

GRAIN STORAGE FACT SHEET

SAFE STORAGE OF SUNFLOWER SEED — AERATION DRYING AND COOLING



**Australian
Sunflower
Association**



**Australian Oilseeds
Federation**



**Queensland
Government**

Sunflower growers can use aeration drying and cooling to successfully manage a range of seed moisture contents (MC) and temperatures during harvest and storage.

KEY POINTS

- ▶ Aeration drying and cooling enables safe storage of sunflower seed across a broad range of moisture contents and ambient temperatures.
- ▶ Optimal sunflower seed storage occurs below 9 per cent MC at 40 per cent oil content. For higher oil contents (≥ 50 per cent), store sunflower seed at 7.5 per cent MC.
- ▶ Moisture content can be lowered two to three per cent in less than a week with aeration drying.
- ▶ Reliable aeration drying requires fan airflow rates in excess of 15 litres per second per tonne (L/s/t), while aeration cooling requires airflow rates of between 2 to 4 L/s/t.
- ▶ Aeration cooling fans can reduce seed temperatures in storage by more than 10°C in two to three days.
- ▶ Sunflower oil quality can be maintained with well-managed aeration drying and cooling systems.



PHOTO: PHILIP BURRILL, DAFF QLD

Early start: Sunflower harvest starting at higher moisture contents.

A moisture content range of 7.5 – 9.0 per cent in storage, is optimal to reduce the risk of moulds and storage pests, while maintaining seed oil quality.

Aeration drying offers the flexibility to start harvest early (at high seed moisture contents) and the ability to harvest for more hours each day. Aeration cooling delivers cool, dry and uniform conditions during storage to maintain optimal seed quality.

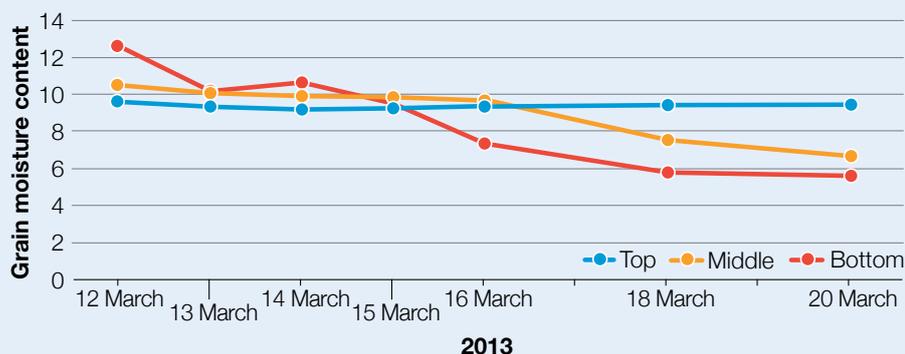
Growers who successfully manage sunflower seed moisture and temperature during storage can build a reputation for supplying a consistent quality of sunflower seed that maximises market opportunities in the short and long term.

When designing storage systems, seek independent technical advice on the correct equipment and operating procedures.

On-farm trials support aeration drying

On-farm trials in three silos run by Department of Agriculture Fisheries and Forestry Queensland (DAFF QLD) revealed that using aeration drying at harvest can allow growers the flexibility to harvest sunflowers at high moisture contents (≥ 13 per cent MC) provided the appropriate size fans are used.

FIGURE 1 SUNFLOWER SEED MOISTURE CONTENT REDUCTION AT THE TOP, MIDDLE AND BOTTOM OF A SILO USING AERATION DRYING



During the trial, the first small load of harvested sunflower seed delivered into the Kotzur silo was measured at 13.7 per cent MC. After subsequent loads, and prior to drying commencing, the bottom third of the silo averaged 12.6 per cent MC, the middle section 10.5 per cent MC and the top portion 9.6 per cent MC (see Figure 1).

After six days of aeration drying, the sunflower seed moisture content was reduced to 5.6 per cent at the bottom, 7.5 per cent in the middle and 9.4 per cent in the top section of the silo.

Note: Averaging silo moisture contents, drying could have ceased on day five to meet delivery standards.

Aeration drying equipment

Aeration drying requires airflow rates in the order of 15 to 25 L/s/t to reliably move drying fronts quickly through the full grain bulk.

For the DAFF QLD trial, a Kotzur drying silo of 75 m³ capacity, holding 27 t of sunflower

seed was fitted with a DF4000 7.5 kW three-phase fan to deliver the airflow rates of 25 to 30 L/s/t.

On a larger 140 m³ cone-based Grainmaster silo, two F650, 1.5 kW single-phase fans were retrofitted. The F650 fans delivered 17 L/s/t to dry 58 tonnes of seed.

High airflow rates can be achieved for drying partly because of the large size and low density (e.g. 41 kg/hL) of sunflower seed, which creates sizeable air gaps between seeds and reduces the back pressure the fans work against. Fan performance is reduced when used on smaller grains such as sorghum and canola, or when the fans work against greater depths of grain in a larger silo.

Drying fan operations

Fan run-times during the trial were managed using a GrainSafe 5000™ aeration controller. The aim was to push drying fronts completely through the full grain depth by maximising fan running hours each day.

During the first two days the controller was set to run fans while the ambient air was less than 75 per cent relative humidity (RH). For the remaining four days the drying settings were altered to use all ambient air below 65 per cent RH.

Ambient air below 75 per cent RH is less than the equilibrium of 9 per cent MC of sunflowers. The second stage of drying using ambient air below 65 per cent RH drives towards moisture contents of less than 8 per cent (see Table 1).

Regular sampling is required to ensure seed is not over dried.

Cost of drying

As ambient conditions for aeration drying vary, a conservative estimate of six days has been used to calculate the cost of drying during the trial.

Over the six days the fan run-time totalled 67 hours. Using a charge rate of \$2.10 per hour to run the 7.5 kW fan, this indicates total electricity costs of \$140 to dry the 27 t of seed — approximately \$5/t.

Benefits of aeration drying

The flexibility to harvest sunflowers early and deal with high seed moisture content has numerous advantages including:

- reduced risk of weather damage to the standing crop;
- less fire risk in harvesters or grain dryers;
- extended harvest days and the ability to resume more quickly after rain events, and
- maximised saleable tonnage and income by limiting over-dry sunflower seed towards the end of harvest.

TABLE 1 APPROXIMATE MOISTURE CONTENT OF SUNFLOWER SEED RESULTING FROM AERATION AT VARIOUS AMBIANT TEMPERATURE AND HUMIDITY LEVELS

| | | TEMPERATURE (°C) | | | EQUILIBRIUM MOISTURE CONTENT (%) |
|-----------------------|----|------------------|------|------|----------------------------------|
| | | 15 | 25 | 35 | |
| RELATIVE HUMIDITY (%) | 30 | 5.2 | 5.0 | 4.7 | |
| | 40 | 6.1 | 5.8 | 5.4 | |
| | 50 | 6.9 | 6.5 | 6.2 | |
| | 60 | 7.7 | 7.3 | 6.9 | |
| | 70 | 8.6 | 8.2 | 7.7 | |
| | 80 | 9.6 | 9.2 | 8.7 | |
| | 90 | 11.1 | 10.6 | 10.0 | |

Source: ASAE Paper 74-3534

*Oil content ~ 40 per cent

Managing admixture

Aim to start harvesting sunflower seed when moisture content is in the range of 10 – 12 per cent and check for acceptable admixture levels in the seed sample. Aim for no more than 2 per cent admixture and keep below the 4 per cent maximum receival limit.

Watch for fine admixture in the sample. Incorporating a perforated section in the harvester outload auger and other augers can reduce admixture fines.

Cooling during storage

In addition to the use of drying fans at harvest to manage high-moisture seed, aeration cooling during storage, using low airflow rates of 2 to 4 L/s/t, can be used to reduce seed temperature and create uniform moisture conditions throughout the storage bulk. This reduces the risk of moulds, storage pests and seed oil quality deterioration.

Aeration cooling trial

During March on the Darling Downs, 65 t of monounsaturated sunflower seed was harvested at between 8 to 9% MC and stored in an aerated 158 m³ capacity cone-based silo.

The silo was fitted with two standard, single-phase 0.37 kW aeration cooling fans (F370) providing 7 L/s/t airflow. Sunflower seed has a lower back pressure than other grains, so the cooling airflow rate for this trial was above the typical 2 to 4 L/s/t.

Cooling fan operations

A Grainsafe 5000™ controller set aeration fans to run through its automatic cooling management program. Typically, this is an initial five days of *continuous* fan run time, followed by a *purge* fan run of seven days taking 9 to 12 hours per day of cool air, concluded by the longer term *protect* fan setting. In most cases, the *protect* setting runs fans for about 100 hours per month, selecting the best available ambient air. To protect grain, all cooling settings automatically stop fans during times of air humidity above 85 per cent (RH).

Cooling results

Sunflower seed temperature in the silo was monitored continuously for six weeks from mid-March into April.

Prior to aeration, harvested seed temperatures in storage were above 35°C (see Figure 2). Two days of aeration reduced seed temperature by 10°C to less than 25°C.

With warm ambient temperatures during the second week of aeration, seed temperatures rose briefly. By week four seed temperatures fell to 20°C, then finally to less than 15°C by week six.

Sunflower oil quality

High-quality monounsaturated oil is the major end product for sunflower seed in Australia, so it is important to maintain oil quality during storage and handling.

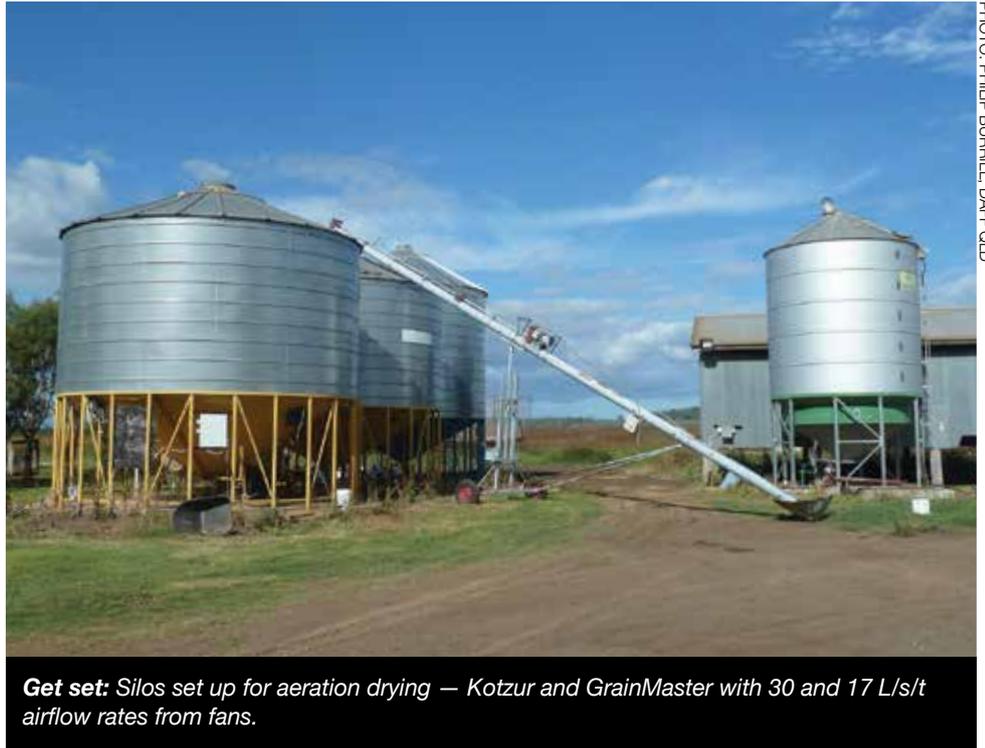


PHOTO: PHILIP BURRILL, DAFF QLD

Get set: Silos set up for aeration drying — Kotzur and GrainMaster with 30 and 17 L/s/t airflow rates from fans.

Poor seed storage conditions, which expose sunflower seed to excess moisture and heat, can degrade oil quality by raising levels of free fatty acids (FFA).

During the aeration drying and cooling trials outlined here, sunflower seed was sampled before and after storage from all silos.

Samples were submitted for analysis and the results demonstrated no increase of FFA levels as a result of aeration drying or cooling (see Table 2.)

FIGURE 2 AERATION COOLING — SUNFLOWER GRAIN TEMPERATURES IN STORAGE AND DAILY AMBIENT AIR TEMPERATURES

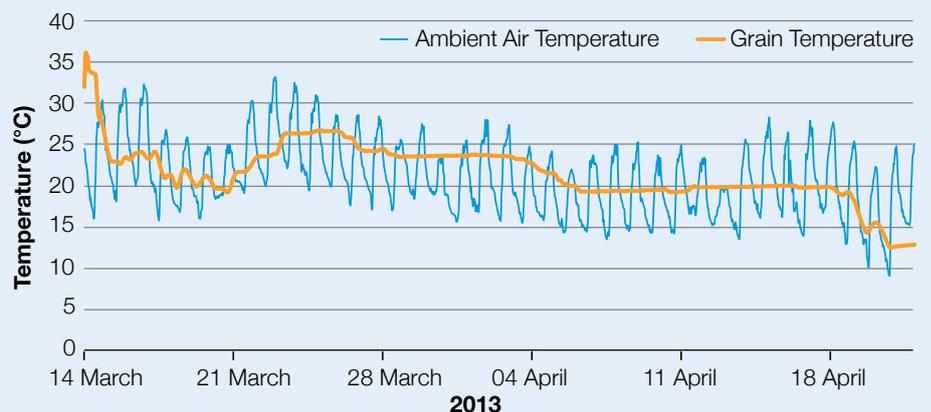


TABLE 2 FREE FATTY ACID LEVELS IN SUNFLOWER SEED BEFORE AND AFTER AERATION DRYING AND AERATION COOLING

| STORAGE / TREATMENT | PRE-STORAGE SAMPLE (FFA%) | POST-TREATMENT SAMPLE (FFA%) |
|----------------------------------|---------------------------|------------------------------|
| Kotzur aeration drying silo | 1.63 | 1.06 |
| Grainmaster aeration drying silo | 1.01 | 0.64 |
| Dennys aeration cooling silo | 1.13 | 0.94 |

Source: DAFF QLD

Setting up for drying



Retro your silo: This silo has been retro fitted with two fans opposite each other, powered by 1.5kW motors for aeration drying. The original pair of lower performance fans remain in place for aeration cooling.



Sample site: Poly water fittings (40-50mm) mounted in the silo wall beside the ladder allow grain samples to be taken with a vacuum probe. Mounting them every few metres up the silo enables easy monitoring of the aeration drying front as it progressively dries grain from the bottom of the silo to the top.



Ducts lined up: Aeration, especially aeration drying requires uniform airflow through the grain bulk. When retrofitting fans, ensure adequate size ducting is installed almost the full length of the silo cone. Where multiple fans are fitted, space them around the cone opposite each other.



Fans for the job: This Kotzur drying silo is built with a high-airflow drying fan powered by a three phase, 7.5kW motor. The silo has been retrofitted with a small fan powered by a 0.37kW motor to provide aeration cooling after drying. To learn how to measure airflow read *Performance testing aeration systems fact sheet* by GRDC. <http://storedgrain.com.au/testing-aeration/>

PHOTOS: PHILIP BURRILL, DAFF QLD

FURTHER READING

Safe Storage of Sunflowers

www.bettersunflowers.com.au/bysp/storage

The Big Yellow Sunflower Pack

Module 7 Safe storage, <https://bettersunflowers.com.au/public/safestorage/#/0>

Dealing with high-moisture grain (GRDC Fact Sheet)

www.storedgrain.com.au/dealing-with-high-moisture-grain/

Aerating Stored Grain – Cooling or Drying for Quality Control (GRDC Booklet)

www.storedgrain.com.au/aerating-stored-grain/

Storing oilseeds (GRDC Fact Sheet)

www.storedgrain.com.au/storing-oilseeds/

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