GRDC GROWNOTES™

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

WHEAT

SECTION 12

HARVEST

PRE-HARVEST SPRAYING WITH GLYPHOSATE | WET HARVEST ISSUES AND MANAGEMENT | FIRE PREVENTION | RECEIVAL STANDARDS | HARVEST WEED SEED CONTROL

SECTION 12

Harvest

Harvesting can commence whenever the header is capable of giving a clean grain sample. This is usually when grain moisture is <20%. Where grain-drying facilities are available, harvesting can start well before the crop dries down to the required 12.5% moisture, reducing the time the crop has to stand at risk from weather damage in the field.

Grain density standard is 75 kg/hectolitre (HL), although wheat often achieves 80 kg/hL. [1]

Figure 1: Harvest underway in NSW.

[1] DAFF (2012) Harvesting and yield. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daff.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/wheat/harvesting-information

12.1 Pre-harvest spraying with glyphosate

Timing of glyphosate application is important; certain glyphosates are registered for pre-harvest spraying and several other groups for salvage control. For more information, visit: https://portal.apvma.gov.au/pubcris

12.2 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. For example, a grower with access to a heated air dryer could harvest at 18% MC, a grower with aerated storage could harvest at ~15% MC, while a grower without high moisture management techniques would have to wait until the moisture was <2.5%. [2]

12.2.1 Delaying harvest

Every day a crop stands in the paddock it is exposed to ongoing yield loss and quality degradation (see 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 (Western Australian 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; 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 (Figure 2).

More information

The WA guide to high moisture harvest management, grain storage and handling: http://www.grdc.com.au/Resources/External-Links/SEPWA-The-WA-Guide-to-High-Moisture-Harvest-Management-Grain-Storage-and-Handling-345-MB-large-file

Figure 2: Yield and risk of quality loss over time

12.2.2 Weed management

Extreme wet weather during harvest across large areas of the Australian winter cropping zone is posing huge problems with weed management for grain growers. Wet conditions have promoted growth of weeds in the standing crop that may have been present prior to the rain, with many summer weeds germinating as soil temperatures increase. Growers will want to harvest the crops as quickly as possible to maintain grain quality; however, being close to harvest, herbicide residues are a high risk and it is critical that only registered herbicides or those with a 'permit' are used prior to harvest

[2] 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, W. Aust.

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and that harvest withholding periods are strictly observed. These problems are greatly compounded if weeds resistant to glyphosate or paraquat are present. [3]

More information

GRDC Fact Sheet: http://www.grdc.com.au/Resources/Factsheets/2012/09/Late-Season-Herbicide-Use-Factsheet

12.2.3 Fusarium head blight

Where Fusarium head blight (FHB) is expected, fields should be inspected prior to harvest, and heavily infected fields or sections of fields should be harvested and stored separately from less affected areas.

During harvest of wheat, some of the grain more lightly FHB-infected can be removed by turning up the air and blowing it out of the back of the header with the straw. This will not remove all FHB kernels because some FHB infections occur late in the development of the kernel, and these infected kernels may still be plump.

After harvest of wheat, gravity-table grain separation may be effective in removing lightweight, FHB-damaged kernels. A test should be conducted before committing to this costly strategy. Size grading is usually not as effective. [4]

12.2.4 Seed retention

Saving viable grain seed following a wet harvest requires careful collection, storage, handling and subsequent planting. Retained seed must be graded and tested for germination and vigour.

All crops are susceptible to deterioration in seed quality during wet harvests. Symptoms can range from mild (a loose and wrinkled seed coat), to severe (seed staining and fully germinated seed). It is essential to recognise whether the damage is cosmetic or the symptom of seed-borne disease, and if it will affect germination.

Seed quality can also decline during storage and growers are advised to test germination capacity before and during storage, and before planting. Generally, a germination percentage of 80% at planting is considered acceptable, but when testing at harvest, the germination percentage should be higher. Weather-damaged grain is likely to have a lower germination percentage and poorer vigour, so seeding rates should to be adjusted accordingly.

With many weedy pulse and cereal crops in a wet season, desiccation or crop-topping is often necessary. Depending on timing and chemicals used, this could affect seed quality for sowing.

Growers are reminded that grain must not be retained for seed when glyphosate has been used in pre-harvest applications.

A laboratory seed test should be used to establish the germination percentage of on-farm, retained seed before sowing, especially if it has been weather-damaged. A vigour test is also recommended. Purchased seed will be certified and should include details of germination percentage.

Key points:

- Ideally retain seed from grain harvested before rain.
- Weather-damaged grain is more susceptible to poor germination, low vigour and degradation during storage and handling, so extra care is needed.
- Harvest under conditions of low moisture and cool temperature. Storage temperature and moisture must be monitored and controlled.
- Germination percentage should be checked at harvest, during storage and before seeding. Low-germination seed should not be used.
- Correct seeding depth, conditions and agronomy are essential when sowing weather-damaged seed.

More information

GRDC Fact Sheet: http://www.grdc.com.au/uploads/documents/GRDC_FS_RetainingSeed2.pdf

[3] Australian Glyphosate Sustainability Working Group (2011) Wet harvest poses difficult weed management decisions for grain growers. Australian Glyphosate Sustainability Working Group, http://glyphosateresistance.org.au/media%20releases/mr_111221_harvest_weed_management.pdf

[4] DAFF (2012) Fusarium head blight or head scab. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daff.qld.gov.au/plants/health-pests-diseases/a-z-significant/fusarium-head-blight

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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. [5]

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. [6]

More information

Farm firewise checklist and action plan: http://www.rfs.nsw.gov.au/dsp_content.cfm?cat_id=1161

Fire Control Centre: http://www.rfs.nsw.gov.au/dsp_content.cfm?CAT_ID=577

12.3.1 Steps to preventing header fires

With research showing an average of 12 harvesters are burnt 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).

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

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

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

More information

Ground Cover: http://www.grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-101/A-few-steps-to-preventing-header-fires

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. [7]

12.4 Receival standards

Wheat delivered into the market place must meet certain grain-quality specifications to be classified into the relevant grades. These testing procedures are important benchmarks for end users in determining flour yield and quality for different bread, bakery, pasta and noodle products.

The following grain tests are applied at receival points to measure quality and to ensure that the high standards of Australian wheat grade classification are maintained.

12.4.1 Protein content

Protein content is one of the important factors influencing the end uses of wheat, and consequently, wheat is graded according to protein content. Protein content is assessed using near-infrared (NIR) technology on delivery at the silo, and payment is based on protein content, as this determines the end product and market. Wheat with 11–13% protein is used for pan bread, 10.5% for udon noodles and 8.5–9.5% for biscuits and cakes.

12.4.2 Protein quality

Protein (gluten) quality differs between wheat varieties and so influences the selection of wheat varieties for production applications. For example, bread makers may require a wheat type with strong protein, whereas a manufacturer of steam buns may seek moderate protein strength. For millers, this is an extremely important quality characteristic as it affects flour water absorption and dough mixing characteristics. Protein quality is accounted for at the receival point by variety declaration.

7 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

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12.4.3 Falling number

The falling number test indicates rain damage at harvest. Rain causes mature wheat grains to sprout and activates the α-amylase enzyme, which breaks the starchy endosperm into sugars. In this test, wheat is ground, mixed with water and heated to form a gelatinous suspension. The time taken for a plunger to fall through the suspension is measured. Wheat that has been weather-damaged forms a more viscous suspension and so has a lower falling number. End products are sensitive to flour with low falling number, as it can result in dough stickiness, excessively dark bread or poor crumb texture and poor slicing ability.

12.4.4 Screenings

Impurities such as white heads, chaff, weed seeds, and shrivelled and broken grains may need to be removed before milling. Payment is based on screening levels, as extensive grading adversely affects mill profit. Although some grain varieties are more susceptible to high levels of screenings, the environment in which the wheat is grown is a major contributor.

12.4.5 Stained grains

Enzymic discoloration such as black point and staining caused by fungal infections (e.g. by *Fusarium*, *Eppicoccum* or *Drechslera* spp.) adversely affect grain quality. In particular, black specks detract from the appearance of noodles.

12.4.6 Hardness

Wheat can be physically hard or soft. Hardness affects milling properties. Hard wheats are used to make pan breads, yellow alkaline noodles and flat breads. Soft wheats are used for biscuits and cakes. The soft wheat flour is much finer than hard wheat flour. Variety declaration is used to segregate hard from soft wheat at receival.

12.4.7 Moisture content

When wheat is delivered into a silo, moisture content is assessed at receival using NIR technology and payment is based on moisture content. Water content affects the value of grain (water *v.* flour) and affects the maintenance of quality during handling and storage.

12.4.8 Test weight

Test weight is also known as 'hectolitre weight' and assessed by weighing a fixed volume of grain. Hectolitre weight informs the miller of the wheat's cleanness, plumpness and packing density, and guides the miller in predicting flour yield. Test weight differs between varieties due to their differences in size and shape. Shrivelled and rain-damaged grains reduce test weight.

To view the latest grain receival standards, click on the links below. Each of these links provides information on receival standards, which are in accordance with the Grain Trade Australia (GTA) national grain receival standards.[8]

GrainCorp Ltd Receival Standards: http://www.graincorp.com.au/storage-and-logistics/technical-services/technical-documents-and-information

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.

More information

Grain Trade Australia: http://www.graintrade.org.au/commodity_standards

12.5 Harvest weed seed control

Targeting weed seeds at harvest is a pre-emptive action against problematic populations of annual weeds. Our most damaging crop weeds, annual ryegrass, wild

8 Queensland Government (2009) Wheat quality and markets in Queensland. Department of Employment, Economic Development and Innovation Queensland, http://www.daff.qld.gov.au/__data/assets/pdf_file/0006/53799/Wheat-FactSheet-Quality-Markets-Qld.pdf

radish, wild oats and brome grass, are all capable of establishing large, persistent seed-banks. Thus, if annual weeds are allowed to produce seed that enters the seed-bank, the cropping system will inevitably be unsustainable. Fortunately, seed-bank decline is rapid for these weed species, with annual seed losses of 60–80%. Without inputs, a very large seed-bank (>1000 seed/m^2) can therefore be reduced to a very modest one (<100 seed/m^2) in just 4 years. A small seed-bank of weeds allows easier and more effective weed control with a reduced risk of development of herbicide resistance. Effective weed management in productive cropping systems is thus reliant on preventing viable seed from entering the seed-bank. Several systems developed over the past three decades target the weed-seed-bearing chaff fraction during harvest. [9]

12.5.1 Intercepting annual weed seed

In Western Australia, where high frequencies of herbicide-resistant annual weed populations have been driving farming practices for the last decade, techniques targeting weed seeds during harvest have been widely adopted. At crop 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 (15 cm) harvest cutting height

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

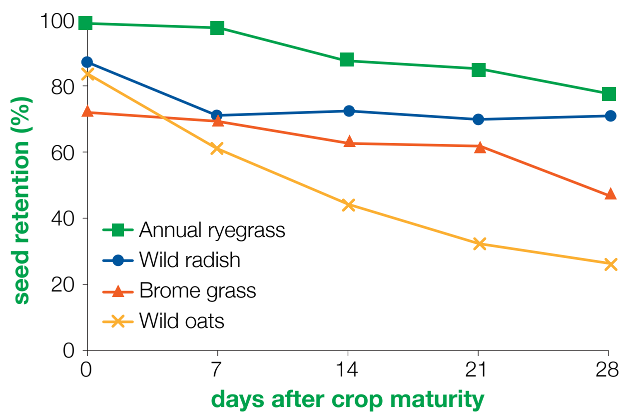

Figure 4: Seed retention above 15 cm harvest height over the first 4 weeks of harvest for the major crop weeds of Western Australian wheat crops.

Lower in-crop weed densities are easier to manage and their potential development as herbicide-resistant populations is dramatically reduced. Western Australian farmers have driven the development of several systems now available that reduce inputs of annual ryegrass, wild radish, wild oats and brome grass into the seed-bank. The adoption of these systems has been critical for the continuation of intensive cropping systems. [10]

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 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

Chaff carts

Chaff carts are towed behind headers (Figure 5) during harvest with the aim of collecting the chaff fraction as it exits the harvester. 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 (Figure 6) in the paddock to be burnt in the following autumn. In some instances though, chaff is removed from the paddock and used as a source of feed for livestock. [11]

Figure 5: Chaff carts towed behind the header to catch weed seeds. (Photo: Cox Inall)

Figure 6: Chaff piles left after collection with a chaff cart. (Photo: Cox Inall)

Baling

An alternative to the *in-situ* burning or grazing of chaff is to bale all chaff and straw material as it exits the harvester. The Bale Direct System, developed by the Shields family in Wongan Hills as a means of improving straw hay production, 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 (Walsh and Powles 2007). As well as being an effective system for weed-seed removal, the baled material can have a substantial

[11] 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

economic value as a feed source. However, as will all baling systems, consideration must be given to nutrient removal. [12]

Windrow burning

Establishing narrow windrows suitable for autumn burning (Figure 7) is achieved by attaching chutes to the rear of the harvester to concentrate the straw and chaff residues as they exit the harvester. 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. [13]

Figure 7: Windrow burning in central west NSW. (Photo: Penny Heuston)

Chaff grinding

Processing of chaff sufficient to destroy any weed seeds 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. Due to the importance and potential industry benefits of this process, there has been substantial interest in the development of an effective system. Darkan farmer Ray Harrington has developed the Harrington Seed Destructor (HSD), a cage-mill-based system attached to the harvester that processes chaff during harvest. Evaluation under commercial harvest conditions by AHRI over the last four seasons has determined the HSD will destroy at least 95% of annual weed seed during harvest. With the efficacy of the HSD system well established, its development is now progressing towards commercial production. [14]

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 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

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

Summary

Productive, large-scale conservation cropping as practiced across large areas of the Australian grain-belt is reliant on herbicides for the management of weed populations. This reliance has produced, and continues to produce, widespread occurrence of herbicide-resistant weed populations. Herbicide dependency and resulting loss of effective herbicides is constraining effective grain crop production. Consequently, producers are farming to control weeds instead of for grain crop production. Harvest weed-seed control provides the opportunity to manage weed populations more effectively and move away from reliance on herbicidal weed control. The consequence is that growers regain flexibility in the overall management of their cropping program. [15]

12.5.2 Harvest weed-seed management in the northern grains region

A survey across 1400 transects in 70 paddocks assessed the weed distribution, density and seed production at harvest in wheat, chickpea and sorghum crops in four cropping zones of the northern grain region. Seventy weed species were identified, of which 12 were found in 7–45 paddocks. The survey identified value in investigating harvest weed-seed management options, including the HSD, to greatly reduce seed-bank replenishment of problem weeds.

Background

The 2011–12 survey was a joint effort between Department of Agriculture, Fisheries and Forestry Queensland (DAFF), Queensland Alliance for Agriculture and Food Innovation (QAAFI) and AHRI. The focus of the project was to identify the potential for harvest weed-seed management in the northern grain region of northern New South Wales, and southern and central Queensland.

Currently, harvest weed-seed management is not practiced as a weed-control option in the northern cropping regions. The potential for this approach has not been evaluated in the summer or winter cropping systems across these regions. The survey was conducted to address this situation.

The approach was to identify weed species with upright, seed-bearing plant parts that could be collected during harvest of the dominant crops of these regions. The survey provides a comprehensive set of data allowing accurate determination of the potential for successful use of at-harvest weed-seed management systems for the northern region.

Approach

A random survey was conducted on 70 paddocks of wheat, chickpea and sorghum in the four main cropping zones of the northern grain region (Table 2).

Within each paddock, 20 transects of 10 m^2 (1 m by 10 m) were selected using a zigzag pattern to be representative of weed infestations across the paddock (this is the same protocol as used in previous published, northern region weed surveys).

The following measurements were made in each transect:

- weed species present
- density of weed species, using the rating scale (plants/10 m^2): 1, 1–9; 2, 10–49; 2.5, 50–100; and 3, >100
- visual estimation of percentage of each species seeding

For each species seeding, three representative samples were collected from each paddock and the following measurements made:

- visual estimation of percentage of seeds or seed heads above potential harvest height (nominated as 5 cm for chickpea, 15 cm for wheat, 30 cm for sorghum)

[15] 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

- visual estimation of percentage total seed retained at time of sampling
- number of seeds or seed heads (and no. of seeds in five representative seed heads) per plant above harvest height
- total seed production, number of seed retained, and potential for harvest management (rated as a percentage)

Table 2: Extent of northern region weed seed at harvest survey

Region and crop	Number of paddocks	Number of species present at harvest	Number of species retaining seed at harvest
Central Highlands, QLD			
Chickpea	5	8	6
Wheat	5	5	4
Sorghum	10	12	11
Darling Downs, QLD			
Chickpea	5	11	7
Wheat	5	12	10
Sorghum	10	15	11
South-west Down, QLD			
Chickpea	5	15	11
Wheat	5	8	3
Sorghum	10	25	19
Liverpool Plains, NSW			
Chickpea	5	22	16
Wheat	5	18	12
Sorghum	-	-	-
TOTAL	**70**	**70**	

Results

The weed flora was diverse, with 70 species found. There were 37 species in chickpea crops, 33 in wheat, and 38 in sorghum (Table 3). Fifteen species were found in both winter and summer crops. Of these, 70% had seed retained at harvest time.

Twelve weed species were commonly found across the cropping zones and crops in 7–45 paddocks (Table 3). The most prevalent were the weeds with wind-blown seed—sowthistle and fleabane. There were three common grasses—barnyard grass, wild oat and feathertop Rhodes grass; three brassicas—turnip weed, mustard and African turnip weed; plus five other broadleaf weeds—bladder ketmia, pigweed, native jute, Australian bindweed and wild gooseberry. Caustic weed was also present in 10 paddocks but not seeding.

For sowthistle and fleabane, many seeds had already dropped from the plants, particularly for sowthistle in chickpea and fleabane in sorghum. However, many seeds remained on the plants, 770–14,660 seeds/plant for sowthistle and 4885–46,255 seeds/plant for fleabane, the majority of which were above the potential harvest height. Thus, these weeds are a priority for harvest weed-seed management.

Barnyard grass was the third most prevalent weed with a substantial number of seeds remaining in all three crops, although there were more seeds dropped in sorghum (3520–4350) than winter crops (0–200). A substantial proportion of feathertop Rhodes grass seeds had dropped in chickpea (370-9905) and sorghum (0–21,940), although large numbers remained on the plant above harvest height.

Several hundred seeds remained on wild oat in wheat (155–294) and chickpea (180–220) but a large proportion of wild oat seed had already dropped in wheat paddocks.

More information

Harvest weed seed management for the northern region: http://www.weedsmart.org.au/giving-a-rats/is-harvest-weed-seed-management-a-goer-north-of-dubbo/

http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2012/04/What-percent-of-northern-weed-seed-might-it-be-possible-to-capture-and-remove-at-harvest-time-A-scoping-study

More information

Windrow burning: http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/02/Windrow-burning-for-weed-control-WA-fad-or-viable-option-for-the-east

Video

Grain Orana Alliance video: http://www.youtube.com/watch?v=vfpvscKiZd8

The brassica weeds produced large numbers of seeds in chickpea (150–112,075) but much fewer in wheat (0–995). Most seeds were above the potential harvest height, and thus these weeds are a priority for harvest weed-seed management.

Bladder ketmia, pigweed, native jute, Australian bindweed and wild gooseberry had either no seed above harvest height or small numbers of seeds, except for wild gooseberry in sorghum, with 11,625 seeds remaining.

Some less common weeds identified with large numbers of seeds (in parentheses) above potential harvest height were:

- cudweed (2500–22,645)
- climbing buckwheat/bindweed (1400–9420)
- dock (30,060)
- mallow (6765)
- malvastrum (1115)
- Mexican poppy (15,970)
- New Zealand spinach (1125)
- paradoxa grass (1040)
- sida (1725)
- St Barnaby's thistle (11,045)
- stink grass (18,995)
- sweet summer grass (1660)
- wild sunflower (2750)
- windmill grass (6225)
- wireweed (820-4000)

Annual ryegrass and barley grass were only found in one paddock in the Liverpool Plains region.

Implications

This survey has shown a clear and urgent need for growers to manage weeds better to prevent large annual replenishments of the seed-bank. A potential tactic is to use one of the harvest weed-seed management options, such as the HSD. These could be useful to greatly improve management of many weeds, particularly the summer and winter grasses, brassica weeds, some climbing weeds, and possibly sowthistle and fleabane if the technique is capable of capturing and destroying wind-blown seeds. [16]

Table 3: The most common weed species seeding at harvest time in wheat, chickpea and sorghum, and data on seed loss, seed remaining and percentage of remaining seed above potential harvest height (averaged across each of four cropping zones) for each species. Seed data for each species are listed in order of wheat, chickpea and sorghum.

Weed	Scientific name	Number of paddocks infested	Number of paddocks seeding	Seeds dropped per plant	Seeds remaining per plant	% above harvest height
Sowthistle	*Sonchus oleraceus*	45	38	150-10,150	770-2040	80-100
				2010-18,680	4470-14,660	100
				1290-3750	1070-8690	65-85
Fleabane	*Conyza bonariensis*	28	17	0-3180	4885-13,950	40-100
				0-14,230	17,790-46,255	90-100
				30,210-130,060	28,710-33,430	55-60

16 S Walker, M Widderick. Weed seed management at harvest. Northern Grower Alliance, http://www.nga.org.au/module/documents/download/146

Weed	Scientific name	Number of paddocks infested	Number of paddocks seeding	Seeds dropped per plant	Seeds remaining per plant	% above harvest height
Barnyard grass	*Echinochloa spp*	20	17	200	3585	100
				0	2865	60
				3250-4350	730-14,040	20-25
Bladder ketmia	*Hibiscus trionum*	19	15	10	45	25
				-	-	0
				55-325	175-215	30-100
Wild oat	*Avena spp*	14	13	55-195	155-295	100
				8-24	180-220	100
				-	-	-
Turnip weed	*Raphanus raphanistrum*	10	9	-	-	0
				0	150-28,170	95-100
				25	455	20
African turnip weed / mustard	*Sisymbrium spp*	9	8	0	995	100
				0	33,130-112,075	100
				-	-	-
Pigweed	*Portulaca oleracea*	8	3			0
						0
						0
Native jute	*Corchorus capsularis*	8	6			0
						0
						0
Australian bindweed	*Convolvulus erubescens*	7	3			0
				0	320	0-80
						0
Feathertop Rhodes grass	*Chloris virgata*	7	7	-	-	0
				370-9905	2485-11,610	100
				0-21,940	13,640-31,040	60-75
Wild gooseberry	*Physalis minima*	7	5	-	-	-
				-	-	-
				210	11,625	15