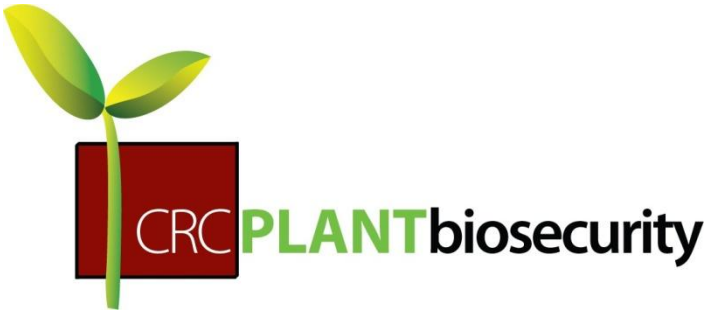

Cooperative Research Centre
for National Plant Biosecurity

Final Report

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Grains Knowledge Networks

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1. Executive Summary

This project was undertaken in response to the need to maintain phosphine as a valuable tool for the management of insects in stored grain. This fumigant has the combined attributes of being cheap, effective for most commodities, compatible with grain handling logistics and accepted by domestic and international markets as residue-free. As a result, phosphine is central to pest management in the Australian grains industry and its continued effectiveness is essential to the sustainability of grain hygiene and market access for Australian grains.

In the past 15 years however, resistance to phosphine in insect pests of stored grain has increased in both frequency and strength such that continued use of the fumigant is now threatened. Through identification of stakeholders and evaluation of current knowledge and practices, the project found that there was significant mis-use of the fumigant occurring, principally for two reasons. Firstly, there is a large volume of complex information in relation to best practice in grain storage, and many stakeholders find the issues confusing or are unaware of their importance. Secondly, there are currently few drivers that encourage best practice or demand changes in poor practice.

The project recognised that practice change takes time, and while it starts with improved awareness through continual and consistent delivery of messages, it must be accompanied by the identification and provision of drivers for change. While there has been initial success in raising awareness of grain storage issues through delivery of information through the Grains Storage Extension (GSE) project and Grains Farm Biosecurity Program (GFBP), for true practice change to occur within the grains industry, fundamental changes are required within the grains supply chain to ensure that improved grain storage best management practice occurs.

2. Aims and objectives

This project aims to develop an effective change management strategy for the grains industry to improve its phosphine resistance management outcomes. Phosphine is a valuable tool for the management of insects in stored grain but in recent years resistance to phosphine in insect pests of stored grain has increased in both frequency and strength such that continued use of the fumigant is now threatened.

In response, significant research has been, and is being, undertaken to develop strategies to maintain the sustainable use of phosphine and a strategy has been developed to provide practical best management guidelines for its use (Collins 2009). This strategy forms the basis for development of extension material to all parts of the grains industry to ensure that consistent key messages are delivered nationally.

A key issue remains the ability to deliver information in a way that results in improved management of phosphine in the grains industry. It has been recognised that in many instances this requires changes in the behaviour of growers, bulk handlers and other industry personnel. To achieve this, evaluation and provision of methods of information exchange was needed and to address this the Grains Knowledge Network (GKN) project was initiated. This project has commenced to manage development of phosphine resistance through three main components:

- Identification and evaluation of the networks that exist within the grains industry for the delivery and exchange of information through research conducted by the Bureau of Rural Sciences (BRS) within Department of Agriculture, Fisheries and Forestry (DAFF).

- Establishment of mechanisms to deliver this information through co-funding of Grains Biosecurity Officers.

- Identification of economic factors that influence phosphine resistance management practices.

As part of the GKN project, the evaluation being conducted by BRS included an assessment of stakeholders including, who they are, their current knowledge and perceptions of phosphine use and resistance, the types of communication activities effective in providing information and the market imperatives that influence their use of phosphine. Information from this evaluation was used to develop a model for enhancing knowledge exchange.

3. Key findings

The project was divided into two major tasks namely the identification of information networks to limit the build up of phosphine resistance in Australia and the appointment of grains biosecurity officers whose role includes the delivery and promotion of extension material and programs to manage the emerging problem of phosphine resistance.

In this project, the priority areas addressed have been broken down into separate activities including:

- Development of phosphine resistance communication strategy
- Review and collation of the strategy to manage resistance to phosphine in the Australian grain industry
- Review of knowledge transfer strategies
- Change management plan for knowledge exchange
- Stakeholder map and literature review of social networks for phosphine resistance management in stored grains
- Development of biosecurity and phosphine resistance knowledge transfer programs and materials
- Development of pilot programs for change management (stage 1 and stage 2)
- Development of end-user benefit-cost analysis (BCA) tool designed to assist decision making at the time of the purchase of a new silo and a review of economic cost benefit analyses, tools and models for on-farm grain storage
- Appointment of grains biosecurity officers in five states (funded partly by this project)

3.1. Development of 'Phosphine resistance communication strategy'

The purpose of the strategy was to promote the strategic adoption and implementation of practical, scientifically-based management strategies to improve the long-term sustainability of phosphine for control of insects in stored grain. Once finalised, the strategy was used as the basis for development of extension material for all parts of the grains industry and to ensure that consistent key extension messages are delivered nationally.

The strategy applies to all sectors of the industry, however as implementation will be voluntary, success will depend on industry commitment and widespread compliance. The development and assessment of a communication plan is therefore a critical component for the uptake of improved phosphine management both on-farm and within bulk storage facilities.

For successful implementation of this plan, the following components must be defined:

- Measurable and achievable objectives
- Target audiences
- Current practices of the target audiences
- Types of media and activities to be used
- Evaluation methods

Evaluation of the stakeholders (audience) was conducted by the BRS and includes an assessment of stakeholders including; who they are, their current knowledge and perceptions of phosphine use and resistance, the types of communication activities effective in providing information and the market imperatives that affect their use of phosphine (see section 3.4).

Effective exchange of information requires the identification of stakeholders with grain growers, grain farming/production consultants, agribusiness (direct contact with growers-include grain end-users, packers, exporters), distributors of phosphine (rural Agchem retailers/ advisors of phosphine), silo manufacturers (and points of sale), bulk handling company staff considered to be the primary target audiences. Scientific researchers and government agriculture staff were considered to be secondary target audiences.

The *Strategy to manage resistance to phosphine in the Australian grain industry* (see section 2.2) provided the technical content for development of targeted, consistent, scientifically sound and practical messages, a critical part of the communication strategy.

Activities identified in the communication plan were:

1. Audit of existing resource material
2. Identification of new resource material
3. Preparation of media articles
4. Grains storage and grain marketing supplements
5. Preparation of web content
6. Preparation and delivery of training
7. A need for national branding

3.2. Review of the 'Strategy to manage resistance to phosphine in the Australian grain industry'

Prior to this project, a draft strategy for management of resistance to phosphine had been prepared as a previous initiative of the National Working Party on Grain Protection. Additional funds were sought from the CRCNPB to hold a workshop that would bring together key grain storage researchers, extension officers, entomologists and laboratory testing personal, representatives from the key bulk handling companies (GrainCorp, CBH, ABB/Viterra) and PHA to review current literature and communication materials for the management of phosphine material and to finalise completion of the national strategy.

The goal of the strategy was to ensure the long-term sustainability of phosphine through the strategic adoption and implementation of commercially viable, practical, scientifically-based management strategies.

The core principles of the strategy were to:

- reduce selection of resistant insects by
    - limiting the number of applications of phosphine
    - using non-chemical methods (ie cooling and storage, and equipment hygiene practices) to minimise reliance on phosphine to control insect populations
    - reducing insect infestation levels at a site by complete emptying of all storages
- destroy resistant insects by
    - ensuring gas concentrations and exposure periods are achieved throughout the storage
    - replacing phosphine with alternative fumigants or controlled atmospheres
    - using alternative chemicals and physical treatments to replace fumigation
- monitor and test
    - gas concentrations during fumigations
    - insects for resistance to phosphine and other chemicals

The implementation plan proposes a number of recommended practices for all fumigations with phosphine, based on the core principles of the strategy. These practices included:

- no more than three conventional fumigations per year on each undisturbed parcel of grain
- implementing a break strategy to allow storage facilities to be cleaned of grain thereby reducing insect populations
- implementing monitoring and management procedures for use of phosphine

Additional recommendations were also proposed for specific storage types including bulkheads, bunkers and pads, Siroflo® fumigation and the size of storage (i.e. <150 tonne or >150 tonne sealable storages), silo (harvest) bags and imported grain. The strategy was developed in consultation with the Australian grains industry to ensure the practical and commercial constraints inherent to the industry were accommodated with resistance management. The success of the strategy will depend on industry commitment and widespread compliance and, for components such as limiting application of fumigant on grain parcels, will be hard to achieve without a mechanism for compliance. Where successful, these strategies will limit the spread and impact of resistance but not necessarily eradicate it.

3.3. 'Review of knowledge transfer strategies'

This report was produced as a tool to assist the grains industry develops a change management strategy with outcomes for the management of phosphine resistance. This paper is an introduction to our understanding of the transfer of knowledge, the uptake of knowledge and the drivers behind change management practices.

From past examples within agriculture and other industries, knowledge transfer and change management have been found to be strongly linked and difficult to separate. Each situation is specific with respect to the people / groups involved and their social barriers, concerns and attitudes, along with the attributes of the business relations.

Knowledge transfer has been described in a number of ways. It can be the process of transferring research from knowledge producers to knowledge users; and also a social process involving interaction and relationships.

Knowledge transfer is considered the one way process of transferring knowledge from the holder to the user. However, in many cases it is the feedback from users on implementation, further development and refinement of the information for practical application that enables adoption. For this reason the process of knowledge exchange is often more appropriate than knowledge transfer.

Knowledge transfer alone will not turn information into action. Change management drives the knowledge transfer strategy, which in turn drives the communication strategy. Therefore, it is more logical to change the approach to identifying extension activities by concentrating on the change management strategy.

The target audiences for change management are stakeholders [i.e. all persons, groups or institutions with an impact (direct or in-direct) on the issue] in the grain storage and handling area.

Based on the diversity of stakeholders, take home messages for each audience must be identified and targeted for the specific audience, for the types of decisions they face and the environments in which they live or work. This paper also presents a case study on populating the change management model for phosphine resistance management in Western Australia. The case study proposed a range of strategies (and associated activities) as follows with a need to;

- Provide incentives for change
- Develop a marketing campaign for industry with a specific knowledge brand
- Streamline information into a central housing system
- Better utilise trace-back systems
- Engage silo manufacturers in providing simplified key messages

3.4. Change management plan for knowledge exchange

This activity builds on from the information gained in section 3.3 the 'review of knowledge transfer strategies' with the basis being a one way model for rural extension. With the decline in independent sources of extension from government agencies and the corresponding shift to the private sector, concerns have been raised that mixed messages are being delivered to the industry. In addition, information overload may also be of concern for the end-user.

The change management model defines that an outcome must be sought, often within a specified timeframe. Within this outcome, target audiences, key messages and methods of evaluation are identified.

In comparison, network models focus on the capacity of those involved to exchange and utilise knowledge of effective practices and to achieve this, must identify 'key points of influence' i.e. individuals or systems that have the greatest impact in changing practices and behaviours. This approach recognises that phosphine resistance management will take place in groups that are linked and the aim is to 'seed' change by identifying connections between stakeholders.

While these two approaches have different methodologies, they may not be mutually exclusive and both have the following commonalities:

- Identification of target audiences or stakeholders.
- Recognition that knowledge may not be the limiting factor in managing the development of phosphine resistance i.e. there may already be sufficient extension material and information on use of phosphine to control insects of stored grain.
- Identification of 'trusted sources' of information. Unless information is received from a trusted source, individuals and businesses are unlikely to consider changing their behaviours.
- The establishment and maintenance of these trusted sources i.e. the development of long term relationships between the information sources and stakeholders.
- Defining methods of communication that produce messages that address the risks and issues of the audience/stakeholders. Messages must have impact on individuals if they are able to see the relevance for their own business and in their own terms.

An important difference between the two methodologies is that the network model is not focussed on a 'result' or a 'practice change' but rather it builds the capacity of those involved to understand and make changes to their activities.

Instead of aiming to raise awareness of the issue of phosphine resistance, the network model will 'seed' change by identifying the points of greatest influence, or nodes.

In this report an interim change management strategy is proposed as outlined below:

- Identification of nodes and networks
    - Identification of these nodes, and the links between them, forms the basis for the BRS component of the GKN project (see section 3.5 for a summary of reports from the BRS study).
- Development and maintenance of trusted reliable sources of information

    - Trusted sources that supply technical information on storage of grain and the correct use of phosphine to control insects include the grain storage extension specialists and grain biosecurity officers.

- Seeding information through networks
    - Key messages can be delivered through the 'Train the trainer' model.
- Economic drivers
    - An economic tool to assist in providing information on economic drivers has been developed as part of this project (see section 3.8).
- Incentives and disincentives
    - The current market specification for the delivery of grain requires only the absence of live insects and does not encourage an incentive to support the uptake of improved best practice for management of phosphine resistance.
    - As such, growers have no incentive to undertake good practice for control of insects in grain, and for some, will result in the delivery of poorly fumigated grain.
- Portal of knowledge
    - Development of a single web portal for the provision of information will ensure the delivery of consistent and relevant messages.

3.5. Stakeholder map and literature review of social networks for phosphine resistance management in the stored grains industry

The BRS study is one component of the GKN project and specifically investigates the pathways for transferring resistance management knowledge to key stakeholders in the grains industry and to profile the knowledge, attitudes, values and behaviours of stakeholders within those pathways.

The three components to this study were a literature review, telephone interviews with stakeholders in grain storage and face-to-face interviews with on-farm fumigators and staff at the private storage and bulk handling facilities.

A number of stakeholders were identified who directly influence the management of insect resistance including:

- Fumigators (growers, bulk handlers and professional fumigators)
- Advisors (agronomists and government science and extension practitioners)
- Service and sales (chemical sellers, silo manufacturers)
- Delivery agents (grain brokers and marketers)
- End users (feed lots, flour mills, food processing, seed merchants)
- Regulatory agencies

Ninety one stakeholders were interviewed with 57 persons interviewed in person during the case study field work and a further 34 by telephone, with 39 growers interviewed. For each case study (NSW, WA, Qld, SA, Vic) 10 to 12 interviews were conducted.

Some of the questions asked to growers on the storing of grain on-farm include:

- How much grain will you be storing?
- Is resistance an issue for you? Or for the industry?
- What strategies do you use to see if you have phosphine resistant insects?
- What are the difficulties with using phosphine on-farm?
- Questions on communication of information to growers
- Seeking information about stored grain and insect management
- What is the significant change required to manage phosphine resistance in stored grain insects?

The study showed that stakeholders benefit when accessing information by using multiple communication pathways and leadership is required to coordinate consistent messages about best practice for phosphine resistance management.

Further reference to the BRS study will be reported in later sections within this document.

3.6. Development of biosecurity and phosphine resistance knowledge transfer programs and materials

It has been identified in sections 3.3 and 3.4 that the development and use of knowledge networks for delivering phosphine fumigation information is important, as many stakeholders, including long term phosphine users, are unaware that their current practices are not completely effective and are contributing to the development of phosphine resistance. This can occur even though extension material has been developed and a wide range of information is available, either because the material is not up to date, is not suitable for some audiences or is too complex. From the stakeholder interviews, the volume of information available to growers for managing phosphine resistance is summarised in the report by Young et al (2010, Appendix E).

Delivery and uptake of phosphine fumigation information is therefore hampered by the lack of targeted, up to date biosecurity and phosphine resistance communication material available, as well as the lack of 'trusted sources' to deliver this information. Grain Storage Extension specialists (Grains Research and Development Corporation (GRDC) funded project) and Grains Biosecurity Officers (GBOs) are presently being used to address these issues and deliver phosphine fumigation information to the industry.

Within the GKN project, the PHA project staff have worked nationally with the CRCNPB, GRDC, researchers, government agencies, universities and industry in consolidating our knowledge and understanding of the issues, recognising the knowledge gaps and working with stakeholders to address these concerns.

As part of the Grains Farm Biosecurity program (previously initiated and funded by the Grains Council of Australia and currently funded by Grains Producers Australia) GBOs have been employed in five states. As the GKN project partly funds Grains Biosecurity Officers

(GBOs) (see section 3.9), a component of their overall role has been directed at the implementation of strategies for phosphine resistance management.

3.7. Development of pilot programs for change management (stage 1 and stage 2)

To demonstrate that the current phosphine fumigation methods are either no longer effective or are contributing to the development of resistant insects requires the consistent delivery of clear messages that are targeted to different stakeholders throughout the supply chain. This is achieved by an evaluation of current, and a provision of new, methods of information exchange. The Grains Knowledge Network (GKN) project was initiated to evaluate and develop knowledge exchange networks to limit the development of phosphine resistance and ensure rapid adoption of new practices.

3.7.1 Pilot study stage 1

The Pilot study (stage 1) looked at existing communication networks together with developing 'key points of influence' within the grains industry for 'seeding' information to promote best practice in grain storage and use of phosphine. Presentation of initial work undertaken in the GKN can be found in the following reports (Taylor *et al.* 2010; Young *et al*. 2009 (section 3.5)).

Within the grains industry there are numerous mechanisms for the delivery of information. The following have been used as key sources of information about phosphine management and grain storage:

- GRDC GSE project.
- GFBP managed and coordinated by Plant Health Australia (PHA).
- Significant research is also being undertaken in the improvement of storage, treatment of grain and grain sampling by the CRCNPB through the following agencies (Department of Employment, Economic Development and Innovation, Queensland University of Technology, Industry and Investment New South Wales, South Australian Research Development Institute, Department of Agriculture and Food Western Australia, Murdoch University and Charles Sturt University).

The BRS study reported growers were often confused about the development, distribution and impact of phosphine resistance in stored grain insect pests. They were often unclear as to whether it is an issue that affects them directly or only elsewhere in the grain supply chain. Where stakeholders were aware of the issues, they often blamed others for the development of phosphine resistance.

The BRS study produced a series of recommendations for establishing and using networks within the grains industry for knowledge exchange. In the pilot study reports , Taylor *et al*. (2010) have responded to these recommendations highlighting possible mechanisms for their implementation within the GFBP or the GSE project. Due to the small number of stakeholders interviewed and sometimes misinterpretation of the issue not all recommendations were promoted and some were found to be outside the scope of the GFBP and GSE project. The topics covered by the recommendations include the following:

- Communication strategy for management of phosphine resistance developed and implemented to raise grower awareness
- Issue of resistance management (including insecticide and herbicide resistance) promoted at regional forums
- Clear guidelines and instructions developed on correct fumigation practices, including recognition of possible resistant insects
- Supply chain engaged to ensure growers and transporters are aware of correct fumigation procedures
- A plain English summary of the phosphine label developed and distributed
- Capability of agronomists, silo manufacturers, grain cleaners, chemical sellers and bulk handling staff developed and resourced, and that messages on phosphine resistance management delivered using multiple approaches
- Industry standard for gas-tight silos promoted to growers, advisors and silo manufacturers
- Grain storage research and extension practitioners develop guidelines and messages for retro-sealing on-farm storages
- Opportunities identified to build and create a leadership role within the grains industry for delivery of consistent messages relating to management of phosphine resistance
- Multi-criteria decision making process conducted that identifies the most appropriate body for coordinating industry-standard and best practice information
- An appropriate evaluation strategy for on-farm education and quality assurance identified and implemented
- Grain end users educated about phosphine resistance and the importance of communicating this to growers
- A strategy developed for on-farm fumigation in storages where monitoring equipment is not available
- Multi-criteria decision making process is conducted with key industry stakeholders to develop criteria for when phosphine should be used in order to reduce the number of fumigations on individual consignments of grain

To initiate implementation of the pilot program (stage 1) a number of components were commenced including:

- Identification of networks, and nodes within, for knowledge exchange
    - Examples of the 'key points of influence' are grains storage specialists, silo manufacturers, chemical sellers, consultants and agronomists, grain cleaners, key growers and farming systems groups
- Preparation of information networks
    - Information has been delivered in the form of media releases, fact sheets, research publications and training workshops and presentations, fumigation warning signs, magnifying glasses to promote correct insect identification etc
- Identification and development of leading growers
    - Identify leading growers undertaking best practice in grain storage

3.7.2 Stage 2

Stage 2 of the Pilot program for change management study (Taylor and Slattery 2010) looks more closely at the progress made by the communication networks in implementing and promoting change management practices in grain storage and use of phosphine and biosecurity outcomes and messages for the grains industry as a whole. In the GKN project the main communication network for the delivery of grains biosecurity and storage information has been the Grains Biosecurity Officers (GBOs) operating in the five major grain states (WA, Qld, Vic, SA and NSW). In addition, the GKN project has linked strongly with activities being undertaken in the GRDC funded Grains Storage Extension (GSE) Project, which commenced in July 2009 and operates in the Western, Southern and Northern regions.

The Grains Knowledge Networks project has addressed the management of phosphine resistance and the development and use of knowledge networks for delivering phosphine fumigation information. Within this project, the GBOs have used the following approach to developing networks that provide information and demonstrate biosecurity practice change to the grains industry:

- Identification of target audiences and stakeholders – who they are, their current knowledge and perceptions of biosecurity.
- Identification of the knowledge and information that stakeholders require to demonstrate current biosecurity practices.
- Identification of 'trusted sources' of information and development of long term relationships between these sources and stakeholders.
- Defining effective methods of communication to produce relevant messages that address the risks and issues of the audience/stakeholders

Using the knowledge exchange network models identified in Phase 1 of the GKN project, Phase II of the pilot program reports on the approach taken by each of the GBOs in identifying target audiences and stakeholders, how they have gone about engaging them and reporting on the approach they have adopted with stakeholders for effective communication. The range of activities and the number of approaches adopted is varied and is also related to the length of time GBOs have been operating in each state, with the first GBO appointment in WA (April 2007) and the most recent appointment in NSW (March 2010).

In summary, the range of activities that have been undertaken to drive practice change include:

- Development of awareness material that outlines phosphine resistance and biosecurity issues
- Raising awareness of the importance of phosphine resistance through consistent and ongoing release of articles within the rural media
- Identification of 'industry champions' or leading growers that will be used to promote aspects of best practice in biosecurity and grain storage best practice amongst the farming community
- Identification of, and engagement with, farming or consultancy groups in training activities that promote awareness of phosphine resistance and grain storage issues

Knowledge exchange activities have been separated into the following:

- Activities within the national component of the GFBP with media, communication material and GBO activities to be reported in section 3.9.
- Economic drivers with reporting of the end-user economic analysis spreadsheet tool for phosphine use reported in section 3.8
- Training workshops – delivery of training workshops as part of the GFBP and GSE project
- Fact sheets and extension material – produced by the GFBP and GSE projects
- 'Seeding information' –information must be tailored for each stakeholder, then 'seeded' through networks including leading growers and farming groups.

3.8. Development of end-user benefit-cost analysis (BCA) tool designed to assist decision making at the time of the purchase of a new silo and a review of economic cost-benefit analyses, tools and models for on-farm grain storage

One of the objectives of the GKN project has been to assess the market and economic drivers that influence stakeholder decisions which impact the development of phosphine resistance, and to identify market-driven market change management opportunities. To address this objective the project leaders initiated development of an end-user benefit-cost analysis (BCA) tool.

Through the GKN project, an end-user economic analysis spreadsheet tool for phosphine use was developed and proofed. The tool was designed to assist the grower at the time of purchase of a new silo comparing the cost of unsealed vs sealed and aerated [as recommended by the *Strategy to Manage Resistance to Phosphine in the Australian Grain Industry* (Collins 2009)]. The end-user BCA takes into account the costs of silo purchase and installation, costs of chemical treatments (including phosphine) and balances them against the benefits gained through reductions in grain damage and rejections, local insect resistance and other grain hygiene factors affected by using the recommended practices.

This spreadsheet provides growers and grains storage extension specialists with a tool for calculating costs and longer term benefits for installing and using gas tight, aerated storage compared to other forms of storages. This tool is now available to members of the GSE and GFBP to assist them in discussions with growers on grain storage. Working with the spreadsheet, team members can promote good phosphine management in a cost-effective approach.

The second part of the economic study has been a review of previous grain storage research undertaken in Australia. Following discussions with members of the GKN steering group, it has been determined that a significant amount of work has previously been undertaken in various projects relating to the cost/benefit of maintaining phosphine for use on-farm and in bulk storage, together with the market access impacts of losing phosphine as a fumigant for the control of storage insects. As a result, it was decided a new industry level benefit-cost analysis would be of little use. However, a requirement for a desktop

review to outline and summarise previously completed economic analyses was identified and information has been collated in a separate report (Slattery and Taylor 2010).

There have been numerous attempts over the last 10 years to produce economic tools or models to assist growers make improved decisions when considering grain storage options. Grain storage is a complex area, and these tools have often been reasonably complicated, incorporating factors such as grain type, storage type, storage and marketing need, storage volume and grain quality.

With respect to insect management in stored grain and limiting poor phosphine fumigation practices in on-farm storages, clear and consistent messages are required that outline technical information. For example, technical information on the use of gas-tight storages for fumigation and the use of aeration to cool grain to limit insect multiplication is required. Specialist advice must be available to growers to assist with options available to achieve these outcomes.

With regard to economic information, as decision support tools and models provide comparisons of different alternatives, it may not be possible to provide consistent messages that fit all scenarios i.e. there may be a number of different alternatives and the choice of a grain storage option will be dependent on both the economic requirements as well as the business and marketing needs. As a result, the decision support tools have been developed to assist make choices.

This review highlighted the quantity of information needed surrounding the decisions to be made when determining appropriate systems for grain storage and purchasing new equipment. Within each of the tools, models or reports identified, significant amounts of data and comparisons are usually presented, and when coupled with economic analyses surrounding purchase of equipment and decisions required on marketing of grain, the tools assist growers determine the right option for their business. Even though models and tools are designed to be as user-friendly as possible, given the large volume of options and information, to get greatest uptake these models and tools need to be accompanied with ongoing training or one-on-one support to ensure information is understood and that uptake and implementation occurs.

3.9. Appointment of grains biosecurity officers in five states (funded partly by this project CRC70096)

3.9.1 The national Grains Farm Biosecurity Program (GFBP)

The GFBP was initiated by the grains industry through the national peak body in response to an industry need to prepare for and respond to biosecurity threats and incursions. The program officially commenced in 2006 and appointment of Grains Biosecurity Officers occurred between 2007 and 2010. The aims of the program are to:

- Provide a national perspective on biosecurity issues affecting the grains industry
- Raise awareness of the importance of biosecurity by developing and distributing awareness material
- Raise awareness of high priority pest threats and key biosecurity issues

- Demonstrate simple and effective methods for implementing biosecurity on-farm
- Facilitate the capture and recording of surveillance data
- Communicate with all parts of the grains supply chain to provide consistent biosecurity messages

As such, the program covers all biosecurity issues; however, development of insect resistance to phosphine was recognised as a key concern, as it has the potential to affect market access. Should the use of phosphine to control insects of stored grain become limited, few other options are currently available to manage insect populations, increasing the likelihood that live insects could be found in grain exported overseas or within domestic markets. For this reason, the GFBP has been used to assist promote awareness of the issue and to develop material supporting other programs such as the GSE project in the activities outlined in this section.

General activities of the GRFB have included development of media releases which covered topics on grain storage and hygiene, development of resistant insects, changes to the phosphine label, biosecurity associated with contractors working on grain farms, and surveillance in stored grains. Media monitoring has picked up distribution of these articles in almost 50 publications (the number in brackets indicates the number of publications that ran the article in each state during the 2009/2010 financial year):

- Grain storage (11 Queensland)
- Biosecurity farm signage (4 Western Australia; 13 Victoria)
- Surveillance in stored grain (2 Western Australia)
- Resistant insects (2 Queensland; 1 South Australia; 1 Victoria; 1 New South Wales; 3 Western Australia)
- Biosecurity associated with contractors on grain farms (3 Queensland; 1 New South Wales; 3 Victoria; 2 Western Australia)
- Changes to the phosphine label (1 South Australia; 1 Victoria)
- Biosecurity Farmer of the Year (67 across all states and territories)

In addition to the development and release of press articles, the following activities have been undertaken as part of the Grain Farm Biosecurity Program:

- To assist deliver information on on-farm biosecurity best practice, the revised version of the *Grains Farm Biosecurity Manual* was released in February 2010. The Manual contains basic information on biosecurity issues including those associated with grain storage and, to June 2010 over 1100 copies have been distributed in Victoria, 100 in New South Wales, 100 in Queensland, 250 in Western Australia and 150 in South Australia by Grains Biosecurity Officers
- Biosecurity fact sheets have been produced which include phosphine resistant pests of stored grain. These fact sheets highlight the market access threat that development of phosphine resistance could potentially have on grain exports. To date approximately 800 copies have been distributed
- Awareness information delivered by GBOs includes details on the importance of biosecurity to the grains industry and where and how to report exotic pests of stored grain

- Commencement of a Farm Biosecurity survey of grain growers to determine baseline knowledge of biosecurity, preferred mechanisms for delivery of information and basic grain storage practices

While the distribution of information in the form of Manuals and pamphlets is not an indication of practice change in itself, when coupled with consistent and ongoing circulation of messages within the rural press, these mechanisms will assist with raising awareness of the importance of the development of phosphine resistance.

In addition to the overarching activities of the national program, individual activities within each region are provided in the following sections.

3.9.2 Western Australian Grains Biosecurity Officer

To identify leading growers who will assist with improved delivery of grain storage messages within their districts, interviews and on-farm discussions have been conducted with five growers regarding their experiences and attitudes with farm biosecurity and grain storage pest surveillance. These interviews and the resulting information have led to the preparation of a grains storage information pamphlet which looked at different options available to growers depending on their grain use and marketing requirements. The three grain storage options considered were aerated silos, sealed silos and silo bags with decision making dependant on their marketing strategies. Growers were implementing different components of best practice in grain storage and biosecurity including:

- Good farm hygiene for storage areas and harvesting equipment
- Farm biosecurity signs
- Best practice in use of aeration, silo bags or gas tight silos for management of insects
- Regular monitoring for insects in stored grain

It is anticipated all leading growers identified will be used to further promote best practice in grain storage through development of additional media articles. One grower was a semi-finalist in the Biosecurity Farmer of the Year (plant producer), and media articles were produced to support and recognise his nomination.

In addition to identification of leading growers, working with farmer groups has been used to instigate targeted on-farm workshops and demonstrations. This approach has been effective in combining general farm biosecurity messages with practical GSE demonstrations to drive home key messages on grain storage biosecurity, reasons for fumigation failures and insect monitoring.

To deliver information in formal presentations, linking and integrating biosecurity messages with established partners and programs such as the Partners in Grain program has been effective in delivering messages and ensuring good attendance. Working with women in agriculture, farm biosecurity messages can reach a wider audience, an approach being trialled this year at the Ladies Field Days with the Liebe Group in the North and the SEPWA group in the South.

In WA, even though large crowds attend the machinery expo field days (i.e. Dowerin and Newdegate) delivering biosecurity messages to this audience appears to have had limited

impact for change management and is considered to be a mechanism for the distribution of awareness material only.

A number of approaches to be assessed in the near future include the promotion of messages and networking with Grain Industry Associations and working with grain contractors and exporters to understand their requirements and drivers for promoting best practice for grain storage to their clients.

3.9.3 Queensland Grains Biosecurity Officer

As a case study to identify a Leading grower/business to promote farm biosecurity best practice, a large grain growing enterprise near Goondiwindi that produces seed wheat, barley and pulses, grain for stockfeed manufacturing and export grain to Japan was identified. This enterprise covers four properties and a total of 12,000 ha and key activities identified that represent biosecurity best practice include:

- Excellent record keeping and consignment identification practices for all stored grain
- Farm signage and visitor management to ensure properties can trace movements of contractors
- High quality wash down facilities for vehicles and equipment
- Training for staff and contractors in farm hygiene

This enterprise was a finalist for the Biosecurity Farmer of the Year (plant producer), and several media releases were developed that highlighted the importance of the biosecurity activities being undertaken.

In other work within the GFBP in Queensland, much of the delivery of information to grain growers on grain storage has been in the Meandarra/Condamine region (central Darling Plains approx 350km west of Brisbane). The study was undertaken initially with funding from the CRCNPB and continued with resources from the GSE project and has involved 15 growers over a three year timeframe. It has focused on grain storage practices and phosphine use to manage insects. This region was selected as there has been a recent shift in farming practices and significant increases in grain production, coupled with the poor baseline knowledge of on-farm storage practices. Detailed surveys, extension and field days promoting grain hygiene and storage practices have been undertaken to demonstrate the value of storing grain on-farm with 30% of growers having since made investments in on-farm storage based on recommendations provided by the GSE expert.

Other grain storage extension activities have focused with grower groups from the Felton region (north of Warwick) as well as grain storage equipment suppliers and silo manufacturers.

While farmer groups have not been used in Queensland as a target group for the promotion of biosecurity messages, workshops and industry training have been delivered to agronomists (e.g. Pursehouse Rural retail agronomist group), rural suppliers (e.g. Riverina Australia) and Queensland agricultural merchants at Kingsthorpe, each of which has been attended with good representation from the grains industry, growers and agricultural advisors.

3.9.4 Victorian Grains Biosecurity Officer

In Victoria farming groups have been used as the link to individual growers with networks established with Birchip Cropping Group (BCG) and the Southern Farming Systems (SFS) group, each with a membership of over 500 growers. These groups are being used as the mechanism for the promotion and exchange of biosecurity messages and to develop programs of relevance to each area.

As one of Australia's leading farming groups, the BCG will endeavour to undertake a biosecurity stock take of their farming group of a whole, and baseline information on biosecurity and farm self assessments will be collected to assist BCG undertake their biosecurity audit. The GBO's involvement with the BCG will include static and field demonstrations and presentations at each BCG activity including spring field days, seminars and expos. Displays will also include demonstrations of footbaths, quarantine areas, vehicle wash and hand wash and biosecurity signage at all field sites. Biosecurity messages will be prepared regularly for distribution via the BCG member mail outs and newsletters. BCG has also recently appointed a biosecurity officer to manage activities within the group. While much of this work has focussed on general farm biosecurity practices, work has begun on delivery of information on grain storage, as it was recognised that this was an area of poorer knowledge within the group. As part of this initial work, eight farmers have been interviewed about their on-farm grain storage and procedures, pre-season hygiene, chemical treatments and the mechanisms for delivery of communication material, and this work has been used to set up future activities with BCG.

Work with SFS will undertake a similar approach, using the group for the delivery of biosecurity training, the development of a biosecurity strategy for SFS, static and field demonstrations and presentations at SFS activities. Biosecurity articles will be prepared quarterly for inclusion in their electronic newsletter to all members.

Over 200 growers have responded to a press release offering grain growers a free farm biosecurity sign (and a copy of the Farm Biosecurity Manual for the Grains Industry). Further grower contact through interviews and/or farm audits to gauge biosecurity uptake and understanding will be undertaken later this year, and these contacts will be used as a starting point to identify leading growers who are undertaking and/or commencing the adoption of best practice for storing grain (in conjunction with Peter Botta, GSE project).

Other activities occurring within Victoria include promotion of biosecurity information and material to a range of audiences including the Department of Primary Industries grain team, Australian Agricultural Contractors Association, Ballarat TAFE and GrainCorp with positive feedback and further invites from all.

3.9.5 South Australian Grains Biosecurity Officer

In South Australia, work with a consultant group (YP Ag) has commenced, with stored grain workshops run in conjunction with the GSE project (Peter Botta). Information was collected from the group using Turning Point software. All who attended indicated their knowledge and understanding of grain storage issues was poor and they needed additional training and support.

As a result of the positive feedback and interest, two farmer workshops were held in April 2010 and an 'on-site' stored grain workshop during August 2010.

Work will continue with the YP Ag group (and with additional farming and consulting groups) in South Australia to identify individual leading growers undertaking and/or commencing the adoption of best practice for storing grain.

3.9.6 New South Wales Grains Biosecurity Officer

The appointment of the GBO in New South Wales has been fully funded by the Grain Farm Biosecurity Program and commenced in February 2010. In this component, work has been initiated on the identification of networks using the New South Wales District Agronomists as a mechanism for delivery of information on key biosecurity messages including grain storage issues and limiting the development of phosphine resistance.

4. Implications for stakeholders

This project has provided an outline of the major stakeholders involved in grain storage, including those that potentially contribute to the development of phosphine resistance in insects. Through this stakeholder identification and analysis, it was determined that there were a number of issues associated with information exchange and practice change. By targeting the types of networks present in different regions and identifying key points of influence it is anticipated that improved uptake of messages will occur.

For different stakeholders, this project will have different implications. For example, increasing and improving delivery of consistent messages to growers and bulk handlers will increase their awareness of the importance of phosphine resistance. Using leading growers to assist deliver messages will provide a trusted source of information.

In addition, messages delivered to growers assists provide market pressure to bulk handling companies to ensure that best practice is followed.

For both growers and bulk handling companies, if improved awareness is coupled with incentives to improve best practice and/or disincentives to reduce poor practice, changes in practices and behaviours will occur over time.

Within this project, the issue of phosphine resistance and its implications for trade and market access has been raised at the Plant Health Committee and the information presented is being elevated to the Primary Industries Standing Committee. Improved understanding of the importance of phosphine resistance at higher levels of government may assist with additional regulatory actions, should they be required, such as further changes to the phosphine label.

5. Recommendations

Extension projects and approaches for grain storage have previously utilised many of the aspects outlined in the pilot program for knowledge exchange. However, the emphasis has been on raising awareness through the provision of technical information to growers. While this remained an important aspect of information delivery, the GKN project has provided alternative mechanisms to increase the effectiveness of the exchange of information. The eventual aim of these activities is to change practices to limit the development of phosphine resistance with the initial focus on creation of networks for knowledge exchange.

To achieve this, several recommendations from the BRS report produced within the GKN project were proposed with implementation in some areas commenced. These included the identification and use of 'key points of influence' within the grains industry most likely to result in dissemination and uptake of information. It was recognised that key points of influence differed between regions, and the GBOs attempted to address this by identifying leading growers, consultancy groups and farming systems groups in their areas who were already undertaking grain storage or biosecurity best practice or who were prepared to improve these practices. These individuals and groups were used to promote awareness and best practice messages. By seeding information through these key points of influence, resources were focussed on areas that resulted in the greatest impact.

Practice change takes time however, and while it starts with improved awareness through continual and consistent delivery of messages, it must be accompanied by the identification and provision of appropriate drivers for change. Although there has been initial success in raising awareness of grain storage issues through delivery of information through the GSE project and GFBP, for true practice change to occur within the grains industry, fundamental changes are still required within the grains supply chain to ensure that there are drivers for improved grain storage best management practice.

To address both the requirements for improved awareness and also the provision of drivers to encourage practice change, it was felt that recommendations provided within the GKN project could be distilled into the two main key findings.

Key finding 1 Growers and consultants find grain storage issues confusing and are unsure or unaware of the importance of the development of phosphine resistance in insects of stored grain

Recommendations to address key finding 1:

a. ***Continuation of information delivery by Grain Storage Extension specialists***

Information delivery from a trusted source is essential before individuals or organisations will commence changes in current practices. Within the area of grain storage, information delivery from a trusted specialist is especially important as there is a large amount of information that must be assimilated. For example, best management in grain storage covers a range of topics including insect identification and monitoring, chemical and physical options for insect control, aeration to cool grain, use of gas-tight silos, pressure

testing of silos to ensure they are gas-tight, farm hygiene and importance of insect control for market access.

b. ***Training targeted at consultants and agronomists***

Few consultants, agronomists, advisors and chemical sellers have knowledge of grain storage issues and best practice as historically they perceive that their advice to growers ends as soon as grain is harvested. As many growers get their information from consultants, agronomists and chemical sellers, this group acts as an important key point of influence and improving their awareness and expertise will have large impact on delivering messages on-farm.

c. ***Engagement with farming groups and consultant groups in grain storage issues and best practice***

Many growers are members of farming groups or use consultants who are part of larger consultancy groups. In the same way that consultants and advisors act as a key point of influence, farming system groups and consultancy groups are a trusted source of information and improving awareness and expertise within these groups will have a major impact on delivery of messages.

d. ***Development and roll out of a Best Management Practice system for grain storage***

A Best Management Practice system is currently being developed within the GSE project which will outline the range of practices that would constitute poor, adequate, good and excellent management of grain storage. Implementation of this system as an online package or through a training course is currently being investigated.

e. ***Regular development of media articles***

The rural press and grain publications such as Groundcover have a wide coverage across the grains industry and are an important source of information across the supply chain. Regular and consistent development of articles highlighting grain storage best practice, new information in grain storage and importance of insect control for market access will keep these messages at the forefront of people's attention, enhancing the potential for practice change.

f. ***The production of a grain storage manual***

As the issues surrounding grain storage are complex, there is a need for a publication(s) with easy to understand information for growers and consultants.

g. ***Identification and promotion of messages through 'key points of influence'***

It is anticipated the GFBP and GSE project will continue to identify key points of influence (see points b and c) in the form of leading growers, grower/farming system groups and leading consultants/consultancy groups to promote grain storage and biosecurity best practice.

Key finding 2 There are currently few drivers to encourage best practice or demand that industry stakeholders change poor practice in the use of phosphine

Recommendations to address key finding 2:

a. ***The introduction of mandatory training for use of phosphine***

While NSW has introduced training for use of phosphine, this has been targeted at the Occupational Health and Safety aspects of using the fumigant. A training course has been developed through Charles Sturt University for grain storage and biosecurity which is aimed largely at operators in bulk handling and grain merchandising. This course is not mandatory and there is currently no mandatory requirement for training in the use of phosphine. Implementing mandatory training at all levels of the supply chain would ensure that all users of phosphine understood the importance of development of insect resistance and the requirements for limiting the development of resistance.

b. ***Further changes to the phosphine label***

While recent changes to the phosphine label have included a need to monitor levels of the gas for the recommended time period and concentration, further changes are required that that reflect changes to the new Australian standard for gas tight silos and the impact of mis-use of phosphine on development of insect resistance. It would also be desirable that changes occurred to mandate the need for training in use of phosphine.

c. ***Development and enforcement of an Industry Code of Practice***

Development of a highly phosphine resistant insect strain within Australia could technically meet the formal definition of an Emergency Plant Pest under the Emergency Plant Pest Response Deed. As such, identification of such a strain could have the potential for cost shared eradication under an agreed Response Plan. At present however, it is unlikely that this would occur as the grains industry cannot provide evidence that the development of insect resistance strains is a 'closed pathway' i.e. that there is an Industry Code of Practice that the entire supply chain is adhering to that limits the development of phosphine resistant insects. Industry leadership in implementing and enforcing this Code of Practice is required.

d. ***Implementation of a Quality Assurance system(s) for grain storage is required***

A Quality Assurance system that supports an Industry Code of Practice would be essential in ensuring the pathway for development of phosphine resistant insects is closed. A Quality Assurance system would also assist in meeting Minimum Residue Limit requirements for trading partners.

e. ***Improved engagement with end users of grain should occur*** (including stock feed manufacturers, mills, feed lots etc) to demand information on chemical use for treatment of insects in grain. This could be achieved through changes to vendor declaration forms to ensure information on chemical use in grain is provided.

Key finding 1 largely describes activities that relate to on-farm grain storage issues while Key finding 2 describes wider industry changes that will provide the drivers for practice change. Without implementation of recommendations within Key finding 2, it is likely that growers and other industry stakeholders within the supply chain will not see the need to

make changes in practices relating to use of phosphine within grain stored on-farm or within bulk handling receival facilities.

If these changes do not occur at an industry level, government regulation may be required to enforce appropriate chemical usage and ultimately retain market access for export grain.

At the conclusion of the GKN project, it is anticipated the GFBP will continue to operate with GBOs in Western Australia, South Australia, Victoria, New South Wales and Queensland. While these GBOs will deliver basic messages on the importance of insect control in stored grain for market access, the main mechanism for delivery of specialist information on grain storage issues will be the GRDC funded GSE project.

6. Abbreviations/glossary

ABBREVIATION	FULL TITLE
BCA	Benefit-cost analysis
BCG	Birchip Cropping Group
BRS	Bureau of Rural Sciences
CRCNPB	Cooperative Research Centre for National Plant Biosecurity
DAFF	Department of Agriculture, Fisheries and Forestry
GBO	Grains Biosecurity Officers
GFBP	Grains Farm Biosecurity Program
GKN	Grains Knowledge Networks
GRDC	Grains Research and Development Corporation
GSE	Grains Storage Extension
PHA	Plant Health Australia
SFS	Southern Farming Systems

7. Plain English website summary

CRC project no:	CRC70096
Project title:	Grains Knowledge Network
Project leader:	Dr Sharyn Taylor
Project team:	Jo Slattery
Research outcomes:	- Identification and evaluation of the networks that exist within the grains industry for the delivery and exchange of information relating to improved grain storage practices and limiting the development of phosphine resistance in insects of stored grain. - Establishment of mechanisms to deliver this information through co-funding of Grains Biosecurity Officers. - Identification of economic factors that influence phosphine resistance management practices.
Research implications:	- Better methods for exchange of information will raise awareness of the issue of phosphine resistance and commence a gradual improvement in practice amongst all parts of the grains supply chain.
Research publications:	Collins P (2009) *Strategy to manage resistance to phosphine in the Australian grain industry*, CRC for National Plant Biosecurity. Sherriff (2009) *Review of knowledge transfer strategies*, Plant Health Australia. Slattery J, Taylor S (2010) *Review of economic cost benefit analysis, tools and models for on-farm grain storage in Australia*, Plant Health Australia. Taylor S, Hughes P, McGrath J, Slattery J (2009) *Communication Plan – Phosphine resistance management*, Plant Health Australia. Taylor S, Slattery J, Dibley S (2009) *Change management plan for knowledge exchange – Towards limiting development of phosphine resistance*, Plant Health Australia. Taylor S, Slattery J, (2010) *Pilot program for change management (stage 2) - Strategies for limiting development of phosphine-resistance in insects of stored grain*, Plant Health Australia.

	Taylor S, Dibley S, Slattery J (2010) *Economic analysis of phosphine management – stage 1*, Plant Health Australia. Taylor S, Slattery J, Dibley S (2010) *Pilot program for change management - Strategies for limiting development of phosphine-resistance in insects of stored grain*, Plant Health Australia. Young M, Carr A, White S, Thompson L (2010) *Social networks for phosphine resistance management in the stored grains industry*, Bureau of Rural Sciences, Commonwealth of Australia.
Acknowledgements:	PHA wishes to acknowledge the CRC for National Plant Biosecurity (CRCNPB) for provision of funding for this project. PHA also acknowledges the contribution of the Bureau of Rural Sciences who were contracted by PHA to undertake the 'Social networks for phosphine resistance management in the stored grains industry' survey, the Grains Biosecurity Officers in each state who implemented the management practices and to all stakeholders involved in the consultation process and who contributed to this project.

8. Attachments (publications arising from each activity)

3.1 Development of phosphine resistance communication strategy

- Taylor S, Hughes P, McGrath J, Slattery J (2009) *Communication Plan – Phosphine resistance management*, Plant Health Australia.

3.2 Review and collation of the strategy to manage resistance to phosphine in the Australian grain industry

- Collins P (2009) *Strategy to manage resistance to phosphine in the Australian grain industry*, CRC for National Plant Biosecurity.

3.3 Review of knowledge transfer strategies

- Sherriff (2009) *Review of knowledge transfer strategies*, Plant Health Australia.

3.4 Change management plan for knowledge exchange

- Taylor S, Slattery J, Dibley S (2009) *Change management plan for knowledge exchange – Towards limiting development of phosphine resistance*, Plant Health Australia.

3.5 Stakeholder map and literature review of social networks for phosphine resistance management in stored grains

- Young M, Carr A, White S, Thompson L (2010) *Social networks for phosphine resistance management in the stored grains industry*, Bureau of Rural Sciences, Commonwealth of Australia.

3.7 Development of pilot programs for change management (stage 1 and stage 2)

- Taylor S, Slattery J, Dibley S (2010) *Pilot program for change management - Strategies for limiting development of phosphine-resistance in insects of stored grain*, Plant Health Australia.

- Taylor S, Slattery J, (2010) *Pilot program for change management (stage 2) - Strategies for limiting development of phosphine-resistance in insects of stored grain*, Plant Health Australia.

3.8 Development of end-user benefit-cost analysis (BCA) tool designed to assist decision making at the time of the purchase of a new silo and a review of economic cost benefit analyses, tools and models for on-farm grain storage

- Taylor S, Dibley S, Slattery J (2010) *Economic analysis of phosphine management – stage 1*, Plant Health Australia.

- Slattery J, Taylor S (2010) *Review of economic cost benefit analysis, tools and models for on-farm grain storage in Australia*, Plant Health Australia.

9. Collaborators involved in this project

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