NORTHERN
FEBRUARY 2017

GRDC GROWNOTES™

GRDC™ GRAINS RESEARCH & DEVELOPMENT CORPORATION

FABA BEAN

SECTION 12

HARVEST

IMPACT OF DELAYED HARVEST ON PROFITABILITY | IMPLEMENTING EARLY HARVEST MANAGEMENT | HARVESTING AND HEADER SETTINGS | MODIFICATIONS AND HARVEST AIDS | ACHIEVING A CLEAN SAMPLE | LODGED CROPS | ASSESSING GRAIN HARVEST LOSSES | HANDLING FABA BEANS | GRAIN CLEANING | GRAIN QUALITY | REFERENCES AND FURTHER READING

Harvest

Well before harvest, marketing plans need to have been developed and practices implemented to ensure that a marketable quality product is grown, harvested, delivered, stored and then marketed.

12.1 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, and hence price, can also suffer through mechanical damage or weathering and seed staining. 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% moisture and then stored in aerated silos or immediately graded and bagged. Crop desiccation with herbicides prior to crop maturity may reduce grain quality and seed germination.

Harvest delays in faba beans cost growers and the pulse industry a lot of money. In any production area, it is not unusual to see a spread of up to 4–6 weeks in the harvesting of faba bean crops planted on the same sowing rain. Many late-harvested crops reduced moisture content of ~8%, whereas the maximum moisture content for receival is 14%.

A grower's decision to delay faba bean harvest is usually influenced by the following factors:

- Faba bean harvest can clash with cereal harvest. Faba beans are still largely considered a 'secondary' crop, with wheat or barley taking precedence at harvest time.
- The possibility of achieving premiums for Prime Hard/Australian Hard wheat or malting for barley is also a major incentive for prioritising the cereal harvest, although in reality, the premiums for early harvested faba beans are often greater.
- The perception that faba beans 'weather' reasonably well is a fallacy (see later discussion).
- Uneven ripening of faba bean crops can occur if not desiccated or windrowed, especially when grown on heavy clay soils or variable soil types. Having a good even plant stand helps to keep the crop even as dry-down occurs prior to harvest.
- Faba beans are considered slower or more difficult to harvest. This does not have to be the case if desiccation is used, and the header is modified to suit them.

Faba beans are the most profitable winter crop for more growers, because they take a more professional approach to production and marketing, rather than treating it as a minor, secondary crop where it is 'planted last, harvested last, and sold to the nearest buyer'. [1]

12.1.1 Yield losses

Yield losses increase significantly the longer harvest is delayed.

1 Southern/Western Faba and Broad Bean—Best Management Practices Training Course 2012. Pulse Australia.

Although they are not normally prone to pod splitting and shelling out in all but extreme wet-weather conditions, faba beans are very prone to pod splitting and pod drop after weather events once the plant has dried down. Weathering of the grain can also occur in split pods.

Yield losses of up to 30% have been recorded in the field:

- It is estimated that grain losses due to a 2–4-week delay in harvest ranged from A$93/ha to A$238/ha, depending on seasonal conditions.
- Most of the losses were due to pod loss at the header front, or unthreshed pods lost out the back of the machine.

Lodging can increase the longer faba beans are left standing, and the risk is higher if the crop is high-yielding and has been planted on wide rows.

Loss of moisture below the National Pulse Receival Standard of 14% moisture content maximum:

- 500 t of faba bean at 14% grain moisture, valued at $450/t, is worth $225,000.
- The same grain harvested at 8% moisture delivers 470 t, so at $450/t is worth $210,600.
- This is a loss to the grower of $14,400. [2]

12.1.2 Deterioration in grain quality

Grain quality deteriorates the longer mature faba beans are left exposed to weathering in the field.

The seed coat of faba bean is very prone to cracking if it has been exposed to wetting and drying events due to rain or heavy dew. 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 field weathering and prolonged rainfall.

Faba beans that do not meet the Number 1 Receival Standard of 6% maximum defective beans will need to be graded.

This incurs a cost to the grower of:

- $15–25/t grading costs; and
- downgrading of the seconds into the stockfeed market at a value of $120–140/t.

Early harvested faba bean seed is much more resilient against breakage during harvesting and subsequent handling, even at low moisture contents.

Some faba beans are ultimately processed into dhal or flour by removing the seed coat (hull) and splitting the cotyledons. Visual appearance is still critical for marketing though. Older seed that is 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.

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

Faba bean seeds discolour and darken when exposed to field weathering. 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

2 Southern/Western Faba and Broad Bean—Best Management Practices Training Course 2012. Pulse Australia.

- cool–mild temperatures
- high humidity
- sunlight

Usually, there is no direct penalty or discount for a moderate degree of seed coat darkening; however, 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 other bean-exporting countries (France and the UK).

We are highly likely to see much greater segregation and premiums paid for lighter coloured, large-seeded faba bean 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 of fungi in late-harvested bean crops. Although *Alternaria* spp. usually predominate, *Asperguillus*, *Gladosporium* and *Penicillium* species may also be present.
- 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 Export Receival Standard for visible ascochyta 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 occasionally attack senescing faba beans, particularly where rainfall has softened the pod. Insect-damaged seeds are classified as defective beans, and they cannot exceed the tolerance level of 3%. [3]

12.1.3 Missed marketing opportunities

Delayed harvest often means that growers miss out on premiums paid for early-harvested crops of good quality. This is the case in most years, with the possible exception where major production problems have been encountered and there is a 'shorts' market place. Weathering and mechanical damage is also more likely in late-harvested crops.

Early harvest gives the grower some degree of control over how and when the crop is marketed, whereas late-harvested faba beans can often be 'price-takers' in a falling market or encounter delivery delays. [4] If the market starts to slide, many farmers will put the faba beans into storage and market them away from the harvest period, often content to leave them in storage until they get the price that they want.

In the northern region, ease of storage has meant that greater marketing has occurred throughout the season, more so than during harvest. Insect storage pests are not much of a concern or risk with faba beans.

12.2 Implementing early harvest management

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

These components include:

1. Sowing

3 Southern/Western Faba and Broad Bean—Best Management Practices Training Course 2012. Pulse Australia.

4 Southern/Western Faba and Broad Bean—Best Management Practices Training Course 2012. Pulse Australia.

- Sow at the earliest opportunity but within the preferred planting window for your area. Dry-sowing in the northern region is not a preferred option to try to get timeliness.
- Moisture-seeking equipment and/or press-wheels can significantly enhance seeding opportunities under marginal soil moisture conditions. The success of moisture seeking, particularly in marginal conditions, is increased greatly by running a set of Kelly discs (or something similar) over the paddock immediately after planting and prior to applying the residual herbicides. This seems to prevent drying out down into the disturbed soil and helps to achieve a more uniform establishment of the crop.
- Use adapted varieties that meet your target for early harvesting.
- Precision planters or machines with automatic depth control will often achieve more uniform plant establishment and crop development, and consequently more even crop maturity. This is particularly so when sowing into marginal soil moisture and drying conditions.

2. In-crop management

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

3. Harvest management

- Consider windrowing to enable earlier maturity and harvest date.
- Consider using a desiccant to dry late 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.
- Set up the header 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.
- Harvesting at 14% moisture content rather than 12% can effectively double the harvest period available on any one day in hot environments.
- Blend, aerate and/or dry the sample to the required receival standard of 14% moisture. [5]

12.3 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 need to be increased to ensure that weeds do not block the machine. Pulses 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 sieve settings should ensure a good sample (Table 1).

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 losses. If there are many weeds in the crop, then desiccation is advisable, to have all plants in the paddock dry for harvest.

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 generally cause less grain damage than conventional harvesters.

5 Southern/Western Faba and Broad Bean—Best Management Practices Training Course 2012. Pulse Australia.

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

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

The crop varies in height from 15 to 80 cm, with pods held up in the canopy. This means that 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. Faba beans thresh easily but are prone to cracking, so adjust thresher speed (400–600 rpm) and concave (10–30 mm) to suit. Removing alternate wires and blank-off plates from the concave will help to reduce cracking. If possible, cover the rasp bars with plate.

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

Harvest early, before summer weeds become a problem, to reduce clogging, staining and sample contamination. Desiccating the crop will kill summer weeds and ensure even crop-ripening.

As faba beans are destined for human consumption, a good sample off the header is usually required. [6]

Table 1: *Harvester settings for pulses.*

	Chickpeas	Faba beans	Green lentils	Red lentils	Lupins	Field peas	Vetch
Reel speed	Medium	Slow	Slow	Slow	Slow	Medium	Slow
Spiral clearance	High	High	Low	Low	High	Standard	Low
Thresher speed (rpm)	400–600	400–600	350–450	350–450	400–600	400–600	400–600
Concave clearance (mm)	10–30	15–35	20–30	10–20	10–30	10–30	10–30
Fan speed	High	High	High	High	High	High	Medium
Top sieve (mm)	32	32–38	32	16	32	25	25
Bottom sieve	16	16–19	8–16	3–10	16	16	10–16
Rotor speed[A] (rpm)	700–900	700–900	350–450	350–450	700–900	700–900	Slow

[A]Rotary machines only.
Source: Grain Legume Handbook.

12.4 Modifications and harvest aids

Early harvesting can solve many problems, and 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 amount of dirt, rock and sticks entering the harvester.

Early harvesting also means 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, weathering and disease.

A straw chopper may be of value to chop up the stubble and spread it uniformly. Crop lifters are not required unless the crop is badly lodged or late-sown and drought-affected.

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

Vibration due to 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.

6 Southern/Western Faba and Broad Bean—Best Management Practices Training Course 2012. Pulse Australia.

Grain loss can be reduced by harvesting in high humidity or at night to minimise pod shattering, and avoid 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. Four-finger guards with open second fingers also reduce vibrations (Figure 1).

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

Figure 1: *Four-finger guards to reduce vibration.*

Other options are available to improve pulse harvesting (Figures 2–5). [7]

Aussie-Air

Directs an air blast through reel fingers, and are suitable for both heavy and light crops.

The manufacturer claims an extra 15 horsepower is required to drive an Aussie-Air, but there is also a lesser horsepower requirement because of wider concave clearances. The actual horsepower required should be no more than for a heavy cereal crop.

Harvestaire

Replaces a 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 very important.
- An optional secondary fan to increase the air blast is worthwhile.
- The device is more effective in light crops.

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; its chief advantage is that this device is very cheap. It is more effective in light crops.

It is important to match groundspeed 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.

7 Southern/Western Faba and Broad Bean – Best Management Practices Training Course 2012. Pulse Australia.

Extension fingers

Plastic extension fingers, ~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.

Extended fronts

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

Platform sweeps

Platform sweeps are used in conjunction with extended fronts and they consist of fingers that rake material towards the auger to help eliminate bunching. They can also be used on conventional fronts.

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.

NB: Cost–benefits must be assessed, because a small area of pulses may not justify the cost of some of the above modifications.[8]

Figure 2: *Belt-front fitted with cross-auger.*

Photo: W. Hawthorne, Pulse Australia

8 Southern/Western Faba and Broad Bean—Best Management Practices Training Course 2012. Pulse Australia.

Figure 3: *Short fingers on a flex-front.*

Photo: Grain Legume Handbook

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

Photo: G. Cumming, Pulse Australia

Figure 5: *Harvestaire front combined with extension fingers and a blue vibra-mat.*

Photo: G. Cumming, Pulse Australia

12.5 Achieving a clean sample

Harvesting faba beans can be costly if debris such as stones, sticks or too much dirt is picked up with the beans. Machinery damage can be reduced by a variety of practices.

12.5.1 Rolling for harvest efficiency

Harvester damage may be reduced by rolling paddocks after sowing to flatten and firm soil and depress obstacles such as stumps and stones.

12.5.2 Perforated screens

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

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

12.5.3 Harvester speed

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

12.5.4 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. It is unwise to harvest faba bean at night unless using a pick-up front or some positive height control, which will stop the front from digging into the dirt. Some farmers have fitted wheels on the outer end of their fronts, as a depth-stop. Others have bought ultrasonic automatic depth controls to control header height.

12.5.5 Pick-up fronts

Pick-up fronts the same as or similar to those used for picking up windrows can be used to harvest windrowed faba beans. The pick-up fronts greatly reduce the amount of dirt 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.

12.5.6 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 lentil and field pea, but can also be used on cereals by locking the hinged sections together. [9]

12.6 Lodged crops

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

If sown 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. [10]

An even plant stand and the correct population density will minimise the impact of lodging at harvest time, because the plants lean on each other as they start to lodge and the header can usually still get under the lowest pods.

12.7 Assessing grain harvest losses

Grain can be lost at a number of points during harvest, and each loss needs to be assessed so that corrective action can be taken. Grain can be lost before harvest (due to pod shedding), at the harvester front (due to the front type or setup), and in the thrashing system of the machine (due to drum, concave and sieve settings) (Figure 6).

To determine harvest losses:

- Harvest a typical area without stopping the machine, then stop and allow the machine to clear itself of material.
- Back the harvester about 10 m and shut down the machine.
- Sample grain losses in each of the following three areas:
    - pre-harvest (i.e. in the standing crop in front of the harvester, 'A' in Figure 6).
    - front (in the cut crop in front of the harvester, 'B' in Figure 6).
    - machine (in the cut crop behind the harvester including trash, 'C' in Figure 6)
- Sampling is best done using a quadrat with an area of 0.1 m^2.
- Count the number of seeds lying within each of 10 quadrats in each of the three locations.
    - Average the 10 samples in each area. [11]

9 Southern/Western Faba and Broad Bean—Best Management Practices Training Course 2012. Pulse Australia.

10 Southern/Western Faba and Broad Bean—Best Management Practices Training Course 2012. Pulse Australia.

11 Southern/Western Faba and Broad Bean—Best Management Practices Training Course 2012. Pulse Australia.

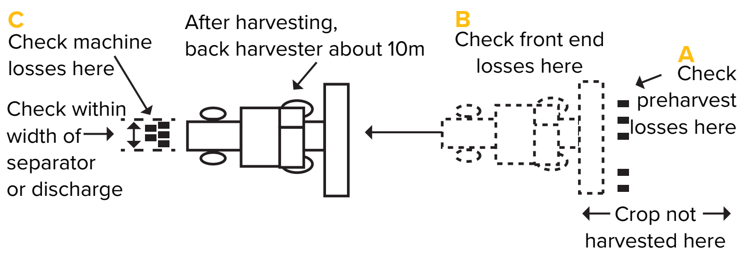

Figure 6: *Sampling places for estimating pre-harvest (A), front (B) and machine (C) losses.*

Source: The Chickpea Book

Example:

Grain losses on the ground can then be calculated, using 100-seed weights.

Faba bean: 100-seed weight = 60 g

Seed on the ground = 8 per quadrat

Seed loss = (no. of seeds/m^2) × (100-seed wt)
= (80 × 60)/10
= 480 kg/ha

12.8 Handling faba beans

Faba beans are a large, plump grain and are very prone to mechanical damage during handling. This especially applies to:

- overly dry grain (<10% moisture content)
- crops that have been exposed to weather damage prior to harvest

The use of tubulators or belt conveyors can reduce damage compared with conventional spiral augers.

Grain may be handled up to six times before delivery to receival points, so it is important to:

- minimise the number of handling stages where possible
- use efficient handling techniques that minimise damage

If using augers:

- Operate slow and full.
- Use large-diameter augers.
- The flight pitch should be greater than the auger diameter.
- Length of the auger should be no longer than necessary; the shorter the better.
- Keep auger incline as low as practical.
- Check flight-casing clearance. Optimal clearance is typically 50% of grain size to minimise occurrence of grain wedging between the auger spiral and the casing, and then cracking.
- Auger drives should be at the discharge end, and not on the intake.
- Putting a fine spray of water onto the stream of faba beans at the bottom of the auger is also used to reduce damage to the seed.

Approximate weight of grain stored in 1 m^3 of silo is shown in Table 2. The actual value can vary as much as 6–7% in wheat and barley and 15% in oats. In pulses, the variation is likely to be less (3–4%), and it will vary with the grain size, variety and season. [12]

Table 2: *Calculating silo capacities.*

Grain	Cubic metres	Weight (kg)	3-bushel bags
Broad beans	1	645	9.2
Chickpeas	1	750	9.2
Faba beans	1	750	9.2
Field peas	1	750	9.2
Lentils	1	800	9.2
Lupins	1	750	9.2
Vetch	1	750	9.2
Wheat	1	750	9.2
Barley	1	625	9.2
Oat	1	500	9.2
Example: silo of faba beans	67.4	50,550	620

Source: Grain legume Handbook.

Calculating the volume of a cylinder

Volume = area of base (diameter squared × 0.7854) × height

Calculating the volume of a cone

Volume = 1/3 (area of base × height)

12.9 Grain cleaning

Re-cleaning of samples after harvest is sometimes necessary. Cereals can be cleaned from most pulses (not lentil) with a 3- or 4-mm rotary screen. The 3.75-mm slotted screen is popular and will help screen out split grain. The paddles or agitators in rotary screens should be either new or sufficiently worn that the grain being harvested cannot jam between the outside of the paddle and the rotary screen.

Screens or paddles can be damaged beyond repair if the grain jams. Fitting the screens with a spacer will provide additional clearance and so avoid the problem.

Milk thistle buds can be difficult to separate if they contaminate the sample because they are similar in size and weight to peas. However, if desiccated or given time to dry, the buds disintegrate when put through an auger and can be easily separated.

Dirt and most small weed seeds can be separated in rotary screens; however, the dirt will increase component wear. [13]

12.10 Grain quality

It is extremely important to monitor the quality of grain before and during harvest. Seed coat and kernel (cotyledon) can be discoloured by crop-topping or premature desiccation in parts of the paddock if ripening is uneven. Staining of seed caused by green plants in the crop or admixture of splits, weeds, stones, etc., will reduce the value of your grain and can lead to rejection or dockages.

12 Southern/Western Faba and Broad Bean—Best Management Practices Training Course 2012. Pulse Australia.

13 Southern/Western Faba and Broad Bean—Best Management Practices Training Course 2012. Pulse Australia.

Visual appearance is vital. Human food markets demand a quality sample without cracking, staining, de-hulled seeds or insect damage. Pulse samples showing no header damage will always be more acceptable to a buyer. The large seed-size of faba beans makes them prone to mechanical damage. Minimising the number of times augers shift grain around helps to reduce mechanical seed damage.

Grain quality is at its highest when first loaded into storage but can steadily deteriorate if the storage environment is not well managed. A combination of good farm hygiene, storage choice and aeration cooling are important keys for maintaining grain quality and overcoming many problems with pests associated with storage.

Critical/key points to remember with regard to storing pulses are:

- Pulses stored at >12% moisture content require aeration cooling to maintain quality.
- Meticulous hygiene and aeration cooling are the first lines of defence against pest incursions.
- Fumigation is the only option available to control pests in stored pulses; it requires gas-tight, sealable storage.
- Avoiding mechanical damage to pulse seeds will maintain market quality and seed viability, and be less attractive to insect pests.

Growers contemplating medium–long-term storage (6–12 months) need to be aware that faba beans continue to age, and quality will deteriorate in sunlight and over time.

All faba beans will darken considerably in storage, and the rate of seed-coat darkening (deterioration in grain colour) will be accelerated by:

- high seed moisture content
- high temperatures
- high relative humidity
- condition of the seed at harvest
- sunlight.

To maintain lighter seed coat colour and minimise darkening of seed, any pulses stored at >12% moisture content will require aeration cooling to maintain quality.

Mature seed subjected to field weathering prior to harvest will deteriorate quickly in storage, even if stored under 'acceptable' conditions of temperature and relative humidity.

Growers should avoid even short–medium storage of weather-damaged grain.

Pulse grain with high germination and vigour when placed in storage can remain viable for at least 3 years, providing the moisture content of the grain does not exceed 11% and cool grain temperatures are maintained.

Storage life of pulses is determined by temperature, moisture content, insects and diseases. Careful management of these factors is critical to avoid deterioration during storage.

After grain enters storage, it needs regular monitoring, which allows early action and intervention if insect or grain quality issues arise. Monitoring grain at least monthly for insects, moulds, grain temperature and moisture should be standard practice.

MORE INFORMATION

GRDC Fact Sheet, 'Storing pulses': https://grdc.com.au/Resources/Factsheets/2014/07/Grain-Storage-Fact-Sheet-Storing-Pulses

Moisture

Pulses harvested at ≥14% moisture must be dried before going into storage to preserve seed germination and viability. As a rule, every 1-percentage point rise in moisture content above 11% per cent will reduce the storage life of pulse seed by one-third. Any pulse stored above 12% moisture content will require aeration cooling to maintain quality.

Temperature

High temperatures in storage will cause a decrease in grain viability. Temperatures of stored pulse grain should not exceed an average of 25°C, and preferably the average temperature should be <20°C. In general, each 4°C rise in average stored temperature will halve the storage life of the grain.

A practical way of reducing temperatures is to paint the silo white; dark-coloured silos will absorb more heat.

Painting a silo white is practical way of reducing the temperature of stored grain next to the silo walls and in the silo headspace area. Dark-grey walls on silos will absorb more of the sun's heat. Grain is a good insulator against heat transfer, so the sun's heat on the north and west walls of the silo plus the roof does not penetrate much further than 30 cm beyond the silo wall.

Grain in large silos (>75 t) will remain cooler because grain is a poor conductor of heat, and day–night temperature fluctuations rarely reach 15 cm beyond the silo wall. Small silos (<20 t) and field bins will have larger temperature fluctuations and this can cause deterioration in grain quality.

Therefore, combining aeration cooling plus white paint or bright, reflective surfaces on small silos storing planting seed or other grains has benefits.

12.11 References and further reading

L Caddick (2000) Sound storage eliminates post-harvest blues. Farming Ahead No. 101, May 2000,

GRDC (2008) The Grain legume handbook. Grain Legume Handbook Committee/GRDC, https://grdc.com.au/uploads/documents/Index.pdf.

GRDC (2010) Aeration cooling grain. Grain Storage Fact Sheet, September 2010. GRDC, http://www.grdc.com.au/uploads/documents/GRDC_FS5_AeratCooling_lr.pdf?shortcut=1

GRDC (2010) Hygiene and structural treatments for grain storages. Grain Storage Fact Sheet, September 2010. GRDC,

GRDC (2010) Pressure testing sealable silos. Grain Storage Fact Sheet, September 2010. GRDC, http://www.grdc.com.au/~/media/0218DA4A22264A31B6202718043758DE.pdf

GRDC (2011) Aerating stored grain: Cooling or drying for quality control. A Grains Industry Guide. GRDC, http://www.customvac.com.au/downloads/GRDC_Aeration_Book_2011_LR.pdf

GRDC (2011) Dealing with high-moisture grain. Grain Storage Fact Sheet, November 2011. GRDC, http://www.grdc.com.au/~/media/2F0FBF97222B4683BDD6A53ACC9DB799.pdf

GRDC (2011) Fumigating with phosphine, other fumigants and controlled atmosphere. January 2011. A Grains Industry Guide. GRDC, http://www.grdc.com.au/uploads/documents/GRDC-Fumigating-with-Phosphine-other-fumigants-and-controlled-atmospheres.pdf

GRDC (2011) Stay safe around grain storage. Grain Storage Fact Sheet, September, 2011. GRDC, http://www.grdc.com.au/~/media/1534CEFD164B4D7C84BDB2B9484CBF1E.pdf

GRDC (2012) Performance testing aeration systems. Grain Storage Fact Sheet, August 2012. GRDC, http://www.grdc.com.au/Resources/Factsheets/2012/08/Grain-Storage-performance-testing-aeration-systems

GRDC (2012) Storing pulses. Grain Storage Fact Sheet, March 2012. GRDC, http://www.grdc.com.au/~/media/625BF9EDEF784496B7F54767EA2A4158.pdf

GRDC (2012) Successful storage in grain bags. Grain Storage Fact Sheet, March 2012. GRDC, http://www.grdc.com.au/Resources/Factsheets/2012/03/Grain-Storage-Fact-Sheet-Successful-storage-in-grain-bags

GRDC (2012) Vigilant monitoring protects grain assets. Grain Storage Fact Sheet, March 2012. GRDC, http://www.grdc.com.au/~/media/F9B0CA23032242DCAED609EEEA0A4C6F.pdf

P Matthews, D Holding (2004) Managing faba bean harvest. Proceedings of Bean Focus 2004. pp. 100–103.

Pulse Australia (2010) Grain bags for pulse storage—use care. Pulse Australia Bulletin, http://www.pulseaus.com.au/storage/app/media/crops/2010_APB-Pulse-grain-bag-storage.pdf

M Richards, S Wentworth (2004) Managing early harvest and white snails in beans. Proceedings of Bean Focus 2004. pp. 105-107.

Stored Grain Website – Information Hub: http://www.storedgrain.com.au