NATIONAL

GRDC HARVESTER SET-UP GUIDE

OPTIMISING HARVEST LOSSES

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

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Contents

This guide has been developed with contributions from a range of third-party independent harvest optimisation experts based on their experiences and is general in nature. No person should act on the basis of the contents of this publication without first obtaining specific professional advice.

Users of this guide should be familiar with the manufacturer's operating manual, safe operating procedures and harvester settings for their particular machine. Owners and operators are advised to consult with their manufacturer, dealer or harvest expert for specific, independent and professional advice prior to making adjustments.

PROFIT AND LOSSES

Photo: GRDC

Profit and losses

There is little room for waste in modern farming and grain growers invest huge amounts of time, energy and resources to achieve incremental yield improvements. However, harvest losses have the potential to undo a large proportion of that effort.

Researchers estimate that grain losses in Australian cropping systems are far above the one to two per cent considered as acceptable by industry – costing producers millions of dollars each season.

A 2022 study of 75 sites and 100 harvesters in Western Australia measured average harvest losses of:

- wheat – two per cent per hectare;
- barley – 4.5 per cent per hectare; and
- canola – 3.2 per cent per hectare.

From these results, it was calculated that more than $300 million worth of grain was left in WA paddocks during the 2022 season alone[1].

Example of a loss calculation for a two tonnes per hectare canola crop, valued at $700/t:

2t/ha x 3.2 per cent = 64 kilograms of lost grain per hectare.

For a 1000ha canola program x 64kg = 64t at $700/t = **$44,800 lost income.**

It is important to note that grain losses are only one part of the profit equation around harvester set-up and that minimising losses must be balanced with operational efficiency, though the two are not mutually exclusive.

Optimising losses through harvester set-up also has the potential to deliver substantial improvements to harvester productivity, through increased tonnes harvested per hour, reduced horsepower requirements and lower operating costs.

To illustrate how to evaluate these components as potential returns, consider a typical harvester with a 12-metre front that is costing $700 per hour to run.

[1] Source: groundcover.grdc.com.au/farm-business/business-management/research-finds-opportunity-to-reclaim-$300m-in-grain-lost-at-harvest

Profit and losses

If optimising the harvester set-up delivers a 20 per cent improvement in operating efficiency and reduces overall grain losses in barley from 2.5 per cent to one per cent, the increased operating speed and 1.5 per cent increase in marketable gain could deliver a $37,460 benefit over a 1000ha barley program – as follows:

Item	Harvest parameter	Calculation	Current (example)	Optimised (example)
a.	Front width (m)		12	12
b.	**Forward speed (km/h)**		**5**	**6**
c.	Harvest rate (t/h)	[(a * b * d) / 10]	24.00	28.8
d.	Yield (t/ha)		4	4
e.	Crop value ($/t)		300.00	300.00
f.	**Losses (%)**		**2.5**	**1.0**
g.	Losses per hour ($/hr)	[c * e * (f / 100)]	180.00	86.40
h.	Total losses ($)		29,250.00	11,880.00
i.	Total program (ha)		1000	1000
j.	Total harvest after losses (t)	[(1 – f / 100) * i x d]	3900	3960
k.	Total hours	[i * d / c]	166.7	138.9
l.	Total days (15 hours/day)	[k / 15]	11.1	9.25
m.	Cost per rotor hour ($)		700	700
n.	Cost of running harvester ($)	[k * m]	116,690	97,230
o.	Revenue ($)	[e * j]	1,170,000	1,188,000
p.	Income net ($)	[o – n]	1,053,310	1,090,770
	BENEFIT ($)	p (Optimised) – p (Current)		37,460

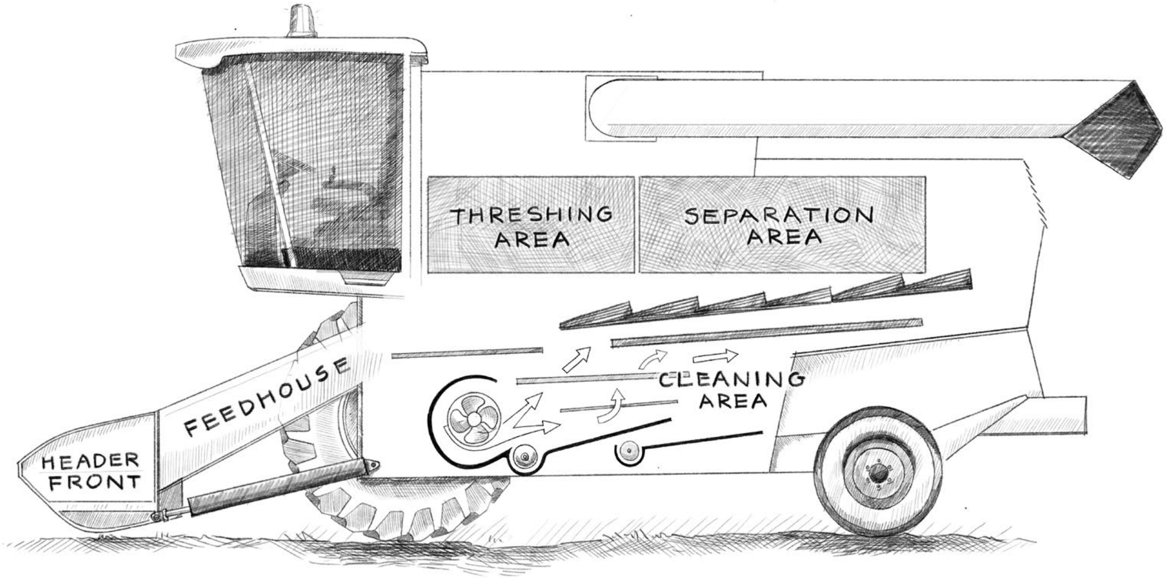
NOTE: These examples exclude any additional crop production and management costs.

Profit and losses

The significant benefit demonstrated on pages 4 and 5 shows why optimising harvester set-up is worth the effort.

This GRDC *Harvester Set-up Guide* is designed to help you understand where harvest losses are most likely to occur, how to measure them and how to adjust your harvester set-up to maximise profitability.

FIGURE 1. Typical harvester arrangement.



MEASURING HARVEST LOSSES

Photo: Evan Collis

Measuring harvest losses

The old adage, 'If you can't measure it, you can't manage it', is a core business and scientific principle that comes from the field of quality improvement. It perfectly sums up the need to conduct grain loss measurements during harvest.

Accurate loss measurement is the critical first step to establishing current losses, so you can make adjustments and quantify their benefit.

Harvest loss sensors are really helpful for visualising losses or alerting operators to changes in loss conditions. However, harvest loss measurement to calibrate the sensors is critical for establishing their accuracy. Without measuring, you could still be accepting significant losses.

This section will look at when, where, how and how often those measurements should be made.

"If you can't measure it, you can't manage it."

1.1 | Potential impacts of header front losses

1. Lost profits

Grain losses at any stage of harvest are lost profit – as well as a lost investment in seed, soil inputs, sprays and operating costs that were used to grow grain that was not captured and marketed.

2. Increased weed costs

Grain losses have the potential to turn into 'volunteer weeds' in the next crop, which then require controlling. In addition, where harvest weed seed control methods are being employed, weed seeds that do not enter the harvester cannot be captured and controlled or destroyed. This may result in a higher weed seed burden and, potentially, increased spraying or crop competition costs next season.

3. Increased mouse infestation

Mice require just three grams of food per day. Each one per cent loss in a 3t barley program will provide sufficient food for one million mouse days in every 100ha.[1]

Regardless of the type of front or the harvesting method, ensuring efficient cutting and delivery of the crop onto the front, including eliminating any shaking, is the key to minimising grain loss. Doing so will usually lead to improved harvester performance as well.

[1] Source: CSIRO ecologist Steve Henry

1.2 | When to measure harvest losses

Understanding when and how often to measure grain losses is closely tied to the factors that affect harvest conditions. Harvester configuration, operation and loss rates should be established for the:

- crop type;
- crop condition (for example, greenness, weed content); and
- weather conditions (for example, relative humidity, which is closely linked to time of day and air temperature).

Key times to measure and refine loss rates

1. **Start of harvest**
   The first point for measuring losses is at the start of harvest, as confirmation of harvester configuration for the season. This initial set-up will provide a benchmark for the target loss rate and any subsequent adjustments.
2. **Start of day**
   Check the harvester settings and losses at the start of each day's harvesting to account for changes in the condition of the crop and for the relative humidity early in the day.
3. **Early afternoon**
   As the day heats up and dries out, check loss rates again. It may be possible to increase throughput in the drier afternoon conditions.
4. **Late afternoon/evening**
   Harvester speed and set-up will need to be checked again as the day cools down, relative humidity rises and the crop absorbs more moisture. Expect productivity to decline (and losses to climb) into the evening and night and use the monitors to detect changes as the conditions continue to cool.

5. **Starting a new crop or paddock**
   Set the harvester to the requirements of each crop to minimise losses for the type of grain. Every paddock is likely to have a different crop condition, grain size and weed load, so harvester settings should be checked and losses measured for each new paddock – even when going from one wheat paddock to another, for example.

6. **Whenever conditions change**
   Be aware of changes that may affect relative humidity at any point of the day – such as a wind change, a passing weather front or even the start of an afternoon sea breeze. All can rapidly alter relative humidity, crop moisture levels and loss rates.

7. **Whenever in-cab monitors show a marked change**
   Keep an eye on the in-cab monitors for signs of change in the crop, power requirements, returns and so on. Stop, investigate and correct these changes to maintain productivity and efficiency with minimal losses.

EXPERT TIP

As you establish benchmark settings for a range of typical conditions, keep a record in the harvester. Use this reference to quickly set up for each paddock – then fine-tune those settings in the paddock.

Be prepared to update your benchmarks as the season progresses too.

1.3 | How to measure harvest losses

Significant grain losses are generally left in the paddock after being either dropped at the header front or lost in the threshing and cleaning system and blown out the back of the machine.

Sample collection unit options to measure these losses:

- **Frames** (with a known area) can be placed in the unharvested crop ahead of the harvester. Any grain already present on the ground within the frame needs to be removed or counted so it can be deducted from the final total. Run the harvester over the frame and count the grains in the frame (deducting the pre-count total if necessary). It is worth noting that losses can be calculated by grain count or, more conveniently, by weight. However, frames make weighing impractical.
- **Pans** can be used in the same way as frames, except there is no need to count and deduct grain that has fallen before the harvester run. The grain in the pan can be counted or transferred to a container and weighed. Trays also minimise the risk of grain lying on the ground or under stubble being overlooked, especially with small-seeded crops like canola.
- **Drop trays** are effectively a pan that can be dropped from the header chassis by remote control, providing a safer, more convenient and flexible way to deploy the units. They use electromagnets to attach to the header front or the back of the harvester. The electromagnets are switched off remotely, allowing the tray to drop to the paddock just before the front or chaff chute passes over it, depending on if you are measuring front or rear losses respectively. Loss calculations can be done using grain count or weight.

Frames and pans are good low-cost options for measuring losses; however, it should be noted that drop trays are now the industry standard due to their significant safety advantage and ease of use.

Measuring front losses versus machine (rotor and sieve) losses

Frames and pans can be used to measure total losses from either the front or the machine (rotor and sieve or threshing and cleaning area losses).

- **To measure losses specifically from the header front:** harvest over the top of the frame, pan or tray that has been placed or dropped into the standing crop, until the front has passed completely over the collection unit. The harvester must then rapidly decelerate to be stationary before the chaff and straw spreaders have passed over, and added material to, the collection unit.
- **To measure machine losses (rotor and sieve):** a collection unit is placed into the standing crop, and the machine is then allowed to harvest over the collection unit until the chaff residue has distributed over the unit. From here, calculated front losses (collected via the above method) are subtracted from the calculated total loss to determine the machine (rotor and sieve losses). Where a drop tray is used, this can be achieved without the subtraction step by dropping the tray from a position after the front has passed, usually the rear axle.

When taking machine loss measurements, it is important to consider that chaff spreaders can distribute chaff and lost grain unevenly, so taking averages from a series of measurements across the spread area will provide more accurate results.

1.3 | How to measure harvest losses

FIGURE 2. Example residue spread modes.

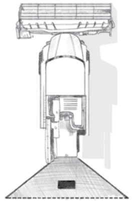


FIGURE 2.1.
Spread (full spread).

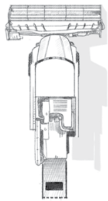


FIGURE 2.2.
Drop (normal windrowing).

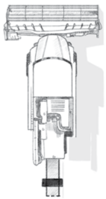


FIGURE 2.3.
Narrow chaff line.

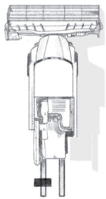


FIGURE 2.4.
Chaff deck.

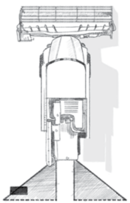


FIGURE 2.5.
Chaff spreader (towards the outsides).

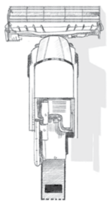


FIGURE 2.6.
Harrington Seed Destructor (open gate).

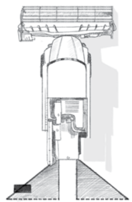


FIGURE 2.7.
Terminator (split spread).

Relative collection unit placement (black rectangle) for machine loss measurements under a range of residue spread modes (birds-eye view of harvester, shaded zones indicate residue spread distribution pattern).

Measure in the mode of harvest

Straw and chaff can be spread differently by different machines. It is important to measure both to understand where losses are coming from (that is, the rotor or the sieves) and to measure while using the same residue spread mode that is being used for the harvest operation.

If the mode being used is to spread the chaff and straw fractions together (figures 2.1 and 2.2), then this is the mode in which loss measurements should be taken. If the straw fraction is being spread but the chaff is being windrowed (figures 2.3 and 2.4), then the losses should be evaluated in this mode.

The only exception is where a harvest weed seed impact mill is also being used (figures 2.6 and 2.7). Refer to Section 1.4 for more on this.

If drop trays are being used, these can be mounted on the front in the ideal position to catch the spread residue as the machine passes over the dropped tray. However, any time the collection unit needs to be placed to the side of the harvester, be mindful of the wheel track (especially if using duals) to ensure the main drive wheels do not run over the pan or tray.

Cleaning grain samples

When measuring losses, all material other than grain (MOG) needs to be removed from the pan or tray before the sample is weighed. A blower separator is an excellent tool for this task. If there are full heads or pods in the collection unit, hand-thresh these to release any grain into the tray or separator before separation.

Once the sample has been separated, the captured grain can be weighed and the loss rate calculated. See Section 1.5 for more information on calculating losses.

Alternatively, the GRDC Harvest Loss Calculator (see Section 1.6) makes this calculation easy, as do the dedicated apps that support commercial drop trays.

1.4 | Measuring harvest losses with HWSC

While many harvest weed seed control (HWSC) systems, such as chaff decks and chaff lining, can be measured using the standard methodologies in the previous section (with minor adjustments), weed seed impact mills and chaff carts require additional steps to isolate and measure losses.

Weed seed impact mills

When using a weed seed impact mill on the harvester, it is essential to bypass the mill. If this is not done, the mill will pulverise the grain with the weed seed and no losses will be detectable. See Section 5 for more information. The steps for bypassing the mill are specific to the mill type.

- **For Seed Terminator mills**

  Remove the mill screen on one side so the ejected grain can pass through without being milled:

  1. Remove the infeed chute.
  2. Take out one mill screen (for example, the right-hand screen).
  3. Replace the infeed shoot.
  4. Place a collection tray so it collects a sample from the outfeed of the removed screen.
  5. Clean and weigh (or count) the collected grain to calculate the total loss rate (remember to double the sample size because the output is only from one half of the mill.)

- **For Harrington Seed Destructor (iHSD) mills**

  Use a rubber mat to bypass the seed mills:

  1. Disengage the mills by removing the drive belt.
  2. Remove the back door and stone trap.
  3. Refit the stone trap door above the auger.
  4. Attach a rubber mat to the back of the sieves and lay it over the top of the auger and stone trap door.
  5. Attach a drop tray to the harvester rear axle or the back of the header front, so it falls in the chaff stream.
  6. Clean and weigh the collected grain to calculate the total loss rate.

- **For Redekop mills**

  The Redekop Seed Control Unit (SCU) has a dog-clutch to allow easy disengagement of the mills. The mills can then be bypassed on machines with the integrated choppers:

  1. Disengage the mills using the dog-clutch.
  2. Using the controls in cab, move the mills back (out of the way).
  3. Attach a drop tray to the harvester rear axle or the back of the header front, so it falls in the chaff stream.
  4. Clean and weigh the collected grain to calculate the total loss rate.

Finally (in all cases) return the mill to its proper configuration.

Chaff cart

When using a chaff cart, sieve and rotor losses can be measured separately, depending on where the drop tray (or collection pan) is placed.

- **To measure sieve losses:**
  1. Start with an empty chaff cart.
  2. Operate the chaff cart with the door open.
  3. Place a pan or drop tray so it collects the material coming out the door of the cart.
- **To measure rotor losses:**
  1. Mount a drop tray on the back of the header front, so it falls into the chaff stream from the back of the harvester.

  In both cases, clean and weigh the collected grain to calculate the total loss rate.

Chaff decks and chaff liners

Measurement methods for these technologies are the same as the standard procedure. However, for chaff decks it may be necessary to adjust the attachment location on the machine if using a drop tray.

- **To position a drop tray or pan so it collects the output of the chaff deck:**
  1. Set up a drop tray so that it falls directly in front of the chaff deck outfeed. Attaching a bracket to the chaff deck arm may be required.
  2. Clean and weigh the collected grain to calculate the total loss rate.

Once a measurement has been made, adjust the sieves or rotor/drum to reduce harvest losses. See Sections 4 and 5 for more on making these adjustments.

Only make *one* adjustment at a time, then collect another sample, so you can quantify the improvement.

Keep repeating this process until improvements are acceptable or the improvement is incrementally small.

1.5 | How to calculate harvest losses

Once a grain loss sample has been collected, the loss needs to be converted to a rate per hectare.

If not being supported by a tool such as the GRDC Harvest Loss Calculator, this can be manually calculated using either grain counts or grain weights. Grain count is more likely to be used if the collection unit is a frame or if accurate scales are not available in the paddock.

However, weight-based measurements are more accurate and should be used wherever possible.

Grain count calculation method

As a rule of thumb, in a collection area of $0.1m^2$ (for example, 316 x 316mm, 100 x 1000mm) the average seed number equating to 1t/ha will be:

Crop type	Average seed number
Wheat	270
Barley	230
Oats	290
Lupins	70
Yellow Lupins	75
Chickpeas (desi)	65
Chickpeas (kabuli)	20
Lentils (red)	330
Lentils (green)	280
Field peas	50
Faba beans	25
Canola	2670

1.5 | How to calculate harvest losses

To calculate losses, the area of the collection unit (frame, tray or pan) must be converted to $0.1m^2$ as follows:

1. Calculate the area of your collection unit.
   For example, 200mm x 300mm = $60{,}000mm^2$ or $0.06m^2$.
2. Divide the collection unit area by $0.1m^2$.
   For example, 0.06 ÷ 0.1 = 0.6
   This is the grain count division factor to get to the average seeds per $0.1m^2$.
3. Once the grains in the sample have been counted, divide this number by the division factor.
   For example, 14 grains ÷ 0.6 = 23.3 grains per $0.1m^2$.

To convert this to t/ha:

4. Use the average seed number for the relevant crop type from the table on page 18 and divide this by the figure of the number of grains per $0.1m^2$ from step 3.
   For example, for desi chickpea:
   23.3 grains ÷ 65 = 0.358t/ha losses.
5. Multiply this result by the number of hectares to calculate total losses in tonnes.
   For example, 0.358 x 500 = 179t.

It is important to note that this methodology makes assumptions around average grain weight, which introduces a level of error. For example, drought-affected grains may weigh less per kernel, in which case this method will lead to an overestimation of losses.

To correct this potential error, losses can also be calculated using the sample weight and either the standard 1000-grain weight for the crop or, for more accuracy, a 1000-grain sample from the harvester.

Grain weight calculation methods

Impact of residue spread mode

The residue spread mode needs to be taken into consideration when scaling the collection unit area to a per-hectare figure.

In chop and spread mode, the residues are assumed to be distributed evenly. However, taking the average from a number of samples will always provide a more accurate assessment of the actual losses.

When operating in normal chop and spread harvest mode, harvest losses can be calculated from the area of the pan and the weight of the grain collected in it (that is, after any chaff is removed):

$$\text{Harvest loss in kg/ha} = \frac{\text{weight of grain x 10}}{\text{tray area (m}^2\text{)}}$$

This calculation does not give consideration for non-uniform spread. See p21 GRDC Harvest Loss Calculator.

However, any mode that affects the spread distribution needs to consider that this also affects the distribution of losses. Where this is narrower than the width of the front, a concentration factor will need to be calculated using the ratio of the front width to the spread width, and the relative portion of losses captured by the width of the tray/pan sample.

The GRDC Harvest Loss Calculator (see page 21) has preset concentration factors that you can use to simplify the process.

1.6 | The GRDC Harvest Loss Calculator

Grain weight methodology

The GRDC Harvest Loss Calculator and other apps use the weight calculation method, developed by Peter Newman from Planfarm. The calculator runs on Microsoft Excel and can be downloaded for use offline.

It offers a selection of harvester operation modes:

- chop and spread;
- narrow windrow;
- chaffline or chaff deck; and
- chaff cart.

With input options for:

- collection pan length and width;
- harvester front width;
- approximate spreading width (if applicable);
- grain weight in tray; and
- crop yield in tonnes per hectare.

Results include sieve, rotor and total losses in kilograms per hectare, and as a percentage of yield.

Access the GRDC Harvest Loss Calculator here:

1.7 | Cracked grain is still lost grain

While most harvest losses can be measured using collection units, there are other factors that can lead to reduced profit harvest – including cracked grain. Grain that is cracked or crushed to powder in the harvester has the potential to reduce harvest earnings not only through volume but also quality downgrades.

It is important to check the grain sample in the harvester grain bin to review the quality and the percentage of dockage or damaged grain.

How to check the grain sample

1. Use a shaker box or a similar system with graded screens and put a 100g sample from the harvester grain bin into it.
2. Shake the sample through the shaker box for one to two minutes.
3. Inspect the contents of the shaker box from the bottom level up:
   I. The bottom level will contain dust, powder and any small weed seeds.
   II. The next level up will contain smaller cracked grain fragments.
   III. The third level will contain larger cracked grain fragments (for example, half grains) and medium-sized wholegrains.
   IV. The top level will contain larger grains and pieces of the chaff fraction, such as straw and head pieces.
4. If the small, cracked grain amounts to more than one per cent of the sample, consider these unacceptably high harvest losses and take remedial action.

Correcting for cracked grain

Cracked grain is usually caused by the feeder chain being too close to the feeder house floor or excessive returns in the cleaning area causing grain to be over-threshed.

Check and adjust the feeder chain so that it clears the feeder house floor by 5mm.

Open the bottom sieve in 1mm increments and take a fresh sample after each increase, until the level of grain cracking falls below one per cent of the sample.

If there is a high percentage of larger cracked grains, check all the augers in the combine to ensure they are not sharp or damaged.

SEE SECTIONS 3.6 AND 4.4 FOR THE POTENTIAL CAUSES OF GRAIN CRACKING AND HOW TO CORRECT THEM.

1.8 | Harvest loss measurement tips

1. Measure, do not guess

It has been common practice to 'eyeball' grain losses by inspecting the chaff line or paddock after the harvester has been through.

It is important to note that what looks right or normal can easily equate to excessive and expensive losses.

At the very least, measure a series of quadrats ($0.1m^2$ or $1m^2$) and calculate actual losses per hectare. Use an average of six to eight quadrats.

Compare the calculated losses to the acceptable loss rates of one per cent per hectare for cereals and 2.5 per cent per hectare for canola.

2. Do not lose money to save time

Measuring harvest losses should not be seen as a costly interruption to harvest. It is a cost-saving exercise.

Once measuring becomes routine, the process can take less than five minutes – even for a single operator to drop the tray, stop the harvester, collect and clean the sample, and put the details into the calculator.

With established benchmark settings and experience, knowing which adjustments to make and by how much will become almost instinctive.

Expect the first full calibration session to take the longest. Subsequent set-ups will be quicker and regular checks through the day should become very quick.

3. Benchmark typical conditions

One way to quickly set up for minimum losses is to establish benchmarks for typical harvesting conditions. For example:

- cool conditions – start of day and night;
- hot conditions – afternoons;
- major crops – wheat, barley, canola and so on; and
- any other common condition for the area (for example, afternoon sea breeze) .

By having pre-calibrated settings for harvester speed, fan speed, rotor/drum speed, concave gap and sieve openings, it is easy to configure the machine to the benchmark setting and begin harvesting with confidence.

Use drop trays to check the benchmark configuration and make final adjustments for the crop and conditions of the day.

4. Calibration

If you have harvest loss sensors, it is critical to calibrate them following the methodology set out in the operator's manual.

REDUCING HEADER FRONT LOSSES

Photo: Evan Collis

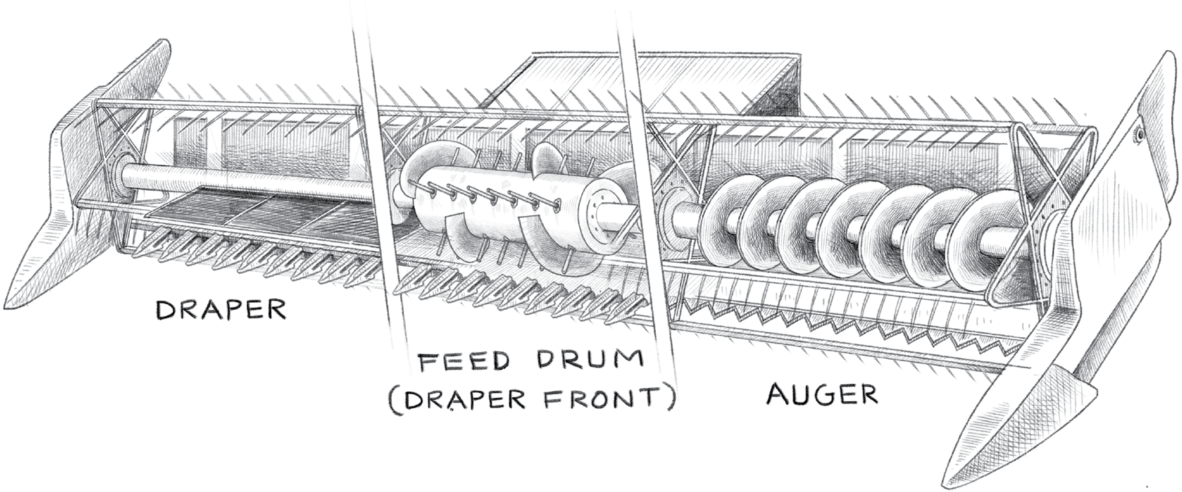
Reducing header front losses

Considering the factors within our control in attempting to optimise harvest loss through harvester set-up, it is worth noting that grain losses can occur well before harvest due to factors like head loss, pod drop and shattering.

However, in many harvest operations, significant grain losses are also caused by the action of the harvester – beginning with the initial contact and movement caused by the header front.

The front must divide, cut, gather and collect the crop without any undue knocking of the stem or head, so the grain is actually gathered into machine to be threshed. For windrowed crops, the same is true when picking up the cut material.

FIGURE 3. Comparison of draper and auger fronts.



2.1 | Primary areas causing front losses

When seeking to reduce header front losses, it is important to understand the causes of front losses. The primary areas that may be causing front losses include:

- crop dividers;
- reel position and finger pitch;
- knife guards, sections and speed;
- cutter bar and knife angle;
- auger position (auger fronts);
- feed drum position and set up;
- feed drum to feeder house fit; and
- poor feeding.

MEASURING HEADER FRONT LOSSES

As always, you can only manage what you measure.

REFER TO SECTION 1.3 FOR ADVICE ON MEASURING HEADER FRONT LOSSES.

2.2 | Crop dividers

Dividers are designed to guide the crop into the cutter bar smoothly and prevent lodging at the edge of the header front.

Dividers can knock grain from the crop when they are:

1. Bulkier than needed

- Many dividers are designed for heavy crops (>10t/ha) and are overbuilt for a lot of Australian conditions. These can throw crops outside or over the front, leading to grain losses.
- Where possible, fit dividers that are suited to the amount of material in the paddock. Ask your machinery dealer or adviser for guidance.

2. Able to catch or snag crops

- Ensure crops can move past the divider without catching, snagging or jolting. This may require adjusting the divider or duct-taping over potential snags.

3. Set at an angle to the direction of travel

- Ensure dividers accurately match the direction of travel.
- Some dividers have a lateral adjustment bolt and jam nut. Others are welded in place and may need to be bent.

4. Set too high or too low

- Dividers can cause excessive stem shaking if they impact the crop stem low down, or direct grain loss if they impact the seed head or pod.
- Adjust the divider height to just under the first node below the grain, or just below the height of the first pods in pulses or canola.

EXPERT TIP

When using crop dividers, cover the first guard on either end of the front or add baffles to guide material around those guards. This will ensure the crop falls onto the front cleanly, to help with feeding.

2.3 | Reel position and finger pitch

The reel is essential for ensuring the cut crop falls onto the auger or belt in the right direction. This, in turn, ensures correct and trouble-free feeding.

Harvest losses can occur if the reel speed is too high or the fingers are set too aggressively. In either case, impact with the crop stems can knock grains to the ground or even cause shattering.

Reel position needs to be set for the type of crop

In canola

- The reel should be positioned behind the cutter bar and the minimum finger pitch used.
- With newer 'shatter-proof' canola varieties, the reel can be moved forward to help with feeding.

In cereals

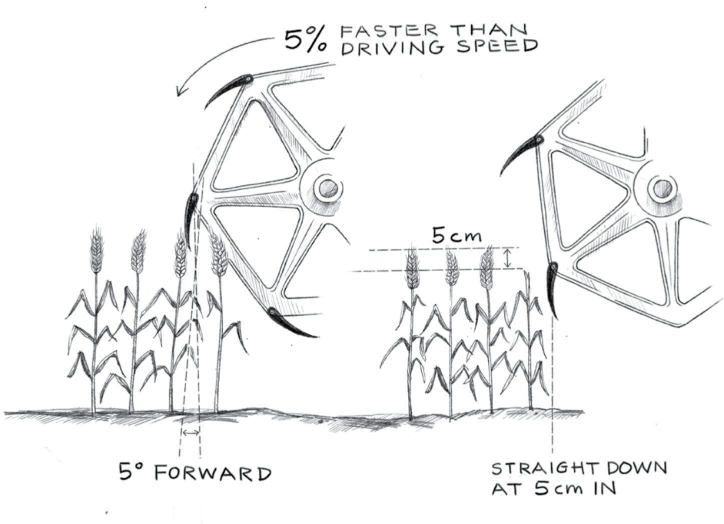
- The reel should be set slightly in front of the cutter bar and fingers set about halfway between the minimum and fully forward positions.
- Reel speed should be around five per cent faster than ground speed.
- If crops are lodged or leaning, increase finger pitch (set them forward) slightly, until proper feeding is achieved.
- Maximum finger pitch may be needed on severely lodged crops in order to lift the crop up to the header.

5:5:5 rule

A good rule of thumb for setting the reel is the '5:5:5 rule':

- five centimetres into the crop;
- five per cent faster than your ground speed; and
- five degrees forward finger position.

FIGURE 4. The 5-5-5 rule.



2.3 | Reel position and finger pitch

Hot points

- The reel needs to (gently) push the crop onto the auger table or belt after cutting.
- Reel pitch can affect reel speed. Increasing finger pitch positive or forward also increases reel speed at the finger tips, as they are moved further from the centre of rotation.
- Shattering can also occur if the reel is working too deep into the crop. In this case, the crop may flip over on the belt, leading to problems with feeding.
- If the crop is shattering, check the reel depth and reduce the reel speed. If shattering persists, reduce forward speed as well.
- If the reel is consistently working too deep, you will see telltale paint wear on the reel bar.
- On auger fronts, the grain should fall against the auger and stand between the flaps to be transported to the centre.
- On belt/draper fronts, the grain should fall evenly on the belts with the heads facing toward the rear of the harvester.

EXPERT TIP

Remember, the reel is a crop guide and *not a rake*.

FIGURE 5. Typical knife section.

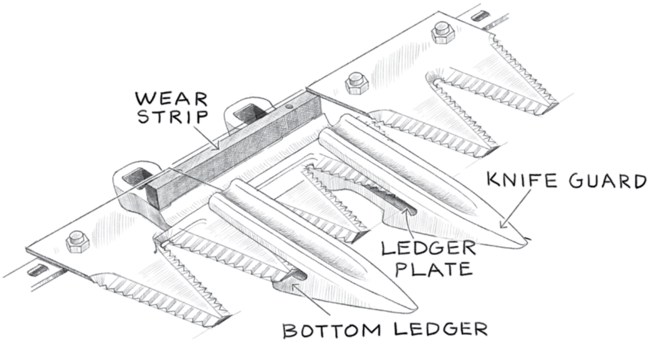
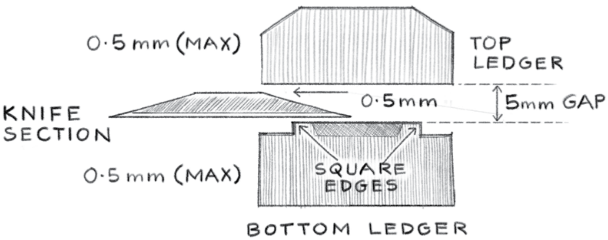


FIGURE 6. Cross section of knife and knife guard.



Poorly performing knife sections and knife guards cause extra shock on crop stems that can lead to grain losses when the grain is ripe or prone to shattering.

Power requirements to drive the knife may be up to 25 per cent higher in tough, green or dense crops, and there will be more tearing and ripping of the stems.

Worn knives and guards can also consume significantly more power than as-new hardware.

Tips for ensuring knives and guards are operating well include:

Knife guards:

Knife guards are critical to knife and feeding performance.
They must have:

- a square edge (not conical, tapered or worn) for the knife to cut against;
- a sharp ledger plate with a consistent 5mm gap for the knife section;
- no more than 0.5 millimetre gap between the knife section and the ledger top and bottom;
- good knife guards will help improve harvester performance and productivity, with reduced losses; and
- regular checks of the individual knife guards on the cutter bar and replacement of the worn ones (you may not need to replace a whole set).

2.4 | Knife guards, sections and speed

Knife sections:

- Knife condition should be checked and managed every day.
- Any damaged or worn sections should be replaced as soon as possible.
- **Fine** knife sections (14 points per inch or five to six points per centimetre) are recommended for grasses, cereals and smaller grain crops where the stem is finer or still contains moisture.
- **Coarse** knife sections (nine points per inch or three to four points per centimtre) are recommended for canola, lupins and any large-stemmed crop, including crops likely to damage or chip the knife section. These crops are more likely to damage or chip the knife section and more frequent checks are recommended.

Knife speed:

If the knife is running too slowly it will not cut properly, the crop will not fall onto the front correctly and the knives may become blocked. All three problems can cause grain loss.

Adjust the knife drive (where this is an option) so the pulley turns at:

- 670rpm (1340spm) for a dual knife; or
- 640rpm (1280spm) for a single knife.

Poor cutting (due to harvesting, crop and/or knife conditions) can lead to harvest losses because the crop will not fall onto the draper belt or table properly. This can result in poor feeding when the cut crop fails to enter the feeder house and threshing section headfirst.

SEE SECTION 2.9: POOR FEEDING FOR MORE INFORMATION.

2.5 | Cutter bar and knife angle

A level cutter bar (horizontal at the knife guards) is right for most cutting conditions and minimises the risk of stone damage to the knives. (Use the feeder house plate and header tilt to level the cutter bar.)

However, this angle is not a set-and-forget adjustment. A level cutter bar or the knife angles given on page 33 should only be treated as a starting position. It is important to adjust the angle, based on what cut crop is doing on the front.

For example, if the crop is slipping off the cutter bar, adjust the angle to slightly negative (tilted back).

Or you may need to use a steeper angle in lodged crops or crops with pods close to the ground, such as beans and lentils.

Regular adjustment is generally easier with draper fronts as they have a hydraulic control in the cab. Because auger fronts usually require manual adjustment, a flat angle tends to be a good compromise position.

Adjust the cutter height to cut the stems just under the first node below the head. Harvesting this node helps with efficient threshing.

Make sure cut stems do not touch the table or they may flip and land headfirst, causing grain losses.

2.5 | Cutter bar and knife angle

Knife angle can vary between crops:

Cereals	Best angle is 12 degrees forward (positive)
Canola – draper front	The angle should be flat or slightly back (negative)
Canola – auger front	Use a negative angle to flat angle
Wet conditions	Set a positive (forward) angle of more than 12 degrees

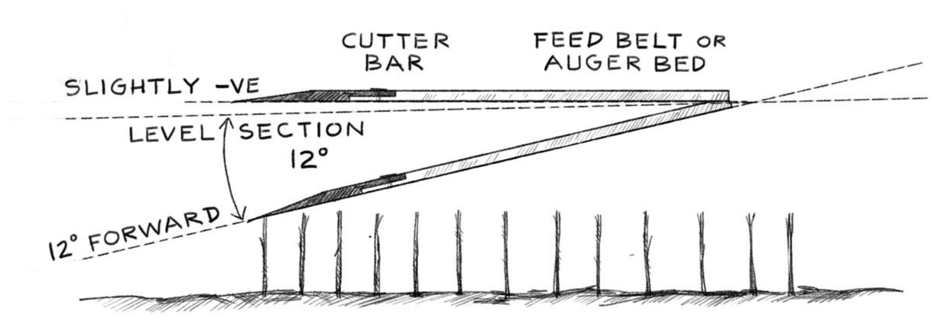
Knife speed settings:

Subject to size of front

Belt/draper front	600 to 680rpm / 1200 to 1380spm
Auger front	630rpm / 1260spm

Most John Deere draper and auger fronts have a fixed speed as they are shaft-driven, whereas MacDon fronts are hydraulically driven and the speed can be adjusted from the cab.

FIGURE 7. Cutter bar and knife angles.



2.6 | Auger position (auger fronts)

An auger front needs to be set up with stripper plates almost touching the back of the auger to ensure constant and even feeding. Typical auger speed is 440rpm regardless of crop or conditions.

If the cut crop is building up in front of the auger, you need to increase the auger speed. This may mean fitting a larger auger drive sprocket.

Setting the auger position

- **For Case IH and New Holland auger fronts:**
  First, adjust the auger height to the table. The gap between the table and auger flaps should equal the width of the average grain head.
  - Wheat: 15mm on average.
  - Barley (two rows): 10mm on average.
- **For Claas and John Deere auger fronts:**
  Set the gap between the auger and the stripper bar underneath it. The back stripper bar should be as close to the auger flaps as possible, without scratching against them.

When harvesting canola, adjust the auger height to 20 to 30mm above the table to improve feeding. The ideal height is the stem thickness at the cut, plus 5mm. In low-yield canola (less than 1t/ha) the height for cereal harvesting can be used.

For detailed instructions on how to make these adjustments, refer to the operator's manual for your front.

Once the correct gap has been set, you will need to adjust the feed drum to minimise losses.

SEE PAGE 35 FOR INFORMATION ON ADJUSTING THE FEED DRUM.

2.7 | Feed drum position and set-up

The retractable fingers in the feeder drum are critical for feeding the crop from the front into the feeder house. One of the main causes of poor feeding is improper timing of these fingers.

Adjust the timing of the fingers so that, when looking from the left-hand side:

- they are fully extended at the eight o'clock position (30 degrees before vertically down). With bulky crops, this may be increased to the 10 o'clock position; and
- they are completely retracted at the two o'clock position (30 degrees before vertically up).

Check:

- The gap between the fingers and the floor should be the same as the largest head (15 to 20mm).
- The fingers should be fully extended by 30 degrees before vertical.
- Position the feeder drum slightly above the minimum setting. It floats, and this will allow it to handle heavier loads.
- With the drum in this position, tighten the feeder chain so the lowest slat is 18 to 25mm above the feeder house floor.

SEE SECTION 3.1 FOR MORE DETAILS.

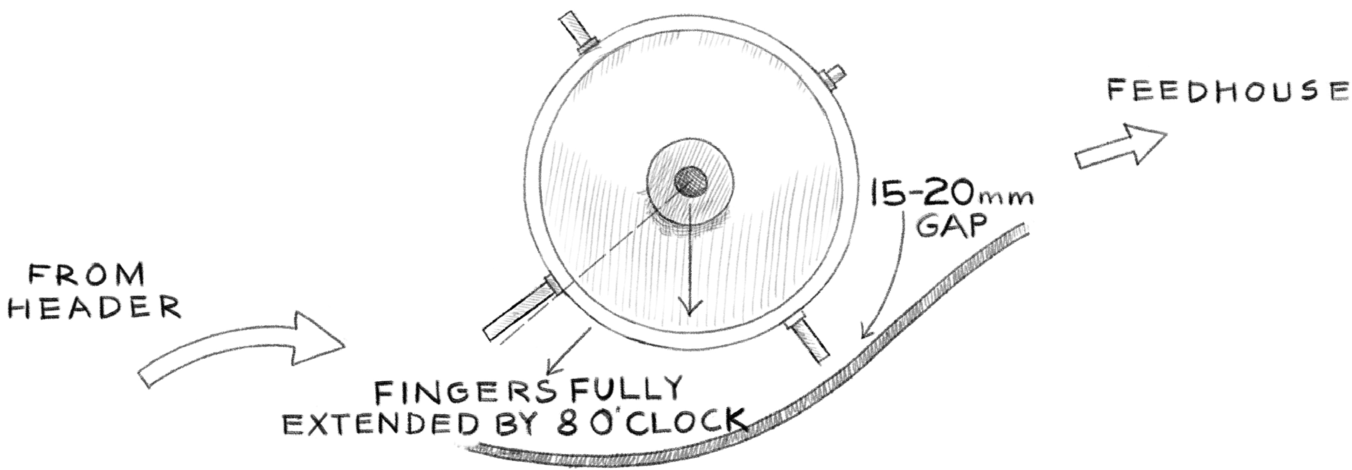
EXPERT TIPS

TIP 1: Having longer, taller flights than the MacDon, standard feed drums will improve the feed.

TIP 2: Fitting an after-market feed drum may help deal with poor feeding if your harvester's standard feed drum struggles in heavy or bulky crops.

2.7 | Feed drum position and set-up

FIGURE 8. Feed drum position and finger extension as viewed from the left hand side.



2.8 | Feed drum to feeder house

Cut crops need to be fed from the feed drum to the feeder house at a consistent width, which is matched to the working width of the feeder house drum.

- If the flow width is too wide, material can become wrapped around the feeder house drum axle and tangled in the drive chain.
- If the flow width is too narrow, material will be bunched up in the middle of the feeder house drum, putting it under unnecessary strain and making inefficient use of the feeder house drum's full width.

Either situation can lead to poor material flow, material jamming, poor threshing and losses at the sieves.

Typical evidence of a poor alignment is paint wear off the feeder house.

Extensions on the header are essential for aligning the width of the material flow with the width of the feeder house drum. These should be fitted, checked and adjusted before harvest.

2.9 | Poor feeding

Regardless of the type of front, the cut crop needs to move toward the feeder drum at the correct speed.

When material moves too slowly, the crop jams up back at the cutter bar.

When material moves too quickly, the heads are thrown to the middle of the feeder house and material crosses over at the centre. When this happens, some of the crop fails to enter the threshing area headfirst, causing rotor losses and white caps.

To adjust the feed speed:

- Auger fronts have drive sprockets that can be adjusted.
- Draper fronts have flow controls on the header.

  Generally, a draper belt should be set to run as quickly as possible without causing the cut material to overlap at the centre draper. Auger speed is usually fixed and can be adjusted by changing the drive sprocket.

Remember...

Auger or draper belt speed, reel position and reel finger pitch settings all affect feeding. Leaving any one of these set incorrectly can cause losses.

If the crop appears to be 'boiling' in front of the feeder house, one of the above needs to be adjusted.

Adjustments to achieve even feeding are essentially the same across all brands of auger fronts. (Some are easier to adjust than others.)

Draper front adjustment is available across all brands; however, reel setting mechanisms may vary.

Five checks for feed performance

1. Knife and guard condition.
2. Reel position and speed – to suit crop conditions.
3. Reel finger pitch and depth.
4. Retractable finger timing.
5. Draper speed.

2.10 | Header front accessories to help reduce losses

Header front accessories can be useful when harvesting:

- canola (windrows and direct head);
- lupins;
- soyabeans;
- chickpeas;
- lentils;
- flax;
- peas;
- rice;
- cereal in heavy crop; and
- light and lodged crops.

Crop lifters

Crop lifters are useful for recovering lodged crops. Tips for their usage:

- Fit lifters at about every fourth knife guard or every 30cm.
- Adjust your forward speed to minimise grain losses from using lifters.
- Look for adjustable lifters so the angle can be changed to suit the condition of the crop (to a maximum of about 25 degrees from horizontal).
- Do not install lifters in the outside 50cm of the cutter bar, as they can cause problems with pushing soil and plant matter in front of the cutter bar.
- Crop lifters are not cultivators. Make sure they clear the ground.

Cereal extensions

Cereal extensions can be valuable in reducing front losses in light crops and where crops are prone to front loss.

Extensions are generally plastic and attach to the knife guard. They are available in different sizes and widths.

Reel paddles, corflute and brushes

Reel paddles, corflute, cut draper-belt and brushes can be useful when harvesting a crop that fluffs up or has difficulties clearing the cutter bar.

2.10 | Header front accessories to help reduce losses

In-paddock research across the southern and western regions identified that improved crop feeding can also lead to an ability to increase ground speed as well as reduce losses.

When combined with cereal extensions, paddles, corflutes and brushes can significantly reduce header front losses.[1]

To get the most out of them, you will need to adjust your reel set-up:

1. Speed – should be equal to ground speed.
2. Reel pitch/tyne position – should be less aggressive than normal (for example, position 1 or 2 on a MacDon front).
3. Reel position – should be set to maximise the use of the draper belt or auger plates.

Air reels

Air reels use air to blow crop clear of the cutter bar. With short and light crops, this can help improve performance by allowing a higher ground speed while reducing losses.

In lupins, chickpeas, barley and similar crops where yield is less than one to 1.5t, grain savings of up to 150kg/ha can be achieved.[2]

- The ideal set-up is where the air tubes align with the crop rows.
- However, in crops over 1t/ha growers have communicated that the air tubes can knock off as many grains as the air blast can save.

[1] How to successfully harvest short, patchy crops, Glen Riethmuller. AGRIC, 5 Sept 2017.
[2] Successful lupin harvesting in Western Australia – A review, 2000, Glen Riethmuller, Dept Ag and Food WA.

2.11 | Header front set-up summary

- While every step is important, a clean cut is king.
- Use the reel to help the grain fall in the right direction.
- Always aim to have the crop moving onto your front and into the feeder house headfirst.
- Set your dividers accurately. Covering the first guard on either end of the front or adding a baffle to guide material into the front cleanly can help with feeding.
- Straw helps the crop flow into the header and aids threshing. Cut short crops down low (beer-can height) to provide adequate material.
- Poor feeding can be caused by slow ground speed. Increase the ground speed to increase material pressure against the cutter bar and adjust the belt speed and auger height to suit.
- Regular guard and knife replacement will result in better feeding and reduced harvest losses, plus you will need less power, use less fuel, and reduce wear on the knife drive gearbox.

Improved feeding equals improved performance, reduced losses and more effective HWSC.

Quick numbers

Reel

- 5:5:5 (5cm down, five per cent faster than ground speed, five degrees in front).
- The reel is not a rake.

Knife section

- Nine (points per inch) for coarse knife sections.
- 14 (points per inch) for coarse knife sections.

Guards

- 5mm ledger gap.
- 0.5mm gap between knife sections and top and bottom of the guard.
- Square sides to the guard.

Feed drum

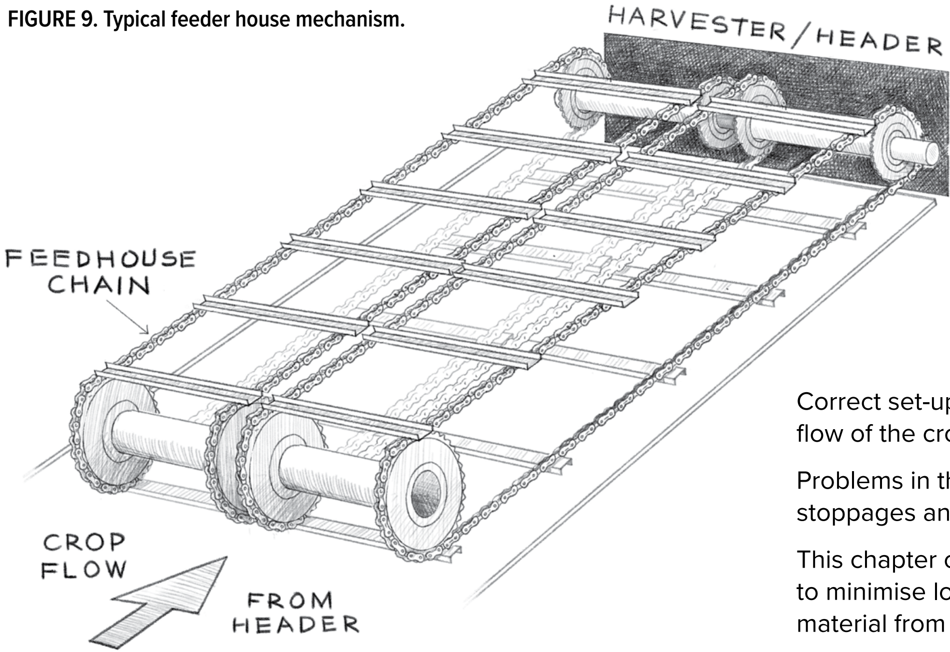
- Fingers fully extended at eight o'clock (viewed from the left).
- This may be increased to 10 o’clock with bulky crops.
- 15 to 20mm, finger to floor.

FEEDER HOUSE SET-UP

Photo: Luke Gaynor

Feeder house set-up

FIGURE 9. Typical feeder house mechanism.



Correct set-up of the feeder house is essential for efficient flow of the crop into the harvester for threshing.

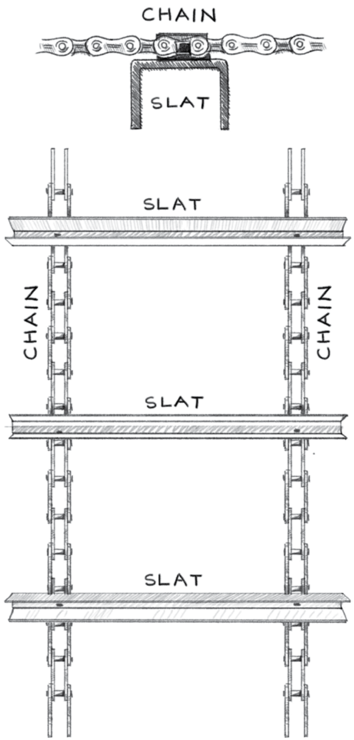
Problems in the feeder house can lead to blockages, stoppages and grain damage.

This chapter covers the correct set-up of the feeder house to minimise losses through smooth, efficient feeding of material from the header front to the threshing system.

FOR MORE ON HOW TO MEASURE HARVEST LOSSES, SEE SECTION 1.

3.1 | Correct feeder house set-up drives efficient operation

FIGURE 10. Feeder house chain.



As its name suggests, the feeder house moves crop material from the header front into the harvester, where the grain will be threshed and separated.

For this reason, the feeder house mechanism must work faster than the conveyor or auger on the front, otherwise material can build up and block the entrance to the feeder house.

It is also essential that the width of the material flow entering the feeder house from the front is matched to the working width of the feeder house slats. Use extensions on the header front opening to the feeder house to adjust the width of the flow from the feed drum.

Once inside the feeder house, the material is compressed and stretched, ready for threshing.

The material exiting the feeder house will be about one quarter the thickness of the material coming in from the front.

To achieve this without causing a build-up of material at the feeder house entrance:

- the feeder house drum needs to run about **30 per cent faster** than the front; and
- the feeder house slats need to be set at the right height to compress, stretch and move the material.

Running the feeder house too slowly can lead to problems with separating, cracked grain and higher losses overall.

3.2 | Run the feeder house drum faster than the front

The feeder house drum needs to operate significantly faster than the feed drum on the header front so the incoming material does not build up at the feeder house entrance.

As a rule of thumb, the speed of the feeder house should be 30 per cent faster than the speed of the front.

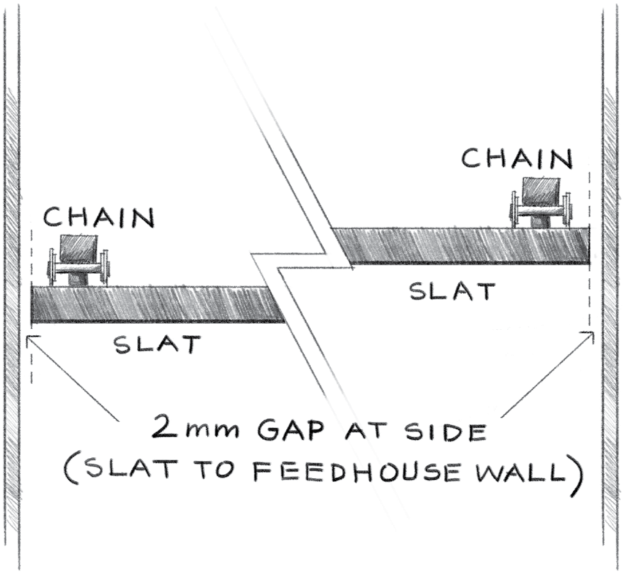
Different machinery brands have different settings:

- **CNH**
  570rpm is an appropriate feeder house speed for most crops. On models where this is adjustable, a slightly slower speed is recommended for fragile crops, such as dry field peas.
- **John Deere**
  Run at low speed unless having issues with a rusty feeder house floor. To clear rust, run at high speed for a short period until the rust is worn off and shiny metal returns.
- **Claas**
  550rpm is generally an appropriate feeder house speed for most crops.

For all makes and models, refer to the operator's manual for feeder house drum speed recommendations.

3.3 | Set correct drum height inside the feeder house

FIGURE 11. Feeder house chain. (Top view.)



The feeder house front drum is arguably the key to good feeder house performance.

1. Set the drum height.

   The method for setting the front drum height differs between harvesters. For the major brands:

   - Case IH – Follow the operator's manual instructions to choose the 'Low' setting.
   - John Deere – Use the 'Down' position.
   - New Holland – Use 'Position 1' at the Block.
   - Claas – Use the 'Down' position for grain.

2. Once the drum height has been set, adjust the left and right position of the third/middle slat, so that it has a 2mm gap at either side.
3. Next, pull the chain through in reverse then double check the settings.
4. Finally, check the gap between the chain and the feeder house floor. It should be **no less than 5mm**.

3.4 | Minimum height of the feeder house drum

The feeder house drum slats are designed to grab the heads of the cut crop and pull them into the feeder house. This is why the material needs to enter the feeder house headfirst.

The straw is held by the ripples in the slats, with small ripples being best for cereal and pulse straw.

John Deere and Case IH harvesters are typically optimised for large-grain crops and have larger ripples. These can be changed at the time of purchase and checking with the machinery dealer to ensure this has been done is recommended.

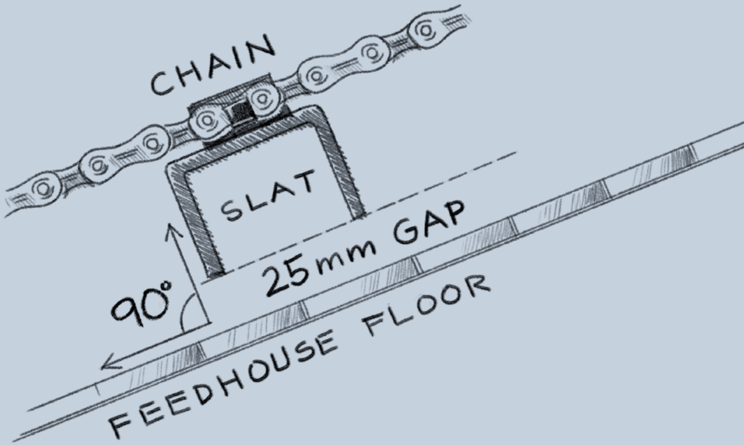
The feeder house drum and slats rest on the thickness of the material flowing through, so as more material moves through the feeder house, the drum will 'float' up.

Setting the minimum height ensures the slats will clear the floor of the feeder house properly whenever the flow reduces.

To set the minimum height for most grains, including cereals, pulses and canola:

- ensure the first slats are perpendicular (at a 90° angle) to the feeder house floor;
- set the height at the first slat back, so there is a gap of 25mm from the feeder house floor;

FIGURE 12. Feeder house chain. (Side view.)



- set this gap at the left and right ends of the slat, not at the centre, and check the distance regularly; and
- if the distance drops down, it may indicate a failed feeder drum bearing.

The minimum height can be increased for thick-stemmed crops, such as maize, to avoid damaging the crop.

3.5 | Chain tension drives smooth flow

Setting the correct feeder house drive chain tension will ensure a smooth flow of material through the feeder house. This reduces damage to the grain and to the machinery.

If the chain is too loose:

- the grain loss monitor will oscillate and never settle on a steady rate;
- the machinery will make loud banging and clanking noises; and
- material feeding will be uneven, increasing the potential for high rates of cracked grain.

If the chain is too tight:

- the grain loss monitor will show large fluctuations;
- the chain may jam;
- the machine will make excess noise and the chopper will spray out bursts of residue resulting in poor residue management.

When the chain tension is right:

- the grain loss monitor will settle on a steady reading rather than fluctuating or jumping;
- smoother, more consistent material feeding will mean the machinery does not make any unnecessary noises; and
- there will be less cracked grain!

3.6 | Stone trap beater speed

Operating the feeder house stone trap beater at the correct speed will reduce plugging and grain losses due to crop damage.

- On Case IH harvesters, the stone trap beater adjusts automatically with the feeder house speed.
- New Holland has ‘High’ and ‘Low’ speed settings, set by a belt drive on the right-hand side of the feeder house. This should be set to ‘Low’ (the large wheel) for a speed of 650rpm. The ‘High’ speed setting of 1100rpm is typically too fast.

3.7 | Feeder house angle protects the front and the flow

The height and tilt angle of the feeder house is critical for header front performance. Working with the wrong angle between the feeder house and the header front can be costly.

The correct set-up will help with proper knife angle, which will also reduce the risk of header front damage and feeding problems.

Obtaining angles

For most harvesters, you can obtain the correct angle by positioning the lower lip of the feeder house entrance 760mm from the ground. At this height, the front plate of the feeder house should be perfectly vertical.

New Holland CR rotary combines have an indicator system that should be set at 3.5.

3.8 | Feeder house set-up summary

Feeder house fingertip checks

1. Angle: Face vertical when 760mm off the ground. (This works for most harvesters, but check your operator's manual.)
2. Slats gap: 25mm from feeder house floor.
3. Third slat: 2mm gap left and right.
4. Drum chain: Not less than 5mm from floor.
5. Drum speed: 570rpm.
6. Stone beater: Use the 'Low' setting (650rpm) where provided.

Once all settings have been made and checked, reverse the feeder mechanism through its full cycle then re-check the settings.

THRESHING SYSTEM SET-UP

Photo: Evan Collis

Threshing system set-up

Correct threshing system set up is crucial for minimising losses – not only as a result of proper separation of grain from material other than grain (MOG), but also through more efficient running of the harvester.

Correct set up can help reduce a range of operating costs, such as the time and labour costs of a longer, slower harvest and the extra fuel costs of running an inefficient machine.

This section addresses the grain and performance losses that can be caused by poor threshing system set-up. It also explains how the threshing system can be configured to minimise grain losses and fuel burn and maximise harvest productivity.

FIGURE 13. Rotary (axial) threshing system.

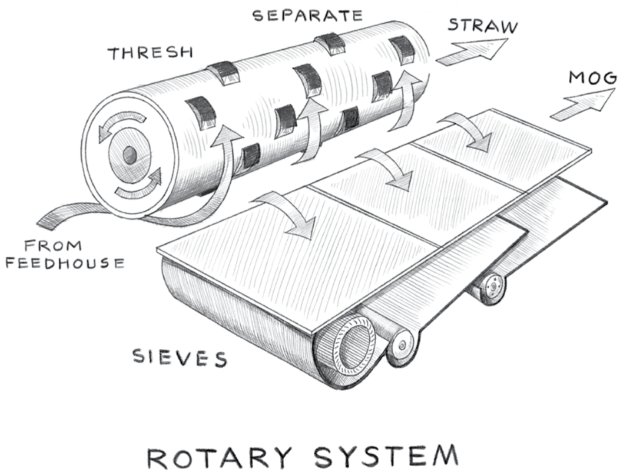
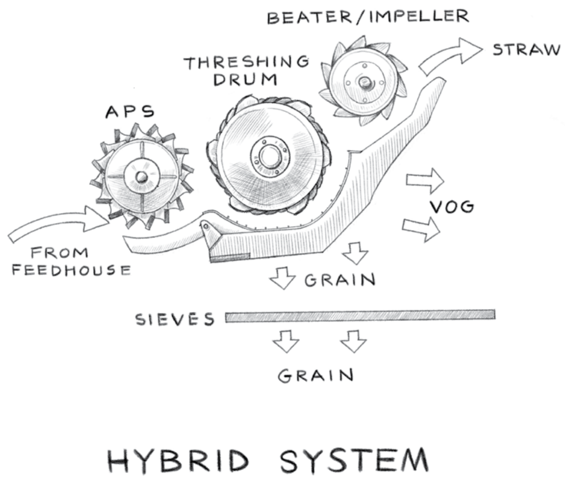


FIGURE 14. Hybrid threshing system.



4.1 | The threshing system has a powerful effect on productivity

A combine harvester has three basic functions. It must gather the crop, separate the grain and eject and effectively spread residue or MOG.

The heart of the operation is the threshing system, which must:

1. remove the grain from the heads;
2. separate the grain and straw; and
3. clear the chaff litter out of the threshing area.

This operation uses a substantial share of the machine's total power consumption.

Correctly 'tuning' the threshing system has been shown to deliver fuel savings of up to 50 per cent in an extreme example, with a corresponding maintenance and amortisation benefit from a reduction in rotor hours as well.[1]

This decreases the overall operating costs for harvest and has been shown to more than offset the power required to run a relatively power-hungry, but important, weed seed mill in some cases.

[1] Farming Ahead No.348 (January 2021), pp.13–15.

4.2 | A poor threshing set-up will lead to losses

As a rule, grain and performance losses occur when the threshing system is unable to separate and remove the grain efficiently.

To function properly:

- threshing of the heads must happen at the start of the concaves, as threshing later, when material has progressed further through the concave area, can lead to rotor and sieve losses; and
- ideally, 90 per cent of the grain must be able to exit the threshing area before the separator grates.

To achieve these goals, the rotor and concaves must be aggressive but also let the grain out.

Factory concaves and rotor set-up may not deliver the best results, and even a 2mm adjustment can make a significant difference to threshing performance and, therefore, productivity. In heavy crops with high feed rates, the widest possible opening will provide the increased throughput required.

Remember, loose is fast. It is essential to balance productivity with low harvest losses, but it is possible to increase capacity and lower losses.

In almost all cases, cover plates should be avoided as they reduce the exit area that is available for the grain, leading to increases in rotor losses.

4.3 | Minimise threshing system losses

Almost all losses in the threshing system are caused by the rotor. This includes grains not properly threshed and separated from the MOG, as well as losses due to grain damage such as cracking.

Grain cracking

- Grain cracking usually only occurs in the threshing system if there is not enough material to thresh, that is, when the rotor is not adequately loaded. Ground speed and material flow are keys to keeping the rotor loaded and light or patchy crops can increase the risk of cracking.
- Cracking can also occur if the concave is not calibrated correctly.

Losses

- Straw is essential for proper threshing.
- To avoid losses, first aim to achieve even filling from the front by pushing more material into the harvester until an even flow is achieved.
- The optimum straw length entering the machine is about five to 10cm for cereal and pulses, or more than 1m for canola. In shorter cereals or lighter crops, set the cut height to maximise the straw length.
- For damp or green material, start with a high rotary speed (60 per cent of maximum plus 100rpm) to avoid plugging the machine.
- If losses are high (over one per cent in cereal or two per cent in canola), open the concave or adjust the rotor speed (only one at a time) to optimise overall performance.
- Longer straw reduces rotor losses.

SEE THE STEPS FOR OPTIMISING THRESHER PERFORMANCE ON THE FOLLOWING PAGES.

4.4 | Set and square the concaves carefully

Calibrating and squaring the concaves is one of the most important adjustments on the combine. Badly set concaves can lead to overloading on one side of the sieves, white caps (where grain is still attached to the glume) and rotor loss.

Setting and squaring concaves:

(Refer to drawings on following page)

Case IH

To avoid losses, the concave must be square to the rotor (parallel from front to back and left to right). To check whether it is square, set the concave to the zero position, then:

1. Measure the distance from the outside of the concave to the rotor skin for the first (at the front) and second (at the back) concaves at the six o'clock position (A).
2. For both concaves, measure the distance from on top of the third interrupter bar to the rotor skin (B).

Make any required adjustments as per the operator's manual.

The pinch point should be as per the operator's manual. However, from his experience, Brett Asphar has found moving the pinch point further to the left can reduce losses and increase capacity under difficult threshing conditions.

New Holland

The concave must be set square to the rotor and level from front to back.

The innermost and outermost threshing bars on the concave should both be 6mm from the rasp bar.

New Holland CX

The concave needs to be set as follows:

- Front: 10mm gap from the rasp bar to the rotor at the pinch point.
- Rear: 14mm gap at the pinch point.

John Deere

- Rotary S and STS models: Set a 6mm gap at the pinch point.
- Conventional T and WTS models:
  - Front: Set a 5mm gap at the pinch point.
  - Rear: Set a 9mm gap at the pinch point.

Claas Lexion

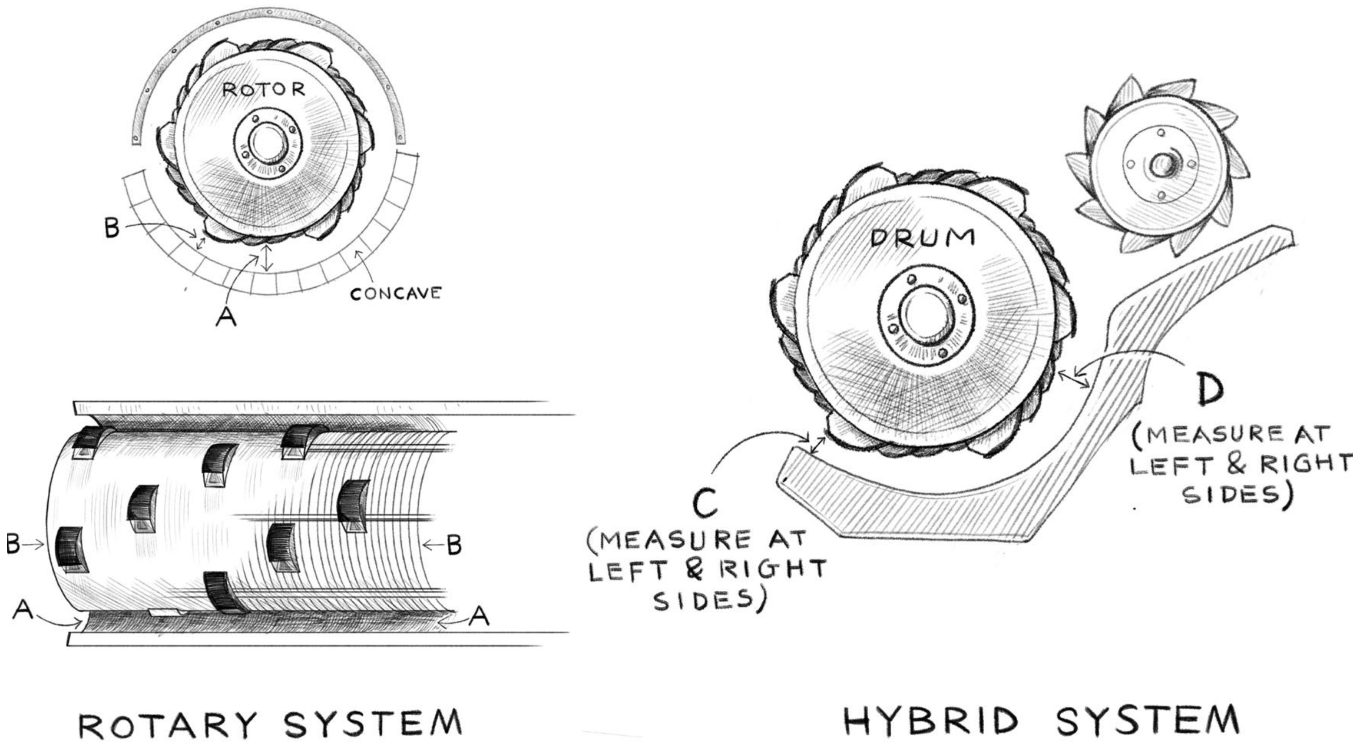
The concave needs to be set as follows:

- Front: 7mm gap at the pinch point (C).
- Rear: 4mm gap at the pinch point (D).

(Claas concaves are difficult to set and may require dealer support.)

It is strongly recommended that operators contact their local dealer, manufacturer or harvest expert to discuss details of squaring concaves, as errors in adjustment can have catastrophic effects.

FIGURE 15. Measuring points for squaring concaves.



4.5 | Open the concave gap

Opening the gap between the concave and the rasp bars attached to the rotor (usually an in-cab adjustment) gives the crop material more space, which means it is less compacted and threshing is generally gentler. Grain will also be able to move through the straw mat more freely, resulting in faster and more effective separation.

Easier separation requires a lower drum or rotor speed, which results in:

- Less over-threshing.
- Reduced harvest losses through the rotor.
- Less broken material on the sieves, for improved separation and reduced grain losses.

The spacing in the concave should always be at least:

- 2mm more than the largest grain head.
- 5mm more than the largest pulse grain.

Narrower settings than these will cause separation to take place further back in the rotor, overloading the top sieve in the centre concave and causing losses.

Always make sure there is enough material going into the machine to fill the threshing system.

TO FURTHER IMPROVE THRESHING PERFORMANCE, REFER TO SECTION 4.8.

4.6 | Fit the right rasp bars for your crop

Unless they have already been changed for Australian conditions, the factory-standard rasp bars on many North American-made harvesters are designed for corn, with large grooves and a 28-degree side angle.

The grooves need to catch the heads of the crop and should match the diameter of the straw. Using large grooves with narrow diameter straw (including most cereals, pulses and canola) can lead to slippage, which can result in a temporary blockage. When this blockage releases, it can overload the threshing system with short straw.

Equally, the standard 28-degree side angle can allow cereal crops to skirt around the rasp bar. A clear sign of this happening is polishing on the rotor skin next to the rasp bar.

Rasp bars with narrow grooves and flatter angles are available, and these should be fitted for most crops except corn.

For John Deere (STS, S), Case IH and Claas rotary harvesters:

- **John Deere:** Rasp bars (rotor elements) for cereals, or dense packs, are available with flatter angles and narrower grooves (also known as riffling). Ask dealers for rasp bars without corn breakers. We can fit a John Deere dense pack to John Deere machines.
- **Case IH:** Hooked or spiked rasp bars may offer improved performance in cereal crops and rice.
- **Claas:** Factory rasp bars are generally suitable for cereals.

John Deere Dense pack: The ability to add 9 extra rotor elements to the rotor. To take the number of rotor elements from 15 to 24 rotor elements. This improves the threshing capability. To do this, it is essential to level the concave and then calibrate the concaves back to zero having added the extra elements/ rasp bars.

4.7 | Keep the rotor vanes fully advanced

Rotor vanes are designed to move threshed straw out of the concave and clear of the threshing area.

As a rule, the vanes should always be advanced as far as possible.

When the rotor vanes are set back, they hold the straw in the threshing area for longer. This retained straw can also trap grain, which gets damaged as the straw is over-threshed.

Over-threshed straw may carry grain out of the rotor or drop it too far back on the sieves, leading to losses.

Having longer straw that is ejected from the concaves quickly will help improve throughput and reduce grain losses.

Example

In Grower A's John Deere harvester in a 4 tonne wheat crop, with the vanes fully set back, straw made two extra revolutions around the drum and losses were recorded at 330kg/ha.

Once the vanes were fully advanced, losses fell to less than 33kg/ha.

4.8 | Optimise threshing capacity in small steps

Optimum threshing capacity, and therefore productivity of the harvester, is affected by:

- crop type;
- rotor or drum speed;
- concave gap; and
- forward speed.

In other words, maximum harvest efficiency involves putting as much crop into the threshing system (forward speed) as it can process (drum/rotor speed) and clear (concave gap).

For cereal crops start with:

- **Concave gap** – Grain head width plus 2mm.
- **Drum or rotor speed** –70 per cent of maximum.

For pulse crops start with:

- **Concave gap** – Pod width plus 5mm.
- **Drum or rotor speed** – 60 per cent of maximum.

Find the threshing threshold

Adjusting the system settings establishes the upper threshold for efficiency. Beyond this point there will be:

- unacceptable levels of grain loss;
- dirty grain samples; and
- use of all available engine power – or apparent power loss.

Once the threshold is reached, settings can be stepped back slightly to maximise productivity without wasting power, fuel or resources. This may mean accepting a slightly slower ground speed, slightly higher grain losses and so on or finding an acceptable compromise between those parameters.

To optimise capacity and minimise losses in the threshing system:

1. **Open the concave (loose is fast)**

   A more open concave provides more space for the grain, which leads to fewer white caps.

   - Open the concave in 1mm increments and check the grain sample after each increase.
   - By about the third increase, the sample will start to look very dirty.
   - At this point, stop opening the concave and increase the drum or rotor speed.

2. Increase the speed of the drum or rotor

Starting from the previous setting or the benchmark speeds given on page 88:

- Increase the drum or rotor speed in steps of 50rpm per time.
- Check the grain sample after each speed increase and repeat this step until the sample is clean.

3. Increase ground speed

Increasing the ground speed increases the amount of material being fed into the system.

- Increase the ground speed in steps of 0.5km/hr, then stop and check the grain sample. (In heavy crops, reduce these speed changes to 0.25km/hr or even 0.2km/hr at a time.)
- Keep increasing the ground speed in small steps until the sieve loss monitor shows an increase or the grain sample becomes dirty.

**As a rule of thumb, when harvesting a 5t/ha wheat crop with a 12m front, every 0.2km/hr speed change brings a corresponding 0.66t/hr change in harvested grain.*

4. Increase the fan speed

Finally, adjust the fan speed to suit the harvest conditions.

- In the morning or in tough conditions, increase the fan speed in steps of 40 to 50rpm.
- As conditions dry out from midday, use increments of 20 to 30rpm.
- Increase the fan speed in these small steps for as long as the losses and sample quality both remain acceptable.

Make one step change at a time until maximum efficiency is found. Repeat the process whenever the crop type or density changes, or at least twice during the day to adjust for morning, afternoon and evening harvest conditions.

Invest time in this process at the start of harvest and use it to establish benchmark settings. Having established benchmark settings will save you a lot of time over the harvest season.

SEE SECTION 4.9 ON THE NEXT PAGE FOR MORE DETAILS.

4.9 | Use benchmark settings to maintain efficiency

It is not possible to thresh efficiently all day on one setting.

The harvester needs to be reset regularly throughout the day to meet the changing temperature and moisture conditions.

Generally, ground speed can be increased and rotor speed can be reduced from morning until early afternoon. Then, as moisture levels increase going into evening, reduce groundspeed by 0.5 to 1km/hr and increase the rotor speed to suit the conditions.

When optimising threshing efficiency (see 'Optimise threshing capacity in small steps' on a page 63) record benchmark settings to support faster adjustments in the future.

These benchmarks will need to be specifically adjusted for:

- higher levels of moisture;
- higher levels of weeds;
- different crop material; and
- lighter or heavier crops.

Other factors that can influence threshing system performance and need to be managed include:

- knife and knife guards that are not sharp;
- rough or undulating paddocks;
- wet paddocks;
- lodged crops; and
- weed volumes.

Having benchmarks means optimising the threshing system can be completed quickly and in fewer steps.

4.10 | Threshing system settings summary

Maximising threshing system throughput means bringing as much crop into the system (forward speed) as it can process (drum/rotor speed) and clear (concave gap).

For cereal crops start with:

- **Concave gap** – Grain head width plus 2mm.
- **Drum or rotor speed** – 70 per cent of maximum.

For pulse crops start with:

- **Concave gap** – Pod width plus 5mm.
- **Drum or rotor speed** – 60 per cent of maximum.

To achieve maximum efficiency, adjust:

1. Concave gap in 1mm steps.
2. Rotor/drum speed in 50rpm steps.
3. Ground speed in 0.5km/hr steps (down to 0.2km/h steps in heavy crops).
4. Fan speed in 40 to 50rpm steps in tough conditions, and 20 to 30rpm steps later in the day.

Use this approach to set benchmarks for different times of the day. These benchmarks can then be quickly fine-tuned to the specific conditions on the day.

4.11 | Good seed separation supports HWSC

Harvest weed seed control (HWSC) is an essential part of any integrated weed management (IWM) program.

There are several HWSC options including chaff lining or chaff decks, narrow windrow burning, chaff carts and weed seed impact mills.

All HWSC options rely on getting all weed seeds into the harvester and on separating weed seeds from the straw in the threshing system, and from the harvested grain on the sieves.

Optimising efficient and effective weed seed separation should be seen as part of optimising threshing system performance, as described on the previous pages.

For a rotary or axial flow combine:

- Open the concave to increase input and increase the rotor speed in 50rpm steps.

For conventional tangential or hybrid combine:

- Open the concave 25 to 35mm.
- Set the rotor/drum speed about 850 to 900rpm.
- Increase the rotor/drum speed 50rpm at a time.

For BOTH types of combine:

- Aim to fill the rotor without over-threshing the material.
- Over-threshing will result in rotor loss and weed seeds being ejected with the straw. It can be detected by rotor loss sensors during harvest and subsequent regrowth of weeds and crop volunteers.
- Over-threshing can also lead to sieve loading. This will cause sieve losses and overloading or blocking of the impact mills if these are being used.

FOR MORE INFORMATION ON HWSC, SEE SECTION 6 OF THIS GUIDE.

THE CLEANING AREA

Photo: © GRDC

The cleaning area

Once material has passed through the threshing area, it enters the cleaning area to ensure any grains that have not fallen out during the separation process can be captured, rather than being ejected with the MOG.

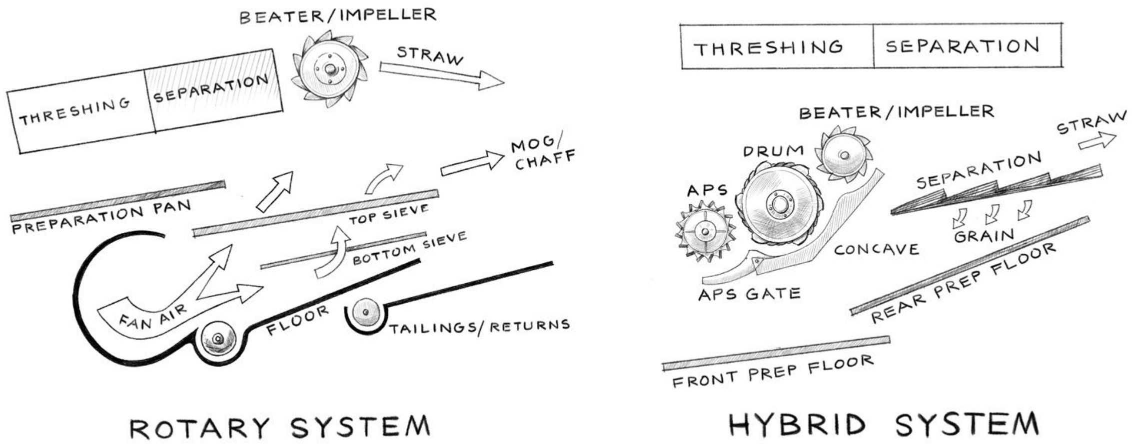
This means setting up the cleaning area incorrectly is another source of potential losses.

Different harvester models have different sieve configurations (pre-sieve, top sieve, back sieve) but the principles are the same – they allow grain to pass through and be augured into the grain bin.

The other key component of the cleaning area is the fan that uses air to mobilise the MOG, and will need to be set to the harvesting conditions.

All sieves need to be calibrated and the fan and sieves adjusted to minimise losses and achieve the desired sample quality.

FIGURE 16. Typical cleaning area configurations.



5.1 | Understand how the cleaning area works

It is important to understand that the cleaning area is predominantly pneumatic, rather than mechanical, in that it relies on pressurised air to separate the MOG from the grain. This air flows constantly and does not rely on moving machine parts to physically separate grain from the MOG.

However, the air pressure must be high enough to support the MOG but not the grains, so that they fall down through the sieves instead.

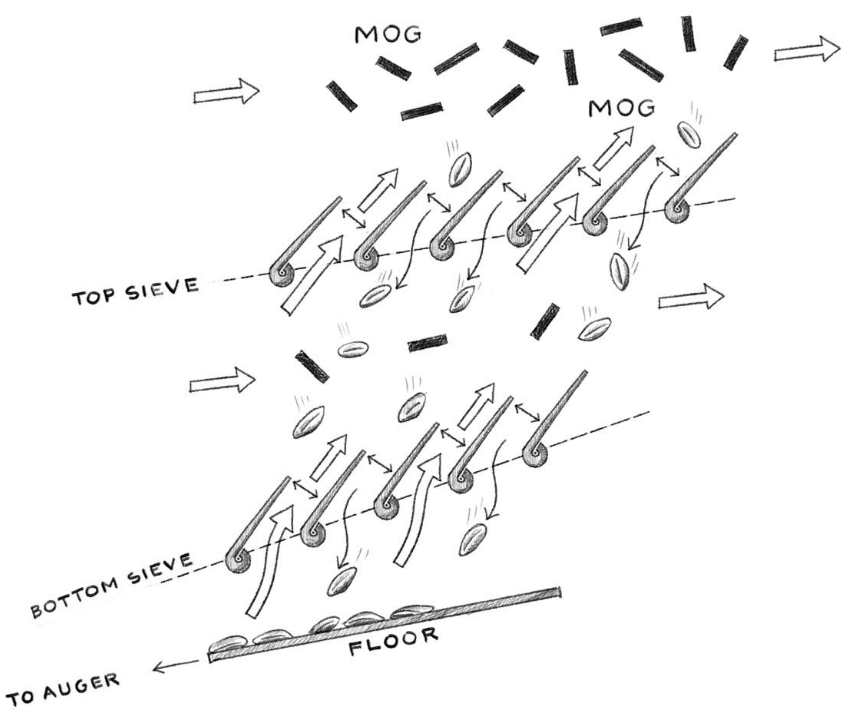
As air blows up from under the sieves, it provides sufficient force to counteract gravity acting on the mat of MOG. This moving mat ‘floats’ over the top sieve while the denser grains fall through. (The process is helped by mechanical agitation from the walkers, but it is primarily air driven.)

There are two types of issues that have the potential to impact grain recovery and separation.

- If the MOG mat has holes from uneven feeding, air will rush through the holes and the pressure supporting the mat will fall off rapidly.
- If the MOG mat is uneven and thicker in patches, grain may not be able to fall though and onto the sieves.

An even flow of harvest material from the front, feeder house and threshing system rotor/drum is essential for creating an even MOG mat and efficient cleaning area operation.

FIGURE 17. Cross-section through sieves.



When the system is working properly:

- clean grain will fall towards the clean grain cross auger and elevator;
- incompletely threshed material will be carried to the return elevator; and
- chaff and weed seeds will be carried to the back of the machine.

To adjust the cleaning area for minimising losses, the main sections that need to be considered are:

1. Pre-sieve set-up and adjustment.
2. Adjusting the sieves and fan speed for crop variation.
3. Return system losses.

5.2 | Pre-sieve set-up and adjustment

Some harvesters have a pre-sieve section of the cleaning area, which is primarily designed to separate grain that has fallen out of the harvest material in the rotor.

The lighter the crop, the smaller the grain will be and the tighter the pre-sieve will need to be set.

With larger crops such as wheat or barley, as productivity increases past 5t/ha, open the pre-sieve to allow higher throughput.

If the pre-sieve is opened too far for a light crop, or left too tight for a heavy crop, grain losses will occur.

Case IH and New Holland combines:

- The pre-sieve on CNH machines has very little air going through it, so it should be used to move the grain and harvested material onto the top sieve.
- The pre-sieve should only be opened to the width of the grains being harvested – between a minimum of 10mm and a maximum of 14mm.
- Opening the pre-sieve too far will allow excess chaff to fall through and miss the top sieve. It can then overwhelm the bottom sieve and end up in the hopper, dirtying the sample.

John Deere combines:

- Models with a frogmouth sieve need the pre-sieve to be opened to 20mm to maximise airflow.
- The pre-sieve on older STS series harvesters is not adjustable.

Claas combines

- Claas machines do not have a pre-sieve, as they rely on a larger preparation floor instead.

5.3 | Adjusting the sieves and fan speed for crop variation

The cleaning area settings most frequently needing to be adjusted to suit harvest conditions are fan speed and the bottom sieve opening.

The thickness and density of the chaff mat moving over the sieves will be affected by the crop biomass and its flow through the machine. This is driven right at the start of the harvesting operation by even filling from the header front and feeder house. See sections 2 and 3 for more details.

In the cleaning area, variation in the chaff mat resulting from changes in crop conditions can be adjusted all by either:

- increasing the fan speed in 30rpm steps, one step at a time; or
- opening the bottom sieve in 1mm steps, one step at a time.

Check the losses, returns and grain sample after each change and remember to only adjust one variable at a time, so you are assessing the effect of that change alone.

As with rotor losses, once you have an idea of the range of settings you may require under one set of conditions, you can record those settings and use them as a starting point for similar conditions.

It is worth taking the time to establish baseline settings for different crops and times of day.

5.4 | Sieve setting tips using wheat as an example crop

John Deere

1. **Calibrate all sieves for accuracy:**
   - Sieves need to be calibrated ahead of every harvest and checked regularly throughout the season. To clean the sieves, open them using the switches at the back of the cleaning area and then re-check the calibration after they have been closed.
   - Open the top sieves right up to 14mm before closing them back down and setting them at 6mm.
   - Once this is done, it is important to physically remeasure the sieves to confirm they have opened 6mm
   - It is likely they will need further short touches on the switches to adjust them until they do measure 6mm (even if it means the monitor reads closer to 5mm or 4mm). **Note:** This is the only way to ensure accuracy and consistency, especially when using more than one harvester in a crop.
2. **Set the top and bottom sieves relative to each other:**
   - The top and bottom sieves should be set relative to each other, with the bottom sieve tighter than the top sieve. For example, set the top sieve at 16mm and the bottom sieve at 6mm for wheat.
   - Open up the top sieve as wide as possible.
   - Check the returns. If there is a lot of chaff and some grain in the returns, then close down the top sieve (2mm at a time) until there is less chaff in returns. Do this until chaff disappears but balance this objective with not throwing grain over the sieves (that is, measure losses at the sieve.)

Case IH Axial-Flow

The Case IH Axial-Flow cleaning area includes a grain pan in front of the sieves, under the concaves. It helps to quickly move any grain that falls from the front of the rotor onto the sieves.

Sieves need to be calibrated ahead of every harvest and checked regularly throughout the season. To clean the sieves, open them using the switches at the back of the cleaning area and then recheck the calibration after they have been closed.

1. **Calibrate the sieves for accuracy:**
   - Open the sieves right up to 14mm before closing them back down and setting them at 6mm.
   - Once this is done, it is important to physically remeasure the sieves to confirm they have opened 6mm.

- It is likely they will need further short touches on the switches to adjust them until they do measure 6mm (even if it means the monitor reads closer to 5mm or 4mm).
  Note: This is the only way to ensure accuracy and consistency, especially when harvesting with more than one machine and sharing settings.

2. Set the top and bottom sieves relative to each other:

- The top and bottom sieves should be set within a few millimetres of each other, with the bottom sieve slightly tighter than the top sieve. For example, set the top sieve at 12mm and the bottom sieve at 10mm for wheat.
- In this configuration, the bottom sieve only needs to 'fine-tune' the material that has been cleaned by the top sieve.

  Note:
  - Never close the bottom sieve on Case IH machines below 6mm. The squirrel cage fan will stop working properly if the sieves are set too tight, and grain can back up in the fan.
  - Adjust the fan speed after the sieves have been set to achieve the cleanest possible sample while still capturing all the grain.

New Holland

The sieves on New Holland combines should also be set so that the lower sieve opening is slightly smaller than the top sieve opening:

- Once the sieves have been calibrated at their 6mm mid-point (following the same steps as for Case IH machines above), open them up until grain losses have been minimised.
- Open the lower sieve to be 2mm tighter than the top sieve.

5.5 | Return system losses

The return system itself does not thresh grain but it does increase potential for grain damage by returning grain to the threshing area to be threshed again. Even when the return is just half full, losses can increase by as much as 200kg/ha.

High return percentages can cause grain losses through:

- grain cracking caused by excessive threshing; and
- grain being dumped on top of the MOG harvest material and carried out of the machine before it can fall through to the sieves.

High returns originate in the back part of the top sieve, the setting of the bottom sieve, or through overloading of the sieves through over-threshing. The return overload is always located on the sieves, either at the side or in the centre.

Conventional Case IH, New Holland, John Deere and Massey harvesters all deposit returns back to the rotary, either from the top or onto the drum. Claas machines with the APS system send the returns to the centre of the APS drum.

It is important to note that newer machines deposit returns back onto the top sieve. This can start to overload the top sieve, leading to more returns, more overloading and so on – all with increasing losses.

In each case, the returns are re-threshed, which can lead to grain cracking and powder, which must also be counted as losses.

5.6 | Minimising returns

Keeping returns to a minimum should be a key goal of harvester set-up and operation.

Proper rotor/drum set-up in the threshing section will reduce returns and subsequent grain loss.
See Section 4 on threshing system set-up for more details.

Returns can be kept to a minimum by:

- threshing the grain effectively;
- running the fan at the lowest effective speed; and
- keeping the bottom sieve as open as possible (relative to the top sieve and grain size).

Ideally, the bottom sieve could be set fully open or even removed and the returns section covered with a plate. This would require everything, including the threshing system, to be running perfectly all the time.

In reality, the bottom sieve and return are essential backups and should always be used as such.

To reduce returns:

Check the threshing area is operating well and check losses to ensure it is not over-threshing. If operating well, manage the chaff mat for even filling across the sieves.

To do this:

1. Increase fan speed in small steps of around 30rpm per time, checking the sample each time.
2. If the sample still needs refining once the mat is even, open the bottom sieve in 1mm increments, one step at a time. Check the sample after each adjustment.

However, if the problem is that the return is full:

1. Open the bottom sieve until the return is close to empty.
2. Adjust the top sieve in 1mm increments, one step at a time.*
3. Adjust the fan speed in 30rpm increments, checking the sample as you go.

***Note:** Some sieve configurations are designed to vary from front to back at the top sieve. The back of the top sieve is typically 4mm less than the front. (Check your operator's manual to confirm these positions and measurements.)

5.7 | Bypass weed seed impact mills during cleaning area set-up

Where a weed impact mill is fitted to a harvester, it is essential to bypass the seed mill while setting and checking the cleaning area, so that the grain being ejected with the chaff can be measured.

This is because weed seed impact mills destroy around 99 per cent of all seeds being blown to the back of the harvester, making it impossible to assess grain losses from the cleaning area.

Note: Bypassing the mills will change the airflow inside the harvester, which can affect the flow of material. While not ideal, it is accepted that the variation can be overlooked in most cases.

The seed mill should only be re-engaged once cleaning area set-up has been adjusted for minimal grain losses and losses out the back have been rechecked.

In contrast, assessing grain losses out the back of the harvester is relatively simple when using HWSC systems such as chaff lining or chaff decks and, to an extent, chaff capture for carting or baling, because these systems dump the chaff section in a specific pattern.

FOR MORE INFORMATION, SEE SECTION 6: HARVEST WEED SEED CONTROL.

HARVEST WEED SEED CONTROL

Harvest weed seed control

HWSC is an important tool that can be used as part of an integrated weed management (IWM) strategy. Without it, the harvester can exacerbate weed issues by spreading weed seeds across the paddock with the chaff, ready to germinate in the following season. This increases the pressure on herbicides, herbicide resistance development and weed control costs.

In contrast, HWSC can capture 50 to 80 per cent of weed seeds at harvest and significantly reduce the soil seed bank over successive years.

For more information on HWSC options and their efficacy, refer to the WeedSmart website at weedsmart.org.au.

HWSC is closely linked to managing harvest losses. Weed seeds must enter the harvester to be captured, so minimising losses from the header front is critical to HWSC effectiveness.

Different types of HWSC will affect the harvest set-up in different ways so it is helpful to understand how each type will affect set-up and loss optimisation.

WEED smart

6.1 | HWSC tool options and set-up considerations

For all HWSC options, the method will affect how harvest loss measurements are undertaken. For more information on how to undertake measurements with different HWSC options in use, please refer to section 1.4.

Front set-up and cutting height are key considerations for effectively implementing all HWSC options, as this affects whether weed seeds make it into the harvester at all. By definition, weed seeds that do not enter the harvester cannot be controlled.

It is critical to consider the most common weed species in the paddock, and therefore the weed seeds that need to be captured, when setting up the threshing and cleaning areas of the harvester. Otherwise, weed seeds may end up being collected in the grain sample or ejected in the uncontrolled chaff fraction.

The main HWSC methods and relevant consideration are:

- **Chaff lining/Narrow windrow burning**

  This method involves retaining harvested crop and weed material in narrow rows and either allowing them to rot down (chaff lining) or burning them to destroy the weed seeds (narrow windrow burning).

  Additional considerations for harvester set-up when chaff lining/narrow windrow burning include:

  - loss measurement calculations, as MOG is concentrated into a row and not spread across the harvest area.

- **Chaff deck**

  The chaff deck separates the chaff fraction (and weed seeds) and dumps it onto the wheel tracks that, in controlled traffic systems, offer a hostile growing environment for weeds. Implications for harvester set-up are the same as for chaff lining, although the sampling patterns and loss calculations differ as material is divided up into two rows rather than one.

- **Chaff carting**

  Chaff is collected and dumped for burning or grazing.

  Areas of harvester set-up that may affect the efficacy or that need to be considered when using chaff carts include:

  - loss measurement calculations. As MOG is heaped into a pile and not spread across the harvest area, the chaff cart will need to be bypassed or losses sampled in a different way, see Section 1 on Measuring harvest losses for more details; and

  - horsepower requirements. Dragging additional machinery behind the harvester will increase the horsepower requirements for the harvest operation and may compromise harvest speed or efficiency (although the power requirements are not as high as for impact mills).

- **Bale direct**

  This system involves towing a baler directly behind the harvester and using a power take-off from the harvester to bale the chaff as it is produced. The connection is complex, but the bales are easily transported and can be sold off-farm. Harvester set-up implications are the same as for those relating to chaff carts.

- **Seed impact mills**

  Seed impact mills pulverise the entire chaff fraction, destroying up to 98 per cent of weed seeds that enter the impact mill. The mills use a caged spinning mill with either counter-rotating bars or high speed air and impact bars.

  Things to consider for harvester set-up optimisation include:

  - loss measurement calculations, as mills will have to be bypassed or disengaged to measure losses from the cleaning area. (Mills pulverise all seeds, including weed seeds and grains, making post-mill measurement impossible.);
  - cost of wear and tear on mill machinery, as mills can suffer significant wear from sandy soils, particularly where crops are harvested low to the ground;
  - horsepower requirements, as mills can reduce performance by up to 30 per cent. This can compromise harvest speed and efficiency and/or result in increased fuel costs; and
  - harvesting conditions – green material can make mills significantly less effective.

When looking at HWSC options, it is important to consider the impacts of a breakdown or adverse conditions on overall operating cost and efficiency. It is also important to consider how quickly the HWSC component can be disconnected or bypassed, how quick and easy it is to get technical support at short notice, and/or whether it will be possible to continue harvesting in the meantime.

6.2 | Front set-up for effective HWSC

The best harvester set-up for capturing weed seeds is usually the best set-up for the crop.

Reducing header front losses for the grain will also minimise the rate of weed seed loss at the front, so the greatest number of weed seeds are fed through to the HWSC system being used.

FOR MORE SET-UP INFORMATION, SEE SECTION 2: REDUCING HEADER FRONT LOSSES.

6.3 | Thresh the weed seeds out

Once weeds have entered the harvester over the front and through the feeder house, the threshing section of the rotor will remove the seeds just as it does with grain from the crop.

As the straw mat moves over the separator, the weed seeds and grain should fall out of the rotor and onto the sieves.

As long as the rotor and concaves are set up to thresh all the grain effectively, they will remove all the weed seeds as well.

Weed seeds should exit the rotor and cleaning section with the chaff. They should then pass into a weed seed impact mill under the baffle, or be managed with the chaff if using chaff carting, lining or decks for HWSC.

Low grain losses from the rotor equal low weed seed losses.

It is critical to measure and minimise grain losses from the rotor using drop trays.

SEE SECTION 4: THRESHING SYSTEM SET-UP FOR MORE DETAILS.

6.4 | Use fan speed to control the chaff

After threshing, at least 95 per cent of the weed seeds that entered the harvester should be in the chaff fraction on the sieve.

The aim is to keep weed seeds supported in the chaff (by airflow from the fan) so they:

- do not fall through the sieve with grain. Weed seeds generally have a lower mass than grain; and
- are not blown out with the straw.

The optimum fan speed for grain cleaning should also be suitable for weed seed capture.

1. Start with a low fan speed and dirty grain sample.
2. Increase the fan speed until the grain sample is just clean.
3. Reduce the fan speed slightly, so the grain sample is just shy of perfectly clean.
4. Next, measure chaff and rotor losses using drop pans behind the harvester, to ensure grain and weed seed losses are minimal.

REFER TO SECTION 1: MEASURING HARVEST LOSSES FOR MORE DETAILS.

6.5 | Set baffles to capture the weed seeds

A baffle is essentially a 'fence' that interrupts the air carrying denser materials coming off the sieves into the HWSC tool.

The baffle position should enable it to capture high terminal velocity material (generally small and dense objects, such as weed seeds) being blown off the sieves, while low terminal velocity chaff (light and large material) is blown over the top of the baffle and exits with the straw.

A typical baffle is set-up, so the top edge is:

- 300 to 400mm above the height of the sieve; and
- directly above the rear of the sieve, when the sieve is as far back as it can go.

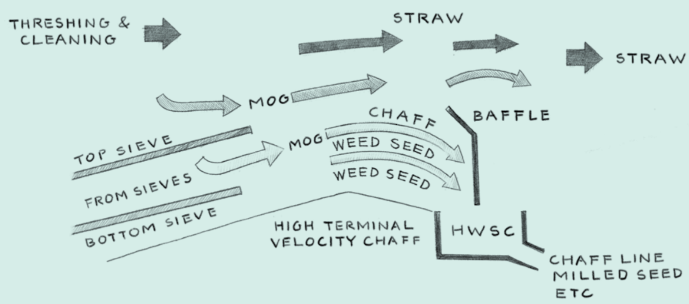
Some harvesters do not require a HWSC baffle:

- **Claas** – chaff and straw are kept completely separate, so a baffle is not necessary.
- **New Holland** – some models have a short conveyor belt, known as a PDS belt, that transfers straw from the rotor to the chopper, so they may not need baffling.

In contrast, most Case IH and John Deere harvesters will require a baffle as the chaff and straw exit the cleaning area together.

Note: Baffle requirements and set-ups vary widely, depending on the type of harvester, the type of HWSC tool and the chopper and straw spreader installation. It is worth seeking advice from the HWSC provider, machinery dealer or an independent consultant.

FIGURE 18. MOG flow around baffle.



6.6 | Measuring harvest losses with HWSC

Harvest losses and HWSC are intrinsically linked, in that achieving minimal grain loss will also result in minimal weed seed loss.

- Once weed seeds are successfully brought into the harvester via the front and feeder house, losses can still occur in the threshing and cleaning systems.
- However, the rule of minimising grain losses to minimise weed seed losses still applies.
- Measuring grain losses from the back of the harvester (that is, rotor and cleaning system losses) is vital for assessing HWSC effectiveness as well.

HWSC tools that utilise chaff control are relatively simple to measure with appropriately placed pans or drop trays.

Seed mills must be bypassed in order to detect grain and weed seed exiting the back of the harvester – otherwise, they will be milled to undetectable dust.

For twin mills, it is acceptable to only bypass one mill for the purpose of assessing loss rates. Remember to double the captured seed weight when calculating overall losses.

REFER TO SECTION 1: MEASURING HARVEST LOSSES FOR MORE DETAILS.

Work safely

Harvester operations carry inherent risks.

Be aware of these risks and the implications of any modifications you make you to the machinery. It is recommended to contact the manufacturer or machinery dealer before making any changes to machinery components, deviating from the manufacturer's recommended operating procedures, or adding after-market modifications.

Fire risk

Harvest fires are typically caused by dust or chaff interacting with hot exhaust system components or overheated bearings. Both threats are amplified when harvesting in hot, dry and/or windy conditions.

These fine, dry materials can easily catch fire if left to build up, with incendiaries propagating from the hot exhaust system as a common ignition source.

Good maintenance is the key to eliminating ignition sources:

- Use an infrared heat gun to monitor bearing temperatures throughout the day and replace bearings that become overheated. Overheating is the first sign of wear and impending failure.
- Note that weed seed impact mills generate much higher volumes of fine dust by nature, requiring the harvester to be blown down more frequently.
- Equip the harvester with fire extinguishers, ideally near the cab and at the rear of the machine.
- Carrying fire extinguishers or a full fire kit on the chaser bin is also a good precaution, as the chaser bin driver is often first to respond to a fire.

Finally, monitor the daily harvest fire risk and stop working if the conditions become dangerous. For example, harvesting must stop at a Grassland Fire Danger Index (GFDI) of 35 in South Australia.

Harvester setting examples

When starting out, the following tables can be used as a general guide to help with baseline settings for each crop. However, these settings will still require fine-tuning for the crop and harvest conditions.

The blank tables on the next page can be used for recording personal harvester settings.

Case IH	Wheat	Canola	Barley	Lupins	Peas
Rotor Speed (rpm)	1000–150	900	900–1000	700–900	700–900
Fan Speed (rpm)	800–950	500–700	860–950	800–950	860–950
Concave Gap (mm)	10–30	25+	10–30	25+	25+
Pre-Sieve (mm)	5–12	0–5	5–2	5–12	5–2
Top Sieve (mm)	12– 6	8–10	13–16	16	13
Bottom Sieve (mm)	10–13	6–8	10–3	16	10

New Holland	Wheat	Canola	Barley	Lupins	Peas
Rotor Speed (rpm)	1250– 350	900–1000	1150– 250	900	900
Fan Speed (rpm)	750	550– 650	700–800	750	750
Concave Gap (mm)	6	25	15	19–25	19–25
Top Sieve (mm)	11	9	12–3	11–2	11–12
Bottom Sieve (mm)	8	6	10–1	10	10

John Deere	Wheat	Canola	Barley	Lupin	Peas
Rotor Speed (rpm)	900–1100	500–600	800–1100	550	450
Fan Speed (rpm)	850	850	1020	1050	1050
Concave Gap (mm)	5	15	15	20	15–20
Top Sieve (mm)	18	15	16	16	18
Bottom Sieve (mm)	7	4–5	6	8	11

Claas	Wheat	Canola	Barley
Rotor Speed (rpm)	710–860	700–900	700–900
Fan Speed (rpm)	1100–300	1000–1300	1000–1300
Concave (mm)	10–3	25–30	10–20
APS Drum (rpm)	610–760	550–650	600–800
Top Sieve (mm)	15	14	15
Bottom Sieve (mm)	9	6	9

Rotor/Drum speed adjustments	
In tough conditions or with tough green weeds:	Increase by 100rpm
In dry/hot brittle conditions:	Set fan at 60% to start

My harvester settings

Record key cleaning area settings for your harvester(s) and crops here.

Harvester	Crop	Crop	Crop
Rotor Speed (rpm)			
Fan Speed (rpm)			
Concave Gap (mm)			
Pre-Sieve (mm)			
Top Sieve (mm)			
Bottom Sieve (mm)			
APS Drum (mm)			

Harvester	Crop	Crop	Crop
Rotor Speed (rpm)			
Fan Speed (rpm)			
Concave Gap (mm)			
Pre-Sieve (mm)			
Top Sieve (mm)			
Bottom Sieve (mm)			
APS Drum (mm)			

Harvester	Crop	Crop	Crop
Rotor Speed (rpm)			
Fan Speed (rpm)			
Concave Gap (mm)			
Pre-Sieve (mm)			
Top Sieve (mm)			
Bottom Sieve (mm)			
APS Drum (mm)			

Rotor/Drum speed adjustments	
In tough conditions or with tough green weeds:	Increase by 100rpm
In dry/hot brittle conditions:	Set fan at 60% to start

Useful resources

GRDC Harvest Loss Calculator
grdc.com.au/resources-and-publications/apps/harvest-loss-calculator

GRDC Video: Any idea how much of your grain was lost during harvest?
youtube.com/watch?v=WMm44AhDYQQ

GRDC Podcast: Minimising canola & cereal harvest losses
grdc.com.au/news-and-media/audio/podcast/minimising-canola-and-cereal-harvest-losses

GRDC *GroundCover*™: How profitable is your harvester set-up?
groundcover.grdc.com.au/innovation/precision-agriculture-and-machinery/how-profitable-is-your-harvester-set-up

GRDC *GroundCover*™: Research finds opportunity to reclaim $300M in grain lost at harvest
groundcover.grdc.com.au/farm-business/business-management/research-finds-opportunity-to-reclaim-$300m-in-grain-lost-at-harvest

WeedSmart resources: Harvest weed seed control
weedsmart.org.au/big-6/harvest-weed-seed-control

GRDC Back Pocket Guide: Reducing harvest fires
grdc.com.au/resources-and-publications/all-publications/publications/2023/reducing-harvest-fires?utm_source=website&utm_medium=short_url&utm_content=Reducing+harvest+fires%3A+The+Back+Pocket+Guide&utm_term=National

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Notes and records

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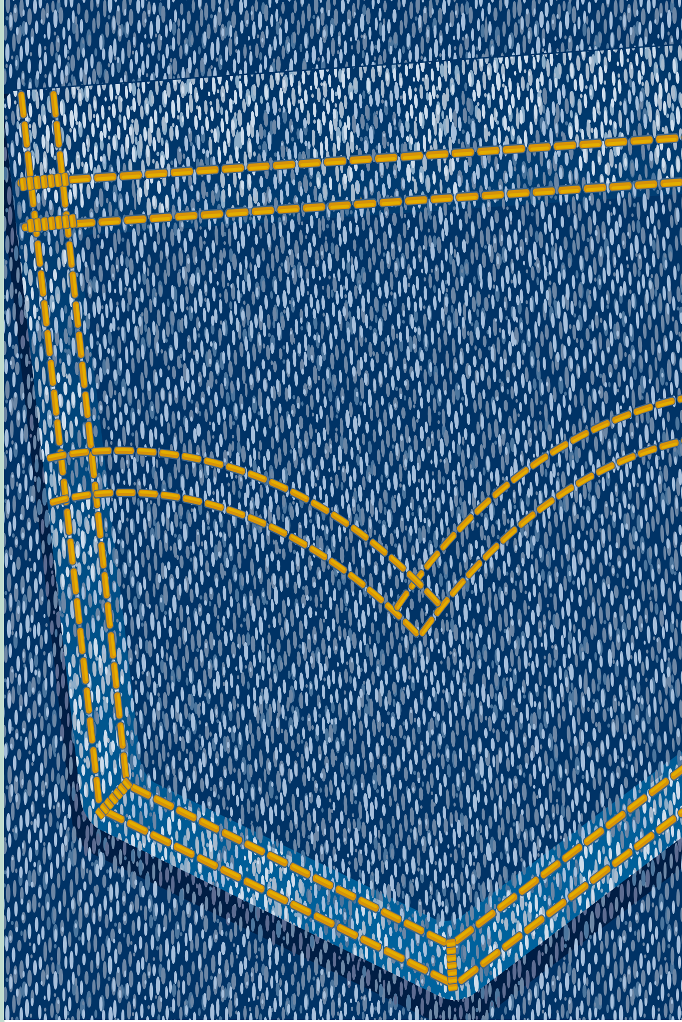

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