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## **Australia's On-Farm Grain Storage Extension Project – a national initiative improving stored grain pest management and maintaining phosphine fumigation efficacy on-farm for the Australian grains industry.**

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### **Abstract**

Phosphine's continued use in Australia to control grain insect pests in on-farm and central storage systems is threatened through increased resistance in both frequency and strength in target insect pests. Effective fumigation combined with best practice integrated pest management is essential to the sustainability of grain biosecurity, food safety, quality assurance and market access for Australian post-harvest grain systems.

The National Stored Grain Extension Program (NSGEP) is an industry funded initiative developed to facilitate best practice in grain storage management within Australia's grains industry. The NSGEP uses a multi approach engagement strategy and a variety of adult learning principles and training techniques aimed at increasing awareness and knowledge to build capacity and support to enable farmers and industry to manage their grain storage systems and meet best practice and market requirements. These include: training workshops, field days, practical demonstrations, industry forums, multi-media and website development and building networks with grower groups, government agencies and agribusiness.

Various evaluation methods have shown that awareness and adoption of best practice in on-farm grain storage management has increased. Key outcomes include increased knowledge in insect identification and skills development and practice change in the management of grain hygiene, aeration, phosphine application, silo testing and planning of storage systems.

The NSGEP contributes to the positive on-going changes observed in Australia's on-farm grain storage systems, primarily through the specialized extension network of information, support and training provided that is highly regarded and in demand. It plays an instrumental role in building capacity and maintaining phosphine fumigation efficacy in the Australian grains industry.

## **Introduction**

This paper reports on a Grains Research and Development Corporation (GRDC) sponsored project in extension for on-farm grain storage. The project was a national extension project, this paper focuses on the south eastern grain growing region of Australia, where the author is based and on-farm grain storage has increased significantly as a consequence of the deregulation of the domestic and export markets.

Phosphine fumigation is widely used to kill insect infestations in on-farm and central receival storages. When applied in unsealed storages poor results are typically attained which can lead to rejection at receival sites due to poor insect control and or detection of phosphine in the delivered grain. Use of phosphine in unsealed storages is a risk to the occupational health and safety of the user and increases resistance to phosphine. Safe phosphine application is essential to maintain the continued use of phosphine.

The project involved a multi approach to improve on-farm storage practises and the efficacy and safe application of phosphine for fumigation. The project consulted and worked with key industry stakeholders including state based departments of agriculture, research institutions, regulators, bulk handling authorities, silo and machinery manufacturers, training bodies, private agronomists and consultants, peak farmer representative bodies and farmer growing system groups.

Key elements of the project were delivery of best practise grain storage management and phosphine fumigation workshops and field days aligned to adult learning principles, information packages, media releases and communication, phosphine label changes and the introduction of an Australian Standard for gas-tight sealable silos.

## **Materials and Methods**

The project involved using a multi approach to improve on farm grain storage management and phosphine fumigation practises including;

Workshops and field days were conducted for farmers, agribusiness and advisers on the principles of best management grain storage and fumigation practises. Grower, industry, silo and agricultural machinery networks were used to set up events in local areas. Events were advertised through these networks and local media and local grain storage issues were assessed to ensure the events were relevant to the immediate needs of participants as well as delivering the key messages around best practise fumigation and grain storage management.

Workshops and field days were developed and conducted using adult learning principles to create a positive learning environment for participants, build capacity in the industry to further support farmers and enable farmers and industry to implement ongoing changes in their grain storage systems. Typically the event would be for 3 to 4 hours depending on discussion and either started or finished with a meal and socialising to foster further discussion and knowledge transfer.

The events used a variety of delivery and training techniques, including auditory, sensory, visual and practical learning examples to cater for the different learning styles of the participants. Learning materials were supplied during the event and contact and further information details were given for participants to follow up on any questions.

Sessions would include presentations of best management practises combined with demonstrations and practical examples either at an on-farm grain storage or local grain storage site.

Group discussion and knowledge sharing was an integral component of each session, fostering learning and skills development for the participants.

A certified phosphine training course, "Responsible, Safe and Effective Use of Phosphine Generating Formulations on Farms" was developed with a chemical training provider (AusChem Training Inc) for on farm users. This course is available for training on-farm users of phosphine throughout Australia.

Best practise fumigation and grain storage management presentations were delivered at a variety of industry forums including GRDC Research and Grower updates, agribusiness and industry field days and seminars.

In consultation with industry a Strategy to manage resistance to phosphine was written to encompass the variety of grain storage systems in the Australian grain value chain. The strategy was written for use by small through to large central receival bulk handling authorities, grain growers and end users. This strategy has been adopted by the industry as a blueprint to manage phosphine resistance.

To support the training activities a variety of media articles were written and disseminated throughout local newspaper, journal and newsletter outlets. Articles were written in response to arising issues and as general information for growers and to promote best practise phosphine fumigation and management. A DVD was recorded on gas-tight sealed silos and phosphine use and distributed via the GRDC to all registered grain growers in Australia and uploaded onto YouTube and GRDC television. Radio interviews and discussions were also used to disseminate information and advice.

As an integral part of the nationwide project information packages and materials were developed and distributed through a variety of industry channels and were available at workshops and field days. Two written specifically for fumigant use were a GRDC factsheet called "Pressure testing sealable silos" and a booklet called "Fumigating with phosphine, other fumigants and controlled atmospheres. Do it right – Do it once".

Label changes to phosphine are currently being written to improve overall management of the product, safe use and to improve resistance management. Label changes have also been made to enable regulators to enforce breaches of the label, particularly in regards to what constitutes a suitable sealed structure.

In conjunction with SAI Global (formerly Standards Australia) the author convened a committee to write an Australian Standard for sealed silos. Prior to the Australian Standard (AS 2628-2010), there was no industry benchmark for sealed silos which growers could use to determine whether a silo they were purchasing was actually sealed and gas-tight when purchased. The committee was made up of representatives from State Department of Agriculture research scientists, the CSIRO, State and national farmer peak industry bodies and silo manufacturers. The committee consulted widely with industry, chemical registrants, the AVPMA and grower bodies and representatives.

All of these approaches were used to deliver a whole of industry extension program promoting best practise on-farm grain storage management and phosphine fumigation.

## **Results and Conclusions**

Personal communication and anecdotal evidence in communication with the grains industry and value chain has demonstrated that on-farm grain storage management and the awareness and implementation of best practise phosphine fumigation has increased. Feedback from silo manufacturers has shown that growers are actively asking for Australian Standard compliant sealed silos when comparing and purchasing sealed silos. The Australian standard enables growers to purchase a sealed silo which meets a standard gas-tight pressure test, enabling them to have the correct system to fumigate. Prior to this standard being enacted growers found it difficult to benchmark silos in the marketplace, where a number of silo manufacturers claimed their silos were sealed but did not meet the standard pressure test.

The Australian standard alone does not ensure that efficacious phosphine fumigations can be administered; however it is the first step in ensuring a grower has the correct system in which to undertake an efficacious and safe fumigation.

Stakeholders across the grains value chain are asking for and disseminating best practise information through their networks and the many grower workshops and field days conducted through the national extension project and industry forums. Development of the various information packages covering best management practises for on-farm storage and fumigation provides a mechanism for growers and industry to support the training and knowledge development they have undertaken. The phosphine booklet "Fumigating with phosphine, other fumigants and controlled atmospheres" was a comprehensive and farmer friendly publication covering sealed storage management, silo testing and best practise fumigation. The Australian standard provided growers with the tools to select sealed storage, the extension program and information packages built on and supported best practise fumigation and grain storage.

At workshops and field days growers are taught the theory behind a successful fumigation and with practical demonstrations shown the features of a gas-tight sealed silo, how to maintain and replace seals and how to perform a standard pressure test to test whether they are sealed. A website [www.storedgrain.com](http://www.storedgrain.com) was developed to further provide a source for growers and industry to look for and download information.

Using mediums such as websites and the media allowed specific and timely information to be brought to the attention of growers and industry and to promote key messages when necessary. An example of this was a major media campaign using rural media and industry networks promoting and discussing the Australian standard for sealed silos, which was a great success and very quickly converted to growers actively asking whether silos being considered and or purchased met the standard.

Newspaper and newsletter articles and radio interviews are regularly released to promote best practise fumigation and grain storage practises when the information is timely and can be used to assist farmers in their storage management.

The accredited phosphine training module has had a minor uptake to date, largely due to growers still not being required to undertake training specific for the use of phosphine in all states except New South Wales. Currently New South Wales farmers are required to undertake phosphine training as a Work Cover (Occupational Health and Safety regulator) requirement. State regulators of chemical use are currently considering mandatory training for phosphine use, particularly in Victoria. The introduction of training is being considered as part of a response by regulators to the potential label changes for phosphine being proposed to the APVMA (Australian pesticides and veterinary medicines authority).

Overall the extension project has had a positive impact on improving the efficacy of phosphine fumigation in on farm fumigation. Growers are actively asking for Australian Standard Compliant sealed silos. Growers, industry and agribusiness are asking for and disseminating best practise information through their networks, and there has been a continuing demand for workshops and field days and addresses at industry forums.

### **Temporal and Spatial Patterns in Aerosol Insecticide Droplet Distribution: Modifying Application Strategies to Improve Coverage and Efficacy**

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