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GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

CHICKPEA

SECTION 12

HARVEST

PLANNING FOR AN EARLY HARVEST | PADDOCK SELECTION AND AGRONOMY | HARVEST TIMING AND TECHNIQUE | IMPACT OF DELAYED HARVEST ON PROFITABILITY | IMPLEMENTING EARLY HARVEST MANAGEMENT | HARVESTING AND HEADER SETTINGS | MODIFICATIONS AND HARVEST AIDS | ACHIEVING A CLEAN SAMPLE | FIRE SAFETY | LODGED CROPS | HARVEST WEED-SEED MANAGEMENT IN THE NORTHERN GRAINS REGION

SECTION 12

Harvest

More information

GRDC Fact Sheet 'Chickpea disease management': http://www.grdc.com.au/Resources/Factsheets/2013/05/Chickpea-disease-management

L Jenkins, K Moore, G Cumming, Pulse Australia, Chickpea: Sourcing high quality seed

'Harvesting and storage of Desi type chickpeas' (J Cassells and L Caddick): http://storedgrain.com.au/wp-content/uploads/2013/06/chickpea_harvest_storage.pdf

http://grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-89-November-December-2010/Clean-harvest-needed-to-stop-ascochyta

Chickpea harvest often coincides with wheat harvest but is considered a lower priority because of the wheat crop's potential quality premiums. However, this thinking needs to be balanced with the potentially higher value of chickpeas and potential losses from a late chickpea harvest. Chickpea yields can average about 70% of wheat yields when sown in an identical situation, in most years.

Harvest timing will depend on the moisture content that is acceptable for delivery or storage. This will be influenced by who is buying the grain, and whether aeration is available in the storage. Generally, harvest should be under way when upper pods have 15% moisture, if aiming to deliver at 13–14%.

The maximum moisture for chickpeas is 14% for grower receivals. Harvesting grain at 13–15% moisture content will help to minimise cracking. Above 14% moisture, the crop should be either aerated or dried. Aeration is usually very effective in reducing chickpea moisture content by several percentage points. [1]

Figure 1: Chickpea harvest under way near Thallon, south-west Queensland. (Photo: R. Bowman, Seedbed Media)

Diseases such as Ascochyta blight, Phytophthora root rot and root-lesion nematode can be transmitted in stubble and soil, and on machinery and boots. Soil and stubble can be moved by machinery, during windy or wet weather, and in floodwater.

[1] DAFF (2012) Chickpea—harvesting and storage. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/chickpeas/harvesting-and-storage

If possible, clean headers and sowing equipment to remove grain, soil and stubble before moving from property to property. Spray rigs should also be cleaned to reduce the risk of disease transmission. [2]

12.1 Planning for an early harvest

Chickpeas should be harvested as soon as they mature, as pods will fall if harvest is delayed. [3] Harvesting early also minimises infection of seed. Crop desiccation enables even earlier harvest. [4]

Chickpea plants are indeterminate and the period of flowering can extend from 20 to 50 days depending on levels of flower abortion and the impact of moisture stress on the plant. Early or timely harvest of the chickpea crop has the potential to increase returns by up to 50%. Management to ensure timely harvest consists of a combination of strategies. [5]

12.2 Paddock selection and agronomy

Planning before and during sowing can reduce many harvest difficulties. Paddock selection will determine the risk of disease, waterlogging, weeds and poor establishment, ultimately influencing crop maturity. Sowing method and row spacing will affect evenness, crop height and lodging potential. All of these factors can affect the ease and timeliness of harvest. [6]

12.3 Harvest timing and technique

Chickpeas have traditionally been harvested after wheat. Costs of delaying chickpea harvest may be considerable, so need to be weighed against potential losses for wheat. Agronomists report that many growers consider losses in chickpeas will generally be less than in cereals.

Delayed chickpea harvest can have several consequences:

- Yield losses can occur from pod-drop as weathering weakens the hinge attaching the pod to the stem.
- Weathered pods become more difficult to thresh, resulting in grain loss in unthreshed pods discarded out of the back of the header, cracked grain and a slower harvest.
- Increased lodging: the risk is higher if the crop is high yielding and has been planted on wide rows.
- Harvesting at 8% moisture, instead of 13%, results in a harvest weight loss equivalent to $25/tonne (t). Farmer experience has shown yield losses of up to 30% if harvest is delayed 2–4 weeks.
- Weathered or drier grain is more likely to crack when handled, increasing the amount of split grain in the sample. The number of unthreshed pods in the sample will increase as they become harder to thresh with weathering. Both of these can result in rejection or the need for grading to meet market requirements.

[2] GRDC (2013) Chickpea disease management (Southern and Northern Regions). GRDC Factsheets May 2013, http://www.grdc.com.au/Resources/Factsheets/2013/05/Chickpea-disease-management

[3] Grain Legume Handbook Committee (2008) Harvesting. In 'Grain legume handbook for the pulse industry'. Supported by the Grains Research and Development Corporation (GRDC), http://www.grdc.com.au/uploads/documents/9%20Harvesting.pdf

[4] GRDC (2013) Chickpea disease management (Southern and Northern Regions). GRDC Fact Sheet May 2013, http://www.grdc.com.au/Resources/Factsheets/2013/05/Chickpea-disease-management

[5] DAFF (2012) Chickpea—harvesting and storage. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/chickpeas/harvesting-and-storage

[6] DAFF (2012) Chickpea—harvesting and storage. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/chickpeas/harvesting-and-storage

- The germination rate and vigour of planting seed will be reduced by weathering. Crops intended for seed are best harvested at 14–16% moisture and dried or aerated back to 12% moisture to maximise germination and vigour.
- Chickpea grain discolours and darkens with weathering, reducing its desirability, particularly in the container market.
- Chickpea prices can reach peaks during harvest to meet shipping schedules. Earlier harvesting may allow access to these opportunities.
- Darker, weathered seed may be discriminated against in the market.
- *Phoma (Ascochyta) rabiei* can infect senescing pods under wet conditions, leading to Ascochyta blight and discoloured seed.
- Late-harvested crops, particularly where there is regrowth, can be a major source of *Heliothis* (*Helicoverpa*) migration into neighbouring summer crops. [7]

12.4 Impact of delayed harvest on profitability

Early harvest of pulses is critical because delays can result in significant yield losses due to lodging, shattering and pod loss. Grain quality can also suffer. Moisture levels at harvest affect the quality of the grain in storage.

If harvesting grain for seed, germination rates are improved if grain is harvested at 12–14% and then stored in aerated silos or immediately graded and bagged. Crop-topping with herbicides prior to crop maturity may reduce grain quality and seed germination.

Harvest delays in chickpeas cost growers and the pulse industry a lot of money. In any production area, a spread of up to 4–6 weeks can occur in the harvesting of chickpea crops planted on the same sowing rain. Many of the late-harvested crops often have moisture content down to about 8%, whereas the maximum moisture content for receival is 14% and the preference is for 12%. [8]

12.4.1 Yield losses

Yield losses increase significantly the longer harvest is delayed (Figure 2).

Although not normally prone to pod splitting and shelling-out in all but extreme wet weather conditions, chickpeas are very prone to pod-drop as the plant dries down.

Prolonged weathering in the field weakens the hinge attaching the pod to the stalk, thus increasing pod-drop both before and at harvest.

Yield losses of up to 30% have been recorded in the field. Grain losses due to a 2–4 week delay in harvest were estimated at AU$93–238/ha, depending on seasonal conditions. Most of the losses were due to pod loss at the header front, or unthreshed pods discarded out of the back of the machine.

[7] DAFF (2012) Chickpea—harvesting and storage. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/chickpeas/harvesting-and-storage

[8] Pulse Australia (2013) Northern chickpea best management practices training course—2013. Pulse Australia Limited.

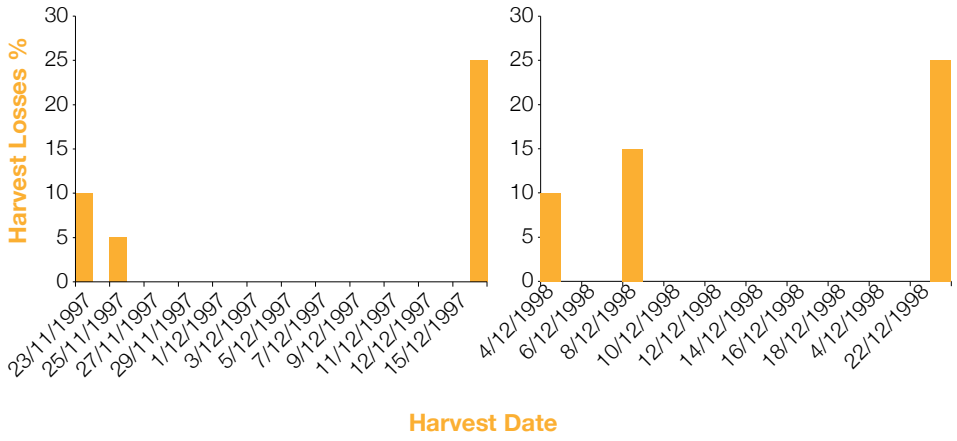

Figure 2: Harvest yield losses in 1997 (left) and 1998 (right).

Lodging can increase the longer chickpeas are left in the field. The risk is higher if the crop is high-yielding and has been planted on wide rows.

Loss of moisture below the Grain Trade Australia (GTA) receival standard of 14% moisture content maximum:

- 500 t of chickpea at 14% grain moisture, at $450/t, is worth $225,000.
- The same grain harvested at 8% moisture delivers 470 t, at $450/t, and is worth $210,600.
- This is a loss to the grower of $14,400. [9]

12.4.2 Deterioration in grain quality

Grain quality deteriorates the longer mature chickpeas are exposed to weathering in the field:

The chickpea seed coat is very prone to cracking if it has been exposed to wetting and drying events caused by rain or heavy dew. Expansion of the seed as it absorbs moisture, followed by contraction as it dries, weakens the seed coat, rendering it much more susceptible to mechanical damage during harvest and handling operations.

Levels of cracked and damaged grain can be as high as 50% in extreme cases of field weathering and prolonged rainfall.

Chickpeas that do not meet the Export Receival Standard of 6% maximum 'defective' chickpeas will need to be graded. This incurs a grading cost to the grower of $15–25/t. Downgrading into the stockfeed market results in a value of $120–140/t.

Early-harvested chickpea seed is much more resilient to breakage during harvesting and subsequent handling, even at low moisture contents.

Desi chickpeas are ultimately processed into dhal or flour by removing the seed coat (hull) and splitting the cotyledons. The process uses abrasive-type mills to gradually abrade the seed coat from the cotyledons, and is reliant on the seed coat being firmly attached to the cotyledons.

Cracking and weakening of the seed coat prior to processing substantially reduces the recovery percentage of dhal, as well as reducing the quality of the final product.

Field-weathered chickpeas after rain are also more difficult to thresh out at harvest, and often contain much higher levels of unthreshed pods and pod material. [10]

[9] Pulse Australia (2013) Northern chickpea best management practices training course manual—2013. Pulse Australia Limited.

[10] Pulse Australia (2013) Northern chickpea best management practices training course manual—2013. Pulse Australia Limited.

12.4.3 Chickpea seed discoloration

Chickpea seeds discolour and darken when exposed to field weathering.

Darkening of the seed coat is caused by oxidation of polyphenol compounds. The following conditions play a major role in accelerating seed coat darkening:

- rainfall
- cool-mild temperatures
- high humidity

Figure 3: Pistol chickpea showing tiger stripe. (Photo: Jenny Wood, NSW DPI)

Although there is usually no direct penalty or discount for a moderate degree of seed-coat darkening, it does have a significant impact on the marketability of the product and the reputation of the Australian industry as a supplier of quality product. Quality is becoming increasingly important as Australian traders attempt to establish market share against other chickpea-exporting countries (Canada, Turkey, Mexico).

We will likely see much greater segregation and premiums paid for lighter coloured, large-seeded Desi types as new varieties with these traits are developed and the Australian industry becomes more quality conscious.

Weathering of seed due to delays in harvesting can substantially increase mould infection levels. High levels of mould infection will also cause darkening of the seed coat. Humid (>70% relative humidity), wet conditions favour the development of a range

More information

http://www.grdc.com.au/Research-and-Development/Major-Initiatives/PBA/~/media/76F25DBABAD348EB87A12682E557CBA5.ashx

GrainCorp, Chickpea standards 2015-2016

Australian Pulse Standards 2014/2015, Pulse Australia

of fungi in late-harvested chickpea crops. While *Alternaria* spp. usually predominate, species of *Asperguillus*, *Cladosporium* and *Penicillium* may also be present.

There is increased risk of late infection by the Ascochyta blight fungus on pods. Ascochyta blight can develop on dry senescing pods under wet conditions, and can penetrate through to the seed. The current Export Receival Standard for visible Ascochyta blight lesions is a maximum of 1% on the seed cotyledon (kernel).

For the current Australian Pulse Standards, go to http://www.pulseaus.com.au/marketing/receival-trading-standards.

Native budworm (*Helicoverpa punctigera*) can cause damage to mature seeds. Larvae can occasionally attack senescing chickpeas, particularly where rainfall has softened the pod. Insect-damaged seeds are classified as defective chickpeas, and they cannot exceed the tolerance level of 6%.

12.4.4 Missed marketing opportunities

Delayed harvest can often mean that growers miss out on premiums that are paid for early-harvested crops. This is the case in many years, with the possible exception being where major production problems have been encountered and there is a shortage in the market place. Premiums of $50–100/t for the earlier harvested crops have been paid in some years.

Early harvest gives the grower some control over how and when the crop is marketed, whereas late-harvested chickpeas can be 'price-takers' in a falling market. [11]

12.5 Implementing early harvest management

A range of management components contribute to an early crop. They can all be important at different times and for different reasons. It is important to understand the potential and limitations of each management component. Optimal results in terms of yield, profit and earliness will be due to these components being applied in the most appropriate and balanced way, and as dictated by seasonal conditions.

These components include:

1. Planting

- Sow at the earliest opportunity within the preferred planting window for your area. Moisture-seeking equipment and/or press wheels can significantly enhance seeding opportunities under marginal conditions.
- Select adapted varieties that meet your target for early harvesting.
- Using precision planters will often achieve more uniform plant establishment and crop development and, consequently, more even crop maturity.

2. In-crop management

- Control Botrytis grey mould if present during flowering.
- Control native budworm during flowering to maximise early pod set.
- Avoid using herbicides that delay crop maturity, such as flumetsulam (e.g. Broadstrike®).

3. Harvest management

- Consider using Roundup Power MAX® + Ally® (or equivalent registered products) to terminate the crop at 80–90% yellow–brown pod stage.
- Set the header up to operate efficiently at 14–15% grain moisture content.
- A major advantage of high-moisture harvesting is that harvest can commence earlier in the season and earlier each day.

[11] Pulse Australia (2013) Northern chickpea best management practices training course manual—2013. Pulse Australia Limited.

- Harvesting at 14% moisture content, compared with 12%, can effectively double the harvest period available on any one day.
- Blend, aerate and/or dry the sample to the required receival standard of 14% moisture. [12]

12.6 Harvesting and header settings

Pulses are easily threshed, so concave clearances should be opened and the drum speed reduced.

If there are many summer weeds, the drum speed may have to be increased to ensure that weeds do not block the machine. Pulse grains are larger than wheat, so a concave with many wires or blanked-off sections can stop grain separation. To get the best performance, alternate wires and blanking-off plates will have to be removed. Maximum wind settings and barley sieves should ensure a good sample.

An alternative to the barley sieve is a mesh sieve made using 18-mm tubing for the frame and 1 cm by 1 cm, 14-gauge wire mesh. This screen increases capacity because the whole area is able to sieve.

If there are summer weeds, the rake at the back of the sieves should be blanked-off to stop them entering the returns. Summer weeds may cause walkers and sieves to block completely, causing high grain loss.

When harvesting pulses for seed, take extra care to reduce grain cracking, even if this means making a poor sample. Gentle harvesting will give the best seed quality. Rotary harvesters are gentler on the crop and will generally cause less grain damage than conventional harvesters.

Chickpeas can be harvested with minor adjustments and modifications to equipment. Open-front or pick-up fronts are best suited to the job.

Chickpeas should be harvested as soon as they mature, as pods will fall if harvest is delayed.

The crop varies in height from 15 to 80 cm, with pods held up in the canopy, so direct heading without crop lifters is possible with open-front and closed-front machines. Some fingers may have to be removed when using closed-front machines. Chickpeas thresh easily but are prone to cracking, particularly Kabuli types, so adjust thresher speed (400–600 rpm) and concave (10–30 mm) to suit (Table 1). Removing alternate wires and blank-off plates from the concave will help reduce cracking. If possible, cover the rasp bars with plate.

Video

Pulse Australia video: http://www.youtube.com/watch?v=oUBym9wa5wY

Harvesting grain at high moisture levels up to 14% should minimise cracking.

Early harvesting, before summer weeds become a problem, will reduce clogging and sample contamination. Desiccating the crop will kill summer weeds and ensure even crop-ripening.

Because chickpeas are destined for human consumption, a good sample off the header is usually required. [13]

[12] Pulse Australia (2013) Northern chickpea best management practices training course manual—2013. Pulse Australia Limited.

[13] Pulse Australia (2013) Northern chickpea best management practices training course—2013. Pulse Australia Limited.

Table 1: Harvester settings for pulses

	Chickpea	Faba bean	Green lentil	Red lentil	Lupin	Pea	Vetch
Reel speed	Medium	Slow	Slow	Slow	Slow	Medium	Slow
Spiral clearance	High	High	Low	Low	High	Standard	Low
Thresher speed	400–600 rpm	400–600 rpm	350–450 rpm	350–450 rpm	400–600 rpm	400–600 rpm	400–600 rpm
Concave clearance	10–30 mm	15–35 mm	20–30 mm	10–20 mm	10–30 mm	10–30 mm	10–30 mm
Fan speed	High	High	High	High	High	High	Medium
Top sieve	32 mm	32–38 mm	32 mm	16 mm	32 mm	25 mm	25 mm
Bottom sieve	16 mm	16–19 mm	8–16 mm	3–10 mm	16 mm	16 mm	10–16 mm
Rotor speed[A]	700–900 rpm	700–900 rpm	350–450 rpm	350–450 rpm	700–900 rpm	700–900 rpm	Slow

Source: Grain Legume Handbook, http://www.grdc.com.au/uploads/documents/9%20Harvesting.pdf
[A]Rotary machines only.

12.7 Modifications and harvest aids

Early harvesting can solve many problems. Losses are reduced because the pods are less prone to shatter or drop. The crop is also easier to gather because it stands more erect, allowing the harvester front to operate at a greater height, reducing the soil, rock and sticks entering the harvester.

Early harvesting also means there are fewer summer weeds to clog the harvester.

A straw chopper may be of value to chop up the stubble and spread it uniformly. Crop lifters are not usually required unless the crop is badly lodged.

Set the finger-tine reel to force the chickpea material down onto the front. Moving the broad elevator auger forward can improve the feeding of light chickpea material.

Vibration from cutter-bar action, plant-on-plant or reel-on-crop impact, and poor removal of cut material by the auger all cause shattering and grain loss.

Grain loss can be reduced by harvesting in high humidity, at night if necessary, to minimise pod shattering. Avoid reaping in extreme heat.

Finger reels are less aggressive than bat reels and cause fewer pod losses.

Double-acting cutter-bars reduce cutter-bar vibration losses. Four-finger guards with open second fingers also reduce vibrations (Figure 4).

Figure 4: Finger guard. (Source: Grain Legume Handbook, http://www.grdc.com.au/uploads/documents/9%20Harvesting.pdf)

A lupin breaker is a cheap and simple device that can increase harvesting capacity to reduce grain loss. A small, serrated plate attaches to the front spiral and creates an aggressive, positive feed action to clear-cut material from the front of the knife. [14]

Air fronts help to reduce shattering losses, and minimise the amount of soil and other debris (stubble, sticks) in the final sample. Where soil contamination is likely to be a problem, fit perforated screens to replace the feeder-house floor and elevator doors, and clean the grain cross augers. Twin blowers may be necessary on fronts wider than 7.6 m. [15]

Options to improve harvesting include:

1. Aussie-Air. Directs an air blast through reel fingers, and is suitable for both heavy and light crops. The manufacturer claims that an extra 15 hp is required to drive an Aussie-Air but there is also less horsepower requirement because of wider concave clearances. The actual horsepower required should be no more than for a heavy cereal crop.
2. Harvestaire. Replaces reel with a manifold that directs a blast of air into the front. The manifold causes some interference with the incoming crop. Correct orientation of air blast is important; an optional secondary fan to increase the air blast is worthwhile. The device is more effective in light crops.
3. Vibra-mat. A vinyl mat that vibrates with the knife, stops bunching at the knife of open-front headers and helps the table auger to clear-cut materials. This device is very cheap. It is more effective in light crops. It is important to match ground speed to table auger capacity and crop density—too slow and the plants will not have enough momentum to carry to the front; too fast and the cut crop will not be cleared from behind the knife.
4. Extension fingers (Figure 5). Plastic extension fingers about 30 cm long that fit over existing fingers can save significant losses, for little financial outlay, at the knife. Pods that would have fallen in front of the knife are caught on the fingers and pushed into the comb by the incoming crop.
5. Extended fronts. Now available for some headers. They reduce losses at the knife by increasing the distance between the knife and auger to a maximum of 760 mm. This helps to stop material bunching in front of the auger, where pods can fall over the knife and be lost.
6. Platform sweeps. Used in conjunction with extended fronts. They consist of fingers that rake material towards the auger to help eliminate bunching. They can also be used on conventional fronts.
7. Draper fronts. Draper fronts such as MacDon® and Honeybee® have large clearances behind the knife and carry the crop to the elevator. The front can also be used for cereals without modification.

Note that cost benefits must be assessed; a small area of pulses may not justify the cost of some of the above modifications. [16]

[14] Pulse Australia (2013) Northern chickpea best management practices training course—2013. Pulse Australia Limited.

[15] DAFF (2012) Chickpea—harvesting and storage. Department of Agriculture, Fisheries and Forestry Queensland, http://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/chickpeas/harvesting-and-storage

[16] Grain Legume Handbook Committee (2008) 'Grain legume handbook.' Supported by the Grains Research and Development Corporation (GRDC).

Figure 5: Plastic extension fingers fitted to a Draper front. (Photos: G. Cumming, Pulse Australia)

12.8 Achieving a clean sample

Harvesting of chickpeas can be costly if stones, sticks or too much soil are picked up with the chickpeas. Machinery damage can be reduced by a variety of practices.

12.8.1 Perforated screens

Perforated screens fitted on the bottom of the broad elevator, cross augers, grain and seconds elevators all reduce the amount of soil in the sample.

The perforated screen at the broad elevator is large and removes soil before it enters the main working mechanism of the harvester.

12.8.2 Harvester speed

Excessive harvester speeds will cause large losses of grain and force more soil into the harvester. Generally, speeds >8 km/h are not recommended, irrespective of the type of harvester front used.

12.8.3 Harvesting in high humidity

Harvesting in humid conditions, when pods are less prone to shatter, can reduce grain losses. However, more unthreshed pods may appear in the grain sample. It is unwise to harvest peas at night unless using a pick-up front or some positive height control, which will stop the front from digging into the soil. Some farmers have fitted wheels on the outer end of their fronts, as a depth stop. Others have purchased ultrasonic automatic depth controls to control header height.

12.8.4 Pick-up fronts

Pick-up fronts that are the same as, or similar to, those used for picking up windrows can be used to harvest windrowed chickpeas. Pick-up fronts greatly reduce the amount of soil entering the harvester and make harvesting easier because harvesting height is not as critical as with a front fitted with lifters. This allows harvesting at night. The fingers on the pick-ups are closely spaced and they will gather the entire crop, so crop losses are reduced.

There are different types of pick-ups. Some have fingers attached to rotating belts (draper pick-ups) and others have fingers attached to rotating drums (peg-roller pick-ups). The peg-roller types are similar and cheap but tend to shatter pods and cause slightly higher grain losses than the draper type. The draper types are more expensive but will reduce losses if harvesting late.

12.8.5 Flexible cutter-bar fronts (flexi-fronts)

The cutter-bars of these fronts are hinged in short sections, allowing the whole front to flex and closely follow the ground contour. They use skid plates and are particularly good for short crops such as lentils and peas, but can also be used on cereals by locking the hinged sections together. [17]

12.9 Fire safety

Fires can be a major hazard, as chickpea dust has a relatively low flash point. The problem is most prevalent where there has been no rain in the 2-4 weeks leading up to harvest. Risk can be minimised:

- Clean down headers regularly during the chickpea harvest.
- Dust settling on the manifold or turbo is usually the initial cause of most fires.
- Dust build-up on the header is often worse when using an air-front.
- Be wary of slipping belts and collapsed bearings that could ignite the dust.
- Keep a water tank nearby during harvest and carry a knapsack that works. [18]

12.10 Lodged crops

If the crop has lodged, the best option is usually to harvest directly into, or at right angles to, the direction the crop has fallen.

If on wide rows, use crop lifters and harvest up and back in the rows. The crop usually feeds in better over the knife section, and also provides the header operator with a better view of any rocks or sticks in the paddock. [19]

12.11 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 Harrington Seed Destructor (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 Australian Herbicide Resistance Initiative (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 practised as a weed-control option in the northern cropping regions. The potential for this approach has not been evaluated

[17] Grain Legume Handbook Committee (2008) 'Grain legume handbook.' Supported by the Grains Research and Development Corporation (GRDC).

[18] Northern Chickpea Best Management Practices Training Course Manual – 2013, Pulse Australia Limited

[19] Northern Chickpea Best Management Practices Training Course Manual – 2013, Pulse Australia Limited

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 previously 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)
- 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 2). 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 was not seeding.

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 the order 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
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

Weed	Scientific name	Number of paddocks infested	Number of paddocks seeding	Seeds dropped per plant	Seeds remaining per plant	% above harvest height
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

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 (Table 3), most 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 seeds/plant) than in 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 seeds/plant) and chickpea (180–220) but a large proportion of wild oat seed had already dropped in wheat paddocks.

The brassica weeds produced large numbers of seeds in chickpea (150–112,075 seeds/plant) but many 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 per plant (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 found in only 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

More information

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

Harvest weed seed control

harvest weed-seed management options, such as the HSD. It is also the ideal window for northern growers to experiment with narrow windrow burning, which is emerging as a cost-effective weed-control option.

These tactics could be used 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. [20]

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