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GRDC
GROWNOTES™

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

TRITICALE

SECTION 12

HARVEST

HARVESTING ISSUES | WINDROWING | HARVEST TIMING | HARVEST EQUIPMENT | FIRE PREVENTION | RECEIVAL STANDARDS | HARVEST WEED SEED MANAGEMENT

Harvest

Key messages

- Harvesting and storage management for triticale is generally similar to that for wheat. However, spring triticale for grain is a late-maturing crop, and is also more susceptible to sprouting conditions at harvest than wheat.
- Preferred harvest moisture to reduce damage due to heating caused by moulding is 14% or less. [1]
- For best returns aim to harvest crops at 12% moisture or less, produce grain with a minimum test weight of 65 kg/hl and minimise other cereal grain contaminants.
- One of the drawbacks of triticale grown for grain is that it is prone shattering.
- Combine settings should be set similar to those for wheat, with care taken to slow the cylinder speed to minimise grain cracking and splitting. [2]
- Some varieties are difficult to thresh cleanly without either leaving intact head sections in the grain sample or causing grain cracking through tight concave settings. Conversely, some varieties are prone to shedding under windy conditions.

12.1 Harvesting issues

One of the drawbacks of triticale grown for grain is that it is prone shattering (Photo 1). There is a spot about a quarter to a third of the way down from the tip on the rachis that is very weak. [3]

Photo 1: *Shattered cereal grain.*

Source: National Plant Germplasm System (USDA/ARS)

1 Mergoum, M., & Macpherson, H. G. (2004). *Triticale improvement and production* (No. 179). Food & Agriculture Org

2 Alberta Agriculture and forestry. (2016). Triticale crop production. http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/fcd10571

3 Alternative crops – Triticale in the US.

Triticale varieties vary strongly in thresh-ability. Some varieties are difficult to thresh cleanly without either leaving intact head sections in the grain sample or causing grain cracking through tight concave settings. Conversely, some varieties are prone to shedding under windy conditions.

Most triticale varieties have inverted heads at maturity which shed rain and therefore make the crop less liable to sprouting at maturity. This can be especially important in regions where storms can delay harvesting.

The level of carryover (hard seed) self sown plants which occurs after a triticale crop appears to be higher than with other winter cereals. No data exists concerning any varietal differences in hard seed levels but especially where some seed shedding has occurred this will need careful management. [4]

Triticale grain generally matures later than wheat or rye and has a higher protein content which makes it a good home grown feed option. Attention must be paid to ensure that ergot levels are less than 0.1 per cent. Newer varieties have fewer ergot problems. Combining standing grain rather than windrowing first is advisable because triticale is more susceptible to sprouting in the windrow than wheat. [5]

12.2 Windrowing

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. [6]

4 Jessop RS, Fittler M. (2009). Triticale production Manual – an aid to improved triticale production and utilisation. http://www.apri.com.au/1A-102_Final_Research_Report_.pdf

5 Albert Lea Seed. Triticale http://www.alseed.com/UserFiles/Documents/Product%20Info%20Sheets-PDF/Basics%20Triticale-2010.pdf

6 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

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

Source: GRDC

12.2.1 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.
- 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. [7]

12.2.2 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. [8]

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

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

12.2.3 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. [9]

MORE INFORMATION

Setting up at harvest for narrow windrow burning

12.3 Harvest timing

Harvesting and storage management for triticale is generally similar to that for wheat. However, spring triticale for grain is a late-maturing crop, and is also more susceptible to sprouting conditions at harvest than wheat.

In dryland conditions, straight cutting of triticale is recommended where conditions allow. This is because straight cutting for grain can help reduce losses from pre-harvest sprouting, which triticale is much more susceptible to than is wheat.

Combining at 14% grain moisture is considered dry for triticale (Photo 3). In Australia is it recommended that triticale be stored at 10% moisture content.

Photo 3: *Harvesting of triticale grain with dry moisture content.*

Source: GRDC

Moisture content lower than 13.5% is very desirable, as most moulds and insects tend to be inactive below this moisture level.

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

For best returns aim to harvest crops at 12% moisture or less, produce grain with a minimum test weight of 65 kg/hl and minimise other cereal grain contaminants.

Kernels with moisture content up to 20% can be harvested and, if properly dried, will not lose quality. If drying triticale grain, maximum desirable temperatures are:

- 40°C for seed.
- 65°C for commercial grain.

Optimum harvest stage for forage is when the plant is at the flag leaf or boot stage before head emergence. Protein content at this stage will vary between 14–19%. Generally, forage yields and palatability will be higher than for either wheat or rye. [10]

One study found that triticale dry matter yield was higher and more nutritious when harvest was shifted from early heading to milk dough stage. [11]

For more information on storing triticale, see Section 13: Storage.

In high fertility situations, lodging can occur. Under such conditions, plan to harvest early. [12]

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 ensure less difficulty in the harvest operation and minimal losses.

Crops lodged for some period of time can be a problem. If the harvester travels in the opposite direction to which the plants are lodged, its nutritive value will be decreased due to harvesting the decaying plants. This decaying plant material will also adversely affect the fermentation process. [13]

Harvesting a frosted crop

Harvesting a frosted crop brings another layer of complexity to an already busy time of year. Some of the complications are limited to this season's harvest; whilst others have ramifications for next season's crop.

Considerations for harvest;

- Frost damage varies across the landscape in severity and scale in some areas.
- Better yielding paddocks and crops should be harvested first.
- Frosted crops are difficult to thresh due to higher residual sugars and lower grain volume. Despite lower tonnages, daily harvest maintenance and regular clean down remain important to minimise machinery fatigue and fire risk in these difficult harvesting conditions.
- Grain quality may also be compromised depending on the frost timing. Frost affected grains usually have a lower hectolitre weight and higher screenings. Adjusting header settings and/or grading can be beneficial but check the feasibility first.

Considerations for next season;

- Frosted stubble can rot off at ground level and be difficult to seed into. To minimise trash flow problems stubbles may have to be cut low.

10 Alberta Agriculture and forestry. (2016). Triticale crop production. http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/fcd10571

11 McGoverin, C. M., Snyders, F., Muller, N., Botes, W., Fox, G., & Manley, M. (2011). A review of triticale uses and the effect of growth environment on grain quality. *Journal of the Science of Food and Agriculture*, *91*(7), 1155–1165.

12 Albert Lea Seed. Triticale http://www.alseed.com/UserFiles/Documents/Product%20Info%20Sheets-PDF/Basics%20Triticale-2010.pdf

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

- Given the residual nutrients in frosted crops there may be a risk of windrow effects.
- Evaluating weed seed burdens and wind erosion risk will help determine the best course of action.
- If keeping seed for next season, it is important to source seed from least-affected areas to maximise establishment. Seed quality can be tested closer to seeding by DAFWA Diagnostic Laboratory Services for a small charge. [14]

12.3.1 Harvesting triticale for silage

The cutting and subsequent storage of triticale forage for silage is similar to that of any small-cereal forage. The harvest date of triticale for silage is very important. As plants develop beyond the boot stage and into early grain fill, the protein and energy levels drops while the fibre level rapidly increases. Although there is a general increase in dry-matter yield as the crop matures, the increased yield is more often offset by the reduction in forage quality. Consequently, the best time to cut triticale for silage is in the boot to early-heading stage. [15]

Timing of harvest should consider the following:

- end use of the silage; i.e. for animal production vs. maintenance rations
- weather conditions at harvest
- soil types and soil moisture conditions at harvest
- if spring sowing, when the follow up pasture is to be sown
- if double cropping, when the follow-up crop needs to be sown
- availability of suitable harvesting machinery
- affect on dry matter yield

Cereals can be harvested at two stages:

1. Flag leaf/boot - early ear emergence stages
2. Soft dough stage.

Triticale is particularly well adapted for high forage yield production on heavily manured fields. Harvesting protocols and timing must be adjusted to accommodate the differences between triticale and barley in these situations. In high productivity systems where lodging is a problem, triticale should be compared to semi-dwarf barley, which also has special adaptation to high fertility conditions.

When using triticale for silage, it has been recommended that the optimum time for harvest was at the soft dough stage in order to best balance potential quality and yield. [16]

MORE INFORMATION

When to cut forage cereals

Triticale for silage

12.4 Harvest equipment

Harvester settings should be set similar to those for wheat, with care taken to slow the cylinder speed to minimize grain cracking and splitting (Photo 4). [17]

Seed size can be of concern when harvesting triticale. Triticale varieties generally have a large seed and a large embryo with an elongated beak compared to bread wheat. Caution must be taken to ensure that any mechanical harvesters, such as modern combines, are appropriately set so that there is no damage to the embryo. Embryo damage and seed cracking can have a significant impact on seed viability during storage. This can be a problem since many triticale varieties are hard to thresh compared to wheat and rye.

In triticale without the wheat rachis, threshing frequently results in incomplete seed and chaff removal from the spike, and breakage may occur at the rachis nodes. In

14 DAFWA. (2016). Harvesting a frosted crop. https://www.agric.wa.gov.au/frost/harvesting-frosted-crop-0

15 Mergoum, M., & Macpherson, H. G. (2004). *Triticale improvement and production* (No. 179). Food & Agriculture Org.

16 Alberta agriculture and forestry. (2016). Triticale for Silage. www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/fcd10569

17 Alberta Agriculture and forestry. (2016). Triticale crop production. http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/fcd10571

the wheat rachis types, breakage does not occur. Improvements in threshing will be an excellent improvement where mechanical threshing equipment is not readily available or economically feasible. [18]

Harvest triticale as you would wheat, with a combine. The combine speed should be slightly slower than for harvesting wheat. It is possible to windrow triticale before combining, but it is likely to begin sprouting in the windrow, so growers are advised to direct-combine if possible. [19]

Photo 4: *Triticale being harvested.*

Source: Kaspar T in MCCC

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 wheat and barley.

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 windrow.

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 30 cm. A rule of thumb is a 10% efficiency increase for every 10 cm of harvest height. If a 100ha 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 5).

18 Mergoum, M., & Macpherson, H. G. (2004). *Triticale improvement and production* (No. 179). Food & Agriculture Org.

19 UVM. Triticale. Northern grain growers. http://northerngraingrowers.org/wp-content/uploads/TRITICALE.pdf

20 Lawson A. (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

Photo 5: *Cereal harvest underway. It is important to clean all equipment prior to and after harvesting.*

Source: Creative Commons

12.5 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. [21]

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 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. [22]

With research showing an average of 12 harvesters burnt to the ground every year in Australia (Photo 6), agricultural engineers encourage care in keeping headers clean to reduce the potential for crop and machinery losses.

Key points:

- Most harvester fires start in the engine or engine bay.
- Other fires are caused by failed bearings, brakes and electricals, and rock strikes. [23]

21 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

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

23 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

Photo 6: *GRDC figures show that there are 1000 combine harvester fires in Australia each year.*

Source: Weekly Times

12.5.1 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 per cent so the wind speed limit is 26kph.

TEMP °C	5	10	15	20	25	30	40	50	60	65	RH%*
15	31	35	38	40	43	45	49	53	56	58	AVERAGE WIND SPEED (KPH)
20	29	33	36	38	40	43	46	50	53	55	
25	27	30	33	36	38	40	44	47	50	52	
30	25	28	31	33	35	37	41	44	47	49	
35	23	26	28	31	33	35	38	41	44	46	
40	21	24	26	28	30	32	35	39	41	43	
45	19	22	24	26	28	30	33	36	39	40	
TEMP °C	5	10	15	20	25	30	40	50	60	65	RH%*

1 2 3

*RH% *(Relative Humidity rounded down)*
†Wind speed averaged over 10 minutes

Figure 1: *Grassland fire danger index guide.*

Source: CFS South Australia

PODCAST

LISTEN: GRDC Podcasts: Harvester Fires.

MORE INFORMATION

GRDC Reducing Harvester Fire Risk: The Back Pocket Guide

An investigation into harvester fires

Plan of attack needed for harvester fires

MORE INFORMATION

Grain Trade Australia – Cereal Rye and Triticale trading standards 2016/2017

12.6 Receival standards

Stay up to date with the Grain Trade Australia (GTA) national grain receival standards. The GTA Trading Standards are a critical tool for anyone purchasing, selling, trading, broking or operating in the commercial grain industry. The GTA Trading Standards cover all grains, oilseeds, pulses and other related commodities.

For Triticale, there is no minimum variety specification and a load may be delivered with a varietal mix at any level.

Any variety is eligible for delivery into the Triticale grade.

Table 1: *Triticale receival standards.*

These Receival standards are current as at 1/09/2016	TRI1
Infratec	
Protein	No Limit
Moisture Content (maximum)	13
½ Litre (Weight)	
Weight (minimum kg/hl)	65.00
Weight (minimum grams)	325.0
½ Litre (Count)	
Type 1 Seeds (maximum)	
Doublegees	1
Lupins	1
Saffron Thistle	1
Variegated Thistle	1
Field Peas	1
Safflower	1
Sunflower	1
Sappy Green Grains/Sappy Green Material (maximum)	10
Storage Mould/ Bin Burnt /Heat Damaged Grains (maximum)	1
Type 2 Seeds (maximum) Barley, Oats, Drake Seed, Black/ Brown or Wild Oats, Radish Pods, etc.	50
Field Insects (maximum) Whole bodies, live or dead, Grasshoppers, Ladybirds, Woodbugs, Pea Weevils, Native Weevils, Bronzed Field Beetles and Army Worms.	15 of each
Whole Snail Shells (maximum) Live or dead, fragments acceptable.	1
Sprouted (maximum)	10
1 Level BPM	
Speargrass (maximum)	5
Type 3 Seeds (maximum) Wheat and Cereal Rye	10
% by Weight	
Screenings/Unthreshed Heads Combined (maximum)	6

These Receival standards are current as at 1/09/2016	TRI1
½ Litre after Screening	
Ryegrass Ergot (maximum)	5 cm
Dead Grain Insects (maximum)	10

Source: GIWA

12.7 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. [24]

Trials in both south-eastern and western Australian grain-growing regions have found a 55 to 58 per cent reduction, overall, in the emergence of annual ryegrass across the three main harvest weed-seed control (HWSC) systems being practised by growers. [25]

12.7.1 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

Key points:

- Herbicide resistance is rapidly becoming more widespread and growers need to act to save what effective herbicides that are left. Harvest weed seed control is a suite of tools to combat this and narrow windrow burning the cheapest and easiest to implement.
- Narrow windrow burning (WB) has proven to be successful in other regions on key weeds such as annual ryegrass and wild radish

MORE INFORMATION

IWM manual section on harvest weed management.

24 Watt S. (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

25 Clarry S. (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 narrow windrow burning.

DAFWA – Burning windrows for weed management- Factsheet

Windrow burning – tips from the experts

The nuts and bolts of efficient and effective windrow burning

IWM manual section on chaff carts

Over the Fence west: Chaff tramlining tackles weeds.

IWM manual section on bale direct systems

IWM manual section on Harrington seed destructor

Lesson and optimism after first iHSD harvest

New data on the integrated Harrington seed destructor and its efficacy on a broad range of weed species, including fleabane and sow thistle

- There is no reason to doubt its effectiveness here on those same key weeds. WB effectiveness on other species that shed seed early such as wild oats may be less reliable.
- Successful WB is not hard and may take some practice to become an expert. Following some simple suggestions may help avoid mistakes
- The biggest factor to success - you must cut the crop low, less than 15 cm
- There are some downsides to WB such as selection for weeds resistant to WB, negative impacts on fallow efficiency or nutrient implications but these must be weighed up against the positive for weed control and resistance management. [26]

During traditional whole paddock stubble burning, the very high temperatures needed for weed seed destruction are not sustained for 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.

Chaff carts

Chaff carts are towed behind headers during harvest to collect the chaff fraction (Photo 7). Collected piles of chaff are then either burnt the following autumn or used as a source of stock feed.

Photo 7: *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. [27]

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).

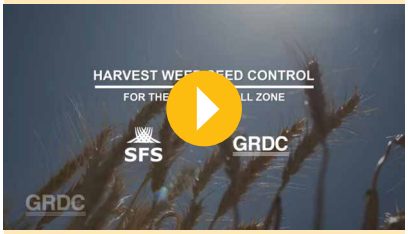
26 Street M. (2015). The nuts and bolts of efficient and effective windrow burning. GRDC Update papers. https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2015/07/The-nuts-and-bolts-of-efficient-and-effective-windrow-burning

27 Clarry S. (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

VIDEOS

WATCH: iHSD

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.

Integrated Harrington Seed Destructor

Developed as a trail behind unit, the Integrated Harrington Seed Destructor (iHSD) [28]system comprises a chaff processing cage mill, 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 water erosion, as well as reducing evaporation loss when compared with windrow burning, chaff carts and baling.[29]

The iHSD, which renders seeds non-viable by collecting and impacting the chaff as it mexits the harvester, can very effective, depending on seed species. [30]

Photo 8: *Integrated Harrington Seed Destructor.*

Source: GRDC

28 http://www.ihsd.com/

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

30 Clarry S. (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