# Storing Oklahoma Winter Canola


Carol Jones
Research Engineer

John Solie
Sarkey's Professor




With the development of winter hardy canola varieties, Oklahoma producers have the option of rotating canola with wheat to break the weed and disease cycle and to potentially increase wheat yields. Production of canola also provides an income source outside of the grain market. The recent increase in canola production in Oklahoma has prompted discussion and questions from producers and buyers about storage methods.

Successful canola storage requires cool, dry conditions. This makes aeration necessary to store canola in Oklahoma. Potential risks of improper storage include heating and spontaneous combustion, insect infestation, clumping due to molding, and free fatty acid (FFA) development.

Ripe canola varies in moisture content and oil content. The moisture content and seed temperature at binning determine the amount of drying and cooling necessary for long-term storage. Canola goes through a period of extended respiration or "sweat" producing heat and moisture for six to eight weeks after harvest. The sweat conditions are worse when harvested seed moisture content and temperatures are high. Aeration and intensive monitoring is required during this period to prevent quality loss.

### Optimum storage conditions

Canola seed may be conditioned upon binning using aeration to reduce moisture and temperature to the appropriate levels for long term storage. Figure 1 shows the moisture content and temperature relationship for storage up to five months. While optimum storage conditions are 55° F and 7% seed moisture, every reduction of 10°F below 77°F and 1% seed moisture below 9% will double the storage life. Charts for length of storage of cereal crops such as wheat may be used for canola by subtracting 5% from the moisture content of wheat. For example, the storage time for wheat at 13% seed moisture is comparable to the storage time for canola at 8% seed moisture. Storage below 6% seed moisture may result in seed damage during handling.

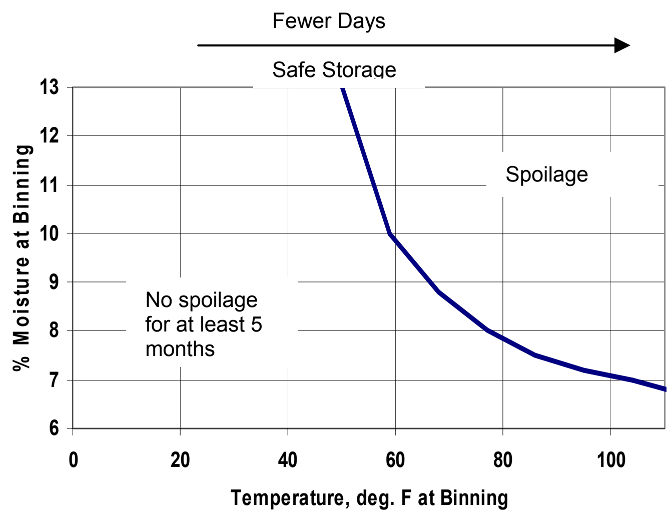


**Figure 1.** Safe storage conditions for canola adapted from Mills (1996).

### Cleaning Canola seed

Broken seeds, pods, dirt and other debris (also known as "dockage") make aeration more difficult by reducing airflow through the seed and may have an effect on the moisture content of the seed. Surface debris in storage also attracts insects. Insect development and activity cause excess heat and moisture which encourage mold growth. Large amounts of broken seeds provide additional opportunity for mold growth which increases the respiration rate. Therefore, the seed may need to be cleaned to less than 2.5% foreign material before placing it in storage. Canola may be cleaned by a number of different methods including air aspiration, indent cylinder cleaning, sieve screening, or a combination of these.

### Moisture, oil content and storability

Equilibrium relative humidity (ERH) is the point at which no exchange of moisture between the seed and the surrounding air takes place. Mold begins to grow when the ERH is above 60%. Temperature and seed oil content determine the ERH of the stored canola. Table 1 shows the ERH for canola with 40% seed oil content at various temperatures and seed moistures. The shaded area in the table is the seed moisture content percentage for optimum conditions to prevent mold growth and seed damage due to handling. For example, a seed temperature of 80°F must have a moisture content of 7.6% or less to have an ERH less than 60%.

Table 1. Equivalent relative humidity and temperature influence on seed moisture content. (NDSU 2005)

| Equivalent Relative Humidity, % | (40% seed oil content) Temperature, °F | | | | | | |
|---|---|---|---|---|---|---|---|
| | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
| 20 | 4.9 | 4.5 | 4.1 | 3.8 | 3.6 | 3.4 | 3.2 |
| 30 | 6.5 | 5.9 | 5.5 | 5.1 | 4.8 | 4.5 | 4.3 |
| 40 | 8.1 | 7.4 | 6.8 | 6.3 | 6.0 | 5.6 | 5.3 |
| 50 | 9.6 | 8.8 | 8.1 | 7.6 | 7.1 | 6.8 | 6.4 |
| 60 | 11.3 | 10.3 | 9.6 | 9.0 | 8.4 | 8.0 | 7.6 |
| 70 | 13.1 | 12.1 | 11.2 | 10.5 | 10.0 | 9.3 | 8.9 |
| 80 | 15.4 | 14.2 | 13.2 | 12.3 | 11.6 | 11.0 | 10.5 |
| 90 | 18.6 | 17.2 | 16.0 | 15.0 | 14.2 | 13.5 | 12.8 |

Higher oil contents require lower seed moisture levels for successful storage. Seed moisture contents may be adjusted for different oil contents by using Figure 2. For example, at 60° F canola with 50% oil content can be safely stored at 6.5% moisture content or less (Figure 2). As the oil content decreases, the safe moisture level increases. For seed with oil content of 40%, the safe moisture level at 60° F is 7.6% (Figure 2). Lower seed moisture and oil contents allow storage at higher temperatures. However, at temperatures greater that 77° F for extended periods of time, excessive free fatty acid may form.

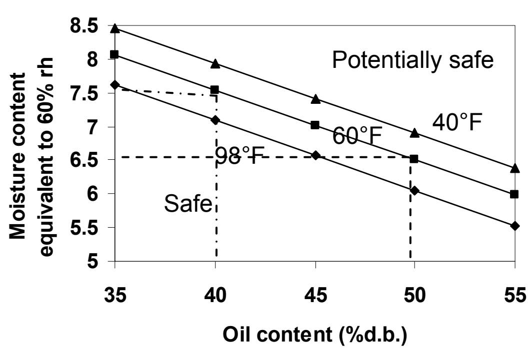


**Figure 2.** Relationship between oil content and moisture content on the safe storage of canola. (Redrawn from Steele 1991)

## Free fatty acid production

Other factors that reduce the quality of stored canola include free fatty acid (FFA) production and oil color changes. FFAs make oil go rancid quickly. FFA levels increase as a result of the hydrolysis of triglycerides and cause off flavors in the oil. Even when the conditions provide little risk of mold growth, these oil quality changes can occur. Usually the cause of FFA production and oil color change is high temperature. Freshly harvested canola seed usually has FFA levels less than 0.5%. However, storage above 77° F for extended periods of time (longer than one year) may cause levels to rise above 2%. These high levels of FFA can be removed during refining but the process is expensive. This makes canola seed with FFA levels above 1% less desirable to buyers. Therefore, it is important to cool canola seed to below 77° F as soon as possible after harvest.

## Aeration for cooling

Aeration systems that are designed properly to provide adequate uniform velocity throughout the stored seed provide a cost effective way to cool and store canola in Oklahoma. Round steel grain bins are well suited for storing canola. They are easy to maintain and to seal against weather and pests. The floor should accommodate an aeration system, preferably with full perforation. Fact Sheets F-1102 and 1103 provide information for the design of aeration systems for flat-bottom and cone-bottom round bins, respectively. Because canola seed is small compared to wheat and other cereal grain, fine mesh screen such as window screen may be placed over the floor perforations to prevent seed leakage through the perforations. Bins should have temperature and relative humidity monitoring equipment. If this equipment is not available, diligent testing with a grain probe is essential. Fact Sheet F-1101 gives aeration and grain cooling information for Oklahoma.

Air movement may be upward (positive pressure) or downward (negative pressure). Positive pressure is generally preferred for canola storage because the aeration progress is easier to check by monitoring the grain at the top of the bin instead of the bottom. Additionally, when the fan is started as soon as bin filling begins, the air helps to keep the floor perforations open. However, condensation may occur on the underside of the roof during cool weather in an upward flow system. Cross-ventilation in the headspace can help to remove this moisture. In a negative pressure system, the warm summer air is pulled down into the grain. If new seed is added to the bin, the heat from the new seed is pulled down into the previously cooled seed requiring it to be cooled again. The negative pressure system may cause more packing with canola seed and increase the static pressure. Figure 3 shows the two different air flow directions.

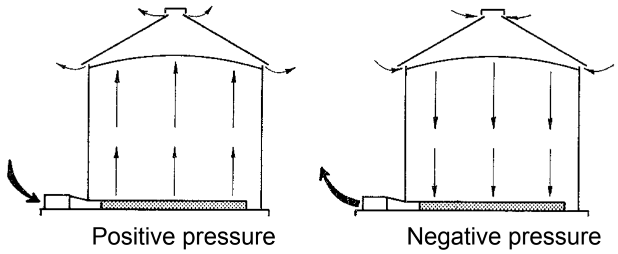

**Figure 3.** Grain bin airflow directions

Airflow rates for temperature management of canola are usually 0.08 to 0.15 cfm/bu. At 0.08 cfm/bu, about 150 to 200 hours are needed to change the temperature of the entire bin 20°F. At 0.15 cfm/bu, the time it takes is cut in half. For example, at 0.15 cfm/bu, it takes about 75 to 100 hours to cool a bin of clean canola from 80°F to 60°F or from 60°F to 40°F. Canola containing fine material will take longer to cool.

Aeration fans should be started as soon as the seed covers the floor and run continuously until the seed temperature throughout the bin is near the average outside temperature. After the initial cooling period, the fans should operate whenever the outside air temperature is 5 – 10°F below the seed temperature and the relative humidity is less than 95%.

## Aeration for natural air drying

The ability to reduce seed moisture content in the bin provides producers more options for harvesting. Canola can be removed from the field in a tough (>10.1% moisture) or damp (>12.5% moisture) condition. Harvest can be started earlier and the higher moisture levels may reduce mechanical losses due to pod shattering (Thomas 1984). Bin aeration can be used to reduce the seed moisture content to the proper storage levels but increased airflow rates are required. Typical airflow rates necessary for drying are in the range of 0.4 to 2 cfm/bu. These higher airflow rates increase the static air pressure. Table 2 shows the static pressure for loose-filled canola with fan airflow rates of 0.75 and 1.0 cfm/bu at several grain depths. For packed canola seed, the static pressure doubles (Jayas and Sokhansanj 1989). Static pressure due to canola seed plus the static pressure due to duct work must be considered when selecting fans. Fact Sheets F-1101, 1102, and 1103 provide additional aeration system design information. Vendor data sheets are also helpful when selecting equipment. The static pressure of canola is two to three times that of wheat. Therefore, if an existing aeration system designed for wheat and other cereal grains is to be used, check the velocity and pressure ratings of the system to ensure adequate airflow for drying canola.

Two types of fans are available for grain bin aeration. Axial type fans are adequate for static pressures less than 4 or 5 inches of water. Centrifugal type fans with backward-inclined blades are more expensive but give more consistent air delivery over a wider range of pressures.

Table 2. Static pressure of canola in storage.

| **Static Pressure** | **Airflow Rate (cfm/bu)** | |
|---|---|---|
| inches of water and psi | 0.75 | 1.0 |
| | **Canola Depth** | |
| 6" (2.6 psi) | 13 ft. | 11 ft. |
| 7" (3.0 psi) | 14 ft. | 12 ft. |
| 8" (3.5 psi) | 15 ft. | 13 ft. |

As the airflow moves through the grain, a drying front develops and moves slowly through the grain. Behind the drying front, the grain is close to the temperature of the incoming air and at a moisture level in equilibrium with the relative humidity of the incoming air. Table 3 shows the relationship between the seed moisture level and the relative humidity of the incoming air. The grain ahead of the drying front will remain at a moisture level within about 1% of its initial storage level.

The airflow pattern in a bin with a fully perforated floor and a leveled grain surface will provide even air distribution unless debris and packed grain have gathered under the filling spout. If this is the case, coring the bin or pulling seed from the center of the bin will help to alleviate the problem. Uneven airflow patterns will leave moisture pockets that will cause mold and hotspots to form resulting in spoilage of the surrounding seeds. Stirring the seed will help to reduce these problems.

Table 3. Incoming air relative humidity influence on seed moisture level

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Relative humidity, % | 50 | 57 | 65 | 62 | 77 | 82 | 86 | 88 |
| Moisture level, % | 6.0 | 6.6 | 7.4 | 8.2 | 10.0 | 11.2 | 12.8 | 13.9 |

(Bailey 1980)

When drying canola, the fans should be run continuously until the desired moisture level is achieved even when the relative humidity occasionally spikes. This ensures the drying front will continue to move through the stored seed. The risk of rewetting will be overcome by running the fans for a few days with lower relative humidity. The moisture will redistribute through the seed and spoilage will not occur.

## Heated air drying

Heated air drying may be used if available. It is much faster but more expensive than natural air drying. Care must be taken to control temperatures. Canola for seeding purposes should not be subjected to temperatures over 113°F. Seed used for oil extraction can be dried up to 180°F. Over drying may cause cracking of the seed coats and free fatty acids may increase. If high-temperature batch and continuous flow dryers are used, two passes may be required for initial seed moisture contents above 17%. The drying process will be quicker and more consistent through the grain bed if the grain depth is less than 10 ft (Mills 1996). For seed moisture contents below 15%, natural air and low temperature drying is adequate.

## Insect and Mite Control

Insects can cause extensive damage in stored bulk products. Good management practices can help prevent this damage. Cleaning bins thoroughly prior to grain storage is essential.

The surface of stored canola seems to be the primary area of attack. Insects are apparently attracted by trash, broken seeds, and fine material that accumulate on the surface. Cleaning the seed before storage will reduce infestations by removing trash, broken seeds, and dockage.

Proper temperature control using aeration will go a long ways in controlling insect and mite infestations. Optimum temperature for rapid insect development is 86 - 95°F. Grain temperatures below 68°F slow the development of insects and development ceases at temperatures below 59°F. Red flour and rusty grain beetles, Indian meal moths, and lesser grain borers are some of the pests found in Oklahoma stored canola. Fact Sheet F-7180 provides detailed information about the different pests causing damage in Oklahoma grain storage systems.

Mites carry mold spores on their bodies. They may eat the surface and interior of canola seeds affecting the quality and seed weight (Hudson et al. 1991). Heavy mite contamination may leave a distinctly minty odor (Mills 1989). These prey mites have been held in check by predatory mites in canola cooled to lower temperatures.

A good plan for controlling insects and mites in canola includes the following:

1. Clean bin by sweeping and/or using a shop vacuum before binning grain
2. Level surface of grain after binning
3. Cool grain as quickly as possible
4. Fumigate with phosphine soon after harvest. Grain bins must be adequately sealed for phosphine to be effective. Warning: Safety procedures, dosage rate, and exposure time specified on the label must be carefully adhered to when using phosphine.
5. Closely monitor insect infestation monthly using traps or a grain trier. If hotspots appear, stir grain and continue aeration to re-cool the entire bin. Safety Note: Take appropriate safety measures when entering a confined space such as a grain bin; do not work alone.

## Grain handling equipment

Equipment used for Oklahoma cereal crop production may be used to handle canola. Since the seed is small, holes in truck beds, grain carts, and combines must be plugged with tape or caulk to prevent seed loss.

Canola has an angle of repose of 22°, compared to 28° for wheat. This difference causes seed to flow more readily and may cause additional force on the sides of carts and bins. Care must be taken to load canola evenly throughout the bin to prevent buckling.

Augers should be operated at full capacity to prevent seed from flowing back down the tube. Belt conveyors should be enclosed in a trough to prevent seed from dropping off the conveyor. Damage to seed due to handling is minimal above 7% seed moisture content (Mills 1996).

## References

Bailey, J. 1980. Oilseed rape harvesting losses can be high. *Arable Farming* May:59 and 61.

Hudson, R., J. Woodruff, G. Shumaker, S. HOdges, T. Murphy, D. Monks, P. Bertrand, and C. Hammond. 1991. *Canola a new crop for Georgia*, *Canola Production Guide*: Georgia Extension Canola Committee.

Jayas, D. S., and S. Sokhansanj. 1989. Design data on resistance of airflor through canola (rapeseed). *ASAE Transactions* 32 (1):295-296.

Mills, J. T. 1989. *Spoilage and heating of stored agricultural products. Prevention, detection, and control*, *Publ. 1823E*. Ottawa, Ontario: Agriculture Canada.

———. 2005. *Storage of canola*. Agriculture and Agri-Food Canada 1996 [cited July 7, 2005 2005].

NDSU. 2005. Canola production field guide.*A-1280*. Fargo, North Dakota: North Dakota State University Extension Service.

Thomas, P. M. 1984. Swathing - combining, storage and conditioning of canola. In *Canola Growers Manual*. Winnipeg, Manitoba: Canola Council of Canada.

Relevant OSU Fact Sheets and Websites:
F-1100 Maintaining Quality of Stored Grain by Aeration
F-1101 Aeration and Cooling of Stored Grain
F-1102 Aeration Systems for Flat Bottom Round Bins
F-1103 Aeration System Design for Cone-bottom Round Bins
F-1105 Auger Conveyors
F-2130 Producing Winter Hardy Canola in Oklahoma
F-7180 Stored Grain Management in Oklahoma
http://www.canola.okstate.edu/
http://www.canola.okstate.edu/relatedsites/index.htm