JUNE 2013

GRAIN STORAGE FACT SHEET

GRDC
Grains Research & Development Corporation
Stored Grain Project

WESTERN REGION
GRAIN STORAGE PEST CONTROL GUIDE

The tolerance for live pests in grain sold off farm is nil. With growers increasing the amount of grain stored on farm, an integrated approach to pest control is crucial.

KEY POINTS

- Effective grain hygiene and aeration cooling can overcome 85 per cent of pest problems.
- When fumigation is needed it must be carried out in pressure-tested, sealed silos.
- Monitor stored grain monthly for moisture, temperature and pests.

PHOTO: CHRIS WARRICK, KONDININ GROUP

Attack early: *Managing grain storage pests starts before grain enters the storage with grain hygiene and structural treatments.*

Prevention is better than cure

The combination of meticulous grain hygiene plus well-managed aeration cooling generally overcomes 85 per cent of storage pest problems.

For grain storage, three key factors provide significant gains for both grain storage pest control and grain quality – hygiene, aeration cooling and correct fumigation.

Hygiene

The first grain harvested is often at the greatest risk of early insect infestation due to contamination.

One on-farm test found more than 1000 lesser grain borers in the first 40 litres of wheat passing through the harvester.

Remove grain residues from empty storages and grain handling equipment, including harvesters, field bins, augers and silos to ensure an uncontaminated start for new-season grain.

Clean equipment by blowing or hosing out residues and dust and then consider a structural treatment (see Table 2, page 2).

Remove and discard any grain left in hoppers and bags from the grain storage site so it doesn't provide a habitat for pests during the off season.

Aeration cooling

Freshly-harvested grain usually has a temperature around 30°C, which is an ideal breeding temperature for storage pests (see Table 1).

Studies have shown that rust-red flour beetles stop breeding at 20°C, lesser grain borer at 18°C and below 15°C all storage pests stop breeding.

TABLE 1 THE EFFECT OF GRAIN TEMPERATURE AND MOISTURE ON STORED GRAIN INSECT AND MOULD DEVELOPMENT

GRAIN TEMPERATURE (°C)	INSECT AND MOULD DEVELOPMENT	GRAIN MOISTURE CONTENT (%)
40-55	Seed damage occurs, reducing viability	
30-40	Mould and insects are prolific	>18
25-30	Mould and insects active	13-18
20-25	Mould development is limited	10-13
18-20	Young insects stop developing	9
<15	Most insects stop reproducing, mould stops developing	<8

Source: Kondinin Group

Aim for grain temperatures of less than 23°C during summer and less than 15°C during winter.

When placing grain into storage, run aeration fans continuously for the first 2-3 days to push the first cooling front through the grain and to create uniform moisture conditions.

Then run the fans during the coolest 9-12 hours per day for the next 3-5 days. This will push a second cooling front through the grain bulk.

Aeration cooling generally only requires air-flow rates of 2-4 litres per second per tonne.

Finally the grain requires approximately 50 hours of appropriate quality air each fortnight during storage.

Use an aeration controller that will perform the cooling process at the right time and continue to aerate the grain selecting the coolest air to run fans.

An effective aeration controller will also ensure fans don't operate when the relative humidity is higher than 85 per cent, which can re-wet and damage grain if operated for extended periods.

Ineffective fumigation

Fumigation with phosphine is a common component of many integrated pest control strategies.

Taking fumigation shortcuts may kill enough adult insects in grain so it passes delivery standards, but the repercussions of such practices are detrimental to the grains industry.

Poor fumigation techniques fail to kill pests at all life cycle stages, so while some adults may die, grain will soon be reinfested again as soon as larvae and eggs develop.

What's worse, every time a poor fumigation is carried out, insects with some resistance survive, and pass the resistance gene into their progeny making control more difficult in the future.

Effective fumigation

Using the right type of storage is the first and most important step towards an effective fumigation.

Only use fumigants, like phosphine, in a pressure-tested, sealed silo.

Research shows that fumigating in a storage that is anything less than pressure sealed doesn't achieve a high enough concentration of fumigant for a long enough period to kill pests at all life cycle stages.

For effective phosphine fumigation, a minimum of 300 parts per million (ppm) gas concentration for seven days or 200ppm for 10 days is required. Fumigation trials in silos with small leaks demonstrated that phosphine levels are as low as 3ppm close to the leaks. The rest of the silo also suffers from reduced gas levels.

TABLE 2 RESISTANCE AND EFFICACY GUIDE FOR STORED GRAIN INSECTS 2010 – CEREAL GRAINS SEPTEMBER 2010 (WESTERN GRAIN PRODUCTION REGIONS).

BEFORE APPLYING – CHECK WITH YOUR GRAIN BUYERS / BULK HANDLERS AND READ LABELS CAREFULLY

TREATMENTS	WHP (DAYS)	 LESSER GRAIN BORER *(Rhyzopertha dominica)*	 RUST-RED FLOUR BEETLE *(Tribolium castaneum)*	 RICE WEEVIL *(Sitophilus oryzae)*	 SAW-TOOTHED GRAIN BEETLE *(Oryzaephilus surinamensis)*	 FLAT GRAIN BEETLE *(Cryptolestes ferrugineus)*	 PSOCIDS *(booklice) (Order Psocoptera)*	 STRUCTURAL TREATMENTS
Grain disinfectants – used on infested grain to control full life cycle (adults, eggs, larvae, pupae).								
Phosphine (eg Fumitoxin®)[1,3] when used in gas-tight, sealable stores	2							
Sulfuryl fluoride (eg ProFume®)[6]	1							
Diatomaceous earth, amorphous silica – effective internal structural treatment for storages and equipment. Specific use grain treatments.								
Diatomaceous earth, amorphous silica (eg Dryacide®)[4]	nil[2]							
Fenitrothion (eg Fenitrothion 1000®)[5]	One month before loading grain	On farm – STRUCTRAL TREATMENT ONLY						

KEY

WHP Withholding Period ☐ Not registered for this pest ☐ High-level resistance in flat grain beetle has been identified, send insects for testing if fumigation failures occur ☐ Effective control

1 Unlikely to be effective in unsealed sites, causing resistance, see label for definitions. **2** When used as directed on label. **3** Total of (exposure + ventilation + withholding) = 10 to 27 days. **4** Do not use on stored maize destined for export, or on grain delivered to bulk-handling authorities. **5** Nufarm label only. **10** Restricted to licensed fumigators or approved users.

Source: Registration information courtesy of Pestgenie, APVMA and InfoPest (DEEDI) websites

Achieve effective fumigation by placing the correct phosphine rates (as directed on the label) onto a tray and hanging it in the top of a pressure-tested, sealed silo or into a ground level application system if the silo is fitted with recirculation.

After fumigation, ventilate grain for a minimum of one day with aeration fans running, or five days if no fans are fitted.

A minimum withholding period of two days is required after ventilation before grain can be used for human consumption or stock feed.

The total time needed for fumigating is 10-17 days.

As a general rule, only keep a silo sealed while carrying out the fumigation (for example, one to two weeks).

If grain moisture content is low (8-12%) the silo can remain sealed after fumigating but regular monitoring is essential to check for insect infestation and moisture migration to the head space.

Monitoring

When grain is put into storage it needs monitoring just like it does when it's in the paddock – regularly.

Check stored grain at least monthly, taking samples from the bottom, and if safe, the top of the storage.

Things to monitor:

- Insect pests
- Grain temperature
- Grain moisture content
- Grain quality and germination

Storage choices

When buying a new silo, buy a quality, sealable silo fitted with aeration and check with the manufacturer that it meets the Australian Standard for sealable silos (AS2628).

Experience has shown that at least two sealable, aerated silos on farm provide the option for an effective fumigation and delivery program.

Many older silos are not designed to be sealed and cannot be used for fumigation, however retro-fitting aeration can reduce insect multiplication through grain cooling.

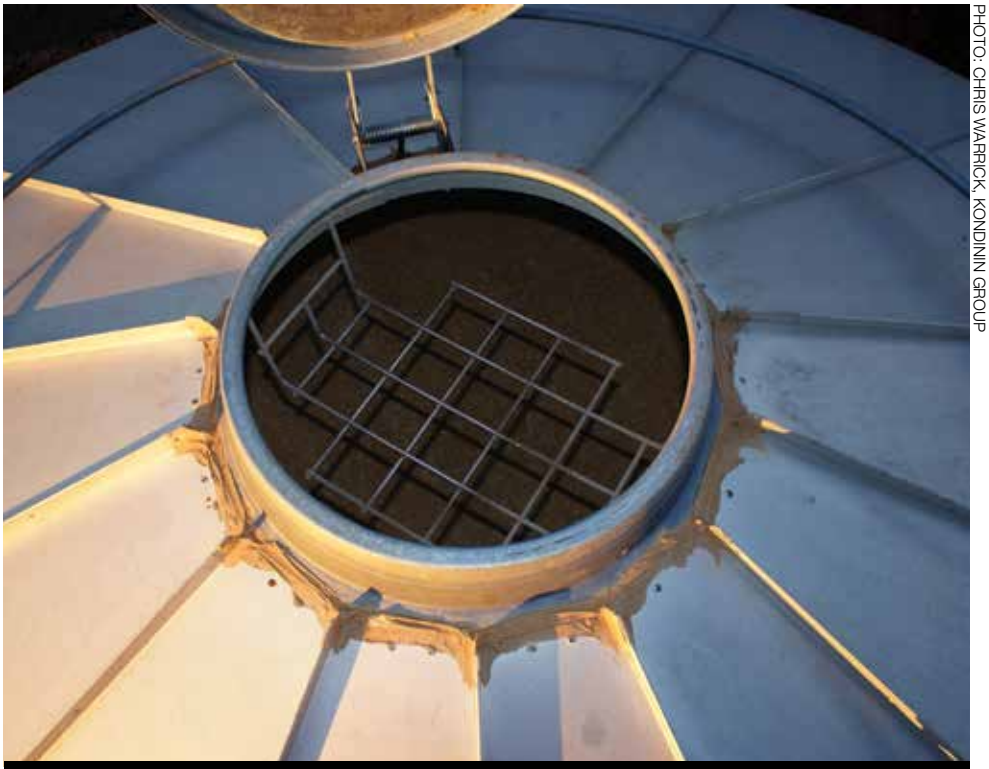


PHOTO: CHRIS WARRICK, KONDININ GROUP

Check regularly: *Monitor stored grain at least monthly, including sampling from the top of the storage, if it can be done safely, or with a pitfall trap.*

Seed held on farm (cereals — wheat, barley, oats)

Seed that is dry, cool and sound (not weather damaged) will remain viable for longer.

In well-managed storage, germination percentages can be expected to reduce by only 5 per cent after six months.

To achieve this, keep grain moisture content below 12%.

Grain temperature also has a major impact on germination.

Aim for grain temperatures of 20°C and below in seed storage by using aeration cooling (with auto control).

Wheat at 12 per cent moisture content stored at 30-35°C (unaerated grain temperature) will reduce germination percentages and seedling vigour when stored over a long period.

Position small seed silos in the shade or paint them reflective white to assist keeping grain cool.

WA growers can treat seed with a grain protectant combined with a dyed grain fungicide in combination with aeration cooling to maximise insect control.

Pulse and oilseeds

Insect control options are limited for stored pulses and oilseeds.

Aeration and phosphine fumigation are the main methods and controlled atmosphere (inert gasses such as carbon dioxide or nitrogen) may be an option.

The effectiveness of phosphine fumigation on oilseeds is often reduced due to phosphine sorption during treatment. Monitoring gas concentrations with a gas monitor is essential to ensure the correct concentration is achieved for the correct length of time.

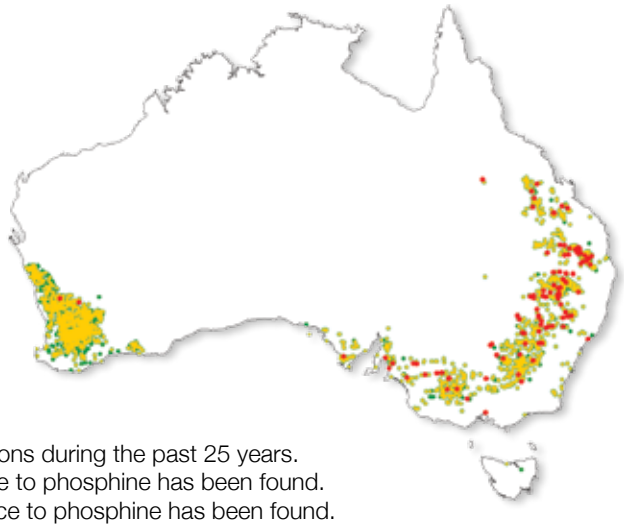
Use sound grain hygiene in combination with aeration cooling to reduce insect activity. Small seed-size grains, such as canola, may need larger-capacity aeration fans to combat the greater amount of back pressure in the storage.

Always store these grains at their recommended grain moisture content level.

PHOSPHINE RESISTANCE IS WIDESPREAD – PLAN, MONITOR AND CONTROL FOR CLEAN GRAIN

- Dispose of grain residues and seed gradings. Clean empty storages and grain handling equipment, including harvesters, field bins and augers.
- Sieve stored grain for the presence of insects at least monthly, or use pitfall traps. Also check grain temperature and moisture.
- If grain temperature has been kept below 15°C by aeration, live insect numbers are likely to be low.
- Sample grain three weeks before sale to allow time for any treatment.
- For effective fumigations, pressure test sealable silos at least once a year to identify any leaks and ensure rubber seals are maintained.
- Phosphine fumigation typically requires 7 to 10 days in a gas-tight sealed silo. When completed, open silo top with care, ventilate using aeration fan for one day; if not aerated, open silo top and ventilate for five days. The minimum withholding period is then two days after ventilation is completed. The total time needed for fumigation is therefore 10-17 days.
- Sieve a half-litre sample onto a white tray. Hold tray in sunlight to warm for 20 to 30 seconds to encourage insect movement.
- If live insects are found, identify them and fumigate in a gas-tight silo according to the label.
- Take care when climbing silos to sample grain for insects and wear a safety harness. Sample from the base, and if safe, take a sample from the surface of the grain.

FIGURE 1 PHOSPHINE RESISTANCE – NATIONAL SITUATION



- Sampling locations during the past 25 years.
- Weak resistance to phosphine has been found.
- Strong resistance to phosphine has been found.

Source: DAFWA

Useful resources

GRDC Grain storage extension project
www.storedgrain.com.au

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GRDC PROJECT CODE

PAD00001

Acknowledgements: Philip Burrill, DAFF QLD. Peter Botta, PCB Consulting. Chris Newman, Stored Grain Services. Ben White, GIWA. Chris Warrick, ProAdvice.

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