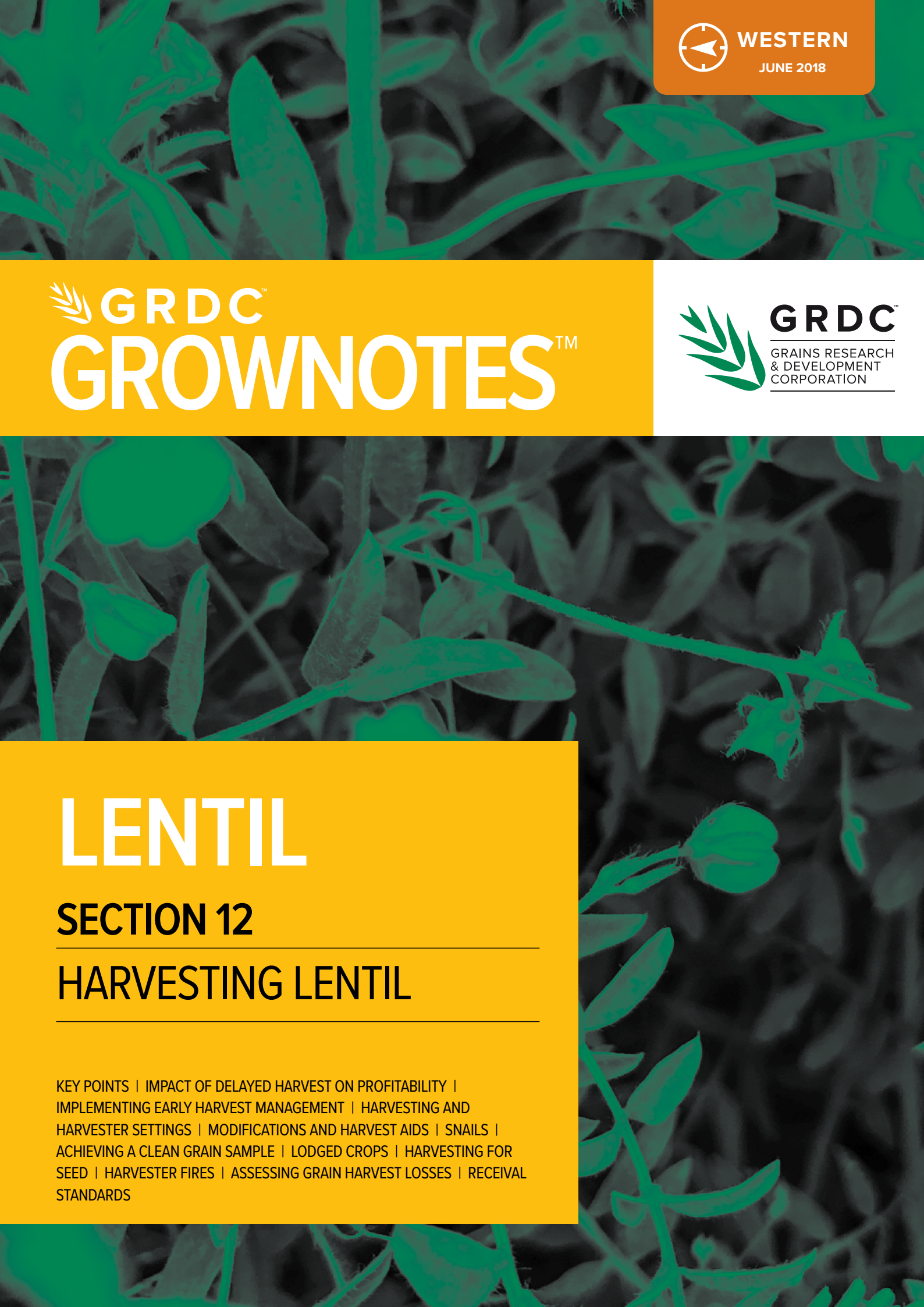

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LENTIL

SECTION 12

HARVESTING LENTIL

KEY POINTS | IMPACT OF DELAYED HARVEST ON PROFITABILITY | IMPLEMENTING EARLY HARVEST MANAGEMENT | HARVESTING AND HARVESTER SETTINGS | MODIFICATIONS AND HARVEST AIDS | SNAILS | ACHIEVING A CLEAN GRAIN SAMPLE | LODGED CROPS | HARVESTING FOR SEED | HARVESTER FIRES | ASSESSING GRAIN HARVEST LOSSES | RECEIVAL STANDARDS

Harvesting lentil

Key points

- Lentil should be harvested as soon as mature, as pods may shed if harvest is delayed.
- Early harvested lentil grain, with higher moisture content, is much more resilient against breakage during harvesting and subsequent handling.
- Grain quality deteriorates the longer mature lentil is left exposed to weathering in the paddock.
- Harvesting grain at high moisture levels up to 14% helps minimise cracking.
- There are several modifications and harvest aids to assist in the harvesting of lentil.
- Flexi-fronts enable harvesting close to the ground to pick up shorter plants.
- Harvesting lentil can be hazardous for starting paddock or harvester fires.

FEEDBACK

12.1 Impact of delayed harvest on profitability

Lentil can be one of the most profitable winter crops; especially when a professional approach to production and marketing is taken, as opposed to treating it as a minor, secondary crop. Early harvest of lentil crops is critical as delays can cost both growers and the pulse industry a considerable amount of money.

Delays can result in significant yield losses and quality downgrading due to lodging, shattering, pod loss and diseases. Grain quality can also suffer through mechanical damage, or weathering and seed staining. Furthermore, grain moisture levels outside of the optimum range at harvest can adversely affect the quality of the grain in storage.

In any growing area, it is often not unusual for lentil crops planted on the same seeding rain to be harvested several weeks apart. This spread in the harvesting window results in a range of grain moisture contents. For many late harvested crops, grain moisture is often low at around 8%; preferred moisture content is 12% with a maximum of 14% accepted.[1]

The main reasons (or perceptions) influencing a grower's decision to delay lentil harvest include:

- Lentil harvest can clash with cereal harvest. Logistical issues may require wheat or barley to take precedence at harvest time.
- The possibility of achieving premiums for high quality wheat or malting for barley is a major incentive for prioritising the cereal harvest, although in reality the premiums for early harvested lentil are often greater.
- There is a perception that lentils 'weather' reasonably well and/or do not shatter. This is not true.
- Uneven ripening of lentil crops if not desiccated (or swathed), especially when grown on heavy clay soils or variable soil types.
- Lentil is considered slower or more difficult to harvest than cereals, resulting in less hectares harvested per day. This does not need be so if desiccation is used, and the harvester is modified to suit lentil.
- The risk of a harvester fire is perceived to be greater in lentil than other crops.

Some growers with a high proportion of lentil in their cropping program use contractors to assist with a timely harvest; recognising the necessity for an early and efficient harvest to avoid potential losses of both yield and quality.

12.1.1 Yield losses

Yield losses in lentil increase significantly the longer harvest is delayed.

Lentil is very prone to pod splitting and pod drop with delays in harvest. This is especially so when weather events (rain and strong winds) occur after the plant has dried down. Weathering of the grain can also occur in split pods.

Lentil plants that have been affected by rain are also more difficult to thresh out at harvest, and often contain much higher levels of unthreshed pods and pod material.

It is estimated that grain losses due to a 1–3 week delay in harvest range from $150–$450/ha, depending on seasonal conditions.[2] Most of the losses are due to pod loss and shattering before harvest, as well as pod loss upon intake into the harvester.

1 Pulse Australia (2016) Southern Lentil: Best Management Practices Training Course. Pulse Australia

2 Pulse Australia (2016) Southern Lentil: Best Management Practices Training Course. Pulse Australia

FEEDBACK

Photo 1: *Yield losses of up to 50% have been recorded in the field after rains or strong winds.*

(Photo: W. Hawthorne, formerly Pulse Australia)

The incidence of lodging of the lentil plant increases the longer it is left standing once ready for harvest. Furthermore, the risk of lodging is even higher if the crop is high yielding and has been planted on wide rows without stubble trellising.

An example of the difference in dollar value of lentil due to yield loss is as follows:

1. **Timely harvest**
   500 tonnes of lentil @ 14% grain moisture @ $450 per tonne = $225,000
2. **Delayed harvest**
   500 tonnes of lentil @ 8% grain moisture = 470 tonnes (due to grain losses)
   470 tonnes @ $450 per tonne = $211,500
   Difference in income: $13,500 (6% loss)

12.1.2 Deterioration in grain quality

Early harvested lentil grain is much more resilient against breakage during harvesting and subsequent handling, even at low moisture contents. Grain quality deteriorates the longer that mature lentils are left exposed to weathering in the paddock.

The seed coat of lentil is very prone to wrinkling if it has been exposed to wetting and drying events due to rain or heavy dew during the harvest months. Expansion of the seed as it absorbs moisture, and then contraction as it dries, weakens the seed coat. This renders 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 delayed harvest combined with rain and/or wind events.

Lentil that does not meet the Number 1 Receival Standard of 3% maximum defective grain needs to be graded to in order to meet the standard. This cost is incurred by the grower and is between $15 and $25 per tonne. Some receival agencies do have a ‘cleaning grade’ for lentils that would otherwise achieve number 1 standard.

Those defective grains that do not meet the receival standards are termed ‘seconds’ and are usually sold into the stockfeed market for a significantly lower price.

FEEDBACK

Most lentil is ultimately processed into dahl or flour by removing the seed coat (hull) and splitting the cotyledons. However, the external and internal appearance is still critical for marketing. Older seed that has darkened with age splits better than new season grain. The milling 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 splits, as well as reducing the quality of the final product.

Lentil seeds discolour and darken when exposed to weathering in the paddock.

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

- rainfall;
- cool to mild temperatures;
- high humidity; and
- sunlight.

While 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 more important as Australian traders attempt to establish market share against Canada, our major lentil exporting competitor.

It is likely that there will be increased segregation and premiums paid for fresh, unstained lentils of good quality. New varieties with quality traits are being developed and the Australian industry is very quality conscious.

Factors that affect the quality of lentil grain include:

- **Mould infection.** Weathering of grain due to delays in harvesting can substantially increase mould infection levels. High levels of mould infection will also cause darkening of the seed coat. Humidity (>70% relative humidity) and wet conditions favour the development of a range of fungi in late harvested lentil crops. While *Alternaria* spp usually predominate, *Asperguillus*, *Gladosporium* and *Penicillium* species may also be present.
- **Ascochyta infection.** Increased risk of late Ascochyta infection can develop on dry senescing pods under wet conditions, and can penetrate through to the seed in susceptible varieties. The current Farmer Dressed Receival Standard for visible Ascochyta lesions is a maximum of 1% on the seed cotyledon (kernel).
- **Insect-damaged grains.** Native budworm can occasionally attack senescing lentils, particularly when rainfall has softened the pod. Insect-damaged seeds are classified as defective, and cannot exceed the tolerance level of 3% current Farmer Dressed Receival Standard.

MORE INFORMATION

Detailed information on lentil receival standards is in Section 15 Marketing

For the current Australian Pulse Standards for Lentil go to: http://www.graintrade.org.au/commodity_standards

FEEDBACK

12.1.3 Missed marketing opportunities

IN FOCUS

An early harvest provides some degree of control over lentil grain quality, as well as how and when the crop is marketed. Late harvested lentil can often result in a grower becoming a price-taker in a falling market or encountering delays in delivery.

Delayed harvest can often mean missing out on premiums paid for early harvested crops of good quality. This is often the case, except for seasons where major production problems have been encountered resulting in a shortfall of grain in the market.

It is recommended that lentil growers maintain connections with marketers from early in the season to understand the marketing conditions and selling options likely to prevail at harvest.

12.2 Implementing early harvest management

There are a range of management factors that contribute to an early matured crop, and all can be important at different times and for different reasons. Each factor has its own advantages and. Optimal results, in terms of yield, profit and timing for maturity are due to these factors being applied in the most appropriate and balanced manner. Of course, seasonal conditions will always be a factor influencing decision-making.

These factors include:

12.2.1 Seeding

- Seed at the earliest opportunity within the preferred planting window for your area. This may involve dry seeding by a particular calendar date.
- Moisture-seeking equipment and/or press-wheels can significantly enhance seeding opportunities under marginal soil moisture conditions.
- Use adapted varieties that meet targets for early harvesting.
- Use precision planters or machines with automatic depth control. This will result in more uniform plant establishment and crop development, and, consequently, more even crop maturity. This is particularly so when seeding into marginal soil moisture and dry conditions.

12.2.2 In-crop management

- Control Botrytis grey mould before canopy closure.
- Control native budworm during flowering to maximise early pod-set.
- Avoid using herbicides that delay crop maturity, for example flumetsulam (Broadstrike®).

12.2.3 Harvest management

- In a short crop, consider weed wiping (where possible) to kill tall, late weeds that might otherwise delay harvest (See “8.6 Herbicide types” for more information on weed wiping.).
- Consider swathing to enable earlier maturity and harvest date.
- Consider using a desiccant to dry late maturing plants and any weeds.
- If using glyphosate, (or equivalent registered products) to terminate crop growth at the 80–90% black-brown pod stage, be aware of potential impacts on seed quality.
- Prepare the harvester to operate efficiently at 14% grain moisture content.

MORE INFORMATION

More information on windrowing, desiccation and crop-topping is in Section 11 Pre-harvest treatments.

FEEDBACK

A major advantage of high moisture harvesting is that harvest can commence earlier in the season and earlier each day.

Harvesting at 14% moisture content, compared to 12%, can effectively double the harvest period available on any one day in hot environments. Growers can consider blending, aerating and/or drying the grain to achieve the required receival standard of 14% moisture.

More information on windrowing, desiccation and crop-topping is in Section 11 Pre-harvest treatments. Information on managing weeds at harvest is Section 8.3 Managing weeds in lentil.

12.2.4 Benefits of early harvesting

Early harvesting results in reduced grain losses because the seed 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.

Early harvesting also plays a role in disease control and crop establishment in the following crop. Early harvested grain is of better quality in terms of colour and weathering, and will have less disease.

Early harvesting of lentil offers the advantages of:

- reduction in grain losses;
- reduced risk of grain discoloration;
- lower percentage of cracked grain; and
- reduced snail contamination.

Early harvesting of lentil is possible with the maximum moisture level for receival at 14%. This allows significant improvements in lentil quality to be realised, with less cracked and/or stained grain, and lower snail contamination. Lentil stems or weeds, or weeds that are still green, could become a problem in rotary harvesters by wrapping around rotors, reducing rotor speed and overloading rotor drives.

Strategies to aid early harvest of lentil may include desiccation, crop-topping and swathing.

MORE INFORMATION

Go to Section 11 Pre-harvest treatments for further information.

12.3 Harvesting and harvester settings

Lentil is easily threshed, so concave clearances on harvesters should be opened and the thresher speed reduced.

Lentil is prone to cracking, particularly green lentil types, so thresher speed should be adjusted (300–600 rpm), and also the concave (10–30 mm) to suit conditions (Table 1 and Table 2). Consideration must be given to thresher impact speeds that vary with the thresher diameter (Table 3). Thresher speed should be adjusted to suit the required 12 metres per second impact speed.

Lentil can be harvested with minor adjustments and modifications. Flexi-fronts are best because they can harvest close to the ground whilst flexing with ground contours. Open-front or pick-up fronts are also suitable for harvesting lentil.

Lentil should be harvested as soon as mature as pods may shed if harvest is delayed, especially after rain.

A lentil crop varies in height from 15 to 80 cm, with pods held up within the canopy. This makes direct harvesting possible with open front machines without crop lifters.

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

FEEDBACK

A good sample from the harvester is required as lentil is destined for human consumption. Desiccating the crop will kill late maturing and summer weeds and ensure even crop ripening. Alternatively, direct harvesting early prevents green summer weeds clogging the harvester, staining the grain and contaminating the sample.

If there are summer weeds present, thresher speed may need to be increased to ensure that weeds do not clog or block the harvester. Maximum wind settings and barley sieve settings should ensure a good sample. Furthermore, the rake at the back of the sieves should be blanked-off to stop summer weeds entering the returns. Summer weeds may cause walkers and sieves to block completely resulting in high grain losses.

Table 1: Harvester settings for pulses.

	Chickpea	Faba bean	Green lentil	Red lentil	Lupin	Field pea	Vetch
Reel speed	medium	slow	slow	slow	slow	medium	slow
Spiral clearance	high	high	low	low	high	standard	low
Thresher speed	400–600	400–600	350–450	350–450	400–600	400–600	400–600
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	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*	700–900	700–900	350–450	350–450	700–900	700–900	slow

* Rotary machines only.
Source: J Lamb, A Poddar (2008) Grain Legume Handbook for the Pulse Industry. Grain Legume Hand Book Committee, https://grdc.com.au/grainlegumehandbook

VIDEO

To view a video on harvesting lentil go to: https://youtu.be/RnFDgpqUI38

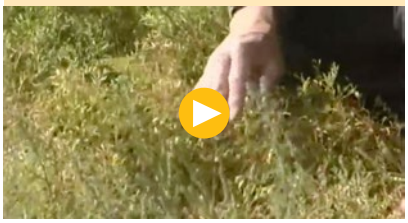

Table 2: Suggested harvester settings for lentil.

Component	Red lentil	Green lentil
Reel speed	slightly faster than ground speed	slightly faster than ground speed
Table auger clearance	7–10 mm	8–12 mm
Drum or rotor speed	300–600 rpm*	300–600* rpm
Concave clearance	10–20 mm (start at 10 mm)	13–20 mm (start at 13 mm)
Fan speed	60.75% (start at 75%)	70.85% (start at 85%)
Top sieve	10–20 mm (start at 20 mm)	13–25 mm (start at 25 mm)
Bottom sieve	5–10 mm (start at 10 mm)	8–16 mm (start at 16 mm)

* Drum or rotor diameter (mm) influences the rotational speed (rpm).
Drum or rotor rotational speed and diameter for 12 metres per second peripheral speed are:
400 mm drum = 570 rpm; 500 mm = 460 rpm; 600 mm = 380 rpm; 700 mm = 330 rpm; 800 mm = 290 rpm.
Source: Successful Lentil Harvesting (1999), Agriculture Western Australia Farmnote 99/99, http://agric.firstsoftwaresolutions.com/fullRecord.jsp?recno=10735

12.3.1 Harvester thresher size and rotor speed

It is impact forces that easily damage lentil. It is important to minimise any mechanical damage of lentil grain, because the appearance of the grain is a very important quality parameter. Ease of threshing and the amount of seed splitting differs between varieties, so some testing is necessary at the start of harvest.

The outside or peripheral speed of the harvester thresher, or rotor, impacts the grain to thresh it out of the pods. This speed depends on the thresher or rotor revolution

speed and its diameter. Keeping this impact speed to around 12 m/sec (the same as for lupin) will reduce the chance of grain damage.

An experiment at Merredin, Western Australia, using a specially designed grain impact tester, showed that grain damage was greater at higher impact speeds (Table 3). Grain with low moisture content is most prone to damage and this is another reason to harvest the crop as soon as it is ripe.

Table 3: Red lentil seed damage with impact speed (seed moisture at 12.7%).

Impact speed (m/s)	Seed damage (%)
9.2	0.5
13.7	0.9
18.9	8.3
23.4	18.4
26.9	30.0

12.4 Modifications and harvest aids

There are a number of modifications and harvest aids to assist in the harvesting of lentil. Growers must assess the cost-benefit ratio of modifications and harvest aids as a small area of lentil may not justify the cost.

12.4.1 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. Flexi-fronts use skid plates and are particularly good for short crops like lentil and field pea, but can also be used on cereals by locking the hinged sections together.

Flexi-fronts are ideal for harvesting lentil, particularly when used in association with some air assistance to blow the plant material into the comb front.

Photo 2: *A harvester set up for lentil with a flexi-front and air assist.*

(Photo: W. Hawthorne, formerly Pulse Australia)

FEEDBACK

Photo 3: *Harvesting lentil with a flexi-front and air assist.*

(Photo: T. Bray formerly Pulse Australia)

12.4.2 Aussie-Air

Aussie-Air directs an air blast through the reel fingers, and is suitable for both heavy and light crops.[3]

12.4.3 Harvestaire

A Harvestaire replaces the reel with a manifold that directs a blast of air into the front of the harvester from the top of the knife. The manifold causes some interference with the incoming crop, meaning correct orientation of air blast is very important. An optional secondary fan to increase the air blast is worthwhile and the device is more effective in light crops.

12.4.4 Vibra-mat

Vibra-mat is a vinyl mat that vibrates with the knife, thus stopping bunching of plant matter at the knife of open front harvesters. The Vibra-mat also helps the table auger to clear out plant matter. Its main advantage is that the device is inexpensive. The Vibra-mat is only effective in light crops.

With the Vibra-mat it is important to match ground speed to table auger capacity and crop density. If the ground speed is too slow, plant material will not have enough momentum to carry to the harvester front. If the ground speed is too fast, the cut crop will not be cleared from behind the knife.

3 J Lamb, A Poddar (2008) Grain Legume Handbook for the Pulse Industry. Grain Legume Hand Book Committee, https://grdc.com.au/grainlegumehandbook

Photo 4: *Harvestaire front combined with extension fingers and a blue Vibra-mat.*

(Photo: G. Cumming, formerly Pulse Australia)

12.4.5 Crop lifters

Crop lifters are an attachment to the knife that extend forward and are designed to lift lodged crops above the knife to reduced grain losses at the harvester front. They are used in situations where crop height is low to the ground due to lodging and harvesting with a standard front would result in a large amount of plant material being unable to be picked up by the harvester.

Most cereal crop lifters can be used. However, since the lentil plant has many thin stems, a slim crop lifter is recommended to reduce the sideways movement of the plant.

Photo 5: *Light crop lifters that can be used in lentils.*

(Photo: G. Riethmuller)

In two experiments at Merredin in 1995 and 1996, crop lifters spaced at 230 mm increased lentil yields by an average of 26% (0.38 t/ha) (Table 4).

FEEDBACK

Table 4: Average lentil yields from two experiments in 1995 and 1996 with and without slim crop lifters at Merredin (Western Australia).

Harvest attachment	Yield (t/ha)	% yield of no lifters
Slim lifters at 23 mm	1.87	126
No lifters	1.49	100

It is best to avoid crop lifters if there are high numbers of sticks on the ground. Also, lifters can result in an increased intake of soil into the harvester; therefore, height control is important.

Soil intake can wear harvester parts and so is best avoided if possible. However, soil can be separated from the grain by fitting screens to the bottom of the clean grain elevator. Elevator screens can also help remove small, damaged or frosted grain.

Crop lifters can dig into wheel ruts left by spraying vehicles so avoid spraying when the soil is very wet or use low-pressure tyres.

A flexible cutter bar is ideal because it has the best height control.

12.4.6 Extension fingers

Plastic extension fingers collect lentil pods that would have fallen off in front of the knife resulting in grain losses. The pods are caught on the fingers and pushed into the comb by the incoming crop. The fingers are approximately 30 cm long and fit over existing fingers. They are relatively inexpensive.

Photo 6: *Plastic extension fingers fitted to a draper front.*

(Photo: G. Cumming, formerly Pulse Australia)

12.4.7 Extended fronts

Extended fronts are now available for some harvesters. They reduce losses at the knife by increasing the distance between the knife and auger to a maximum of 760 mm. This helps stop losses from plant material bunching in front of the auger, where pods can fall over the knife and be lost.

12.4.8 Platform sweeps

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.

12.4.9 Draper fronts

Draper fronts such as John Deere, CaseIH, MacDon® and Honeybee® have large clearances behind the knife and carry the crop to the elevator. These fronts can also be used for cereals without modification.

FEEDBACK

12.4.10 Other modifications and harvest aids

A **straw chopper** may be of value to chop up stubble and spread it uniformly across the paddock.

Crop lifters are not always required but can help if the crop is badly lodged.

Set the **finger tyne reel** to force the lentil material down onto the front.

Moving the **broad elevator auger** forward can improve the feeding in of light lentil material.

Vibration due to cutter bar action, plant on plant, 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 or at night** to minimise pod shattering, and avoiding harvesting 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.[4]

Four finger guards with open second fingers also reduce vibrations.

Figure 1: *A four finger guard.*

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

There are other options available to improve lentil harvesting.

4 J Lamb, A Poddar (2008) Grain Legume Handbook for the Pulse Industry. Grain Legume Hand Book Committee, https://grdc.com.au/grainlegumehandbook

FEEDBACK

Photo 7: *Belt front fitted with cross auger.*

Photo: W. Hawthorne, formerly Pulse Australia

Photo 8: *Short fingers on a flexi-front.*

Photo: Grain Legume Handbook

12.5 Snails

Snails can be a major issue in some areas. Snails can accumulate in the lentil canopy, climb up standing stubble of the previous crop or migrate into lentil swaths and are eventually collected by the harvester.

Snails cause a whole range of problems:

- damage to the lentil plant;
- damage to the seed pods affecting grain quality (Photo 9);
- clogging and damaging harvesting machinery;
- causing delays while snail pulp is removed; and
- contamination of the grain sample.

The receival standard for 'farmer dressed' lentil is one snail per 200 g sample.

FEEDBACK

MORE INFORMATION

See Section 9.3.3 Snails for more information.

There is no quick and easy way to control snails, but a combination of a number of strategies and modifications to harvesting equipment can help.[5]

Before sowing:

- Burning or cabling stubbles.
- Baiting snails.

Before harvest:

- Baiting snails. Complete all baiting by the end of August to avoid the risk of bait entering grain samples at harvest (refer to Section 9 Pest management).
- Harvest crops early: the later they are left, the more difficult they will be to harvest.
- Leave badly infected areas until cool or damp weather when snails are more likely to be down on the ground and off the plants.

At harvest:

- Minimise the entry of soil into the harvester by using a grate in the bottom of the front elevator;
- Use a smaller top sieve, or 10 mm punch hole or octagonal top sieve.
- Weld a lip onto the front of the top sieve to stop snails falling off.
- Add removable panels to the harvester to allow easy cleaning.
- Add a steel slat in the elevator to keep the elevator clean.
- Slow down the speed of the grain elevators.
- Harvest with the repeat door open, but monitor losses.

After harvest:

- Burning stubbles in autumn is effective, particularly when a complete burn of the paddock is achieved;
- Control grass along fence lines where snails can remain undisturbed; and
- Roll, slash, cable or trash harrow stubbles so snails cannot get above 5 cm off the ground. Beware of erosion.

Photo 9: *Snail damage to a near-mature pea pod.*

Photo: M. Raynes, formerly Pulse Australia

Photo 10: *Snails accumulate under the lentil canopy, but can also climb upstanding cereal stubble or lentil plants.*

Photo: W. Hawthorne formerly Pulse Australia

5 J Lamb, A Poddar (2008) Grain Legume Handbook for the Pulse Industry. Grain Legume Hand Book Committee, https://grdc.com.au/grainlegumehandbook

FEEDBACK

12.5.1 Harvester modifications to minimise snail contamination

A number of harvester modifications have been tested to address the issue of snail contamination when harvesting faba bean early.[6] These modifications may have some relevance to lentil.

Disrupter kit (faba bean)

A disrupter kit fitted to a rotary harvester can lead to further improvements at early harvest, including reduced cracked grain. However, increased cracking of mature bean stalks with the disrupter has the potential to cause higher grain losses, unless the harvester wind and sieve settings are adjusted more finely to suit harvest conditions.

- Harvesting beans at close to the maximum moisture receival level improves grain quality and reduces losses, providing temperatures are not excessive. Earlier harvesting reduces snail contamination.
- A disrupter kit allows early harvest of bean crops with immature green bean stalks with minimum rotor speed loss. Adjust disrupter settings to minimise excessive shattering of bean stalks.
- As bean stalks mature and harvest temperatures increase, machine settings need careful adjustment to prevent significant losses from the excess flow of shattered material over the sieves.
- The disrupter kit should be removed for harvesting mature bean canopies; and
- Frontal harvest losses are more affected by temperature and humidity at harvest than by early or late harvest timing.

Photo 11: *Disrupter peg (left) and disrupter bar (right) fitted to harvester for early bean harvest.*

(Photos: M. Richards)

Snail dislodgers (faba bean)

Either pusher bars with dangling belts, or a rotary brush, can be effective in reducing snail contamination when harvesting bean crops with high snail numbers. However, the reduction in snails in the grain sample is at the expense of increased grain losses. The rotary brush is used at low revolutions per minute (rpm) brushing against the direction of travel. A fixed pusher bar with dangling belts can increase frontal grain losses by up to 5% while dislodging up to 60% of round snails from the harvested zone.

6 M Richards, S Wentworth (2004) Managing early harvest and white snails in beans. Proceedings of Bean Focus 2004 pp105-107

FEEDBACK

Photo 12: *Pusher bar with dangling belts fitted to harvester to reduce snail contamination.*

(Photo: M. Richards)

Photo 13: *Rotary brush fitted to harvester to reduce snail contamination.*

(Photo: M. Richards)

FEEDBACK

MORE INFORMATION

Refer to Section 5 Post planting for detailed information on rolling lentil

12.6 Achieving a clean grain sample

Harvesting lentil can be costly if stones, sticks or too much soil are picked up with the lentil. As well as reducing the quality of the grain sample, damage can be incurred to the harvester.

12.6.1 Rolling for harvest efficiency

Harvesting efficiency can be increased and harvester damage reduced by rolling paddocks after seeding to flatten and firm soil and depress obstacles like stumps and stones. It is said that harvesting efficiency with lentil starts with the surface condition of the paddock after seeding.[7]

Photo 14: *Clods formed at seeding need to be rolled to enable easier harvest.*

(Photo: W. Hawthorne formerly Pulse Australia)

Photo 15: *Stones left unrolled create harvest difficulties and losses.*

(Photo: W. Hawthorne formerly Pulse Australia)

7 Pulse Australia (2016) Southern Lentil: Best Management Practices Training Course. Pulse Australia

FEEDBACK

12.6.2 Perforated screens

Perforated screens fitted on the bottom of the broad elevator of the front, and cross augers, grain and second's elevators in the harvester all reduce the amount of soil in the grain sample.

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

12.6.3 Harvester speed

Excessive harvester speeds will cause large grain losses and force more soil into the harvester. Generally, speeds greater than 6–8km/h are not recommended, irrespective of the type of harvester front used.

12.6.4 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. Care should be exercised when harvesting lentil at night, unless using a flex-front or a pick-up front with some positive height control to stop the front from digging into the ground. Some growers have fitted wheels on the outer end of their fronts, as a depth stop. Others have used ultra-sonic automatic depth controls to control the height of the harvester front.

12.6.5 Pick-up fronts

Pick-up fronts, the same as, or similar to, those used for picking up swaths, can be used to harvest lentil. The 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-up fronts are closely spaced and will gather the entire crop, so crop losses are reduced.

There are different types of pick-up fronts. Some have fingers attached to rotating belts (draper pick-ups) and others have fingers attached to rotating threshers (peg roller pick-ups). The peg roller types are similar and less expensive 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 later in the day.

12.7 Lodged crops

If the crop has lodged it is usually best to harvest into the opposite direction, or at right angles, to the direction the crop has fallen. Crop lifters may help.

If sown on wide rows, crop lifters should be used and the direction of travel of the harvester up and back in the rows. The crop usually feeds in better over the knife section, and also provides the harvester operator with a better view of any rocks or sticks in the paddock.

12.8 Harvesting for seed

Lentil seed, kept for seeding in the following season, should be harvested from an area that is as free as possible from diseases, pests and weeds. Contaminant weeds can be hard to control in lentil, and seed infected with Ascochyta blight will transfer the disease into the next crop.[8]

If harvesting grain for seed, germination rates can be maintained if the grain is harvested at 12–14% moisture and then stored in aerated silos or immediately graded

8 J Carter, M Materne (1997) Lentil Growers Guide: A Guide to the Production of Lentils. Victorian Department of Natural Resources and Environment, Horsham

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and bagged. Crop-topping with herbicides prior to crop maturity may reduce grain quality and seed viability. Retaining crop-topped seed is not recommended.[9]

Extra care must be taken when harvesting lentil for seed to reduce grain cracking, even if this means making a poorer sample (including limited unthreshed pods). 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.

12.9 Harvester fires

Harvesting lentil can be hazardous for starting paddock or harvester fires, perhaps more so than in other crops. Lentil, chickpea, sunflower and lupin are more flammable than other broadacre crops grown in the western region because of the very fine dust produced, which has a lower ignition point than cereal dust.

With hot, dry conditions in Australia's western cropping region each summer, harvester fires are an extreme risk to life, crops and property. Growers and contractors need to make ensure harvesters are well maintained and cleaned regularly to reduce fire risk, especially when harvesting lentil.

Flammable material can collect on the exhaust manifold and turbocharger in a harvester's engine bay, which is the most common cause of harvester fires. When these materials ignite, they can blow around the machine and into nearby crops, where they can cause spot fires.

Keeping the harvester clean and well maintained is the best way to prevent harvester fires. Taking steps to prevent harvester fires should be a priority in all crops.

Harvester fires can be prevented by undertaking the following:

- keep at least two fire extinguishers accessible on each harvester;
- perform regular blow-downs on the harvester. In extreme conditions this might be every half hour or every time after filling the harvester box;
- keep equipment clean and well maintained;
- ensure the manifold, turbocharger and exhaust are free of flammable material; and
- do not overload electrical circuits.

Harvesting, and any other paddock activity, should be halted in high fire-risk periods, which typically have low humidity, high winds and vulnerable crop conditions.

Photo 16: *A harvester fire in a safflower crop. Like lentil and chickpea, harvesting safflower produces a fine dust meaning the risk of fire is great.*

(Photo: D. McLellan)

MORE INFORMATION

For more information on harvester fires go to:
https://grdc.com.au/Media-Centre/Media-News/South/2014/11/Take-simple-steps-to-reduce-harvester-fire-risk

and watch:
https://www.youtube.com/watch?v=WqTfR2ifM1I

9 Pulse Australia (2015) Best Management Guide – Lentil Production: Southern Region. Pulse Australia, http://www.pulseaus.com.au/growing-pulses/bmp/lentil/southern-guide

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12.9.1 Harvest check list

1. Recognise the five factors that contribute to fires:
- relative humidity;
- ambient temperature;
- wind;
- crop type; and
- conditions.

☛ **Stop harvest when the danger is extreme.**

2. Redouble efforts for **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 extra wary of side and tailwinds that can disrupt the radiator fan air blast that normally keeps the exhaust area clean.
4. Be ultra-alert for areas on the harvester where **chafing** can occur: fuel lines, battery cables, hot wires, tyres, drive belts etc.
5. Avoid **overloading electrical circuits**.
6. Regularly **check bearings** on the harvester; both the front and the machine body. Use a hand-held digital heat-measuring gun for temperature diagnostics on bearings, brakes etc.
7. Drag chains, drag cables or grounding conductors may help dissipate **electrical charge** but are not universally successful in all conditions. In certain conditions a drag chain could even start a fire from rock strikes.
8. The **battery isolation switch** must be used when the harvester is parked. Use **vermin deterrents** in the cab and elsewhere, as vermin chew certain types of electrical insulation.
9. Observe the **Grassland Fire Danger Index** (GFDI) protocol on high-fire-risk days.
10. It should not be assumed that static electricity is a cause of fires; current evidence does not support this as a prime cause of harvesters.
11. Maintain **two-way contact** with all harvest workers. Remain vigilant for hazards on machinery during the fire season.[10]

MORE INFORMATION

For further information on harvest fires go to:
www.grdc.com.au/GRDC-BPG-ReducingHarvesterFireRisk

http://www.grdc.com.au/Media-Centre/Hot-Topics/Harvester-Fires/Details #sthash.5a7xgzkY.dpuf

10 Grains Research and Development Corporation (2014) Take simple steps to reduce harvester fire risk. Grains Research and Development Corporation, https://grdc.com.au/Media-Centre/Media-News/South/2014/11/Take-simple-steps-to-reduce-harvester-fire-risk

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Photo 17: *A harvester fire in a chickpea crop. This fire took 5 minutes to destroy the harvester.*

(Photo: G. Cumming, formerly Pulse Australia)

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12.10 Assessing grain harvest losses

Grain can be lost at a number of places during harvest and each loss needs to be assessed so that corrective action can be taken. Figure 2 shows the three places where grain can be lost:

- before harvest due to pod shedding;
- at the harvester front due to the type of harvester front or set-up; and
- in the threshing system of the harvester, due to drum, concave and sieve settings.

To determine grain losses, the following action should be undertaken:

- Harvest a typical area then stop and allow the machine to clear itself of material.
- Reverse the harvester about 10 m and shut down the machine.
- Check for grain in each of the three areas:
  - » in the standing crop in front of the harvester (A);
  - » in the cut crop in front of the harvester (B); and
  - » in the cut crop behind the harvester including trash (C).

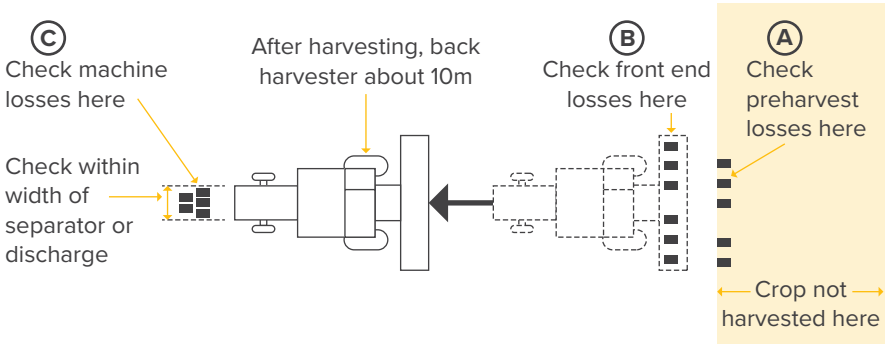

Figure 2: *Sampling places for grain losses at harvest.*

Sampling is best done using a quadrat with an area of 0.1 m^2:

- count the number of grains lying within each of 10 quadrats in each of the three locations; and
- average the 10 samples in each area.

Example:

Grain losses on the ground at each location (A, B and C) can be calculated using the 100 seed weights from the sowing rates in Section 4 Planting.

Lentil: 100 seed weight	= 5 grams
Grain on the ground	= 96 per quadrat (average of 10 quadrats)
Grain loss	= (seed/m^2) X (100 seed weight)
	= (96 X 5)
	= 480 kg/ha (or ~0.5 t/ha)

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12.11 Receival standards

The national receival standards for lentils are set by the pulse industry via Pulse Australia, and reflect the market requirements for a quality food product. Receival standards are set in order to achieve the export standards used by marketers and buyers internationally.

Variety types are segregated with only 1% off-type varieties allowed. Delivery requires low discolouration or staining of grain seed coat (1% maximum) and lentil kernel (maximum 1% poor colour), as well as low insect damage and breakages (defectives 3% maximum) and minimal foreign material or impurities (3% maximum).

Sizing through round and slotted screens may also occur. Failure to achieve these receival standards may mean price discounts, necessitate re-cleaning or even market rejection if severe. Local buyers may accept lentils that are 'out of specification', but only by arrangement and when it suits.

Table 5: Summary of lentil receival standards.

	Maximum moisture content (%)	Minimum purity (%)	Maximum defective plus poor colour (%)	Screen size for defective (mm)	Poor colour maximum (%)
Red lentil receival standard	14	97	4	2.00 or 2.2 slotted	1 seed coat 1 kernel
Green lentil receival standard	14	97	4	2.0 or 2.2 slotted	1 seed coat 1 kernel
	Unmillable material maximum	**Snail maximum**	**Insect maximum**	**Nominated weed seed maximums (maximums for each type)**	
Red lentil receival standard	0.5 (0.3% soil)	1 per 200 g	15 per 200 g	See nominated weed list below for weeds and amounts allowable	
Green lentil receival standard	0.5 (0.3% soil)	2 per 400 g	30 per 400 g	See nominated weed list below for weeds and amounts allowable	

Source: http://pulseaus.com.au/growing-pulses/bmp/lentil/southern-guide#marketing,-enduses-and-standards

Nominated foreign weed examples

- Type 1 (4 per 200 g): three-cornered Jack
- Type 2: (nil per 200 g): wild garlic, coriander and any other tainting agents
- Type 3a (1 per 200 g in total): Bathurst burr, caltrop
- Type 3b (2 per 200 g total): vetches (tares)
- Type 3c (4 per 200 g total): heliotrope
- Type 4a (10 per 200 g total): cut leaf mignonette, melilotus (if no taint), nightshades, skeleton weed, variegated thistle
- Type 5 (20 per 200 g in total): knapweed, salvation Jane
- Type 6 (5 seeds or pods total per 200 g) medic pods, marshmallow pods, saffron thistle, wild radish pods
- Type 7a (10 seeds per 200 g total): other pulses
- Type 7b (10 seeds per 200 g total): cereals, turnip weed, bindweed
- Type 7c (1 seed in total per 200 g): safflower, sunflower
- Type 8 (100 seeds per 200 g): bellvine.
- Small foreign seeds (0.6% by weight): amsinkia, canola, charlock, marshmallow seeds, hedge mustard, etc

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MORE INFORMATION

Information on lentil variety cross-contamination can be found here: http://pulseaus.com.au/growing-pulses/bmp/lentil/variety-cross-contamination

Definitions:

- **Defective grains:** includes poor-coloured, broken, damaged and split, shrivelled, distorted, grub-eaten, sprouted grain and grain affected by field mould. Do not include contrasting colours in designated varieties.
- **Poor colour:** if seed coat or cotyledon colour is distinctly blemished and/or off-colour from the characteristic colour of the predominant class, including the 1% visible Ascochyta.
- **Contrasting colours:** for designated varieties, contrasting colour of seed coat is seeds of the same variety that genetically has contrasting colours of seed coats.
- **Foreign material:** includes unmillable material and all foreign vegetable matter (includes cereals, wild oats, oilseeds, other legumes and weed seeds not otherwise specified).
- **Unmillable material:** includes soil, stones, metal and non-vegetable matter.

Standards

The most recent standards are available at Pulse Australia. Please see http://pulseaus.com.au/storage/app/media/markets/20160801_Pulse-Standards.pdf

Pulse Standards Review

The Pulse Standards Review Industry Consultation Paper was updated following a review of submissions and suggestions received by the Pulse Australia Standards Committee following the 2016 harvest.

This details various proposed changes to the Pulse Trading Standards, for implementation in the 2017-18 season.

Most changes are minor and directed at improving/clarifying interpretation.

Visual quality charts

Visual quality charts are available for growers to download at http://pulseaus.com.au/marketing/receival-trading-standards#current-standards.

These charts are designed to be used as a guide in conjunction with the current Australian Pulse Trading Standards.

Additional grade – cleaning grade

Some buyers or bulk storage operators offer a cleaning grade.

The cleaning grade allows:

- an increase in the maximum for total defective material to 11%; and
- a higher tolerance for foreign seed contaminants