Store canola cool and dry to enhance oil quality

Oilseeds often can be more difficult to store than cereal crops due to problems with heating and quality losses. CSIRO Stored Grain Research Laboratory scientists have investigated the reasons why oilseeds can overheat in grain storage bins and how growers can better manage the problem.

by Len Caddick,
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Keeping oilseeds cool and dry in storage will reduce the risk of spoilage and loss of grain quality.

Oilseed spoilage and oil quality losses during storage are mainly caused by heat, although excessive moisture levels lead to rapid heating.

CSIRO recommends growers store canola at temperatures less than 25 degrees Celsius and an average moisture content of less than seven per cent.

Oilseeds need to be stored cool and dry because of their high oil content.

Refined edible oil pressed from oilseeds is susceptible to quality loss through heating and chemical and enzyme-based changes such as oxidation and hydrolysis.

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

There are several management factors influencing successful on-farm oilseed storage such as harvesting at low moisture content, storage at low grain temperature and adequate insect control.

High oil content

Cereals contain only about 2% by weight oil, compared with oilseeds, which contain significantly higher levels.

At a glance

- Keeping oilseeds cool and dry during storage will reduce the risk of spoilage and loss of seed and oil quality.
- CSIRO recommends that canola is stored at a temperature less than 25 degrees Celsius and an average moisture content of less than seven per cent.
- The rate of deterioration of oil quality depends on storage temperature, relative humidity and seed moisture content, storage time and initial seed quality.

Scott Boyle

Differences in moisture and oil content of canola at harvest can result in seed being placed in bulk storage that is at a higher risk of overheating and quality loss. Harvest canola at less than seven per cent moisture content to account for this variability.

The oil content varies widely between oilseed types. For example, it can be as low as 17% in soybeans and as high as 50% in several new canola varieties.

Minimal amounts of water are absorbed by the oil fraction and the higher the oil content, the lower the amount of total seed moisture required to produce conditions which cause heating and quality loss.

Canola oil content varies from 35% up to 50%. At 50% oil, only about half the total seed matter in the bin is available to absorb water and the limit of safe long-term storage occurs at 5.9% moisture content.

Higher storage temperatures or higher moisture levels will increase the risk of quality loss (see Figure 1).

Reducing storage temperature lowers the risk and allows canola at higher moisture levels to be stored safely.

In studies of oilseed moisture, moisture content is converted to an oil-free basis.

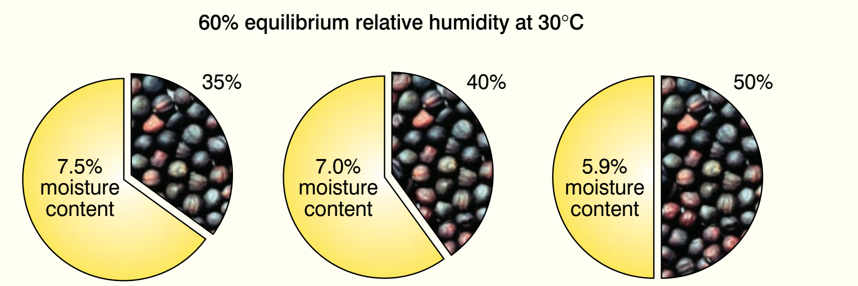
Using this conversion for moisture, the equivalent moisture content for canola with 45% oil content, compared with wheat at 12.5%, is 22.7%.

On an oil-free basis, the established 8% receival limit for canola with 45% oil content is equivalent to 14.5%.

Cereals stored at 14.5% moisture content are at high risk of moulding and quality loss. This is similar for canola at 8% moisture.

In both situations, drying and cooling using aeration are recommended.

FIGURE 1 Influence of oil content on storage potential of canola



Note: All three bins of stored canola produce the same equilibrium relative humidity (ERH) at a given temperature, even though the moisture and oil contents are different.

Source: CSIRO Stored Grain Research Laboratory.

Harvest at low moisture content

Ripe oilseed crops vary in moisture and oil content. Differences in moisture and oil content of seed harvested can result in seed being placed into bulk storage which is at higher risk of heating and quality loss than the overall bulk.

Harvest canola at less than 7% moisture content to account for across paddock variability and ensure any high moisture seed is mixed with drier seed in store.

Direct harvesting of a standing canola crop is more likely to result in higher average moisture in individual loads, compared with crops which have been windrowed or swathed.

Windrowing is commonly used to hasten and even out the drying rate of ripe canola and can also reduce yield losses from pod shatter at impact during direct harvesting.

But windrowed seed is prone to rain damage and dries excessively during hot dry weather, increasing losses due to pod shatter during harvesting.

Storage potential

The relative humidity of stored canola is dependent on moisture and oil content and the storage temperature.

Relative humidity (RH) is a measure of the amount of water in air, which surrounds and fills the spaces between kernels.

Relative humidity is expressed as a percentage of the amount of water air could carry if fully saturated (100%). It is the water outside the grain and temperature which influences mould growth and insects.

CSIRO recommends an equilibrium relative humidity (ERH) of 60% as a safe level for long-term canola storage.

The ERH of canola is the relative humidity where exchange of water between the oilseed and surrounding air is in balance (there is no net gain or loss of water).

The relationship between grain moisture content and ERH is temperature dependent. Moulds require an ERH of more than 68%, to grow when temperatures are favourable.

The variable amount of oil present in oilseeds affects the relationship between water inside and outside the grain.

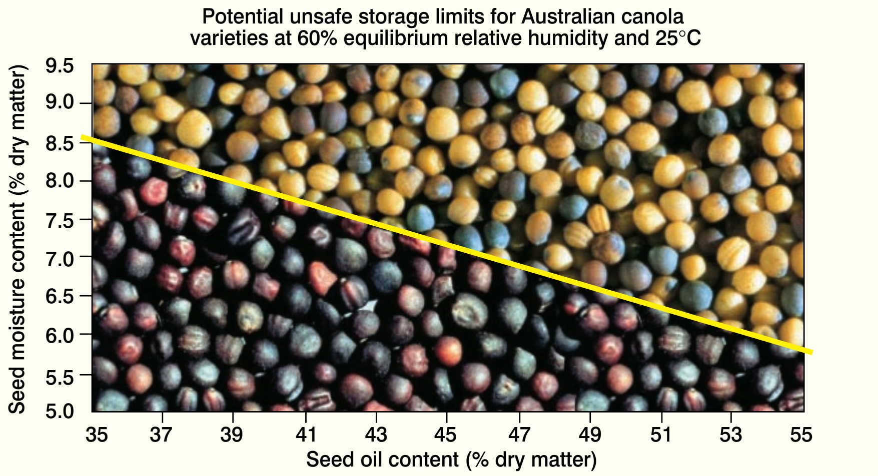
Water in an oilseed bulk is in a continuous process to achieve equilibrium.

Water is transferred between adjacent seeds and as water vapour between areas of different ERH.

The presence of temperature gradients, or differences in oil content, will result in different ERH levels for oilseeds at the same moisture content. So, parts of an oilseed bulk can be at higher risk of heating and quality loss.

Safe storage limits for Australian canola varieties at 60% ERH and 25°C are shown in Figure 2.

FIGURE 2 Potential unsafe storage limits for Australian canola varieties



Note: The figure shows safe storage conditions for canola at 60 per cent equilibrium relative humidity. The relationship between seed moisture content and oil content is shown at 25 degrees Celsius. Canola stored at conditions above the line is at potential risk of seed and oil quality loss.

Source: CSIRO Stored Grain Research Laboratory.

Canola is at risk of quality loss when stored at conditions above the yellow line. For example, canola with oil content of 35% can be safely stored at 8.5% moisture content.

As oil content increases, the recommended safe moisture level decreases. Where canola with oil content of 50% is stored, the safe moisture level is 6.5%.

Seed temperature affects quality

Seed is a poor conductor of heat. Oilseeds will remain warm for a considerable time when harvested at high temperatures and placed in storage. During storage, moderate to high temperatures can result in oil quality loss.

For canola, it is now common practice for storage operators to set a maximum temperature receival limit.

The upper temperature limit is aimed at reducing the heat load, which needs to be removed rapidly to obtain safe storage temperatures.

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

Mould growth

Moulding in canola can occur where relative humidity is more than 68% and temperatures are favourable. Storage temperatures of more than 25°C favour mould development. At temperatures less than 20°C mould growth is curbed.

If short-term storage of high moisture content canola is unavoidable, it is important to cool and store seed at low temperatures until drying or blending with drier seed is possible.

Poor storage conditions can readily cause heating. In extreme cases, canola can ignite if spontaneous heating is left unchecked. Heating is caused by the metabolic activity of fungi and other microbes, insects and natural respiration of the seed.

Premium quality canola

The level of free fatty acids (FFA) present is a useful indicator of oil quality. There is a maximum limit of 1.5% FFA in freshly harvested canola.

Fatty acids in oilseeds 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 undesirable compounds and free fatty acids.

Higher moisture levels also influence the rate these chemical processes occur.

Oil quality loss is often accompanied by a darkening in oil colour.

The level of accumulated FFA and products of oxidation in canola oil reflect the paddock and storage history of the seed.

Canola and other oilseeds stored at moderate to high temperatures and high moisture levels are therefore at risk of rapid oil quality losses.

Free fatty acids can be removed during processing and refining but high FFA levels affect production efficiency.

Seed condition at harvest

As the quality of freshly harvested canola decreases, its relative storage potential also falls.

Weathering of ripe canola, either in the standing or windrowed crop, accelerates the rate of deterioration post-harvest.

The rate of quality loss in weathered seed will already be quick before storage and processes such as oxidation are 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 has occurred.

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. Canola with FFA levels more than 1% will be more difficult to store than seed with lower FFA levels.

Fumigate for insect pests

Stored oilseeds are prone to insect attack, particularly at the surface. Bulk storage of oilseeds for prolonged periods is relatively recent.

Insect infestation appears to be an increasing problem, with rust-red flour beetle *(Tribolium castaneum)* frequently infesting the surface of oilseed bulks.

Stored product moths and psocids are also known to infest the bulk surface.

Two products are registered for insect control in oilseeds, phosphine and pyrethrins.

Phosphine treatment will only be effective when used in adequately sealed silos.

CSIRO Stored Grain Research Laboratory

Flour beetles are the major pest of stored canola in Australia. Stored canola is prone to insect infestation, particularly at the store surface, so it may be necessary to fumigate.

Carefully adhere to the safety procedures, dosage rate, and exposure time specified on the label when using phosphine.

But it is important to remember phosphine does not control insects effectively when grain temperatures fall to less than 15°C.

An initial fumigation using phosphine soon after harvest, followed by cooling using ambient aeration, is a useful management strategy to keep oilseeds insect-free and retain harvest quality.

Pyrethrins are extracted from the pyrethrum daisy and this natural insecticide is used for insect control within the organic food industry.

Natural pyrethrins are expensive and storage operators should check with end-product processors or marketers before using this chemical on oilseeds.

The level of residues of pyrethrins permitted on oilseeds sold to domestic or export markets is lower than that permitted on cereals.

To meet acceptable residue limits at outturn, pyrethrins may need to be applied at rates below that required to protect seed from insect attack over the entire storage period. This limitation significantly affects the usefulness of pyrethrins to control insect pests in stored oilseeds.

CSIRO is working closely with the Australian Oilseeds Federation, bulk handling companies and government regulatory agencies to resolve many issues associated with the use of chemicals on oilseeds.

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