HGCA

Integrated grain storage strategies

Topic Sheet No. 7
Winter 1997

Background

Buyers demand that grain is free from pests and contains minimal pesticide residues. Cost-effective storage strategies - based mainly on drying and cooling, pest monitoring and surface pesticide treatment - therefore have an important role.

HGCA-funded work has been led by David Armitage at the MAFF Central Science Laboratory, York. The work has covered cereals in general and barley for malting. Some of the information has been incorporated into an HGCA/MAFF-funded decision-support system *Integrated Grain Storage Manager*, developed by the Centre for Environmental Technology at Imperial College and CSL[1].

The 'basic' strategy

Grain can be cooled by blowing air from the outside through it if the air temperature is lower than that of the bulk. It usually makes sense to turn the fans on at night or during any day time cold period. This can be done manually, which is not efficient and demands continuous temperature monitoring. Alternatively, a differential thermostat can be used to turn the fans on when the temperature falls below the set differential and turn them off when it does not. Thus, a thermostat set at 4ºC when the day time maximum temperature is 20ºC will operate at 16ºC or below, but not at 17, 18 or 19ºC.

Grain stored in farm-scale (20 tonnes) and commercial-scale (1,000 tonnes) bulks was successfully cooled to below 5ºC by December. Fans blew for 300 hours at 10m³/ hour/tonne in three successive winters using a differential thermostat set at 6ºC. Electricity costs were less than 4 pence/tonne (at 7.5 pence/k W hour). Pesticide admixture costs a least 37 pence/tonne.

Calculations based on weather data for warm winters suggest that cooling should always be fast enough to arrest insect development. Experiments in 20 tonne farm bins have confirmed this. But fan control is critical - a thermostat set at a 4ºC differential used less than a third of the power compared to one set at 2ºC to achieve the same cooling.

Information in Tables 1 and 2 will help farmers apply ambient air cooling on their farms.

The grain surface absorbs moisture in winter where insects, especially mites, may be found. Cooling alone does not prevent mites breeding at the surface so pesticide treatment is needed. A 2% a.i. dust raked into the top 0.3m of grain at 50g/m² and costing 13 pence/m² has worked well in experiments. Cooling alone also does not prevent sawtooth grain beetles becoming active again in the spring. In grain cooled only during storage for two years, grain weevils emerged in the second winter after breeding at the surface the previous summer. The surface treatment remedies this.

Table 1. Cooling schedule for grain aerated at 10m³/hour/tonne

Grain cooled to:	Number of fan hours	Date cooling ends starting from: 1/7	1/8	1/9	1/10
15ºC	139	16/7	17/8	12/9	8/10
10ºC	278	29/9	9/10	14/10	9/11
5ºC	417	8/12	8/12	9/12	1/1

Table 2. Hours of aeration and days taken to cool grain in 20 tonne farm bins to 15, 10 and 5ºC

Grain cooled to: \ Differential	Days 2ºC	Days 4ºC	Hours 2ºC	Hours 4ºC
15ºC	7	15	86	57
10ºC	63	63	423	139
5ºC	161	77	734	188

[1]Available to HGCA levy payers for £49.99 excluding VAT from Dr Jonathan Knight at Imperial College, tel: 01344 294496.

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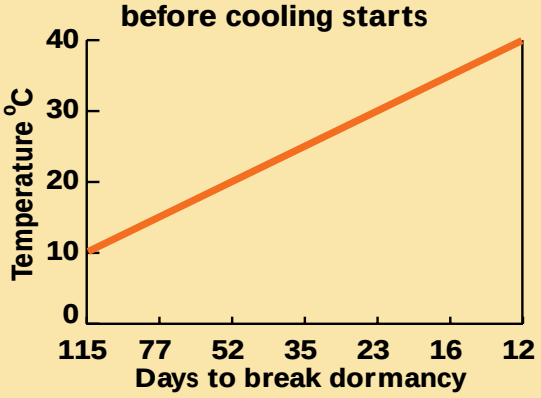
Storing malting barley

A different storage strategy is required for malting barley because of the need to break dormancy before cooling is started. Dormancy can be broken quickly at a high or slowly at a low temperature (Figure 1) but it is important not to encourage infestation.

Figure 1. Days to break dormancy between 10°C and 40°C before cooling starts



Dormancy loss and germination decline has been studied in HGCA-funded research . Using this information and also insect breeding rates at different temperatures, a model was developed to select the best strategies for malting barley. It was validated in laboratory tests which also confirmed that low temperature storage does not induce 'secondary dormancy'. Options for storing grain were tested in commercial trials over two seasons in the north and south of England with grain initially at between 22°C and 50°C.

On your farm

Since September 1995, grain stores have been designated as food premises, subject to the Food Safety Act, 1990. Pest prevention and control measures must be in place and sound hygiene standards practised. Store managers must follow a code of practice for the control of *Salmonella* in grain for animal feed.

Considerable savings can be made if cooling is used as the main pest control strategy, with only limited pesticide application. But monitoring and record keeping for temperature, fan running times, moisture and pests are essential. Automatic fan control is efficient and allows use of cheap, off-peak electricity.

Storage of malting barley using the integrated strategy principles is a specialist job, best left to maltsters with bin storage.

Looking ahead

Further work is needed on storage of grain for specific markets and on oilseeds. Alternatives to organo-phosphorous compounds are required, particularly for mites. Existing compounds need to be tested on lesser known pests and developing stages within grain. Decision support systems are needed for oilseeds and malting barley.

Action:

- **Dry grain to 15% or less to eliminate mites and moulds.**
- **Cool grain at10m³/hour/tonne:**
  - **to below 15°C within two weeks to prevent sawtooth beetles breeding**
  - **to below 10°C within a further two months to prevent grain weevils breeding**
  - **to below 5°C to prevent mites breeding and kill insects.**
- **Use automatic fan control with a differential thermostat set at 4-6°C, and preferably a timeclock.**
- **Monitor insect numbers using traps.**
- **Treat the grain surface with pesticide dust raked into the top 0.3m to kill upward moving insects and mite infestations.**
- **Break dormancy at below 20°C or over 40°C to discourage infestation.**
- **Cool malting barley immediately after dormancy has been broken.**

Further information:
Project Reports 24, 57, 138

Home-Grown Cereals Authority
Research & Development
Caledonia House
223 Pentonville Road
London N1 9NG
Tel: 0171 520 3900
Fax: 0171 713 2000