downwards.

DUST

Having milled the chaff component, the resulting product coming from the chaff mills is an enormous volume of dust.

This can reduce clean-down and filter cleaning intervals and make operating difficult depending on prevailing wind.

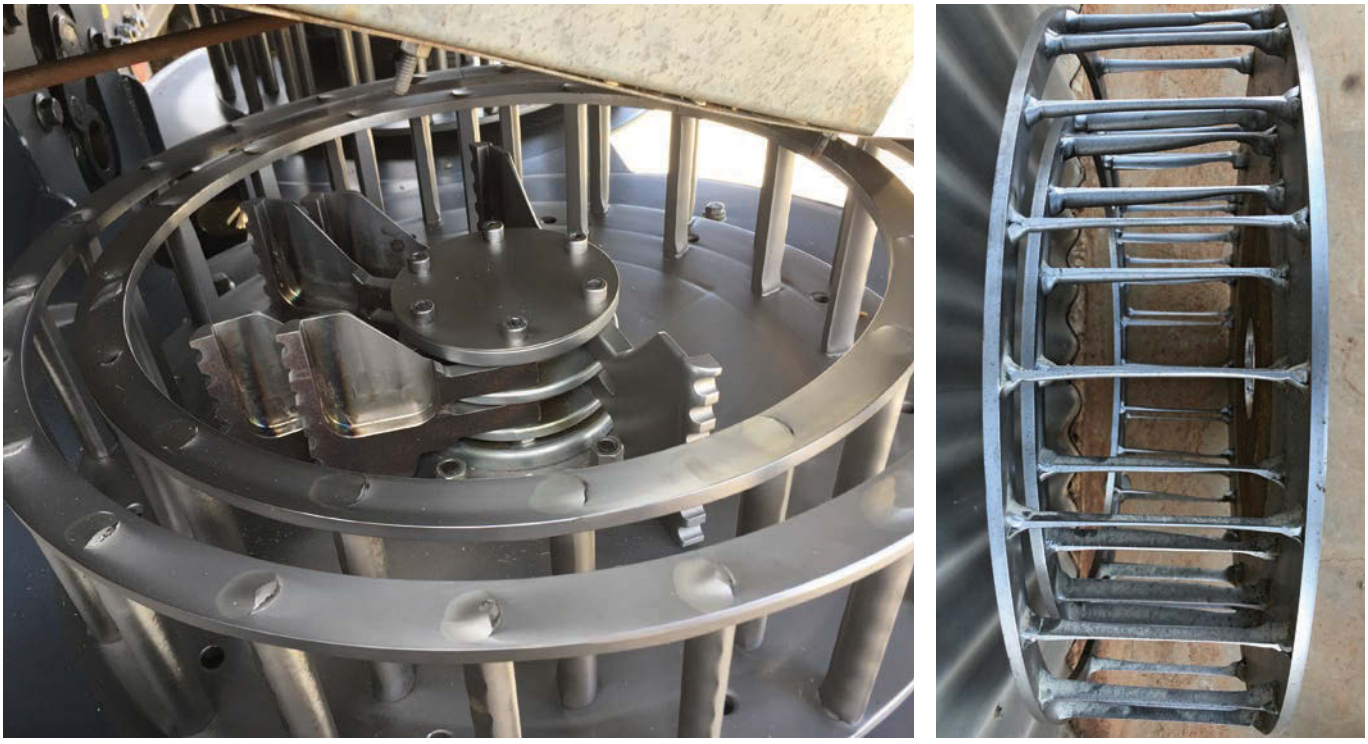
Visibility can also be severely hampered which can increase the risk of machine damage and reduce operational speed.

Increased levels of fine dust also increases potential fire risk and therefore the requirement for increased hygiene. One operator of an iHSD, Roger Newman from Cuballing WA, modified the outlet deflectors on top of his chaff mill to push the dust stream down and keep it separate from the air-stream of the straw spreader.

Mill running cost breakdown

Understanding the running costs of a chaff mill is a little more complex than other harvest weed seed control options. Comparatively, there is an initial upfront cost which is in the order of $115,000 or $160,000 fitted excluding GST for the Seed Terminator and iHSD respectively. Based on a 5% rate of return, there is an opportunity cost of around $5–8000 annually to purchase a chaff mill. Depreciation costs are largely unknown. Despite the differences in capital cost, operating costs are similar.

2017 Figures collected by Kondinin Group engineers suggest that on a per tonne of grain harvested basis, both the Seed Terminator and iHSD used similar additional fuel volumes. They also had comparable consumable component costs.



Naked mills: Mill running cost can be significant due to wear which can out-strip fuel costs on a per-tonne of grain harvested basis. Note the differing designs with the Seed Terminator with internal flail hammers and rotor bars (left). A heavily worn iHSD mill rotor (right).

Fuel use for both the iHSD and the Seed Terminator were surprisingly on a par.

FUEL USE

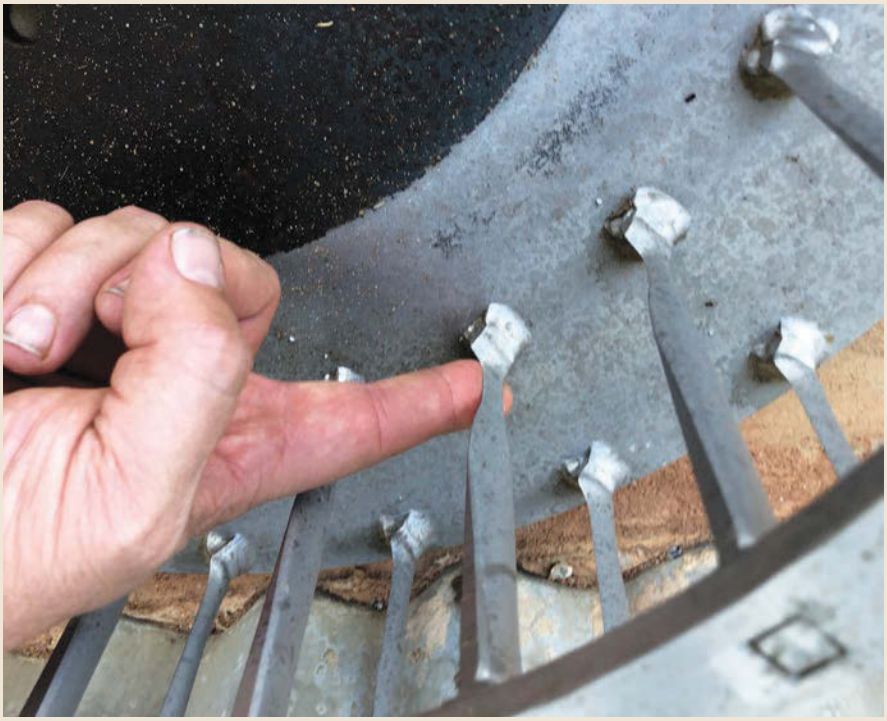
Kondinin Group engineers were surprised to observe both the iHSD and the Seed Terminator used comparable volumes of fuel in addition the regular harvester fuel consumption.

Mean fuel use across five machines with iHSD fitted covering 2300ha of wheat averaging 3.2t/ha was 3.7l/t of grain harvested.

Harvesters with Seed Terminator units fitted covering 1840ha of wheat averaging 2.9t/ha delivered a mean fuel use of 3.8l/t.

For comparison, five similar specification harvesters without chaff mills running in 2500ha of comparable wheat crop conditions (3.0t/ha) averaged 2.3l/t

While there is a slight inverse correlation with fuel use and crop yield, additional fuel use for the chaff mills alone averaged around 1.5l/t. At a nominal cost of $1.10/litre, this equates to $1.65/t and in the context of other mill running costs including capacity and consumables, this fuel cost is considered minimal.



Chaff Mills: cost/benefit
(Example for 2000ha wheat at 2.5t/ha)

Additional Fuel:	$1.65/t ($4.13/ha)
Mill maintenance:	$1.75/t ($4.38/ha)
Capacity cost*:	$2.46/t ($6.15/ha)
Opportunity cost:	$1.20/t ($3.00/ha)
Total Cost:	**$7.06/t ($17.65/ha)**
Total benefit:**	**$2.25/t ($5.63/ha)**
Net cost of harvest weed seed control:	**$4.81/t ($12.02/ha)**

Assumes 16% reduction @ $450/h and 25t/h capacity
***Assumes low K soil benefits from nutrient retention*

Extracting maximum life: Getting the most out of a pair of rotors valued at over $3000 is important, so understanding what mill life could be expected with a benchmark wheat tonnage figure would be useful. These iHSD mill rotors are at the end of their useable life after just 305h of mixed operation including 700ha of canola @0.6t/ha, 300ha of oats @3.3t/ha, 1800ha barley @ 3.3t/ha and 80ha wheat @ 2.5t/ha.

MAINTENANCE

Mill life varied considerably, largely depending on crop type. From a maintenance perspective, the rotor and stator components are the primary consumables.

Putting a measure on mill life is tricky, but a standard of sorts needs to emerge to gain an understanding of what can be expected.

Rather than quoting mill life in hours, we suggest a figure reporting expected total tonnes of wheat would be less ambiguous. Admittedly, variations in soil and sand loading depending on cut height could influence this figure, but we believe it would provide a more realistic measure of expected mill life.

As late as August 2017, quoted "facts" suggested iHSD mill life could be expected to be between 800 and 1000 hours of operation. At 30t/h in wheat, that equates to 24–30,000 tonnes of operating life. None of the 10 iHSD owners Kondinin Group engineers visited were even able to achieve even 50% of that.

In terms of costing mill life, one operator estimated the overall maintenance cost at $1.75 per tonne of wheat harvested. This estimate was confirmed by three other owners who were yet to receive final invoices for consumables but suggested this nominal figure was within 10% of their estimates. It is interesting to note this figure alone exceeds the fuel cost associated with running the mills.

CAPACITY COST

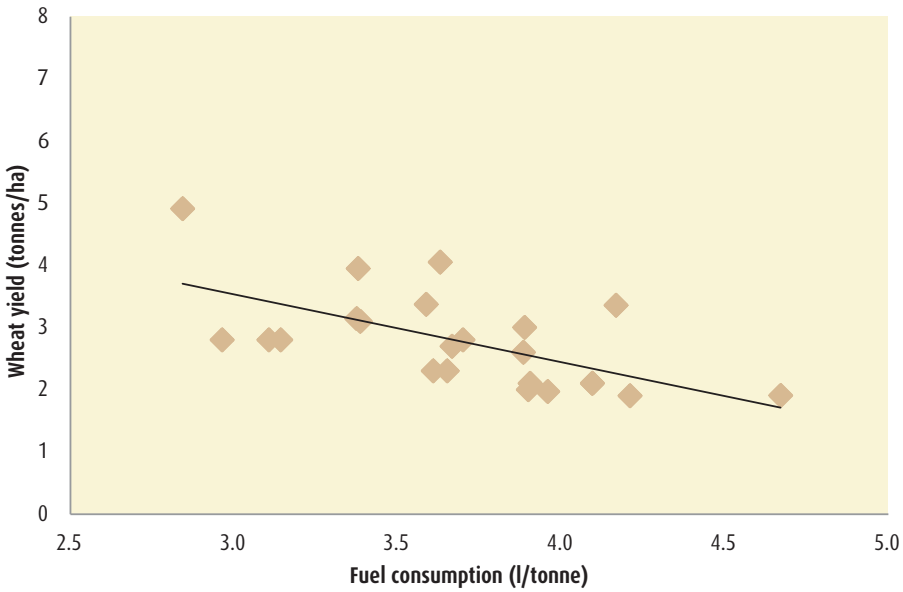
Consultants in Western Australia use an operational harvester cost of between $400 and $500 per separator hour including depreciation when calculating input costs. This is likely to be lower for machines with more separator hours on the clock in accordance with a depreciation curve.

With a reduction in operating capacity of between 12 and 20% even after an engine remap, one of the more substantial costs is therefore additional operating costs including depreciation. For example, if harvesting 2000ha of 2.5t/ha wheat crop at 25t/h, the cost of additional depreciation through reduced capacity would be between $1.71 and $3.33 per tonne of harvested grain or between $4.29 and $8.33/ha. There is also an increased standing crop risk if harvest is slowed.

WARRANTY IMPLICATIONS

Integrating a chaff mill in a new harvester will undoubtedly see the machine work harder, so questions around impact on warranty are well-founded. According to industry contacts, the integration of chaff mills will see warranty voided and owners forking out for repairs to the harvester at the "adjudication of the manufacturer".

Figure 1. Fuel use (litres/tonne) relative to crop yield in harvesters using chaff mill



HIGHER YIELD IMPROVES EFFICIENCY

When discussing fuel use we noted a slight inverse correlation between yield and fuel use. See figure 1. This reduction in fuel use as yield increases is likely to be due to the relative reduction in basic in-field fuel consumption including the rolling resistance of the harvester relative to the volume of grain being harvested. ▶

CHAFF MILLS: A COMPLEX HISTORY

Ray Harrington, a farmer from WA, received an Order of Australia medal for his work championing the HSD which partly bears his name in recognition of his efforts.

But the path to commercialisation has been complex.

The hullabaloo around the two competing products centres on the development of the iHSD which was funded by GRDC and was designed at the University of South Australia. Patent documents list the inventors of the iHSD as Nick Berry and Chris Saunders and the assignee as the University of South Australia and the GRDC.

It could be argued that the process of commercialising the iHSD product could have been better handled. Grower funds invested in the product for commercial return, now have a competing product in the market, developed by a common talent with all the background knowledge and expertise in the iHSD's development.

It could also be argued that this is a healthy outcome and that market competition will ultimately deliver a superior product. But on face value, it does appear as a dilution of effort with two parties striving for a similar outcome.

THE FUTURE

Kondinin Group engineers are aware of at least three other companies working on the development of a harvester-integrated harvest weed seed control solutions.

All three focus on mechanically damaging weed seeds contained in the chaff portion of the residue stream. Two are large international companies involved with harvesters and harvester components while the third is another Australian-based company.

We expect to hear more about each of them before the 2018 harvest and will bring members more details as soon as we are able to.

GRIST TO THEIR MILLS? OWNER EXPERIENCES IN 2017

Kondinin Group engineers visited the owners of 20 harvesters fitted with chaff mills. Most were located in Western Australia.

Experiences varied, from a relatively trouble-free harvest, to serious downtime and issues including fires caused by chaff mills. With a substantially more efficient driveline than an iHSD, Kondinin Group engineers expected the Seed Terminator to deliver lower fuel use figures and a reduced impact on capacity. But despite the iHSD running an independent hydraulic system, both systems consumed similar volumes of fuel per tonne of grain harvested and had comparable reductions in machine capacity over a similar machine without a chaff mill fitted.

Having inspected numerous units and the resulting chaff dust, Kondinin Group engineers surmise this is because the Seed Terminator mill may be over-processing the chaff fraction.

Testing would need to be conducted to confirm this, but with a more efficient driveline and comparable power draw and fuel use, it would be expected that the Seed Terminator would devitalise weed seeds with less power drawer and fuel use than the iHSD.

SEASON SUMMARY: IHSD

Seventy iHSD units were reportedly in operation nationally during the 2017 harvest according to DeBruin, the company selected by the GRDC and UniSA to manufacture the iHSD.

Distribution of the mill is via McIntosh distribution who in-turn fit and provide parts and backup for DeBruin.

Owners generally had high levels of praise for the service provided by McIntosh, reporting commitment to the product with prompt service attention and supply of parts through their network.

But iHSD owners did report a number of common issues in 2017. In one instance a serious fire occurred when a mill failed causing damage to the harvester.

We put these issues in a Q&A format to iHSD manufacturer, DeBruin Engineering requesting an update on the issues raised by owners.

With a reduction in operating capacity of between 12 and 20% even after an engine remap, one of the more substantial costs is therefore additional operating costs including depreciation.

QUESTIONS FOR DEBRUIN ENGINEERING REGARDING IHSD

1: There were a number of significant issues with the iHSD mill shaft tapered roller bearings in 2017, has this now been rectified and what is the final solution?

Ultimately, this was a bearing unit design flaw that was identified midway through the 2017 harvest, an interim fix was developed to prevent further issues and rolled out to every customer through the iHSD Product Support Network during harvest. Our top priority in 2018 is the redesign of the bearing housing and shaft, with major bearing manufacturers involved in the design and manufacturing process. The new design has features that both improve the reliability and simplify maintenance on the bearings. We will present the solution to existing customers as soon as possible, once the new bearing is adequately reviewed and tested. Of course, the solution will be rolled out to all iHSD customers with minimal inconvenience ahead of the 2018 harvest by our iHSD Product Support Network.

2: Have issues with software been resolved? (We understand this was causing memory-full shut downs)

The issues we had with software presented as a voltage drop which led us to look at the electrical system as the cause initially. We identified and corrected the issue and updated the software, we can report that operators completed the 2017 harvest without further recurrence. The software is being further modified to be used within a new testing framework that allows us to extensively test the system out of field and prevent recurrence of identified issues.

3: The iHSD screen is very large with a lot of additional information (the most important information, mill-speed, is well out of the line of view for the operator) – is there likely to be an option of a reduced size screen or optimised layout in 2018?

Our original size was chosen to support the optional video feed, however we have taken on that our customers have preferred no camera, or to use our optional infrared camera system. We have ordered several smaller screens to review their form and function. We will apply the feedback from users to improve the screen functionality, layout and customisation.

4: Are all components now fused and are the voltage stabilisers fitted to some units in 2017 required?

All components are fused at the factory. Voltage stabilisers were installed on some machines to eliminate voltage issues related to the above software issue.

We plan to review the electrical circuit in response to differences in combine power sources and in field operational requirements. Some of these circuits may benefit from the addition of a voltage stabiliser.

5: Mills tend to be wearing more at a point near the bottom plate making this the dominant point of attrition. Why is this? Is there a solution for this to extract maximum life out of mills?

There are two dominant factors involved in that pattern of mill wear: ▶

Image: iStock.com/MetalArena

Firstly, material being processed will naturally fall to the bottom of the mill and the heaviest materials are the most abrasive.

Secondly, the process of welding the mill bars changes the material properties of the hardened steel we use, effectively softening the steel at and around the wear point, this particularly affected the material we used in 2017 mills.

We have reverted to the material used in 2016 mills which performed adequately in the field, and we are currently testing new materials and manufacturing methods to provide the best wear resistance and value for money. It's part of our continual R&D program to improve mill wear, life and throughput as we continue to improve the iHSD products over time.

6. Please confirm mill and stator costs and any available options.

Retail prices will remain Rotor fans $608; Rotor $1650; Stator $2085 (excluding GST)

Stators come in hi-flow and mid-flow options both provide product class leading weed seed kill rates. The hi-flow stator provides optimal seed kill at 3000RPM and provides the highest throughput. The mid-flow option provides excellent weed seed kill rate but does so at 2750RPM with reduced throughput.

7: With an additional season of in-field operation completed, is there any update regarding expected mill life in wheat (can this be quoted in tonnes of crop harvested?):

a. Are we able to specify expected life for: (Rotor and stator)?

b. If not, can an indicative range be given?

It could be misleading to quote mill wear life in those terms because of the variance seen in soils and cutting heights that we see operator to operator.

We have seen rotors operating for 600+ hours across multiple crops including wheat, others less excluding the excessive wear seen in 2017.

It is our goal to continually improve wear rates and mill life while maintaining throughput and our product class leading weed seed kill rates.

We won't be lowering our straw separator to reduce the volume of chaff processed as we want to catch every weed seed and destroy as many as possible.

One annual ryegrass plant can produce up to 1000 seeds (Stanton et al. 2002), so every percentage drop in kill rate is a step further from controlling weeds. To gain control over weeds you have to be as effective as possible in killing weed seeds.

8. We understand there is a mechanical drive option in development and options for smaller capacity machines. Is this expected to be available commercially in the next 12 months?

We have been developing several additional iHSD products but we still have some work to do before they are available commercially.

Mechanical drive systems have additional safety factors to consider with exposed mechanical components that require adequate guarding, we also wish to retain control of the mill operation. We have added other features to this system in response to requests from customers with our hydraulic driven system.

There will be a limited number of mechanical drive systems available this year for pre-production testing suited to a small range of class 6, class 7 and class 8 combine models.

9. Regarding the rotary screens on the hydraulic oil cooler – some were observed with brushes, some without? What is the latest design for the rotary screen? Is fitment of a cooler behind the harvester rotary screen only an option on 10.90's?

Another area of continual improvement; your readers would recognise that screening changes frequently on agricultural equipment.

Effectiveness of screening varies across regions, crop types, and weather conditions. It's a balance to get it right but I believe we are improving the product.

The integrated cooler option was only available on NH CR10.90s but that option is no longer available.

10. Observations were made where oil was insufficiently cooled, this caused fusing of the plastic hydraulic hose wrap. Are there any plans to reduce operational oil temperatures?

Particular models of combine have provided additional challenges to cooling due to the very hot exhaust systems and space limitations.

We have addressed and implemented solutions to effectively cool the hydraulic oil. This solution has significantly reduced the oil temperature, and users have been satisfied with the results.

11. What is the RRP of an iHSD?

The current iHSD H600 hydraulic drive systems retail from AUD$160,000 ex GST delivered, installed and commissioned on Claas machines with pricing on other combines model and option dependent.

Pricing on iHSD mechanical and lower power variants are yet to be confirmed but these will retail below the price of the hydraulic system.

12. Please list all machine series an iHSD can be purchased for:

Presently the iHSD hydraulic driven system can be fitted to:

- Case IH 9120 8230, 9230, 8240, 9240;
- New Holland CR9090, CR9080, CR8.90, CR9.90, CR10.90;
- John Deere S680, S690; and
- Claas 770, 770TT, 780, 780TT.

We are expanding the list of supported models each year and the introduction of mechanical drive and lower power options will see the addition of new and in service combine models in 2019.

Our top priority in 2018 is the redesign of the bearing housing and shaft, with major bearing manufacturers involved in the design and manufacturing process. The new design has features that both improve the reliability and simplify maintenance on the bearings.

SEASON SUMMARY: SEED TERMINATOR

Around 32 Seed Terminator units were operational nationally in 2017.

Owners reported outer stator screen wear at an approximate ratio of 3:1 with the inner screen. Fortunately these screen sections can be individually replaced.

Outer stator screen life varied between machines with one owner using two John Deere S680 harvesters with Seed Terminators to harvest 1540ha wheat at 4t/ha, 1060ha barley at 4.5t/ha, 1800ha bonito canola at 1.17t/ha. Outer screens on both machines were due for replacement at the completion of harvest. Note that for an individual machine, these figures should be halved.

Others were only able to get 800ha (120h) of wheat at 2.5t/ha out of a set of outer screens and had to replace the middle screen set at 1700ha (225h). This same owner also trialled a new tungsten-coated screen set provided by Seed Terminator and reported significantly improved wear rates. Other owners trialling the tungsten-coated screens reported similar outcomes.

The majority of owners were running mills at 2850rpm, but two had changed up to the 3000rpm by swapping over the drive pulleys and adjusting the idler settings.

Despite the high power load and speeds, only two owners reported having to replace belts during harvest.

Most owners were happy with the overall performance and build quality of their Seed Terminator. Concerns were primarily regarding reductions in harvester capacity, mill wear and resulting consumable costs.

Considering the comparative efficiency of the driveline, Kondinin Group engineers believe the Seed Terminator may be over processing the chaff stream. If so, this may be impacting both capacity and mill wear rates. With an absence of test data to demonstrate kill rates at varying mill speeds, mill aggressiveness settings and resulting impacts on both mill life and capacity, we put a series of questions to the Seed Terminator team.

Most owners were happy with the overall performance and build quality of their Seed Terminator. Concerns were primarily regarding reductions in harvester capacity, mill wear and resulting consumable costs.

QUESTIONS FOR THE SEED TERMINATOR TEAM

1. What is the cost of consumable mill components (inner rotor, outer rotor, stators, hammers)?

We are in the process of completing a full component list and cost from 2017 and updating this for 2018; we expect the full list to be finalised for 2018 by the middle of February.

2. With a full season of in-field operation completed, is there any update regarding expected mill life (can this be quoted in tonnes of crop harvested (wheat pref.)?):
a. Given they vary, are we able to specify expected life for: inner rotor, outer rotor, stators, hammers?
b. If not, can an indicative range be given?

We are currently completing review of the 32 Prototype Seed Terminators across four Australian states and are aiming to release this information in March 2018. We have already commenced research into the lessons and learnings in regards the performance of the Seed Terminator in a wide range of conditions, by make, model and the users.

The indications so far are that the major cause of wear is any soil that reaches the mill. When harvesting crops with the front right on the ground or if the ground is undulating, soil can enter the harvester fronts. For high silica soil types wear rates are highest. Outer screens are the first component to wear (because of maximum material speed).

We have seen uncoated outer screens last anywhere from in worst case conditions under 100 hours in wheat to finishing a season of 400 hours with acceptable wear. The middle and inner screens last proportionally longer (reduced tip speeds) than outer screens. Rotor and flails are similar to middle screen life. We have learnt that there is another compromise that needs to be managed; cutting height to capture weeds and wear rates because of soil entering the front. We are committed to improving wear life as part of our priorities of creating the best technology possible, get it to as many farmers as possible, as quickly as possible and as economically as possible.

3. Are the two mill speeds needed? If so in what scenarios would this be recommended?

The multi-stage hammermill provides flexibility to setup for different crop conditions. Just as a harvester is setup differently for different crops, we believe that there is no perfect setting for the entire cropping program. The high-speed drive improves capacity in tough conditions such as green straw or frosted crops that are more difficult for the mill to clear.

High speed also increases pulverisation improving seed kill for more challenging seeds (eg. lighter airborne seeds, and high moisture content seeds). However, running at high speed increases power draw and wear. We are still learning about the best way to set up the Seed Terminator in different conditions and are relying on user feedback to help us.

Harvesting grain in a timely manner must be the number one priority so our machine downtime and power draw must be minimised as much as we can.

4. When should the varying "aggressiveness" (cage position) settings be used?

Screen position is another setting for crop conditions. Screen positioning determines the residence time 'cap'. That is, it determines maximum time in the milling zone. Current recommendation is to run at most aggressive setting unless there are capacity issues (tough conditions, frosted material, green material) and amount of power draw can be reduced by reducing agressiveness. Additionally there is an ability to change individual screen sizes.

Again we are learning about best setup and are relying on users of our prototype machines to guide us. SAGIT is funding a project with Trengrove consulting that is looking at seed kill performance under different settings and data will be available later this year.

5. We note that the idler pull the side belt away from the drive pulley on CaseIH machines reducing the wrap angle. Why is this?

We use Kevlar metric belts (SPB) for this drive. The section has a taller cross section than classic B section belts, which means significantly more drive capacity but bending stresses are higher. We use inside idlers where possible for reduced belt fatigue and improved life.

6. Kondinin Group research indicates the additional fuel required to operate the Seed Terminator is comparable to that used to run an iHSD. With a substantially more efficient driveline, is it possible the Seed Terminator is doing too much at the mill (over-processing)? Could it be made less aggressive and still achieve what is expected (also prolonging mill life)?

There are two parts to the efficiency of this technology. The first is the proportion of energy that is going into the chaff to do useful work (pulverise chaff to kill seeds) relative to the energy wasted in driveline power and energy to pump air (no load power). We have spent a lot of time minimising both the drive waste (with a grave yard of power transmission parts) and minimising the no load power (through aerodynamic elements).

The second part of the efficiency is what is the right amount of pulverisation or 'kill'? There is an argument for all levels of chaff pulverising. Less pulverisation to save power and wear; more to give head room when pulverising smaller airborne seeds or if the moisture content goes up. The sweet spot is something that we are continually refining. In 2017 what we understood from the market was that they want maximum lab kill results and anything less was not acceptable.

We wanted to make sure we were doing a great job of the kill and had set machines up to optimise kill; overkill rather than underkill. Out of the box we setup MY17 Seed Terminators with most aggressive screens and many growers moved to high speed drive to ensure maximum kill and capacity.

However, like a lot of things, there is always a compromise and we are working hard to understand that compromise. Harvesting grain in a timely manner must be the number one priority so our machine downtime and power draw must be minimised as much as we can. Maximum kill means more power and more wear. At the end of the day only what enters the front and is threshed out of the rotor can be killed. There is also the law of diminishing return; the additional power to achieve a few percent more kill is significant.

Furthermore, the importance of the percentage kill in lab for field performance is a question that needs answering. Research from Oklahoma state in the 90's using hammermills to kill weed seeds that exit a harvester in the chaff residues showed that achieving high level of seed kill in the field required significantly less damage than for lab-scale germination. Slightly damaged seeds struggle to survive in the hostile environment of the soil but can germinate in the lab. We need to understand this better so that we are aiming for an economic proposition in the field rather than be obsessed with achieving 100% kill in the lab.

Luckily the multi-stage hammermill is inherently adjustable (speed, screen size, screen aggressiveness). First set of tests in January 2018 show that 15–20% power reduction is looking very achievable within current design framework. Currently we are relying on manufacturing expensive prototypes based on simple statistical models to improve mill design. In parallel we are investing in developing brand-new computer modelling techniques that can capture the complex phenomena occurring in the multi-stage hammermill; crushing, grinding, shear, impact and size classification (screening) so that we can more rapidly improve our mill performance.

7. We have observed the trials with hard facing – is this likely to become standard or optional? What is the expected additional cost and operational life over a standard mill?

We are looking at a range of options to economically improve wear life and our best option at time of manufacture will be standard as part of our commitment to making the best technology possible.

We have found certain coatings have seen significant improvements over standard, hardened steel mills but there are a number of challenges in using the coatings.

8. Higher levels of mill wear was reported by some users on the LH side of John Deere machines, presumably because that is how the sieves get loaded. Is there any fix for this issue? Should both sides of a mill component be replaced at the same time, or can they be individually replaced as they wear?

There are some harvester setups that can improve distribution on the sieve (eg. concave blanking plates). An additional option would be to swap the left and right mills when they are halfway worn (they are identical and spin the same direction). Otherwise, all components can be replaced as individual components (flail set, rotor, inner screen, middle screen, outer screen).

9. Wear from sand entering through fan intake (near the front RH harvester wheel/track) appears to be an issue on John Deere machines, particularly those on tracks. Are there any plans for a modified intake for John Deere machines to reduce mill wear?

It wasn't until late in the season when one of our farmer research partners discovered what was happening.

We have tried some field fixes which have seemed to help but we are looking at putting together a panel kit to reduce this issue.

10. Dealer networks can assist in providing timely service and spare parts. Are dealership agreements being established? If so where will these be located?

We have engaged select dealers over the past year and they were invaluable in the 2017 harvest; Dealership agreements are being completed and are expected to be in place by end February 2018. We will expand our network in 2018. Dealerships we worked with in 2017 were:

- WA: AFGRI Equipment, AG Implements, Boekeman's machinery, Farmers centre 1978, Farmers centre WA; and
- SA: Wickam Flower.

11. What is the RRP of a Seed Terminator?

As with 2016 and 2017, sales of Seed Terminator in 2018 are prototype sales. We haven't got all the answers yet and we need our users to help us create best technology possible. 2018 RRP of Seed Terminator base kit is $99,700 plus GST; The Harvester adaptation Kit including delivery, fit-up and commissioning of $14,400–$19,200 plus GST (depending on make, model, year and location).

12. Please list all machine series a Seed Terminator can be fitted to:

As part of our commitment to getting to as many farmers as possible, we are always looking to fit to different machines. We are in the process of designing for Claas Lexion and Massey Furguson. There are many configurations within each series that need to be checked but the following machines have been fitted:

- John Deere: STS9760 (with MAV chopper), S670 (2016), S680 (2018, 2017, 2016, 2015, 2014, T2012), S690 (2017);
- New Holland: CR9090 (2013), CR8.90 (2017), CR10.90 (2017); and
- Case IH*: 7120, 7230 (2012), 7240 (2016), 8120, 8230 (2012), 9230 (2012), 9240 (2017).

*Best performance when internal chopper is fitted

Chopping it up: the last straw

Most harvester manufacturers offer several versions or levels of residue management which cover chaff and straw spreading with chopping options for the straw.

The chopper mechanism is commonly a rotating shaft with several banks of single or dual, reversible knives which work in conjunction with a row of stationary or counter knives. Manufacturers offer several options which vary according to the amount of knives, different levels of functionality (manual adjustment versus from-the-cab) and the ability to cope with cross wind. As well as the factory fitted residue management systems, modules such as the Canadian-made Redekop MAV (Maximum Air Velocity) are also proving popular as an aftermarket product.

Clutching at straws: Spreading straw residue uniformly across the machine operating width minimises blockages at seeding.

MAV

Redekop manufactures a range of straw choppers to suit most current models of harvesters.

The Maximum Air Velocity or MAV straw chopper uses two zones for cutting and spreading, rather than a traditional rotor design that relies on the cutting blades to also spread the straw.

The standard MAV chopper has four rows of long-life blades mounted in pairs on the rotor while the blades are reversible to add extra working life to the unit.

The airflow-generating zone uses Redekop's patented fan blades which are separate to the cutting zone. Specially designed shrouds build up air speed around the six fan blades at either end of the rotor to generate air velocity speeds up to 145km/h.

A MAV Plus+ option provides some extra spread to throw material beyond 12.2m (40 feet).

All MAV Plus+ rotors run larger 50mm bearings on a forged end rotor and the rotors are fitted with larger, tighter tolerance fan blades which increase the air velocity up to 241km/h.

STOP WEED SEEDS IN THEIR TRACKS.....

Reduces weed seed germination
Positively delivers chaff to narrow bands within wheel tracks
Adjustable for different wheel track widths
Models can be provided for most combines
Very affordable
Simple to install and maintain
Australian made from quality materials
Does not impact on combine performance
Reduces dust and water erosion on tracks

PRIMARY SALES AUSTRALIA
www.primarysales.com.au

Secure your order for the coming harvest season (see www.primarysales.com.au)

Designers, Manufacturers and Wholesalers for Agriculture

"The Hay Express" ™

Patent Number 2003901125

Square bale feed-out trailer

Manufactured and Marketed under license

Ask for our latest Hay Express DVD !

Stockfeeding is now quick, safe and easy !

P.O.A.

"The Hay Express" features.....

* Robust steel construction
* 2 tonne rated load capacity
* Stable, easy-to-tow design
* Patented mechanism controls feed-out rate
* Superior W A R N winch mechanism
* Optional breakaway braking system and lights
* Suitable for 4x4, 4x3 big square bales (with an optional kit for 3x3 bales)
* Tandem load-sharing, roller-rocker spring assemblies

and benefits.....

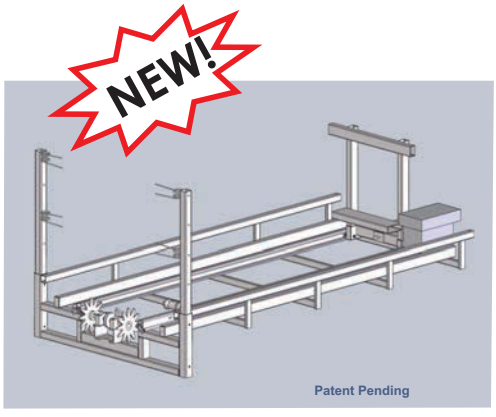
* One person operation
* Considerable time and labour saving
* Safety first (stay in the cab while feeding out)
* Low maintenance
* Wise investment compared with your current feed-out methods
* Can be towed by any vehicle with a tow-hitch
* Feeds hay in "biscuits" so stock can feed from all directions with less trampling and wastage compared to windrows

---

The Hay Express Single-bale, Ute mounted

available soon!

The "son" of Hay Express mounts easily on any substantial farm ute, to provide measured delivery of hay when a trailer is not practical or justified. Made to the same high quality and durability as the trailed version and fitted with cordless remote control and a substantial winch



CLAAS

Claas Lexion harvesters (750, 760, 770 and 780) have a range of straw management options called Special Cut which offer choppers of either 72-knife or 108-knife configurations.

The Special Cut system has the straw moving directly from the rotors to the chopper (with knives in four rows). The package includes an adjustable cross cutter, rasp bar, adjustable friction concave plate and adjustable static (counter) knife arrangement.

Recent changes to the Special Cut include optional hydraulic adjustment of the friction concave plate and static knives.

Changing from straw chopping and spreading to windrowing can be done from the cabin.

Another new feature of the system is the mechanical-drive power spreader where two counter-rotating discs are driven by belts.

Each spreading rotor has two adjustable deflectors and there is an option to run the deflectors in an auto-adjustment mode, using sensors attached to the left and right rear light brackets, effectively providing automatic crosswind compensation.

JOHN DEERE

John Deere S series harvesters have three residue management systems; a basic straw spreader, a Deluxe system and Premium system.

The Premium package allows the operator to drop straw into a windrow for baling for example, while still spreading chaff. The Deluxe package feature John Deere's Powercast tailboard, while the Premium package features an Advanced Powercast system which John Deere claims will spread straw 7.6m–15.24m.

Deluxe and Premium versions of the S700 series have John Deere's integrated wind compensation system which allows the operator to change the offset for the direction of spread to compensate for wind direction.

The Standard package has 44 rotating and 44 stationary counter knifes, two manually adjustable speeds for small grain and corn and changing from chopping to dropping in a windrow is performed manually.

The Deluxe and Premium packages use a 100-knife chopper and in the Deluxe system, there are two manually adjustable chopper speeds for small grain and corn, manual conversion between chopping and dropping and the chaff is distributed through the chopper in chopping mode or dropped below the windrow in windrow mode. Chaff cannot be spread while windrowing straw.

The Premium system allows the operator to change from chopping to dropping straw from the cab and in chopping mode, chaff and straw are distributed through the chopper. In dropping mode, chaff is distributed through the chopper and straw is windrowed, hence there is no separate chaff spreader.

The Powercast tailboard has two hydraulically-driven, counter-rotating disks with paddles. Residue is discharged from the chopper to the spinning disks. The disks' speed of rotation is controlled through the CommandTouch armrest in the cab.

The Advanced PowerCast has two hydraulically-driven enclosed disks and a centre divider that moves back and forth in a pendulum motion.

CASE IH

Case IH offers several versions of straw chopping with a number of different options for the control of chopper speeds and deflectors (manually controlled or in-cab).

The company believes the residue system needs to be thought about in two main parts, the first being the beater or integrated chopper, which is exclusive on Case IH harvesters.

The second part is then the rear-mounted equipment and case IH has three options. Two use different spreading styles (both hydraulically-driven) and the recently introduced Xtra-Chopping system (which is pending successful evaluation for Australian conditions).

The Xtra-Chopping system is an integrated, two-speed system that keeps Case IH's two-speed Magna Cut chopper, which also acts as the discharge beater to pre-chop residue and move the residue into the Redekop MAV chopper.

The Xtra-Chopping design incorporates 96 knives and counter knives (reversible) in eight rows. Straw can be spread or windrowed while adjustable straw guides enable the swath widths to be altered to suit the baler. Changing from windrowing to chopping is from the cab via the AFS 700 terminal.

For Case IH's standard system, the three-sided chutes (to control straw spread pattern) have been replaced with manual-adjust deflectors to provide a more consistent spread pattern. The deflectors are located below the straw windrow chute.

Kondinin Group Bookstore

Browse through our variety of practical manuals, the popular *Workshop Series*, educational resources about farming and agriculture and much more on the ***Kondinin Group Bookstore***!

www.kondininbookstore.com.au

NEW HOLLAND

New Holland's Opti-Spread system is an option on the CR range of harvesters. The Opti-Spread is a fully hydraulic-drive package which runs two counter-rotating discs and each disc has three paddles or vanes. In cab controls allow adjustment of a directional chute, which can be adjusted closer to or further away from the discs, up or down, or to favour either the left or right-hand side to allow for wind compensation.

New Holland has made a few changes to the Opti-Spread package with the recent launch of the CR Revelation series of harvesters, claiming spread widths up to 13.72m (45 feet).

The improvements to the chopper, include an increase in chopper speed.

The chaff spreader has been redesigned with a patented air crop flow system replacing the traditional impact-based design.

Other improvements include V-shaped paddles which should allow material to be thrown further for a wider spread pattern.

AGCO

The integral chaff spreader on the Gleaner S9 Series uses high-volume air passing below the accelerator rolls to blow chaff out the back of the combine. The spreader features an adjustable tailboard and fins to help spread material other than grain (MOG) into a wider swath as it leaves the machine.

On Gleaner S9 series harvesters for straw management, straw exits the rotor discharge where non-grain material is handled by either an impeller or chopper. The S9 series has a mechanical-drive, two-speed chopper. For high-speed chopping, the smaller 19.5 cm chopper drum features 24 knives and an operating speed of 3250rpm to help create enough vacuum pressure to "pull" residue through the mechanism. The chaff spreader is hydraulic drive.

For increased chopping, a retractable, stationary six-knife bed provides better chopping and straw breakup. Baling straw can be achieved by manually changing from a large diameter pulley to the small pulley, reducing rotor speed, removing the standard hydraulic spreader and dropping the residue into a wind row.

AGCO's recently-released Ideal harvester is currently being trialled in Australia and while its features may vary slightly when it's retailed here next year, the basic chopping package has straw dropped by gravity into a 128-knife, two-speed chopper with the knives arranged in eight banks on the rotor.

ACKNOWLEDGEMENTS

Kondinin Group gratefully acknowledges the assistance of many in the production of this report, often in the middle of harvest to provide data, information and photographs. Thanks to Peter Newman, Andrew Todd, Graham Dickson, Aaron, Dion and Jerome Candeloro, Ashley and Steven Lord, Alex and Roger Newman, Tom Brown, Ross Freeman, John and Steve Mansell, Greg Harris, Mick and Tyson Schutz, Devon Gilmour, Trevor Syme, Warwick Holding, Greg Harris, Trent King, Justin Carruthers, Graham Kotzur, Mark Taylor, Brendan Williams, Nick Berry, Jud Wheatley, Marney Strachan. Tom Lewis, Peter Broley and Tristan Friend amongst others who made this report possible.