GRDC SUPPORT FOR GRAIN STORAGE EXTENSION

Following the successful 2009-2012 Grain Storage Extension Project, the GRDC have committed support through to 2015.

The investment provides a stored grain information hub to equip growers with the skills and knowledge to implement best management practices for storing grain on-farm.

Some familiar faces continue as key members of the extension team, while some new blood's will take on a front line role as part of a succession plan for grain storage extension.

Development Agronomist Philip Burrill continues as the key contact for the northern region, conducting workshops for growers and advisers. He will also act as a conduit to ensure new research outcomes are passed onto growers / advisers and current problems that industry raise are passed back to research teams.

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www.storedgrain.com.au

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PUBLICATIONS ON GRAIN STORAGE AVAILABLE FROM THE GRDC

GRDC has a number of excellent publications on grain storage - including:

- **Grain Storage Facilities – Planning for efficiency and quality (GRDC747)**

Grain storage systems come in a range of shapes and sizes to meet farm requirements and careful planning is needed to optimise an on-farm grain storage facility investment. This booklet looks at the benefits and pitfalls of various storage types including silos, grain storage bags, sheds and bunkers, facility and site considerations and case study examples of storage layouts.

- **Aerating stored grain – cooling or drying for quality control (GRDC650)**

A guide to managing aeration cooling and drying - outlining the process, equipment requirements and potential results.

- **Fumigating with Phosphine, other fumigants and controlled atmospheres (GRDC579)**

This 14-page, full-colour booklet explains how using phosphine the wrong way can contribute to resistance problems, and clarifies how to use it most effectively to achieve reliable results.

These are FREE publications (there is a P&H charge of $10.00). Copies are available from Ground Cover Direct: Freephone: 1800 11 00 44, Freefax: 1800 00 99 88

Email: ground-cover-direct@canprint.com.au

One stop website for stored grain information www.storedgrain.com.au

A large range of resources are available at www.storedgrain.com.au to assist growers and their advisers in decision making and management of grain storage. Resources include information on:

- Storage pests and insects
- Insect control
- Hygiene and structural treatments
- Grain storage facilities
- Grain aeration
- Economics and grain storage
- Safety around grain storage
- Grain quality
- Other information

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Grains Research UPDATE
NORTHERN REGION

STORED GRAIN INSECTS: HOW THEY SPREAD AND IMPLICATIONS FOR RESISTANCE

New research in southern and central Queensland has thrown light on the flight dispersal by the lesser grain borer (*Rhyzopertha dominica*) and the rust-red flour beetle (*Tribolium castaneum*), both of which are major insect pests of stored grain.

"Until recently, little was known about the flight dispersal abilities of these beetles despite the threat they pose to growers", said Dr Greg Daglish from the Department of Agriculture, Fisheries and Forestry (DAFF) Qld. He explained that researchers used traps with species-specific pheromone lures to catch these small and sometimes elusive pests. "In this research, with the assistance of GrainCorp staff, beetle traps were set along a 30 km transect running from north of the Emerald depot to south of the Gindie depot. This work was important", Dr Daglish said "as it expands the focus from just storages, to the broader rural landscape. Understanding pest ecology will provide guidance on how to manage these pests".

Dr Andrew Ridley, also from DAFF Qld, explained that "the lesser grain borer is flying all year round in Central Queensland while the flour beetle appeared to be located mainly around storages during the winter months and then spread out into the surrounding district in summer."

"This study highlights the importance of finding and dealing with infestations to limit the number of pests that can infest clean grain. In another study, the team found that beetles were flying between farms on a scale of at least 100 km. The industry may need to consider an area wide approach to pest and resistance management", said Dr Ridley.

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This research was supported by the former CRC for National Plant Biosecurity (CRCNPB) of which GRDC was a core participant.

SULFURYL FLUORIDE – A SOLUTION TO PHOSPHINE RESISTANCE?

According to the research results from scientists at Queensland's Department of Agriculture, Fisheries and Forestry, Sulfuryl fluoride (SF) has excellent potential as an alternative fumigant to control phosphine resistant grain storage pests. Project leader Dr Manoj Nayak said "to manage phosphine resistance, reliance on a single treatment should be avoided and the strength of each alternative should be manipulated and fitted to an integrated strategy". The good news is that SF is currently registered in Australia as a grain disinfestant.

SF, supplied under the tradename of ProFume™, can only be used by a licensed fumigator who has also undertaken training designed by the manufacturer Dow AgroSciences. The licensed fumigator can apply it both at bulk handlers and farmer's

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storages. SF, as with Phosphine, requires a sealable gas tight storage for fumigation.

Phosphine continues to be the grain fumigant of choice for the Australian grain industry as it is low cost, relatively easy to use and has broad international acceptance as a residue-free treatment. “Over-reliance on this unique fumigant, has led to the development of resistance in major grain storage pests. The strongest levels of resistance are in *Cryptolestes ferrugineus*, said Dr Nayak. With current registered rates of phosphine failing to control resistant populations of this pest, *Cryptolestes ferrugineus* has emerged as a major problem in bulk grain storages, particularly in the northern and southern grain belts of Australia.

“Both domestic and international markets demand insect free grain. Thus to sustain our access to world markets and maintain a competitive edge, it is imperative that we develop and use strategies to combat phosphine resistance”. This key industry issue was addressed in a CRCNPB project that established fumigation protocols for using SF as an alternative to phosphine and validated these in large bulk storages.

“Field trials run in collaboration with bulk grain handling companies have shown that SF can control strongly phosphine resistant *Cryptolestes ferrugineus* populations. Monthly sampling of fumigated grain has revealed no live insects for 3 consecutive months in large-scale bunker (pad) storages after the fumigation.

“The impact of using SF as an alternative fumigant was also assessed by analysing annual resistance monitoring data. This revealed that after the introduction of SF in central storages across the northern and southern grain regions in 2010, there was a 50% reduction in the incidence of strongly phosphine resistant *Cryptolestes ferrugineus* populations at the end of the first year, and the downward trend is continuing. Complimentary laboratory experiments have shown that phosphine resistance does not show cross-resistance to SF, which is an additional advantage for using SF”, Dr Nayak said.

As with all sound pest control strategies, SF or phosphine use should be integrated with good practices including, storage hygiene, regular pest monitoring and use of aeration to reduce grain temperatures.

Based on the research findings, Dr Nayak recommends the following for use of SF:

1. All SF fumigations should be carried out by accredited fumigators using current registered rates
2. SF should only be used as a ‘phosphine resistance breaker’ and be used exclusively where phosphine fails to control infestations
3. The number of fumigations should be limited in a calendar year to delay the development of resistance

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SILO BAG FUMIGATION

Research conducted by Dr Andrew Ridley and Philip Burrill from DAFF Qld and Queensland farmer Chris Cook, has found that if you are careful, sufficient concentrations of phosphine can be obtained for the required length of time to successfully fumigate grain in a silo bag. “Recent trials on a typical 75m bag containing approximately 230 t of grain were successful in controlling all life stages of the lesser grain borer (*Rhyzopertha dominica*)”, said Dr Ridley.

“For a fumigation to be successful, the bag must be well sealed. Part of good silo bag management is the regular inspection for holes in the bag. Prior to fumigation, special effort should be made to seal any holes that may have been created by birds, mice and other wildlife. Silicone-based sealant products create an effective seal over small punctures. It is illegal to mix phosphine tablets with grain because of residue issues, but it is easy to keep them separated. In trials, 1m perforated conduit was used to hold the tablets and contain the spent dust. The tubes can easily be speared horizontally into the silo bag and removed at the end of the fumigation.

“Trial results suggest that the spears should be no more than 7m apart. In previous trials, when spears were spaced 12m apart, the phosphine diffused through the grain too slowly (Figure 1). Even with the spears at 7m apart, the fumigation time is slightly longer than in a sealed silo – needing to be extended to 12-14 days”, said Mr Burrill.

“Venting before outloading is essential for safe fumigation of any structure with phosphine. To vent the bag, a standard Customvac F650 aeration fan (powered by a 1.5 kW electric motor) was used in trials. A 100mm diameter aeration grain spear was inserted into the start of the bag and connected to the suction side of the fan. The finish end of the bag was opened up widely during venting to ensure maximum airflow. The fan was run continuously for 12 hours”, said Dr Ridley.

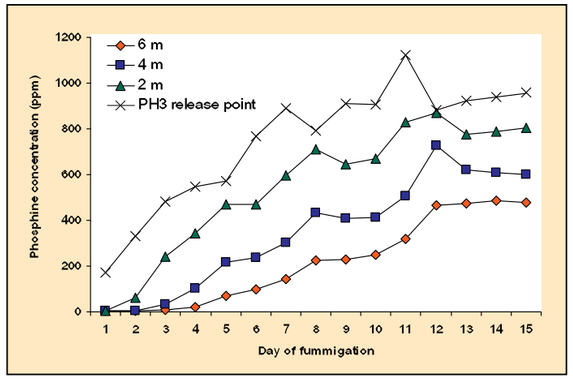

Figure 1. Spread of phosphine gas in a silo bag from a release point to gas monitoring lines at 2, 4 and 6 m along a silo bag.

The above graph shows that phosphine concentrations in grain close to the site of release rise much faster than grain that is more distant from the point of release.

Just like a silo, it takes time for phosphine to move through the bag. This graph showed that the tablets need to be inserted every 7 m to ensure that phosphine gets to all the grain within 2-3 days. We still require a 12 – 14 day fumigation period to ensure an effective fumigation.

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PERFORMANCE TESTING AERATION SYSTEMS

It is critical that aeration users can accurately measure aeration fan performance on their silos. Currently however, users have no method to measure the working airflow rates of fans in situ and rely on estimates and advice from fan suppliers. Very serious grain damage has occurred when fan performance has not met required airflow rates L/s/t (Litres / second / tonne). When cooling or drying grain with elevated moisture levels, an inadequate air flow rate and / or poor system design can see sections of the storage develop very high grain temperatures. When aeration drying, moisture drying fronts can be moving too slow to prevent grain spoilage. Grain quality losses from moulds and insect damage can occur rapidly. This type of damage often makes the grain difficult to sell and in some cases may cause physical damage to the silo itself.

Aeration cooling using fan-forced ambient air is a key non-chemical tactic for protecting stored grain. Forcing cool air through grain lowers grain temperature and stops or reduces reproduction of grain storage insect pests limiting the need for chemical treatments. At high flow rates, aeration is also used for drying grain to reduce mould growth and to meet market requirements for moisture content.

Using readily available materials, DAFF Qld researchers Mr Philip Burrill and Dr Andrew Ridley in a collaborative project supported by the CRC for National Plant Biosecurity with Toowoomba based aeration equipment supplier CustomVac and Dr Chris Saunders from the University of South Australia, developed a device that measures working airflow rates of fans fitted to grain storage.

The device called the ‘A Flow’ has been validated under controlled conditions using an Australian Standard fan performance test rig to be within 2.6% of the true fan output. The device was then used on a typical grain storage that was in the process of aerating recently harvested grain. A fan advertised to provide 1000 L/s, (equivalent to 6.7 L/s/t on a full 150 t silo), was demonstrated to be only producing 1.8 L/s/t. As a result of this test, the farmer recognised a need to make changes to his current aeration system design.

Aeration is a vital part of the pest control strategy. Reducing grain temps by 10 degrees C during summer time storage, significantly reduces the threat of a serious insect infestation in storages. There are also plenty of grain quality benefits for cereal grains, oilseeds and pulses.

There are a number of changes that may be required if airflow rates are not suitable for efficient aeration cooling or drying. A new fan that is better suited to the task could be installed; a second fan added; or the amount of grain in the silo reduced to increase flow rate per tonne of grain. A GRDC factsheet explaining how to build and use an A Flow is available at http://www.grdc.com.au/Resources/Factsheets/2012/08/Grain-Storage-Performance-testing-aeration-systems

Figure 2: The ‘A-Flow’ fitted to the aeration fan intake ready for air flow measurements.

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