WHY PLANT BIOSECURITY?

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ABSTRACT

Plant biosecurity is a global issue that continues to grow in importance as the volume of trade between countries and the number of people travelling increases. Australia is free from many of the pests and diseases that affect plant industries and natural environments in other countries. This freedom provides a competitive advantage to Australia as a major agricultural exporter reliant on its international reputation as a producer of ‘clean and green’ agricultural and food products. Australia also places a high value on protecting our unique environment and lifestyle for future generations. Plant biosecurity is essential to protect these values.

Plant biosecurity is focussed on those pests (insects and plant pathogens) that are; not currently present in Australia, are present but not in all production regions of Australia and are being actively controlled, or those pests that represent a new threat as their biology has changed.

Plant biosecurity can impact on food safety, food security, trade, market access, market development, production costs and, ultimately, the profitability and sustainability of plant industries. Incursions of new pests directly threaten the economic viability of Australia’s plant industries, which have an annual farm gate value of over $18 billion and annually contribute over $12 billion to export income. Even the perception that a pest is present in Australian produce can have a rapid and negative impact on Australia’s reputation as a producer of safe, quality food products.

The Australian lupin industry is threatened by several pests including Sitona spp. and Uromyces lupinicola (lupin rust). Both pests would significantly impact on lupin production in Australia should they be introduced.

To minimise the risk of entry and establishment of threats such as a Sitona sp. and lupin rust, research activities must cover the full biosecurity continuum, pre–border, border and post–border.

Plant biosecurity is a continuum that draws together many different disciplines. It differs from plant protection in that it is risk management – being strategic for the future needs.

This paper provides an overview of plant biosecurity from an Australian perspective with two case studies of serious biosecurity pest threats to the Australian lupin industry. The case studies explore the critical questions that need to be addressed when identifying the threat posed by a pest species. The paper also addresses the need for a high level of biosecurity awareness and reporting throughout the international lupin industry.

KEY WORDS

biosecurity, pathogens, insects, market access, trade

INTRODUCTION

The ease and rapidity of transport across the globe is shrinking the world, exacerbating threats to the biosecurity of humans, animals and plants. The increasing volume of trade between countries and movement of people is increasing the need for active biosecurity programs to protect agriculture, the natural environment and amenity plants in our built environments.

Plant biosecurity has been defined as:

“Biosecurity is protecting the economy, environment and people’s health from pests and disease. It includes trying to prevent new pests and diseases from arriving, and helping to control outbreaks when they do occur. While robust response arrangements are in place to combat outbreaks, preventing pest and disease incursions in the first place, remains a national priority.” (Australian Government, Department of Agriculture, Fisheries and Forestry)

“Plant biosecurity is a set of measures designed to protect a crop, crops or a sub group of crops from emergency plant pests at national, regional and individual farm levels.” (Plant Health Australia)

“Plant biosecurity management is relevant to the protection of crops against intentional and unintentional introduction of unwanted pests, pathogens and agents.” (University of Missouri)

Biosecurity is not plant protection, dealing with the existing pests, but is rather an insurance policy for the future. Plant biosecurity is risk management, being
Biosecurity exists within a regulatory framework that, in the case for Australia, involves both State and Commonwealth legislation. To ensure the legislation can operate and maintains relevance to current pest status it is essential that a robust research program is maintained. Biosecurity must be built on science.

Freedom from many of the pests and diseases which impact crops elsewhere in the world gives Australia a competitive advantage in a global market place where consumers place a premium on food safety and quality. The mere perception that a breach of biosecurity has occurred may put at risk the profitability and sustainability of Australia’s plant industries which have been valued at more than $18 billion, within that, the export value of the Australia lupin industry is currently $100 million.

The importance of plant biosecurity is emphasised by the potential impacts. While the impact of a new pest on profitability can be identified, there can also be significant impacts on the long term sustainability of an industry. The presence of a new pest can impact on trade, market access and market development with phytosanitary restrictions existing for many pests. Importantly, this can impact on both international and domestic trade. For example, the 1996 incursion of lupin anthracnose (*Colletotrichum lupini*) into Western Australia (WA) and South Australia has resulted in major marketing restrictions on lupin export from these states to New South Wales and Victoria. Confirmed freedom from the disease is a major advantage in marketing of lupin grain between Australian states. The lupin anthracnose incursion also destroyed a developing market for *L. albus* from WA which were being exported to the Middle East thus reducing the profitability of the crop for growers in the most suited regions/environments of WA and South Australia.

Biosecurity exists within a continuum that can be broken down into three broad areas: pre–border, border and post–border. Biosecurity issues are best dealt with ‘pre–border’ (offshore), that is, before a breach of Australia’s biosecurity occurs. Accordingly, engagement with Australia’s neighbours, trading partners and with the global biosecurity community, forms an essential part of biosecurity ‘insurance’. Should an incursion occur, biosecurity measures will need to be invoked at the border, where the Australian Quarantine and Inspection Service (AQIS) provides a pivotal role. If a pest species gets past Australia’s border defences, resulting in an incursion, then ‘post–border’ action, which may involve a multitude of agencies (Federal, State, Local and Non–government) and the vigilance of the community comes into play.

A functional view of the continuum breaks it into four areas described as prevention, detection, identification and response. A biosecurity system needs to have access to the knowledge to underpin decisions on the risk of entry, establishment and spread for pests. By improving our capacity to identify threats, to prioritise them and to allocate appropriate resources to mitigate threats, we can strengthen the system, raise our level of preparedness and negate or minimise the impact of future incursions. As quarantine risk analyses for pests and import are a key process upon which international trade (including germplasm importation) is regulated, the stronger the science base underpinning a country’s trade decisions the better it is placed to defend them. Just knowing the highest priority threats does not alone provide an industry the protection it needs from biosecurity threats. The capacity to detect and diagnose these threats accurately, and in a time effective manner, is critical to minimise the impact of any incursion.

Every industry needs to have a response plan to enact in the event of an incursion. Assuming an industry has the capability for rapid and accurate detection and diagnosis, there must also be the capacity to contain and if possible eradicate any new incursion. Any response action within an industry needs to consider the impact on the growers, the full supply chain and the environment, while maximising the probability of maintaining the industries profitability and sustainability.

A key competitive advantage for an export commodity is a minimal risk of pest infestation. Plant biosecurity plays a role nationally in ensuring that effective disinfestation and pest resistance management strategies are in place to maintain competitiveness in premium markets.

Plant biosecurity globally has many challenges with the number one issue being the diminishing numbers and increasing age of the experts. Many countries, including Australia, are losing expertise in many of the disciplines that underpin biosecurity through the retirement of skilled Plant Pathologists and Entomologists. For example, Australia currently has very limited capacity in the areas of bacteriology, nematology and aphidology. It is highly unlikely that the expertise base of the past will be regained. The future will see a smaller number of plant pathology and entomology experts who will have more generic skill sets that are underpinned by new technologies and tools. The future will also require a greater level of international collaboration to provide the required biosecurity skills. This is highlighted by one of the fundamental problems for plant biosecurity research, being the large number of plant species and the even larger number of exotic plant pests that may be encountered. This complex is addressed by a relatively small group of expert scientists when compared with the animal and human sectors. This problem requires a more generic approach to biosecurity to provide solutions.

Biosecurity brings together many diverse disciplines and the engagement of Plant Pathologists and Entomologists with Economists, Engineers, IT


specialists, Chemists, GIS specialists, Social Scientists and regulators, is necessary. These linkages will enable leverage of technology and assist in development of new technologies that may not have been considered within the confines of a single discipline. Not only is biosecurity a compilation of a diverse set of expertise disciplines but it also is an issue along the entire value chain from the farm paddock to grain export centre, i.e. involves all sectors of industry.

From an Australian context, the lupin industry needs to have confidence that the current post entry quarantine protocols for lupin seed, and other hosts that may introduce serious pests, are suitable to minimise the threat to an acceptable level. Inspection and release based on visual inspection for symptom expression, may not provide the level of protection required. Furthermore, future fumigation protocols may not provide complete eradication of all insect life stages in imported host material. The industry needs to have confidence that the capacity exists, whether human or technological, to enable wide scale surveillance of lupin production throughout the country. This will maximise the chance of early detection should an incursion occur and will provide the data to enable phytosanitary certificates to state ‘known not to occur’, which may be essential for market access. A statement that a pest is not known to occur in a production area may no longer be sufficient to satisfy market requirements. An industry also needs a ‘toolbox’ of eradication tools and strategies to ensure cost effective and timely eradication. Strategies that lead to wide scale destruction of crops may no longer be acceptable without evidence for the need and effectiveness of this strategy.

CASE STUDIES

The development of an Australian national biosecurity plan for the grains industry has been completed by Plant Health Australia. As part of the plan, expert opinion has been utilised to identify pathogens and pests of lupins worldwide, determine those which are not currently present in Australia and to identify the greatest or priority pest threats to the Australian lupin industry. These priority threats identified in the industry biosecurity plan include: pea leaf weevil (Sitona lineatus), khapra beetle (Trogoderma granarium), leafminers (Liriomyza huidobrensis, L. trifolii), turnip moth (Agrotis segetum), apion weevils (Apion antiquum, A. arrogans, A. clavipes), fusarium wilt (Fusarium oxysporum f.sp. lupini), rust (Uromyces lupinicolus, U. renovatus), leaf spot (Mycosphaerella lupini) and Bean yellow mosaic virus (seed–borne). These pests have been ranked as priorities based on the potential for them to enter, establish and spread in Australia, as well as their potential impact on the Australian lupin industry. In addition to the risk analysis, the best methods of surveillance for the pests have been determined, the accepted diagnostic methodology determined and response plans developed for many of the high priority threats should an incursion occur.

Two case studies are provided that give an overview of the analysis undertaken and the characteristics that have led to each pest being ranked as a priority threat to Australia’s lupin industry.

CASE STUDY 1

Pea leaf weevil (Sitona lineatus) (extracted from GrainGuard™ Threat Data Sheet 2002).

Sitona lineatus is one of many Sitona species posing a threat to lupin production. It is very likely that other Sitona species will be damaging to lupins, however, there is limited information available in the global literature.

Host range. The larvae of the S. lineatus are broadly polyphagous and attack the roots of many cultivated and wild legumes, while the adults prefer cultivated legumes.

Distribution. S. lineatus has wide distribution around the world.

Potential distribution in Australia. Indications are that the whole of the lupin production area of Australia would be suitable for S. lineatus.

Dispersal (natural). Dispersal by flight and in stored grain (human aided) S. lineatus feed on many different plants, and because they are small, dusty and inconspicuous, they can easily be transported in plant material such as peas, lupins, lucerne, clover and vetch grain.

Economic impact (moderate). S. lineatus has caused considerable losses (> 20%) in Vicia faba and lucerne and losses have been reported for pea (Pisum sativum), vetch and Trifolium repens.

Sitona lineatus has been reported to transmit viruses such as broad bean stain comovirus, and broad bean mottle bromovirus (neither virus is known to occur in Australia). Both viruses are potential threats to the Australian lupin industry. Sitona lineatus has also been reported to transmit the bacterium Corynebacterium michiganense pv. insidiosum [Clavibacter michiganensis subsp. insidiosus]. It is not known whether this bacterium would affect lupins.

Entry potential (moderate). S. lineatus is an inconspicuous weevil with a wide host range within the legume family. Sitona weevils are strong flyers and can be present on many export products. The related S. discoideus, also a pest of legumes, has been intercepted in New Zealand on oranges from Australia.

Establishment potential (moderate). The climate of the southern Australia provides suitable conditions for S. lineatus.

Spread potential (high). Sitona weevils can disperse over long distances. Sitona discoideus adults have been recorded to fly over 20 km in distance and higher than 300 m in Australia. During their flights to aestivation (summer hibernation) sites, and then again
during the post aestivation period, there is a complete redistribution and no inclination to remain in a particular area. Based on this knowledge it is highly likely *S. lineatus* would spread rapidly in southern Australia. *S. lineatus* is also likely to infest a range of cultivated and wild legumes and may be present on some of the more than 1000 species of native and introduced legumes in Australia.

**Total risk category (moderate)**

**CASE STUDY 2**

Fusarium wilt (*Fusarium oxysporum* f.sp. *lupini* (extracted from GrainGuard™ Threat Data Sheet 2002)

Host range. *Fusarium oxysporum* f.sp. *lupini* has several races that are specific to different *Lupinus* species. There is limited information available in the global literature.

Distribution. *F. oxysporum* f.sp. *lupini* has been reported in countries in Africa and Europe.

Potential distribution in Australia. *Fusarium oxysporum* f.sp. *lupini* could survive throughout the whole of the lupin production area of Australia.

Dispersal. Chlamydospores of *F. oxysporum* f.sp. *lupini* can survive for over 10 years in soil.

Natural dispersal may be with lupin trash/stubble within fields or contaminated soil. Run-off water can also spread *F. oxysporum* f.sp. *lupini*. Seed of lupin will also carry the pathogen and is responsible for long distance dispersal.

Human aided dispersal is most likely as contaminated soil and infected seed.

Economic impact (high). *F. oxysporum* f.sp. *lupini* has a major impact on all three commercial species of lupin (*L. luteus, L. angustifolius, L. albus*) in Eastern Europe. Prior to the development of resistant varieties *F. oxysporum* f.sp. *lupini* devastated lupin crops in Germany, Poland and the former USSR.

Entry potential (low). Australia currently restricts all importation of lupin seed, lupin plant material and soil. If these restrictions were reduced, the entry potential would be increased.

Establishment potential (high). *F. oxysporum* f.sp. *lupini* is adapted to survive in soil and with the distribution of potential host material across southern Australia, it is highly likely it would establish if introduced.

Spread potential (low). The potential is low assuming strict restrictions were put in place following establishment. The restrictions would need to apply to lupin seed, lupin plant material and contaminated soil on both machinery and people. The pathogen would spread easily throughout a field, once introduced, through water movement.

**Total risk category (moderate)**

**CONCLUSION**

Both case studies are rated as moderate risk largely due to the current strict quarantine restrictions that exist in Australia. Easing of these restrictions on movement of lupin and legume seed and soil into Australia, could increase the risk to high. The risk of entry of both pests on humans is a real risk that should be considered. Without adequate hygiene, pests such as *F. oxysporum* f.sp. *lupini* could enter Australia in personal belongings or on contaminated clothing or footwear following exposure to infected fields.

While these priority threats are based on current expert knowledge there is the potential for ‘sleeper’ pests and diseases, which by inference have not yet been identified. This is particularly the case for the Australian and world lupin industry. Given the strong science that is developing and promoting this relatively newly domesticated crop it is important that the lupin industry has a high level of biosecurity awareness. As the world lupin industry grows, due to better varieties which are more palatable to humans, the industry will progress down the path of other domesticated legume and cereal species. Lupins will become more acceptable to human consumption and in many cases there will be selection of varieties that are more susceptible to pest threats. As these new species are being planted in larger acreages and in wider environments the new varieties will encounter new pest species, some of which over time will have the potential to utilise the crop as a food source and become a pest species of cultivated lupins. The international literature has identified *Sitona grisea, S. explicitus, S. crinita, S. gressorius, Bruchidius villosus, B. incarnates, Bruchus obtectus and Macrosiphum albifrons* as threats to lupin production, however, these are only a few of the species that could have the potential to be major threats to the growing lupin industry in Australia and worldwide. Regular monitoring of international lupin production and collaboration between entomologists and plant pathologists is an essential part of maintaining a vigilant Biosecurity system for any agricultural industry.

It is important that all people involved in the lupin industry are proactive by looking for subtle changes in pest status or presence and report these changes in the published literature. This will enable biosecurity responses in a timely and cost effective manner should a new threat to the lupin industry be detected.

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