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Enhancing surveillance for exotic stored pests in the Australian grains industry using a partnership approach with industry and government.

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Abstract

Verifying freedom from exotic pests such as Khapra beetle (*Trogoderma granarium*) & Karnal Bunt (*Tilletia indica*) is critical to supporting & maintaining access for Australian grain producers to international markets. Despite Australia's geographical isolation & strong quarantine systems, increasing levels of travel & trade continues to place pressure on our biosecurity systems, emphasising the need for improving our regional efforts in prevention, preparedness & surveillance to mitigate risks. The Australian Grains Farm Biosecurity Program (GFBP) is a national initiative to assist in the development & implementation of improved biosecurity practice, playing a vital role in the education of exotic pests & the role of surveillance by industry. The GFBP has undertaken a targeted surveillance program for stored product pests, with Khapra beetle as the main focus. A range of sites based on potential risk groups & pathways (e.g. farming enterprises, seed distributors & agricultural stores) were targeted, with different approaches used across the three grain growing regions of Australia depending on State activities & pre-existing collaborators. All regions used a combination of pheromone traps & other sampling methods appropriate for host materials & environment. The surveillance is aimed at strengthening evidence of absence, building industry knowledge & participation in grain storage surveillance & promoting improved management practices around storage. These regionally specific engagement methods & surveillance efforts are discussed. Australia remains free of Khapra beetle.

Keywords: grains biosecurity, exotic pest surveillance, on-farm storage and hygiene, risk mitigation practices

Introduction

Exotic plant pests threaten production, market access and sustainability of Australian plant production systems. For the Australian grains industry, over 600 exotic pests have been identified of which 54 are considered high priority pests (HPPs), posing a significant threat. Despite Australia's geographical isolation and strong quarantine systems, increasing levels of travel and trade continues to place pressure on our biosecurity systems, emphasising the need for improving our regional efforts in prevention, preparedness and surveillance to mitigate risks. Verifying freedom from HPPs such as Khapra beetle (*Trogoderma granarium*) and Karnal Bunt (*Tilletia indica*) is critical to supporting and maintaining continued access for Australian grain producers to domestic and international markets (including biosecurity, food safety and quality assurance aspects).

Currently many surveillance activities are done through crop monitoring in the field and sample assessment through the bulk handling system, but little useful data is captured at the national level with regards to exotic stored grain product pests. This type of data is limited, and gaps exist particularly on-farm, where on-farm storage of grain is increasing and becoming common practice, particularly in eastern Australia. Thus, expanding surveillance efforts regionally on-farm to capture more evidence of absence is required.

The national Grains Farm Biosecurity Program

Within Australia, the Grains Farm Biosecurity Program (GFBP), a national initiative to assist in the development and implementation of improved biosecurity practice, plays an instrumental role in awareness and education about exotic pests (Taylor-Hukins et al, 2015). As Australia's flagship biosecurity extension program, the GFBP contributes to the Australian grains industry's risk mitigation activities (under the formal signing of government / industry agreements around biosecurity and emergency response (PHA, 2016) and has now been running for 10 years. The GFBP was acknowledged with a national biosecurity award in 2018 for its contribution to biosecurity and promoting a partnership approach involving government, industry and community (http://www.agriculture.gov.au/biosecurity/australia/public-awareness/aba#australian-biosecurity-award--government).

The GFBP emphasises the importance of surveillance and reporting by industry stakeholders to support and maintain market access and to detect an incursion early, increasing the likelihood of early detection and facilitating the eradication or containment thus reducing its impact on industry and community. A strength of the program is the ability to build collaborative networks for a wide range of activities at national, state, regional and local levels (Bellati et al 2010). This strength has been used to encourage general surveillance and the collection of data for key exotic grain pests through a variety of industry reporting avenues: e.g., National variety trails, state diagnostic laboratories, bulk handlers, researchers, industry consultants and grower groups. Data has been captured from over 90 surveillance programs from a range of broad acre crop types.

Whilst surveillance has been one of the GFBP key activities, it has also been one of the most challenging to execute and maintain, as its voluntary and relies on the 'good will' of those contributors.

The Project (Objectives)

The GFBP recently piloted a targeted surveillance monitoring program for stored product pests with the main target being Khapra beetle (*Trogoderma granarium*), one of the highest ranked exotic pests for grains which is also listed as a prohibited or invasive species for many of Australia's export trading partners.

The key aims of the project were to strengthen evidence of absence data for Khapra beetle and to build industry awareness, knowledge and participation in grain storage surveillance regionally within the grain-growing regions of Australia. The program also aimed to identify and promote industry advocates and to assist industry in promoting and improving management practices around grain storage, especially in hygiene, and improving the use and efficacy of phosphine application in on-farm storage systems.

The Approach (Methods)

For the pilot surveillance program to be successful, it was imperative to use a partnership approach with reputable programs, networks and alliances for effective industry engagement and uptake. Benefits to using a partnership approach also allowed for a wider coverage of locations, took advantage of cost-sharing for required resources and ensured we were value-adding to contributors.

Different approaches for implementation were used across the three grain regions of Australia (southern, western and northern zones), depending on types of linkages and pre-existing collaborators, state government surveillance activities and industry networks and alliances that could assist and were willing to participate.

A range of sites based on potential risk groups and pathways were targeted. These included privately owned farming enterprises (grain, mixed production and intensive animal production systems), milling, processing and bulk handler establishments, importers of high risk materials, seed distributors, grain/ stock and/or feed producers/ wholesalers and regional agricultural re-sellers.

Host materials and target environments included: older silo systems; products with slow turnover/ minimal fumigation routines; longer term storage, containers and bulker bags (feed /seed, fertiliser/ baits, by-products, other); stockfeed and other dry food stuffs; packing/ bagging materials; cracks/construction joints in cement walling near product storage; areas of low hygiene and inadequate sanitation (within sheds, barns and around machinery and product storage areas) and; dark, dry and low movement corners spaces in processing and production areas.

A range of complimentary sampling techniques appropriate for host materials and favourable environments, for Dermestidae species, were used. These included vacuuming and visual inspection of grain and other host materials, and pheromone specific traps which improved participation and industry engagement due to its novelty.

Access to expert diagnostic support for identification of Dermestidae species was a critical component to the program and states had access to a service (paid or provided in-kind).

Regional specific (State) focus and development of surveillance efforts in 2016-2017 included:

- *Queensland (Qld):* Growers (grower groups) targeted - surveillance and monitoring is occurring, but not formally recorded; potential to develop a storage best management practice / accreditation based around storage and monitoring in conjunction with Qld grains storage research and extension team.

- *New South Wales (NSW):* Targets included privately owned farms, warehouses importing high risk products (e.g. rice, pulses, seed and spices), feedlots and stock-feed manufacturers and wholesalers. Partnered with regionally based NSW Local Land Services (NSW Govt.) that provided staffing to service the traps.

- *Victoria (Vic):* Intensive farming enterprises (e.g. poultry, feed lots, dairy) were targeted due to their tendency of having poorer hygiene practices around grain storages. Also, targeted grain mix and stock-feed manufacturers. The CropSafe program is being used for diagnostics support (http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/cropsafe-program).

- *South Australia (SA):* Significant State government support provided an extensive extension of the program that allowed for a wide coverage of locations and a wider range of target groups surveyed compared to other states which included producers, milling/ processing, stock feeders, bulk handler/ seed distributors, agri-suppliers, regional high school, and a regional research centre. Program was also promoted across the supply chain through a State campaign (http://www.pir.sa.gov.au/primary_industry/crops_and_pastures/clean_grain).
- *Western Australia (WA):* Commercial agronomists targeted, and value added to the existing sentinel merchants and agronomist activities under the Biosecurity eSurveillance projects in WA, which was modelled on the successful Pantry Blitz campaign (an externally funded 'citizen science' project that demonstrated absence of Khapra beetle in WA with 2,252 reports (pers comm. L. Fagan, Department of Primary Industries and Regional Development, WA).

Outcomes (Results)

Over 100 target sites were surveyed and over 1000 'zeros' scored against Khapra beetle in 2016-17. The surveillance data captured is compliant with the Australian national minimum dataset specification for plant health surveillance and was entered into AUSPestCheck, a national database for plant pest surveillance (http://www.planthealthaustralia.com.au/resources/auspestcheck/).

As the program is currently on-going the large sample size being generated allows for comparisons and evaluation, in terms of target group risk profiles, suitability and effectiveness of trap types and where closely related Dermestidae species are found on-farm and within the farming environment regions.

The challenges and considerations identified to date included:

- trap positioning and suitability on farm; every place is different; trial and error due to other factors (e.g. abiotic and biotic factors)
- time length the traps and lures stayed out in the environment (dependent on remoteness of location and who could assist to service traps)
- surveillance program rigor, uniformity and geographical coverage across the regions
- finding voluntary participants and concerns of confidentiality
- reliability of contributors and their ability (skills and training requirements)
- processing and pre-sorting of multiple samples (stored grain insect identification training required)
- value of by-catches (non-targets) to producers and others (e.g., researchers)
- new technologies to assist / trial and to improve automation for data collection
- use of postal services (for sending lures to participants) to help reduce travel costs associated with servicing traps

Discussion

Over 200 industry advocates were identified during the surveillance activities in 2016/17. While there were mixed results within the regions in terms of industry engagement, in general the benefits of the program were positive overall and provided valuable insights.

Anecdotal evidence shows a higher level of learning and training is being sought by producers, with extension moving from simple awareness to more technical and specific information for their farming enterprise.

There was value in the by-catches for grower engagement as it provided insights into species composition within their own farming environments. Producers known to have a closely related Dermestidae species present in their farming system or operations, will hopefully help them to implement improved management practices and encourage extra vigilance in their operations.

Practice change especially around improvements to hygiene of grain storage was observed in many participants throughout the surveillance program.

In South Australia (SA), the programs significance was also acknowledged through additional industry funding (in the form of a SA grains industry trust grant to state diagnostics) as the extension of the program provided a unique opportunity to investigate the by-catches and the related native species composition in SA. The grant has allowed for further analysis, curation and permanent lodgement of reference material into a nationally recognised collection (Waite insect and Nematode Collection).

Biosecurity strategies emphasis the need for industry and community participation. Clearly this type of biosecurity surveillance program is a lot of work, expensive and time consuming, but has made a beneficial contribution in the collection of proof of absence data and industry awareness and education. Future engagement, cost effective resourcing, collaboration and value adding are required along with evaluating the real value of this type and source of surveillance data.

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Testing Wheat for Internal Infesting Insects with an Electrically Conductive Roller Mill

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Abstract

Although grain is always inspected for adult insects and insect damaged kernels upon shipping and receiving, immature insects living inside the kernels of grain cannot be readily detected. A laboratory roller mill was modified to measure and analyze the electrical conductance of wheat as it was crushed. The electrical conductance of normal wheat kernels is low and fairly constant. In contrast, the electrical conductance of infested wheat kernels produces a sudden change in the electrical signal. The peak height of the electrical spike depends on the size of the larvae and the resulting contact of the crushed larvae between the rolls. This instrument was designed to test wheat with moisture content of 13.5% or less. The laboratory mill can test a kilogram of wheat in less than 2 min. Hard red winter and soft red winter wheat samples were used in experiments. Known numbers of infested kernels were added to the wheat samples. The infested kernels contained larvae of rice weevils and lesser grain borers sorted into large, medium, and small size groups. The instrument detected ~8 of 10 infested kernels per 100 g of wheat with large-larvae (fourth instar or pupae). It detected ~7 of 10 infested kernels with medium-larvae (second or third instar) and ~5 of 10 infested kernels infested with the small-larvae (first or second instar). Under