High moisture levels increase yield and quality

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Early harvesting has the potential to increase yields and grain quality in Australian grain-growing areas.

In some areas, harvesting at higher moisture levels could give yield increases equivalent to more than 10 years progress in plant breeding, at present rates.

But harvesting grain with a higher moisture content increases the risk of degrading post-harvest quality and the grain needs careful in-store management. Growers need to consider carefully the economics and manage risk to maximise the benefits.

Traditional harvesting

Most grain in Australia is harvested after it has been sun-dried in the paddock to acceptable receival moisture levels. This method has been successful in the past but research has shown it may no longer be the optimal practice. Growers in some areas can benefit from harvesting cereals and pulses at higher moisture levels.

When the grain in the standing crop reaches maturity it loses contact with the mother plant and nutrients are no longer transferred to the grain. The seed is isolated and at the mercy of the elements, protected only by pods or husks. The seed is sensitive to weather and rapidly loses water in response to the sun's warmth and the prevailing temperature, wind and humidity. Grain moisture at maturity is about 25 per cent but the seed dries rapidly to a level which may or may not be below receival limits.

Most seed changes post-maturity result in a loss of grain quality. A few of these are beneficial, including breaking dormancy in malting barley and changes in dough properties of some wheat varieties.

Ideally, grain would be harvested immediately after maturity to capture peak quality. But most often, grain is harvested with reduced quality due to:

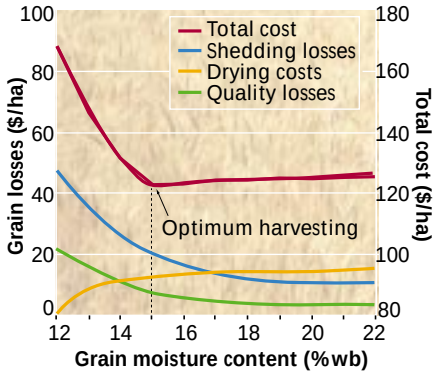
- A range of maturity levels in a single crop.
- The practicalities of harvesting and use of harvest machinery.
- Storability of the harvested grain.
- Processor requirements.
- Market expectations.

TABLE 1 Moisture and harvest hours*

Moisture content (% water-weight) limit	average	Harvest time available (hours)
12.0	10.8	150
13.0	11.5	230
14.0	12.1	310
16.0	13.1	445

* Effect of raising receival moisture content on available harvest hours. This model is for wheat harvested in the northern wheatbelt of eastern Australia.
Source: CSIRO

FIGURE 1 Effect on overall costs*



*Effect of harvesting wetter grain on costs. Harvesting at the optimum point to give 12% moisture.
Source: Abawi

Of these, the current dominant factors affecting harvest are grain storability and market expectations. World grain prices and the demand for Australian grain includes the expectation that buyers are paying for more grain and less water per tonne compared with grain from competing suppliers. This expectation underpins the current 12.5% wheat receival standard.

Receival moisture standards are limits, not averages. Delivery at a maximum of 12.5% means the average moisture content of received grain is less than 11%. These levels ensure the grain is received in a state dry enough to prevent it from going mouldy in store, maintaining Australia's reputation as a supplier of premium quality dry products.

Many grain growers can usually meet moisture limit receival standards with ease but this is more difficult in northern New South Wales and Queensland, and southern Australia from Geelong, Victoria, to Dongara, Western Australia, within 50 kilometres of the coast.

Effects of harvest delays

In northern NSW and Queensland, thunderstorms and high humidity are common during harvest and restrict dry grain harvesting. In coastal areas afternoon sea breezes raise grain moisture content to above the moisture limit. Growers manage these conditions by delaying harvesting until the grain is sufficiently dry. The consequences of this delayed harvest are:

- Loss of dry matter in the head post-maturity of 0.5-1.0% per day.
- Risk of weather damage in the northern wheatbelt, which results in downgrading of an average 18% per year.
- Typical losses of 10-30% from field pea crops from waiting for dry-down to meet receival standards.
- Loss of up to 0.3% protein per week in wheat post-maturity.

Growers using harvesters fitted with yield monitors will quickly confirm in-head losses from delays are substantial. The risk of having a load downgraded from high moisture may be averted but these high yield losses of 4-7% per week can surprise some growers.

Models of harvesting at different moisture levels show the optimum harvest time is when moisture content is about 16% followed by post-harvest drying to give a storable and marketable product (see Figure 1). Actual figures vary with harvesting capabilities and crop area but it is clear there are substantial benefits to be gained from harvesting earlier.

Using weather data, it is possible to calculate optimum harvest hours at particular localities to capture grain at or below a set moisture content. To meet a 12.5% limit from the paddock, harvesting hours are typically restricted to four hours or less per day in southern coastal areas.

But a substantial increase in available harvest time occurs as the maximum harvest moisture is raised, though average crop

Timing and storage...

TABLE 2 Benefits and pitfalls of harvesting grain at high moisture levels

Pitfalls	Benefits
Storing and handling more water	Decreased weather risk
Increased insect risk in store	Reduced in-head quality and yield losses
Increased mould and moisture migration in store	Reduced harvesting losses
Decreased storage life of grain	Better use of harvesters
Inability to meet market requirements	Improved harvest scheduling with crops of differing maturities
Mechanism needed to compensate for storage risks	Improved bulk grain quality
Post-harvest grain conditioning is often expensive	Assists cropping in high rainfall areas
	Increased reliability of supply of high quality grain
	Opportunity for value adding in-store

Source: CSIRO

moisture remains at less than 12.5% with continuous harvesting.

Simulations for summer harvested grains in the northern areas of NSW and Queensland show similar effects, although the average bulk moisture exceeded 12.5% at about 15% limit of harvesting (see Table 1, page 39).

Grains harvested during autumn can, on average, be much closer to the moisture limit as humidity can remain high through the day.

The rice industry in NSW faces this problem with rice received at up to 22% moisture being routinely dried in-store.

Late-planted sorghum harvested during April and May is unlikely to meet receival limits in many seasons and post-harvest drying is often necessary. But for growers to receive maximum benefits, the benefits of wetter harvesting must be reconciled with storage and market needs (see Table 2).

Active storage

One approach is to consider storage as an active process. This involves harvesting grain at optimum moisture levels (to maximise yield, quality and profitability) and then reducing moisture to meet market requirements.

The higher the moisture, the greater the post-harvest risks of quality loss, which would generate extra costs.

But active storage also gives handlers and storers an opportunity to carry out a value add to the grain.

Active storage could also be coupled with blending to produce grain to meet market requirements.

The technology for handling and drying wet grain is now well established in Australia and is routine overseas. Purpose-built driers are often expensive to buy and run but are one available option.

On-floor (drying on the floor of the store) and in-bin drying is used by the rice industry and is being actively considered for other grains and pulses.

Air flow rates needed for grain aeration-drying are typically 10 times that needed for grain aeration-cooling, with modified control regimes.

Some growers and handlers may be able to sell or use high moisture grain without the expense and effort of drying.

Already some growers blend their own grain to meet moisture receival specifications. Red wheat growers in Tasmania harvest at high moisture contents and feed or sell the grain as stock feed soon after harvest.

Windrowing and desiccation also will assist growers to capture the advantage of high-moisture harvesting.

Storage limits for cereals

The hotter and wetter the grain the higher the storage risk. Under Australian conditions, grains with more than 16% moisture need to be dried within a few days of harvest to prevent spoilage.

Cooling also may be necessary to prevent spoilage while waiting to meet dryer capacity. Growers can also blend or set up on-floor drying.

At 14-16% moisture, cereals need cooling to less than 20 degrees Celsius to be stored up to one month. If a longer storage period is needed moisture will need to be reduced.

At 12.5% most moisture cereals can be stored for years with grain aeration-cooling only. At less than 12.5%, robust cereals such as wheat can be stored without cooling in most areas.

But cooling may retain grain quality and assist in the suppression of storage pests. At all moisture contents, adequate storage and pest management are needed to maintain optimum grain quality.

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For information on grain aeration see *Farming Ahead* No. 93, page 53.