Drying and cooling grain: an update

**Bulk drying**

For long-term storage grain should be dried to 14.5% or less.

Ambient-air drying systems should deliver 180 m³/hr/t in order to pass a drying front through grain in ten days. Undried grain, ahead of the drying front, can deteriorate if its moisture content remains too high for too long.

Germination loss has hitherto been the best indicator of biodeterioration. More serious is the possible formation of ochratoxin A (OTA), a carcinogen that may be produced above 18% mc by Penicillium verrucosum.

Bulk dried grain will be around 15-20ºC due to evaporative cooling. There is a danger that OTA can form at 20-22% mc even if drying is complete in ten days (Figure 1). Action to reduce mc below 18% mc before bulk drying should be considered, especially if harvest backlogs lead to damp grain being stored.

**Cooling with bulk dryer**

Often the same fans are used for both cooling and drying. However, cooling requires only one twentieth of the airflow compared with drying.

A bulk drying system will take only five hours to achieve the first cooling front of 15-20ºC after harvest, whereas a low volume aeration system may take up to 100 hours. However, heat from the fan’s motor limits cooling efficiency. Excessive fan use wastes electricity but grain is unlikely to dampen at airflow rates used for cooling.

A float meter at the grain surface measures airflow for bulk drying, but is too insensitive for cooling rates.

**Cooling by aeration**

Low volume aeration systems should be used at an aeration rate of about 10 m³/hr/t. This airflow can be calculated from maker’s performance charts.

**Measuring fan hours**

It may take up to 300 hours to drop grain temperature below 5ºC, so it is essential to record fan running time to monitor cooling efficiency. Inefficient cooling, despite many hours of fan use, may be

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**Action:**

- If grain is wet, consider hot-air drying or stirring to reduce time grain is above 18% mc.
- Cool grain using airflow rate of around 10 m³/hr/t. Either measure airflow rate or obtain data from manufacturer.
- Record fan hours run. Remember: “cooling dose” = airflow x hours run.
- Control fans, ideally using a differential thermostat, especially after warm, dry harvests.
- If cooling grain with bulk drying fans, run fans for proportionately shorter time as fans blow up to 20 times more air than cooling fans.
- Consider ways of voiding hot air from any building containing fans. Include adequate louvered vents or link roof fans to cooling/drying fans.

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*Figure 1. Maximum days for safe storage of wheat without risk of OTA formation*


If you are unsure about any of the suggested actions, or want them interpreted for your local conditions, consult a professional agronomist.
Summary

Previous HGCA publications have outlined the principles of successful grain storage: dry to below 14.5% mc; cool to below 15ºC within two weeks and to below 5-10ºC by Christmas.

This Topic Sheet amplifies these ‘rules’ in the light of feedback from recent HGCA workshops on cooling and drying as well as difficulties many farmers had to cool grain after the hot, dry 2003 harvest. Key messages are: know your airflow, record fan hours, use a thermostat. Bulk drying fans used for cooling must run for much shorter times than dedicated cooling fans.

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Topic Sheet Nos. 7, 16, 34, 53

‘The grain storage guide’, revised 2003 (HGCA)

GrainPlan (cd)

Effects of climate change

In 2004, 15% of grain offered for sale was rejected due to infestation. The autumn weather of 2004 was considered by many to be too warm to cool grain rapidly enough to prevent infestation.

The past decade has been warmer than the 30-year average (Figure 2), but the day-night average is still below 20ºC, low enough for the first cooling front to stop the saw-toothed grain beetle from breeding. The real problem is selecting the most suitable periods for cooling.

Fan control using a thermostat

Grain cools most rapidly if only the coldest air is blown. Grain temperature follows ambient if cooling fans run continuously. A simple thermostat wired to the fans can be set at 15-20ºC until the first cooling front is through in around 100 hours; then the setting is dropped to 10ºC, and finally to 5ºC. Use of a differential thermostat is more efficient. This only switches the fan on when ambient is cooler than grain, and would typically be set at a 6ºC difference. Airflow rates used for cooling will not usually dampen grain, so blowing in damp weather is not a problem.

Figure 2. 30-year average (1961/90) autumn temperatures compared with years 1995 to 2003

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Source: Hadley Centre for Climate Prediction and Research, Met. Office, Berkshire, UK.