Harvesting

High moisture levels increase yield and quality

by Jonathan Banks, CSIRO

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.

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:

- 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

### TABLE 1 Moisture and harvest hours

<table>
<thead>
<tr>
<th>Moisture content (% water-weight)</th>
<th>Harvest time available (hours)</th>
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</thead>
<tbody>
<tr>
<td>limit</td>
<td>average</td>
</tr>
<tr>
<td>12.0</td>
<td>10.8</td>
</tr>
<tr>
<td>13.0</td>
<td>11.5</td>
</tr>
<tr>
<td>14.0</td>
<td>12.1</td>
</tr>
<tr>
<td>16.0</td>
<td>13.1</td>
</tr>
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*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*

![Graph showing the effect of harvesting wetter grain on costs.](image)

*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.

### Table of moisture and harvest hours

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### Figure 1: Effect on overall costs

- **Total cost**
- **Drying costs**
- **Quality losses**
- **Drying costs**

![Graph showing the effect of harvesting wetter grain on costs.](image)

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### 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.
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.

### 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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### Pitfalls and benefits of harvesting grain at high moisture levels

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

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