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GRDC GROWNOTES™

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

OATS

SECTION 12

HARVEST

WET HARVEST ISSUES AND MANAGEMENT | FIRE PREVENTION | RECEIVAL STANDARDS | HARVEST WEED SEED MANAGEMENT (HWSM)

SECTION 12

Harvest

Australian oats are harvested during October to December by direct heading as soon as the crop is ripe (Figure 1). [1]

While the direct heading of grain is the cheapest method of harvesting, the danger is that there may be long periods of unsuitable weather conditions in which the harvesting of dry grain may not be possible. This may cause considerable delays to the harvesting operation and increase the risk of head loss or grain being discoloured by early summer rains. Oats can shatter or shell out more readily than any other cereal crops.

In environments that regularly receive pre-harvest rainfall, oats should be harvested at a moisture content above 12% and below 18% and then placed under aeration to maintain quality or passed through a grain dryer to reduce the moisture content to a level that can be safely stored.

Prioritise the varieties that are likely to shed or lodge. Delays can lead to significant lodging and shedding due to crop movement in the wind.

Lodging of oats is a problem, particularly in tall varieties and in high-rainfall zones or high-nitrogen situations. The heavy mat of stems that is formed in a lodged crop can result in delayed ripening due to reduced airflow, increased shading and higher soil moisture. Lodged crops should be harvested panicles-first (one direction only) to ensure maximum pick-up. Fitting crop lifters to the harvester front can make a larger difference to harvest yield and efficiency.

Consider management of stubble for the following crop (straw length and spreading) and collection of weed seeds for herbicide resistance management in an effort to reduce the weed burden for the following crop.

Care must be taken in harvesting milling varieties to minimise the amount of dehulled grain. Harvester settings can be adjusted to manage the amount of dehulled grains.

Swathing involves cutting the crop and placing it in rows held together by interlaced straws, supported above the ground by the remaining stubble. 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 swathing than low-yielding crops. Generally, crops expected to yield less than 2 t/ha should not be swathed. Picking up swathed oats 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 swath above the ground, the crop should not be swathed. Heads on the ground may sprout and attempts to pick up heads that are lying close to the soil surface will pick up soil. [2]

[1] AEGIC. Australian Grain Note: Oats, http://www.aegic.org.au/media/23324/140214 Oats Note.pdf

[2] DAFWA (2015) Oats: harvesting, swathing and grain storage, https://www.agric.wa.gov.au/oats/oats-harvesting-swathing-and-grain-storage?page=0%2C2

Figure 1: Harvesting oats. (Photo: AM Mostead)

12.1 Wet harvest issues and management

Ideally, harvest begins as soon as the crop is mature or ripe. A cereal crop can be harvested any time after it reaches physiological maturity and dries down from about 20% moisture content (MC). In most situations, however, harvest does not begin as soon as the crop is ready. The actual start of harvest is usually dictated by the options each grain grower has available to deal with high-moisture grain. [3] CBH receival standards in Western Australia (WA) indicate moisture of oats must be <13%.

Oats can often be the first crop harvested after a rainfall event during harvest because the architecture of the head (grain hanging down) minimises the amount of moisture taken up by the groat.

12.1.1 Delaying harvest

Every day a crop stands in the paddock it is exposed to ongoing yield loss and quality degradation (Figure 1). Yield is reduced by shedding, head loss and general exposure to the elements. This is measured as a loss of yield each day in dry matter (DM). Research on this topic in the 1980s at Esperance, by M Bolland and J Richardson (WA Department of Agriculture), revealed daily DM losses for wheat of 0.18%–0.53% DM and for barley of 0.25%–0.75% DM (depending on the season and distance from the ocean).

Most growers have also experienced some form of grain-quality loss due to delayed harvest. Barley becomes darker in colour, reducing its acceptance for malting grade; wheat sprouts, reducing its flour-quality characteristics; oats can become discoloured or dehullled and fungal growth reduces the end use possibilities.

These factors can combine to result in heavy discounts from a crop's net return. Time increases these risks, and ongoing exposure to moisture will eventually cause yield loss and development of one or more of these quality defects.

[3] N Metz (2006) The WA guide to high moisture harvest management, grain storage and handling. CBH Group and South East Premium Wheat Growers Association, Perth, WA.

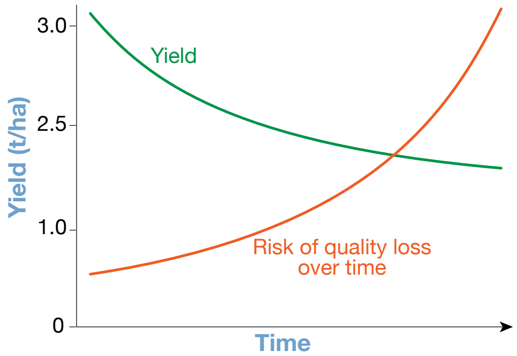

Figure 2: Yield and risk of quality loss over time.

12.2 Fire prevention

With research showing an average of 12 harvesters are burned to the ground every year in Australia, agricultural engineers encourage care in keeping headers clean to reduce the potential for crop and machinery losses (Figure 3).

Figure 3: Keeping headers clean can reduce the risk of fire. (Photo: Rebecca Thyer)

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.
- Regular removal of flammable material from the engine bay is urged. [4]

[4] 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

More information

http://www.graincorp.com.au/_literature_141941/Oats_GrainCorp_Standards_2015-16

More information

GRDC Weed Webinars: Beginners guide to harvest weed seed control

DAF WA (2015) Oats: weeds and integrated weed management

12.3 Receival standards

For up-to-date information on oats trading standards from Grain Trade Australia, visit

http://www.graintrade.org.au/sites/default/files/file/Commodity%20Standards/2015_2016/Section%2002%20-%20Oats%20Trading%20Standards%20201516%20Final.pdf

12.4 Harvest weed seed management (HWSM)

Targeting weed seeds at harvest is a pre-emptive action against problematic populations of annual weeds. Our most damaging crop weeds—annual ryegrass, wild radish, wild oats and brome grass—are all capable of establishing large, persistent seedbanks. Thus, if annual weeds are allowed to produce seed that enters the seedbank, the cropping system will inevitably be unsustainable.

Fortunately, seedbank decline is rapid for these weed species, with annual seed losses of 60%–80%. Without inputs, a very large seedbank (>1000 seed/m^2) can therefore be reduced to a very modest one (<100 seed/m^2) in just four years. A small seedbank of weeds allows easier and more effective weed control with reduced risk of development of herbicide resistance. Effective weed management in productive cropping systems is thus reliant on preventing viable seed from entering the seedbank. Several systems developed over the past three decades target the weed-seed-bearing chaff fraction during harvest. [5]

12.4.1 Intercepting annual weed seed

WA has been leading the way in the fight against resistant weeds, where high frequencies of herbicide-resistant weed populations have been driving farming practices for the last decade. Techniques have been developed to target weed seeds during harvest, and these techniques are now being adopted in the eastern states. At harvest, much of the total seed production for the dominant weed species is retained above harvester cutting height (Table 1). Additionally, for some of these species, such as wild radish, high levels of seed retention are maintained over much of the harvest period (Figure 4). Therefore, the collection and management of the weed-seed-bearing chaff fraction can result in significant reductions in population densities of annual weeds.

Table 1: Proportion of total seed production retained above a low harvest cutting height (15 cm)

Species	Seed retention above 15 cm (%)
Annual ryegrass	88
Wild radish	99
Brome grass	73
Wild oats	85

[5] M Walsh, S Powles (2012) Harvest weed seed control. GRDC Update Papers, 12 April 2012, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2012/04/Harvest-weed-seed-control

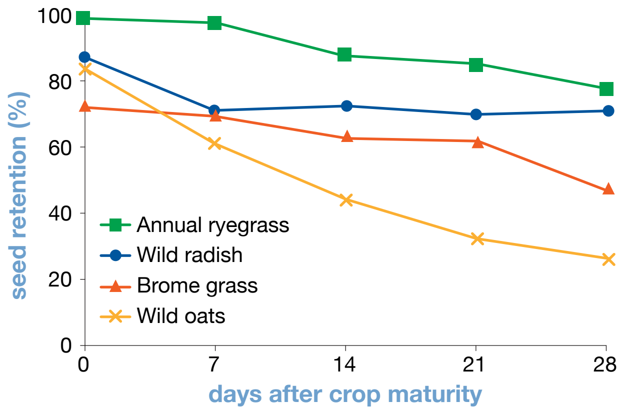

Figure 4: Seed retention above a harvest height of 15 cm over the first four weeks of harvest for the major weeds of WA wheat crops.

WA farmers have driven the development of several systems such as windrow burning, and chaff carts that reduce inputs of annual ryegrass, wild radish, wild oats and brome grass into the seedbank. The adoption of these systems has been critical for the continuation of intensive cropping systems across Australia. [6]

More information

IWM Section 4: Tactics

A key strategy for all harvest weed-seed control operations is to maximise the percentage of weed seeds entering 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).

12.4.2 Burning of narrow windrows

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, in particular wild radish. 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. Stubble cover is also retained across the paddock, resulting in less erosion and greater moisture retention.

Establishing narrow windrows suitable for autumn burning is achieved by attaching chutes to the rear of the harvester to concentrate the straw and chaff residues as they exit the harvester (Figures 5 and 6). This concentration of residue increases the seed-destruction potential of residue burning. With more fuel in these narrow windrows, the residues burn hotter than standing stubbles or even conventional windrows. Weed-seed kill levels of 99% for both annual ryegrass and wild radish have been recorded from the burning of wheat, canola and lupin stubble windrows. [7]

When burning oat windrows it is common for the whole paddock to burn due to the heavier stubble load. This must be taken into account when considering windrow burning.

[6] M Walsh, S Powles (2012) Harvest weed seed control. GRDC Update Papers, 12 April 2012, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2012/04/Harvest-weed-seed-control

[7] M Walsh, S Powles (2012) Harvest weed seed control. GRDC Update Papers, 12 April 2012, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2012/04/Harvest-weed-seed-control

Figure 5: Harvest in action—producing narrow chaff rows for burning in the following autumn. (Photo: A. Storrie)

Figure 6: Windrow burning. (Photo: Penny Heuston)

More information

[GRDC: Narrow windrow burning in southern New South Wales]

[GRDC Report: Developments in stubble retention]

[IWM Section 4: Tactics]

GRDC Videos

[Weed seed bank destruction—windrow chute design]

[Weed seed bank destruction—Header setup and tips for narrow windrowing]

[Weed seed bank destruction—narrow windrow burning]

[Weed seed bank destruction—burning windrows safely]

[Weed seed bank destruction—nutrient losses: comparing chaff heaps with narrow windrows]

[Weed seed bank destruction—vary windrow placement to avoid potassium concentration]

12.4.3 Chaff carts

Figure 7: Chaff cart in action, WA. (Photo: Trent Butcher, ConsultAg)

Chaff carts are towed behind headers during harvest to collect the chaff fraction as it exits the harvester (Figure 7). Collected piles of chaff are then burnt the following autumn or used as a source of stock feed. [8]

The weed-seed collection efficiency of several commercially operating harvesters with attached chaff carts was evaluated by the Australian Herbicide Resistance Initiative (AHRI). Harvesters were found to collect 75%–85% of annual ryegrass seeds and 85%–95% of wild radish seeds entering the front of the header during the harvest operation. Collected chaff must be managed to remove weed seeds from the cropping system. Typically, this material is left in piles in the paddock to be burned in the following autumn. In some instances, though, chaff is removed from the paddock and used as a source of feed for livestock. [9]

More information

IWM Section 4: Tactics

GRDC Videos

Weed seed bank destruction—an integrated approach to weed management

Weed seed bank destruction—more efficient use of chaff carts

Weed seed bank destruction—wild radish seed

Weed seed bank destruction—burning chaff dumps

Weed seed bank destruction—seeing results from integrated weed management

12.4.4 Bale-direct systems

An alternative to the *in situ* burning or grazing of chaff, the bale-direct system uses a baler attached to the back of the harvester to collect all chaff and straw material as it exits the harvester. As well as removing weed seeds, the baled material has an economic value as a livestock feed source. [10]

The bale-direct system was developed by the Shields family in Wongan Hills as a means of improving straw hay production. It consists of a large square baler directly attached to the harvester that collects and bales all harvest residues. A significant secondary benefit is the collection and removal of annual weed seeds. Studies by AHRI determined that ~95% of annual ryegrass seed entering the harvester was collected in the bales. [11]

8 GRDC. Section 6: Managing weeds at harvest. GRDC Integrated Weed Management Hub, http://grdc.com.au/Resources/IWMhub/Section-6-Managing-weeds-at-harvest

9 M Walsh, S Powles (2012) Harvest weed seed control. GRDC Update Papers, 12 April 2012, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2012/04/Harvest-weed-seed-control

10 GRDC. Section 6: Managing weeds at harvest. GRDC Integrated Weed Management Hub, http://grdc.com.au/Resources/IWMhub/Section-6-Managing-weeds-at-harvest

11 M Walsh, S Powles (2007) Management strategies for herbicide-resistant weed populations in Australian dryland crop production systems. Weed Technology 21, 332–338, http://www.jstor.org/stable/4495856?seq=1#page_scan_tab_contents

As well as being an effective system for weed-seed removal, the baled material can have a substantial economic value as a feed source. However, as with all baling systems, consideration must be given to nutrient removal and access to market. [12]

For the story of development of header-towed bailing systems, see: http://www.glenvar.com/.

Figure 8: Bale direct machine at Kellie Shield's "Gunwarrie" Frankland River. (Photo: Penny Heuston)

More information

IWM Section 4: Tactics

12.4.5 Chaff grinding—the Harrington Seed Destructor

Processing of chaff sufficient to destroy any weed seeds that are present during the harvest operation is the ideal system for large-scale Australian conservation cropping systems. Rendering weed seeds non-viable as they exit the harvester removes the need to collect, handle and/or burn large volumes of chaff and straw residues. Because of the importance and potential industry benefits of this process, there has been substantial interest in the development of an effective system.

Ray Harrington, a progressive farmer from Darkan, WA, invented and developed the Harrington Seed Destructor (HSD), a cage-mill-based system attached to the back of the harvester that processes chaff during harvest.

The HSD 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 water erosion, as well as reducing evaporation loss compared with windrow burning, chaff carts and baling. [13]

Evaluation under commercial harvest conditions by AHRI has determined that the HSD will destroy ≥95% of annual weed seed during harvest. With the efficacy of the HSD system well established, its development has progressed to commercial production. [14], [15]

12 M Walsh, S Powles (2012) Harvest weed seed control. GRDC Update Papers, 12 April 2012, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2012/04/Harvest-weed-seed-control

13 GRDC. Section 6: Managing weeds at harvest. GRDC Integrated Weed Management Hub, http://grdc.com.au/Resources/IWMhub/Section-6-Managing-weeds-at-harvest

14 M Walsh, S Powles (2012) Harvest weed seed control. GRDC Update Papers, 12 April 2012, http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2012/04/Harvest-weed-seed-control

15 de Bruin Engineering. Harrington Seed Destructor. Projects, De Bruin Engineering.

More information

IWM Section 4: Tactics

GRDC Videos

IWM—Harrington Seed Destructor (3 videos)

Weed seed destruction—beer can height

Weed seed bank destruction—lessons learned—windrowing canola

Weed seed bank destruction—Spear grass (*Bromus* spp.) an emerging problem

More information

http://www.nufarm.com/Assets/28377/1/weedmasterDSTHay_Silage_v1.pdf

http://www.grdc.com.au/GRDC-FS-PreHarvestHerbicide

A new chaff grinder that is integrated into the back of the header is nearing commercial production stage. It has similar principles to the HSD and it was developed at the University of South Australia.

12.4.6 Cutting oaten hay to reduce weed seeds

If you have a weedy oat crop, cutting this for hay can be a viable option to clean up the paddock and prevent a weed blow-out.

Usually oat crops planted for grain have a thicker stem diameter than that planted for hay and can struggle to make premium export hay due to the lower seeding rate. However, export and domestic hay can tolerate a relatively high level of ryegrass without compromising hay quality.

While export hay regularly has high returns, it can be a time-consuming and expensive exercise if you don't have your own equipment, so it is important to make sure contractors are available and to undertake your own market research. [16]

With the registration of Weedmaster DST for desiccating hay pre-cutting, growers now have an option which reduces weed seed set and prevents re-growth of weeds and oats.

Desiccating 1-11 days pre-mowing delivers benefits including:

- Reducing weed seed set
- Preventing hay and weed re-growth
- Preserve soil moisture
- Maintain or improve hay quality

For some growers wheel tracks can be an issue for mowing but this is best managed by spraying in a different direction to the hay mower.

[16] Personal comms G. Knell 2016