



# MANAGING DISEASE INCURSIONS

## an economic perspective

Lisa Elliston, Luke Mathews and Alasebu Yainshet

- **Exotic pest and disease incursions can impose significant costs on Australian agriculture and surrounding regional economies.**
- **Advance assessments of alternative responses to potential incursions can improve the likelihood that an exotic pest or disease incursion can be successfully eradicated from Australia.**
- **An exotic incursion management model is used to demonstrate the ability of improved farmer detection and reporting to reduce the overall economic costs associated with a potential incursion of karnal bunt, a disease affecting wheat.**
- **Appropriate incentive payments to farmers may be required in order to obtain the estimated benefits to the regional economy from early reporting.**

### Assessing impacts using a disease incursion model

Australia has a valued reputation for supplying high quality agricultural products with disease free status to export markets. Disease incursions pose a serious threat to this reputation and can cause significant harm to the agricultural industry affected and to the surrounding regional communities, resulting in considerable losses in trade and incomes.

A wide range of strategies can be put in place to reduce the incidence and effects of pest and

disease incursions within Australia. These include border control and surveillance measures that focus on preventing a disease or pest from entering the country or a particular region. In the event of an incursion being identified, containment strategies such as the establishment of quarantine boundaries as well as measures to eradicate the pest or disease can be employed.

Often a rapid response to an exotic pest or disease incursion is required in order to limit the extent of the incursion. While real time modeling and evaluation of alternative management strategies for the most part is infeasible, advance assessments of response options can increase preparedness.

With responsibility for coordinating and designing policies to improve the ability of Australian agriculture to respond to pest and disease incursions, organisations such as Plant Health Australia and Animal Health Australia require tools to evaluate the effectiveness of potential incursion management strategies for key pests and diseases that pose the greatest threat to Australian agriculture.

In this paper the development of ABARE's exotic incursion management (EIM) model is described and an initial case study application to karnal bunt of wheat is analysed. The ability of early detection to greatly increase the likelihood of eradication and to lower the overall costs of an incursion is explored, with the results highlighting the importance of understanding the financial incentives for farmers to learn to identify and report the presence of exotic pests and diseases on their property.

## Exotic incursion management model

The EIM model is an integrated bioeconomic model that integrates the biophysical aspects of disease incursion with the agricultural production system and the wider regional economy. The spatial and agent based nature of the model makes it possible to capture the physical process of disease transmission from a variety of different vectors, the economic impact of the spreading disease, and any resulting management to eradicate or control the incursion.

The model consists of four main components that represent the pest or disease, the farm system, the incursion management system, and the regional economy. The pest or disease module captures the unique characteristics of the particular pest or disease, including transmission vectors and estimates of the rate of movement or spread. The farm system is modeled on a weekly time-stepped basis and includes production choices and estimates of financial returns. The incursion response and management module incorporates the methods by which the pest or disease is first identified, the process by which potential incursions are investigated, and any subsequent containment and eradication measures that are put in place. A stylised representation of the regional economy is also included to enable calculation of the flow-on effects of an incursion to the wider community. For a more detailed description of the model see Elliston, Yainshet and Hinde (2004).

## Case study application

The EIM model was used to analyse a hypothetical incursion of the wheat disease karnal bunt in a region of south eastern Queensland. A number of scenarios were constructed to analyse the ability of specific quarantine measures to contain and eradicate karnal bunt from the region, and to estimate the impact of an incursion on the regional economy.

### Western Darling Downs

The case study region is located in the western Darling Downs, south of Roma and west of Dalby in Queensland. The region relies heavily

on the agricultural sector, with almost 60 per cent of all businesses belonging to the agriculture, forestry and fishing industry (OESR 2003). Around 90 per cent of all land in the region consists of agricultural holdings. More than 1.1 million hectares of crops were grown in the region in 2001, and over half of this was sown to wheat. The wheat produced in this region is generally of a high quality and attracts a significant price premium on world markets.

### Karnal bunt

Karnal bunt of wheat is caused by the smut fungus *Tilletia indica* Mica (Bonde, Peterson, Schaad and Smilanick 1997). Karnal bunt teliospores, spread by air currents, vehicles and farm machinery, infect developing wheat heads at the time of flowering. Despite the strong fishy odor of infected grains, only a portion of an infected kernel is replaced with a mass of teliospores with only a few kernels in each head usually infected, making detection of the disease difficult.

Karnal bunt teliospores have proven resistant to a number of adverse environmental conditions, remaining viable for up to five years in contaminated soils (Bonde et al. 1997). Despite some recent advances in the development of fungicide treatments and resistant wheat varieties (John Brennan, Principal Research Scientist, NSW Department of Agriculture, personal communication, February 2004), the primary means of containing the disease is to ban the planting of wheat in affected paddocks for at least five years.

### Trade impacts

Only mild losses in wheat yield occur as a result of the disease. However, when more than 3 per cent of grains are infected, the wheat becomes unfit for human consumption (Nagarajan et al. 1997). This quality effect, combined with the difficulty in controlling a karnal bunt incursion, has made karnal bunt the subject of strict quarantine regulations by a number of wheat importing countries. Currently more than twenty countries have karnal bunt on their quarantine list, preventing the imports of wheat from any country in which karnal bunt has been confirmed (American Phytopathological Society 1996).

Originating in India, karnal bunt is now endemic throughout much of the Middle East. It has also been recorded in Mexico, the United States and South Africa, but has never been reported in Australia. With Australia's high reliance on export markets and the quarantine restrictions imposed by many of those markets, a karnal bunt incursion in Australia would have a potentially devastating impact on the domestic wheat industry.

In 2002-03 Australia exported around 11 million tonnes of wheat, valued at more than \$3 billion. The antipathy of Australia's major wheat export markets toward karnal bunt infested wheat is reported in table 1. Countries with a high antipathy toward the disease are likely to refuse all imports from a country with karnal bunt, while countries with a low antipathy will not refuse any wheat products on the basis of their karnal bunt status. Countries with a medium degree of antipathy are likely to accept wheat only from regions that have been tested and certified free of the disease.

Five of Australia's ten most important wheat export markets have quarantine restrictions on all wheat from nations infected with karnal bunt. It is therefore likely that a karnal bunt incursion in

Australia would lead to an immediate and significant loss of valuable export markets.

### Customised EIM model

The generic EIM model framework was adapted to analyse the impact of karnal bunt in the case study region. A range of transmission vectors were explicitly incorporated into the model. These include the wind, farmers and their machinery, contractors and their machinery, and farm inputs such as seed and fertiliser. Each disease vector interacts with the spatial environment, with its own patterns of behavior and movement. For example, contract workers and farmers are able to spread karnal bunt teliospores across and between farms as they move throughout the region. Subsequently, the disease may spread across neighboring paddocks by wind or the movement of machinery on-farm.

The farm system captures the decisions made by farmers to plant different crops. Four major agricultural activities are included in the model: wheat, feed wheat, sorghum and an aggregate representing all other agricultural activities. The timing of planting, spraying for weeds, harvesting and the use of contract labor is all determined within this module. During spraying and harvesting, karnal bunt teliospores can be spread across and between farms in the region. At all other times of the year farmers move randomly around their farm potentially spreading the disease if it is present on their property. Based on average yields, the total volume of wheat, sorghum and other commodities produced on each farm is calculated. The grain produced is sent to the silo and, based on average farm grade prices, gross receipts for each of the major commodities are calculated.

There are two ways in which a karnal bunt incursion can be identified. First, farmers can identify signs of diseased crops on their property. Second, teliospore infested grain can be identified when harvested grain is sent to the silo.

When diseased crops are identified, a quarantine response is triggered to investigate the extent of the incursion and attempt to contain it so that it cannot spread further. The farm from which the infected grain came is immediately quarantined and a tactical response officer is dispatched to the

## 1 Australia's major wheat export markets

	Antipathy toward karnal bunt			
	2000-01	2001-02	2002-03	
	kt	kt	kt	
Indonesia	2 174	2 073	1 662	high
Japan	1 160	1 193	1 132	high
Iran	2 352	2 418	1 064	low
Iraq	2 587	2 245	1 037	low
Korea, Rep. of	1 139	953	1 014	high
Egypt	955	1 680	602	high
Yemen	507	450	412	medium
Malaysia	775	681	370	low
New Zealand	189	335	306	high
Thailand	269	282	290	low
Other	4 463	4 096	2 917	
Total exports	16 570	16 406	10 806	

property. All neighboring properties are placed in a buffer quarantine zone. Tactical response personnel visit each of the neighboring properties and search for signs of karnal bunt. If the disease is identified on any of the properties, these properties are upgraded to full quarantine status and all properties neighboring the newly identified farm are then searched. Where signs of infestation are not found on neighboring properties, those properties remain in the buffer quarantine region and the search of other properties is stopped.

At the same time, any contractors that have visited teliospore infested farms that are now fully quarantined are identified to trace back the source of the incursion and limit its spread. In the first instance, contractors identified in this process are asked to provide a list of farms that they have visited during the year. Tactical response personnel are then dispatched to each of these farms in order to identify the extent of the incursion. Where an infestation is identified on a property, that property is fully quarantined and the search through all neighboring properties begins. Any contractors contacted in this trace back process who were carrying teliospores on their machinery are disinfected before the next season begins.

In the event of an identified disease incursion, farms can be classified as:

- identified as having an infestation and fully quarantined;
- identified as not having an infestation but in a buffer quarantine zone because neighboring properties have the infestation; or
- not quarantined, either clear of infestation or not yet identified.

The planting options available to farmers are then restricted for a period of years based on their level of quarantine. Farmers identified as having the disease are quarantined and are unable to grow grain crops for five years. Neighboring farms that form the buffer zone are unable to grow grain crops in the first year after an incursion is identified.

In the remaining years of the five year quarantine period, wheat grown on these farms can only be used for feed purposes within the region. In all scenarios considered, when the disease is first identified the price for wheat produced in

the region, even wheat that is free of the disease, receives a lower price. The price for wheat only returns to the higher export price after the disease is deemed to have been eradicated from the region on the basis that no new incursions are identified for at least one year.

A twelve sector input–output model represents the regional economy of south eastern Queensland. Input–output tables contain the supply and demand of goods and services in an economy over a particular period, along with the interdependencies between the industries and associated primary factors of production. Changes in the value of agricultural production as a result of a disease incursion can therefore be traced through the rest of the regional economy in terms of output, employment, income and imports.

The input–output analysis provides estimates of both the direct and indirect impacts of a change in agricultural production resulting from a disease incursion. The direct — or initial — impact captures the changes in the value of production and any associated changes in employment and income in the directly affected agricultural industries, as well as any changes in imports required by these industries. Subsequent changes in all other industries and the directly affected industries form indirect or flow-on impacts.

## Incursion scenarios

Two different incursion scenarios, with different levels of farmer detection and reporting were analysed to investigate the importance of early detection on the likelihood of eradicating the disease and the overall economic cost of a karnal bunt outbreak.

The first scenario involves a limited and slowly expanding incursion with karnal bunt introduced into the case study region by contractor equipment. The incursion begins with just two contractors and spreads across the region by the movement of farmers and contractors, as well as the wind.

The second scenario represents a diffuse starting point with potentially rapid expansion, with a load of fertiliser contaminated with karnal bunt sold throughout the region at the beginning of the simulation.

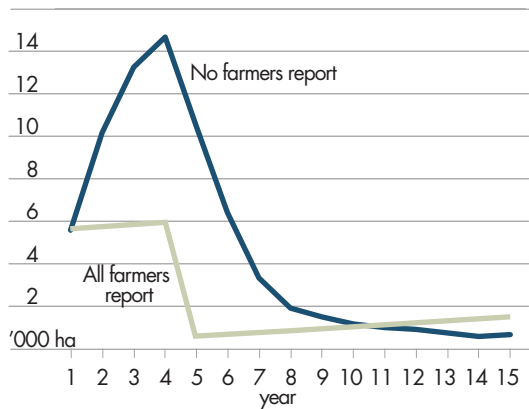
## Contractor based incursion

Two contractor based incursion scenarios were investigated. In the first scenario, the likelihood of teliospore infested grain being identified at the silo was assumed to be 50 per cent, and farmers did not report signs of the disease on their property. In the second scenario, the likelihood of detection at the silo remained at 50 per cent and all farmers reported signs of the disease on their property.

When farmers do not report signs of the disease on their property the area infested increases from around 5500 hectares in the first year to more than 14 000 hectares by the fourth year of the fifteen year simulation (figure A). At this point in time, almost 80 per cent of all infested land has been identified and quarantined. As a result, the extent of the incursion is curtailed and the area infested reduces to negligible levels by the end of the planning horizon.

In contrast, when farmers report signs of the disease on their property the extent of the incursion is reduced, with a maximum of 5900 hectares infested by the fourth year of the simulation. More than 95 per cent of all infested land is quarantined in the fourth year and the ability of the disease to spread is reduced. The area infested is reduced significantly. Despite a slightly higher level of infestation in this scenario compared with the scenario where no farmers report in the latter years of the simulation, more than 95 per cent of the infested land is quarantined and the likelihood of the disease being eradicated within another five years is high.

### A Area infested, contractor scenario



The combined effect of the low level of infestation in the region and the ability of quarantine measures to contain an outbreak caused by contractors means that the adverse economic effects of this hypothetical karnal bunt incursion are relatively minor. Over the fifteen year planning horizon, an incursion, even when no farmers report signs of the disease on their property, results in a net loss of production valued at around \$58 million in net present value terms (table 2).

Over the fifteen year planning horizon, the indirect effect of the hypothetical incursion on all industries is estimated to be around \$22 million (in 2003 prices). The total industry and consumption effects, reflecting the indirect effects along with the initial (direct) effects, capture the overall impact of this particular karnal bunt incur-

## 2 Regional economy effect of alternative incursion scenarios

	Initial (direct)	Flow-on (indirect)	Total
	\$m	\$m	\$m
Contractor incursion, no farms report	-58.0	-22.3	-80.4
Contractor incursion, all farms report	-55.6	-21.5	-77.1
Fertiliser incursion, no farms report	-430.2	-165.3	-595.5
Fertiliser incursion, all farms report	-368.9	-141.5	-510.3

sion. It is estimated that over the fifteen year planning horizon, the decline across the case study region is around \$80 million (in 2003 prices).

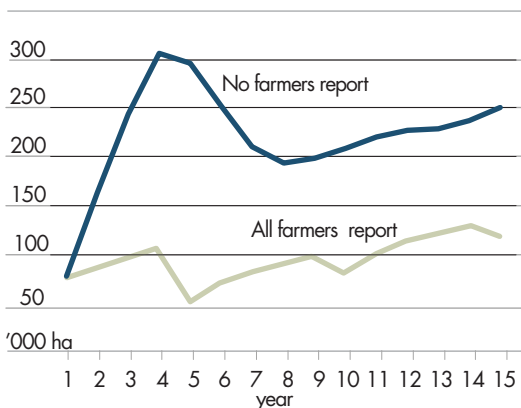
When farmers report signs of the disease on their property the incursion is contained in a shorter period of time and the overall economic effects of the outbreak are reduced. Over the fifteen year planning horizon, the loss in value of production is estimated at under \$56 million. When the direct and indirect effects of changes in production are aggregated across the region, the decline in economic performance is \$77 million.

The \$3.3 million difference in the economic performance of the region under these two contractor based incursion scenarios provides an indication of the value associated with improving the likelihood of detection by farmers on their property. This in turn can provide a benchmark against which expenditure aimed at improving farmer awareness of the disease, and therefore the likelihood of detection, can be assessed.

### Fertiliser based incursion

Two fertiliser based incursions, with the same likelihood of detection at the silo and on-farm, were also investigated. When farmers do not report signs of the disease on their property, the area infested increases from around 76 000 hectares in the first year to more than 300 000 hectares by the fourth year of the simulation (figure B). Unlike the contractor scenario, only around

## B Area infested, fertiliser scenario



two-thirds of all infested land has been identified and quarantined at this point in the simulation. As a result, despite the reduction in infestation between the fifth and eighth years of the simulation, the disease fails to be contained and the area infested continues to increase throughout the remainder of the planning horizon.

When farmers report signs of the disease on their property, the extent of the incursion is reduced significantly, but still fails to be eradicated. The area infested follows a cyclical pattern and at the end of the fifteen year planning horizon almost 120 000 hectares of land is infested.

The much larger incidence of infestation across the region and the failure of quarantine measures to adequately contain the disease when it is brought into the region via contaminated fertiliser results in the economic impact of this scenario being much larger than the contractor based incursion scenario.

Over the fifteen year planning horizon, a fertiliser based incursion where farmers do not report signs of the disease results in a net loss of agricultural production valued at around \$430 million, compared with a reference case of no disease (table 2). When the indirect effects are added to this, the economic impact of the disease incursion is estimated at more than \$595 million over the fifteen year planning horizon.

When farmers do report signs of the disease on their property the extent of the incursion is reduced and the economic impact of the incursion is correspondingly reduced. The net loss in agricultural production that results from the fertiliser based incursion falls to around \$369 million when farmers report signs of the disease on their property. This converts to an overall loss in regional income of \$510 million.

Once again, the difference in the economic performance of the region under the two fertiliser based incursion scenario provides an indication of the value associated with improving the likelihood of detection by farmers on their property.

## Incentives to self report

The results presented in the previous section indicate that the region as a whole is better off when

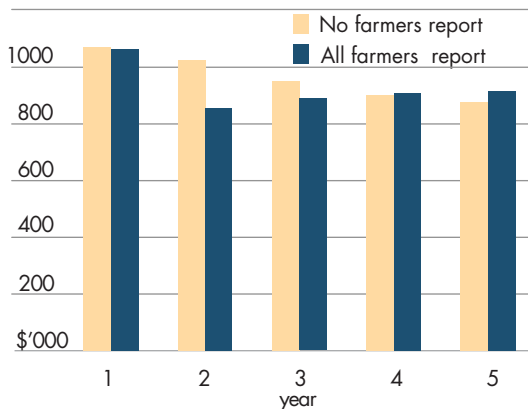
farmers report signs of the disease on their property. However, an analysis of the gross receipts earned by farmers identified as having the disease suggests that at least in the initial years of the simulation, farmers are unlikely to have an incentive to report signs of the disease on their property.

In the contractor based incursion scenario the receipts per infested farm for the scenario where no farmers report signs of the disease on their property are higher than the scenario where all farmers report for the first two years (figure C). In the third year the receipts per farm are on average equivalent. In subsequent years when the quarantine measures take effect and the disease is contained, the receipts per infested farm are higher under the scenario where farmers report signs of the disease on their property.

Similar results were observed for the fertiliser based incursion scenario. Average receipts per infested and quarantined farm were higher in the first three years of the simulation under the scenario where no farmers report signs of the disease on their property (figure D). In the final years of the simulation this trend reverses and the average receipts per infested farm are higher when farmers report signs of the disease on their property.

These results indicate that while the region as a whole is better off when farmers report signs of the disease on their property, at least in the early years of the simulation farmers appear to

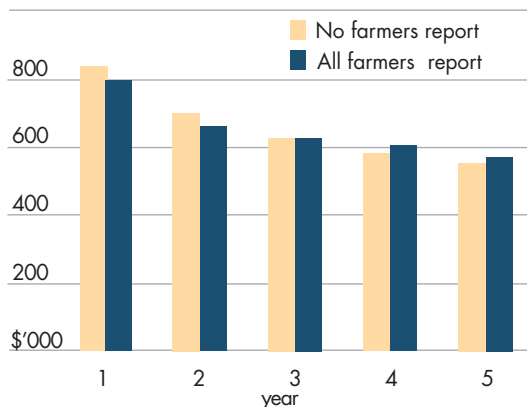
## D Receipts per infested farm, fertiliser scenario



have little incentive to report signs of the disease on their property. This is an important result because the ability to successfully contain a disease such as karnal bunt is likely to depend critically on it being identified within the first few years of its introduction to Australia. Further, the estimated economic costs of a karnal bunt incursion presented in this paper include only the costs incurred within the case study region. If Australia's major wheat export markets were to refuse all wheat produced within Australia the additional cost of the incursion across the rest of the country is likely to be significant, particularly if the disease cannot be eradicated.

To ensure self reporting, farmers with the disease may require financial payments to offset the disadvantages associated with reporting the disease and being placed under quarantine restrictions. The results presented in figures C and D indicate that the size of the financial disincentive is likely to be higher when the disease is more widespread.

## C Receipts per infested farm, contractor scenario



## Conclusions and further work

The initial case study application of the EIM model indicates that it can be used for assessing the likely effectiveness of alternative management strategies in the event of an exotic plant disease incursion such as karnal bunt. The integrated bioeconomic nature of the model makes it possible to undertake a comprehensive analysis of

the impact of an incursion and any resulting incursion management. This includes not only an assessment of the biophysical impact of an incursion, but the resulting on-farm economic and regional economy effects as well. The ability to investigate the incentives that farmers face to engage in strategic behavior is likely to greatly enhance the accuracy with which the effect of proposed containment strategies can be assessed.

The results from the case study analysis demonstrate the ability of improved farmer detection and reporting to reduce the overall economic costs associated with a potential karnal bunt incursion. They also highlight the need to provide appropriate incentives to farmers in order to obtain the estimated benefits to the regional economy.

The findings from the scenario with a wide-spread and diffuse start indicate that such an incursion scenario is likely to lead to a rapid expansion of the disease that fails to be eradicated despite a range of containment and eradication strategies. This suggests that optimal management policies will vary with the nature of a disease incursion.

The modeling framework is generic in nature and is capable of being adapted to analyse a wide range of incursion scenarios, as well as the incursion of other plant diseases and pests. It is anticipated that additional development of the framework will occur so that the model can be extended to analyse the spread of both weeds and insect pests in other case study regions. This is

likely to require an expansion of the pest and disease transmission vectors, as well as the range of agricultural activities modeled explicitly. An expanded representation of transport systems and networks is also likely to be required for the analysis of other pests and diseases.

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# OUTLOOK 2004

## SPEAKERS PAPERS

Speaker

**Simon McKirdy**  
Program Manager  
Plant Health Australia

Title

Coordinating a national plant health  
system

Session

**Product Integrity**  
11.00am Wednesday 3 March  
National Convention Centre, Canberra

## **Coordinating a national plant health system**

Dr Simon McKirdy,

### **Summary**

Plant Health Australia (PHA) is a public company with members including all Australian governments, and key plant industries in Australia.

PHA's vision is to assist development of an internationally outstanding plant health management system that enhances Australia's plant health status and the sustainability and profitability of plant industries.

The company seeks to reach this vision by working closely with its members on agreed programs that enhance the overall capacity and capability to respond effectively to emergency and exotic plant pests.

Australia's animal health system is more advanced than arrangements in the plant or aquatic sectors, and so PHA has been working across a wide range of areas to ensure effective and coordinated processes and mechanisms are put in place in the areas of prevention, preparedness, response and recovery.

### **Introduction**

Australia has an enviable position of being relatively free from serious pests and diseases, and an international reputation as a reliable supplier of 'clean, green' crops and food. Our geography and lack of land borders have provided a level of natural protection, but increasing growth in movements of passengers, mail and cargo pose an ongoing challenge to Australia's favourable pest and disease status.

Australia's plant industries are worth approximately \$17bn, with a substantial component of that value being generated from exports. For example, Australia is a net exporter of grain, with 80 per cent of the total grain crop usually exported. This generates approximately \$4bn in exports. The viticulture industry is another strong export performer, with exports in excess of \$2bn per annum.

As more and more plant industries seek to capitalise on export opportunities, it is vital that our favourable pest status is maintained if we are to continue to gain access to overseas markets.

Unlike the livestock industries, where there are a relatively small number of well researched diseases, the challenge is much greater for the plant industries. Plants can be affected not only by diseases, but also insects, fungi, viruses and nematodes (collectively referred to as plant pests). While individual livestock industries may have 10 key potential exotic disease threats, some plant industries have hundreds or even thousands of potential pest threats.

For this reason, plant industry bodies and the Australian and state/territory governments established PHA as a public company in April 2000 to adopt a partnership approach to

key plant health issues, and through this, to enhance Australia's ability to minimise incursion risks, and effectively respond to both exotic and emergency plant pests.

In particular, PHA is focusing on efforts to enhance Australia's preparedness, prevention and emergency response capacity, and examining the information needs and scientific capability required to underpin plant health policies and operations. This is reflected in the company's four priority areas:

- a nationally coordinated plant health preparedness and prevention system;
- an enhanced plant pest and disease emergency response system;
- a national perspective on plant health service capability; and
- a national system of plant health information.

## **Prevention and preparedness**

### *Surveillance and monitoring*

Australia needs an effective and coordinated surveillance and monitoring capacity to assist in making declarations on our pest free status, and to assist in the identification of and response to exotic and emergency plant pests.

State based surveillance and monitoring programs have been developed over a number of years to meet specific requirements within jurisdictions, but a national policy on roles and responsibilities, funding options and methodologies needs to be established.

PHA is now working with members to assess existing surveillance and monitoring programs with the intention of then coordinating a national policy on surveillance and monitoring.

This work links with PHA projects to develop industry biosecurity plans and to establish a national diagnostic network (see below).

### *Biosecurity plans*

PHA is developing national Industry Biosecurity Plans (IBPs) with individual plant industry members as a pre-emptive measure to ensure potential threats are identified and appropriate response mechanisms are put in place.

The development of an IBP is a collaborative process, which engages both industry and government representatives as well as other technical experts.

IBPs are currently being developed with the grains, sugar, citrus, rice, pome fruit, nursery/garden and viticulture industries. PHA is also negotiating IBPs for the mango, tropical fruit and vegetable industries. PHA has received significant funding and support from the Grains Research and Development Corporation and Horticulture Australia in advancing IBPs.

The Banana IBP was launched in February, with the Citrus IBP due to be launched in April.

### *Diagnostic standards*

Developing diagnostic standards for exotic pests is expensive and time consuming, and limited by its non-commercial nature. However, having appropriate diagnostic capacity is vital for ensuring pests are quickly and correctly identified, for mounting appropriate and rapid responses, and minimising the overall impact on industry.

PHA is seeking to establish, and gain acceptance of standard diagnostic protocols for serious exotic threats for which there is no Australian diagnostic standard. Drawing on high priority exotic pests identified through the grains (and other) IBPs, PHA has commissioned the development or finalisation of approximately 30 diagnostic protocols. Further diagnostic requirements will be identified and addressed via the industry biosecurity planning process.

### *Laboratory accreditation scheme*

In responding to serious pest incursions, both industry and government leaders need confidence that the diagnostic advice they are receiving is both accurate and timely. An accreditation scheme exists for animal diagnostic laboratories and personnel. Accreditation for plant laboratories/personnel has been optional, resulting in a small proportion of plant diagnostic laboratories being accredited, and there is no single recognised accreditation scheme.

PHA has received Australian Government funding to develop a plant laboratory accreditation scheme. This will involve the development and maintenance of appropriate quality control protocols to accredit both laboratories and personnel, and will be linked to the development of a diagnostic network.

### *Diagnostic network*

PHA is undertaking a project to develop a potential structure for a diagnostic network in Australia. A Steering Committee comprising relevant expert representatives been formed, and the first meeting of this group was held in late 2003. This project will be developed in conjunction with PHA's project to develop a plant laboratory accreditation scheme. Once a preferred network structure has been determined, PHA will commission a cost/benefit analysis of the network and present both the structure and supporting economic analysis to Primary Industries Standing Committee/Primary Industries Ministerial Council for consideration and potential adoption.

## **Response**

### *Incursion management funding*

The biggest plant health issue for Australia's plant industries is the issue of funding incursion management responses. Delays in funding pest responses may dramatically decrease the potential for pest eradication, and increase the difficulty of containing the pest.

At present, the Australian Government and state/territory governments share the costs of eradicating exotic plant pests on a 50:50 basis (with affected states collectively sharing half the eradication costs based on the value of crops at threat). This arrangement was never formalised, so individual governments can withdraw from this arrangement at any time. Budgets are shrinking, and agriculture departments increasingly need to seek funds from Treasury or Finance Departments to secure funding for individual pest eradication campaigns.

Currently industry has no formal role in decision-making, although individual growers and the overall industry are clearly impacted by any eradication effort.

Under existing arrangements, it has taken months or even years for government agencies to negotiate funding arrangements and begin eradication efforts for some pests. For example, it took two years for a response to be undertaken in response to a detection of Grapevine Leaf Rust in the Northern Territory. However, most experts agree that the greatest chance of a successful pest eradication effort comes from rapid detection and response.

PHA is negotiating an Emergency Plant Pest (EPP) Response Agreement to address identified weaknesses with the current arrangements.

Under this agreement, the most serious emergency pests identified for each industry will be categorised according to the severity and impact of the pest. The costs of eradicating the pest will then be split between government and industry (with contributions varying depending on the relative benefits of eradication to industry and government).

This intention is to have funding sources and cost sharing responsibilities determined and agreed before an emergency plant pest occurs, so that a response can begin as soon as possible.

In addition, the agreement includes significant risk minimisation obligations for both industry and government, which will help to reduce both the risks and potential costs of emergency plant pests.

PHA is working towards ratifying the EPP Response Agreement at the PHA General Meeting in May 2004.

#### *National response plan*

Until recently, there was no single agreed manual for jurisdictions to use in responding to plant pest incursions. PHA is now developing PLANTPLAN, a manual for all Australian jurisdictions to use in managing responses to emergency plant pests. Once finalised and formally endorsed, PLANTPLAN will provide benefits to both plant industries and government agencies by documenting procedures and ensuring serious pest incidents are handled consistently across jurisdictions, and providing greater certainty in how pest responses are handled.

#### *EPP Response Training*

A key issue in mounting effective pest responses is ensuring that participants are well training and capable of performing their respective roles. Currently, there is no nationally recognising training or accreditation scheme covering emergency plant pest responses.

PHA is working to establish and implement a national competency based approach to assessment and training for Emergency Plant Pest Preparedness, covering both government and plant industry representatives. Training packages will be advanced once PLANTPLAN is endorsed.

### *Information systems*

Information systems are also required to assist pest responses. PHA has been developing a national expertise register, which will allow relevant experts (e.g. diagnosticians, surveillance and monitoring experts) to be readily identified and contacted if required. The system will initially capture Australian expertise, but over time, the potential to identify and record international expertise will be investigated.

PHA is also involved in the deliberations of the National Information Technology Management Group, a cross jurisdictional working party that is examining the potential to develop a national emergency response information system to support response activities in both the animal and plant health sectors.

### **Recovery**

Once a pest has been eradicated, there needs to be a process to move back to normal arrangements in the industry. In any incursion, it is likely that there will be local, regional and probably state quarantine restrictions, and possibly, international trade restrictions.

In order to resume trade and lift these quarantine restrictions, a pest free declaration needs to be made. Increasingly, overseas and domestic quarantine regulators are requiring a more evidence based approach to such declarations.

PHA is currently coordinating the development of national policy on domestic declaration of pest free areas consistent with relevant international requirements and agreements.

### **Conclusion**

For many years, unlike the livestock industries, Australia's plant industries did not have the benefit of robust and nationally coordinated arrangements to ensure more effective responses to exotic and emergency plant pests.

The majority of activities listed in this paper have been supported by Australian Government, through a budget initiative funding package, *Building a National Approach to Animal and Plant Health*, which will conclude in the next few months. This funding, and the formation of PHA means that governments and plant industries are now beginning to see the advantages of investing in a more coordinated and effective plant health system.

However, increasing growth in world trade, passenger movements and mail means that development of Australia's plant health and biosecurity arrangements must be an ongoing process. The programs currently being undertaken by PHA provide a sound basis for achieving a more coordinated and effective plant health management system that can effectively respond to both current and emerging challenges.

# OUTLOOK 2004

## SPEAKERS PAPERS

**Speaker**

**Peter Merriman**

Consultant in Plant Protection and Bio-security

**Title**

**ERADICATION versus CONTAINMENT**

**Session**

**Product Integrity**

11.00am Wednesday 3 March  
National Convention Centre, Canberra

# ERADICATION versus CONTAINMENT

**Peter Merriman**

*Consultant in Plant Protection and Bio-security*

## **Introduction**

The arrival of a new plant pest or pathogen into a country usually means additional costs to farming communities and allied industries. Understandably, at such times, *eradication vs containment* is the subject of vigorous debate. One frequent reaction of affected stakeholders is to seek funding for eradication. Ideally, it would be preferable to eradicate all introduced organisms, however this is not always technically feasible, nor cost effective.

Depending on the organism and industry affected, eradication can be a costly exercise which requires immediate action and substantial funding. For this reason it is imperative to ensure that decisions to eradicate can be justified and, increasingly, there is pressure on stakeholder governments and industries to develop a robust framework within which decisions can be made.

There are three main components when considering the options to either eradicate or contain. One is an assessment of the extent of the incursion. The second involves a biological assessment concerning the type of organism involved and the feasibility of proposed action. The third analysis considers the wider economic, social and environmental factors which may affect regions and industries where the commodity is produced.

This paper provides general background on the definitions, systems and resource requirements. It also examines the biological factors which are an important part of the “eradication/containment” equation. Selected examples are used to illustrate how variability between organisms requires a case by case approach to appraising economic and environmental impact. There is no set formula.

## **Definitions**

A glossary of terms relating to quarantine, bio-security, eradication and containment can be found at the web site of the Food and Agriculture Organisation ([www.fao.org/docrep/W3587E/w3587e01.htm#glossary](http://www.fao.org/docrep/W3587E/w3587e01.htm#glossary) of phytosanitary terms).

*Eradication* is defined as “the application of phytosanitary measures to eliminate a pest from an area” and *containment* is “the application of phytosanitary measures in and around an infested area to prevent spread of a pest”.

When countries chose to eradicate, there is a requirement to demonstrate pest “freedom” after eradication is reported. Pest free areas can also be an important part of containment strategies particularly for organisms which are listed as “under official control”.

*Pest free area* is defined as “an area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained”

The clause “as demonstrated by scientific evidence” is deliberately non specific. One reason is that demonstration of absolute freedom is nearly impossible because of cost and logistical difficulties. A sensible interpretation is that the pest is not detected by appropriate diagnostic testing of samples from approved survey within specified confidence limits.

## **The Australian system**

Australian State and Commonwealth Governments have worked with primary industries to maintain and develop an active and effective system for incursion response in plant industries. More recently this has been significantly strengthened by the establishment of Plant Health Australia (PHA), which has responsibilities, on behalf of industry and Government, for the development and coordination of national bio-security strategies.

New arrangements are in place for approving decisions on eradication or containment. Confirmation of an incursion triggers a two tier process involving a Consultative Committee of technical experts in entomology, plant pathology and quarantine and a National Management Group. The latter currently comprises representation from heads of State and Commonwealth Departments of Primary Industries. Plant Industries have observer status and its membership is proposed subject to ratification of cost sharing agreements.

The Consultative Committee, with the assistance of technical experts, makes recommendations on the feasibility of eradication and supports this by detailed technical, economic, social and environmental analysis. The process is developed within very tight deadlines in order to preserve any opportunities for action. The recommendations are considered by a National Management Group, which has

responsibility for approving and funding eradication. If this is not approved, the issue is usually referred to the appropriate State and Industry organizations for containment action.

### **Resources**

In Australia, eradication usually involves a targeted quarantine program requiring relatively short term expenditure over 3-5 years. Recent planning agreements propose that costs are covered by a nationally agreed cost sharing arrangement between government and the affected industry organizations. Funded activities include surveys to identify the boundaries of the affected areas, the application of quarantine and control strategies, the destruction of the organism and affected plant material, disinfestation of soils, equipment and associated items. A final important commitment involves confirming “freedom” by a planned process of survey and diagnostic testing.

Resources for containment are usually committed over much longer time frames and costs are generally borne by the industry and government in the affected area. The objective is to restrict further spread of the organism and costs are associated with a combination of survey, quarantine regulation and control strategies. State quarantine legislation is used to contain pests which are identified as “under official control”. For other organisms, the responsibility for containment usually rests with industry and individual farmers. Costs are mostly concerned with the introduction of new control treatments such as resistant varieties, new pesticides and/or biological agents.

### **Technical assessments for the eradication vs containment decision**

#### **1. Predicting impact of exotic plant pests and diseases**

Accurate estimates of the impact of exotic pests are an essential input for decisions on eradication or containment. This presents significant challenges for experts, because of the requirement to predict impact of organisms which have not yet arrived on the Australian landscape.

The process requires collection and interpretation of overseas data and extrapolation to Australian agricultural and natural ecosystems. Government and industry rely on Australian experts in plant pathology and entomology who have an understanding of the biology, spread and control of specific types of pests and pathogens.

One of the important keys to success is collaboration between scientists from different countries. International networks are crucial, and their significance and value is not always fully appreciated. Experts use the collective experience of scientists in countries where the organism is endemic to predict effects and impact in the country where the organism is considered exotic.

To assess impact, information is required on the host range of the organism (including the presence of resistance genes), its rates of reproduction as influenced by host plant distribution and climate, and potential control strategies. Hidden costs should also be identified. These include estimates of unanticipated effects on farming operations such as disruption of rotation practices and integrated pest and disease management programs. Quarantine information is also provided on phytosanitary regulations, which restrict market access. Completed analyses present estimates of impact on yield and post harvest quality, on value adding operations, trade and on the costs of controls.

The question of predicting environmental impact is difficult because of the lack of information on the effects of exotic pests on Australian fauna and flora. Some assessments can be made by checking for the effects of pests or pathogens on Australian flora growing in other countries and by analysis of the specificity of the pest/pathogen on host plants.

#### **2. Assessing the extent of the incursion**

As soon as the diagnosis of an exotic organism is confirmed surveys are commissioned by quarantine agencies to define the boundaries of the outbreak. This is an intense period of activity designed to provide accurate information on the distribution of the pest within the shortest possible time frame. It involves three types of initiative. Surveys around the infestation which define the extent of the infested site. Trace back and trace forward surveys to identify any infestations at sites which are connected to the infested site. Area wide surveys to confirm whether there are other infestations. This latter issue is particularly important to avoid the assumption that the first detection is “ground zero”.

Other important information is provided on the distribution of host plants in and around the affected site, the prevailing weather conditions prior to and since the detection, and ease of access to sites.

### **Development of technical recommendations**

Information on the biology and predicted impact of the organism, together with the data on the extent of the incursion are used to estimate the technical feasibility and the costs of eradication. This is

factored into models which use data on predicted impact in a regional economic setting. This can cover farming, allied industries and any associated effects on communities. Recommendations usually compare the cost benefits of eradication with those of containment over specified time frames. Interaction with technical experts is essential to clarify biological detail and differences between the costs of eradication or on going containment. Comment may also be required on possible spill over effects on rural communities and natural systems. Data from the models is considered, reviewed and clarified by the Consultative Committee in association with technical experts (local and international). As soon as possible the Consultative Committee provides its recommendations for urgent consideration by the National Management Group. Under proposed new arrangements, when eradication is approved by this group, cost sharing arrangements are applied according to a pre-determined formula. This assigns the proportion of funds required from Governments and Industry according to the anticipated wider benefits on the “public good” or the more specific industry beneficiaries.

### **Three examples which illustrate the variability of different types of exotic plant pests and diseases**

There are thousands of exotic plant pests and pathogens and within which all types of biological variation occur. The three examples presented below show how organisms vary in their impact. This may be by direct effects on yield, on market access and value adding or on the environment. Prospects for cost effective control also differ significantly. Accurate assessments of impact for decisions on eradication or containment depend on an understanding of the variability of the exotic pest/pathogen within the Australian environment.

#### **Karnal Bunt - *Tilletia indica***

A disease caused by a fungus which is specific to wheat. Its presence in wheat crops and bulk grain can be difficult to detect. It produces millions of wind borne spores which can contaminate and survive in soils. Effects of disease on yield are insignificant, but its presence in Australia is predicted to have significant impact on milling quality and market access for grain. There is no commercially available source of resistance to the pathogen and the effectiveness of chemical controls is considered marginal. The organism is host specific and impact on Australian grass species is considered low risk.

#### **Russian Wheat Aphid – *Diuraphis noxia***

An insect which can reproduce on cereals and related grasses. The insect and symptoms are easily recognised. Alate (winged) forms disperse the pest and it survives on volunteer cereals and other grass species. Significant yield losses are predicted for wheat and barley industries from feeding damage and injection of a plant toxin. No major effects on international market access are predicted. Insecticidal control is possible and would add significantly to costs of production. There are no commercially available sources of resistance. Biological predators are present in Australia but effects as control agents are unknown. The impact on Australian grasses is unknown.

#### **Sudden Oak Death – *Phytophthora ramorum***

A fungus which causes death of a range of forest and amenity plant species. Strains of the pathogen exist and its detection may prove difficult. It is spread by water, contaminated soil and planting material and possibly by wind. Significant impact is predicted on nursery, forest and landscape plants. Restrictions may be anticipated on national market access for selected nursery plants. This is a newly reported organism in California and Europe and control strategies are still under development. The impact on Australian vegetation is considered potentially serious because of the wide host range of the pathogen.

### **Conclusion**

How is the system working? The three examples listed above highlight the issue of variability and clearly indicate the need for analysis on a case by case basis.

There have been only a few examples of incursions where the application of predictive cost benefit analysis has been used to assist decisions eradication or containment. One successful example was the incursion of Papaya Fruit Fly in Far North Queensland, where analysis successfully predicted eradication within time frames and budget.

More time is needed to test and refine the system but, ultimately, it can be confidently assumed that a robust process will evolve which provides increased certainty in risk management decisions and minimises the cost of error.