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GRDC GROWNOTES™

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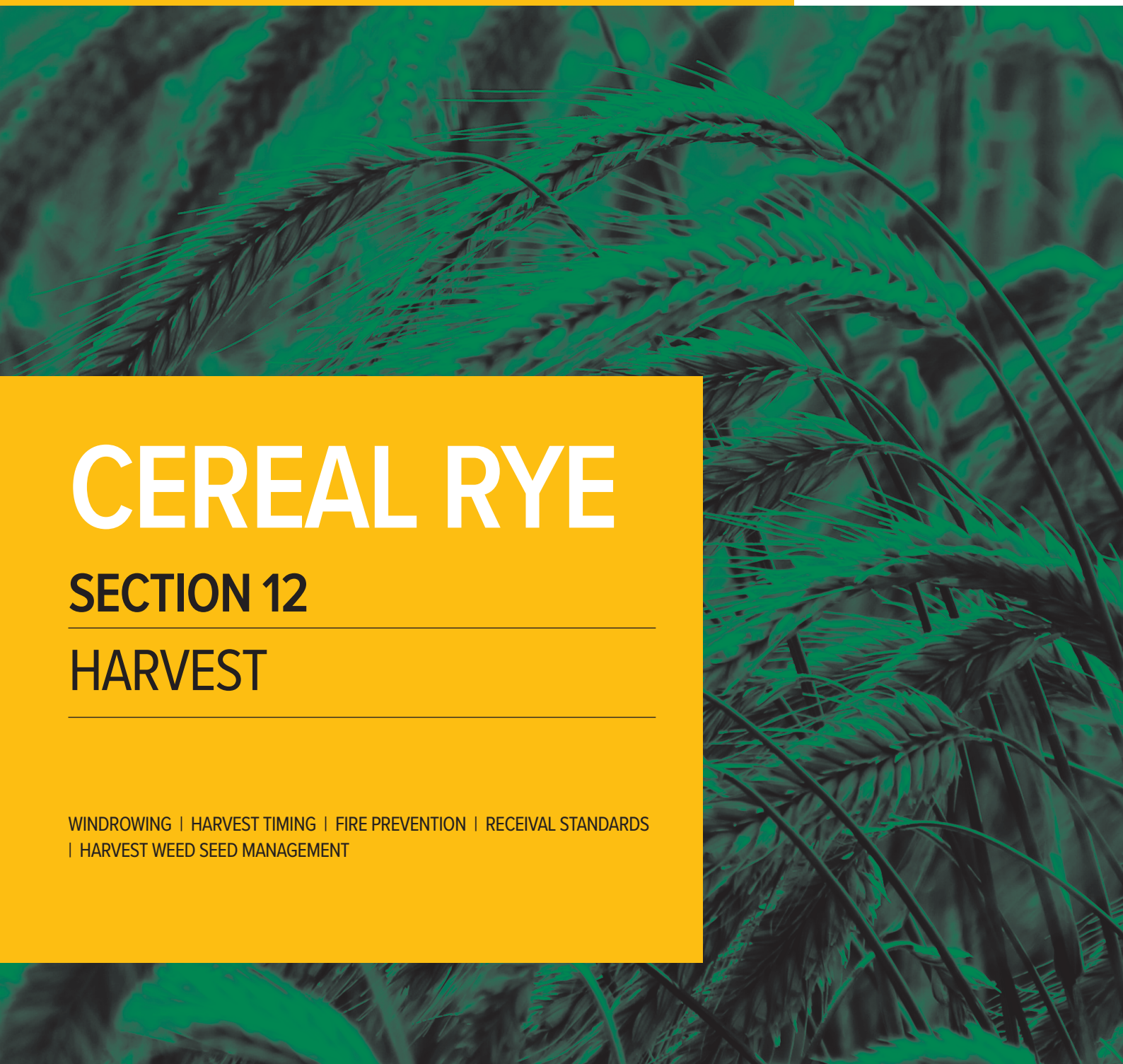


CEREAL RYE

SECTION 12

HARVEST

WINDROWING | HARVEST TIMING | FIRE PREVENTION | RECEIVAL STANDARDS | HARVEST WEED SEED MANAGEMENT

Harvest

Key messages

- Rye is ready to harvest when the leaves are dead and the stems have turned yellow-brown in colour. [1]
- Rye is susceptible to head shatter, which makes it difficult to harvest and results in many volunteer plants emerging in the field next season (Photo 1). [2]
- Because cereal rye matures earlier than other small grains, strict harvest and grazing management procedures are important to prevent it from becoming a weed.
- The limited information available on cereal rye suggests that the preferred growth stage to harvest for silage is the boot stage. Feed quality of cereal rye deteriorates more quickly with maturity compared to other cereals. [3]
- Ensure that all equipment is clean and work to avoid blockages so that fire risk can be minimised.

Although rye comes into ear earlier than wheat, the grain takes much longer to mature. Rye is ready to harvest when the leaves are dead and the stems have turned yellow-brown [4], and the crop should be harvested as soon as the grain is thoroughly dry and hard. Seed losses due to shattering can occur soon after it ripens. Rye is harvested with a conventional header. The grain is slightly lighter and longer than wheat, so the machine will require minor adjustments from normal wheat settings. [5] The grain threshes very easily. Under dry threshing conditions care must be taken to adjust the concave setting and/or cylinder speed to minimise cracking. [6]

Photo 1: *Seed head shatter in mature rye. About ¾ of the head has broken off and fallen to the ground.*

Source: Homegrown Goodness

1 Plant Village. Rye Secale Cereale, https://www.plantvillage.org/en/topics/rye/diseases_and_pests_description_uses_propagation

2 Van Veldhuizen B (2010) Growing small grains in your garden, http://www.uaf.edu/files/snras/C135.pdf

3 DPI NSW. Chapter 5: Crops and by-products for silage. In Successful Silage, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/294053/successful-silage-topfodder.pdf

4 Plant Village (n.d.) Rye *Secale cereale*. Plant Village, https://www.plantvillage.org/en/topics/rye/diseases_and_pests_description_uses_propagation

5 Agriculture Victoria (2013) Growing Cereal Rye, http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/growing-cereal-rye

6 Alberta Agriculture and Forestry (2016) Fall rye production. Revised. AgDex 117/20-1. Alberta Agriculture and Forestry,

12.1 Windrowing

Windrowing is a practice in high yielding crops to prevent excess shattering of grain. High yielding crops are not common in the Southern growing region except in unusual circumstances, therefore windrowing is not a common practice.

Windrowing or swathing involves cutting the crop and placing it in rows held together by interlaced straws, supported above the ground by the remaining stubble (Photo 2). It can be considered as an option where:

- the crop is uneven in maturity, or the climate does not allow for rapid drying of the grain naturally
- there is a risk of crop losses from shedding and lodging

High yielding crops may gain more from windrowing than low yielding crops. Generally, crops expected to yield less than 2 t/ha should not be windrowed. Picking up windrowed cereals is significantly slower than direct heading because of the large volume of material.

If the crop is too thin or the stubble too short to support the windrow above the ground, the crop should not be windrowed. Heads on the ground may sprout and attempts to pick up heads that are lying close to the soil surface will pick up soil. [7]

Photo 2: *Directing chaff into a narrow windrow using a custom-made chute.*

Source: GRDC

12.1.1 Timing

Windrowing can begin when grain moisture content is below 35%—when grain is at the medium dough stage, hard but can still be dented with the thumbnail.

- It is better to windrow early to prevent losses from shedding and lodging, but not when the ground is wet after rain.
- Avoid windrowing too early as the grain is not fully developed and will result in small pinched grain.

7 G Troup (2016) Oats: harvesting, swathing and grain storage, Swathing. DAFWA, https://www.agric.wa.gov.au/oats/oats-harvesting-swathing-and-grain-storage?page=0%2C1

- Although it may be easier to windrow later, the windrows of a ripe crop may not interlock well enough to withstand disturbance from strong wind. [8]

12.1.2 Cutting

- Cut across the sowing direction, or at 45 degrees for crops with wider row spacing, so the windrow sits-up on the stubble. Windrowing is not recommended for paddocks where the crop row spacing is over 25 cm.
- Avoid placing windrows in the same location each year so nutrients are not concentrated in one place.
- Windrow size or width of cut should match header capacity. A double-up attachment to the windrower or placing two windrows side by side requires a larger capacity header and concentrates the residue in a narrow band within the paddock.
- Cutting height should be adjusted to keep sufficient straw on the head to hold the windrow together (minimum 30 cm) and sufficient stubble height to support the windrow.
- Start the cutting height at 10–20 cm above the ground (one-third crop height) and adjust to produce an even windrow with well-interlaced straws that sit above the ground. This allows good air circulation and rapid drying should rain occur. [9]

12.1.3 Harvesting the windrow

Harvesting of the windrowed crop must be completed as soon as possible, ideally within 10 days of windrowing.

- If left too long and subjected to long periods of wetting (more than 25 mm of rain over 4–8 days), grain may sprout and become stained. The windrow may also become contaminated with bronze field beetle.
- When the windrow is picked up, the reel should be rotating slightly faster than ground speed, but not fast enough to knock the heads off the stems.
- The conveyor canvas should be revolving sufficiently fast to prevent the crop material banking up.
- Rows pick up best when the header follows the direction of the windrow (heads first).

One of the major sources of contamination in windrowed cereals is the stubble being torn out during the windrowing operation. This generally occurs when the windrower is operated at too high a ground speed or when trying to windrow when the straw is tough due to it being cool or damp. [10]

MORE INFORMATION

Setting up at harvest for narrow windrow burning

12.2 Harvest timing

Although rye 'heads' much earlier than wheat, it takes much longer to mature its grain, so the harvest of the two crops can clash. The crop should not be harvested until the grain is thoroughly dry and hard, but it should then be harvested immediately as shattering is likely to occur soon after ripening. [11]

Grain is harvested at about the same time as wheat. Harvest as soon as the grain dries and hardens. Ripe crops that are left to stand are likely to shed grain. Maturity is often uneven, so inspect the whole paddock before harvest.

The moisture level in rye should be about 12% at harvest (Photo 3). Only harvest in dry conditions. When harvesting with a combine, growers may need to cut the straw

8 G Troup (2016) Oats: harvesting, swathing and grain storage, Swathing. DAFWA, https://www.agric.wa.gov.au/oats/oats-harvesting-swathing-and-grain-storage?page=0%2C1

9 G Troup (2016) Oats: harvesting, swathing and grain storage, Swathing. DAFWA,https://www.agric.wa.gov.au/oats/oats-harvesting-swathing-and-grain-storage?page=0%2C1

10 G Troup (2016) Oats: harvesting, swathing and grain storage, Swathing. DAFWA,https://www.agric.wa.gov.au/oats/oats-harvesting-swathing-and-grain-storage?page=0%2C1

11 RL Reid (Ed.) (2013) The manual of Australian agriculture. Elsevier.

high in order to avoid clogging the equipment, since rye is tall and produces a large quantity of straw. This will obviously leave taller stubble in the paddock. [12]

Photo 3: *Rye ripening.*

Source: PlantVillage

MORE INFORMATION

GRDC Grain Storage Fact Sheet: Hygiene and Structural Treatment for Grain Storages.

12.2.1 Lodging

Lodging occurs when portions of the crop 'fall over' due to strong wind, and occasionally in very high yielding crops and/or varieties with weak stems.

The lodged plants will then begin to deteriorate in nutritive value, and the grain may even begin to sprout if advanced enough in its formation (hard dough stage).

If possible, harvest the crop within days before its nutritive value deteriorates too much and mould and deleterious bacteria build-up occurs. Travelling in the opposite direction to the lodged plants will allow crop to better feed into harvester front, ensuring less difficulty in the harvest operation and minimal losses. [13]

12.2.2 Harvesting for silage

Cereals suitable for ensiling are oats, barley, wheat, triticale and cereal rye. The limited information available on cereal rye suggests that the preferred growth stage to harvest for silage is the boot stage. Feed quality of cereal rye deteriorates more quickly with maturity compared to other cereals. [14]

Hay

When harvesting rye for hay, it has been found that delaying harvest until three weeks after rye has flowered results in losses of approximately 50% in the crude protein and only slight gain in total yield. For the best hay quality and near maximum yields, harvest rye while in flower. [15]

When to cut for silage

The timing of harvest should take into consideration the following:

- End use of the silage; i.e. for animal production versus maintenance rations.

12 UVM Extension Crops and Soils Team. Cereal Rye, http://northerngraingrowers.org/wp-content/uploads/RYE.pdf

13 Agriculture Victoria (2008) Harvesting Forage Cereals, http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/harvesting-forage-cereals

14 DPI NSW. Chapter 5: Crops and by-products for silage. In Successful Silage, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/294053/successful-silage-topfodder.pdf

15 F Sneva, D Hyder (1963) Raising dryland Rye hay, http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/15547/StationBulletin592.pdf;jsessionid=01647E0066F56EBD1CE909A02C046403?sequence=1

- Weather conditions at harvest.
- Soil types and soil moisture conditions at harvest.
- If double cropping, when the following crop needs to be sown.
- Availability of suitable harvesting machinery.

Harvesting at the correct DM content is important to ensure optimal yield, minimal loss of nutritive value and a desirable fermentation process.

Cereals can be harvested at the flag leaf/boot to early ear emergence stages or the soft dough stage.

One study found that delaying harvest until three weeks after rye had flowered resulted in:

- losses of approximately 50% in the crude protein per acre, and
- only slight gain in total yield.

For the best hay quality and near maximum yields, harvest rye while in flower. [16]

DM levels recommended for ensiling

If cutting at the flag leaf/boot stage, the recommended DM level is in the ranges of 33–40% DM for forage harvested material and 38–50% DM for baled silage. The recommended DM ranges for cutting at the soft dough stage are 35–42% DM for forage harvested material and 38–45% DM for baled silage.

Cereal plants contain large stems, leaves ranging from green (alive) to yellowing (dying) and grain heads in various stages of formation in the latter stages of growth. This makes the estimation of the DM content at which to begin harvesting difficult.

It is essential that a representative sample be obtained for estimating the DM content of the crop.

Mowing

The stage of growth of the crop at harvest will determine whether it is mown and wilted before harvesting or direct cut and ensiled as a "standing" crop. However, the height of cutting can have some implications on the stored product.

Mowing height

Cutting height is usually 7–10 cm above ground level. Cutting higher will result in a slight increase in nutritive value, but reduced yields. Research in Australia and New Zealand has shown that cutting 10 cm higher on a 15 t DM/ha crop will reduce yield by approximately 1 t DM/ha.

If mown and wilted, the higher cutting height will also tend to keep the mown windrow higher off the ground, thereby allowing more airflow under the crop and a slightly faster wilting rate. It will also reduce the risk of soil contamination from other equipment operations such as raking. However, cutting at greater heights will leave behind increased levels of stubble, which creates a problem of removal in the future and preparation for the next forage. [17]

12.2.3 Equipment

Cereal rye is tall, and the bulky straw makes harvest slow due to the large volume going through the harvester. A standard wheat header is suitable for harvesting cereal rye. Adjustments need to be made to the harvester settings to avoid grain losses and damage, because the grain is lighter and longer than wheat. Tall crops

16 F Sneva F, D Hyder (1963) Raising dryland Rye hay, http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/15547/StationBulletin592.pdf;jsessionid=01647E0066F56EBD1CE909A02C046403?sequence=1

17 Agriculture Victoria (2008) Harvesting Forage Cereals, http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/harvesting-forage-cereals

are likely to lean or lodge, so crop lifters might be necessary. Clean out all machinery after harvest to prevent other cereal grains becoming contaminated with cereal rye. [18]

Rye is harvested with a conventional header. The grain is lighter and longer than wheat, so the machine will require minor adjustments from normal wheat settings. [19]

Recent trials have found there is a 10% lift in header efficiency for every 10 cm increase in harvest height. The trials in the HRZ compared three harvest heights (15 cm, 30 cm and 50 cm) in winter cereals.

Harvesting low is done to reduce stubble loads to manageable levels, and achieved by baling or burning the windrows, or simply spreading trash and straw as evenly as possible across the header swathe.

Harvesting low and treating weed seeds also has the potential to reduce the soil weed seedbank over time, which can assist with weed control and herbicide resistance management.

The work in 2014 has shown how much slower harvesting is at a 15 cm height and the additional fuel consumption required. When increasing the height to 50 cm it was found that harvesting was around 25% faster than at 30 cm. A rule of thumb is a 10% efficiency increase for every 10 cm of harvest height. If a 100 ha crop is harvested at 15 cm it will take about 20% more time to harvest than a crop cut at 30 cm, or 38% more time than if it had been harvested at 50 cm. [20]

Ensure that all equipment is clean and free from potential contaminants to the harvested grain (Photo 4).

Photo 4: *Cereal harvest underway. It is important to clean all equipment prior to and after harvesting.*

Source: Creative Commons (Wikimedia)

Forage harvesters

Whole-crop cereals should ideally be harvested using a precision chopping forage harvester to ensure a short chop length (20–50 mm actual length). This ensures the material can be well compacted in the stack or pit, minimising the amount of air

18 P Matthews, D McCaffery, L Jenkins (2016) Winter crop variety sowing guide 2016. DPI NSW, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2016.pdf

19 Agriculture Victoria (2013) Growing Cereal Rye, http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/growing-cereal-rye

20 A Lawson (2015) Ground Cover Issue 118: Header efficiency increases with harvest height, https://grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-118-Sep-Oct-2015/Header-efficiency-increases-with-harvest-height

trapped and resulting in reduced losses (nutritive value and DM). Losses are due to continued plant and microbial respiration during the early phases of fermentation.

Most other forage harvesting machines, such as self-loading wagons, cut the material to varying lengths, often over 200 mm, making adequate compaction very difficult.

The drier the crop DM content at harvest, the shorter the chop length required. Chopping the material short also ensures a thorough mixing of the high nutritive heads with the much lower nutritive stems and leaves.

Increased density also reduces the rate of aerobic spoilage at stack opening, a common although not insurmountable problem with cereal silages. Less wastage also occurs as animals cannot easily select the heads and leave the stem material when fed.

Increasingly, forage cereals are being direct-harvested at the later growth stage with forage harvesters that have a cutterbar instead of the typical rotary disc mowers, to reduce grain loss. Grain loss from the gaps in the housing of the chopping and feeding mechanisms can be minimised by fitting blanking plates.

Due to the rotary disc action of the mower, particularly if raked before harvesting, grain loss may be slightly higher in pre-mown crops. DM yield and nutritive value will also be slightly lower.

If the crop is harvested after the soft dough stage, the grain will be hardening as it matures. Forage harvesters, which are fitted with specific rollers for cracking grain (often referred to as ‘primary processing’) will be essential.

Balers

Harvesting whole-crop using balers is not recommended, as dense compaction is often not achieved and vermin damage to the bales in storage can be a serious problem. If whole-crop cereals are to be harvested with round and square balers, the material needs to be wilted to slightly higher DM contents to ensure a lactic acid fermentation occurs.

Balers with chopping mechanisms are highly recommended to aid compaction. The fermentation process and animal intake of WCS will also benefit substantially from the chopping. Once past the ideal stage for harvesting, cereal stems become more lignified (stiffer) and the stems are hollow, i.e. they contain more air internally. These drier stems will allow increased air to be trapped within and between the stems in the bale. In this situation, a chopping baler, with all knives in operation, is highly recommended. An alternative is to bale at the moister end of the DM range recommended for baling. Baling with some dew on the material will also be useful if DM levels are above those recommended.

Baling at a slower forward speed will also allow most balers to produce a denser bale. Baling material that is too dry, or not tightly compacted, results in large volumes of air being trapped in the bale thus reducing nutritive value and increased risk of puncturing by the stalks.

Anecdotal feedback from some machinery operators indicate that if a mower only is used for the later growth stages of the crop, particularly when baling, the baler should travel in the opposite direction to the mower. The heads of the crop are picked up first which results in much less trouble in the "picking up" and "feeding in" of the forage into the machine. However, one piece of research has indicated that friction from the rolling mechanisms in some balers induces heavier grain loss than that from forage harvesters. More research is needed to determine losses at all stages of WCS harvesting and storage.

Applying netwrap instead of twine will also reduce the amount of air trapped between the plastic and the bale as the twine, especially in slightly loose bales, will "pull" into the bale. This allows air to travel around the twine once plastic is applied, possibly becoming mouldy—particularly if holed. Applying netwrap will also minimise straw

stalks protruding from the bales, which can puncture the stretchwrap plastic seal, allowing air to enter. [21]

12.3 Fire prevention

Grain growers must take precautions during the harvest season, as operating machinery in extreme fire conditions is dangerous. They should take all possible measures to minimise the risk of fire. Fires are regularly experienced during harvest in stubble as well as standing crops. The main cause is hot machinery combining with combustible material. This is exacerbated on hot, dry, windy days. Seasonal conditions can also contribute to lower moisture content in grain and therefore a greater risk of fires.

Harvester fire reduction checklist

1. Recognise the big four factors that contribute to fires: relative humidity, ambient temperature, wind and crop type and conditions. Stop harvest when the danger is extreme.
2. Focus on service, maintenance and machine hygiene at harvest on the days more hazardous for fire. Follow systematic preparation and prevention procedures.
3. Use every means possible to avoid the accumulation of flammable material on the manifold, turbocharger or the exhaust system. Be aware of side and tailwinds that can disrupt the radiator fan airblast that normally keeps the exhaust area clean.
4. Be on the lookout for places where chaffing can occur, such as fuel lines, battery cables, wiring looms, tyres and drive belts.
5. Avoid overloading electrical circuits. Do not replace a blown fuse with a higher amperage fuse. It is your only protection against wiring damage from shorts and overloading.
6. Periodically check bearings around the harvester front and the machine. Use a hand-held digital heat-measuring gun for temperature diagnostics on bearings and brakes.
7. Maintain fire extinguishers on the harvester and consider adding a water-type extinguisher for residue fires. Keep a well maintained fire fighting unit close-by to the harvesting operation ready to respond.
8. Static will not start a fire but may contribute to dust accumulation. Drag chains or cables may help dissipate electrical charge but are not universally successful in all conditions. There are some machine mounted fire-suppression options on the market.
9. If fitted, use the battery isolation switch when the harvester is parked. Use vermin deterrents in the cab and elsewhere, as vermin chew some types of electrical insulation.
10. Observe the Grassland Fire Danger Index (GFDI) protocol on high fire risk days.
11. Maintain two-way or mobile phone contact with base and others and establish a plan with the harvest team to respond to fires if one occurs. [22]

Using machinery

To preventing machinery fires, it is imperative that all headers, chaser bins, tractors and augers be regularly cleaned and maintained. All machinery and vehicles must have an effective spark arrester fitted to the exhaust system. To prevent overheating of tractors, motorcycles, off-road vehicles and other mechanical equipment, all machinery needs to be properly serviced and maintained. Fire-fighting equipment

21 Agriculture Victoria (2008) Harvesting Forage Cereals, http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/harvesting-forage-cereals

22 Barr R. (2015). Plant of attack needed for harvester fires. https://grdc.com.au/Media-Centre/Media-News/South/2015/10/Plan-of-attack-needed-for-harvester-fires

must be available and maintained—it is not just common sense; it is a legal requirement.

Take great care when using this equipment outdoors:

Be extremely careful when using cutters and welders to repair plant equipment; this includes angle grinders, welders and cutting equipment,

Ensure that machinery components including brakes and bearings do not overheat, as these components can drop hot metal onto the ground, starting a fire.

Use machinery correctly, as incorrect usage can cause it to overheat and ignite.

Be aware that when blades of slashers, mowers and similar equipment hit rocks or metal, they can cause sparks to ignite dry grass.

Avoid using machinery during inappropriate weather conditions of high temperatures, low humidity and high wind.

Do repairs and maintenance in a hazard-free, clean working area such as on bare ground, concrete or in a workshop, rather than in the field.

Keep machinery clean and as free from fine debris as possible, as this can reduce onboard ignitions. [23]

Harvester fire research

With research showing an average of 12 harvesters burnt to the ground every year in Australia (Photo 5), agricultural engineers encourage care in keeping headers clean to reduce the potential for crop and machinery losses.

Key findings:

- Most harvester fires start in the engine or engine bay.
- Other fires are caused by failed bearings, brakes and electricals, and rock strikes. [24]

Photo 5: *GRDC figures show that there are 1000 combine harvester fires in Australia each year.*

Source: Weekly Times

23 NSW Rural fire Service. Farm firewise. NSW Government, http://www.rfs.nsw.gov.au/dsp_content.cfm?cat_id=1161

24 GRDC (2012) A few steps to preventing header fires. GRDC Ground Cover Issue 101, http://www.grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-101/A-few-steps-to-preventing-header-fires

PODCAST

MORE INFORMATION

GRDC Reducing Harvester Fire Risk: The Back Pocket Guide

An investigation into harvester fires

Plan of attack needed for harvester fires

AWB receival standards for Cereal rye in the 2016/2017 season.

Grain Trade Australia, Cereal Rye and Triticale trading standards 2015/2016

Cereal Rye Standards.

12.3.1 Harvesting in low-risk conditions

Growers can use the Grassland Fire Danger Index guide to assess the wind speed at which harvest must cease (a GFDI of 35), depending on the temperature and relative humidity (Figure 1).

Step 1: Read the temperature on the left hand side.

Step 2: Move across to the relative humidity.

Step 3: Read the wind speed at the intersection. In the worked example, the temperature is 35°C and the relative humidity is 10% so the wind speed limit is 26kph.

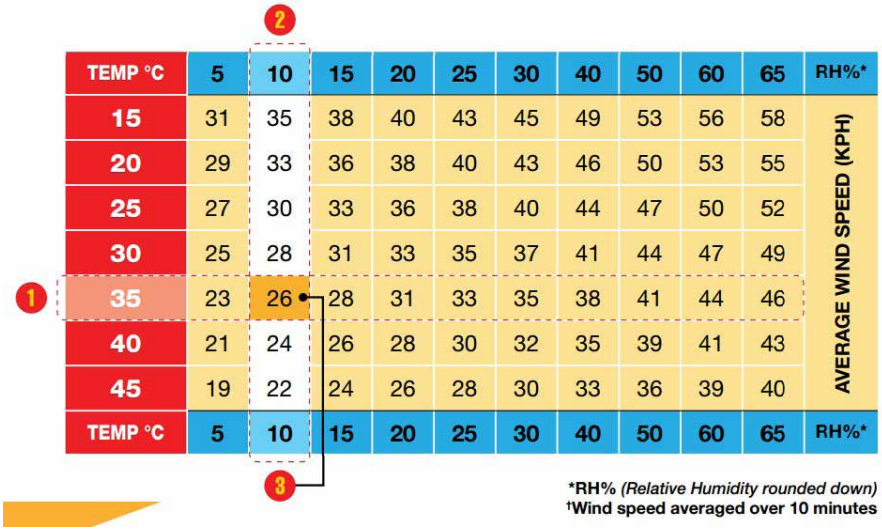


Figure 1: *Grassland fire danger index guide.*

Source: CFS South Australia

12.4 Receival standards

Cereal rye standards for the recent season. These standards are to be applied on individual truck loads and must not be averaged over a number of loads.

Table 1: *Grain Trade Australia recieval standards for cereal rye.*

Category	Standard
Moisture max. (%)	12.0
Description	Clean, sound mature whole grain, amber-light brown colour, free from genetic modification. The seller warrants the rye is fit for human consumption and complies with the standards laid down under the Food Standard Code.
General	Rye tendered for delivery shall be free from any uncharacteristic odours, infestation, objectionable material and any nominated commercially unacceptable contaminant.
Specific Allergens	Nil presence of peanuts or biological material of any kind derived from the peanut plant in rye tendered for delivery.
Chemical treatment	No chemical treatments are to be used on harvested rye unless authorised in writing by Allied Mills, any other chemical treatments must be declared at the time of receival. It is illegal to deliver grains containing above 0.3ppm phosphine.

Source: Grain Trade

12.5 Harvest weed seed management

Controlling weeds after harvest may be more difficult in southern regions, as there can be several months of good growing conditions for weeds.

In the southern cropping region's high rainfall zone (HRZ), an important question needs to be answered: how can harvest weed seed practices be adopted to reduce soil weed seed banks to address herbicide resistance? And more specifically, how can growers get weed seeds into the header?

Southern Farming Systems (SFS) is answering these questions through its Grains Research and Development Corporation-funded HRZ harvest weed seed control (HWSC) project. Paddock-scale trials will demonstrate to growers the suitability and effectiveness of a number of HWSC measures, using commercial equipment to highlight the potential of these management practices to complement large scale trials.

Trial plots have been established at SFS's Lake Bolac site in western Victoria and in Tasmania. [25]

Trials in both south-eastern and western Australian grain growing regions have found a 55–58% reduction, overall, in the emergence of annual ryegrass across the three main harvest weed-seed control (HWSC) systems being practiced by growers. [26]

MORE INFORMATION

IWM manual section on harvest weed management.

IWM manual section on narrow windrow burning.

12.5.1 HWSC Strategies

Weed seed capture and control at harvest can assist other tactics to put the weed seed bank into decline. Up to 95% of annual ryegrass seeds that enter the harvester exit in the chaff fraction. If it can be captured, it can be destroyed or removed.

Western Australian farmers and researchers have developed several systems to effectively reduce the return of annual ryegrass and wild radish seed into the seed-bank, and help put weed populations into decline.

A key strategy for all harvest weed seed control operations is to maximise the percent of weed seeds that enter the header. This means harvesting as early as possible before weed seed is shed, and harvesting as low as is practical, e.g. 'beer can height.'

Narrow windrow burning

During traditional whole paddock stubble burning, the very high temperatures needed for weed seed destruction are not sustained long enough to kill most weed seeds. By concentrating harvest residues and weed seed into a narrow windrow, fuel load is increased and the period of high temperatures extends to several minutes, improving the kill of weed seeds.

Windrow burning for weed control—WA fad or a viable option for the east?

- Continued reliance on herbicides alone is not sustainable in our continuous cropping systems. Rotating herbicides alone will not prevent the development of resistance.
- Early implementation of windrow burning will prolong the usefulness of herbicides, not replace them.
- Windrow burning is the cheapest non-chemical technique for managing weed seeds present at harvest.
- Even with higher summer rainfall, windrow burning is a viable option for NSW cropping systems.
- Windrow burning is an effective weed management strategy, even in the absence of resistance.

25 S Watt (2016) Weed seed project aims to keep growers out of the woods, https://grdc.com.au/Media-Centre/Media-News/South/2016/03/Weed-seed-project-aims-to-keep-growers-out-of-the-woods

26 S Clarry (2015) Trials measure harvest weed-seed control, https://grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-115-MarApr-2015/Trials-measure-harvest-weed-seed-control

MORE INFORMATION

Windrow burning for weed control – WA fad or a viable option for the east?

IWM manual section on chaff carts

IWM manual section on bale direct systems

- Growers need to begin experimenting now on small areas to gain the experience needed to successfully implement the strategy. [27]

Narrow windrow burning is extremely effective—destroying up to 99% of annual ryegrass and wild radish seeds—but it must be done properly. For ryegrass, a temperature of 400°C for at least 10 seconds is needed to destroy the seeds' viability. For wild radish, the temperature needs to be 500°C for at least 10 seconds. [28]

Chaff Carts

Chaff carts are towed behind headers during harvest to collect the chaff fraction (Photo 6). Collected piles of chaff are then either burnt the following autumn or used as a source of stock feed.

Photo 6: *Chaff cart in action*

Photo: A. Storrie

Chaff carts will collect and remove up to 85% of annual ryegrass and wild radish seeds that pass through a header. Collected chaff must be managed to ensure the seeds are then removed from the cropping system. This can be done by burning in the following autumn or by removing the chaff from the paddock and using it as a livestock feed. [29]

Bale direct systems

The bale direct system uses a baler attached to the harvester to collect all chaff and straw material. This system requires a large baler to be attached to the back of the harvester. As well as removing weed seeds, the baled material has an economic value as a livestock feed source. (See http://www.glenvar.com/ for the story and development of header-towed bailing systems).

Harrington Seed Destructor

The integrated Harrington Seed Destructor (iHSD) is the invention of Ray Harrington, a progressive farmer from Darkan, WA (Photo 7). Developed as a trail behind unit, the iHSD system comprises a chaff processing cage mill, and chaff and straw delivery systems. The retention of all harvest residues in the field reduces the loss and/or banding of nutrients and maintains all organic matter to protect the soil from wind and

27 M Street, G Shepherd (2013) Windrow burning for weed control—WA fad or a viable option for the east? https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/02/Windrow-burning-for-weed-control-WA-fad-or-viable-option-for-the-east

28 S Clarry (2015) Trials measure harvest weed-seed control, https://grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-115-MarApr-2015/Trials-measure-harvest-weed-seed-control

29 S Clarry (2015) Trials measure harvest weed-seed control, https://grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-115-MarApr-2015/Trials-measure-harvest-weed-seed-control

MORE INFORMATION

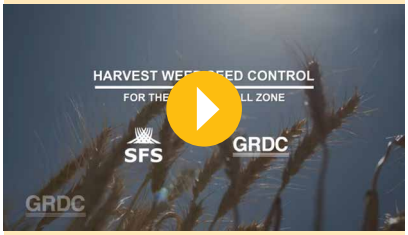
IWM manual section on Harrington seed destructor

Section on the Harrington Seed Destructor in GRDC's Tactics for managing weed populations

Chaff deck concentrates weeds in

VIDEOS

WATCH: Harvest weed seed control for the high rainfall zone.



WATCH: Harvest – the time to get on top of resistant weeds.

WATCH: A beginner's guide to harvest weed seed control.

water erosion, as well as reducing evaporation loss when compared with windrow burning, chaff carts and baling. [30]

The HSD, which renders seeds non-viable by collecting and impacting the chaff as it exits the harvester, can be 92–99% effective, depending on seed species. [31]

Photo 7: *Harrington Seed Destructor at work.*

Source: GRDC

The chaff deck places the chaff exiting the sieves of the harvester on to permanent wheel tracks. Growers using chaff decks have observed that few weeds germinate from the chaff fraction and believe that many weed seeds rot in it. A permanent tramline farming system is necessary to be able to implement the chaff deck system. [32]

30 GRDC Integrated weed management hub. Section 6: Managing weeds at harvest, https://grdc.com.au/Resources/IWMhub/Section-6-Managing-weeds-at-harvest

31 S Clarry (2015) Trials measure harvest weed-seed control, https://grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-115-MarApr-2015/Trials-measure-harvest-weed-seed-control

32 Roberts P. (2014). New systems broaden harvest weed control options. GRDC. https://grdc.com.au/Media-Centre/Media-News/West/2014/11/New-systems-broaden-harvest-weed-control-options