Exotic plant pests – a threat to the sustainability of Australia's grains industry

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Abstract
Exotic plant pests (EPPs) threaten production, market access and sustainability of Australian plant production systems. For the grains industry there are over 600 identified EPPs of which 54 are considered high priority, posing a significant threat. Despite Australia's geographical isolation and strong quarantine systems, the threat from EPPs has never been higher with the increasing levels of travel and trade, emphasising the need for improving our efforts in prevention, preparedness and surveillance for EPPs.

An EPP considered an "extreme" risk to Australia's grains industry is the disease Karnal bunt (*Tilletia indica*). With a significant number of countries having import restrictions relating to Karnal bunt, extreme economic consequences are expected to occur if the disease was to become established, primarily due to loss of international market access. Russian wheat aphid (RWA) (*Diuraphis noxia*), another high priority EPP, threatens the sustainability of cereal production systems, with yield losses up to 80% recorded in countries where it's established. Different biotypes of RWA exist overseas, as do cereal varieties with varying resistance levels to different biotypes. This makes pre-emptive breeding for resistance difficult. Therefore insecticides remain important for managing RWA. The national Grains Farm Biosecurity Program plays an instrumental role in the awareness of EPPs and implementing biosecurity best practice through extension, education and training. The program places a heavy importance on the role of surveillance and reporting by industry personnel in order to detect an incursion early, increasing the likelihood of eradication and reducing its impact on industry and community.

Key words
Grains biosecurity, Russian wheat aphid, Karnal bunt, Grains Farm Biosecurity Program

Introduction
Exotic Plant Pests (EPPs) are invertebrates or pathogens not currently in Australia, which pose a significant economic threat regionally or nationally to a plant production industry and/or the environment. In regards to the Australian grains industry there are over 600 identified EPPs for the 25 leviable grain crops that encompass our temperate and tropical cereals, oilseeds and pulses. Any one of these EPPs could have significant impacts on the sustainability of grains production in Australia. Some EPPs are likely to significantly impact on yield (e.g. Russian wheat aphid) while others (e.g. Karnal bunt) would have a detrimental impact on our market access.

Many levels of government and industry work together as part of the biosecurity continuum that helps protect Australian producers from a wide range of exotic pests and diseases. However threats cannot be fully eliminated and the growth of travel and trade puts increasing pressure on the systems for continued efforts in prevention, preparedness and surveillance for EPPs.

This paper briefly discusses the plant biosecurity continuum within Australia and priorities within the grains industry. It highlights case studies for two grains EPPs and the efforts and outcomes of the Grains Farm Biosecurity Program, a national initiative, funded by Grain Producers Australia and state governments, in biosecurity awareness and risk mitigation.

The biosecurity continuum
Sound biosecurity systems are crucial to the success of the Australian grains industry in maintaining market access, sustainability of agricultural production, food security and integrity by safeguarding the industry

from EPPs. 'Biosecurity is a national priority, implemented off-shore (prior to goods arriving in Australia), at the borders (national and state), regionally and on farm' (Bellati et al. 2012). Australia's geographical isolation and strong biosecurity system has ensured that many pests of crop production (including post-harvest storage) overseas are not present in Australia. Freedom from EPPs provides both a yield advantage as well as real trade benefits for Australian crop production industries such as grains.

Importantly, national and state biosecurity systems are complemented and supported by measures carried out at the industry and regional level. As risks of new pests entering Australia can never be totally eliminated industry biosecurity is regarded as a shared responsibility where all links in the production and supply chain engage and take responsibility for minimising biosecurity risks that are within their control. Growers implementing farm biosecurity practices, agronomist, researchers and other service providers including contractors can all play an important role in safeguarding the industry at a farm, regional and national level. An aware and trained grains industry has the capacity to minimise the risks posed by new pests, and respond effectively to any pest threats that would impact on the future sustainability and viability of the industry.

The grains industry peak body, Grain Producers Australia (GPA), plays a significant role on behalf of industry. As the signatory to the Emergency Plant Pest Response Deed (EPPRD), GPA consult with federal and state governments on biosecurity issues pertaining to the grains sector.

Pest Risk Analysis

In order to prioritise mitigation activities and focus on the most damaging pests, a Pest Risk Analysis (PRA) was undertaken on each of the 600 identified EPPs (PHA 2014). PRA's take into account a range of factors such as the potential for the pest to gain entry into Australia (risk pathways); how easily it could become established and spread throughout the cropping areas; the estimated damage it could cause (e.g. yield loss, management costs, loss of market access or downgrading of product) and; the potential economic threat and feasibility of eradication of each pest. From this PRA process, 54 EPPs are considered high priority meaning they pose a high to extreme risk of causing significant impact to the grains industry if they were to become established in Australia (PHA 2014).

By identifying key EPPs a pre-emptive approach may be taken to risk management. Identification of high risk pests also assists in the implementation of effective community awareness campaigns, targeted biosecurity education, training and surveillance programs for industry stakeholders, pre-emptive breeding for resistance in host varieties and the development of pest-specific incursion response plans.

Case study 1: Karnal bunt – overall risk Extreme

Of the 54 high priority EPPs identified for the grains industry, Karnal bunt (*Tilletia indica*) is regarded as the highest pest threat for the grains industry. Karnal bunt is a fungal disease affecting grain quality producing a characteristic 'dead fish' odour and discolouration of grain. Hosts include wheat, durum wheat and triticale, where only a few spores are enough to make a product unfit for human consumption. The disease differs from other bunts and smuts present in Australia, as the grains are only partially replaced by Karnal bunt spore masses, rather than a total replacement of the grain by spores (Wright et al. 2006).

Currently, Karnal bunt is distributed throughout the world in a number of regions, including Asia, the Middle East, Africa, North America and South America with a number countries having trade restrictions in place for this pest (Wright et al. 2006).

Impact

Karnal bunt has caused substantial economic loss where it occurs overseas and if it were to become established in Australia, the economic impact is expected to be extreme. Loss of market access due to reduced grain quality, and the fact many countries consider the disease as a quarantine pest would see a significant impact upon the industry and Australia (Wright et al. 2006).

Murray and Brennan (1998) estimate the cost of declined quality of loss of markets to be worth 17% of the value of production in Australia. Other impacts may arise from costs associated with planting restrictions that may be imposed in the case of an incursion, as well as costs resulting from testing and control, cleaning for grain shipments and machinery and research such as plant breeding (Murray & Brennan 1998).

Incursion potential
The entry potential of Karnal bunt into Australia is rated as low, however a number of risk pathways have been identified that may facilitate entry. The more likely entry pathways are the importation of bulk grain and fertiliser, and agricultural machinery that are contaminated with spores. Travellers also have to be taken into consideration, especially those travelling from India and USA into Australian farming areas (Wright et al. 2006).

Climate modelling has been used to estimate the potential distribution of Karnal bunt in Australia, through analysing the development and lifecycle of the disease and associated climatic factors in current areas of distribution. Models indicate that a large proportion of Australia's wheat growing regions are climatically suitable for Karnal bunt to establish and develop (Murray & Brennan 1998).

Case study 2: Russian wheat aphid – overall risk High
Russian wheat aphid (*Diuraphis noxia*) is a major pest of barley and wheat but can attack most cereal crops. Russian wheat aphid (RWA) can cause significant yield losses if not controlled, especially in barley which is more susceptible. It is absent from Australia, but is found in most other major wheat growing regions including Russia, the Middle East, North and South America, Asia, Africa and most countries bordering the Mediterranean.

USA incursion
Since the first detection of RWA in South West USA in 1986, the total economic damage due to the pest has exceeded $1 billion. These damages include costs from crop losses, cost of pest control, and lost revenue to rural economies throughout the seventeen affected western states. The barley industry in the USA has been severely impacted upon by RWA since its incursion. Barley is very susceptible to RWA, resulting in the rapid decline of malt barley production with it virtually ceasing in badly affected areas (M Christopher 2014, pers comm., 17 April). It is not unreasonable to expect a similar impact in Australia if RWA was to become established.

Impact
Climatic modelling indicates that RWA would spread rapidly and become established across most of the major cropping regions within Australia. Estimates of crop damage range from 25-50% and up to 80% for some regions (Hughes & Maywald 1990).

A range of biotypes exist throughout the world where RWA is distributed, with 8 biotypes in the USA alone (Puterka et al. 2014). This variation poses a serious threat to Australia's barley and wheat production, as an incursion's origin will influence the level of resistance that will be available in our varieties. As such, GRDC (project UMU00029) are conducting research for pre-emptive breeding to develop wheat and barley varieties with RWA resistance with wide adaptation to Australia's grain growing regions (GRDC 2011).

Incursion potential
A Pest risk analysis conducted by PHA (2012) rated the entry potential for RWA as medium. However more recently expert entomologists suggest that entry potential more realistically may be considered low due to Australia's geographical isolation from countries where RWA is present, resulting in a low probability of entry via wind dispersal (M Christopher 2014, pers comm., 17 April). Overwintering eggs may be transported on harvested grains or fodder, however eggs are only produced in some populations, and as Australia does not import large volumes of these materials this is considered very unlikely (PHA 2012).

The Grains Farm Biosecurity Program – a national awareness and risk mitigation initiative
The Grains Farm Biosecurity Program (GFBP), initiated in 2007 program contributes to the grains industry's risk mitigation activities, and promotes a shared responsibility involving governments, industry and community.

The national GFBP has aligned key awareness messages and education objectives to current grains industry extension programs, in order to deliver grains biosecurity training and education seamlessly. A critical element to the success of these strategic alliances is "value adding" to existing program content, where biosecurity messages and exotic pest identification information is embedded within industry training programs such as Pulse Australia best management practice accredited workshops (Bellati et al. 2010).

Biosecurity – a shared responsibility

Biosecurity is everyone's business and must be considered in our day to day activities, especially when working in the field and travelling between production areas. Surveillance, hygiene and record keeping are important and practical tools to implement in order to practice good biosecurity. An awareness of key biosecurity threats, both endemic and exotic to Australia, associated with your industry can aid in early detection of a pest.

In order to detect a pest early, increasing the chance of eradication or effective management, routine surveillance and monitoring of crops and production areas is necessary. Surveillance is not only important for the management of endemic pests; it has now come to the forefront for pest status requirements for export markets. There is a need to provide scientific evidence of 'proof of absence' from key exotic pests, and surveillance data both specific and general, contributes to this required proof (Bellati et al. 2012). Surveillance at the farm level contributes essential information to regional biosecurity efforts, and ultimately to the national status of a pest. In order to gather the farm level data, the grains biosecurity officers of the GFBP rely on volunteer surveillance by a network of agronomists, researchers and other key stakeholders.

Agronomists and growers travelling overseas on farm tours and entering fields pose a high risk when returning to Australia and production areas. Awareness of high risk pests in other areas of the world, such as RWA in the USA, and practicing good hygiene such as leaving clothes behind, or making sure they are laundered sufficiently before returning are important and must be considered.

Conclusion

Awareness and surveillance are key to ensure early detection of an exotic plant pest incursion, however must be complemented with timely reporting of a suspect EPP. As the grains industry is a signatory to the Exotic Plant Pest Response Deed, there are obligations in order for reporting of suspects. Under some state government plant health acts, there is also a legal obligation to report a suspected exotic pest. A reporting mechanism includes the Exotic Plant Pest Hotline (1800 084 881), a national number which will automatically redirect the caller to the state department of primary industry they are in.

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