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GRDC
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GRDC
GRAINS RESEARCH
& DEVELOPMENT
CORPORATION

CHICKPEA

SECTION 12

HARVEST

WINDROWING AND SWATHING | HARVEST TIMING | HEADER MODIFICATIONS AND SETTINGS | GETTING A CLEAN SAMPLE | FIRE PREVENTION | RECEIVAL STANDARDS | HARVEST WEED-SEED MANAGEMENT

Harvest

Key messages

- Greatly improved crop management and harvest timing has meant that chickpeas can be harvested earlier, with associated yield and marketing benefits. The tradition of delaying the harvest of chickpeas until after wheat can result in considerable chickpea yield and quality losses.
- Early, or timely, harvest of the chickpea crop has the potential to increase returns by up to 50%.
- If harvesting grain for seed, germination rates are improved if grain is harvested at 12–14% (Photo 1), and then stored in aerated silos or immediately graded and bagged.
- During harvest, chickpeas can produce a dust which is quite flammable, so make sure headers are blown down frequently to avoid fire.

Photo 1: *Chickpea harvest under way.*

ABC Rural

12.1 Windrowing and swathing

Windrowing of chickpeas is possible, but it is not widely used because there is little or no stubble for the windrow to sit on as there is, for example, with canola. Losses at harvest may be greater, and more dirt may enter the grain sample. Light windrows can be blown away in strong winds. Despite this, provided the windrows are large enough and compacted, windrowing is possible. It may also be possible to place two swathes into the one windrow and compact it with a cotton reel roller when windrowing. This technique shortens harvesting time.

In chickpeas, windrowing or desiccation can occur when <20% of pods are green and 90% of seed is changing from a green colour. The main advantages of windrowing are earlier harvest, reduced seed damage and less shattering or pod loss, particularly if harvest is delayed. Pod loss and shatter are reduced because windrowers allow unhindered passage onto the canvas due to the absence of platform augers. Lower harvesting heights may also be possible.

Windrowing also helps to dry out green broadleaf weeds, such as radish, which can cause major problems at harvest.

Windrowing also reduces damage to headers. Sticks and stones in rougher country can damage knife fingers and sections, retractable fingers and other components of headers, but pick-up fronts leave most of these on the ground. The cutting height for windrowing should be just below the bottom pods, with the reel following the top of the crop. The reel speed should be quite slow. The delivery opening in the

windrower should be large enough to prevent blockages; otherwise, there will be lumps in the windrow. Windrows should be dense and tightly knit for best results.

Curing should take about 10 hot days. However, heavy infestations of radish and other weeds could delay drying. Pick-up fronts are the most common type used for harvesting windrows. However, crop lifters used close together on open fronts have been used with some success. [1]

12.2 Harvest timing

Chickpea harvest can often clash with wheat harvest, and traditionally wheat has been given priority due to potential quality premiums. However, this thinking needs to be balanced against the relatively higher value and potential yield and quality losses that can result from a late chickpea harvest. Agronomists report that many growers consider losses in chickpeas will generally be less than in cereals. However, yield losses increase significantly the longer harvest is delayed.

Chickpeas should be harvested as soon as they mature (Photo 2), as pods will fall if harvest is delayed. [2] Crop desiccation enables even earlier harvest. [3]

Photo 2: *Mature chickpea plant.*

Source: The Land

Harvesting early also minimises infection of seed. Diseases 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. To reduce the transmission of diseases, clean headers, sowing equipment and spray rigs to remove grain, soil and stubble before moving from property to property. [4]

Harvest timing will depend on the moisture content that is acceptable for delivery or storage. This will depend on who is buying the grain, or whether aeration is available in the storage. Harvesters should be set up to operate efficiently at 14–15% grain MC. This effectively doubles the harvest period available on any one day compared to harvesting at 12%. Research has shown that average harvest losses increased as harvest was delayed (and seed moisture decreased). [5]

1 Pulse Australia (2013) Northern Chickpea—Best Management Practices Training Course Manual 2013. Pulse Australia.

2 GRDC (2008) Harvesting. In Grain Legume Handbook. GRDC, https://grdc.com.au/resources-and-publications/all-publications/publications/2008/03/2008-grains-legume-handbook

3 GRDC (2013) Chickpea disease management (southern and northern regions). Fact sheet. GRDC, http://www.grdc.com.au/Resources/Factsheets/2013/05/Chickpea-disease-management

4 GRDC (2013) Chickpea disease management (southern and northern regions). Fact sheet. GRDC, http://www.grdc.com.au/Resources/Factsheets/2013/05/Chickpea-disease-management

5 B O'Mara, S Belfield, G Cumming (2007) Chickpea harvest and seed storage. Pulse Australia, http://www.pulseaus.com.au/storage/app/media/crops/2007_Chickpea-Harvest-Storage.pdf

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. [6]

Harvesting at moisture levels below the receival standard of 14% can be costly. Moisture content decreases with late harvest (Table 1). [7] Delaying harvest from 14% MC to 8% MC for a 500 tonne crop equates to a 32 tonne weight reduction, and a loss of $17,500 (at $550/t). This is in addition to any harvest losses that occur due to low moisture at harvesting.Pulse Australia has calculated the economic losses caused by loss of moisture below the Grain Trade Australia (GTA) receival standard of 14% moisture content (MC) 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. [8]

Table 1: *Yield and moisture loss with delayed harvest.*

Harvest timing	Average moisture	Harvest loss
On time	12.7	10%
Late	10.3	23%

Source: Pulse Australia

Note: Crops intended for seed are best harvested at 14–16% MC and dried or aerated back to 12% to maximise both germination and vigour when held in storage. [9]

Yield losses of up to 30% have been recorded in the field, due to delayed harvest (Figure 1). Grain losses due to a 2–4 week delay in harvest were estimated at A$93–238/ha, depending on seasonal conditions. In this instance, most of these losses were due to pod loss at the header front, or unthreshed pods discarded out of the back of the machine.

In most years, chickpea yields can average ~70% of wheat yields when sown in an identical situation. The use of specialised headers and separate storage facilities for chickpeas may alleviate the competition with wheat for time, labour and equipment usage.

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

7 B O'Mara, S Belfield, G Cumming (2007) Chickpea harvest and seed storage. Pulse Australia, http://www.pulseaus.com.au/storage/app/media/crops/2007_Chickpea-Harvest-Storage.pdf

8 Pulse Australia (2013) Northern Chickpea—Best Management Practices Training Course Manual 2013. Pulse Australia.

9 B O'Mara, S Belfield, G Cumming (2007) Chickpea harvest and seed storage. Pulse Australia, http://www.pulseaus.com.au/storage/app/media/crops/2007_Chickpea-Harvest-Storage.pdf

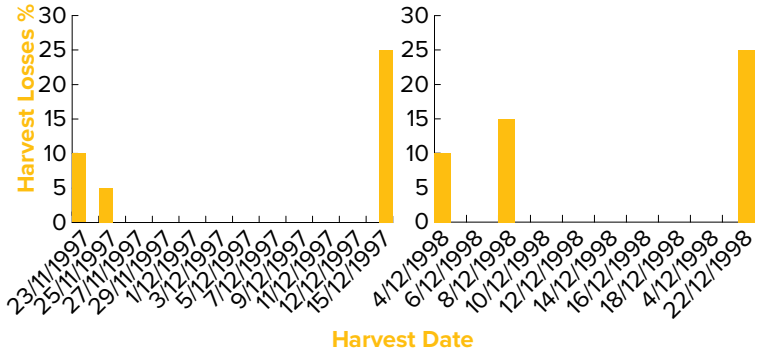


Figure 1: *Harvest yield losses in 1997 (left) and 1998 (right).*

Source: Pulse Australia

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, and causing drops in yield.

Lodging is increasingly likely 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 of 70–100 cm.

Increased storage is helping farmers to manage losses, and in some instances, reduce freight and handling costs where direct transport of grain to the end-user is possible.

12.2.1 Major losses from late harvest

Major losses incurred by harvesting chickpeas late include loss of yield, loss of quality, greater likelihood of disease and insect damage to pods and seeds, and loss of markets.

Loss of yield

- Losses due to pod drop can be severe as weathering weakens the hinge attaching the pod to the stem.
- Weathered pods become more difficult to thresh, resulting in grain loss from unthreshed pods passing out the back of the header, increased numbers of cracked grains, and a slower harvest.
- Increased lodging, especially in higher-yielding crops that are planted on wide rows.
- Harvesting at 8% MC instead of 14% results in a harvest loss.
- Farmer experience has shown yield losses of up to 30% if harvest is delayed 2–4 weeks.

Loss of quality

- Weathered or very dry grain is more likely to crack when handled, increasing the amount of split grain in the sample. Levels of cracked and damaged grain can be as high as 50% in extreme cases of field weathering and prolonged rainfall.
- The number of unthreshed pods in the sample will increase, as they become harder to thresh with weathering.
- Both split grain and unthreshed pods can result in rejection or the need for grading to meet market requirements.
- The germination rate and vigour of planting seed will be reduced by weathering.

- Chickpea grain discolours and darkens with weathering, reducing its marketability, particularly in the container market. The following conditions play a major role in accelerating seed-coat darkening (Photo 3):
- rainfall
- cool–mild temperatures
- high humidity
- 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 such as Canada, Turkey and 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.

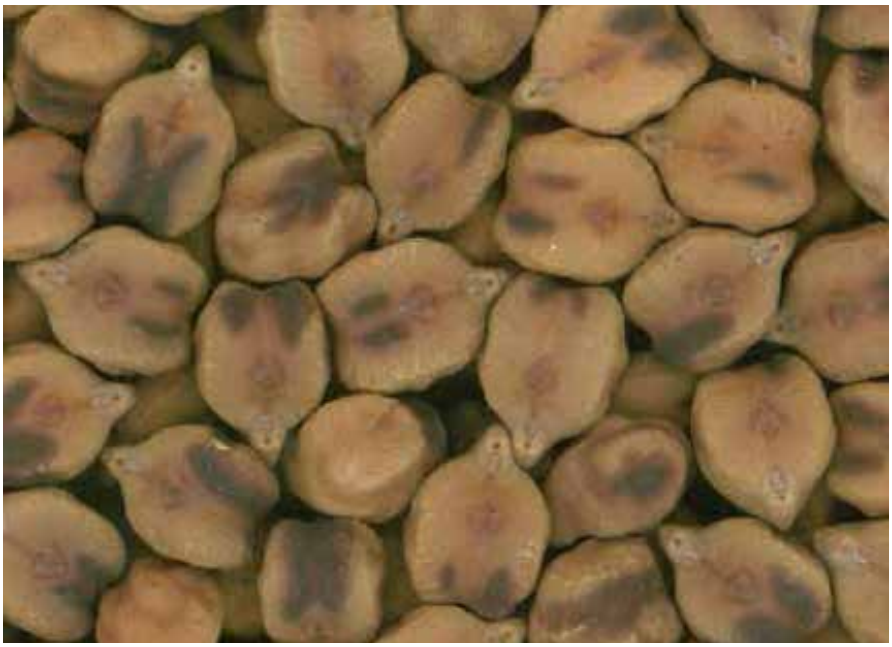


Photo 3: *PBA Pistol*[Ф] *chickpea showing grain discolouration due to weathering.*

Photo: Jenny Wood, NSW DPI

Note: Chickpeas that do not meet the export receival standard of 6% maximum 'defective' chickpeas 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.

Increased disease and insect risk to pods and seed

- Weathering of seed due to delays in harvest can greatly increase levels of mould infections. 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 of fungi in late-harvested chickpea crops. *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 infect senescing pods under wet conditions, leading to infected and discoloured seed (and possible rejection). The current export receival standard for visible Ascochyta blight lesions is a maximum of 1% on the seed cotyledon (kernel).

- 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, and they cannot exceed the tolerance level of 6%.

Lost marketing opportunities

- Chickpea prices can reach peaks during harvest, when demand is higher to meet shipping schedules. Earlier harvesting may allow access to these opportunities.
- Early harvest gives the grower some control over how and when the crop is marketed, whereas growers of late-harvested chickpeas are more likely to end up being 'price-takers' in a falling market.
- Darker, weathered seed may be discriminated against in the market.

Harvest delays in chickpeas cost growers and the pulse industry a lot of money. In any production area, a spread of 4–6 weeks may occur in the harvesting of chickpea crops planted on the same sowing rain. Many of the late-harvested crops have moisture content down to ~8%, a big drop from the maximum moisture content for receival of 14%, and the preference for 12%. [10]

12.2.2 Planning for early harvest

Early, or timely, harvest of the chickpea crop has the potential to increase returns by up to 50%. Management to ensure even crop maturity and timely harvest consists of a combination of factors, including:

- paddock selection and agronomy
- disease and insect control
- desiccation
- harvest timing and technique
- handling and storage [11]

These influence the management options that contribute to an early harvest. They will all be important at different times and for different reasons. It is important to understand the potential and limitations of each component in how a crop is managed. 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. The components include the following.

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. Precision planters are not widely used in the south but there is growing interest in them.

2. In-crop management:

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

3. Harvest management:

- Consider using Roundup UltraMAX® and Ally® (or equivalent registered products) to terminate the crop at 80–90% yellow–brown pod stage.
- Set up the header to operate efficiently at 14–15% grain moisture content.

10 Pulse Australia (2013) Northern Chickpea—Best Management Practices Training Course Manual 2013. Pulse Australia.

11 B O'Mara, S Belfield, G Cumming (2007) Chickpea harvest and seed storage. Pulse Australia, http://www.pulseaus.com.au/storage/app/media/crops/2007_Chickpea-Harvest-Storage.pdf

- A major advantage of high-moisture harvesting is that harvest can commence earlier in the season and earlier each day: harvesting at 14% MC, 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% MC. [12]

12.3 Header modifications and settings

Early harvesting means that plants can be easier to gather because they stand more erect, allowing the harvester front to operate at a greater height, reducing the amount of soil, rock and sticks that enter the harvester. Early harvesting also means there are fewer summer weeds to clog the harvester. Grain loss can be reduced by harvesting in high humidity, at night if necessary, to minimise pod shattering. Avoid reaping in extreme heat. [13]

Chickpeas can be harvested with minor adjustments and modifications to equipment. Open-front or pick-up fronts are best suited to the job. Pulses are easily threshed, so concave clearances should be opened and the drum speed reduced. The crop varies in height from 15–80 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 to 400–600 rpm and the concave to 10–30 mm to suit (Table 2). Because chickpeas are destined for human consumption, a good sample off the header is usually required. [14]

Table 2: *Harvester settings for pulses.*

Reel speed	Spiral clearance	Thresher speed	Concave clearance	Fan speed	Top sieve	Bottom sieve	Rotor speed
Medium	High	400–600 rpm	10-30 mm	High	32 mm	16 mm	700–900 rpm

Source: Grain legume handbook.

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. 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 2). [15]

12 Pulse Australia (2013) Northern Chickpea —Best Management Practices Training Course Manual 2013. Pulse Australia.

13 Pulse Australia (2013) Northern Chickpea —Best Management Practices Training Course Manual 2013. Pulse Australia.

14 GRDC (2008) Harvesting. In Grain Legume Handbook. GRDC, https://grdc.com.au/resources-and-publications/all-publications/publications/2008/03/2008-grains-legume-handbook

15 Pulse Australia (2013) Northern Chickpea —Best Management Practices Training Course Manual 2013. Pulse Australia.

Figure 2: *Finger guard.*

Source: Grain Legume Handbook

12.3.1 Options to improve harvest

- 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.
- Extension fingers (Photo 4): plastic extension fingers ~30 cm long that fit over existing fingers. Extension fingers can save significant losses at the knife for little financial outlay. Pods that would have fallen in front of the knife are caught on the fingers and pushed into the comb by the incoming crop.
- Extended fronts are 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.
- Platform sweeps are 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.

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

Photo 4: *Plastic extension fingers fitted to a draper front.*

Photos: G. Cumming, Pulse Australia

16 GRDC (2008) Grain Legume Handbook. GRDC.

Draper fronts

Draper fronts (e.g. MacDon or Honeybee) have become increasingly popular. The centre-feed draper platform provides uniform crop flow into the header, with minimal crop loss and little damage to the seed. The cutter-bar design allows for both vertical and end-table flotation. While their contour following ability is not quite as good as a floating cutter bar, they have performed very well, provided the paddock is relatively level. Operators claim they can be operated at higher travel speeds than a conventional front in chickpeas.

Preferred air-front set-ups

Air fronts help to reduce shattering losses, and minimise the amount of soil and other debris (e.g. 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. [17]

- Harvest-Aire or other air fronts are generally considered better than batt reels as they minimise the risk of pods detaching from the plant.
- They also improve feed in over the knife section, and reduce soil and stubble contamination, and allow the operator a clearer view of the cutting platform, as well as any rocks or sticks in the paddock. Adjustment of the angle and height of the air nozzles is critical, and may need adjustment as crop conditions change.
- Fit a Vibra-mat to improve the flow of material over the knife-section and along the platform. They are relatively cheap to buy and to maintain.
- Fit cast, short-crop fingers. If using a closed front the fingers will need to be spaced 19 mm or more apart.
- Fitting double-density Kwik-cut knife guards will help reduce plant vibration and the risk of pods detaching from the plant. This method may be unsuitable if there are a lot of green weeds in crops that are not desiccated, as the weeds will cause blockages.
- Check that the header front is level, and not higher at one end than the other. Set the knife at the correct angle for short crops, and install a simple depth gauge.
- In crops with a short height to the lowest pods, soil contamination is likely to be a problem, so it is advisable to fit perforated screens under the platform auger and/or broad elevator. Fit screens to repeat and clean-grain cross-augers.
- Floating or flexible cutter bars can be useful in short crops.

Conventional headers

- Aim to harvest at 300–500 rpm where possible to minimise cracking. Adjust upwards if jamming occurs in crops that are not desiccated.
- Set concave clearance at 10–30 mm depending on seed size. Check the concave for uneven clearance. Standard concaves tend to bow in the centre when fully loaded, and may need strengthening or replacement (e.g. with a Loewen concave). Removing alternate wires and the blank-off plates from the concave will also help reduce cracking. If possible, cover the rasp bars with plate.
- Beater: reduce speed to 100% of drum speed (for wheat it is usually set at 150%.)
- Set fan speed at 80–100% of maximum. The relatively heavy weight of individual chickpea grains allows the use of high air flow. [18]

17 DAF Queensland (2012) Chickpea—harvesting and storage. Department of Agriculture and Fisheries Queensland, https://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/chickpeas/harvesting-and-storage

18 B O'Mara, S Belfield, G Cumming (2007) Chickpea harvest and seed storage. Pulse Australia, http://www.pulseaus.com.au/storage/app/media/crops/2007_Chickpea-Harvest-Storage.pdf

Sieves

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. [19]

Set sieves to suit the grain size of the chickpea being harvested. This is more critical than for wheat:

- Top sieve 20–25 mm—a B & D Airfoil non-adjustable top sieve is reported to work well in chickpeas, and increases overall sieving capacity.
- Bottom sieve 12–16 mm—the bottom sieves can be altered so that the front 400 mm can be adjusted separately to the rear section. This allows the front section to be left open, and more air can be directed onto the top sieve if required.

Header speeds

Relatively slow ground speeds are considered essential when harvesting chickpeas to minimise excessive losses at the front of the header and the amount of dirt entering the machine.

- A maximum speed of 8 km/h is recommended.
- If using a batt reel, it should be set at the same speed as the header. [20]

12.4 Getting a clean sample

The 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.

12.4.1 Perforated screens

Perforated screens fitted on the bottom of the broad elevator, cross-augers, and 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.

12.4.2 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.

12.4.3 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 chickpeas 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.

12.4.4 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. They allows harvesting at night.

19 Pulse Australia (2013) Northern Chickpea—Best Management Practices Training Course Manual 2013. Pulse Australia.

20 B O'Mara, S Belfield, G Cumming (2007) Chickpea harvest and seed storage. Pulse Australia, http://www.pulseaus.com.au/storage/app/media/crops/2007_Chickpea-Harvest-Storage.pdf

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.

12.4.5 Flexible cutter-bar fronts (flexi-fronts)

The cutter-bars of flexi-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. [21]

12.4.6 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. [22]

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.

During harvest, chickpeas can produce a dust which is quite flammable, so make sure headers are blown down frequently to avoid fire.

12.5.1 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.

21 GRDC (2008) Grain Legume Handbook. GRDC.

22 Pulse Australia (2013) Northern Chickpea—Best Management Practices Training Course Manual 2013. Pulse Australia.

7. Maintain fire extinguishers on the harvester and consider adding a water-type extinguisher for residue fires. Keep a well-maintained firefighting 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 a fire if one occurs. [23]

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. Firefighting 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 machinery components, including brakes and bearings, do not overheat. These components can drop hot metal onto the ground and start 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, on 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. [24]

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

Key points

- Most harvester fires start in the engine or engine bay.
- Other fires are caused by failed bearings, brakes and electricals, and rock strikes. [25]

23 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

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

25 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 5: *GRDC figures show that there are 1000 combine harvester fires in Australia each year.*

Source: Weekly Times

12.5.2 Harvesting in low-risk conditions

Growers can use the Grassland Fire Danger Index (GFDI) to assess the wind speed at which harvest must cease (a GFDI of 35), depending on the temperature and relative humidity (Figure 3).

- 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 3: *Grassland Fire Danger Index guide.*

Source: CFS South Australia

MORE INFORMATION

GRDC Reducing harvester fire risk: The Back Pocket Guide

An investigation into harvester fires

Plan of attack needed for harvester fires

Standards and charts to check visual quality of desi chickpeas are available from Pulse Australia

Australian Pulse Standards 2016–2017

Desi chickpea sample chart of visual standards

12.6 Receival standards

National receival standards for chickpea are set by the pulse industry and maintained by Pulse Australia. Receival and export standards reflect the market requirements for a quality food product. Desi chickpeas should be sound, dry, fresh and light to medium brown in colour, although a greenish tinge is allowed (Tables 3 and 4). Kabuli chickpeas should be sound, dry, fresh and cream to light brown in colour.

Failure to achieve the receival standards may mean price discounts, re-cleaning or, if severe, market rejection. [26]

26 Pulse Australia (2016) Receival and trading standards. Pulse Australia, http://pulseaus.com.au/marketing/receival-trading-standards

Table 3: *Example of visual charts designed to be used as a guide in conjunction with the current Australian pulse trading standards.*

Defect	Visual examples of defective chickpeas
Frost damaged, shrivelled and wrinkled	
Broken, chipped, loose seed coat, and split.	
Insect damaged, and sprouted.	
Hail damaged	

Source: Pulse Australia

12.6.1 Definitions

- *Defective grains:* a maximum of 2% field peas (in desi), 2% of grains that are poor-coloured grains, broken, damaged and split, shrivelled, distorted, grub eaten, sprouted, or affected by field mould.
- *Poor colour: a maximum of 2%* of cotyledon that is distinctly blemished and/or off-colour from the characteristic yellow colour of the predominate class, including a maximum of 1% visibly affected by Ascochyta blight.
- *Foreign material:* includes unmillable material and all foreign vegetable matter (i.e. anything that is not desi chickpeas, therefore includes cereals, oilseeds and other crops, and wild oats, and weed seeds not otherwise specified).
- *Unmillable material:* soil, stones, metal and other non-vegetable matter.

Table 4: *Receival standards for desi and kabuli chickpea.*

Chickpea type	Max. moisture content (%)	Min. purity (%)	Max. defective & poor colour	Screen size for defective seeds (mm)	Poor colour max. (%)	Foreign material max. in total (%)	Unmillable material max.	Snails max.	Insects max.
Desi	14	97	6	3.95 slotted	2% (but 1% Ascochyta)	3	0.5 (0.3% soil)	1 per 200 g	15 per 200 g
Kabuli	14	97	3	6 round	2% (but 1% Ascochyta)	3	0.5 (0.3% soil)	2 per 400 g	30 per 400 g

Source: Pulse Australia

Individual commodity traders are responsible for ensuring that specific country requirements and those pertaining to compliance with the Export Control Act 1982 are included as additional specifications on the contract.

MORE INFORMATION

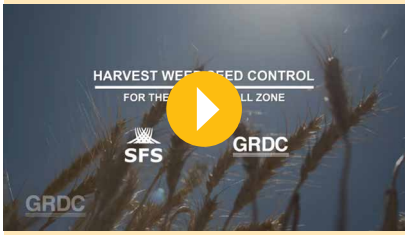
http://www.pulseaus.com.au/storage/app/media/markets/2009_Chickpea-visual-quality.pdf

MORE INFORMATION

Manual of Importing Country Requirements

VIDEOS

1. Harvest weed seed control for the high rainfall zone.



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

3. A beginner's guide to harvest weed seed control.

MORE INFORMATION

IWM manual section on harvest weed management

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. [27]

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. [28]

12.7.1 Harvest weed seed control 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 per cent 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'. Chickpea does not as readily lend itself to these practices of weed seed collection or confinement because of its late maturity relative to the weed seeds that have often fallen to the ground by crop harvest.

27 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

28 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