Cool and dry conditions maintain canola quality

It is commonly acknowledged that canola and oilseeds are more difficult to store successfully than cereal grains. But CSIRO Entomology researcher Len Caddick explains how by keeping cool, farmers can reduce the risk and maintain the seed quality of canola in store.

Keeping grain cool and dry is the key to successful canola storage on-farm.

The extent and rate of deterioration of canola seed and oil quality depends on storage temperature, relative humidity, seed moisture content, length of storage and initial seed quality.

Poor storage conditions can cause heating and, in extreme cases, canola can spontaneously ignite. Spontaneous combustion is infrequent and results from a lack of understanding of canola storage.

CSIRO and the Australian Oilseeds Federation Incorporated (AOF) recommend canola is stored 'cool and dry'. Maintain an in-store temperature of less than 25 degrees Celsius, preferably at 20°C.

Ensure the average moisture content of the bulk is less than seven per cent, and maintain moisture levels even lower at oil contents of more than 42%, wet basis. In optimum conditions, no moulds will develop and seed and oil quality will be maintained.

Harvest conditions

To aid successful storage, harvest canola at less than 7% moisture content. Spoilage of oilseeds is primarily the result of heat but excessive moisture leads to rapid heating.

A ripe canola crop varies in moisture and oil content and this influences how well seed can be stored. Harvesting at less than 7% moisture content will account for variability across the paddock, and ensure any high moisture seed is mixed with drier seed in storage.

Windrowing or swathing is commonly used to hasten and even out the drying rate of ripe canola. Windrowing can also reduce pre-harvest losses due to pod shatter. But windrowed seed is prone to rain damage and also tends to dry excessively during hot, dry weather which can increase losses due to shatter at harvest. Direct harvesting of a standing crop can result in higher average moisture in individual loads.

Scott Boyle

By harvesting canola at less than 7% moisture and keeping storage conditions cool and dry, seed quality can be maintained for extended periods.

Seed temperature

Bulk seed is a poor conductor of heat. When canola is harvested at high temperatures and placed in storage, the seed will remain warm for a considerable time, resulting in oil quality losses. Warm areas in a seed bulk may lead to rapid heating, especially in canola stored at high moisture levels.

Windrowing can result in seed harvested at temperatures of more than 35°C. Commercial storers generally will not receive canola where seed temperature exceeds 35°C. This upper limit for seed temperature reduces the amount of heat operators are required to remove from the seed bulk to ensure a safe temperature in storage.

Apply the same principle when storing canola on-farm. Reducing the average grain temperature of freshly harvested canola placed into storage will increase the efficiency of cooling using aeration.

Oil content and storability

The safe storage of canola is influenced by relative humidity, moisture, oil content and temperature. The equilibrium relative humidity of canola is the point at which there is no exchange of moisture between the seed and surrounding air.

Moisture in a canola bulk will tend to redistribute to achieve equilibrium. Equilibrium relative humidity largely influences heating and deterioration of stored canola due to biological activity; for example, mould development is prevented at less than 65% equilibrium relative humidity.

The relationship between seed moisture content and equilibrium relative humidity is temperature-dependent. Seed temperature and oil content determine the equilibrium relative humidity of stored canola.

Where canola at 45% oil content is received into storage at 7% moisture content, the equilibrium relative humidity will be higher and the seed less storable at 30°C compared with 20°C.

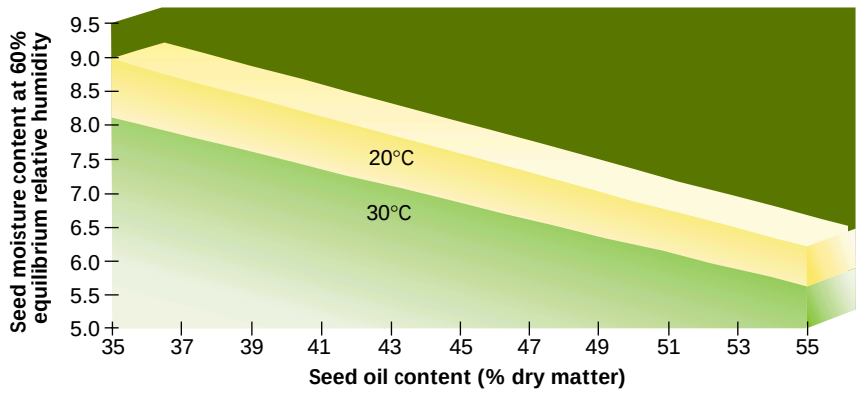
The temperature dependence of equilibrium relative humidity (ERH) is the essence behind the message that canola has to be stored 'cool and dry'. Figure 1 shows potential unsafe storage limits for Australian canola varieties at 60% equilibrium relative humidity, and 20°C and 30°C. Safe storage conditions are indicated in the area beneath the lines shown in Figure 1. High oil content seed requires lower moisture levels to obtain a similar storability.

For example, at 20°C, canola with oil content of 35% can be stored safely at 9% moisture content. As oil content increases,

in brief

- Premium-quality canola will have high oil content, low free fatty acid (FFA) level, good oil colour, no chemical residues and freedom from insect pests, moulds and mycotoxins.
- Storing canola at low temperatures and moisture contents will reduce storage risk and maintain oilseed quality.
- To aid successful storage, harvest canola at less than 7% moisture content. High oil-content seed requires lower moisture levels to obtain a similar storability.

FIGURE 1 Potential unsafe storage limits for canola at 60% ERH, 20°C and 30°C



Source: CSIRO Entomology.

Storage...

the recommended safe moisture level at 20°C decreases. Where canola with an oil content of 50% is stored at 20°C, the safe moisture level is 6.3%.

The influence of temperature is also shown in that there is about a 1% difference in the safe moisture content recommended for canola stored at 20°C, compared with 30°C (see Figure 1, page 51). Lower seed temperatures enable seed at higher moisture and oil contents to be stored safely.

The oil content of canola received into central storage is extremely variable. Canola variety and climatic conditions during seed development influence oil content.

Similar to moisture content, oil content will vary within a ripe canola crop and time of harvest will influence the oil content of the seed, with a decrease with time.

The oilseeds industry will be increasingly challenged to store the burgeoning canola crop safely, particularly in view of possible carryover stocks and the upcoming release of new canola varieties with oil content of up to 50%.

Cereals versus oilseeds

Cereals only contain about 2% by weight oil, compared with current Australian varieties of canola which contain up to 48% (dry basis). Minimal amounts of moisture are absorbed by the oil fraction. The large amount of oil contained in oilseeds compared with cereals influences moisture measurement carried out on a whole seed basis.

In moisture studies for canola, the moisture content is converted to an oil-free basis. Using this conversion for moisture, equivalent moisture content for canola with 45% oil content, compared with wheat at 12.5%, would be 22.7%. On an oil-free basis, the established industry 8% receival limit for canola with 45% oil content would be equivalent to 14.5% in wheat.

Insect control

Stored canola is prone to insect attack, particularly at the surface of the grain bulk.

Bulk storage of canola for prolonged periods is relatively recent. Insect infestation appears to be an increasing problem, with the rust-red flour beetle (*Tribolium castaneum*) frequently infesting the surface of canola bulks. The warehouse beetle *(Trogoderma variabile)* is also a potentially important pest of canola.

Only two products are registered for insect control in canola: phosphine and pyrethrin.

Phosphine treatment of stored canola: will only be effective when used in adequately sealed silos. Adhere to the safety procedures, dosage rate and exposure time specified on the label. Phosphine does not control insects effectively when seed temperatures fall to less than 15°C. An initial fumigation using phosphine soon after harvest, followed by cooling using ambient aeration, will maintain canola insect-free and retain harvest quality.

Cooling using ambient aeration has limitations as a sole method of insect control. Seed temperatures at the boundary layers of the bulk will remain higher and more vulnerable to insect infestation during warmer months. Aerating canola is more difficult than cereals due to the higher resistance to airflow in the seed bulk. An aeration system dedicated to canola is needed.

Mould development

Moulding in canola can occur where relative humidity exceeds 68% and temperatures are favourable for mould growth (more than 20°C). CSIRO recommends 60% relative humidity as a safe level for long-term canola storage.

Due to the variability of oil content in freshly harvested canola, it is likely some regions in a bulk will have higher relative humidities than others. A safe level of 60% relative humidity is well below the moisture levels needed for growth by the most tolerant species of spoilage moulds, and accounts for variability in relative humidity within seed bulks.

At temperatures less than 20°C mould growth is curbed. If short-term storage (up to seven days) of high moisture content canola is unavoidable, then store seed at low temperatures until drying or blending with drier seed is possible.

Storing at higher moisture

In-store drying using a fan with a high airflow rate is an option to dry canola. Equipping a silo with an aeration system that can effectively dry and cool grain during storage provides more flexibility in timing the harvest.

An aeration system, that has a capacity to deliver a high airflow rate of more than 15 litres per second per tonne, is needed to reduce moisture levels in early harvested oilseeds where moisture contents higher than the industry's 8% maximum receival limit are expected.

Airflow rates needed for aeration-drying of oilseeds are typically 5–10 times higher than that needed for aeration-cooling, with specific control regimes. Ambient conditions and type of controller will largely influence the rate that moisture can be removed.

Inspect damp canola regularly for signs of deterioration during storage. The aim of drying is to prevent mould development, heating and loss of quality. Oil quality can deteriorate rapidly in moist canola so it is important to remove moisture and reduce temperature quickly.

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The highs and lows of oilseed quality

Efficient management practices during crop growth, harvesting and storage are critical to produce premium-quality canola.

In general premium-quality canola will have high oil content, low free fatty acid (FFA) level, good oil colour, no chemical residues, and freedom from insect pests, moulds and mycotoxins.

There is a maximum limit of 1.5% (FFA) in freshly harvested canola. Some marketers and processors may require 1.0% FFA. Total FFA level is one of the most useful direct and quantitative indicators of oilseed quality. Free fatty acids result from the breakdown of long-chained fatty acids to smaller chained free fatty acids.

Premium quality canola oil is high in unsaturated long chained fatty acids such as oleic acid. Unsaturated fatty acids are desirable in a range of foodstuffs. The breakdown of unsaturated to smaller chained saturated or free fatty acids reduces oil quality.

Free fatty acids can be removed during processing and refining, but the presence of high FFA levels affects production efficiency.

Rancidity and odours

Hydrolysis and oxidation of fatty acids in the oil results in breakdown products that typically give off a rancid odour and cause off-flavours in the oil. Rancidity in canola can be detected simply by crushing and smelling the seed. Fatty acids in the seed are subjected to slow, consistent breakdown during storage. Heating of canola increases the rate of hydrolysis and oxidation of fatty acids in the seed, leading to a higher level of by-products and short-chained free fatty acids. Such changes also tend to be accompanied by a darkening in oil colour. The level of accumulated FFA and products of oxidation in canola oil reflect the age of the seed.

Seed condition

As the initial quality of freshly harvested canola decreases, its relative storability also decreases.

Weathering of ripe canola, either in the standing or windrowed crop, accelerates the rate of deterioration post-harvest. The rate of deterioration in weathered seed will already be rapid before storage, and processes such as oxidation are well in progress and difficult to slow.

The presence of a strong rancid odour in crushed seeds indicates weathering and loss of oil quality. Seed coat colour is also a useful indicator of weathering.

Dull grey and brown seed coat colour indicates weathering. The colour of crushed seed will be light brown, compared with the bright yellow colour of normal crushed seed.

In weathered canola, the formation of FFA and off-flavours in oil will occur at a more rapid rate, compared with sound seed stored under similar conditions. Canola harvested at 1.5% FFA is more difficult to store than seed with lower FFA levels.

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