Timing all important in boosting quality

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Time of harvest and safe storage play a major role in improving the marketability of pulse seed by preventing yield losses and maintaining quality.

After a crop has fully matured in the field, delaying harvest until it reaches moisture receival limits, especially in seasons when weather conditions are not ideal, can result in substantial yield losses.

Weathering of the mature crop can severely reduce seed quality through loss of viability and discoloration. Increases in splitting of mechanically harvested seed and poor seed size uniformity can also result from delays.

Safe storage is also important to maintain the physical and processing quality of pulses. Key factors influencing the quality of pulses during storage are the initial condition of the seed, moisture content at the time of harvest, grain temperature and storage length.

A research team at CSIRO's Stored Grain Research Laboratory at Canberra and New South Wales Agriculture at Wagga Wagga investigated the effect of harvest and storage issues on field peas, lupins and chickpeas, focusing on the effects of different harvest times and harvesting techniques on yield and seed quality.

Harvesting techniques

The impact of harvest timing on yield and quality of field peas was assessed at Wagga. NSW, using the pea varieties Jupiter and Bohatyr. The crops were machine harvested at three different times — at the earliest possible time that the header could thresh the seed, 'on-time' when seed had reached 14-15 per cent moisture content, and late (two weeks after the on-time harvest).

Beth Field

Trials with lupins have shown harvesting early and storing seed at a higher moisture content reduces seed deterioration compared with waiting for moisture levels to drop to 12% before harvesting.

The optimum time to start machine harvesting was found to occur when seed had dried to a moisture content of 15%.

Delays in harvest and further drying of the pod and seed resulted in substantial losses due to pod drop and shattering (see Table 1).

A 15-day delay during a rain-affected harvest resulted in 24% of the Bohatyr crop (one tonne/ha) being lost to shattering. This loss would have been higher had the crop been left standing until the seed dried from 13.8% to below 12% moisture content.

Generally, pulse quality fell in tandem with increased delays in harvest. Germination decreased, the seed became bleached due to weathering, field mould infection increased and field peas became more susceptible to breakage. The extent of these quality changes varied with variety and harvesting technique.

Earlier harvesting of seed at higher moisture contents would allow pulses, especially field peas, to be taken off before the start of the barley and wheat harvest. Pulse harvesting is often delayed because growers give preference in their schedules to cereal harvesting.

But the consequent weathering and drying of the pod and seed result in lower yield and quality.

For pulses that were machine harvested, the highest yields and seed quality were obtained when the plants were harvested fully mature, with a seed moisture content of about 15%.

Windrowing and desiccation are management options which will allow harvesting to be carried out at the earliest possible time.

Windrow and desiccation investigations at Wagga showed yields were highest when these operations were conducted at moisture contents between 30% and 50%. Windrowing lupins as early as 50% moisture content maximised yield and seed quality. Field peas required a longer time for seed filling and colour uniformity.

Storage considerations

Laboratory trials with field peas and lupins showed that at a storage temperature of 35 degrees Celsius, seed quality rapidly deteriorated. Higher moisture content seed stored at 27^{o}C deteriorated at a slower rate. Seed stored at 20^{o}C and 13% and 14% moisture content for lupins and field peas respectively, showed no loss in viability or increase in mould levels during a 10-month storage period.

The colour of pulses, important for determining the marketability and value of the commodity for human consumption, was found to change with increased temperature, moisture content and time in storage. Colour degradation was greater in the field peas, especially the green-hued variety Jupiter.

Storage trials carried out on desi-type chickpeas showed the colour of the seed coat

in brief

- Harvesting pulses earlier will improve yield and quality
- Early-harvested, high moisture seed may need cooling or drying to maintain quality and meet market demands.
- Premium quality pulse seed stores better than weathered, late-harvested seed.

TABLE 1 Machine harvest yields and losses of field peas

Variety	Harvest time (weeks)	Moisture content (% w.b)	Header yield (t/ha)	Unthreshed pod yield (t/ha)	Shatter on ground Before Harvest (t/ha)	Shatter on ground After Harvest (t/ha)	Total potential yield (t/ha)	Harvest loss (%)	Economic loss ($/ha)
Jupiter	0	20	3.9	0.01	0	0.2	4.1	5	52
	1	15.2	4.2	0	0	0.32	4.5	7	82
	3	14.1	3.4	0	0.19	0.37	4	15	151
Bohatyr	0	20.1	4	0.01	0	0.2	4.2	5	52
	1	15.5	4.5	0	0	0.32	4.8	7	81
	3	13.8	3	0	0.34	0.63	4	24	241

* Yield measures on a dry basis.
* Economic loss is based on the estimate of price per tonne at $225/tonne and a seed moisture content of 12%.

Harvest and storage...

darkened under more extreme temperature and moisture conditions.

Breakability of the field peas was not affected by time in storage, but by the repeated wetting and drying of the seed before harvest. Weathered peas were shown to be more susceptible to breakage during handling and the quality of splits was reduced.

To determine the seed quality and handling advantages of receiving field peas at a higher moisture content, trials were held at South Australian Co-operative Bulk Handling's Wallaroo terminal. More than 2500 tonnes of peas were received at an experimental limit of 12-13.5% moisture and stored without aeration for six months.

Inloading and out-turn seed quality and handling characteristics of high moisture peas were compared with deliveries received up to the current 12% standard limit (see Table 2).

Post-harvest breakage was similar for early-harvested high moisture receivals, compared with lower moisture peas.

Late-harvested peas showed a three-fold increase in post-harvest breakage, suggesting that harvest delays increase post-harvest breakage to a greater degree than seed moisture content.

Late-harvested peas contained far more small seeds due to lower moisture content. At out-turn, the field peas received and stored at higher moisture levels showed improved handling characteristics, producing lower dust levels compared with late-harvested, lower moisture seed.

Requirements for safe storage

Low temperatures and seed moisture contents provide safe conditions for the long-term storage of pulses. Temperature and moisture interact to determine the speed of quality deterioration.

Storage experiments on field peas and lupins suggested a range of safe storage limits for both crops in short and long-term situations (see Table 3).

Dry seed (10% moisture content or less) stores well at storage temperatures up to 30^{o}C, but delaying the harvest to achieve this dryness can result in substantial yield and quality losses.

Pulses harvested at moisture contents at or more than 14% will require careful management during storage. The use of aeration is recommended to reduce and provide a uniform storage temperature.

The susceptibility of pulses to break during handling means there needs to be minimal disturbance during storage.

Conditions are ideal for moisture movement in undisturbed bulks and potential problems may arise with localised moisture damage and moulding.

Regular checks of the bulk surface are therefore essential during prolonged storage.

TABLE 2 Breakability and seed size of Dun type field peas received 1997-98

Date of receival	Average receival moisture content (%)	Breakability (%)	Seed Size Screen aperture (mm) 7	6	less than 6
High moisture receivals (12%-13.5%)					
10-20/11/1997	12.4	0.9	45.6	44	10.4
Low moisture receivals (less than 12%)					
12-20/11/1997	10.9	1.1	32.8	47.8	19.5
11-19/12/1997	8.6	3.1	12.9	50.8	36.3

* All grain received at the Wallaroo grain terminal, South Australia.
* Breakability determined using a modified Steinlite maize breakage tester.

Improved yield and quality

Harvesting pulses earlier will improve yield and quality, but the actual time to harvest depends on prevailing weather conditions. In general, pulse seed should be harvested at a moisture content that minimises yield loss and deterioration in quality.

Delays in harvesting following harvest ripeness can result in lower quality due to weathering and substantial deterioration occurs when wetting takes place 'on the stalk'.

Early-harvested, higher moisture seed may require cooling or drying to maintain quality or to meet marketing demands, and the extra cost of such measures will need to be weighed against the extra return from reduced harvest losses, a lower probability of weather damage and better quality seed.

Premium quality pulses store better than weathered, late-harvest seed (when held under similar conditions).

Improved storage, handling and processing characteristics of premium quality pulses provides benefits to storers, marketers and processors.

The experimental higher moisture content receival limit established at Wallaroo resulted in the acquisition of premium quality field peas that were stored unaerated for six months without any quality loss. In this case, no additional management was needed to receive and store the better quality seed.

Pulse growers in the Wallaroo area were fully supportive of a moisture receival limit that allowed harvesting of their pea crop before cereals had reached harvest ripeness.

Recommendations

The studies have resulted in several recommendations which concern not only growers but the industry as a whole.

Research suggests the moisture content receival limit for field peas should be increased to allow earlier harvesting and delivery of premium quality seed, particularly where aeration facilities are available to actively cool higher moisture pulses.

The results indicate the current 12% standard for field peas can cause considerable delays in harvesting ripe seed, resulting in substantial yield and quality losses.

Moisture damage and moulding in undisturbed bulks is a concern to commercial storers and is a major issue to be investigated before any recommended increase in the industry receival limit for field peas.

There needs to be a premium to encourage growers to adopt changes in harvest management, such as the use of driers and aeration, including in-bin drying, to reduce the cost of yield and quality losses.

The strengthening of domestic and export markets and the establishment of national quality standards are likely to provide greater incentive to improve yield and quality.

Further studies are needed to quantify the benefits from windrowing and desiccation harvest processes.

There is evidence that given the right conditions, higher yields and better quality seed can be obtained using these methods.

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TABLE 3 Suggested maximum moisture content for field peas and lupin storage

Pulse type	Storage temperature (degrees C) 20		3	
	Storage Period (months) 3	10	3	10
Field peas varieties				
Jupiter	14	13.5	13.5	12.5
Bohatyr	14	13.5	13.5	12.5
Lupins varieties				
Merrit	14	13	13	12
Kiev mutant	14	13	13	12
Ultra	14	13	13	12