Vegetable biosecurity & quarantine gap analysis

Prue McMichael
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HORTICULTURAL SERVICES

FINAL REPORT

Vegetable Biosecurity and Quarantine Gap Analysis

VG07087

Prepared for	:	Horticulture Australia Ltd
HAL Project No.		VG07087
Prepared by	:	Prue McMichael
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PURPOSE OF REPORT

This Final Report has been prepared to document information acquired, analysed and considered during the review undertaken for HAL, into all aspects of the biosecurity of Australia's vegetable industries that are members of AUSVEG. The Final Report includes identification of biosecurity gaps and recommendations for industry, research partners and government authorities who together drive and influence on-farm, regional and national biosecurity.

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GLOSSARY

Term/Abbreviation	Definition
Additional declaration	A statement that is required by an importing country to be entered on a phytosanitary certificate and which provides specific additional information pertinent to the phytosanitary condition of a consignment (FAO, 1990).
ALOP	Appropriate Level of Protection
ALPP	Area of Low Pest Prevalence
APPD	Australian Plant Pest Database
APVMA	Agricultural Pesticides and Veterinary Medicines Authority
AQIS	Australian Quarantine and Inspection Service- operating under the Department of Agriculture, Fisheries and Forestry, Australia. AQIS is charged with the responsibility for quarantine matters and the export certification of live animals, animal products, plants and plant products.
Area	An officially defined country, part of a country or all or parts of several countries.
AVRDC	Asian Vegetable Research and Development Centre (World Vegetable Centre – Taiwan)
BA	Biosecurity Australia
CA	Compliance Agreement: voluntary agreement entered into by the Australian Quarantine and Inspection Service and an independent party to undertake specific procedures/activities on behalf of AQIS, using suitably trained/skilled persons and approved inspectors.
CABI	The CAB and CABI abstracts is a database comprehensively covering the world's literature in agriculture and allied fields.
CCEPP	Consultative Committee on Emergency Plant Pests
CDFA	California Department of Food and Agriculture
CODEX	Codex Alimentarius Commission
Commodity	A type of plant, plant product or other article being moved for trade or other purpose (FAO, 1990; revised ICPM, 2001).
Consignment	A quantity of plants, plant products and/or other articles being moved from one country to another and covered, when required, by a single phytosanitary certificate (a consignment may be composed of one or more commodities or lots).
Consignment in transit	Consignment which passes through a country without being imported, and without being exposed in that country to contamination or infestation by pests. The consignment may not be split up, combined with other consignments or have its packaging changed (formerly country of transit).
Country of origin	Country of origin for a consignment of plants is the country where the plants were grown.

Term/Abbreviation	Definition
CRC	Cooperative Research Centre
DAFF	Department of Agriculture, Fisheries and Forestry, Australia.
DFAT	Department of Foreign Affairs and Trade
Delimiting survey	Survey conducted to establish the boundaries of an area considered to be infested by or free from a pest.
Detection survey	Survey conducted in an area to determine if pests are present.
DQMAWG	Domestic Quarantine and Market Access Working Group (sub-committee of PHC, within DAFF)
Entry (of a pest)	Movement of a pest into an are where it is note yet present, or present but not widely distributed and being officially controlled.
Equivalence	Situation of phytosanitary measures which are not identical but have the same observable effect.
Eradication	Application of phytosanitary measures to eliminate a pest from an area.
ERL	Extraneous residue limits
Establishment	Perpetuation, for the foreseeable future, of a pest within an area after entry.
EU	European Union
EXDOC	AQIS Electronic Export Documentation System and its purpose is to electronically process and produce Government to Government documentation required for export of Prescribed Goods.
FAO	Food and Agriculture Organisation of the United Nations
Free from	(of a consignment, field or place of production) Without pests (or a specific pest) in numbers or quantities that can be detected by the application of phytosanitary procedures.
FSANZ	Food Standards Australia and New Zealand
FSC	Food Standards Code
HAL	Horticulture Australia Limited
Harmonization	The establishment, recognition and application by different countries of phytosanitary measures based on common standards (FAO, 1995; revised CEPM, 1999; based on the World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures).
HECC	Horticultural Exports Consultative Committee
HMAC	Horticultural Market Access Committee
ICA	Interstate Certification Assurance
ICPM	Interim Commission on Phytosanitary Measures

Term/Abbreviation	**Definition**
IMAAG	Import Market Access Advisory Group
Import permit	Official document authorizing importation of a commodity in accordance with specified phytosanitary requirements.
IRA	Import Risk Assessment
Inspection	Official visual examination of plants, plant products or other regulated articles to determine if pests are present and/or to determine compliance with phytosanitary regulations.
Introduction	The intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity.
Invasive species	An alien species whose introduction does or is likely to cause economic or environmental harm to human health.
IPPC	International Plant Protection Convention, a multilateral treaty for international cooperation in plant protection was deposited with FAO in 1951 and administered through the IPPC Secretariat and subsequently amended.
ISPM	International Standard for Phytosanitary Measures.
ISTA	International Seed Testing Association
LBAM	Light Brown Apple Moth
LC/MS	liquid chromatography/mass spectrometry (machine)
MAF	Ministry of Agriculture and Forestry, New Zealand.
Monitoring survey	Ongoing survey to verify the characteristics of a pest population.
MPC	Maximum Permissible Concentration
MRL	Maximum Residue Limit
Native species	With respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.
NBP	National Biosecurity Plan (formerly IBP)
NOI	Notice of Intention
NPHS	National Plant Health Strategy
NPPO	National Plant Protection Organization: Official service established by a government to discharge the functions specified by the IPPC. 1 Officially Established, authorized or performed by a National Plant Protection Organization.
NRS	National Residue Survey
OCPPO	Office of the Chief Plant Protection Officer (within DAFF)

Term/Abbreviation	Definition
Pest	Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products.
PFA	Pest Free Area, 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.
Pest free place of production	Place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period.
Pest risk analysis	The process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it.
PHC	Plant Health Committee
PHYTO	PHYTO is the AQIS plant and plant produce export conditions database.
Phytosanitary certificate	Certificate patterned after the model certificates of the IPPC Phytosanitary certification. Use of phytosanitary procedures leading to the issue of a phytosanitary certificate.
Phytosanitary measure	Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests.
Phytosanitary regulation	Official rule to prevent the introduction and/or spread of quarantine pests, by regulating the production, movement or existence of commodities or other articles, or the normal activity of persons, and by establishing schemes for phytosanitary certification.
Place of production	Any premises or collection of fields operated as a single production or farming unit. This may include production sites which are separately managed for phytosanitary purposes.
Plant products	Un-manufactured material of plant origin (including grain) and those manufactured products that, by their nature or that of their processing, may create a risk for the introduction and spread of pests.
Plants	Living plants and parts thereof, including seeds and germplasm.
Practically free	Of a consignment, field, or place of production, without pests (or a specific pest) in numbers or quantities in excess of those that can be expected to result from, and be consistent with good cultural and handling practices employed in the production and marketing of the commodity.
Pre-clearance	Phytosanitary certification and / or clearance in the country of origin, performed by or under the regular supervision of the National Plant Protection Organisation of the country of destination.
QEAC	Quarantine and Exports Advisory Council
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled.
RDC	Research and Development Corporation

Term/Abbreviation	Definition
Re-exported consignment	Consignment which has been imported into a country from which it is then exported without being exposed to infestation or contamination by pests. The consignment may be stored, split up, combined with other consignments or have its packaging changed.
Regulated article	Any plant, plant product, storage place, packaging, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved.
Regulated non-quarantine pest	A non-quarantine pest whose presence in plants for planting affects the intended use of those plants with an economically unacceptable impact and which is therefore regulated within the territory of the importing contracting party.
RFP	Request for Permit (through EXDOC system in AQIS). The RFP describes product, when and where it was processed, its overseas destination, and other details, for example describing consignor, consignee and transport.
Seed transmitted	Organism present in the seed embryo (in the case of viruses eg Tobacco mosaic virus, pathway by which the pathogen is transferred to the seedling).
Seedborne	Organism transferred on or in the seed coat.
SPS	Application of Sanitary and Phytosanitary Measures
Survey	Methodical procedure to determine the characteristics of a pest population or to determine which species occur in an area.
WGMARD	Working Group for Market Access Research and Development
WTO	World Trade Organisation
WTO-SPS	World Trade Organisation Sanitary and Phytosanitary Agreement

MEDIA SUMMARY

This review was commissioned by Horticulture Australia Limited (HAL). The challenges of biosecurity and quarantine are global in nature, local in effect and ideally a shared burden of responsibility pre-border to post-border. HAL is proactively assisting horticultural industries to identify the nature and source of their threats, so they may undertake their expected role in risk minimisation and biosecurity within the national biosecurity continuum.

This review discusses the international obligations that dictate our quarantine and biosecurity activities. It also includes discussion of the changing nature of quarantine and biosecurity globally, and its local effects. The review identifies that nature and source of biosecurity threats to Australia's vegetable industries, and includes assessment of existing quarantine and biosecurity measures for both regulatory and biological threats. It identifies biosecurity gaps and emerging threats. The report also provides recommendations on the future research and investment needed to enhance vegetable biosecurity within a national framework that is reliant on government-industry partnership. Although used as examples, the review does not include the tomato, onion and potato industries.

The effects of inadequate biosecurity are economic, social and environmental in nature and they arise from multiple sources pre-border to post-border. Growers routinely manage a diverse range of production pests, diseases and weeds, and it is recognised that today these threats are not the serious market access impediments for Australian fresh vegetables, that they are for fruit. However all horticultural growers will be increasingly be relied upon to document pest status by recording results of on-farm inspections, trapping and monitoring. Industries will increasingly be relied upon to collate the on-farm data into regionally-accessible surveillance data that includes intelligence on direct pest status (presence/absence) and also indirect biosecurity threats like changing chemical availability and security, regulations and contamination sources etc. Rural and peri-urban communities will also be increasingly important as informed observers and early detectors of threats.

To achieve this, greater investment and commitment by the vegetable industries, are required. It has not been possible to-date to achieve a coordinated and concerted vegetable industry approach to export, but it is essential that coordinated, collaborative, and well-resourced improvements in vegetable industry biosecurity are achieved. Underpinning the advancements in biosecurity must be documented, science-based evidence. In their absence, the sustainability, viability and cost effectiveness of the industries and production regions, and the demand for and reputation of Australian fresh produce, will be eroded.

The vegetable industry is encouraged to prioritise the recommended research and development themes and to identify those for which collaborative investment is necessary and has clear benefits (eg. resource-and data-sharing, surveillance, pollination and post-harvest alternatives, communication and awareness material development etc.). Neither industry nor government has the capability or resources to enhance biosecurity, in isolation.

The biosecurity gaps presently lie in industry and community biosecurity awareness and commitment; preparedness and response capacity. It is therefore concluded that the major areas requiring investment are:

- Regional and national surveillance
- Co-ordinated data acquisition
- Human capacity building
- Communication

TECHNICAL SUMMARY

This review was commissioned by Horticulture Australia Limited (HAL). The challenges of biosecurity and quarantine are global in nature, local in effect and ideally a shared burden of responsibility pre-border to post-border. HAL is proactively assisting horticultural industries to identify the nature and source of their threats, so they may undertake their expected role in risk minimisation and biosecurity within the national biosecurity continuum.

This review discusses the international obligations that dictate our quarantine and biosecurity activities and our import and export processes. It also includes discussion of the changing nature of quarantine and biosecurity globally, and its local effects. The review identifies that nature and source of biosecurity threats to Australia's vegetable industries, and includes assessment of existing quarantine and biosecurity measures for both phytosanitary and regulatory threats. It identifies biosecurity gaps and emerging threats. The report also provides recommendations on the future research and investment needed to enhance vegetable biosecurity within a national framework that is reliant on government-industry partnership.

The fresh produce vegetable industries are currently more exposed in the areas of regulatory threats than they are to phytosanitary threats. The threats include input security (crop protectant quality assurance, fertiliser quality assurance, pollination services and biosecurity etc.); inconsistent interstate regulations, and residue testing; inconsistent data sharing esp. from border quarantine activities, and across industries sharing production regions and/or threat profiles); lack of coordinated data to establish an 'area status' (i.e. pest-free area, area of low pest prevalence etc), and/or respond to media reports and public perceptions. The vegetable industries reliant on imported seed are more exposed to phytosanitary threats. Most vegetable seed continues to be imported without prior risk analysis. The potential traceability of seed to sites of production is low under currently required import documentation and verification, and as such viruses and viroids in imported seed remain an ill-defined threat to several vegetable industries.

The report has concluded that vegetable industries and horticulture in general, need to invest more (financially and in-kind through planning, coordination activities, training incentives etc.) with a longer-term commitment, to regional, industry biosecurity, while also increasing their commitment to NAQS, sentinel hive programmes and other border activities. The existing biosecurity gaps are multi-faceted. They are found pre-border to post-border, within and outside the vegetable industries themselves, and within the rural communities that are increasingly relied upon for early detections and plant biosecurity support. The most notable gaps are in biosecurity awareness, commitment and understanding of the shared responsibility; regional collaboration across industries in surveillance planning and methodology, technology development and response capacities – eg. data collection and collation, consistently-applied detection and diagnostic tools and protocols, personnel availability and capabilities; and in the tools and expertise available to prepare for, manipulate, and manage realised and potential pest threats. It is therefore reasonable to conclude that the major areas requiring increased vegetable industry investment are:

- **Coordinated regional and national surveillance** (underpinned by on-farm and regional plans, research and technology development; and increased AQIS and NAQS resources)
- **Coordinated data acquisition and sharing mechanisms** (that include research and intelligence on direct and indirect threats - input security, pests presence and absence, weather events, regulatory changes etc. pre-border to post-border)
- **Human capacity building** (and the research commitment and educational incentives, training and schemes necessary to underpin and advance it)
- **Communication** (that is outcome-focussed and regionally-targeted; regularly evaluated for effectiveness and reach; and clear and consistent in its articulation of the economic [and social] necessity for engagement and participation, by each targeted sector).

1 GENERAL INTRODUCTION

The challenges of biosecurity and quarantine are global in nature, local in effect and ideally a shared burden of responsibility. Quarantine measures have been in place for many decades, and AQIS has long been charged with finding, treating and/or prohibiting imports and exports that carry risk. Our biosecurity and quarantine systems have protected Australia and provided the basis of an earned 'clean and green' image for our agricultural products. The systems however are currently challenged by changing domestic and global conditions. Only this century has the broader agricultural community, openly and actively engaged in discussion of the concept of shared responsibility for biosecurity management. This has been imposed to a degree by international requirements, but also reflects the general acceptance that today, external threats to our production regions and food quality, can potentially reach us in less than 24 hours, and have immediate social, economic an d/or environmental effect.

The essence of the challenge for the United States was well stated by their National Research Council in 2002. It applies equally to Australia. "*As the United States faces biological warfare for the first time and ponders the consequences of growing genetically modified crops, a largely unnoticed biological attack is underway; actually, it has been under way for centuries and shows no sign of slowing. Nonindigenous species – animals, plants, and microorganisms occurring beyond their natural geographic ranges – are flowing into this country at a remarkable rate. …From coast to coast, there is hardly a place in the country untouched by invasive nonindigenous species."* The effects of such invasions are widespread and costly. The challenge today is to adequately resource (through human, technical and financial contributions) and coordinate, the necessary efforts of industry and governments to enhance biosecurity generally, but especially in the areas of agriculture, health and the environment.

The World Trade Organisation's Sanitary and Phytosanitary (WTO-SPS) Agreement has introduced and driven phytosanitation to the point it is the key consideration and determinant of world fresh produce trade. Since the GATT Uruguay round, discussions of the scientific basis of phytosanitary measures, thresholds and appropriate levels of risk, and biological trade barriers have been commonplace. More recently trade negotiations have also included discussions on the environment, climate change effects and diversity maintenance through recognition of potential effects on native species. At the same time trade in plant products has increased dramatically, free-trade agreements have increased, and new pathways for pest distribution and entry are increasingly being recognised.

Because agricultural and horticultural commodities are potential carriers of biological organisms, and therefore 'threats' to some natural, amenity and/or commercial production environments, as well as public health, they are subject to phytosanitary scrutiny. Perishable commodities (fruit, vegetables and cut ornamentals) are greater threats than those moved in a dried or processed state. The applied regulatory measures and treatments reflect the demonstrated threat pathway. The biosecurity and quarantine issues are greater in unprocessed, 'for consumption' or 'for sowing' produce. This review is therefore focussed on fresh vegetables and vegetable seed. It has not sought to re-state the information presented in the Industry Biosecurity Plan (IBP), and therefore the two documents should be viewed as complementary and read in conjunction.

This report includes assessment of quarantine and biosecurity measures in place, identifies biosecurity gaps and emerging threats and provides recommendations on research and investment needed to enhance vegetable biosecurity in a national government-industry partnership. The review brief and consultation list are included in Appendix 1.

2 AUSTRALIA'S VEGETABLE INDUSTRY

Horticulture is Australia's second largest agricultural industry and vegetables are the largest commodity group within the horticultural industry. The vegetable industry is comprised of a large number of separate commodity groups and allied industries (seed, compost, apiary, processing, transport, marketing, research, inspection, certification and diagnostic services etc.). The allied industries and commodity production locations are widely dispersed across most of Australia, and production sites span the country's climatic zones.

The industry is characterised by a diverse range of commodities and products. The major industry commodities include potatoes, tomatoes, carrots, onions and lettuces, and the minor ones include niche products like specialist Asian vegetables. The products marketed as vegetables technically and botanically include fruit, seed, tubers, bulbs, stems, and leaves. They may be marketed as fresh, dried, chilled/frozen, semi-processed and processed goods.

The vegetable and potato commodity groups are nationally represented by AUSVEG. This project however does not include the biosecurity or quarantine issues surrounding potatoes, onions or tomatoes, although they are drawn upon for biosecurity examples. AUSVEG member groups vary in their incentives to pursue export markets, their preparedness, suitability and capability to export, their capacity to compete with cheaper imports and to expand their markets. The export culture has developed most strongly in Western Australia (WA) and Tasmania (Tas.) but for many other regions the exporting of vegetables is somewhat opportunistic in nature.

Growers in each of the industries routinely manage a diverse range of pests and diseases, and in addition will increasingly be relied upon for crop inspection and monitoring information to support regional pest status determinations, within a national surveillance and reporting framework. Although it has not been possible to achieve a coordinated and concerted vegetable industry approach to export, it is now essential that a coordinated, science-based response from the vegetable industries - to the changing quarantine and biosecurity environments - be achieved.

The definition of 'biosecurity' proposed by Plant Health Australia (PHA), is accepted as it incorporates both the microbial threats (pests, diseases, contaminants etc) and regulatory threats (chemicals etc). 'Fresh vegetables' in this report refers to those vegetables intended for sale to consumers without processing (raw) – or with minimal processing. The vegetables may be sold intact (i.e. carrots) or may have received some cutting or trimming – broccoli, asparagus. Although we recognise some vegetables are also provided as 'fresh cuts' (salad mixes, pre-cut soup mixes) their consideration in this report will be primarily as fresh produce.

2.1 The Changing Environment in which our Vegetable Industries are Operating

There are global and local developments that necessarily affect the status of our plant industries and the environment in which they are operating:

- Global competition and new domination in vegetable supply from developing countries – eg. the rise of cheaper producers - China, Thailand, Indonesia and India; subsidies in EU etc.
- Identification of chemicals and microbiological organisms as terrorism inputs - eg food, input security; chemical security and availability
- Growth of free-trade agreements; declining terms of trade
- Increased movement of produce and plant material, animals and people (including organism movement for diagnostic purposes, year-round research, breeding trials, seed production etc.)

- Human capacity and formal capability decline - eg discipline expertise and commodity specialist resources are not feeding into agricultural industries from education institutions; skills and labour shortages, esp. competition from mining
- Changing expectations on industry – eg. quarantine continuum and concepts of shared responsibility, users and beneficiaries pay; investment priorities in preparedness and protection/prevention vs. responsiveness (reactivity)
- Structural change in a fragmented industry – leadership tensions; marketplace concentrations
- Scientific evidence requirements – eg. to underpin and safeguard trade
- Limitations imposed by the Quarantine Act 1908 – especially post-border
- Communication technology - information overload ("information rich – knowledge poor")
- Climate change and variability – water security, changing pest profiles

2.2 Relevant Vegetable Industry Statistics

2.2.1 Worldwide

World trade in agricultural commodities has risen in recent years. In 2005 the value of agricultural and horticultural commodities traded was US$852 billion, an 8% increase over the previous year (Heather & Hallman, 2008). Internationally, horticulture is growing faster than agriculture and developing countries are increasingly important as sources of agricultural and horticultural imports for developed countries. (Future Focus, 2007).

China's share of global production and trade is large and will get larger (currently 12%, increase of 44% over last 5 years, forecast to grow 5.3%/year over next 5 years) (Future Focus, 2007). The AVRDC in Taiwan (FAO Stat 2006, [C. Clavero] SeedQuest News, October 2006) stated in 2006 that vegetables were the world's fastest expanding crop sector in land area and it is expected that much of the production will enter world trade despite existing food shortages in some of the producing countries. It was noted, '*The expansion of vegetable production in China has been particularly significant, having grown almost as fast as its economy, at almost 6% per year over most of the last 20 years*'. They stated that the area of arable land devoted to vegetables is increasing at 2.8% per year and this is higher than for fruits, oil crops, root crops and pulses. Policy changes and foreign investment have triggered the increase in area of land under vegetable production (and export expansion).

Chinese fresh vegetable exports in 2005-07 ($1.5 billion) increased three-fold over the previous decade and resulted in displacing the United States as the main provider of fresh produce to the lucrative Japanese market. Interestingly, while increasing their presence in the Japanese market (except during periods of poor publicity over contaminants), the percentage of Chinese exports to that market in value terms, has recently declined. China has successfully diversified their exports and established new Asian markets, despite on-going concerns about their control over food safety and phytosanitary issues.

In value, Chinese garlic and mushrooms account for nearly 60% of their fresh vegetable exports and have done so for a decade. However in the last few years, onions, carrots, and potatoes have contributed to the rapid rise in the standings of China as a major exporter of fresh vegetables (Huang, 2008). China's exports of frozen vegetables have grown similarly and they are the leading supplier of all frozen vegetables to Japan, except sweet corn.

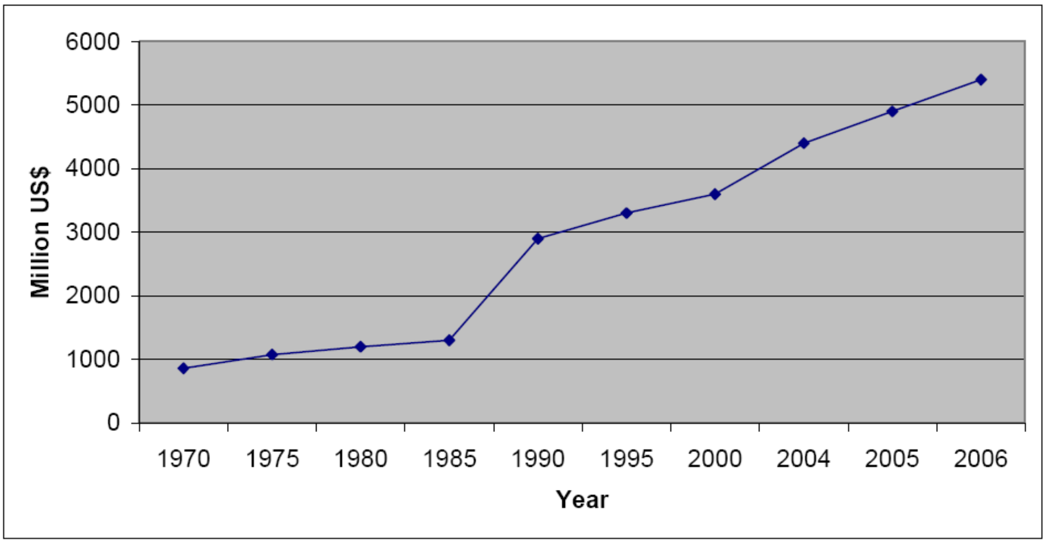
For the immediate future, perishable Chinese products are predicted to continue their domination within the neighbouring Asian markets, but this could rapidly change once China addresses some of their produce quality and cool storage challenges. On the other hand their export domination may decline as the increasingly affluent Chinese population demands more produce domestically, thereby diverting it from the potential export volume. Australia continues to have potential in the Chinese and Asian marketplaces but export commitment and strategic endeavour across specific industries (that have niche, high-value potential) and government, appears to be the necessary foundation. Prowse (Prowse, 2008) provides good evidence of Chile's (and other southern hemisphere producers) recognition of this, and their subsequent financial, technical and collaborative diplomatic investments.

Expected in the future will be another significant rise in the impact felt from India. At present its agri-food exports (which were valued at US $9.3 billion in 2005) are focussed on tropical goods (tea, coffee and spices) and world commodities (grains, milled rice, cotton, maze, soy). However there is realisation amongst Indian policy makers and economists that there is unmet potential to increase their exports of value-added horticultural goods (chutneys, pickles) and, after infrastructure and supermarket investment, fresh vegetables. Given that their exports of floricultural and seed goods in 2006-07 were already worth US $192.8 million and value-added fruit and vegetable exports were worth US $602.9, the expected transformation within Indian horticulture should not be ignored during Australian deliberations of our horticultural future as exporters (Pritchard, 2008).

Worldwide, the major importers of agricultural produce are the EU (US$97 billion), the USA with US$68 billion and Japan with US$66 billion (Heather & Hallman, 2008). This suggests demand for fresh produce by these partners will remain strong.

The growth in international seed trade has been consistent since 1985 (Figure 1) and this trend is predicted to continue. A summary view of Australia's position within world seed trade is given in Table 1.

Figure 1 : Growth in International Seed Trade



Source: http://www.worldseed.org/cms/medias/file/ResourceCenter/SeedStatistics/SeedTradeGrowth/Seed_Trade_Growth.pdf

Table 1 : World seed trade statistics

Domestic seed markets	Value $US mill.	Vegetable seed imports (2006)	Value $US mill.	Vegetable seed exports (2006)	Value $US mill.
USA	7,080	USA	189	Netherlands	641
China	4,000	Netherlands	180	USA	288
France	1,915	Spain	147	France	200
Japan	1,500	Mexico	142	Canada	71
Brazil	1,500	Italy	111	Japan	70
India	1,300	France	78	Israel	62
Germany	1,000			Chile	60
Australia	400	Australia	17	Australia	12
Netherlands	208				

Source: (USDA Fresh Fruits and Vegetables Import Manual – ISF Secretariat, 2008)

2.2.2 Australia

Australia is a small player in the world of horticultural production. Oceania production is approximately 1% of global output, with Australia approximately 50% of this, or approximately 0.5% globally (Future Focus, 2007).

The Australian Horticulture industry is valued at $6.9 billion, and is third in size to meats and grains, and consists of fruit, vegetables, nuts and nursery products (HAL, 2008b). The value of horticultural imports to Australia in 2007, was $1,410 million. This was a 60% increase since 2002, and $200 million of the increase was attributable to 2007 alone. Australia imports a range of fruit and vegetable products from many countries. The majority are imported as fried, frozen, chilled, fresh, juiced and preserved products. The main horticultural imports to Australia in 2007 included $71m of Brazilian orange juice, $45m of Chinese apple juice, $62.5m fresh or dried cashew nuts from Vietnam, $38m fresh table grapes from US, $30m potatoes from NZ, $25.5 prepared vegetables from NZ, and $29m dried grapes Turkey (*The Advertiser*, April 30, 2008).

The vegetable industry is Australia's fourth largest industry sector, with a value of $2.75 billion, 40% greater than wool and lamb, more than double the size of wine and poultry, and triple that of sugar and cotton. Queensland is the largest vegetable producing state (35% of production), followed by Victoria (24%) (James, 2008).

2.2.3 Vegetable Imports

The volume of imported vegetables increased 18.9% in 2007, and Australian exports dropped 10.9%. (*The Weekly Times*, April 2008). Australia is now a net importer of vegetables. The value of processed ($93.0m) and frozen ($92.6m) vegetables is highest, followed by fresh and chilled produce valued at $26.1m or 10% of the total value. Overall, most imported vegetables come from New Zealand ($70.4m), China ($42m), Italy ($35.1m) and the USA ($24.0m). Although data are not readily available to identify the sources of all imports, it is known that imports from China and Thailand continue to surge (up 22.4% since 2006); and that Canada is emerging as a major source of frozen potatoes (AUSVEG Industry Statistics, March 2008).

The Australian vegetable industries and the community in general are aware of the increasing range and volume of imported fresh produce now available, despite country of origin labelling not being provided on all fresh produce. Capsicum, asparagus and peas are the imported crops highest in value and volume. They have increased each year over the last three years (Table 2). Capsicum volume increased from 2,074 tonnes in 2005 to 2,463 tonnes in 2007; asparagus from 1,157 tonnes in 2005 to 1,737 tonnes in 2007, and peas from 1,165 tonnes in 2005 to 1,264 tonnes in 2007. The major import destinations for products are NSW (asparagus), Victoria and Queensland (Capsicum) and WA (peas).

Table 2 : Australian Import Trade Volume (Tonnes) and Value (A$m) for 2005 to 2007

(Tomatoes, potatoes and onions not included. Broccoli, cauliflower, lettuce removed as no imports.)

	Australian Import Trade Volume (tonnes)			Australian Import Trade Value (A$m)		
	2005	2006	2007	2005	2006	2007
Capsicum	2,074	2,247	2,463	7.9	9.0	9.3
Asparagus	1,157	1,470	1,737	4.4	5.5	6.7
Peas	1,165	966	1,264	2.6	2.5	2.8
Beans	523	484	681	0.3	0.3	0.6
Mushrooms	275	307	327	1.2	1.2	1.2
Carrots	38	9	4	0.0	0.0	0.0

Source: HAL 2008 Summaries of Australian Vegetables industry production and trade – provided with Brief

Australian horticultural seed imports are currently valued at around $22 million per annum. (HAL,2008c), with crops like tomatoes being totally reliant on imported seed. Other crops grown in significant volumes from seed are shown in Table 3.

Table 3 : Crops from seed, Victoria 2002

Crop	Volume (tonnes)
Tomatoes	262,435
Carrots	113,310
Lettuce	32,970
Cabbages	30,391
Celery	29,532
Cauliflower	24,090
Broccoli	19,027
Asparagus	approx 5000
Leeks	4,034
Brussels Sprouts	2454
Spring Onions	1791

Source: Irvine, 2005 (from: Australian Statistics Handbook 2004).

2.2.4 Vegetable Exports

Australia is not a large and successful exporter of either fresh or processed horticultural products. It exports around 10% of production and imports about 17%, making it a net importer (Future Focus, 2007). Export of primary horticultural products has increased only $50m in the last 10 years. Horticultural products exported from Australia generally include (principally fresh) fruit, vegetables and nuts, processed horticultural products, flowers and nursery products with a total combined value of $1024m. Growth of exports has been seen in almonds, citrus, macadamia nuts and table grapes, however the $200 decline in export markets has been felt mostly by the apple, pear, cauliflower, asparagus and frozen vegetable industries (HAL, 2008b).

Since 2001, 37% of the Australian vegetable export trade has been lost and the vegetable trade deficit increased 63% to $143m in 2007. Contributing factors are the ongoing drought and resulting high water and input prices and line of supply, as well as the strong Australian dollar (*The Weekly Times*, April 2005). Australia has the advantage of counter seasonal export opportunities in the Northern Hemisphere, but share them with strong southern hemisphere competitors like Chile, South Africa and New Zealand (Future Focus, 2007). The international marketplace is highly competitive and interconnected. It favours countries and industries supplying higher volumes of consistent quality of lines, and those best prepared to respond to changing trade requirements and consumer preferences (HAL, 2008b).

The Horticulture Australia Limited (HAL) Review of Export Policies and Programs May 2008 states that "*Phytosanitary market access is the single greatest obstacle to the expansion of the horticulture industry's export performance*" (HAL, 2008b). While true for fruit, it is not widely agreed that fresh vegetable exports from Australia have been greatly impeded by phytosanitary issues, although the WA carrot market loss in Taiwan, is a current example.

It is more widely accepted that our vegetable export market growth, unlike for forestry, nuts and seafood, has been stalled as a result of more fundamental issues:

- **The value of the Australian dollar.**
- **The line of supply** – need 12 months reliable supply, and responsiveness to changes in consumer demand; sustainability of small suppliers not guaranteed.

- **Fragmentation of industry** – affects the above. Structural changes and leadership uncertainty.
- **Cost of labour and inputs; efficiencies and relative costs** – inability to compete on price.
- **Opportunistic export culture** – rather than long-term development and commitment.
- **Drought and water insecurity** – provided some openings.
- **Free-trade agreements** – few have included horticulture.

However it remains true that pests and diseases (and weeds) cost the Australian vegetable growers billions of dollars annually, in costs of production and lost production, rather than in lost market opportunities. The significance of market access biosecurity for all horticultural industries will grow with the demands for surveillance, especially in the traditionally difficult markets (China, South Korea, Japan, USA). The recent listing of some vegetables as fruit fly hosts may also increase our market access problems (HAL, 2008b).

Until recently Taiwan was an important export destination for Western Australian carrots, our largest volume fresh vegetable export (excluding potatoes, onions and tomatoes). The ban on carrots also incorporated onions and potatoes as they were considered also to be "root vegetables." In few vegetable industries has the development of and commitment to exporting, been consistently long-term as it has for WA carrots, and they remain the major vegetable export crop from Australia, with volume remaining steady over the last three years.

Asparagus, broccoli and cauliflower are the next most important, however these have declined in volume since 2005 (Table 4). Asparagus, broccoli and cauliflower are exported from Victoria, Queensland and NSW. Asparagus for export is grown in two regional areas of Victoria. Fresh product is air freighted to markets in Japan, Singapore and Hong Kong. Broccoli production for export to Taiwan, Singapore and Japan has also been successfully achieved. Some squash exports from Tasmania have been reported and the destinations are within Asia and Europe.

Table 4 : Australian Export Trade Volume (Tonnes) and Value (A$m) for 2005 to 2007

(tomatoes, potatoes and onions not included)

	Australian Export Trade Volume (tonnes)			Australian Export Trade Value (A$m)		
	2005	2006	2007	2005	2006	2007
Asparagus	5,571	4,789	3,515	26.9	22.1	18.0
Beans	1,363	1,280	1,245	2.9	3.1	2.9
Broccoli	4,995	3,810	3,580	9.4	7.9	8.0
Capsicum	1,313	1,187	1,066	2.9	3.1	3.3
Carrots	60,552	62,414	62,836	36.9	40.8	41.4
Cauliflower	4,385	1,664	958	6.0	2.3	1.5
Lettuce	1,633	999	1,146	4.8	3.6	4.3
Mushrooms	295	202	100	2.1	1.4	0.7
Peas	36	39	157	0.1	0.1	0.2

Source: HAL 2008 Summaries of Australian Vegetables industry production and trade – provided with Brief.

3 BIOSECURITY AND QUARANTINE

3.1 Background

'*Biosecurity*' refers to the minimisation of risks posed by emergency plant pests to the economy, environment and people's health through exclusion, eradication and control" (PHA, 2007).

In practice, *biosecurity* is about protection of our produce, livelihoods, sustainability and environmental stability, each of which is susceptible to harm from biological and chemical entries.

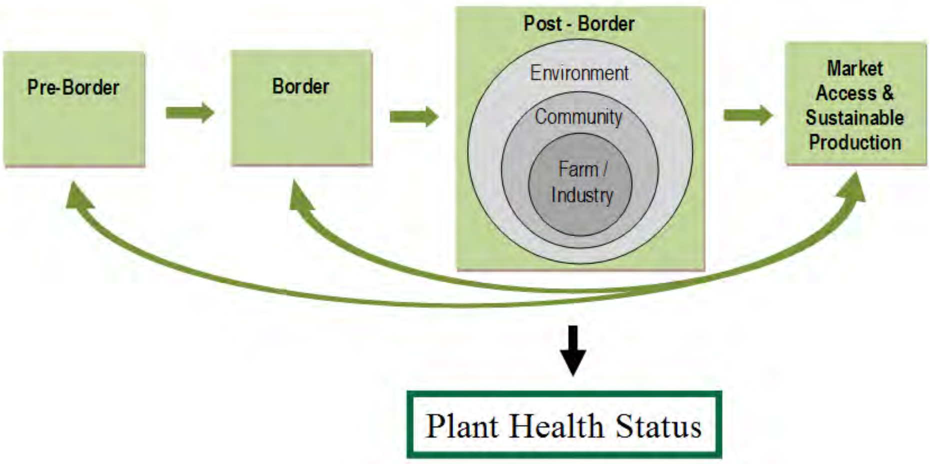
Australia's *quarantine* strategy is based on risk management and the concept of the continuum which starts off-shore, progresses via inspection and surveillance at the border, and concludes with the release of plant material after post-entry procedures. In practice, the integrity of *quarantine* depends on science-based risk assessment and effective border control. The Australian Quarantine and Inspection Service (AQIS) facilitates the safe movement of plants into and out of Australia, and receives policy and risk assessment advice from Biosecurity Australia (BA).

Since most pests and diseases are introduced and spread as a result of human activity (including plant material movement), biosecurity and quarantine are basic components of trade negotiations and decisions. Phytosanitary knowledge, evidence and measures, underpin Australia's trade in agricultural produce. Market access in part, is affirmation of a country or region's biosecurity management and evidence.

General plant biosecurity applies to plants in commercial and non-commercial production, native and amenity settings and their surrounding environment, and to the well-being of those businesses and people, in contact. It also includes chemical and regulatory effects on plant health, food safety, plant movement, and public health. The National Plant Health Strategy (NPHS) recognises the continuum for biosecurity and in so-doing it highlights the shared responsibility for biosecurity management - between governments, communities, industries and individuals; and the necessity for suitable, reliable and up-to-date, documented information at each level (Figure 2).

The draft NPHS project is a national strategy to guide the plant health sector into the future. It "*incorporates all areas of the national plant health system and involves all stakeholders that have a shared responsibility and commitment to the plant health status of Australia.*" The Strategy should provide for greater collaboration and coordination of biosecurity efforts, with sustainable production and market access driving its adoption. Enablers to implementation across all sectors and activities, have been identified as research and development (and innovation); regulations; operational tools, methods and systems; education and training; risk analysis and priority setting; and policy. This is discussed in more detail in Sections 8 and 17.

Figure 2 : Plant Health Continuum



Source: DAFF, 2008 (OCPPO Pers. comm.)

3.2 Informed General Plant Biosecurity

It has been raised by several jurisdictions, industries and individual growers that the specific nature and sources of their biosecurity and quarantine risks are largely unknown to them. Although the IBP (now national biosecurity plan – NBP) has clearly and comprehensively identified exotic pest and disease threats (and pathways) specific to commodities, they alone are insufficient for industries and state governments to prioritise preparedness efforts. Threats of different natures (eg endemic pests, microbiological or abiotic contaminants, weeds, chemical, regulatory etc.) and sources (seed, water, other hosts, compost on-farm, processing, etc), require consideration at all levels within the biosecurity continuum. Similarly, risk evaluation is required across the continuum – from quick mental checks of risk associated with entering vehicles at the on-farm level to the risk of viral introductions on imported seed. Each requires evaluation within dynamic systems – of production, regulations, trade patterns, climate and weather variability.

Information and communication are essential components of biosecurity management and at each level of the propagation, production or supply chain, the sophistication of the information acquired and required for preparedness and/or response action is slightly different. Plant Health Committee (PHC) recognises the risk exposure of industries, regions and state governments and the necessity of informed biosecurity. They collate information on emerging biosecurity pest threats. A number of states have adopted software that directs regular web crawling for key words as an early alert system. ProMed and European Plant Protection Organisation (EPPO) are useful international sites that provide current information on international plant health matters. Specific information on chemical biosecurity issues, contaminants and resultant food safety, is less readily available, unless a breach has occurred.

Several jurisdictions have expressed their desire for border interception data to alert them to organisms and/or chemicals, commodities (and countries of origin) that are reaching our borders in unsatisfactory sanitary or phytosanitary condition. It has been presented to us that the value of border and pre-border intelligence and investments in testing and inspections etc, while great, are not optimised due to the fact the acquired knowledge (trade statistics, interception data) is not shared beyond the border. Northern Australia Quarantine Strategy (NAQS) inspectors however have established good communication links with northern jurisdictions, and their data exchange is greatly valued.

Discussions with AQIS revealed clearly that its hierarchy are aware of the desire for greater transparency regarding interceptions. The reasons for such data protection however are based on its incompleteness and its potential to result in incorrect conclusions. For example, suspect perishable vegetable consignments are treated (fumigated), rather than extensively tested, at the importers' request usually. The delay incurred by diagnostic confirmation is neither economically nor physically practical, for most importers. Causal organisms are rarely identified to species, and strains of viruses are not determined because importers of perennial horticultural material with suspect viral presence usually decide on plant destruction or heat treatment options. Any identification carried out will only be to the extent required to determine if it is quarantineable or not. In acknowledging their border interception data as being less informative than it could be (to jurisdictions and industries), AQIS has recently invested in a project to produce a useful dataset and mechanisms for sharing it.

3.3 Informed Biosecurity and Market Access

Market access and trade issues are handled and negotiated by a number of government and industry groups. The negotiations are influenced by more than the specific commodity and market in question, and often economic relations, free-trade agreements (USA, Thailand, Singapore) and treaties, working groups (Indonesia) and Cooperation Agreements (China); phytosanitary issues, and technical barriers to trade, are included in discussions.

Producers and their industries have roles and responsibilities that may assist, stall or negate negotiations undertaken on their behalf. These might include the provision of internationally-accepted data and evidence to support phytosanitary status declarations; cooperation and commitment to line of supply; accredited laboratories to undertake testing etc.

Through wide consultation during this project (Appendix 1), we have been unable to verify that phytosanitary status is either a key driver or obstacle to expansion of international markets for Australian vegetables. There is one current example of an international vegetable market under threat due to a biological organism. The Taiwanese government has flagged its intention to prohibit imported fresh produce from 2009, from areas with the burrowing nematode. This potentially will affect the WA carrot export market. However there have been few biological impediments to market access for vegetables, prior to this. Although there may not be widespread agreement that the phytosanitary status of our fresh vegetables is impeding our export growth, it is agreed that standardised competencies for harmonised and well-resourced surveillance, are necessary to enhance biosecurity in the vegetable industries. Our relative freedom from pests and diseases needs documentation, if it is to be the market access advantage for Australia that it should be.

Our discussions during this review process, with AQIS, Biosecurity Australia (BA), Office of the Chief Plant Protection Officer (OCPPO), the Domestic Quarantine and Market Access Working Group (DQMAWG), HAL and state department researchers, also confirmed that the commercial pathways for vegetables are not being viewed as a major source of emerging threats. There have been no documented, systemic breaches of import conditions at the border, in vegetables. There is an accepted view that the initial import risk analyses for fresh vegetables have been thoroughly, if not slowly, completed. This, in combination with AQIS' programmes and surveillance pre-border and at the border, and importers' desires to lose neither reputation nor consignments at the border, have minimised threats associated with fresh produce imports to Australia.

Vegetable seed however, and also nursery stock and ornamentals, continue to raise concern at the border and post-border as they are hosts for many pests and diseases to which vegetable crops are also susceptible. Their entry pathways have, as a rule, been less intensively investigated, being non-consumables.

Biosecurity in the local marketplace appears both more problematic and powerful, than it is in international trade. There are numerous examples of market access obstacles for inter- and intra-state movement of fresh produce. Various trade impediments with legislative support are mentioned in the IBP. Although the states are required to balance risk and responsibility, in order to provide reasonable access, justification for some of the regulatory restrictions and quantification of their trade effects, are difficult to ascertain given the limited availability of interstate vegetable trade statistics, and scientific support for some regulations.

3.4 Informed Biosecurity Regulations and Food Safety

The Codex Alimentarius Commission (CODEX), attached to the FAO and WHO, sets the international standards that are aimed to protect the safety of consumers of raw (and some processed) food of plant origin. They set maximum residue limits (MRLs) for agricultural (and veterinary) chemical residues, maximum permissible concentrations (MPCs) for heavy metals and extraneous residue limits (ERLs) for some environmental contaminants in foods.

In Australia, the Commonwealth government assumes responsibility for the safety of our food supply. All food (locally produced and imported foods) made available for human consumption in Australia must comply with the Australia New Zealand Food Standards Code (FSC). On arrival there may or may not be inspections. The Imported Food Inspection Scheme is jointly run by AQIS and Food Standards Australia and New Zealand (FSANZ), with FSANZ developing the risk assessment policy and standards that apply also to the food and food additives produced in

Australia. (See: http://www.daff.gov.au/aqis/import/food/inspection-scheme). AQIS undertakes the operational aspects (sampling and inspecting) of ensuring safety of imported food. According to FSANZ, horticultural products are low food safety risks and they are therefore inspected by AQIS at the 5% level.

The Australian Pesticide and Veterinary Medicines Authority (APVMA) is charged with the responsibility of conducting chemical reviews, risk analyses, registering products, and use limitations in agriculture. The APVMA may also review existing chemicals for which new uses are requested, or on a case-by-case basis to ensure 'they meet contemporary standards.' These might include a review of older products that previously have not undergone modern spray drift risk assessment.

The APVMA also sets the national MRLs for chemicals in use, and these are published in the MRL Standard. FSANZ maintains a list of MRLs for food commodities (Standard 1.4) within the FSC. This standard is used by state health departments within their food regulations.

A registered product is one deemed, through scientific principles, to be capable of achieving its claimed purpose, and in its approved use pattern will not harm human health, the environment or Australia's trade. The states and territories are responsible for determining and overseeing compliance with the APVMA use instructions and limitations.

The National Residue Survey (NRS), a programme administered by DAFF but funded by industry users, monitors food commodities destined for human consumption within Australia, or for export. The surveys conducted by the NRS and FSANZ suggest Australia's compliance with food standards is high.

3.5 Nature of Plant Biosecurity Threats

Human activity is the critical component at both ends of the biosecurity spectrum. Most incursions or compromised biosecurity results from human involvement. Biosecurity management also relies on human activity - pathway determination, inspections and observations, and the development and implementation of best practice measures that recognise and address potential threats, regardless of their nature.

While many insects, in various life cycle stages can actively move, there is little unassisted movement of most pathogens. Region-to-region spread may occur when winds distribute spores, or continuous corridors of alternative host providing a pathway, but in most cases plant or soil movement by people (legally and illegally), are responsible for long-distance spread of diseases.

The potential to introduce pests in food, depends on the nature of the commodity and the method and level of processing it has (or will be) subjected to before consumption. It is accepted that processing (i.e. cooking, freezing etc.) eliminates or removes most pest threats, while commodities intended for raw consumption or sowing, present the greater risk. Biosecurity threats are diverse in their nature and potential effect. They are discussed in brief below.

3.5.1 Microbiological Threats

Microbiological threats generally incorporate pests and diseases and their vectors, however contaminants of human health concern have recently crippled some horticultural industries in the United States and our awareness of such threats has been heightened (Section 6). In assessing the potential effects of microbiological threats, one must have information on: their biology (and epidemiology if possible), source/s and entry pathways, likelihood of establishment (therefore climate, alternative hosts etc.), spread and their potential impact (damage, yield loss, vector or public health issue etc.).

Bioterrorism involves microbes that are either naturally occurring or human-manipulated. Such organisms could potentially be introduced to a country on pelleted seed, but of greater concern has been those present naturally within a region but spread in concentrated form intentionally (eg. *Bacillus anthracis*). Bioterrorism and the maintenance of food integrity are emerging issues that will divert resources and attention from commercial crop biosecurity at times. It is important for industry to be confident that there are mechanisms in place for both industry and government to respond to changing situations at short notice.

Endemic and exotic pests and diseases of bees (as pollinators, and honey producers) have been identified as significant microbial threats to Australian horticulture. The CSIRO estimates that the establishment in Australia of the exotic *Varroa destructor*, a mite that is parasitic on adult and larval honey bees, would cost Australia's plant industries between $21.3 and $50.5 million per year for thirty years after its arrival (House of Representatives, 2008). Section 16 includes discussion of pollination threats in more detail.

3.5.2 Input-Derived Threats

It has been reported to us that there is growing awareness of and concern regarding the quality and security of accessories to farming and processing systems, eg. threats sourced from production, handling, harvesting or processing inputs. Input threats might include: resistance to chemicals, compromised water quality, fertiliser quality, and worker hygiene; reduced and unsustainable pollination services.

Improving the security of chemicals, utilities and water supplies has become a higher priority since September 11, 2001. One effort to reduce a national vulnerability resulted in restricted access for growers, to ammonium nitrate. Benchmarking of quality standards and specifications for some inputs has helped. It is however evident that all crop protection products, mulches, composts etc. are not of equally high quality and safety.

3.5.3 Regulatory Threats/Impediments

The nature of some regulatory biosecurity issues are: Interstate Certification Assurance (ICA) interpretation; state borders relative to quarantine boundary decisions; harmonised legislation; lack of statistics and information, disclosures, alerts; traceability systems; chemical registrations, security sensitive chemicals, chemical availability for emergency plant pests etc; chemical residues; genetically-modified crops; and identified bioterrorism inputs.

The Quarantine Act 1908 is generally agreed to be out-dated and inadequate for today's trade and biosecurity requirements. It has been identified as impeding Australia's negotiation powers, burdening local producers with multiple standards and conditions, while local regulations have provided indirect import opportunities (i.e. table grapes) through their inconsistency.

International protocols, agreements and conventions are responsible for driving most of the pre-border and border activities associated with biosecurity and quarantine. Post-border, state legislations, regulations and industry certification assurances (ICAs), determine regional protection and quarantine decisions, and regulation of pests, some residue and other testing, and approved plant movement. The regulatory environment presents both opportunities to enhance biosecurity and challenges to its management and therefore to general preparedness.

The implications of the closure of South Perth Quarantine station and the impending final leases on Knoxfield and Eastern Creek have not been investigated in this review, but all industries should be aware of these events. Each horticultural industry will be affected and it is recommended that forward planning identifies required quarantine space, the most suitable and efficient entry points for the future, state regulations that may be needed to ensure inspections and diagnostic services to the required level (especially for seed, nursery stock and fresh produce), and the cost-benefits to industry of privatised services etc.

3.5.4 Support Mechanisms and Service Deficiencies

Support services and expertise needed to enhance biosecurity, include: human capacity in disciplines (pathology, entomology, nematology, molecular testing, taxonomy, epidemiology etc.) and commodities; training and awareness development; reporting and communication. These need to be enhanced through the provision of good resources and generous funding; national collaboration (and possibly international, eg. with NZ); cross-agency and cross-industry partnerships; and inclusion also of allied industries and media.

The capacity of countries, industries and regions to enhance biosecurity is dependent on human capacity and its resourcing. Inspections, detections, monitoring and surveillance, and diagnostics are time-consuming activities that require specific training. They underpin biosecurity. Without these services and the provision of expertise (often needed in taxonomy and epidemiology also), well-resourced laboratories, data collation and communication networks, the return from initially labour-intense activities, is greatly reduced.

The necessity for diagnostic and pathological, forensic expertise was recently highlighted in the US *Salmonella* Saintpaul outbreak. This episode crippled an entire industry, based on initial reports that later proved inaccurate. The outbreak was initially traced to tomatoes and national advisories not to eat certain types of tomatoes, resulted in the removal of tomatoes from every local market overnight. Later the media revealed the inconclusive nature of the testing, traceability problems, and the likely role of Mexican peppers in the outbreak. This is discussed further in Section 6.

Similarly, the reputation of Australian produce can be eroded rapidly in a foreign marketplace, and without the knowledge of producers or marketers in Australia. The Weekly Times June 2008 reported on unscrupulous retailers selling cheap overseas produce labelled as "Australian." Second grade fruit was also sold as first grade, in the UK over the same period.

3.6 Sources of Plant Biosecurity Threats

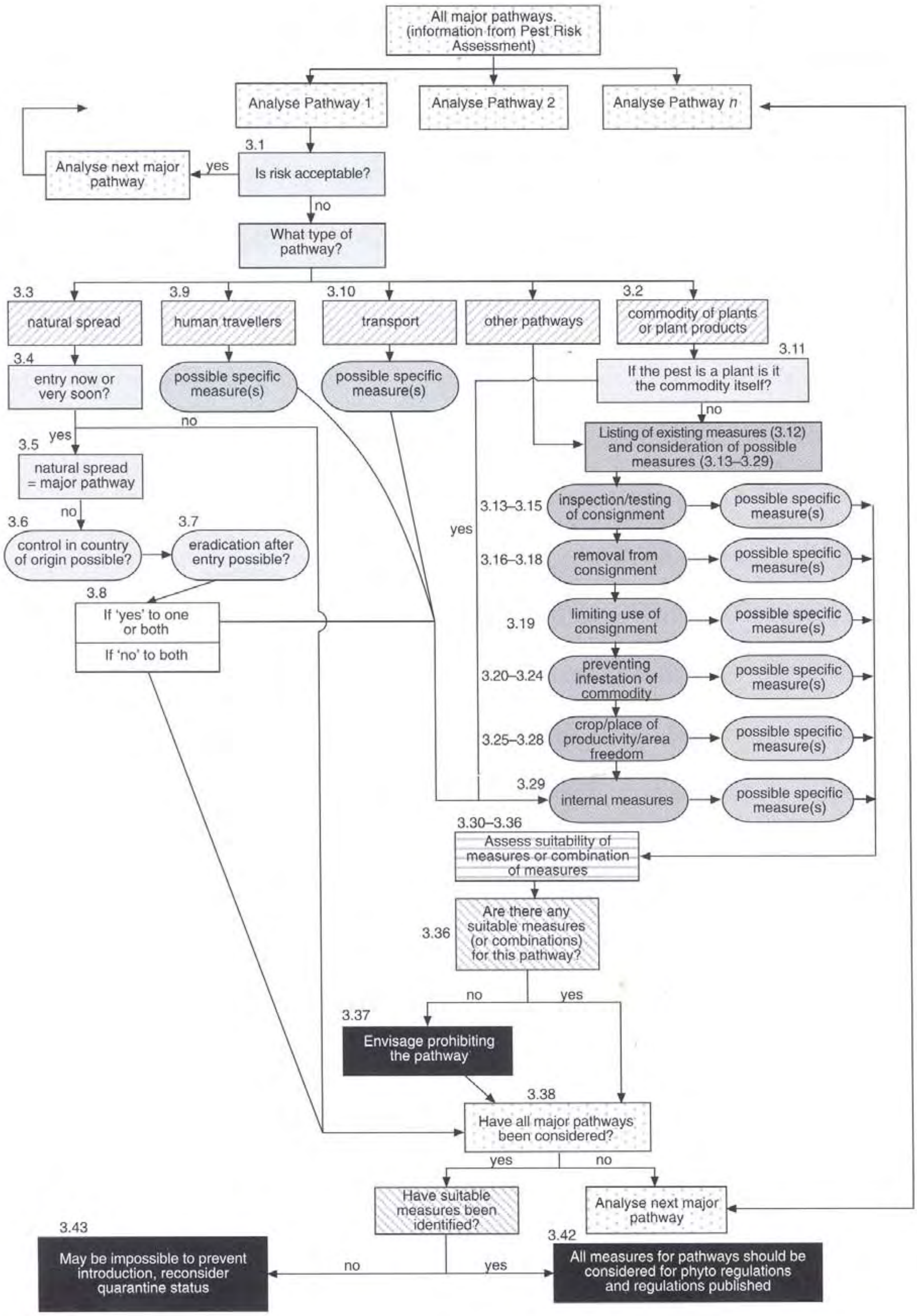
Just as the nature of biosecurity threats are many, so too are their sources. Examples of potential sources of microbiological threats (and their active or passive entry mechanisms) and their relevance for certain types of pests, are tabled (Table 5) below. Once the nature, source, and potential pathways have been identified, it is possible to assess the risk that fresh produce imports/exports present. In conducting a risk assessment for a vegetable commodity for example, it is essential to have an understanding of the produce, the form in which it is to arrive (eg. fresh, frozen, chilled, dried etc), its source and that region's pest profiles; the pests of concern and their biology and epidemiology.

Table 5 : Entry pathways for microbiological threats

International Pathways (of plant material)	Microbial Threat	Examples from Australian Horticulture
Illegal introductions-plant material	All – virus, bacteria, viroids, fungi, insects, mites, thrip etc	Suspect: illegal budwood introduced citrus canker
Legal importation of infested or infected material; or Infested containers, crates	All	Fire Ants; PSTVd in tomato seed; plum pox interceptions on plum fruit
Passive transport, eg. in planes, baggage, goods, clothing	Winged insects	Psyllids?; grapevine leaf rust
Air movements (eg. prevailing winds, cyclonic conditions, jet streams)	Bacteria, fungal spores; winged insects, (damage, vectors); infected plant parts	Currant-lettuce aphid (from NZ)
Movement of migrating birds	Parasitic plants, insects, fungi	
Movement of people: Regulated – planes; ships Unregulated - boat landings	All	Grapevine leaf rust on personnel returning from East Timor
Mail – regular e-Bay, internet orders	All; bioterrorism	Prohibited seeds in herbal medicines, greeting cards

The following chart schematically outlines the risk assessment steps for an international plant trade.

Figure 3 : EPPO pathway



(Source: EPPO, in Heather and Hallman, 2008)

The sources of compromised or poor quality inputs arriving at the border are less clearly identified, but some are given in Table 6.

Table 6 : Potential sources of poor quality inputs or illegal products

Sources of Input Threats - International or Domestic	Threat – Product Integrity
Illegal introductions or manufacture	Incorrect labels Product substitutions MRL breaches
Legal importation or manufacture	Registration data misrepresented End-use – Terrorism Fertiliser contaminants

At the on-farm enterprise level, there are many sources of microbiological and chemical biosecurity threats. Some that are relevant to a vegetable-growing operation are given below:

Table 7 : On-farm sources of microbiological and chemical biosecurity threats

Sources of On-Farm Threats	Threat Micro-organisms	Threat Chemical
Previous crops (volunteers and residues); crop rotation	Harboured fungi, bacteria, , nematodes, insects etc	Effects of long residual chemical
Neighbouring crop	Insects, pathogens	Yield, quality losses from spray drift
Seeds, seedlings/transplants – health; cultivar susceptibility	Fungal, bacterial, insects, virus, viroids	Unknown growth regulator effects
Soil	Fungi, nematodes, insects, weeds	Residuals
Mulch, compost, fertilisers	Insects, weed seed, bacteria, fungal spores; infected plant parts	Substituted fillers – rubber; heavy metals contaminants
Weeds, alternative hosts	Many	Herbicide resistance
Vectors – insect, dodder, nematodes	Viruses	
Weather conditions – wind, storms, hail	Fungi, insects	Spray drift; or inability to spray
Neighbouring land use – livestock	Bacterial, fungal contamination of water and/or produce	Run-off quality
Water	Fungi, water moulds, bacterial contaminants	Effect on host, processing etc
Chemical inputs	Resistance	Efficacy, integrity, storage security, available –registered
Equipment	Pathogens, pests	Effective use
People	Pathogens, pests, contaminants	Spray choices, legality, residues, resistance etc.

Source: partial input from Kinsella, 1999.

3.7 International Regulatory Responses to Phytosanitary Threats

Regulatory authorities around the world assist their own countries and others, to identify the nature and source of their plant biosecurity threats. They respond with negotiated quarantine regulations and import conditions, set within an internationally-agreed framework. Australia's import and export processes, are discussed in the following sections. In Australia, DAFF (and DFAT) have an important role in influencing the direction of international policy (eg. WTO-

SPS, technical barriers to trade etc) through their participation at a high level in committee and working groups such as the WTO's SPS Committee and the 'International Standard Setting Bodies'.

Following are excerpts from the most recent (August 12, 2008) DAFF update on Agricultural Trade (see http://www.daff.gov.au/market-access-trade/market-access/ag-trade). The excerpts serve to highlight the nature and number of biosecurity issues relevant to Australian horticultural trade that are under discussion at any one time government-government. They also indicate the importance of government and industry cooperation and communication in preparation for such negotiations, and the requirement for scientific data to support negotiations.

United States Food Protection Plan: The US Food and Drug Administration (FDA) has launched a Food Protection Plan (FPP) that signals expanded authority for the FDA to **increase surveillance of imported food products** in the medium to long term, adding costs and additional **layers of regulation to exporters such as Australia**.

Taiwan – Vegetable, Seed and Nursery Stock Access: On 17 December 2007 Taiwan announced proposed **changes to their import requirements** likely to **affect vegetable, seed and nursery stock exports**, in particular the **prohibition of carrots from Western Australia** due to the burrowing nematode. In collaboration with the vegetable industry and state departments, DAFF provided a **submission to Taiwan in March 2008**, receiving an interim response advising that additional **information** was required to **support recognition of pest free areas**. DAFF will submit additional information to Taiwan for consideration pending the enactment of the changes.

Thailand - The Sanitary and Phytosanitary Expert Group will meet in Thailand in late August 2008 to exchange information on **regulatory reforms**. Discussions at the 2007 meeting of the SPS Expert Group included Australia's reforms of its **import risk analysis** process, Thailand's new plant quarantine regulations, **market access requests for plant products….**

Malaysia –The **Malaysia-Australia Agricultural Cooperation Working Group** is an important forum for progressing agricultural trade, **market access** issues between Australia and Malaysia.

Japan – Horticulture Market Access: Recent market access gains include Japan's acceptance of Australia's technical report of the efficacy of two and three degree treatment for citrus. After sustained efforts by Australia, Japan agreed to a **reduction in the inspection rate for fresh mangoes** from five % to two %. Japan is considering the outcomes of a **pilot trial for a non-fumigation protocol** for Tasmanian **cherry** exports. Japan will consider Australia's **request for recognition of seasonal fruit fly freedom for the Greater Sunraysia area** and **new market access for table grapes and grapefruit** following completion of the Tas. cherry application.

Republic of Korea – Market Access Gains: Access for **Tasmanian carrots into Korea was regained** on 13 November 2007, following Korea's **acceptance of Tasmania's area freedom from the burrowing nematode**.

4 THE IMPORT PROCESS

The Australian import process operates under international agreements and requirements. To determine the risk associated with the requested entry of a new commodity, an import risk assessment (IRA) is undertaken. Several international submissions (from EU, USA, India) to the Beale Inquiry (Quarantine and Biosecurity Review, 2008) suggested Australia's systems have at times been conservative in approach and outcomes, slow to complete, and apparently lacking in consistency, independence and transparency. Within the WTO, Australia is perceived to have a disproportionate number of complaints raised by its trading partners (Stanton, 2008). There is also a perception that Australia's importation requirements have not always been based on scientific grounds, with the advantage seen as protecting domestic markets (Oxley, 2008). To-date, complaints have largely related to aquaculture and fruit, however Australia's treatment of mushrooms has also been questioned. The import conditions as published in ICON for mushrooms for human consumption vary with the source and the genus of mushroom. Australia, according to the EU's submission to the Quarantine and Biosecurity Review (2008), while authorising the importation of several wild mushroom genera from Poland, Italy and France, continues to mandate fumigation and low temperature (14°C) storage for several hours. In their view, this equates to a 'ban' because of the cost impost and irreversible impact of these treatments on the mushroom quality.

Despite its reputation in these areas, the volume and value of imported produce entering Australia is increasing significantly, and most local horticultural industries expressed to the same review, their desires for tightened import conditions. Australia's growth in horticultural imports has been primarily the result of dried, frozen, chilled, preserved and fresh vegetables, seeds, fruit, nuts and juices. Fresh vegetables and true seed are covered in this review as they carry the greater biosecurity risks.

Quarantine restrictions apply to raw foods and some processed foods that enter Australia through ports, airports, or via the mail systems. Imported food must comply with the requirements of the *Imported Food Control Act 1992*, regulated by the *Imported Food Inspection Scheme.* Fresh fruit, vegetables, seeds and nuts are 'prohibited' and therefore commercial importers of these must first obtain government approval for doing so. The import requirements are documented on the Import Conditions database (ICON). ICON is undergoing systematic review at present and there will be some updated conditions (including onions) provided in the near future.

The import process as it relates to quarantine and biosecurity is outlined below.

4.1 Import Conditions Database – ICON

It is not useful to summarise the import requirements included on this database, due to the vast array of produce and number of sources for which conditions have been applied. The conditions under which specific fresh produce imports are required to enter Australia, are available on-line from: http://www.aqis.gov.au/icon32/asp/ex_querycontentasp. The specific requirements of particular states may be accessed independently, eg. import conditions for Tasmania: http://www.dpiwe.tas.gov.au/inter.nsf/ThemeNodes/DREN-4VH82R?open.

In most cases, Australia demands that produce entering the country be accompanied by a Phytosanitary Certificate provided by the country of export. For example, fresh fruit and vegetables, commercial consignments of cut flowers and foliage, medium risk tissue cultures, and some genera of seed require phytosanitary certificates. However, Australia does not demand that frozen fruit and vegetables, some dried vegetables, nor non-commercial consignments of vegetable seeds, fresh flowers and foliage (provided no berries or fruits are attached), be accompanied by a Phytosanitary Certificate. Additional requirements are also placed on some countries and produce exported to Australia, eg. treatment certificates. Pre-clearance programmes (eg. Capsicums and some fruit from New Zealand) move some risk and entry and post-entry quarantine requirements, off-shore.

BA amended the list of permitted seeds in December 2006. The list is available at: www.aqis.gov.au/icon. The entry conditions for seed for sowing, includes visual inspection of all lots, and follow-up seed analyses for lots with detectable contamination. Some vegetable seed requires an acceptable phytosanitary certificate *and* seed analysis certificate from an International Seed Testing Association (ISTA)-accredited laboratory. The detailed ICONs for seed imports may be accessed from:
http://www.aqis.gov.au/icon32/asp/ex_TopicContent.asp?TopicId=1452
and the list of seed species not requiring a phytosanitary import permit, is accessible from: http://www.aqis.gov.au/icon32/asp/ex_querycontent.asp.

There are general conditions that apply to all seed entries including: packaging in new containers; labelling with botanic names (genus and species); freedom from soil[1]; freedom from live insects, plant and animal material. Commercial (> 10 kg) seed consignments without an accompanying seed analysis certificate are subjected to mandatory sampling and analysis on arrival in Australia, and the consignment remains within AQIS quarantine until the results are delivered. Accepted seed analysis certificates must have satisfied a number of criteria, including: issuance by an ISTA-accredited laboratory; sampled and analysed according to ISTA rules; weights of bulk and sub-sample; full botanical names of all seed types found in sample; percentage of soil particles in sample; certification no quarantine weed species found in sample.

Packaging requirements are noted in most import conditions. Compliance with them may be costly, but the conditions set reflect the recognised risks associated with packaged produce and plant origin packaging material, eg. wooden crates (pests include termites, borers, beetles, spiders, ants etc); peat moss, sacking and paper are prone to microbial degradation and infestation and they may include difficult-to-detect soil particles.

4.2 Import Permits (AQIS)

Since 30 April 2008 AQIS systems have allowed the electronic receipt of Import Permits and for Import Permit holders to be informed of upcoming expiry dates enabling timely reapplication. (Quarantine Alert PQA0552). This is a positive development in terms of efficiency. The following websites provide more details: ICON Administrator and Import Permit application forms. There are three components of the application form (*Importer and exporter details; Product/commodity details and importer declaration; and Payment details).* The information provided in the second half is critical for effective management of biosecurity. Not all in-coming produce or seed require Import Permits.

4.3 Biosecurity Gaps in the Import System

The regulatory effectiveness of the delivery of Import Permits is high. However several biosecurity gaps or impediments exist within the current system. They expose Australia and some industries to threats, due to the international obligations underpinning them, and the time and resources made available to AQIS for verification of provided data. The lack of risk assessment carried out on seed and nursery stock, necessarily results in lower risk awareness, and greater risk, associated with these entries.

With examples drawn from fresh vegetables and seed, biosecurity provided by the current import permit system is discussed below. Although gaps are identified and discussed, it should be noted that there have been no incursions that have resulted from the commercial fruit and vegetable pathways in recent years. This has not been the experience with vegetable seed however (see discussion of Potato Spindle Tuber Viroid (PSTVd) in Section 6).

Common/ Product name	Scientific name (Genus, species)*	Description (e.g. strain, variety, cultivar; unprocessed, fresh, frozen, cooked)	Quantity/Volume

* AQIS cannot issue an Import Permit until the scientific name is provided.

It is neither AQIS' role, nor within their expected capabilities to identify incoming material to the correct species, cultivar or variety. However it is widely recognised that different seeds, varieties and cultivars are bred for different characteristics and tolerances. They are not therefore equal in the threat they pose. Incorrectly identified seed and produce is a biosecurity risk that might be realised at its earliest, at the farm level.

[1] Yet AQIS has a 0.1% tolerance for soil.

A recent example of the importance of correct identification of fresh produce, was reported in Quarantine Alert PQA0548 (February 6, 2008). Fresh *Lyophyllum* spp. mushrooms are permitted entry into Australia but shipments of the prohibited *Hypsizygus* spp., were received. Differentiating the two species is difficult since they are visually almost identical. Identification keys and chemical tests are now being developed to assist in this process. It remains the importer's responsibility however to ensure the correct species is shipped.

Examples of post-entry requirements for taxonomic expertise and resources are not confined to imported produce. The exotic bee mite *Varroa destructor* is related to *V. jacobsoni*. Each has the Eastern honeybee as its primary host in the Asian region, however it has been found that the strains of honey bees found in northern and southern Asia, influence the mite distribution. There are microscopic, morphological characteristics that distinguish the two mite species, and now molecular markers that have allowed detection of genotypes capable of parasitism of Western honeybees.

Such taxonomic intelligence has allowed some rationalisation of targeted, pre-border and border biosecurity, and also researchers to investigate why the two *V. destructor* genotypes are more capable of parasitising the western honeybee (Yeates, 2007).

Proposed end use

Post-entry quarantine and import conditions are determined after consideration of the proposed end use of the imported plant material. Seeds for sowing have different importation conditions and testing regimes, than seeds for consumption. In general food products for consumption, are fumigated on arrival. This renders them less desirable for future planting should the intended end use change post-release. However there is no guarantee for example that garlic entering 'for consumption' is not planted out in some urban or small plots. It therefore seems unnecessary for import conditions on imported *in-vitro* (tissue-cultured) garlic plantlets, to be more restrictive than those for garlic for consumption.

Country of origin	Country of export

Verification of the 'country of origin' is an increasingly complex biosecurity issue at the border.

There is evidence from the vegetable seed industry and others (i.e. *Prunus* spp.) that the 'country of origin' as listed in some cases is the 'country of export' but not the 'country of production'.

The information as requested on the current import permit applications in this area of the form, is non-specific. It appears impossible to verify the location of production from provided information, and therefore AQIS and industries are compromised in their capacity to verify information on pest and diseases status at the source, and conduct traceability investigations (as evidenced in the tomato seed–PSTVd investigations), should they be required.

Another biosecurity gap appears in this area. The questions asked on the form are not sufficiently specific to allow identification of 're-exports'. An example of the associated risk might be: seed grown in Asia and exported to Japan, USA or Netherlands under bi-lateral systems of additional declarations. This seed may later enter Australia (with Netherlands, USA or Japan identified as country of export and origin) under the import conditions for USA, Netherlands or Japan. However Australia does not/may not recognise the 'additional declarations' that were the basis of the initial export from Asia. Such seed poses a risk.

In ornamentals, perennial horticulture and other industries there are also parallels. For example, the demand for *Prunus* spp. seed (for rootstocks) was high at the time of rapid expansion of the almond and stone fruit industries. Although established, approved suppliers were in California, the high demand could not be met by them, and seed was sourced from new suppliers in India (and reportedly, Spain) and from wholesalers in the USA who sourced seed, both certified and non-certified from all over the United States. The requested information on the import permits were insufficient to evaluate the true risk associated with the entry of this material, because the sources were not identified. Traceability to the site of production, would not have been possible, in the event of an incursion.

Product preparation (include method of preparation/treatment; certified scheme/accredited source; virus and disease testing procedures.

It is not possible for importers nor AQIS, to verify the testing and certification methodologies associated with imported produce and seed, on arrival. Although AQIS and the Commonwealth government have made contributions to the reviewing and setting of standards for testing methodologies etc., there has not been similar commitment to auditing overseas certification programmes. Several horticultural industries have recognised this risk and no longer accept the assignment of "approved" or "accredited sources" as justification for reduced inspections in PEQ.

The vegetable industry needs to engage with AQIS to ensure that the inspections, certification and testing applied to ornamentals, commodities (and all relatives), and vegetable seed are not dependent upon acceptance of certification schemes or testing authorities which have not been recently audited by AQIS. They also need to ensure that the newer sources of produce and seed have reliable, high standard, pre-border testing capabilities.

It is my opinion that commercial vegetable seed importers need greater engagement with AQIS to ensure each is aware of the potential risks associated with new commercial, non-commercial, and unconventional seed imports, sources and delivery means eg. herbal medicines and those seeds used in decorative cards, cooking mixes (Photo 1) etc. There has been a recent increase in the importation of coriander for example, but it is our understanding that there has been only a cursory import risk assessment conducted and there is little information about the sources of this seed. Seed and nursery stock remains a threat to the vegetable industry. Both seed and nursery stock need to be a high priority within BA as it is a source of many pests and pathogens with wide host ranges and is a recognised pathway for the many viruses.

Location grown/collected (include country, province, state, region; treatment centre, collection centre)

See above. Information on the pest status within the region of production is the major consideration in determining ICONs for any commodity. Therefore information on import permits must accurately identify the location of production, if biosecurity is to be optimised. ICON is currently under review for commodities (eg. onions, tomato seed) for which new information about threats or emerging threats is available.

Mode of transport (e.g. air, sea)	Estimated date of arrival (dd/mm/yyyy)
Route details to Australia	

Shipping routes at different times of the year and conditions of packaging and containers (refrigerated etc) moderate biosecurity threats should they exist within a consignment. The nature of mixed consignments and passage through tropics, delays in ports (on/off power) etc.

have all been identified as causes of disease progression, and/or pest proliferation during transit. As such the transport route and time of year are biosecurity considerations.

Public Quarantine Alert PQA0414 advised that fresh produce shipments arriving by air no longer require automatic and immediate AQIS intervention to verify the security of packaging at the Cargo Terminal Operator's (CTO) premises. However nine high-risk pathways were identified for continued testing. They included asparagus from all countries (need to be in sealed boxes or pre-packs); capsicums, (unless pre-cleared from NZ); taro and mixed consignments from Pacific countries; and snow peas and snap peas from African sources.

Plant material movement via mail order, e-Bay, and the internet, and the volume of pelleted seed have increased the need for new systems of inspection and screening. All mail is scanned but it is known that pelleted seed is not detectable in all screening processes.

Where will the product be inspected and/or processed and/or held in Post Entry Quarantine?

The techniques and capabilities (space, personnel, training, equipment) at inspection locations, and the commitment to quarantine management as core business in the national interest, is highly variable across Australia.

Most inspections at the border are visual. This is inadequate for detection of viruses, viroids and any other pathogens, microbial contaminants etc. In some cases seeds arrive with fungicide dusting or pelleted, and therefore seedborne inoculum can rarely be detected visually.

There has been an increase in the number of 'medium risk' imports of new varieties that have not undergone pest risk assessments. Many ornamental ones are entering Australia retail-ready, and in large volumes. The capacity and preparedness of inspectors to ensure their health status is unclear. This remains a gap particularly as medium risk entries are increasingly entering via private quarantine premises.

Photo 1 : The arrival of beans through Express Post

Source: L. Thompson, Pers . comm.

5 THE EXPORT PROCESS

5.1 Understanding our International Obligations in Exporting

International standards for phytosanitary measures have been developed under the auspices of the World Trade Organisation (WTO) and the International Plant Protection Convention (IPPC). The Interim Commission on Phytosanitary Measures (ICPM) develops International Standards for Phytosanitary Measures (ISPMs), and established the IPPC as the forum for reporting and exchange of phytosanitary information. The IPPC and the WTO-SPS Agreement provide the legal framework under which the ISPMs are developed. The standard-setting and country consultation processes are managed by the Standards Committee (SC).

International agreement on the application of sanitary and phytosanitary measures came with the establishment of the WTO in January 1995. The WTO SPS Agreement recognizes international standards that help ensure phytosanitary measures are not unjustified trade barriers, and that plant trade is not a means for introducing new pests to trading partners. Phytosanitary measures that conform to ISPMs are presumed to be consistent with the SPS Agreement.

Australia's SPS interests in the international arena are represented by DAFF's International Division in partnership with other state and federal government agencies. The WTO and IPPC underpin plant-related political trade negotiations. WTO member governments have the right to tailor their specific phytosanitary measures within the international framework of the IPPC. Therefore in evaluating the opportunity to gain market access, producers must be familiar with key pests restrictions placed on imports in the targeted market, the potential to demonstrate freedom from these in produce and within the production region, and the suitability and availability of supportive certification and documentation. For example ISPM #04 acknowledges variation in risk (eg. imposed by crop and pest type) and required biosecurity, and therefore the level of evidence and statistically valid data necessary to support pest free area determination, eg. regular monitoring, laboratory testing, official surveys and inspections during the growing season, post-harvest etc.

The IPPC suggests that data sent to the National Plant Protection Organisation (NPPO) of exporting countries be centrally collated (eg. by FAO or regional plant protection organisation) and made available to all interested NPPOs on request. Should this be adopted, Australia will find itself not fully prepared since centrally harmonised collation of data across states and regions, and surveillance details in support of pest-free areas, are not yet available. However they are in the development stage.

5.2 Relevant ISPMs for Australian Vegetable Exporters

The ISPMs relevant to Australian vegetable exporters are:

- **ISPM # 01**: *Principles of Plant Quarantine as related to international trade*
- **ISPM # 02**: *Guidelines for Pest Risk Assessment*
- **ISPM # 04**: *Requirements for the establishment of Pest Free Areas*
- **ISPM # 05**: *Glossary of Phytosanitary Terms 2002*
- **ISPM # 06**: *Guidelines for surveillance*
- **ISPM # 08**: *Determination of pest status in an area*
- **ISPM # 10**: *Requirements for the establishment of pest free places of production and pest free production sites*

- **ISPM # 11**: *Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms (2004)*
- **ISPM # 12**: *Guidelines for Phytosanitary Certificates*
- **ISPM # 14:** *The Use of Integrated Measures in a Systems Approach for Pest Risk Management (2002)*
- **ISPM # 20:** *Guidelines for a phytosanitary import regulatory system*
- **ISPM # 26:** *Establishment of pest free areas for fruit flies (Tephritidae)*
- **ISPM # 26**: (proposed annex) *Fruit Fly trapping*[2]

These and the other ISPM can be found at https://www.ippc.int/IPP/En/default.jsp.

Of new interest to plant industries are the draft additions for fruit fly trapping (Annex 1 to ISPM No. 26)[2] - the 'establishment of pest free areas for fruit flies (Tephritidae)', and 'pest free potato micro-propagative material and mini-tubers for international trade'.

5.3 The Export Process in Australia

Akbari *et al* (2008) outlined this process well in *Towards a National Surveillance Plan for the Australian Grains Industry*. There are few differences at the regulatory level, for fresh vegetables and grains.

The Request for Permit (RFP) triggers within AQIS, a series of certification activities aimed at ensuring the produce to be exported is compliant with a range of requirements. If so, an Export Permit Number (EPN) or appropriate certificate, are issued by AQIS. The details required on an RFP include:

- registered or listed establishment, where the product is to be inspected
- quantity, description, and identification marks of product
- description of how the product is packed, and container number(s) if applicable
- exporter details
- name of vessel, voyage number (or alternatively flight details), date of departure
- consignee, country of destination, port of discharge, and place of final destination
- type of certificates and endorsements required, if applicable.

5.4 The Export Documentation System (EXDOC)

The EXDOC system is an integral part of AQIS' procedures for horticultural exports as well as meat, dairy, fish and grain. While electronic certification (EXDOC) cannot be mandated (unless requested by the trade partner), the desire to replace manual certification is clear. It achieves four steps within the export process, largely electronically: processes RFPs; issues Export Permit Numbers (EPN); generates Phytosanitary Certificates, other certificates that satisfy declarations etc; and processes Export Clearances via the Customs EXIT System. The computerised system has resulted in improved timelines, harmonised instructions and interpretation.

The Establishment Register (ER) is aligned with EXDOC on the AQIS network. It is an official register of establishments exporting food products. EXDOC accesses ER to validate the eligibility of establishments to carry out processes like production, handling and packing for exports to a particular market. The EXDOC Grain and Horticulture Export Manual also register these processes for horticulture exports.

[2] This annex is relevant to all ISPMs relating to fruit flies. It includes description of the available trapping systems and procedures for different fruit fly species, their population and control status in target areas, i.e. for an infested area, an area of low pest prevalence (ALPP), or a pest free area (PFA).

5.5 Phytosanitary Certificates

As in Australia, most importing countries require Phytosanitary Certificates for regulated goods or plant products potentially capable of introducing regulated or exotic pests. A Phytosanitary Certificate is the official document of the Australian Government that certifies to the importing country that the product meets their import standards and regulations. The type of product and the destination determines which certificates and details are required by importing countries.

The Phytosanitary Certificate must be 'earned' via export inspection of the horticultural products before they leave Australia. They are generated and printed by AQIS, and additional declarations must be verified, (eg. with government-approved laboratory certificates or statutory declarations). Australian phytosanitary certificates are prepared in alignment with the IPPC's ISPMs #7 and #12. Similarly, specific treatments (eg. for disinfestation) that may be required pre-shipping, must be supervised and endorsed by an AQIS Inspector. If such treatments are not supervised, the treatment may only be 'endorsed' on to a phytosanitary certificate. If the treatment is conducted by an AQIS-approved Compliance Agreement (CA), and licensed operator, and supported by a written Statutory Declaration and/or a fumigation certificate, it may be approved.

Phytosanitary certificates may be complete and accurate yet still not be relied upon to meet conditions of entry in some countries. Therefore inspections are still undertaken unless pre-clearance programmes allow them to be waived.

5.6 PHYTO Database

PHYTO is AQIS' plant and plant product export conditions database. It is a resource for details on import permits, phytosanitary certificates, additional declarations and/or specific requirements or requests or treatments. On the database, "additional requirements" are now regularly updated and listed specifically for each country and commodity. The database information however does not supplant that requested on the import permit from the importing country.

The onus for checking that the requirements of our trading partners are fair, currently resides with Biosecurity Australia. Personnel in DAFF are also involved when quarantine conditions are changed. Sections 3 and 5 include excerpts from recent (August 12, 2008) DAFF updates on Agricultural Trade (see http://www.daff.gov.au/market-access-trade/market-access/ag-trade). They highlight the nature of government-government negotiations of biosecurity relevance and include interpretation of international standards, justifciation for imposed conditons, and determination of reasonable 'equivalence'.

5.7 Australian Plant Pest Database (APPD)

Data that verifies (or otherwise) the presence or absence of a plant pest in Australia is generally available through the APPD. It is a nationally-linked database that incorporates information from multiple databases and collections on insect, fungal, bacterial, viral and nematode records but each category is not equally current or accurate. It is this database however that is heavily relied upon in government-government negotiations and in support of pest risk assessments. It warrants investment to ensure it is regularly updated and accurate.

The commodity pest lists provided by MAF are useful documents that alert NZ exporters to everything that has been found on like commodities exported from NZ. The lists are of organisms (mostly pests and diseases, but may also include contaminants). Although the records in the APPD may be similar, the NZ lists are more accessible and are provided to importing countries during deliberations of NZ imports. They are used export inspectors also. The value of this information collated on behalf of industry, is increased because it is openly-shared.

5.8 Phytosanitary Biosecurity and Quarantine Gaps in the Export System

There are few market access biosecurity impediments in Australia's fresh produce export process. There are many biosecurity requirements however, that exporters need awareness of. PHYTO is not error-free and all users are advised to check "What's Changed" regularly. Discrepancies exist in the database in taxonomy. ISPMs demand correct spelling on phytosanitary certificates. Old taxonomy can therefore be confusing and delay the export process.

There are examples within the export system of unjustified requests and phytosanitary trade impediments. Industries need to be alert for such cases and to be familiar with the process required to correct them. For example where scientific literature reports that an organism is present in a region, it is (usually) unacceptable for that country to require freedom from this organism in import conditions. It is acceptable if the pest is not present in all regions of the country and is under regulation (i.e. thrips in Tasmania). An example of such a situation occurred in the grains industry. Argentina requested area freedom from Wheat Streak Mosaic Virus despite it being published that it was present in their country. The contradictory request was resolved through negotiations between OCPPO and the South American region's National Plant Protection Organisation (NPPO). The impediment Australia will increasingly confront, is that of evidence to support our own pest status and therefore the basis on which such negotiations can proceed.

AQIS' PHYTO database is a significant resource, but the over-riding final requirements that must be met by exporters are those on the current import permit.

The biosecurity impediments for local produce in the domestic market (inter- and intra-state movement) process are discussed later in Section 9.

Biosecurity of fresh vegetables would be enhanced by more affordable and accessible diagnostic services. Industries will play a crucial role in articulating the incentives, and educating growers about the necessity to submit plant samples with unusual symptoms, for diagnosis. This is an effective early detection system and has the potential therefore to avert industry crises, and form part of industry surveillance data at the regional level. Several states have reported on the price sensitivity of diagnostic services. User pay introductions saw dramatic declines in the number of samples submitted in NSW and WA. Knowing the biosecurity value of submitted diagnostic samples, these states have moved to counter this situation by agreeing to waive fees for unusual samples. To support the quarantine inspection service and on-farm monitoring systems, human capacity needs to be built into the diagnostic, epidemiological and taxonomic areas. It is incumbent on Australian vegetable growers to drive demands for accessible and well-resourced diagnostic services.

General examples of phytosanitary requirements set by some trading partners, for Australian produce exports are given below. These examples, and those for specific crops (following), highlight both the range and specificity of requirements.

India: General prohibitions listed for imports into India include that all plants and plant products require a phytosanitary certificate, and must be free of the pests listed. Some commodities such as field peas (fresh fruit/vegetables) are prohibited as imports into India.

Indonesia: General restrictions specify that all permitted imports are subject to pre-shipment inspection. Living insects and invertebrates are prohibited, except when imported for research purposes and under an Import Permit. A phytosanitary certificate is also required for all plants and plant products.

Japan: Japan's general restrictions apply to: all plants and plant products which serve as hosts of injurious insects or pathogens unknown or of restricted occurrence in Japan; living insects and pathogens; and soil and plants with soil, unless these are covered by a special import permit (only for experiment and research purposes).
Pea seed being exported to Japan for the purpose of sprouting requires a Phytosanitary Certificate with "endorsement number 1475". All bags in the consignment must be permanently marked with the following words: "*The pea seeds in this consignment are for hydroponic sprout production and are not intended for cultivation*" or have labels attached with these words.

Taiwan: All consignments of horticulture commodities to Taiwan must be accompanied by EXDOC-generated certification (manual issues not accepted).

New Zealand: A phytosanitary certificate is required for most commodity classes but is not required for flower seeds, cut and dried flowers/ foliage for decoration, or most agricultural seeds for consumption/processing.

European Union (EU): Large lists of quarantine organisms are regulated (A1 and A2 pests) in all EU EPPO regions, and are generally prohibited. In addition, specific phytosanitary certificates are required for seeds of *Brassicaceae* originating in Argentina, **Australia**, Bolivia, Chile, New Zealand and Uruguay.

Iraq: Seeds for sowing such as navy bean require an additional declaration that "samples of the seed have been tested and found free from seed-borne viruses". General prohibitions include "all seedborne viruses infecting beans, and any insects (living or dead of **any** species), fungi and bacteria that are harmful to plants".

Israel: For some products, such as peas (*Pisum sativum*) for consumption, the importer must be an Israeli citizen, with the product clearly packaged and marked as "for human consumption".

United States of America: PHYTO states that although The United States of America "does not have a comprehensive list of pests, it may consider any pest that is not widespread in the United States as a quarantine pest". A Phytosanitary Certificate is required for root, bulb, seed or other plant products for or capable of propagation, as well as vegetables, plants and plant products, nursery stock.
An original certificate (or authorised copy) must accompany each package if exported by mail. Certificates must be issued not more than 15 days before shipment. Other USA specific restrictions of note, include an emphasis on weed freedom.

Chile: Additional declarations for many consignments (regardless of end use) require that consignments have been fumigated against insects of the Bruchidae family as stated in the treatment section for Chile e.g. lupins, chickpea and faba beans.

Middle East: Although not a phytosanitary requirement as such, Muslim countries require certification that all plant and plant products exported comply with Halal, and as such have not come in contact with any meat products or alcohol of any kind. This also applies to some countries in Asia such as Indonesia.

Examples of export requirements and biosecurity issues for specific crops and markets are given below (Table 8 and Table 9).

Table 8 : Export approvals (from PHYTO) for some of Australia's vegetable crops

Commodity	Country – market	Documentation required				End Use	Market accessible
		Import Permit	Phytosanitary Certificate	Additional Declaration	Post Entry Quarantine		
Asparagus	Mauritius	YES	YES	YES	NO	Fresh	Yes
	Micronesia	YES	YES	NO	NO	Fresh	Yes
	New Zealand	NO	YES	NO	NO	Plants - Nursery stock	Yes
	Northern Mariana Is.	NO	YES	NO	NO	Fresh	Yes
	Palau	NO	YES	NO	NO	Fresh	Yes
	Taiwan	NO	YES	YES	NO	Fresh	Yes
	Thailand	NO	YES	NO	NO	Fresh	Yes
	Thailand	NO	YES	NO	NO	Plants - Nursery stock	Yes
	Thailand	NO	YES	NO	NO	Sowing	Yes
	US of A	YES	YES	YES	NO	Fresh	Yes
Brassica spp.	Fiji	YES	YES	YES	NO	Fresh	Yes
	Micronesia	YES	YES	NO	NO	Fresh	Yes
	New Zealand	NO	YES	YES	NO	Fresh	Yes
	Northern Mariana Islands	NO	YES	NO	NO	Fresh	Yes
	Norway	NO	YES	NO	NO	Fresh	Yes
	Palau	NO	YES	NO	NO	Fresh	Yes
	Reunion	YES	YES	YES	NO	Fresh	Yes
	Saint Lucia	YES	YES	NO	NO	Fresh	Yes
	Solomon Islands	YES	YES	YES	NO	Fresh	Yes
	Taiwan	NO	YES	YES	NO	Fresh	Yes
	Thailand	NO	YES	NO	NO	Fresh	Yes
	Tonga	YES	YES	YES	NO	Fresh	Yes
Lettuce	Micronesia	YES	YES	NO	NO	Fresh	Yes
	New Zealand	NO	YES	YES	NO	Fresh	Yes
	Norway	NO	YES	NO	NO	Fresh	Yes
	Sierra Leone	NO	NO	NO	NO	Fresh	No
	Solomon Islands	YES	YES	YES	NO	Fresh	Yes
	Sri Lanka	NO	NO	NO	NO	Fresh	No
	Thailand	NO	YES	NO	NO	Fresh	Yes
	Turkey	NO	YES	YES	NO	Fresh	Yes
	US of A	YES	YES	NO	NO	Fresh	Yes
Mushrooms	Japan	NO	NO	NO	NO	Fresh	Yes
	Mauritius	YES	YES	YES	NO	Fresh	Yes
	Micronesia	YES	YES	NO	NO	Fresh	Yes
	New Caledonia	NO	YES	YES	NO	Fresh	Yes
	Solomon Islands	YES	YES	YES	NO	Fresh	Yes
	Thailand	NO	YES	NO	NO	Fresh	Yes
Carrot	Bermuda	NO	NO	NO	NO	Fresh	No
	Chile	NO	YES	YES	NO	Seeds	Yes
	China	YES	YES	YES	NO	Seeds	Yes
	Haiti	NO	NO	NO	NO	Fresh	No
	India	YES	YES	YES	NO	Seeds	Yes
	Philippines	YES	YES	YES	NO	Seeds	Yes
	South Korea	NO	YES	NO	NO	Fresh	Yes
	Micronesia	YES	YES	NO	NO	Fresh	Yes
	No. Mariana Islands	NO	YES	NO	NO	Fresh	Yes
	Palau	NO	YES	NO	NO	Fresh	Yes
	Reunion	YES	YES	YES	NO	Fresh	Yes
	Saint Lucia	YES	YES	NO	NO	Fresh	Yes
	Taiwan	NO	YES	YES	NO	Fresh	Yes*
	Taiwan	NO	YES	YES	NO	Seeds	Yes
	Thailand	NO	YES	NO	NO	Fresh	Yes
	Thailand	NO	YES	NO	NO	Seeds	Yes
	Turkey	NO	YES	YES	NO	Fresh	Yes
	Tuvalu	YES	YES	NO	NO	Fresh	Yes
	US of A	YES	YES	NO	NO	Fresh	Yes
	Vanuatu	YES	YES	NO	NO	Fresh	Yes

* Potentially closed for WA carrots by 2009

Table 9 : Specific biosecurity requirements for some export markets for Australian vegetables

Commodity	Country	Further information
Asparagus	Mauritius	Option 1: Asparagus latent virus is known not to occur in Australia. EXDOC Endorsement 1301
	Micronesia	The shipment must be free from soil and/or debris and shipped in new, clean packages. It is prohibited to import into the Federated States of Micronesia any vegetables after they have transited through areas known to be infested with any fruit fly species other then *Bactrocera fraunfeldi* (Mango fly), *Oryctes rhinoceros* (Rhinoceros beetle) or any other quarantine pests not established within the Federated States of Micronesia, unless the vegetables are maintained in original packages and such packages have not been exposed to any quarantine pests between the point of origin and the entry point in Micronesia.
	New Zealand	Subject to examination at a MAF Biosecurity Authority registered laboratory at the Importers expense, prior to release to the Importer
	Northern Mariana Islands	
	Palau	
	Taiwan	On 4 November 1999, Taiwan's import conditions for asparagus were amended to allow the export of asparagus from New South Wales and Queensland. The amendment relates to the removal of burrowing nematode (*Radopholus similis*) as a quarantine pest of asparagus. A Phytosanitary Certificate and Additional Declaration must accompany asparagus exports from New South Wales and Queensland to Taiwan.
	Thailand	All consignments must be free from pests of quarantine concern to Thailand
	US of A	All farms, packing plants and treatment facilities must be registered in accordance with USDA requirements. Option 1: Grown in an area free from Red-legged earthmite (*Halotydeus destructor*) EXDOC Endorsement No 1874
Brassica spp.	Fiji	Option 1: fumigated with methyl bromide at 32g/m^3 for 2 hours at 21◦C EXDOC Endorsement No 1397
	Micronesia	as for Asparagus
	New Zealand	This consignment has been inspected in accordance with appropriate official procedures and found to be free from any visually detectable quarantine pests, specified by the New Zealand Ministry of Agriculture and Forestry (5 Options for crops, 5 different EXDOC Numbers)
	Reunion	Restriction applies to cabbages and cauliflowers only, Additional declarations Option 1 1) a representative sample has been inspected and found to be free from insect pests, particularly fruit flies, flies that attack leguminous crops and other *Diptera* spp., 2) A representative sample free from any form of larva or adult of Lepidoptera and Coleoptera, 3) a representative sample free from Acarids, Thrips, *Homoptera* spp. (Aphids, Cochineal , Aleurones), Nematodes. EXDOC Endorsement No 1331
	Saint Lucia	
	Solomon Islands	A valid Import Permit must be presented to the AQIS inspector prior to inspection of the consignment. Add Dec Option 1 1) the product has been derived from an area free of *Bemisia tabaci* Biotype B as verified by an official survey. Or Option 2 to 5 fumigated with varying levels of methyl bromide under varying conditions, with varying EXDOC endorsements.
	Taiwan	BAPHIQ has advised that if the listed pests under the actionable regulated pest list are found on arrival in Taiwan, the plant or plant product will be treated with appropriate quarantine methods to eradicate the pests before importation is permitted. If there is no appropriate treatment method available to eradicate the pests found, the plant or plant product will not be allowed to be imported into Taiwan, or will be destroyed on arrival in Taiwan. *Sminthurus viridis* (Lucerne flea) is of the *Collembola* spp. (Springtails) species and considered an actionable regulated pest by the Bureau of Plant & Animal Health Inspection Service (BAPHIQ), Taiwan. Additional Declarations: Option 1 The product has been thoroughly inspected and found free from *Ditylenchus dipsaci*, *Naupactus leucoloma* and *Franklinella occidentalis* (Pergande).
	Thailand	All consignments must be free from pests of quarantine concern to Thailand
	Tonga	1. Leafy: Inspected on arrival for *Pieris rapae* and other insects. If infestation is found to be insects, the consignment is to be fumigated with methyl bromide at 32g/m^3 for 2 hrs at 21°C or above. 2. Roots require an additional declaration. 3. Refer to Import Permit. Additional Declarations: Option1 1) The turnips are locally grown, 2) Grown in an area free from *Pieris* spp, 3) A representative sample was inspected and found free from insects, 4) *Psila rosae* is known not to occur in Australia. (EXDOC Endorsement No 1853) OR Option2 1) The vegetables are locally grown, 2) Grown in an area free from *Pieris* spp, 3) A representative sample was inspected and found free from insects.(EXDOC Endorsement No 1854).
Lettuce	Micronesia	As for Asparagus
	New Zealand	Commodity may also be exported to New Zealand as a salad mix component. Please refer to salad mix for additional details. Refer to *Brassica* spp.
	Sierra Leone	Commodity is prohibited as an import into Sierra Leone
	Solomon Islands	As for *Brassica* spp.
	Sri Lanka	This commodity is prohibited as an import into Sri Lanka

Commodity	Country	Further information
	Thailand	As for Asparagus
	Turkey	All fruit & vegetables must be free from soil
Mushrooms	Japan	*Psalliota campestris* without certification
	Mauritius	Option1 Grown on a sterile medium and free from any growing media. (EXDOC Endorsement No 1295)
	Micronesia	As for Asparagus (*Agaricus* spp., *Psalliota campestris*)
	New Caledonia	*Psalliota campestris*. Option 1: A representative sample was inspected and found free from live insects, mites and mushroom flies. EXDOC End. No 1531
	Solomon Islands	*Psalliota campestris*, A valid Import Permit must be presented to the AQIS inspector prior to the inspection of the consignment, Option1. The mushrooms are cultivated and not field grown. (EXDOC Endorsement No 1895)
	Thailand	*Psalliota campestris*, as for asparagus
Carrot	Bermuda	Commodity is prohibited as an import into Bermuda
	Chile	Option 1. Carrot bacterial blight (*Xanthomonas campestris* pv. *carotae*) is known not to occur in the area of production. EXDOC end no. 913
	China	Option 1 has 3 sub options related to Stem nematode (*Ditylenchus dipsaci*), Arabis mosaic virus and Tobacco ringspot virus are known not to occur in the area of production
	Haiti	This commodity is prohibited as an import into Haiti
	India	A copy of the Import Permit must be presented to the inspector at the time of inspection. Additional Declarations:Option1 3 sub-options to do with Bacterial blight of carrot (*Xanthomonas hortorum* pv *carotae*), Carrot mottle dwarf virus, Carrot red leaf virus and Carrot yellow leaf virus
	Philippines	Option1 has 5 sub-options related to Bacterial blight of carrot (*Xanthomonas hortorum* pv *carotae*), Carrot mottle dwarf virus, Carrot red leaf virus and Carrot yellow leaf virus, Broad bean wilt virus, Charcoal rot of bean/tobacco (*Macrophomina phaseolina*) and Turnip mosaic virus
	South Korea	Permitted EXPORT FROM TASMANIA ONLY. All consignments must be sourced, packed & inspected in Tasmania. Phytosanitary Certificate and each carton must be marked to indicate as the state of Tasmania
	Micronesia	As for asparagus
	Reunion	Additional declarations as for *Brassica* spp.
	Saint Lucia	Only the underground portion of *Daucus carota* is considered host tissue for White Fringed beetle (*Naupactus leucoloma*). If carrots have any green stem material (green tops) they must be certified against *Frankliniella occidentalis* (Endorsement #1406). All vegetables must be free from soil. The following conditions apply to the UNDERGROUND PORTIONS of vegetables: PROHIBITED FROM NEW SOUTH WALES AND QUEENSLAND- Those plants and plant products that are sourced from permitted areas to be inspected, completely sealed and certified in the state of origin prior to export. Additional Declarations: Option1. The product has been thoroughly inspected and found free from *Ditylenchus dipsaci* and *Naupactus leucoloma*. (EXDOC Endorsement No 1823) OR Option2. The product has been thoroughly inspected and found free from *Ditylenchus dipsaci, Naupactus leucoloma* and *Frankliniella occidentalis*. (EXDOC Endorsement No 1406)
	Taiwan	Option 1: the seed has been tested in an approved laboratory and found to be free from stem and bulb nematode (*Ditylenchus dipsaci*).(EXDOC Endorsement No 749)
	Thailand	As for asparagus
	Turkey	All fruit & vegetables must be free from soil

5.9 Regulatory Biosecurity Gaps and Impediments in the Export System

5.9.1 Chemicals and Chemical Residues

Governments for each country set their own limits for the amount of residue of an insecticide, fungicide, herbicide etc that is legally allowed in food entering their country. These limits are the MRLs. In Australia they are listed in the Australian and NZ Food Standards Code. It is not uncommon to find products and active constituents routinely used in Australia, not having an MRL established within a targeted export market. This means an MRL would not have been set and the importing country may not allow any detectable levels (even if safe) of the chemical. Exporters of horticultural products and fresh produce must be aware of the varying conditions of entry to each country.

The different MRLs between countries (which may be as much as 100-fold) is an area of biosecurity exposure for many vegetable producers who may either export opportunistically, or who may unknowingly have their 'domestic market' produce repackaged and exported. Breaches and rejections of product are costly in terms of lost markets, tarnished reputations and lack of returns. The National Residue Service (NRS) supplies foreign MRL test results, but at this time onions are the only vegetable industry funding routine testing in that scheme.

Examples of recent negotiations regarding MRLs are given in the DAFF update on Agricultural trade (August 2008) and shown below.

Indonesia – Draft regulations for food safety control of plant products: Indonesia has proposed draft regulations concerning **food safety** control for **fresh foods of plant origin**. The draft regulations include overly burdensome requirements for **pre-export testing and certification of** grains, **fresh fruit and vegetables for freedom from, or compliance with maximum residue levels**, for various chemicals. There are also Hazard Analysis Critical Control Point **certification requirements** that would be problematic to address. Indonesia has indicated a willingness to recognise **Australia's production systems** as providing an **equivalent level of food safety protection** as that proposed in the draft regulations.

Japan's maximum residue limits for agricultural chemical residues: DAFF, with the Australian Pesticide and Veterinary Medicines Authority (APVMA), have made since 2006, 157 **technical submissions in support of Australia's maximum residue limits (MRLs**).

There are other biosecurity impediments relating to chemicals. Chemical risk exists when importers (individual, corporate) apply more onerous compliance requirements than their own governments. Examples of this are reported within Europe where GlobalGap requires one test per commodity per year, but an importer (i.e. company) may believe risk can be further reduced, by imposing a testing regime of one test per cultivar per year, with more stringent tolerances.

All industries utilising chemicals for pest and disease control need systems for evidence collection (eg. compulsory spray diaries). The requirement for industries to gather evidence and supportive data cannot be understated. The inability (due to lack of evidence) to refute claims (i.e. product mis-use etc), trace the source of MRL breaches, or determine if violations are 'isolated' or 'systemic', leaves many industries vulnerable and unable to rectify trade dislocations or loss of community confidence.

It is recommended that export-focussed vegetable industries (eg. carrots, asparagus) invest in the preparation of specific chemical approval lists and standardised spray diaries that are suitable for all likely export markets. This has been the approach of the wine grape industry. This industry has maintained its 'clean and green' reputation internationally, through deliberate and strategic recommendations regarding chemicals and biological control agents. There are some crop protection products registered for use in Australia on wine grapes, that have had a use restriction placed on them by the industry, eg. an 'export harvest interval' greater than the withholding period for azoxystrobin – '*use no later than 80% capfall'*. Other chemicals have been removed from the approved industry list for grapes destined for the export wine market, eg. phosphorous acid is '*not recommended for use on grapes destined for export wines'*. The wine grape industry is now more reliant on their own conservative recommendations, annually published in the "Dog Book" (Bell and Essling, 2008), *Agrochemicals registered for use in Australian viticulture 2008/09)*, than they are on registration lists, because it has been prepared to ensure that the lowest MRL for *any* of Australia's major wine markets, will be satisfied.

6 MICROBIOLOGICAL BIOSECURITY THREATS: FEATURES & IMPORTANCE BY COMMODITY TYPES

The most adverse effect of failed microbiological biosecurity is the introduction of a pathogen (or pest) or new strain/pathovar to a previously disease-free area. Not only does this change the management required and economics of production, but also future market access and acceptance of the region's produce and possibly quarantine status.

The following describes the major types of microbiological threats and the relative importance in seed and fresh produce of different types.

6.1 Seed

There is a general lack of awareness of the epidemiological nature of many seedborne diseases. It is important to be able to equate the pathogen, Australian conditions and the likely economic impact – not merely the presence of inoculum or contaminant. The Australian vegetable industry would benefit if import risk assessments for vegetable seeds, were placed significantly higher on BA's pest-risk assessment (PRA) priority list. Industries reliant on imported seed should drive this.

For a region or commodity industry, clean seed is a basic essential for crop establishment, crop protection and area freedom status. In its largely unregulated position, seed presents the greatest biosecurity threat to the vegetable industries reliant on imported seed. The major biosecurity threats associated with seed are contaminant seeds (ie weed seeds, or unidentified seeds), and pathogens (especially fungi and viruses). Most pathogen entries on seed are fungal in nature (two-thirds), but viruses are the most problematic, and bacterial infections are increasing (Hanold, 1966).

Seed testing is expensive, and not yet reliable for a number of pathogen types. It is not accepted that the risk associated with seedborne disease can be zero, but vegetable and seed industries must prioritise (in the IBPs) those organisms that are most damaging. Races and strains of diseases and new seed pathogens are an international biosecurity issue. Quarantine decisions based on data to the species level only, is insufficient for many diseases, on most hosts (not just seed) eg. races of *P. infestans* and mating types; viral strains; pathovars of bacteria etc. Secondary to the direct damage caused, is the potential threat of resistant (esp. fungicide) strains being introduced.

There is insufficient testing by seed companies, breeders or quarantine personnel to evaluate all potential seedborne threats. The emphasis is rightly being moved back to the seed companies and breeders to demonstrate disease/pest status pre-shipment. Both the ISTA and the International Seed Health Initiative (ISHI) operate within international regulatory and accreditation parameters. The ISTA validates the seed testing methods developed by the ISHI. Trueness-to-type and purity are also important and will be increasingly requested, with 'genetically-modified' compliance documentation.

Economically-important seedborne diseases of vegetables include tomato canker (tomatoes), PSTVd (tomatoes, potatoes), halo blight of beans (zero tolerance in US), *Xanthomonas* sp. (*Brassica* spp.). Australia has experienced introductions of asparagus seed from USA with *Fusarium proliferatum* (Elmer, 2001 as cited in Irvine, 2005); basil seed infected with *F. oxysporum* from US (Elmer, 2001 as cited in Irvine, 2005); *Alternaria radicina* on carrot seed, PSTVd on tomato seed, and *C. gleosporidoides* on lupin seed in 1996 (Elmer, 2001 as cited in Irvine, 2005).

Biosecurity threats associated with seeds are not generally well-addressed by current ICONs. The ICON for carrot (*Daucus carota)* seed, for example allows:

- Entry to Australia (no Import Permit required).
- Entry to Australia (no acceptable seed analysis certificate required).

- Entry to Australia from Khapra beetle countries.
- Treatments on arrival (no documented tests of efficacy undertaken).
- PEQ visual inspections (which in most cases are not capable of detected seedborne viruses, fungi, viroids or bacteria).
- Entry with supplier declarations (that apply to the *exporter* only).
- (Entry without identification of the specific place of production).

Some general biosecurity measures, if introduced could increase the biosecurity of seed, regardless of the specific nature of the threats. Consideration however must be given to the net effects, i.e. could increased inspections become a regulatory trade barrier that imposes an unreasonable burden/cost on seed industries, and ultimately the growers?

The cost of seed, BA's lack of PRAs on seed, and AQIS resources, are disincentives to more intensive and complete seed testing. Sample sizes required to ensure detection of low level seedborne pathogens, are very high. For example there is evidence that infection levels of Lettuce Mosaic Virus (LMV) as low as 0.03% in lettuce seed, or bacterial canker in tomato seed, may result in an epidemic. To detect infection through routine testing, could require a grow-out of 30,000 seeds, which are then lost to production. Given the cost of hybrid seed (eg. each hybrid cucumber seed costs 25 cents), it is recommended that investment be directed to in-field research (eg. to determine the stage of development to maximise detection) to exclude pathogens, and molecular testing that is capable of and validated for detection of low levels of infection, and new strains. Access to suitable controls must also be assured.

General recommendations for improved seed health and biosecurity, include:

- increased inspections and /or pre-shipment testing evidence that includes seed health (eg. health status declarations on Seed Analysis certificates)
- research and investment in the development of advanced detection technology and optimal sample sizes (eg. for PSTVd, pelleted seed etc.)
- uptake of requirements for labelling of treated seed
- increased grower engagement in communication of seed alerts
- limitations on non-commercial imports, eg. approvals for research purposes primarily
- pest-risk assessments for all vegetable seeds on which local industries are reliant
- identification of high risk seed and high risk pathogens
- increased requirements for information on import permits to allow full traceability
- retention of sub-samples of imported seed under pre-determined conditions and timeframes
- increased links with established seed testing authorities and validation of their techniques
- assigned responsibilities to update APPD in consultation with CABI's Crop Protection Compendium seedborne disease database.

It is also recommended that AQIS be given the resources and opportunity to enhance their understanding of the internal quality assurance systems of large seed companies, and of the purpose and effectiveness of some voluntary certification programmes. While some such seed programmes have allowed industries to manage many pests down to levels deemed (by themselves or their local industry) to be acceptable, they are less suited to preventing original introductions. Most have not been developed for that purpose, and therefore have greater marketing, than regulatory or phytosanitary, benefit.

6.1.1 Seedborne Viruses and Viroids

There are no controls for viroids (or viruses) once they have entered seed, and viruses and viroids cannot be detected in visual seed inspections. For these reasons, enhancement of seed biosecurity requires greater focus at the seed production site, and also at the new crop site as vector control may limit spread of an introduced virus or viroid. Seedborne vegetable viruses include the crypticviruses, nepoviruses, tobraviruses, tobamoviruses, tombusviruses, sobemoviruses; ilarviruses and some poty- and potex-viruses (Murant, 1988).

In determining the risk posed by nepoviruses for example, there must be local knowledge of the endemic nematodes in Australia and their potential to vector exotic nepoviruses. It is thought that Australia has many potential vectors. Threats include tomato black ring virus which is a nepovirus with a wide host range, 20% seed infectivity and it is present in 25 countries with whom Australia trades (DAFF 2003; Brunt *et al.,* 1996; Murant, 1983).

6.1.2 Viruses

Irvine, 2005 compiled a useful list of exotic pathogens that are seedborne, seed transmitted, or have suspected seed transmission. It is included in Appendix 2. Since this time world literature has included comment on new pathogens or strains (not all exotic), new sources of the pathogens or vectors and areas exposed, and continued seed-associated biosecurity alerts. Some are noted below:

Table 10 : Seed-associated, pathogenic biosecurity threats (since 2006)

Pathogen	Crop	Literature source	Comments
Albugo candida	Brassicas	SeedQuest(SQ) Feb 08	New strain; disinfest'n of seed approved
Beet western yellows	Beets, lettuce	SQ May 07	Found in China, USA
Beet soilborne pomovirus	Beets, beans, tomatoes	SQ May 07	Fungal vector; found in USA, Europe, China
Colletotrichum dematium	Spinach		On seed, into Australia
Columnea Latent Viroid (CLVd)	Tomatoes	SQ Aug 07	Spread on tools; seed transmitted; latent ornamental reservoirs; related to PSTVd
C. michiganensis subsp. *sepedonicus*	Potatoes	SQ Jan 08	Netherlands – new incursions; suspected contaminated 'seed' from Bolivia; seed transmission approx. 1%
Cucurbit yellow stunting disorder virus (CYSDV)	Cucurbits	SQ March 07	USA; transmitted to all cucurbits by biotypes of sweet potato whitefly; infected transplants and possible seed transmission
F. solani f. sp. *cucurbitae* race 1, 2	Cucurbits, esp. pumpkin	SQ Oct 07	Seedborne fruit rot
Iris yellow spot virus (IYSV)	Onions, amaryllis, leeks, iris, weeds	SQ Sept 07; Feb 08, EPPO Alert	Not seed transmitted but vernalised bulbs carrying viruliferous thrips cause problems - EU, Aust, Nth Am, Asia
Mirafiori Lettuce Big Vein Virus	Lettuce	SQ Mar 08	Fungal vector; seedborne, soilborne and aphid roles
Melon necrotic spot virus	Cucurbit, Vigna	SQ Jan 08	Seed transmitted 10-40%; soil fungal vector; now USA, UK, China, Japan (new strains), Netherlands, Greece
Pepino Mosaic Virus	Tomatoes, esp. greenhouse tomatoes	May 08; (EPPO, 2004)	Two strains; low level seed transmission dependent on interval between infection and harvest
Ps. syringae pv. *syringae*	Tomatoes, capsicums	SQ 2007, 2008	Very wide host range, suspect seed contamination and transmission
Carrot Virus Y (CarVY)	Carrots and some Apiaceae	WA Farm Note 29/2003	Only in Australia
Cauliflower mosaic virus, Lettuce mosaic, cucumber mosaic virus; gooseberry veinbanding virus	Various	SQ Jan 08	Vectored by currant-lettuce aphid; registered insecticide control; seed role in LMV, CMV and possibly others
Tomato chlorotic dwarf and tomato planta macho viroid	Tomatoes	SQ Aug 07	Related to PSTVd and latent in Solanaceous ornamentals; seed role suspected

Pathogen	Crop	Literature source	Comments
‘Torrado’ disease - new virus	Spanish tomatoes	SQ March 07	No specific details
Tomato apical stunt viroid (TASvd)	Tomatoes	2008	USA in asymptomatic *Solanum jasminoides* from Netherlands and Germany. Transmitted in seed and by bumble bees.
X. campestris pv. *campestris*	Brassicas		Seedborne (reported in Aust.)
Other cucurbit viruses: Cucurbit leaf crumple virus (CuLCrV); squash vein yellowing virus (SqVYV);	Cucurbits	SQ April 08	Pathogen-free transplants and host free periods for control
Impatiens necrotic spot virus	Lettuce, g/h ornamentals, potatoes, peanuts	SQ May 08	Thrips vectors, USA, EU-related to TSWV (not seedborne)

Given the increased production of seed in Asia /developing countries, and the lack of established seed pathogen lists for most of these areas, Australia must remain cognisant of research investigations and viral surveys in neighbouring tropical countries where viruses and their vectors are often more prevalent, and rate of seed transmission may be higher than in other environments. Researchers in Indonesia have increased their efforts to improve the seed health of their vegetable crops. Their surveys revealed that the most important seedborne pathogens in their production region were: for hot pepper: *Colletotrichum capsici*, X. *campestris* pv. *vesicatoria*, cucumber mosaic virus (CMV), tobacco mosaic virus (TMV); for tomato: *Alternaria solani*, *C. michiganensis* subsp. *michiganensis*; *X. campestris* pv *vesitcatoria*, CMV and TMV; and for cucumber: (seedborne) Zucchini yellow mosaic virus (ZYMV), *Didymella bryoniae*, and anthracnose. The specific locations of such seed production are important for Australian biosecurity in pre-border intelligence, and post-entry traceability.

6.1.3 Viroids

Viroids are transmissible via equipment, handling and seed (for many, but not all viroids). Pollen transmission has also been demonstrated in tomatoes. Of importance to the vegetable industry is the range of symptomless, herbaceous ornamental viroid hosts. Ornamentals are a likely pathway of introduction of viroids to greenhouse crops (when raised in close proximity in nurseries). The Netherlands had an outbreak of Potato Spindle Tuber Viroid (PSTVd) in their greenhouses in the 1980s and there was some thought the origin of it was pepino seed imported from NZ and Greece. PSTVd has been detected in symptomless *Solanum jasminoides* and *Brugmansi*a spp. and its main transmission is via vegetative propagation. Tomato chlorotic dwarf viroid was first detected in Canada in tomatoes grown from seed from the Netherlands, via USA. Tomatoes and potatoes develop symptoms of several viroids that also have known asymptomatic hosts. The best means of viroid management is therefore exclusion or eradication.

Viroids are rarely tested for in PEQ. Biological indexing is effective for their detection, but ELISA is not (no coat protein). Molecular hybridization is the most frequently used method today. There are however more cost-effective techniques that are available to simplify the process of simultaneous diagnostic detections of multiple pathogens in infected plant material - eg a macro-array capable of detecting 11 potato viruses, PSTVd in mixed infections has recently been reported (Agindotan and Perry, 2008).

In response to a number of PSTVd outbreaks in greenhouse tomatoes since 2001, BA recently undertook a pest risk analysis (PRA) on tomato seed. They demonstrated that tomato seed was a pathway for the introduction of this viroid. Their scientific evidence showed the potential for the viroid to be moved as an external seedborne contaminant and also within the seed embryo.

Since 1992 when the last quarantine restrictions were removed, commercial tomato seed lots have been entering Australia without any risk mitigation measures. However as a result of the recent BA investigation, and considerable pressure from the potato and tomato industries and plant health committees, new import conditions for tomato seed have been introduced, as announced by the WTO in June 2008 (WTO ref. G/SPS/N/AUS June 2008). They follow.

Phytosanitary certification requirements for tomato seed for sowing:

Each consignment must be accompanied by a Phytosanitary Certificate endorsed with one of the following additional declarations:

'*The tomato seed in lot(s) … … … (numbers) in the consignment was grown in … … … (Country) in an area that is free of potato spindle tuber viroid, based on an official survey covering the complete range of potato spindle tuber viroid hosts*'

or

'*The tomato seed in lot(s) … … … (numbers) in the consignment was derived from seed and pollen parent plants grown by … … … (producer) in … … … (country) that were tested during the growing period and found free of potato spindle tuber viroid*'

In practice this delivers improved biosecurity for the potato and tomato industries. All tomato seed imported into Australia will be placed in quarantine; and tomato seed shipped after 24 June, 2008 that is not accompanied by a valid Phytosanitary Certificate with the required additional declarations, will not be permitted entry into Australia.

Despite the potential for extensive and rapid mechanical transmission of PSTVd in potato fields, certification of seed potatoes (free of PSTVd) has been successful and is believed to have helped eliminate this viroid from production areas in USA and Australia.

6.1.4 Seedborne Bacteria

Seedborne bacteria may be effectively treated with hot water, however some such treatments have detrimental effects on the seed germination. The levels of seedborne bacteria often reflect the growing season and production area. Wet periods prior to harvest usually increase the threat of seedborne bacteria. Seed crops, for the same reason, should not be overhead irrigated.

Bacterial speck in tomatoes is thought to have seedborne implications, in Australia. It is believed by several pathologists familiar with tomato crops, that bacterial speck (race 0) was present and managed in Australia until the removal in 1992 of the risk mitigation measures at the border for commercial tomato seed. Although potentially coincidental, it has been reported to us that since the removal of hot water + sodium triphosphate treatment, the new race (race 1) of bacterial speck, has appeared and it is more difficult to manage.

6.1.5 Seedborne Fungi

The most reliable management of fungi in seed crops is via in-field inspections and treatments, and careful post-harvest handling (i.e. drying, storage away from other hosts of potential fungal pathogens, treatments). Many vegetable seeds may be effectively treated post-harvest with fungicides, and are shipped with this coating. Fungicidal efficacy may be affected by the location and type of fungi, eg. thiram controls the fungus on *F. solani f. sp. cucurbitae*-infested seed but it will not control the same fungus once it is borne within the seed coat (SeedQuest news, October 26, 2007).

6.2 Fresh Produce

Wind, birds, animals, insects, seeds and planting material, routinely spread pathogens, but human activity accounts for a vast majority of disseminations. At present 230 high priority pests have been identified by PHA in their Emergency Plant Pest Response Deed (EPPRD) and IBPs.

However the majority of vegetables provided are wholesome and free of pathogens and harmful microorganisms.

Good agricultural practices are intended as much for food safety as they are for sound and efficient production. Just as for biosecurity, food safety is a shared responsibility. Effective delivery of both requires a coordinated and comprehensive effort throughout the production and transport systems, with each component encouraged to take a proactive role in minimising microbial hazards over which they have control. Microbial and chemical hazards affect the safety and quality of fresh produce. Chemical (pesticide residues and chemical contaminants) hazards are discussed in Section 7. Heavy metal contamination is not discussed in this report.

The import conditions and export conditions for fresh produce for consumption, are more onerous than for seed largely because of the public health component of biosecurity, but there are also threats to reputations, and risk associated poorly managed discarded produce. The import requirements for example, for imported fresh snow peas and sugar snap peas, for human consumption for all countries (excluding New Zealand, Zambia, Zimbabwe and Kenya), are:

- An import permit is required.
- A Quarantine Entry must be lodged.
- An original Phytosanitary Certificate is required and must be sighted before entry and product inspections.
- Commercial Treatment Certificate – if treated prior to export.
- Freedom from live insects, disease symptoms, contaminant seeds, soil and other debris prior to arrival in Australia.
- Consignment in clean, new packaging, which is (for fresh produce) inset proof and compliant with range of packaging options.
- All consignment subject to arrival inspections unless: pre-cleared in 'country of origin' under AQIS approved arrangement.

Additional requirements:

- If live insects are detected, the consignment must be treated, re-exported or destroyed;
- If Khapra beetle detected, consignment must be fumigated with methyl bromide.

6.2.1 Insects

Insects present biosecurity challenges for inspectors. Detection in shipped produce is often difficult if they are in the egg, crawler or nymph stages of development within the flesh or under the skin or calyx of vegetables. Not all inspectors and inspection locations have suitable microscopic aids, and therefore detections may also be limited by equipment. Export produce also has to be inspected (AQIS inspectors or under ICA) and while all inspections would ideally take place at the time optimal for detection, this is not the reality.

Biosecurity associated with insects is influenced by the presence of other potential hosts (i.e. neighbouring crops, during storage, shipping etc), alternative hosts and those that might harbour insect populations, weather conditions, available insecticides, and the presence of pathogens that they may effectively vector. When specific knowledge of migration triggers and patterns, life cycles, preferred and alternative hosts and seasonal thresholds is available it is possible to extract from trapping data, valuable predictive epidemiological information, and evaluation of control options (eg. crop free periods). The value of monitoring and surveillance programmes is greater in cross-industry programmes that include multiple surveillance locations, partners, targets and techniques. Strong industries and those that are signatories to the Deed, are justified in imposing pressure on those industries that threaten their own, through inaction on biosecurity and/or lack of awareness and response preparedness.

The vegetable industries have completed pest threat tables in the IBP. High risk insects include exotic fruit flies (Oriental, Papaya and Philippine), melon fly, Colorado Potato beetle (*Leptinotarsa decemlineata*), a number of leaf miners (tomato leaf miner, vegetable leaf miner, South American miner fly, potato leaf miner, pea leaf miner, serpentine leaf miner, American serpentine leaf miner affect vegetables), and carrot rust fly. Domestically, fruit flies remain a significant market hurdle.

Recently the brinjal fruit and shoot borer (*Leucinodes orbonalis*), a major pest is Asia, has been detected in Queensland and will require review to determine its status as an emergency plant pest (EPP). The threat presented by insects in their various stages, may be direct damage, as vectors, and/or as impediments to viable production and market access. Although the tomato leaf miner pathway is considered to be fruit, its larvae feed on all plant parts and it is therefore assumed that truss tomatoes present increased risk. It is believed that the most likely pathway for the majority of leaf miners will be on flowers, as eggs.

The vegetable leaf miner (*Liriomyza sativae*) is a major threat to vegetable crops. It is present in Timor Leste and its potential natural and assisted pathways suggest added vigilance and preparedness for it, are warranted. NAQS includes this pest on its surveillance in the area and in the islands on the Torres Strait.

Traps may be effective early detection means for a range of winged insect pests moving actively and passively. Trapping may also provide intelligence about airborne spores. Using the example of the Currant-Lettuce Aphid (CLA) in NZ, it is evident that the spore trapping, transport monitoring, and research that identified primary and secondary hosts and temperature influences on insect migration, have allowed long term management of this pest, as well as predictive information that is conveyed to growers who link this to their decisions on susceptible crop growing periods (Feutrill, 2008a, 2008b).

The Oriental Fruit Fly has been recorded for more than 150 kinds of fruit and vegetables (including capsicum, tomatoes, stone fruit and tropical fruits etc) and this serves to highlight the need for cross-industry approaches to managing biosecurity. This fruit fly has the potential to be more costly in terms of damage and trade losses, than Mediterranean fruit fly and melon fly, should it become established.

The seriousness of exotic fruit fly threats is recognised and the resources devoted to the National Fruit Fly strategy are well-justified. An incursion response plan exists and serves to optimise the opportunities for early detection, local confinement and eradication. The HAL submission to the Quarantine and Biosecurity Review, chaired by Roger Beale AO (Quarantine and Biosecurity Review, 2008) provides comprehensive information on these and other insect threats.

Ants are considered an increasing threat and several incursions of ants have occurred in recent years.

6.2.1.1 Thrips

The draft IRA for capsicums from Korea, identified three thrips that would require quarantine measures pre-export, as well as on-arrival inspections. Exotic thrips from nearer northern neighbours are also recognised threats with passive and assisted pathways. Thrip entry on produce, is 'high' risk for three reasons: 1) their cold tolerance, 2) propensity to lay eggs under skin of fruit making them difficult to detect, 3) their status as important vectors of viruses with wide host ranges. Two of the thrips are known to be present in Australia, but are regulated in several states. Western Flower Thrips are under official control (quarantine pests) in NT and

Tasmania; melon thrips in NT, SA, Tasmania and Western Australia. European thrips (*Frankliniella intonsa*) has not been found here. Nematodes

Nematodes not only feed on plant roots and disfigure crops, some are also important virus vectors. Many vegetable crops are susceptible to nematodes. The management of nematodes needs specific attention since root crops, corms, tubers, plant material, even seed of ornamentals and vegetables may be good vectors of them. They are moved primarily in planting material and soil. Soil management is an important component of biosecurity for nematodes. Regions where contractors are used and/or equipment shared, run a greater risk of moving and introducing nematodes. There are however good regional programmes that effectively contain nematode populations and spread, through systems approaches. A survey-based compliance programme has been developed to support the additional declarations required by Taiwan, for exports from states with Potato Cyst nematode (PCN) (D. Beardsell, Pers. comm.).

Fresh produce (production) biosecurity associated with nematodes must be primarily focussed on site selection, soil and equipment management. Australia has at times been required to demonstrate regional freedom for a number of nematodes: PCN, *Ditylenchus destructor*, *D. dipsaci* and *Radopholous similis*. The reported presence of the burrowing nematode in WA, despite being 1000 kilometres from the nearest commercial carrot production site, has resulted in threatened closure of Taiwan as a carrot market for WA. The biosecurity response to this is discussed further in Section 9.

The carrot cyst nematode is an EPP. It survives many years without a host (like PCN). It fortunately has a very limited host range of cultivated and wild carrots, with some weeds acting as reservoir hosts. Mainly found in UK and Europe with limited distribution in the USA. It is difficult to manage and may cause up to 80% losses.

Although pre-plant nematicides, hygiene (waste water and refuse disposal), crop rotations and nematode resistant or tolerant varieties have been important in nematode management and systems approaches, biosecurity management must continue to include population monitoring. It is possible, for example that populations of the exotic white potato cyst nematode, *G. pallida,* could build up unknowingly to a threshold (at which it may be detected), in blocks planted to golden *G. rostochiensis*-resistant cultivars. All testing and risk reduction measures must therefore be suitable for exotic, and also regulated, endemic species.

6.2.2 Snails

There are a number of exotic snail threats. They range in size from very small to quite large. As adults they are visible to the naked eye and their arrival on produce is less likely than their entry on or in containers. They may also be moved in other packing materials. Several exotic snails are delicacies in some parts of the world and therefore inspections for these in luggage, (as well as in containers etc.), requires vigilance.

6.2.3 Fungi

Fungal pathogens of plants, animals and humans are widespread. Some plant pathogens and food contaminants are also human pathogens. For example *Aspergillus flavus* a pathogen of peanuts and corn also causes disease in humans and insects. The potential for bacteria and fungi and their toxins to be used in bioterrorism has been increasingly recognised since 2001. *Synchytrium endobioticum*, the cause of potato wart, is on the United States' bioterrorism list.

Most plant diseases are caused by fungi. Fungicides have traditionally been necessary to maintain production levels, quality of produce, and market access. Efforts to manage fungal threats now integrate cultural, biological and chemical tools, and consider the wider ecosystem and its biodiversity.

Surveillance and monitoring are scientifically-based biosecurity measures and it is necessary to understand the purpose, target, host and the environment before starting either activity. Specific considerations may be required for the fungal pathogens of different produce types. For example the spread of fungi as aerial borne or splash-distributed spores, is influenced by the crop canopy and structure, weather and growing environment. The canopy of some crops at various stages of development will serve as filters (carrots) and others as traps (lettuce, leeks). The rates of development of epidemics will be altered by the relative rates of development of the host, the pathogen, the weather conditions, and the spatial density of susceptible tissue (hosts and alternative hosts) *in situ* etc.

6.2.4 Bacteria

Bacteria often are often 'hitch-hikers' on fresh produce. However at injury sites, or in swollen lenticels, the bacteria may infect and cause rots, ooze, spots etc. In the field and post-harvest, water quality and irrigation methodologies influence the presence of bacteria on produce. Shipping and storage conditions are very important in risk mitigation against proliferation of any bacteria still present on the fresh produce at the time of packing.

The quality of the water contacting edible parts of fresh produce, the timing and method of application, the land topography, the crop profile, condition and crop phenology (i.e. rough surfaces, whorls etc), and the biology of the bacteria, influence their potential to infect or contaminate. Water applied overhead to large surface area leaves like lettuce, comes into direct contact with edible tissue, and any bacteria present would therefore be harboured in the whorl given the leaf arrangements and texture of leaf lettuce, and *Brassica* spp. in their early development stages.

A recent market disruption occurred in NZ where a new bacterium *Candidatus* Liberibacter was detected in tomatoes and then potatoes. These bacteria (potentially a complex rather than single strain) are phloem-limited and usually spread by psyllids. The disease was first observed in NZ hothouse tomatoes, January 2008, but was mis-diagnosed. The subsequent appearance of odd symptoms in a neighbouring Capsicum crop was the first indication that the problem might not be psyllid yellows. Subsequently the bacterium was detected and identified in tomatoes. The government of NZ alerted the international authorities; removed phytosanitary certification from tomatoes and capsicums, thereby preventing their export. BA imposed additional bans on all NZ solanaceous crops. This has placed the onus on NZ to demonstrate the non-hosts amongst that group, and to produce surveillance data demonstrating pest-free areas (or a process of management that would provide equivalent confidence), in order to re-gain market access (Breckon, 2008). In July, NZ found the organism in a potato crop and reports have suggested that this bacterium may be linked to a potato disease known as "zebra chip" which is spread by the potato psyllid in the USA. It may also be related to huanglongbing, the cause of 'citrus greening'.

6.2.5 Viruses

Viruses in fresh produce (for consumption) are less important than those in seed, bulbs, corms or tubers for sowing. However it is still important that fresh produce be free of viral pathogens, as they have the potential to affect biosecurity in regions where vectors exist and waste/discard piles remain uncovered.

Davis, *et al.* (2007) were funded by the Secretariat of the Pacific Community (SPC) to survey the virus and virus-like diseases of food plants in fourteen Pacific Island countries, some of which are trading partners. A wide array of viral diseases of quarantine concern for Australia, were identified. The highest incidences of virus and virus-like diseases were detected in edible root crops, cucurbits, legumes, *Brassica* spp. and Solanaceous crops.

Tospoviruses and geminiviruses are increasingly problematic around the world, but were not detected in Solanaceous crops in these islands. Zucchini yellow mosaic virus (ZYMV) was the most commonly detected cucurbit virus, followed by Papaya ringspot virus (PRSV-W). In legumes, bean common mosaic was most frequently detected and amongst the aroid root crops, Dasheen mosaic virus was most prevalent. Phytoplasmas were detected in crops and weeds, with most belonging to the *Candidatus* Phytoplasma aurantifolia (16SrII) strain group.

6.2.6 Phytoplasmas

In assessing the biosecurity of vegetables, there are few phytoplasma threats. However the presence of an effective vector can rapidly alter the seriousness of a threat. Aster yellows for example can cause extensive deformity and damage to lettuce, celery and carrot crops in the US and Canada. The aster leafhopper, *Macrosteles phytoplasma* (AYP) is its vector in these regions. The three parameters, leafhopper infectivity, leafhopper abundance and percent yellows infection, are the key elements of the epidemiology of aster yellows. Only leafhopper abundance and percent yellows are quantified, in management programmes, but when infectivity of leafhoppers is high, more wild hosts (weeds) are exposed to aster yellows and they subsequently act as disease reservoirs and sources, with perennial weed hosts carrying the infection through to the next season. Biosecurity preparedness involves sticky trapping of leafhoppers, but at certain times these traps need daily checking so that rapid changes in the population can be detected.

6.2.7 Microbial Contaminants and Food Safety

The biosecurity threats of greatest concern for fresh produce are food safety and/or chemical contaminants. It is fortunate that in-tact natural barriers (skins and their surface relief and natural waxes etc) minimize the movement of surface contaminants to internal food safety risks.

There are six main reasons why there is currently a heightened awareness of food safety of fresh produce:

- Recent and recurring, high profile outbreaks where large numbers of humans have been affected.
- Recent outbreaks that have crippled horticultural industries during investigation stages.
- Awareness of bioterrorism and resource (eg water) contamination as threats to food security.
- Detections of human pathogens in random surveying of imported and local produce (here and overseas).
- Acknowledgment that surface disinfecting is not effective for some produce and contaminants, leading to discussions of other methods (eg. irradiation).
- Potential removal of chemicals under review, but currently used as post-harvest dips.

In general, microbial hazards are not a subset of microbial pathogens and pests. There are some unique sources of each, but others are linked, eg. water used to apply chemicals aimed at pathogen reduction, may in fact introduce food safety contaminants. Biosecurity measures appropriate to both groups are: traceability capacity (i.e. the mechanisms in place for early detection of undesirable microbes, to their source); knowledge of the hazard pathways; the capacity to respond to detections and minimize their impact with a balance between risk mitigation and external effects of them on other crops, foods or the environment (eg. excessive use of disinfectants that could result in resistance build-up; temperature control in mixed consignments, excessive packaging etc). When fresh produce at any position in the production or supply chains is traceable, investigations can proceed quickly, and the potential for economic burden from inaction, incorrect assumptions or conclusions, are lessened.

Contamination results from external sources and therefore efforts to minimise microbial contaminants and food safety hazards (eg. heavy metals, chemicals etc) are based on systematically-applied practices for growing, harvesting, washing, sorting, packing, handling, and transporting produce. Vegetables packed in the field present the highest risk, but for fresh-cut vegetables eaten raw, there are no treatments that reliably and 'permanently' remove contaminants.

Industry biosecurity awareness of fresh produce contamination is necessary to:

- Identify reduce or remove exposure points (eg. prevent contamination);
- Prepare systems that allow early detections of unintended and intended (crop/produce sabotage, tampering) contamination;
- Prepare response systems of elimination (produce surface texture, products registered important in determining what is feasible) or reduction that minimise costs and market dislocation associated with any detections; and
- Prepare reporting and documentation systems that collate evidence of response actions and effectiveness, traceability (that may be used to further increase industry awareness, and/or to counter or support publicity surrounding the event).

There is more discussion of contamination exposure points on-farm in Section 11. In brief, biosecurity management of it must include management and evaluations of: input quality (chemicals, water, manures and biosolids), animal influences, hygiene and sanitation (worker, equipment, transport, facility), and waste disposal. In the production chain only one of these components of food safety is regulated (chemical use) although worker safety regulations do consider facilities for hygiene and sanitation. At the retail end of chain, there are also regulations on food handling and service.

It is evident in most horticultural industries, that there is almost total reliance for fresh food produce of high quality and safety, on the capability of growers, packers and transporters to identify potential microbial hazards and their source, and to be proactive in minimizing their impact. To retain and justify the confidence the law and consumers place in them, growers, processors etc. require good information, risk management skills, and sound knowledge of available treatment and response options. For every enterprise mix, the decision-making details will be slightly different. For example, water is a shared resource and therefore most growers 'inherit' rather than control its quality. Upstream land uses, and peri-urban activities affect downstream water quality. Livestock, in blocks neighbouring the canals feeding irrigation water to spinach producers, were the likely source of the 2006 *E. coli* incident in fresh spinach.

In the USA there have been two recent and serious, microbial food safety incidents that crippled the respective fresh produce industries – spinach tainted by *E. coli* in 2006, and tomatoes (initially) by *Salmonella* sp. in 2008. The tomato incident is described below to give perspective to the disruption and costs associated with a presumed breach – for a nation, an industry and individuals. It provides valuable insight into the complexity of investigations, the range of investigators and involved agencies; the importance of industry cooperation, awareness and preparedness (with traceability systems etc); and of diagnostic expertise. Each group aimed to resolve a public health issue, minimise market dislocation, and manage public confidence.

There have also been Australian examples of serious microbial food safety compromises: *Salmonella* sp. in Nippy's orange juice, rockmelons from Bowen, Queensland, and in pawpaws from Qld and NT. In each case the infection has been traceable to either water contamination (ducks on dams, wash water in packing shed) or fresh manure.

6.2.7.1 Food Safety Incident - USA, June 2008

Salmonella is a bacterium often associated with uncooked meats, but it can be present on the skin of fruits and vegetables. It can be transferred to fruit or vegetable during the growing process, harvesting, or post-harvest, with animal waste or dirty water being its main sources. Thorough washing of fresh produce is no guarantee of protection. Under some conditions, *Salmonella* sp. reportedly can penetrate the skin of the fruit and grow internally.

On June 7, 2008 the Food and Drug Administration (FDA) issued a warning to consumers about an outbreak of *Salmonella* Saintpaul, that had hospitalized 1329 people in 43 states, since April. Retailers across the US including McDonald's, Burger King, Wal-Mart, supermarkets etc were advised to remove raw plum, round and Roma tomatoes from their shelves and food, but most removed all tomatoes, and consumers stopped eating tomatoes and fresh tomato products (eg. salsa).

Media headings like "Florida's tomato industry in complete collapse" did not exaggerate the situation as losses of US $100-500 million in farm gate sales, from the US $ 1.3 billion industry, were believed realistic in the lucrative summer market. The losses however were incurred before the FDA, the Centre for Disease Control and Prevention, or state and local health departments in fact had traced the contamination source to tomatoes. By July 17, 2008, the FDA made a new announcement that chillis from Mexico were a likely source and had now been linked to the outbreak. It was revealed that the traceability of produce like tomatoes was an inexact exercise, at best.

The effects of the outbreak on the tomato industry are multi-layered:

- 252 people were hospitalized as a result of the Salmonella outbreak. The cost of this alone is estimated at US $52 million
- Massive, negative media coverage on tomatoes. In the months of June-July, 631web pages discussed the incident and after the second FDA announcement, another 445.
- Loss of public confidence in fresh produce, especially American tomatoes. This added to the skepticism that lingered after the 2006 spinach incident.
- The industry could not quickly deliver supply chain details to assist traceability investigations. Other vegetables were drawn into the investigations – onions, coriander, and it took FDA weeks to determine the source/s.
- Compensation claims of US $100 million have been filed in Florida alone.
- Industry will shoulder the burden of increasing consumer confidence through lower pricing and promotions of the health benefits of fresh tomatoes.

7 REGULATORY BIOSECURITY GAPS RELEVANT TO VEGETABLE CROPS AND THEIR PRODUCTION INPUTS

7.1 Regulatory Measures

Agricultural production worldwide includes the application of chemicals as part of pest and disease control. This necessarily introduces risk associated with illegal use, mis-use or unintended consequences. Therefore chemicals, their use and residues, are regulated.

Chemical residues and contaminants are also managed because even at very low levels that do not affect human health or product safety, they may affect trade. Although an agreed authority sets the international standards for food commodities, there are no uniform requirements around the world for residue limits. It therefore remains the responsibility of individual exporters to be familiar with the requirements of the importing country.

Fresh produce is also routinely exposed to soil amendments of different types and to fertilisers. Their quality is important to vegetable biosecurity. The biosecurity of vegetables exposed to chemical and other inputs, and regulatory threats are discussed below.

7.1.1 Chemical Use

Most vegetable industries are reliant on minor use registrations of crop protection products. The inclusion of vegetables as fruit fly hosts has increased the interest of vegetable growers in the APVMA review of dimethoate and fenthion as post-harvest dips. This review has not yet been completed, but chemical availability is increasingly a biosecurity issue for minor crops. As such, discussions of alternative post-harvest and quarantine treatments such as irradiation, are increasing.

Ionising radiation has been approved for use in Hawaii and 10 European Union states. It is viewed as the most reliable treatment for food safety associated with bacteria on fruit surfaces and in leaf tissue. It is effective on most fruit flies, codling moth, weevils and mites. However, irradiation remains controversial because its long-term effects on human health have not been completely. For most commodities, there is also a belief that irradiation reduces the nutritional quality of the treated food. The uncertain future for insecticidal dips/sprays (eg dimethoate, fenthion), fumigation and irradiation, suggest there should be urgency within vegetable industries to investigate further the full range of remaining post-harvest options - cold, heat, controlled-atmosphere, food safe oils, new fumigants, air pressure etc.

It is recommended that vegetable industries also become familiar with the work of the APVMA regarding spray drift. The preliminary regulatory impact statement in relation to spray drift risk, is now available. This is particularly important given the mixed cropping on many vegetable-growing enterprises and in production regions; the wide range of products used in these areas (and their differing withholding periods), the potential for resistance and cross-resistance, and the unintended effects of some products on neighbouring crops, and bees.

7.1.1.1 Generic Products

Once chemicals have ‘come off patent”, there has been a trend for registrations of that active constituent to be lost. This is often detrimental to agricultural industries and might be averted by encouragement of the original holder of the patent, to provide information necessary for the continued support of registration of the active constituent. It has been reported to us, that when essential data has not been forth-coming from that source, the APVMA has not been inclined to accept information from other providers, perhaps new to that market.

7.1.2 Chemical Residues

The monitoring of chemical residues in fresh produce has important implications for domestic trade and consumers, and for international market access and protection.

Chemical residues are those chemicals (and metabolites) present in food due to their exposure (intended or unintended) during food production. They may be present as a direct result of intended chemical treatment (i.e. for pest and disease control) or from unintended or indirect exposure (i.e. spray drift, uptake from soil residuals, or other inputs - water, manure etc). Chemical contaminants include remnant traces of persistent chemicals no longer used (i.e. organochlorine pesticides), heavy metals such as cadmium, lead or mercury, and some biologically-derived toxins (i.e. mycotoxins).

The NRS and state and territory governments conduct residue testing programmes. The programmes under which fresh produce testing is carried out include: Victorian Produce Monitoring Program (Victorian produce only), Cleanfresh (NSW product only), FreshTest Australia and by a number of market wholesalers. Some states also use detector dogs to detect organochlorines. AQIS conducts the testing for imported produce and it is understood that some supermarket chains also conduct residue testing on occasions. Unfortunately, only the NRS readily provides residue data.

FreshTest Australia was established by the Australian Chamber of Fruit & Vegetable Industries in 2001. It conducts a national programme for Australian produce. Quality assurance facilitators collect samples from the Central Markets, and they are tested at NATA-accredited laboratories, for chemical residues, food safety contaminants and heavy metals. The results are sent electronically to wholesalers, and forwarded to their growers as required.

Vegetable growers require information about the relative merits of each programme, and the process and requirements for testing. The choice of residue testing prior to export, for example must be cognisant of the requirements of the importing country. The FreshTest programme uses a generic screen with levels of reporting (or detections) appropriate for Australian MRLs. Since many export markets have either lower (or no) MRLs, the FreshTest results may not always provide the necessary evidence to support entry to a particular importing country.

There are also notable differences in obligations to report breaches (i.e. over MRLs or detection of unregistered product). When a laboratory within the NRS scheme detects a residue above an Australian Standard or defined residue action level, the NRS is notified. The NRS informs the owner and relevant state and territory government authority who undertake the traceback investigations. The NRS is also able to assist investigations through the provision of scientific advice, explanations and often an historical perspective gleaned from the extensive database of results kept for each industry participant. These services are particularly valuable in trade incidents. The historical data will reward participant industries as new requirements for evidence become commonplace. Such data for example, would have assisted compliance with the new (2006) Japanese MRL limits for chemicals and food additives.

The NRS conducts an onion programme each year. The onion industry is the only vegetable industry that currently funds a chemical residue testing programme through the NRS. The onion industry reputation is strengthened by its evidence to support claims of an exemplary record in terms of managing chemical risks.

While NRS and some state governments have mandated the reporting of MRL breaches, other states have not. This regulatory biosecurity gap has serious consequences. It has resulted, reportedly, in a diversion of produce for testing, from the states mandating reporting to those not requiring it. For the vegetable industries to protect and enhance their reputation and markets, growers, merchants and consumers should be confident in the quality and safety of exported product (local or international). It is recommended that all states mandate MRL breach notification from any laboratory testing fresh produce. Testing is a useful form of audit for herbicide, insecticide, fungicide, fumigant and post-harvest treatments. Unless the results however are reviewed and acted upon, the testing will remain under-valued, and the risk will move with the produce beyond the industry and into the community or international market place, where implications are vastly more serious.

The resources devoted to, and technical capacity for, residue testing, are increasing internationally, but declining locally. While the Queensland government has invested in one liquid chromatography/mass spectrometry (LC/MS) machine for residue testing, and some states continue to operate without one, Singapore and Japan have buildings and companies devoted to residue testing with many hundreds of these machines at their disposal. This capacity, combined with the mass screening technology for detection of up to 1000 “pesticides” at a time, and their propensity to rapidly share detection concerns and information globally, has made the market place even more competitive, but safer. Australian horticultural industries need to be assured their testing capabilities are equivalent technically, although the capacity will never match that of such countries.

Vegetable industries that are export-focussed might consider directing levy funds to residue testing services (like NRS), or activating a levy specifically to support NRS involvement. By comparison, the commitment of vegetable industries to this degree of testing, is extremely low, relative to that undertaken for meat, grains and diary products. SAFEMEAT (www.safemeat.org) is a high level industry committee that is chaired by industry unless an incursion or emergency occurs in which case DAFF will assume the Chair. It aims to monitor and respond to residue detections in the interest of the national industry. Horticulture Australia Limited (HAL) might consider the merit of something similar for the horticultural industries marketing fresh produce. This would provide a forum for immediate response to detections (i.e. voluntary halting of exports, increased pre-harvest intervals etc) and a forum that could work more closely with BA and other authorities capable of approving without delay, the introduction of new technology or new testing targets (i.e. aflatoxins), should the need and opportunity arise.

7.2 Input Security

7.2.1 Fertilisers

Denis Hamilton of QDPI has provided valuable insight into the biosecurity risks stemming from changed regulations and practices in fertiliser manufacturing overseas. Queensland monitors commercial fertiliser quality and a number of chemical contamination and substitution cases, have been revealed.

The disposal of waste from all sources (i.e. health care, industrial and domestic industry, water treatment bi-products etc) is presenting new challenges in many parts of the world. The waste itself presents some biosecurity threats, i.e. organic solids from water treatment plants may contain organic matter, nutrients, pathogenic bacteria, viruses, Helminths, fungi or chemical contaminants, thus creating human health, environmental, trade and sustainability challenges to the down-line users. The recycling of sewage sludge to fertilisers is effective as a process, however systems to evaluate its safety and quality have not yet been developed.

The fertiliser registration system was removed in 1995. Until then it had been effective in identifying and intercepting waste (eg. industrial waste and heavy metals) products in fertilisers. Today there are no such safeguards and responsibilities are unclear. The control of industrial waste is under the Department of the Environment, Water, Heritage and the Arts, but only to the point at which the 'waste' becomes 'beneficial', eg. as fertiliser.

In the US there have been extreme examples of waste diversion, detrimental to agriculture, eg. low-level radioactive waste licensed as a liquid fertiliser; lead contaminated waste sold for use on crops, some of which were destined for livestock feed. At another level, it is known that non-nutrient components of fertilisers (eg. inhibitors that slow the release of nitrogen), may leave residues in some crops to which it is applied. Although the situation is Australia has not escalated to one of repeated, serious biosecurity threats, there are examples of contamination and industrial residues in our fertilisers, eg. zinc oxide from China contained excessive levels of lead and was applied in WA to crops intended for pig feed. As a result no pig offal could be sold in WA for six months.

A Fertiliser Working Group has been established to set national standards for contaminants in fertilisers. The aims of this group and an associated CSIRO research programme, are outlined in Appendix 3. It is clear that the handling of fertiliser quality has implications at all levels of sustainability – environmental quality, social justice and economic stability.

7.2.2 Agricultural Chemicals

In international regulatory circles there is increasing concern about the quality of some crop protection products, counterfeit products, label substitutions, chemical product contamination and tampering, and the provision of false documentation for registration purposes (Denis Hamilton, Pers. comm.; Woods, 2007; Woods, 2007b). Today there are many more chemical 'manufacturers' in India, China and Eastern Europe, than a decade ago. The term 'manufacturer' as used includes re-packagers and formulators, rather than those only in the corporate business of pesticide development and manufacture.

Poor quality pesticides are not only a waste of money in terms of efficacy, but also a potential human and environmental health risk. Under current arrangements there are biosecurity gaps attributable to chemicals. In recognition of this, there are calls for the global pesticide industry to adopt an international code of practice for pesticide quality management that complements the analytical and physical testing products undergo to gain registration. The development of chemical *quality* specifications under FAO/WHO procedures has been proposed (Woods, T.S. 2007). Underpinning their potential effectiveness however would have to be government commitments to observe their principles, provide facilities suitable for verification, and to adopt an agreed system for exercising control. In Australia, the APVMA could satisfy these requirements should they be given this additional responsibility.

The following photographs (Photo 2-6) have been provided for the purpose of reproduction in this report, by Dr. TS Woods (Principal, E.G. Mahler and Associates, Pennsylvania USA). They illustrate recent experiences in Europe with poor quality product, and the challenges to recognise them *before* they arrive in Australia, or are applied to Australian crops.

Photo 2 : Counterfeit product killed crops in several European countries

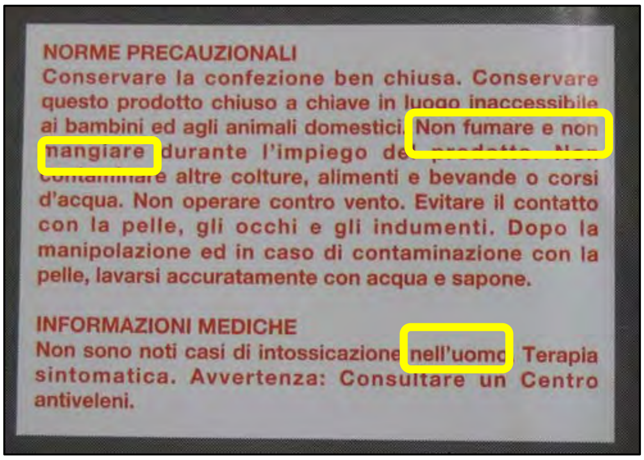
Counterfeit product with the wrong herbicide active ingredient killed crops in several countries in Europe in 2004. Shown here is an affected potato crop.

Photo 3 : Counterfeit herbicide damaged corn in Italy

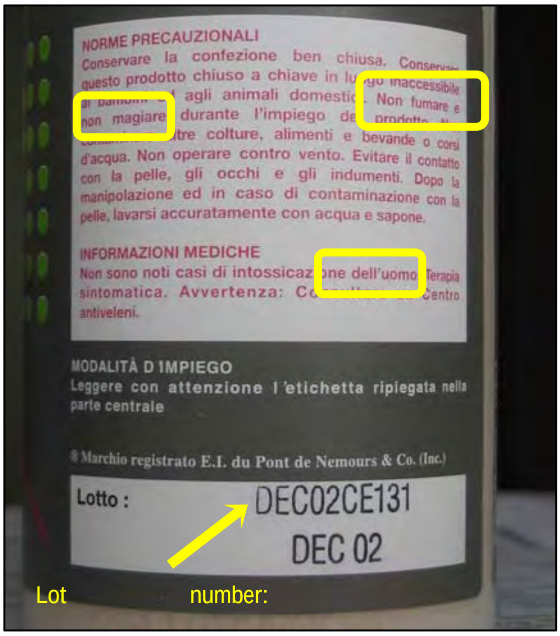
Healthy corn treated with authentic herbicide.

Corn damaged by counterfeit herbicide.

Photo 4 : Counterfeit packaging (Italy) – clues from container labels



Original label



Italian counterfeit label

Photo 5 : Counterfeit packaging (Italy) – clues from seal and cap

Authentic Original - A pattern of wax dots can be seen both on the seal and inside the cap, due to the Induction Heat Sealing process used at Manufacturing Plant.

Counterfeit - No pattern of wax dots can be seen - These containers were not sealed by induction.

Photo 6 : Counterfeiting activities - product removed and replaced with talc

(Source with permission: Woods,TS. Presentation to 3rd Int'l Symposium on Pesticide and Environmental Safety, Beijing, PRC October 2007).

IPMnetNEWS (May 2008) revealed a proposal to change EU pesticide regulations from a risk-based to a hazard-based approach. The negative response was immediate, with scientists and agricultural authorities explaining that under the new proposal chemicals could potentially be approved or prohibited on their inherent properties, rather than the risk associated with their use. An estimate that 85% of UK registered products could be affected was given, and the additional problems for those that export into the EU, noted.

Other international chemical regulatory discussions have related to bees and requests for the effects of pesticides and wetting agents on honey bees, to be included on labels. Appropriate testing and inclusion on labels has been undertaken for many products. The testing needs to include seed treatments. On occasions (eg. imidacloprid, clothianidin), there have been coincidental deaths of bees around fields planted with treated seed (eg corn, canola). Despite a lack of conclusive evidence there was a temporary ban on the products' use.

In our domestic marketplace, there are biosecurity and national security concerns about agricultural chemicals. The review by COAG titled "*Control of Chemicals of Security Concern*" is raising fear that the response may be a 'ban' in essence, similar to that imposed on ammonium nitrate two years ago. However, in discussions with leaders within the NSW Chemical Risk Management Group, there were firm assurances that the identified security sensitive chemicals would not suffer the same fate. Their access may become restricted but the mechanisms are likely to be imposed, are training and storage requirements.

Australia has not escaped chemical bans and recalls. Given its resources, the APVMA admirably conducts its business. However their level of testing of imported product has been questioned, and the limited attention given to data validation has been raised. The latter was raised in relation to Imtrade Australia Pty Ltd. This Western Australian company formulates and imports agricultural chemicals (mainly insecticides, herbicides and fungicides) and recently suggested it had supplied false details in seeking registration of a range of agricultural chemicals. The APVMA ordered a product recall. The case is on-going but an initial court decision suggested the APVMA's action in removing product approvals and registrations, be reversed.

Chemically-based crop sabotage has also been experienced in Australia. There have been several reports of malicious crop damage in the Bowen vegetable production region of Queensland. Some incidents were traced to a common spray contractor. Growers in the area have been advised on how to respond to suspected incidents of intentional crop damage. The check list (Appendix 4) includes how to prevent further harm (eg. closing site access; shutting down irrigation and drainage systems; alerting neighbours etc); who to contact (police, government departments of agriculture, health etc.); how to preserve evidence (photos, detailed notes, collecting samples etc.) and how to protect their businesses (risk mitigation, seeking compensation or legal advice, restoring reputations etc. Ultimately growers have to increase both vigilance (locked storage facilities, inventory management, purchase and application records, including batch numbers etc, and personnel checks and records etc.) and security on-farm.

7.3 Public Confidence

Regulatory gaps allowing poor quality or counterfeit crop protection products have effects beyond those felt on-farm and in the surrounding environment. As described for food safety incidents, there are political and social effects that may result from agricultural chemical spills, media reports of false chemical registrations, or untested product reaching our borders and/or food crops.

Public confidence in agricultural practices and products is essential, and communication with the public is a basic requirement if biosecurity is to be maintained and increased. Recent experiences in California are evidence of the power of the community in thwarting or enhancing biosecurity considerations and actions. In early 2008, Light Brown Apple Moth (LBAM), a native pest of Australia and New Zealand, and present also in Hawaii was detected in California. Eradication commenced with the application of synthetic pheromone-based pesticides in urban areas (with the legal assistance of an 'emergency exemption'). Thirty-one cities passed resolutions to stop the spraying, media members and academics openly clashed with the California Department of Food and Agriculture (CDFA) and declared that the stated 'emergency' was fraudulent as no damage due to LBAM, had occurred. The regulators were forced to change direction and pheromone-laced twist ties were distributed in urban areas. This was objected to also. The window of opportunity for eradication was closed, but sterile moth release as a potential management mechanism, has commenced.

8 GENERAL SYSTEMS IN PLACE FOR THE MANAGEMENT OF VEGETABLE BIOSECURITY

The vulnerability of the Australian vegetable industry to biosecurity and quarantine issues of different nature and sources, derives from:

- Our status as a net importer of vegetables and vegetable seed and therefore the pressure on our border, pre-border and post-border operations.
- Lack of risk assessment (and therefore PEQ scrutiny) on seeds, ornamentals and nursery stock which are proven pathways for a number of vegetable pests and pathogens.
- Australia's proximity to the islands of Indonesia and to PNG where a number of viral diseases of vegetable crops, strains of some pests, and races of other pathogens exotic to Australia, are endemic.
- Presence of potential hosts for some EPPs around the Australian coastline and inland.
- Our limited awareness of native vegetation susceptibility to some EPPs.
- Our limited knowledge of the capability of our endemic insects, nematodes, beetles etc. to serve as vectors of exotics, should they enter.
- Coastal positions of our cities and widespread plantings of potential hosts in gardens and parks, and in general landscaping.

The National Plant Health Strategy (NPHS) will address the range of factors that negatively affect the health of cultivated plants (of value to primary production and/or public amenity), their sustainable production and/or market access. These factors include exotic and endemic pests (invertebrate, vertebrate, diseases, invasive plants etc) and their hosts (weeds, crops, amenity plantings, feral or abandoned sites); pest management options, residues and contaminants, and consumer concerns pertaining specifically to biosecurity. To advance national plant biosecurity there must be awareness of the current position, the gaps and limitations; strategies driven by the national interest, that recognise priorities across sectors, coordinate and integrate activities, and result in synergies and efficiencies.

The Commonwealth government has agreed to facilitate development of the NPHS (derived from the National Fruit Fly Strategy), but each industry will need to develop and approve their strategy. While a focus on 'prevention' is paramount, there are other necessary activities in the draft framework: detection, eradication, management, diagnostics, communication and awareness, and information and data management. The strategic elements form a continuum from pre-border to individual farms.

AUSVEG will be required to consult with industry and then articulate the industry's health priorities and position, as elements of the NPHS. They might include: sustainable production (yield, quality, food safety, profitability – eg. integrate biosecurity to support economic outcomes); recognition of 'regionality'; agreed priorities (production vs. market access pest impediments? engagement with governments, nurseries, peak bodies and regional associations? threat reduction across other industries? harmonised legislation? etc.); and communication and awareness on-farm, and on-farm surveillance. A draft framework with some inclusions for AUSVEG to consider is included in Table 11.

Understanding the nature, source and pathway of threats allows determination of their likelihood of entry, and in the event they enter, their establishment, spread and economic impact. It also allows assessment of the options for eradication, containment, or control. Biosecurity management requires input and commitment from those along the entire continuum and gaps in capabilities or undertakings, compromise biosecurity for countries, regions, industries and individuals.

Table 11 : Framework of elements in the National Plant Health System relevant to vegetables

Strategy Element	Activity						
	Prevention	Detection	Eradication	Management (unofficial[3] & official[4])	Diagnostics	Communication and Awareness	Information and data Management
Contemporary continuum of quarantine - extended to on-farm from original reference in the Nairn Quarantine Review of ca. 1996 **Strategy** - *to protect the asset* **Visions** – *what is priority*	*Preventing entry of EPPs* *Preparing for their arrival through development of contingency plans, and early detection capability*	*Early detection of new pests. Surveillance to define, delimit distribution of existing pests – surveillance and detection* *i.e. where/how to look*	*Application of the EPPRD (Deed) including all obligations of signatories*	*Management of pests already in Australia that impact on the yield, quality and marketing of produce*	*Capacity and capability nationally to identify pests that occur in Australia or that may be detected as an incursion or border interception*	*Increasing national awareness of biosecurity across the continuum including the concept of a shared responsibility*	*Collection, recording and analysis of information that supports the plant health system, including pest occurrence, pest management etc.* *Shared and accessible*
Pre-border – primarily BA/AQIS, capacity building, intelligence	Update offshore surveillance	Use latest surveillance methods to certify and audit.					
Border – operations by AQIS	Awareness of international literature; incursions etc	Use best methods, indicators; extend molecular test range			Advance specialist training	Communication with industries and PEPICC	Develop industry inventory databases
Post Border – OCPPO/Plant Health Australia, Plant Health Committee	Harmonise legislation	Incentive for on-site surveys, protocol compliance	Inclusive process to establish eradication criteria in advance.		Facilitate (cost-free?) suspect sample submission		
Environment – DEW and counterparts in states/territories							
Community – local councils, regional organisations, households, Landcare, schools etc.							
Industry – peak bodies, industry organisations, growers, allied groups							
Farm – individual growers and their support systems							

Source: Edited for vegetable industry from : *Operations Working Group to the National Fruit Fly Strategy January 2007*

[3] Official management - The active regulation and enforcement of activities that manage fruit fly species to a defined threshold in a defined area e.g. PRA, ALPP
[4] Unofficial management - Activities that are undertaken to manage fruit fly species which are not regulated or enforced e.g. sustainable crop production

Biosecurity preparedness starts pre-border with the acquisition of intelligence through specific surveillance, auditing and accreditation of facilities and processes, and sentinel operations; engagement with authorities and standards-setting committees. At the border, biosecurity is managed primarily through inspections and treatments, but NAQS also carries out border surveillance. Post-border, biosecurity management becomes dependent on the regulatory framework of the states, awareness of growers and industry-allied personnel, and the community.

Table 12 outlines the roles and responsibilities in biosecurity management, as currently understood. The gaps and limitations are discussed in Section 9.

Table 12 : Roles and activities within the plant health continuum

Location	Responsible Parties	Activities
PRE-BORDER	Commonwealth Government	International standards setting (IPPC) – BA, AQIS, DAFF, DFAT
		Pest and Disease intelligence – new and emerging threats; control measures
		Import Risk Analysis
		Pre-Clearance
		Off-Shore Verifications – certification, accreditation
		Off-Shore treatments (Imports)
		Training
		Quarantine policy development
		Market Access negotiations
		NAQS
BORDER	Commonwealth Government	AQIS: Quarantine (airports - detector dogs, ports - sentinel hives, container management etc)
		PEQ Screening
		Export Certification
		NAQS
POST-BORDER	State & Territory Govts and Industry	Prevention
		Detection and Surveillance
		Emergency Response Preparedness (IBPs, EPPRD)
		Pest Status & Management
		Diagnostics & other Specialist Technical Expertise
		R&D; Innovation
		Germplasm Assessments
		Communication & Awareness
		Training & Education
		Regulations
		Information Management
		Policy Development
		NAQS

The Commonwealth Government's lead role in pre-border and border activities has been discussed, with gaps in the current import and export systems raised. Systems in place in these sections of the continuum are not discussed further in detail. Given the expected role of industry in post-border biosecurity planning and preparedness, discussion in the remainder of the report focuses on the systems, roles and responsibilities in the post-border section of the continuum.

8.1 Pre-Border Activities in Biosecurity Management

8.1.1 Preparation and Intelligence Acquisition

Pre-border partnerships in intelligence gathering and capacity building are important components of biosecurity preparedness and reduction of off-shore, pre-shipment threats. There are many examples of the Australian government's range of activities in these areas (eg. identification of alternative hosts, assessment of trade routes and pathways, pre-border surveys, literature reviews, training etc). Several are briefly described.

Australian researchers in PNG have assisted the local industry with the management of the virulent strain of *P. infestans* (potato late blight) that killed their crops in 2003. Successful combinations of fungicide sprays and potato resistance, have been demonstrated. From a biosecurity perspective this project has been valuable since it has also provided details on the other significant potato diseases in the region - potato leaf-roll virus, Rhizoctonia stem canker, bacterial wilt and target spot (*Alternaria solani*).

Recently, training of plant health personnel from PNG was supported by the Crawford Foundation and carried out in Australia in June 2008 (Department of Primary Industries, 2008). It brought together AQIS and NAQS personnel with PNG scientists, and provided specific training in diagnostics, biosecurity awareness, post-entry quarantine expectations and processes, and surveillance and capacity building.

Dr TK Lim has provided the following list of ACIAR projects on vegetables in regions important to our biosecurity and trade. AQIS and BA are aware of these projects but are not directly involved in them. Formalising the reporting of surveillance, literature reviews and outcomes of relevant pre-border research to all interested parties, would strengthen our pre-border biosecurity.

The current ACIAR projects of high biosecurity interest to Australia are:

CP/2003/029	*Management of potato late blight in Papua New Guinea*
CP/2003/036	*Managing pest fruit flies to enhance quarantine services and upgrade fruit and vegetable production in Indonesia*
CP/2003/042	*Fruit fly management in Papua New Guinea*
CP/2004/048	*Integrated disease management (IDM) for anthracnose, Phytophthora blight and whitefly transmitted geminiviruses in chilli pepper in Indonesia*
CP/2004/071	*Reducing pest and disease impact on yield in selected PNG sweet potato production systems*
CP/2005/167	*Optimising the productivity of the potato/Brassica cropping system in Central and West Java - include Potato cyst nematode, viral and bacterial diseases of potato, Club root disease of Brassicas*
HORT/2003/046	*Integrated control of powdery mildew and other disease, weed and insect problems in squash in Tonga and Australia*
HORT/2004/049	*Improved farming systems for managing soil-borne pathogens of ginger in Fiji and Australia*
HORT/2004/063	*Integrated pest management in a sustainable production system for Brassica crops in Fiji and Samoa*
HORT/2006/053	*Evaluation of the effects of dasheen mosaic virus on taro yield*

AQIS' schedule of pre-border sentinel inspections, inspections of production regions and sites, and audits of certified or AQIS-approved premises or laboratories, is unclear.

8.1.2 Surveillance - NAQS

Surveillance is a key component of pre-border government activity. The Northern Australia Quarantine Strategy (NAQS) is a respected and effective initiative, with calls for it to receive increased funding and authority to expand its surveillance regions and targets, reflecting this. The NAQS survey territory is shown below:

Source: P. Barkley (Pers. comm.) and NAQS: http://www.daff.gov.au/aqis/quarantine/naqs/zones

The NAQS methodologies include:

1. Surveillance and monitoring (for early detection of targeted pests and diseases) in northern Australia and (in collaboration with the respective governments) Timor Leste, Indonesia and Papua New Guinea.
2. Identification of unique quarantine risks; priority target lists
3. Regulation of movements of goods carried by travellers (including those moving within the terms of the Torres Strait Treaty).
4. Strengthening of Australia's quarantine through collaborative capacity building in neighbouring countries; and public awareness initiatives (eg. Quarantine Top Watch!) and communication.

Pre-border, NAQS focuses on pest, disease and weed surveillance in PNG, Indonesia and East Timor and some capacity building in these countries. NAQS surveys have resulted in the early detection of a number of significant insects, weeds and plant diseases. While NAQS role is largely to detect new incursions, the management of incursions is the responsibility of State and territory agencies.

NAQS was established within AQIS in 1989 and each of their programmes plays a significant role in the maintenance of a quarantine border in northern Australia. Large-scale, unregulated movement of people over shorter ocean distances between PNG and Australia, the environmental conditions, pest, pathogen and crop ranges, present risk in this region. Memoranda of understanding between countries around the Torres Strait and Australia, facilitate collaborative surveillance of the area.

8.2 Border Activities in Biosecurity Management

Australia's activities at the border are dictated by international agreements and our stated pest and disease status (with increasing demands for scientific evidence to support). Importation restrictions cannot be placed on commodities with potential to introduce threats already present within Australia.

8.2.1 Border Inspections and Treatments

On arrival of produce, there are a range of procedures undertaken depending on the accompanying documentation, status and condition of the imported commodity.

Phytosanitary certificates, while valuable additions to import inspections, are not guarantees of product safety or health status. Using the Australian system as an example, inspectors providing these documents are not always specifically trained for this purpose. There are high turnover rates amongst Australian inspectors and the same might be assumed internationally. Inspectors are often called at short notice, not at the prescribed time to optimise the chance of detecting pathogens or pests of quarantine concern. Within Australia, the ICA system is more robust in this area, and adoption of some ICAs internationally will increase in the future.

Cargo container checks are limited by resources and the efficiency of technology available for internal inspections. As the volume, range and potential means of entry for agricultural produce into Australia increase, risk profiling and targeted inspections will also increase. In the future, PEQ may be strengthened if consideration is given to risk-based assignment of human resources, to ensure both capability and capacity are optimised pre-border and at the border.

While PEQ protects Australia from a wide array of problems, it is not possible to screen in-coming material for its propensity to genetic disorders. The perennial horticultural industry is more aware of this deficiency than many others. However other industries must be aware that problems in this area are likely to increase if sourcing, supply and distribution of material for sowing (esp. nursery stock, vegetative material, and true seed) does not have full traceability, or meet some agreed labelling and nomenclature standards.

8.2.2 Border Surveillance

At the border, NAQS are focussed on entries of pests, diseases and goods via boats and people crossing the Torres Strait. Surveys along the northern Australian coastline are timed to match the level of assessed incursion risk. They range from visits once per year to once every five years. Prioritising and developing risk profiles have allowed NAQS to protect the huge area of Australia's northern shoreline and all the inhabited islands of Torres Strait.

Significant resources and effort have been expended in ensuring Australia's appropriate level of protection in some areas of quarantine and biosecurity, at the border. Although largely driven by international obligations, there have been programmes introduced to increase efficiency, for Australia's additional protection - the sentinel hive and baiting surveillance programmes at ports, airport and mail screening, sniffer dog programmes; and pre-clearance programmes.

8.3 Post-Border Activities in Biosecurity Management

8.3.1 General Surveillance

General surveillance is essentially a process whereby information on particular pests and diseases of concern, is gathered from many sources. There are surveillance programmes operated by industry, federal and state governments beyond the border. Their compliance with agreed international survey systems (eg ISPMs for pest-free area establishment), is needed if they are to be used to support future market access negotiations and industry development in the areas of preparedness and response capacity.

Although surveys are important throughout the continuum, about two thirds of plant pest incursions in Australia over the last 15 years have been detected incidentally. The majority were detections made by growers, allied industry members and the general public (Pheloung, 2004). Unfortunately, incidental detections are rarely 'early detections', because they are usually noticed only after the pest population has grown to a level that casual observers notice 'something unusual'. These observers complement a system of more formal surveys and inspections. Neither alone is sufficient to ensure national plant biosecurity.

Most industry-funded biosecurity activities have been directed to the management of established pests. These programmes have been traditionally under-valued in terms of national biosecurity, because the results frequently remain regionally 'in-house', uncoordinated, and rarely subjected to independent review and oversight by those charged with responsibility for national vegetable biosecurity. Those researchers, diagnosticians, scouts, IDOs and growers involved in pest management at every level, are an expertise base that has the potential to provide early warnings of new incursions, and information that underpins claims of pest freedom. There is potential for surveys at any level to be designed and executed to provide the level of statistical confidence necessary (independently or cumulatively) for the results to be meaningful for biosecurity management, and regulatory purposes.

8.3.2 Specific Surveillance

Specific surveys are procedures by which information is obtained on particular pests/diseases of concern on specific sites in an area over a defined period of time. Both NAQS and Northwatch, a Queensland state government programme, are structured approaches to specific surveillance in Australia, with dedicated staff, target pest lists, and formalised systems of data capture and collation. The NAQS focus post-border is surveillance of northern Australia, and it includes trapping and monitoring. The onshore component of the NAQS programme covers a coastal band of 20 km in width from Broome to Cairns. They are also actively engaged in public awareness.

Northwatch is a regional surveillance programme in northern Queensland. It prepares for, identifies and responds to incursions of exotic pests and diseases in the area. Its methodologies include early detection and detection surveys suitable for demonstrating pest freedom in urban, peri-urban and other strategic areas, and raising public awareness. Northwatch prioritises it activities to the detection of exotic pests and diseases with a high chance of entry to Australia from geographically-close neighbouring countries and islands (some as close as 5 km to nearest Queensland coast) in which they are endemic.

Neither NAQS nor Northwatch are 'national' programmes in that they cover limited areas, but their contributions to national biosecurity are extremely valuable. They work closely and together they enhance the protection of northern Australia, a source of many of Australia's identified pest and disease threats.

Within most states there are some quarantine boundaries that relate to specific pests or planting material (as well as movement of animals). The 'Tri-State fruit fly exclusion zone' lies in the southeast and includes parts of South Australia, Victoria and New South Wales. This is a major vegetable and fruit-producing area reliant on fruit fly freedom for market access in several key international markets. The surveillance involves trapping and baiting and the risk mitigation measures are largely movement restrictions, road blocks, public awareness campaigns. The regional and state surveillance being formally undertaken is included in the IBP.

Specific surveys for EPPs are also important in providing a case for compensation. Compensation is not provided to growers of crops not directly affected by the EPP, even if the crop is compulsorily destroyed because of its proximity to the affected crops or within the quarantine zone. Compensation is not provided for loss of income as a result of wages needing to be paid despite loss of crop or restricted marketing, or from non-production periods etc.

Missing from existing biosecurity activities is nationally-coordinated regional and on-farm surveillance. Surveillance is discussed in greater detail in Section 11.

8.3.3 Registration Process for Agricultural Chemicals

Australia has a dependable chemical registration system, which is essential for biosecurity of chemical users, consumers and the community at large. Similarly there are residue testing requirements and programmes. In terms of biosecurity, it is also critical to have a registration system that can provide effective and timely delivery of chemical response options, in the event of an incursion. There are biosecurity gaps in this area, and in the quality assurances associated with some imported chemical crop protectants and fertilisers.

8.3.4 Notification Systems

Australia has an established system of reporting in place. If a grower, consultant, or other person detects a suspect case of an EPP, there is an expectation they would contact the Exotic Plant Pest Hotline 1800 084 881. This would result in the Plant Health Manager of the State or territory being made aware. If a diagnostic laboratory receives samples of diseased material suspected of being an EPP, diagnosticians are expected to provide a full description of the symptoms or pest and the reasons why these are suspected to be an EPP, to the State or territory Plant Health Manager. A preliminary investigation of the incident will be conducted by a representative of the State's Plant Health Manager, and if there is reasonable certainty that an EPP is involved, the Chief Plant Protection Officer (within DAFF) will be notified. The property owner or manager who reported the incident will be notified of the investigation and the potential outcomes and responses.

Each jurisdiction has a listing of quarantineable pests and diseases under their respective plant health legislation. In most cases, there is an obligation to notify authorities of declared diseases (eg. under the Fruit and Plant Protection Act 1992, in SA) "*where a person knows or has reason to suspect that fruit or plants owned by the person, or in the person's possession or control, are affected by disease*", and the obligation applies to producers, wholesalers, retailers and persons in possession of fruit and plants i.e. purchasers. Failure to report carries a penalty. A broadening of reporting obligations to include consultants, pest monitors and anyone who suspects the presence of a quarantineable pest or disease, is being considered in several states.

8.3.5 PHA and Contingency Plans

The capacity to mount a response to an incursion is reliant on quality operational systems and prior investment in training, research, regulatory agreements (i.e. border agreements), and technology development. PHA has prepared generic emergency pest response plans and the regulatory framework (eg. notification instructions, quarantine determinants, personnel and consultative committee instructions etc.) in which they would operate, have been trialled in part in recent incursions. PHA is driving the development of contingency plans for pests and industry signatories to the EPPRD. The vegetable industry should engage in this process as soon as possible.

Biosecurity post-border is the responsibility of state and territory governments and industry. The HAL Biosecurity Portfolio Plan recognises the PLANTPLAN and EPPRD requirements of PHA, but at his time the vegetable industry is not a signatory to these. Being a signatory to the Deed, would greatly enhance the vegetable industry's capacity to engage in discussion and decision-making regarding biosecurity. Signatories are able to evaluate their preparedness, to contribute effectively and financially to incursion management, and to ensure their stakeholders receive compensation (in the event eradication is the management option undertaken).

In their submission to the Quarantine and Biosecurity Review (2008), the Nursery and Garden Industry Association (NGIA) estimated in Queensland alone, that the incursion of Red Imported Fire Ant continues to cost the industry more than $18 m a year in compliance costs.

Although the specific costs of the citrus canker outbreak have not been published, it is known how widely the effects of it were felt: on detection domestic and export citrus trade from Queensland was stopped. This flowed through to employment losses in the field (pickers, contractors etc), packing sheds, carton manufacturing, transport networks and rural communities suffered as a result. In addition, Queensland consumers paid higher prices for citrus imported into the state.

8.3.6 Domestic Regulations and Legislation

Australian states have developed regulations and legislation to protect them from introduced pests and diseases, to limit the movement of endemic pests and diseases and to monitor for those that affect market access.

The vegetable industry has national strength, derived from regional advantages - in harvest times and market opportunities that occur as a result of staggered planting and harvesting periods; crop ranges; relatively low pest and disease pressure. Regional areas with scientifically-justified pest status may be officially recognised in legislation, by quarantine and/or regulation. Much of the pertinent legislation relating to vegetable industries is listed in the IBP. Notable are those limiting movement of potato material and soil (soil is 'regulated' in essence) out of the PCN areas in Victoria (D. Beardsell, Pers. comm.); potato material other than as tissue-cultured plantlets onto Kangaroo Island in SA; silverleaf white fly host material (nursery stock, cut flowers, foliage, leafy vegetables etc) movement into the Kimberley region; restrictions on hosts of cucumber fly strains affecting cucurbits, entering the NT; western flower thrip host material into NT, and many plants and produce into WA and Tasmania. For several states the interstate restrictions and treatments, have greater impact than international biosecurity issues.

8.3.7 Interstate Certification Assurances (ICAs)

ICAs provide a cost-effective alternative to the traditional plant health certificates that relied on government inspectors. ICAs allow interstate movement of produce under nationally-agreed terms. The national ICA scheme provides a harmonised approach to the audit and accreditation of businesses nationally, and mutual recognition of the Plant Health Assurance Certificates that accompany assignments. The certification is based on quality management principles demonstrated by accredited businesses. Such businesses are accredited to issue the assurance certificates for their own produce that satisfies the quarantine requirements of the states. ICAs and their consistent national interpretation, will be increasingly valuable to vegetables recently named as fruit fly hosts.

Most of the ICA protocols for local trade are based on systems approaches deemed suitable to achieve phytosanitary security. While it is agreed that many existing ICAs do not meet international standards (and were not intended initially to do so), many do include relevant information (eg. area freedom, low pest prevalence evidence, pest-free harvest periods; non-host status; in field controls - chemical applications, monitoring, baiting, pheromone trapping, dips), and could be adopted more widely internationally, to the be benefit of local industries.

The vegetable industry might consider investing resources in the prioritisation of ICAs that would advance market access for key target markets and commodities. These should be progressed. Future ICAs should aim for alignment with international requirements.

8.3.8 Market Access Initiatives

There are many systems and formal committees in place to assist with market access. Each includes within their deliberations, biosecurity issues. The industry through levies and the Commonwealth government, both independently (DAFF, BA, OCPPO, AQIS) and through HAL, provide considerable support for market access. New market access is dependent on inputs from industry, BA and DAFF; existing market access changes include inputs from the relevant industry, AQIS and DAFF (through the Horticultural Exports Consultative Committee - HECC); market access R&D considers inputs from industry and the government agencies through the Working Group for Market Access R&D (WGMARD), Quarantine and Exports Advisory Council (QEAC) and others; the broader environment for market access also has inputs from the Department for Foreign Affairs and Trade (DFAT). For imports, BA and DAFF's Import Market Access Advisory Group (IMAAG) play important roles.

The Horticultural Market Access Committee (HMAC) is the peak industry committee for market access, and it is coordinated through HAL. This peak committee includes both government and industry representatives, determines key market access strategies, defines market access priorities and aligns biosecurity needs to them. The work of HMAC is defined by a five year rolling Market Access Strategic Plan (latest version 2008-2112) under nine sub-programmes. They are: 1) the Doha Round; 2) Free Trade Agreements; 3) plant quarantine export access; 4) plant quarantine access to China; 5) plant quarantine access to Taiwan; 6) plant quarantine import access; 7) WTO disputes as particularly relevant to Australian horticulture; 8) market access R&D and 9) contaminants management. There is a companion Market Access Strategic Research and Development Plan (2007-2013) through WGMARD. WGMARD reports to HMAC, and leads the research agenda.

For market development, Australia exhibits at Fruit Logistica (leading annual exhibition for fresh produce industries worldwide) under the banner of AUSTRALIA*fresh*. This also is managed by HAL. Australia's presence at such events assists in raising the profile of high quality Australian produce. Also, HAL is the Australian representative on the Southern Hemisphere Association of Fresh Fruit Exporters (SHAFFE) which was established to collectively improve export conditions for southern hemisphere fruit destined for northern hemisphere markets.

Industry responses to export market access are managed in a whole-of- industry manner, through HMAC. However, for most vegetable industries, the domestic market is their primary focus. Even in this arena, industries will increasingly be required to unite and focus on market access. Data demonstrating active testing or monitoring of pest status in a production region will drive market access locally and internationally. It will force industries to cooperate in surveillance efforts, share resources, increase their human capacities, and to value investment in national data collation programmes. Awareness, training and surveillance have become critical components of effective market access programmes, and they are discussed in greater detail in Sections 11, 13 and 14. The acquisition of evidential support for market access will demand increased attention and resources from all horticultural industries.

8.3.9 Research and Development

Support for biosecurity research is provided by the Commonwealth government through matching RDC funds as well as direct initiatives within DAFF, OCPPO, BA and DFAT. Industry is supporting many research programmes within CSIRO, universities, HAL and PHA through grower levies. The state departments continue to provide biosecurity support where their resources allow. They are central to the provision of diagnostic services and need long-term commitment of funding to advance and expand those services and training associated. The Cooperative Research Centre for National Plant Biosecurity (CRCNPB) provides research input to market access and biosecurity challenges.

The focus programmes within the CRCNPB, are useful research categories for the vegetable industry, and most of horticulture, to pursue and support:

- Science and training: eg. *Preparedness and prevention; diagnostics; detection; surveillance; and impact management.*
- Education and training: eg. *Building resources and capabilities; identifying performance targets and indicators.*
- Commercialisation and utilisation: eg. *Adoption; recognition of non-competitive sectors; communication; and risk reduction.*

All research providers are encouraged to identify cross industry risks in order to leverage the most from biosecurity research funds and to maximise their contributions to risk management within social, environmental and economic contexts.

8.3.10 Information and Data Management and Collation

There are several strategies currently being advanced by the Commonwealth government and PHA. The National Plant Health Strategy and AusBiOSEC include environmental impacts and risk assessments. BioSIRT, is a recent initiative to manage incursion responses and data, and the Australian Biosecurity Intelligence Network (ABIN) has been designed to house biosecurity management tools and information, so that industry groups, producers, researchers, policy makers in all jurisdictions, may utilise and share it. Rationalisation of software and database systems is not without risk. Key performance indicators must be searchable and accessible data.

9 GAPS IN CURRENT BIOSECURITY SYSTEMS

Specific pests, diseases and/or weeds, are not today's major biosecurity impediments amongst the vegetable industries, although phytosanitary issues rightfully remain at the core of most biosecurity activities.

Australian horticultural industries are increasingly aware of the biosecurity gaps derived from an historical lack of nationally-coordinated, regional surveillance. The subtle but onerous change to demonstrate "known not to occur" (as opposed to "not known to occur") has presented a challenge and exposed gaps in our capacity to support with science, negotiations in local and international market places. Industries themselves are now aware that market access decisions are largely dependent on submissions supported by scientific evidence.

Human capability and capacity, biosecurity research funding and information management are the other areas that are currently limiting and they require coordinated investment, if biosecurity is to be advanced with a national focus. For domestic producers, the legislative framework and interpretation of regulations have caused confusion and unnecessary complexity in biosecurity management and local trade. Specific legislation is not discussed but examples are given in this section.

9.1 Surveillance

At present there is no nationally-coordinated system of surveillance for the vegetable industry or any other horticultural industry, for exotic and/or endemic pests (except some fruit flies). This constitutes a significant biosecurity gap. There are many surveillance programmes operating in regional areas, and most are listed in the IBP. Surveying currently undertaken is limited in its extent by participation levels, resources and human capabilities. There are insufficient State government pathologists and/or entomologists to conduct routine surveillance for exotic or endemic pests, even in economically-important or sensitive production regions. Many industries have too few industry development officers with experience in field entomology, pathology, nematology etc.

Surveillance requires a focussed industry and government effort to ensure the structure and coordination are internationally acceptable and locally achievable. It is recommended that the industries collaborate, outline surveillance plans within the ISPM framework, systems approaches requiring validation, on-farm responsibilities, regional partnerships (government with industry) and potential for the collated data to provide a national 'map'. The focus initially should be on the emergency pests, and biosecurity situations likely to affect the efficiency, security and quality of fresh produce, and the vegetable industry. The government will retain its responsibility for surveillance of non-commercial and amenity sites.

9.1.1 Self- Audits and On-Farm Surveillance

Within the continuum, a significant biosecurity gap exists post-border with the limited level of formal on-farm surveillance, and support systems to motivate and support it. There must be resolve for national surveillance achieved in stepwise coordinated units, starting on-farm. Self-surveys are important components of best management practices, preparedness and incursion management programmes. Grower surveys (of crops and surrounding native vegetation, livestock, water sources etc) are critical for several reasons. They overcome man-power shortages; increase overall awareness via direct involvement; augment the detail, intensity and scale of surveys that may be undertaken by regulatory agencies; are proactive (and reactive when needed); and biosecurity at the grassroots is effective as the messages can be direct and specific, eg. 'look for this, in these places' etc. On-farm biosecurity is discussed in more detail in Section 11.

Ideally self-audits and on-farm surveillance will become part of formalised management and quality assurance programmes. Until then, growers need incentives to undertake on-farm surveillance and to record and report their findings. Many growers are reliant for pest control advice, on re-sellers, and most qualified pest scouts do not have a results collation system that could be shared across a region.

The cumulative output of on-farm biosecurity and risk-reduction measures is national surveillance and awareness – something not achievable any longer by state (and territory) and Commonwealth governments, alone.

9.2 Regulatory Framework

9.2.1 Legislation

A difficulty for Australia lies within its Federation and the rights of each state to dictate its own quarantine and biosecurity. The various state requirements are well-documented in the IBP. A lack of harmonised quarantine standards, legislation and terminology exists between states, and the outcomes of these appear to be business inefficiencies and biosecurity management that is more complex and less collaborative that it might otherwise be. There are inconsistent phytosanitary interpretations by inspectors, quarantine boundaries distorted by state borders, and at times trade restrictions imposed without clear evidence of the scientific basis and on-going surveillance provided by the state imposing them. It is the belief of several jurisdictions that their capacity to prioritise biosecurity efforts and resources, would be enhanced by the provision of more pre-border and border information.

Biosecurity progress via harmonisation, development of nationally-agreed contingency plans and protocols etc requires collaboration and cannot be considered suitably comprehensive for the vegetable industries, in the absence of input and participation from the ornamentals, potato, onion and tomato industries. The incentives to harmonise, and challenges in achieving harmonisation, are recognised by the states, producers, Plant Health Committee (PHC) and DQMAWG. Each is involved to some degree in over-seeing changes in this direction.

The PHC has recently endorsed an interstate phytosanitary trade dispute settlement process as a first step towards resolution of issues that do not appear to be technically justified. A paper detailing this plan and considered by the new National Biosecurity Committee, will be forwarded to the Primary Industries Standing Committee for endorsement.

9.2.2 Agricultural Chemicals

There are biosecurity gaps in the current system of chemical preparedness. Further input to chemical quality assurances may be provided by APVMA, should their resources allow.

The vegetable industry needs some assurances about the availability of chemicals that could be effective against EPPs. They are fortunate to have established links with minor use and registration expertise within Grow-Com, AgAware Pty Ltd and AKC Consulting Pty Ltd, however PHA and OCPPO are best placed to develop the high priority listing of desired EPP management products since they have overview of all EPPs and susceptibility to them, across commodity groups. Most threats to the vegetable industries are likely to emerge from outside, and some will not be on any government or industry's radar (eg. *Candidatus* Liberibacter). Other threats will result from changes within industry - poor water quality, loss of a chemical etc.

PHA and OCPPO have access to the knowledge gained from other incursions (eg. citrus canker) which have involved not only permits for crop protectants, but also crop destruction chemicals, vehicle and equipment disinfectants, suitable treatments for non-host crops moving out of quarantine areas, and baits used in delimiting survey work.

The APVMA does not intend to 'pre-register' or prepare 'emergency permits' or 'import permits' for products suitable for application in the event of an incursion by any of the identified emergency pest threats for Australian horticulture. An agricultural exception, is a registered foot and mouth vaccine. Discussions with APVMA are necessary to ensure that their planned system of 'pre-approvals', is capable of rapid activation, that the products approved for use would be the preferred ones based on scientific efficacy data provided from sources experienced with management of the EPPs, and that the time between incursion detection and chemical application response (if deemed appropriate), would be minimal.

It is recommended that the vegetable industry through PHA, and in cooperation with OCPPO, progress their work on chemical crop protectant priorities, and commence risk assessment (efficacy, human health, occupational, environmental and trade risks) in preparation for potential short-notice, emergency use. To assist in the acquisition of such data (and with increasing minor use registrations important for vegetable industries) there should be renewed effort to engage with the IR-4 programme in the United States and the Minor Use scheme in Canada. The benefits of shared data (especially on efficacy against EPPs), trial establishment across climatic regions and hemispheres, are compelling.

With this information, the vegetable industries will be better placed to predict or model the corporate risk associated with particular outbreaks (eg. those for which there is no likely control; those that might result in unintended damage to other crops or regions etc), and therefore future biosecurity investments. Without such information, the industry is ill-prepared not only to address incursions but also will remain oblivious to potential liabilities associated with response options. Just as there are shared responsibilities in biosecurity, there are shared liabilities also. For the chemical system, liabilities lie with various parties as shown below (Hamilton, 2004).

Table 13 : Liabilities within the Chemical system

Risk	Registrant	APVMA	Permit Holder	Authority in Control
Public Health	✓	✓		
Occupational health	✓	✓	✓	
Environment	✓	✓	✓	
Trade			✓	
Failure to control pest			✓	✓
Unintended damage			✓	✓

9.2.3 Post-Entry Quarantine

There are industry expectations for increased post-entry quarantine services – especially in the levels of inspection, and the adoption of latest methodologies to undertake inspections. To close perceived biosecurity gaps at the border, industry must drive the retention and expansion of competencies in quarantine and PEQ (or increase their self-sufficiency in testing).

The citrus industry has resolved to have all citrus material and relatives tested for endemic and exotic pathogens in PEQ. The vegetable industries reliant on true seed should consider the merits of routine seed testing for seedborne pathogens, in commercial lots. This, and calls for pest risk analyses for seed and nursery stock, are reasonable first steps in enhancing biosecurity, and increasing the confidence in seed, while also demanding advancements at the border and risk-based investment in human resources.

9.3 PHA and Contingency Plans

The vegetable industry is hampered in its biosecurity preparedness and focus while it is not a signatory to the EPPRD.

Few industries have developed and approved many contingency plans. It will be industry's responsibility to drive their development and the development of surveillance procedures (eg. survey instructions, tools and personnel requirements, and data recording templates) and control/management procedures. It is suggested in prioritising their development, consideration be given to the pest categorisations (in IBP), risk assessment (quantitative and/or qualitative), host availability and continuity, vector presence, biology and epidemiology and of the available diagnostic expertise and management tools. They must also include how to monitor environmental and social effects, undertake trace back investigations and determine resources needed for agreed responses, i.e. contingency plans are a required foundation of effective responsiveness.

9.4 Biosecurity Research and Funding

Biosecurity research has traditionally focussed on production pests. There has generally been a lack of risk-focussed, cost-benefit demand driven, collaborative research that has provided great steps forward in national biosecurity. The lack of knowledge of trade statistics, incursion management costs, border interception information etc has limited the Australian horticultural industries' commitment to research and development in preparedness strategies, validation of systems approaches, education and training etc. As such, the industries are not generally capable of responding efficiently and rapidly to changing demands from certain market places, controversial media reports, unexpected incursions or proactive surveillance.

There are some good examples of effective government, community and industry research collaboration, eg. regional plant protection programmes. The recent introduction of phytosanitary certification for tomato seed was achieved with cooperation between the tomato and potato industries, state pathologists and the Commonwealth and state governments. However there have been too few serious attempts to collaborate across RDCs and research agencies, leverage funds, ensure adoption, and avoid duplication. The vegetable industries (and others in horticulture) risk not maximising their returns on investment, if this continues. In the areas of collaborative research, industry must be the driver.

Research themes conducive to collaborative biosecurity-related investigations include new technology development (eg. remote microscope system, detection methods; disinfestation, irradiation, new chemistry or dip replacements etc.); water efficiency; surveillance methods; climate change predictions and modelling; systems approach validations; and human capability development etc. The Australian vegetable industries needs to ensure a high proportion of future biosecurity research is targeted for wide adoption, rather than limited commercialisation. In so doing, they will reveal the limiting factors in inspection services, preparedness and response capacities etc are in fact inter-linked and not just funding related.

9.4.1 Diagnostic Services and Capabilities

The negative effects of cost-recovery diagnostic services have been raised by several industries and states. In each state the introduction of significant diagnostic charges, resulted in a reduction in samples submitted. Some states have responded by either removing the charge or reducing charges for samples with unusual symptoms, as they recognise sample submission to be an important and effective 'early detection' mechanism. Diagnostic results, particularly if samples are accompanied by data on the specific location and time of collection, site details and symptom distribution etc., are valuable entries into databases aimed at supporting PFA, Area Wide Management, and ALPP determinations.

As demands for time and resources devoted to the development of community and industry awareness, national surveillance and a biosecurity-responsible culture, are increased, any disincentive to submit samples for diagnostic purposes, appear counterproductive. Each state should be encouraged to assess the affordability and practicality of their sample receival, processing and recording systems, in the national biosecurity interest.

9.5 Data and Information Management

Within and across the vegetable industries there are biosecurity gaps and market access impediments directly related to the lack of nationally-coordinated data and input to national databases. There is currently no reporting template or national coordination of surveillance and diagnostic service data. BioSIRT is the initiative designed to address this biosecurity gap and it is expected to be operational this year. The vegetable industries require development of the mechanisms to collaboratively undertake surveillance, collect and collate data in forms suitable for input to national databases.

The data however must also be capable of retrieval and interpretation at regional and local levels, for particular commodity groups. Targeted communication is reliant on data management in the form of grower registers, traceability documents (diagnostic sampling, supply chain movements, inventory records for chemicals, spray diaries etc), and human capacity and workforce assessments.

Industry data have also been required at times to demonstrate the public good contributions of research, an industry or commodity (eg. nutritional value, support for local rural communities, water efficiency, minimal pesticide use, 'clean and green' etc). Equally, they are necessary to counter poor public perceptions, false claims or unreasonable demands of certain market places. The Privacy Act has complicated the sharing of some data but each industry has to manage this impediment with government, to ensure that industry post-border biosecurity is not compromised by a lack of mandated reporting (eg. of residue breaches, PEQ findings etc.) by government (or industry).

These biosecurity gaps, as areas warranting further investment and research consideration, are discussed in the following sections. Recent examples of how each has presented as an impediment to market access or biosecurity management, are given below.

9.5.1 Example 1: Western Australian Carrots and the Taiwan Market

Western Australian carrot exports were valued at $37.5 million in 2005/06, and they account for 94% of the Australian carrot export volume (Department of Agriculture and Food WA, 2007). The production region is predominantly in the sandy soils of the Swan Coastal Plain, with the most northern farm being 140 km north of Perth.

Radopholus similis is a tropical burrowing nematode and it has twice, in 1958 and 2002, been detected in WA. It was detected in a banana sample from Carnarvon, WA. Carnarvon is 750km north of the nearest carrot production farm in WA. *R. similis* is only known to occur where bananas grow or have been grown. It is reported not to be a native nematode, but Hodda and Nobbs (2008) noted that the genus *Radopholus* is Australasian in origin, "*with 90% of the described species occurring in the region, and 60% of species described from Australia or New Zealand*." However most of the described species are from native vegetation, rather than from commercial crops.

In February, 2008 it was announced that WA carrots could potentially lose their export market in Taiwan, due to quarantine restrictions related to the burrowing nematode. These are to be drafted into legislation by the Government of Taiwan, by 2009. This was not the first warning Australia had received concerning this pest. The Industry Advice Notice 2006/40, from Horticultural Exports Manager of AQIS Plant Programs, advised that the National Plant Quarantine Service (NPQS) Republic of South Korea, had issued a WTO notification of its intention to amend the plant quarantine requirements, to exclude the imports of carrots (*Daucus* spp.) from countries in which the burrowing nematode was present.

The WA written response to the potential ban on carrot exports to Taiwan (Department of Agriculture and Food WA, 2007), outlined their carrot growing practices, including routine use of nematicides for root knot nematode management; evidence in the form of survey data from wheat and carrot fields, of *R. similis* absence; diagnostic laboratory sample records and passive surveillance on-farm in WA; and climatic limitations on *R. similis* survival and establishment in the WA carrot production regions. The WA submission also outlined the specific measures that have long been in place to limit the importation of *R.similis* hosts, esp. banana material, which is banned. This submission is more complete than could be provided for most other horticultural crops. It includes relevant survey data, however negotiations to–date suggest the Taiwanese desire multiple years (five) of survey data.

It is agreed that neither the government nor industry could have foreseen this threat, as carrots are believed to be a non-host of the burrowing nematode. However, for the purpose of addressing potential market access impediments relevant to many industries growing root crops, some suggestions of industry and government activities, and research outcomes that may strengthen WA's carrot case, are raised below:

- Recognising the export destinations where protective local practices are increasing;
- National pro-activity at the time *R. similis* was first raised (by Asian trading partners) as a potential market access impediment, for 'non-hosts'.

Taiwan is recognised as a difficult market as evidenced primarily by fruit exporters. This country and others in the region, are becoming increasingly aware of the value of protecting their local agricultural sectors, as the demands for food increase in-line with their constituents' wealth. As the Australian government becomes familiar with 'difficult markets' and new types of trading imposts, industry should be engaged and alerted to potential marketing difficulties.

- Specific surveying for *R. similis* (and other nematodes) in carrot regions.

This may be undertaken to establish either pest-free areas or pest-free places of production. In either case, there must be an agreed intensity of surveying, frequency of repeat surveys, accredited laboratories to conduct this diagnostics, and accepted measures to 'maintain' status once it has been achieved. For individual growers or the industry at-large to undertake such testing, requires significant investment.

While consideration of the relative value of the Taiwanese market will be very important to individual exporters in the immediate term, the carrot industry's decision on investment in such surveys will require consideration of the longer-term benefit of evidence-based regional biosecurity. The surveys would provide records of presence *and* absence (and therefore 'known not to occur') of a range of soilborne organisms, that may be required by other markets in the future.

There is no validated molecular test for *R. similis*, but in general DNA-based screening has worked well for nematode detections. For this to be accepted by Taiwan, Australia would be asked to provide evidence showing that the tests correlated well (at agreed confidence limits) with manual counts of *R. similis.* DNA tests have previously been used to support (rather than 'confirm') visual inspections for several pests in other crops (bacterial wilt of lucerne in lucerne seed crops). Other DNA testing in a biosecurity framework has been undertaken in SA to monitor *Orobanche* sp. (branched broomrape) seed levels in the eradication zone.

It is important for the Australian vegetable industries to engage with researchers who have over long periods of time gathered diagnostic records over wide areas and from a range of crops, native woodlands and coastal habitats. These data will be the most valuable in finding a starting point for mapping distributions of economically-important plant parasitic nematodes, in their regions. Hodda and Nobbs in 2008 found that Australia's geographic isolation and relatively recent introductions of plant materials from the rest of the world have afforded this continent (and NZ and PNG) a nematode fauna that is substantially different to that in other countries. They also discussed the nematode fauna on native vegetation, a consideration needed in today's regulatory climate. They tabulated the plant parasitic nematodes known to be present or absent in Australasia and their valuable scientific insight may be useful in quarantine and trade discussions.

- Documentation of equipment sharing, movement and routes to demonstrate the lack of risk associated with these and other soil movements from northern WA into WA carrot production regions, and
- Quality assurance programmes that incorporate on-farm biosecurity.

The benefits of a dedicated 'production zone' for carrots could be considered. Measures as noted above, and those undertaken on-farm, would form part of a status maintenance programme also.

The value of grower surveillance is increased by its potential to be regionally-collated and standardised. The starting point for regional surveillance is on-farm biosecurity records of regular monitoring schedules and systems.

- National coordination capable of demonstrating the effectiveness of the WA border and lack of entry/movement records for host material, into and through the state.

The effectiveness of the WA border in terms of biosecurity, is recognised but requires documented evidence. Worldwide movement of ornamental hosts (*Maranta*, *Athurium*, *Philodendron* and *Spathiphyllum* spp.) have possibly spread the burrowing nematode farther than acknowledged by several market places, and therefore records of entries (and surveys) of these hosts in WA, as well as bananas, may be appropriate.

Western Australian carrot exporters have acknowledged the Taiwan market as a difficult one as their carrot orders are often *ad hoc* and seasonal – often in response to an unforeseen local production failure. For this reason the quantum of the potential Taiwanese market loss is not considered as great as it would be for the regular Asian export markets that place forward orders, thereby dictating production schedules in WA. The exporters however also stressed that the loss of any market is serious and therefore individual exporters, the WA and Commonwealth governments and industry personnel are collaborating on the appropriate response to the Taiwan situation.

9.5.2 Example 2: *Ditylenchus destructor*

This example demonstrates the cumulative value of research and specialist services (taxonomy, diagnostics) in response and preparedness capability.

This EPP (nematode) is known commonly as the potato rot nematode or potato tuber nematode, but its host range extends well beyond potatoes – to sweet potato, carrots, ornamental bulbs, rhizomes and corms, peanuts and garlic. It survives also on a range of weed species and can feed on many soil fungi.

Demonstrated freedom from this nematode is an import condition listed for several crops (potato, carrots, parsnips, sweet potatoes) by some of Australia's trading partners. Area freedom for Australia has now been granted, despite some early reports of the nematode having a presence here. The time taken and process to achieve area freedom and to refute early reports of its presence, have not been easy to ascertain, but they would provide valuable 'preparedness' information to industries, should they be made available.

Despite a lack of direct surveying for *Ditylenchus* spp. in Australia, relevant work on this nematode has been done in the past. It is the view of several nematologists that cumulatively, the work was sufficient to support area freedom status - had it been standardised. There is a long national history of diagnostic services, and certification scheme inspections etc. Early reports of this nematode in Australia came from potatoes in Tasmania (one report), mushrooms in NSW, and an interception of it on peanuts from South Africa. Later work (Hodda and Nobbs, 2008) dispute these early reports and suggested there is no material (slides) supporting the identifications, under the old taxonomy (Nobbs, Pers comm., 2008). Despite the accepted absence of this nematode in Australia now, at one time a mis-leading statement was included in an EU report that claimed this nematode was widespread here. Such mis-information, if not able to be officially corrected and countered in good time, can severely affect trade.

9.5.3 Example 3: Collaborative Biosecurity Achievements (and weaknesses) in the National Biosecurity Interest

In the absence of timely collaboration (and contingency plans), industries themselves have at times shown determined resolve in addressing restrictive interstate practices. When the discovery of White blister rust was made in Victoria, NSW placed restrictions on Brassica seedlings coming into that state. No protocol had been developed to provide clean seedling assurances. In this case a nursery reportedly developed one, and ultimately it was accepted, and widely adopted. The biosecurity gap however remained since there were no audits to confirm its correct adoption by nurseries sending seedlings, and not surprisingly white blister rust is now present in NSW. Nurseries are a crucial part of the biosecurity continuum and need greater engagement by the vegetable industry.

Similarly, no state had an approved/agreed protocol for lettuce movement once currant-lettuce aphid arrived. The state restrictions put in place in 2005 were complex. They are tabulated and included in Appendix 5. In response, nurseries reportedly put forward the NZ-based protocols which were approved and adopted by SA and NSW. The vegetable industry would benefit from commitment to PHA in the development of contingency plans for their high risk endemic and exotic pests. This should however also be undertaken with input from the NGIA and other industries that affect vegetable biosecurity and/or have identified similar EPPs.

Since the release of the IBP (which details some regional plans), OrdGuard Biosecurity Plan has imposed restrictions on the movement of nursery stock, cut flowers and foliage, and leafy vegetable hosts of Silverleaf Whitefly (SLWF), in an effort to protect the Kimberley region of WA from this pest which is established in the Carnarvon and Perth regions. These restrictions are additional to those already in place at the WA border where plant material hosts of SLWF are restricted. This is a good example of collaborative regional biosecurity for a non-regulated pest from a local source. It is also effective in the monitoring for Mediterranean fruit fly which is not present in the region.

The Northern Territory has established a PFA south of Adelaide River for the Spiraling whitefly. The infested area is around Darwin and it is suspected that the sources of the pest were Asian vegetables and melons brought into Katherine and Darwin. The presence of this pest in the NT has made entry to the WA and Tasmanian markets for melons, very difficult.

Vegetable and cut flower growers in the NT were affected by the introduction of *T. palmi* on nursery stock from Queensland. Their research indicated that chemical use (and presumably the death of predators) exacerbated the thrip population and its movement. Collaboratively industry and government developed IPM strategies and the reduction in chemical use has seen a corresponding increase in parasites, a decline in the thrip population, and reduced damage. However, it appears there have not been serious efforts to close the virus pathway from Queensland into NSW for another pest, Tomato Yellow Leaf Curl virus (TYLC), which could spread to capsicums and *Euphorbia* spp. Its vector *B. tabaci*, is present in NSW.

Fruit flies remain the single most significant biological impediment to fruit trade and it is appropriate that resources are being directed to surveillance and management of them. White flies, leaf miners and mites are also market access issues for a number of vegetable crops, and systems approaches across regions and industries should be validated for their management.

9.5.4 Example 4: Inconsistent State Legislations

Some state legislation is trade restrictive, but other regulations have in fact provided unintentionally, 'assisted' entry of imported product, even though an import permit does not overrule state legislation. BA, in recognition of this potential for inconsistent regulations to provide unexpected opportunities for those exporting to Australia, now gives greater consideration to regional differences when making quarantine policy decisions. A recent example with Californian table grapes gave this biosecurity issue increased focus.

In 2007 new import conditions for Californian table grapes removed the previously-mandated methyl bromide treatment. South Australia, Western Australia and Tasmania are free of phylloxera. Protecting them from its entry have been a number of long-time grape material movement restrictions out of phylloxera-infested zones (eg. Victoria, NSW, California). Californian table grapes cannot enter these states without methyl bromide treatment. Domestically, packed table grapes however move between NSW and Victoria with a sulphur pad included in boxes. The sulphur pads are registered for control *Botrytis* spp. and other fungal pathogens, but they are not registered for phylloxera control. There is evidence however that phylloxera crawlers are controlled by the release of sulphur at rates achieved by sulphur pads. This local information (in part) and the local sulphur pad legislation, were used by the Californians to support their case for methyl bromide-free shipments. The cost advantages to them (from the removal of mandated methyl bromide treatments) resulted in a 12-fold increase in imported Californian table grapes last season.

Western Australia and Tasmania quarantine and biosecurity. The biosecurity systems in place in Tasmania and Western Australia are at the core of their advantageous trading positions internationally and nationally. They each exert quarantine influence beyond the national arrangements. Provided they present evidence of a PFA, (or equivalent for the state or region into which imported product is to be prohibited) and the Commonwealth and other states accept the scientific bases of their risk management (good border control; demonstrations a pest or disease is not present and poses a threat to industry or environment; or a pest or disease is present but under official control with on-going surveillance etc, as for WFT in Tasmania), their strict quarantine measures are likely to be maintained and supported.

9.5.5 Example 5: Value of Accessible Industry Data and their Management

Damage to an industry's image can be minimised by the availability of pertinent, accurate data. The damage may arise from mis-leading articles (eg. technically-compromised research reporting), or ill-informed press reports, postings etc. on international email services or websites read by importing countries. For example, in 2006 meat product exports from NSW were (temporarily) banned as a direct result of a false press cutting placed on the ProMED site. To regain access, it took high level negotiations between AQIS, DAFF and Thailand officials.

A horticultural example of a biosecurity issue that arose from both mis-information and a lack of industry data, occurred in strawberries. A media release by CHOICE (Appendix 6) was titled "*Most conventionally grown strawberries contain pesticide residues – some at concerning levels*". It stated that its own tests showed the presence of chemical residues, and suggested poor pesticide practices in strawberries, in Australia. The generalisation and accusations were damaging and reportedly could not be immediately refuted by industry through the presentation of coordinated data showing historically-sound patterns of chemical use and practices amongst strawberry growers, consistent records of random and targeted residue testing, or of prior detections and violations. The capacity of industry (to respond to detections through efficient traceback systems) was at the time, not immediately apparent. Despite the media release itself not providing data on the strawberry sources (by state), nor the validity of their test methodology, it highlighted to horticultural industries, the power of the media, the importance of data collection and collation in biosecurity and reputation management, and preparedness.

10 FOCUS AREAS FOR THE ADVANCEMENT OF NATIONAL BIOSECURITY PREPAREDNESS

Nationally-coordinated surveillance; funding commitment for biosecurity (including research and development); human capacity and capability building (including training and education); and communication and awareness are the major areas on which the Australian vegetable industries will need to focus if impediments are to be overcome and efforts towards national biosecurity, rewarded. Each is discussed in more detail in the following sections 11-14.

11 SURVEILLANCE

11.1 General Surveys

General surveillance in Australia requires extensive engagement, and a broad knowledge and expertise base (Pratt and Barry, 2005). Raising public awareness generally and specifically through quarantine campaigns, preparation and distribution of fact sheets, DVDs, pictorial guides etc on particular plant pests is central to increasing engagement – to underpin surveillance generally. General surveillance must also complement and enhance other activities, eg. crop monitoring for established pests, that places informed people in appropriate places, to optimise the chance of detecting new pests.

Recommendations of the strategy paper, "Towards the Development of Nationally Coordinated Plant Pest Surveillance System" (OCPPO and PHA, 2004) are to:

- *have effective, standardised and well-targeted resource material, networks, and record management to enhance general surveillance in Australia in order to maximise early detection capability and contribute to a quantitative measure of health status.*
- *identify or establish the role of industry in … surveillance …eg. by incorporating early detection surveillance capability into existing pest monitoring activities.*
- *incorporate risk-based early detection capability, through specific surveys against target pests and general surveillance, into industry biosecurity plans.*

This suggests that an early requirement for national surveillance programmes, is the development, production and dissemination of resource material on high priority vegetable pests and diseases (including vectors), to wide audiences. This should be co-ordinated between the states, OCPPO, PHA and industry in an endeavour to improve the knowledge base of horticulturists (state and industry), growers, nurserymen and allied industry personnel (bee keepers, transporters etc.). There are some fact sheets available on vegetable exotic pests. Their completion and collation in a booklet available to all growers and field and packing personnel (and researchers, IDOs etc.) is recommended. The Orchard Biosecurity Manual is a useful guide to how this might be developed so all relevant commodity groups become aware.

The vegetable industry is aware of the necessity, on occasions to conduct specific surveys, for specific purposes. Some of the aims, purposes, design and execution considerations are discussed below. Surveillance is required throughout the supply chain but the appropriate methodology changes as the produce progresses through the chain. For example transporters' surveillance may involve monitoring of temperatures in refrigerated consignments, and collation of post-gate manifests and documents demonstrating traceability. Increasingly however specific checks for tampering, bioterrorism are being included in quality assurance programmes throughout the supply chain.

11.2 Regional Surveillance

OrdGuard is a useful example of a successful, collaborative approach to protecting a region from a range of pests, that have potential international, inter- and/or intra-state sources. OrdGuard, the Regional Biosecurity Plan for the Ord River Irrigation Area, incorporates awareness material, surveillance and incursion management guidelines and pest lists. The OrdGuard document (Kimberley Primary Industries, 2005) is available on-line and was prepared cooperatively over a three-year period, by the government of WA, Kimberley Primary Industries Association and the Agriculture Protection Board of WA. The pests lists are include in Appendix 7 and they include regional biological threats not present in the Ord River Irrigation Area but present elsewhere in WA (eg. silverleaf whitefly and Mediterranean fruit fly), pests exotic to WA but present in other parts of Australia (eg. spiralling whitefly, crimson spider mite, red-banded mango caterpillar, Lesser Queensland and Queensland fruit flies,) and pests exotic to the country (eg. cucumber beetles, melon fly, Oriental fruit fly, lesser cucurbit fly, giant African snail).

The protection of this region incorporates a range of measures. The region includes a national border (and NAQS territory), and a state border. The residents have a high level of awareness of the advantageous position of the region as it relates to pest, diseases and trade. Consultation included producers, processors, all communities and urban residents, freight company personnel, conservation groups, land and natural resource management groups, water authorities, chemical industry members and re-sellers, and itinerants including back-packers, tourists etc. The groups expressed a shared vision and commitment to effective surveillance.

Due to the range of crops in the region and range of pest susceptibilities, a regional biosecurity plan rather than multiple, commodity-based, biosecurity plans (there is one for cucurbits) was decided on. Government and industry collaborated to achieve the silverleaf whitefly protection zone with six options initially discussed: 1) certification that packing and growing had been from a SLWF-free area (Plant Health Certificate accompanying each consignment), 2) SLWF-free property development; 3) pre-shipment inspections; 4) inspections on arrival in the Kimberley; 5) fumigation or 6) treatment on arrival. Also in the region is a specific trapping grid for Mediterranean fruit fly and a Pest Free Area (PFA) programme (which includes an eradication plan) for Mediterranean Fruit Fly, melon thrip (a market access concern for produce destined for SA or southern WA), and other exotic fruit flies. The NAQS group also surveys in the region for a native rat and Heliothis populations.

The action strategies are applied on-farm and regionally, and they incorporate surveillance and monitoring of a wider range of pests than an industry biosecurity plan (for a particular commodity) might. This has the benefit of creating a regional focus and status (i.e. area freedom), rather than enhanced biosecurity for a single commodity only. It has also assisted with funding since all commodity groups have contributed funds, regardless of their perceived risk or beneficiary status. OrdGuard is funded in part through a council levy, and also through government environmental grants and pest management funds. The region has also been able to agree on research priorities (trapping techniques, resistant varieties). Stage 2 of OrdGuard proposes to extend across the state border to maximise both regional protection and safe produce movement.

The National Fruit Fly Strategy although national in focus, is regional in implementation. This strategy has identified an effective and sustainable approach to fruit fly management. It is structured to allow collation of all fruit fly monitoring network and research data, 'removal' of jurisdictional border constraints and it covers multiple fruit fly pests.

11.3 On-Farm Surveillance

It is important that vegetable growers and nurserymen are provided with the incentives to adopt biosecurity plans and undertake routine surveillance on-farm, as part of their crop, farm, and enterprise management. For this to be achieved growers and nurserymen must appreciate their position as essential components in a system, which if broken, could expose them to threats that would affect their reputation, operations and economic viability. Their crucial role in early detection and biosecurity is not yet clearly understood by producers, but without their engagement the opportunities for early detections are reduced, and acquisition of evidence for establishment of pest free areas, areas of low prevalence etc. will not be readily achieved.

While the incentive for many growers will be avoidance of the cost and disruption of an incursion, and the realisation of their current ineligibility of to receive reimbursement/compensation (or eradication), for others, tangible incentives may be required, eg. an insurance benefit, rebates or subsidies on biosecurity activity costs and supplies, combined audits for biosecurity and quality assurance; regional data management and sharing for contributors etc.

National, regional and on-farm biosecurity packages need to be accompanied by an outline of the continuum, the position of growers within the continuum, demonstrable regional support and commitment to biosecurity, and specific examples of the expected contribution of growers, eg. 'completed' monitoring templates, spray diaries etc.

The surveillance package itself should contain details on the threats (eg. fact sheets) and the "how, when, and where to look" for them (timetables, photos, diagrams etc); how to sample for presence, absence (sampling methods, locations, surveillance patterns etc); how to record all activities and results (templates). Every on-farm plan needs to include clause options that allow specific details relevant to the specific enterprise and enterprise mix, market targets, and environmental variants, to be incorporated. If on-farm surveillance is to be undertaken, there must be provision for every grower to tailor the plan for his property. However, the benefits of on-farm surveillance will be maximised (for the region and nationally) if the individual plans and recording templates fit into a regional framework that can supply data for collation at the national level.

The US Food and Drug Administration's *Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables* (Food and Drug Administration, 1998), suggests that compulsory in every on-farm biosecurity plan, should be consideration of the factors listed below. On-farm surveillance is therefore required to self-audit the success or otherwise in these areas which have traditionally been included in quality assurance programmes. In addition, on-farm surveillance requires active inspections of the health status of the crops and surrounding vegetation. Table 14 summarises these.

Water sources: Whenever water contacts fresh produce, its quality directly affects that of the produce, eg. irrigation water (surface flow, bores, recycled, treated); hydro-cooling (frost protection etc); carrier for fertilisers, chemical applications; processing (washing, waxing etc.).

Manure and municipal biosolids: The use of these as moisture 'conservers' is likely to increase in drought conditions. These inputs, if not compliant with specifications (eg. aging, composting, aeration etc.) pose a risk of introducing pests/pathogens to the area over which they are applied. Consideration should be given to pre-harvest interval, storage sites away from fresh produce, barriers and physical containment of product and leachates, equipment cleaning schedules etc. Research (Downer *et al.,* 2008) has recently demonstrated the survival for over eight weeks up to a depth of 100cm, of *Sclerotinia sclerotiorum* in partially-composted green waste and aged green waste. Green waste and compost management must ensure that inversion and movement of piles places pathogens, especially those with resistant life stages (eg chlamydospores, sclerotia), in positions where they are killed by heat, microbial action and/or chemical degradation.

Workers: Personal hygiene is a critical element of food safety management. The facilities provided and awareness training about food safety issues will assist with the management of human pathogens transmitted by food handlers – i.e. Hepatitis A, *Salmonella, Shigella* spp.

Field hygiene and sanitation: Growers need to be aware of the risk associated with animal and human waste and hygiene generally in field-packed produce, pick-your own enterprises, roadside stands etc.

Packing: Sanitation of facilities and containers; inventory and storage security are important in biosecurity plans.

Transport: Considerations are needed for access control, physical (and human) separation between receiving, processing and release areas; cross-contamination from other food and non-food sources; temperature and ventilation control; packing formations to allow circulation as intended; sanitation of handlers and minimising of damage etc.

Waste disposal: old chemicals, containers, waste water and crop debris are biosecurity threats and their disposal needs consideration.

Table 14 : On-farm biosecurity and surveillance considerations

Category	Components	Examples	Purpose – comments
Site Choice	Topography	Drainage, influence of animals, septic tanks locations	Prevent/avoid contamination
	Crop history	Rotations; pre-plant populations (nematodes, fungi etc)	Avoid infested sites
Site	Signage		
Water	Drainage	Patterns. Note positions of livestock/wild, septic tanks, stock piles manure, crops	Prevent contamination
	Irrigation	Quality of source	
	Chemical applications		Potable water- for any crop/vegetable contact Prevent spread of persistent pests or pathogens
	Cooling		
	Post-harvest washing	Water quality; sanitizers, chlorine concentration (and pH); contact time	
	Re-cycled water	Single return system only	
	Dust settling sprays		
	Wheel dips	Water change schedule	Avoid introduction of pest
Inputs	Planting material	Choice of – resistance? Seed, vegetative material	Traceability; health status, early contaminant ID
	Chemicals	Permits, labels; storage security, batch numbers	Traceability; safety, efficacy; legal use
	Manure, compost	Specifications of aging, supplier details and records, batch numbers; storage	Traceability; avoid non-compliant lots; contamination
Hygiene	Field workers	Facilities available	Food safety
	Packing shed	Sanitation; reporting illness/wounds; separate eating areas	Food safety
	Facilities	Sanitation foot baths, hand washing	Worker and food safety
	Clothing	Appropriate; clean changes – coveralls, gloves	Worker and food safety
	Equipment	Restrict movement and access; cleaning and inspection regime – bins	Preventing spread
Waste disposal	Crop debris	Removal methods	Avoid point source contamination
	Chemical waste	Storage; removal	Avoid accidents; contamination
	Equipment-used crates etc	Inspection, storage, removal	
Crops *	Surrounding vegetation; weeds	Other crops, neighbouring crop age	Surveillance: presence, absence, distribution, management; detections of harboured pests/pathogens
	Visual checks; inspections	Appearance, distribution of symptoms	Surveillance – adding to the network; early detection preparedness
	Trapping/monitoring	Frequency, trap locations, results interpretation	
	Sampling	Soil, water testing, diagnostics; GPS locations	Early detections; reveal management options
	Abandoned plantings	Destroy unpicked crops.	
Personnel	Staff	Education -biosecurity training; resources and contacts (eg posters; diagnostic, commodity specialists)	Increasing awareness of food safety and biosecurity. Increase management capacity and response preparedness
	Visitors	Entry sign-in; signage around property, facility	Preventing introductions of pest/pathogens
Record keeping	Batch numbers, labels; supplier details	Seeds, planting material, chemicals	Traceability
	Key dates	Irrigations, treatments, planting, symptom development; weather events	Preparedness; traceability; management options
	Photos; GPS details	Symptoms, distributions	
	Weather	Major events	Preparedness
	Inspections/monitoring	All pests – presence, absence, distribution, timing	Preparedness; surveillance to support area freedom determinations

* See discussion on crop types below.

The IBP provides suitable guidelines for on-farm biosecurity and surveillance. They incorporate detection surveillance (to find a pest if it is there), general surveillance, quality assurance practices to minimise threats of biosecurity significance, and reporting tools. Future plans will need to include more details on weeds and invasive species, and mechanisms for continuous improvement assessment, eg. self-audits. These could be an efficient means by which growers could assess their level of (continuous) improvement, and industry could gauge engagement, participation and competency levels amongst their producers.

Specific considerations are required in on-farm biosecurity and surveillance for particular pest types and these have been discussed above. There are also some requirements specific for crop types, and general environmental influences. The enterprise mix and the targets of inspection, therefore determine the timing and relative importance of many of the on-farm surveillance and biosecurity activities.

Vegetable crops from seed: Ensure labels on seed indicate testing undertaken. If not, request test results from supplier; inspect for contaminant seed. Depending on enterprise mix and pest threats, a crop free period for some hosts may be needed. Overlapping of hosts/crops of different ages is not recommended.

Seed crops: Weather is a key factor in pathogen/pest and host interactions, epidemic development, and pollination effectiveness and efficiency etc. In seed crops site selection is therefore important, especially as it relates to the likelihood of rain events, pre-harvest. If irrigated, water sources and timing become very important in biosecurity management. Weed-free, isolated, cooler areas that have lower natural levels of pests, are often chosen. Regular monitoring of crops, insect sticky traps on leading field edge of prevailing wind, trapping at block borders are all important components of on-farm surveillance. Volunteers and crops of different ages provide a greater threat due to virus transmission potential.

Leafy vegetables and leeks, onions etc: The nature of development and leaf formation of these crops, and their growth position in relation to soil surface makes water source and quality, and irrigation method and timing, very important. The irrigation method may serve to splash or place water, soil and/or pests into developing heads, whorls. Thereafter the pests are hidden and protected so spray timing and equipment are also important. Surveillance for soil presence, and many pests and diseases of these hosts requires physically looking at, under and into, leaves and whorls.

The harvested product requires inspection also. This may require physically cutting open the produce at the base and mid-head/bulb etc. Leafy vegetables should be inspected for soil presence (esp. in crops like leeks), slime trails (evidence of slugs, snails), ants, transparent channels (evidence of leaf miners - end of ‘mine’ may include the larvae from which identification is possible), frass and for attached soil which may cling longer to damaged sites.

Brassicas: On-farm biosecurity management requires vigilance in the choice of seed. Seed of the highest quality (preferably certified, treated seed) is required. The site chosen should not be one in which Cruciferous crops (or related weeds) have been grown for (minimum) 2 years (ideally four years). There should be no crop debris that remains unincorporated. The soil ph has an effect on some important diseases, eg choose sites of pH > 6.5 in areas where club root is an issue. Because of the potential for spread of some pathogens of *Brassica* spp. it is recommended that there be separation of direct-seeded and transplanted crops, and crops of different ages.

Root or bulb crops: The choice of site, especially in regard to pre-plant nematode and other soilborne pest populations (eg. *S. cepivorum* in *Allium* spp.), require specific consideration because fumigation is a pre-plant management option only. Although roots or bulbs are the marketable portion, the health status of tops is very important in ensuring efficient mechanical harvest. Root crops like carrots, and bulbs, should be inspected post-harvest for evidence of soil (in bulb crops), boring insects (wire worms) and other insects, and larvae that might be within bulbs. For nematodes check for surface discolouration, fine root galls, depressions or puffiness around stem plate, sunken fleshy parts, and for attached soil.

Fleshy vegetables post-harvest: fleshy vegetable inspections should include a whole of surface inspection for evidence of boring insects, followed by a slice into the produce to uncover larvae if present. Stem and calyx ends should be carefully inspected as thrips frequently shelter in these areas. Early disease generally presents as soft spots, lesions or off-colour areas with surface irregularities. For *Capsicum* spp. it is necessary to make internal and external inspections.

11.4 Delimiting Surveys

The response to a recognised incursion will depend on the disease/pest, and where it has been detected. Commercial production areas often require the most rigorous delimiting surveys to determine the size of the affected area. Delimiting surveys in urban areas (parks, gardens, backyards) generally require a variation to the strategy. The delimiting survey is often the indicator of the feasibility of the management options: eradication, containment, control and/or management.

The first reported detection in an incursion may not be the initial infection site. Therefore important components of delimiting surveys are trace-back and trace-forward analyses. It is these that determine the (likely) source of the outbreak and other premises that may have been exposed because of either proximity (consider distance and weather conditions) or receipt of infected produce/seed. Nursery and packing shed inspections may also be needed.

Results of a delimiting survey are generally reviewed by the Consultative Committee on Emergency Plant Pests (CCEPP) or technical equivalent, and their decisions (on boundaries of the quarantine area), will also take into account factors including climate, prevailing weather, proximity to commercial production sites, host corridors and resource availability. A buffer zone will be established around affected areas until the extent of the outbreak has been confirmed. Further outbreaks, if discovered during the delimiting survey, force on-going surveying until all affected properties are identified.

Delimiting surveys require the involvement of specifically-trained people operating under the supervision of pathologists and/or entomologists, specifically experienced in the epidemiology of the pest/disease, its symptom development in certain conditions on a range of hosts, and on the optimal means of collecting and safeguarding samples. Details of surveys must be recorded.

Delimiting surveys must have within their design appropriate forms for all aspects (survey pattern, frequency, GPS coordinates if possible, diagnostics specimen tracking and sampling details etc.). There are some useful descriptions of delimiting surveys from the citrus industry. See http://www.doacs.state.fl.us/pi/caps/images/pdf_caps-az_hlb-acp_2006.pdf.

11.5 Surveys for Area Freedom

The establishment of pest free areas is required to support trade. PFA surveys may be undertaken to demonstrate freedom from a pest thought never to have been present; or they may be undertaken to provide assurance that a particular pest has been eradicated, if once present. The requirement of area freedom is based on IPPC guidelines that state that area freedom is an area (officially defined country, part of a country or all or parts of several countries) free from and without pests (or a specific pest) in numbers or quantities that can be detected by the application of phytosanitary procedures.

The basis on which area freedom is demonstrated and declared in Australia, and the quality of the supportive data, will ultimately determine whether the phytosanitary requirements of the vegetable trading partners are met and whether market access is approved. Such surveys are being undertaken routinely for fruit flies in several locations and states.

Jorgensen *et al.* (2006) prepared guidelines for the establishment of pest free areas for Australian quarantine. His report provides a standard system suitable for approving a PFA for interstate quarantine use, and it includes a list of potential resources required to establish a PFA. These are included in this report, (in Appendix 8) as they are a useful guide to available resources and industry investment that may be required to achieve PFA status. PHA has also prepared a '*How to Guide for the Declaration of a Pest Free Area following a pest incursion*' (Plant Health Australia, 2006). It includes surveillance plans and verification plans, and the steps required for approval of each.

The grape industry has undertaken surveys to demonstrate area freedom from a regulated, soilborne organism called phylloxera. These surveys have been developed within a national protocol with prescribe survey methods and frequency. In several states, the ground survey work has supported remote sensing research, and it has been supported by long-time legislative restrictions on grape plant material and equipment movement. The National Phylloxera Management Protocols are accessible to industry and the public from: www.gwrdc.com.au.

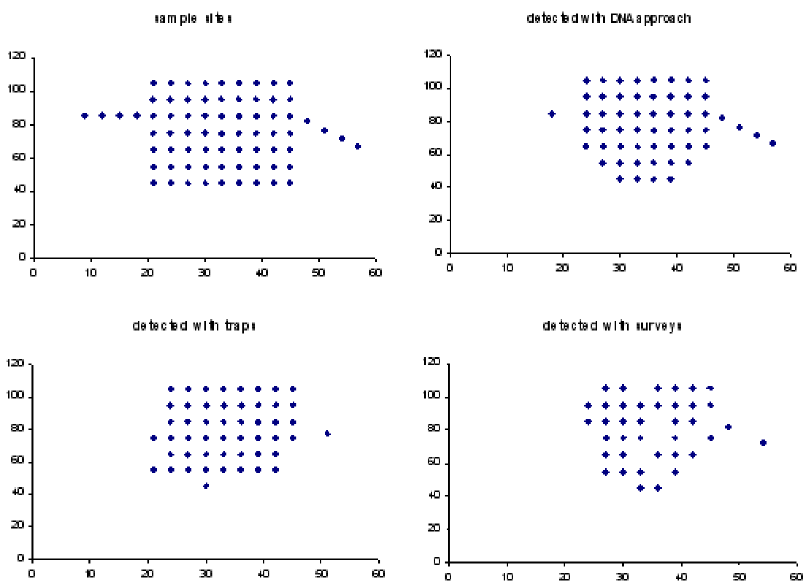
The result of surveys in which no phylloxera are detected over a three year period (and two survey years) is the gazetted assignment of a 'phylloxera exclusion zone". This equates to area freedom and is accompanied by systems to maintain that status.

11.6 Surveys for Property Freedom

Commercial production areas: When detections are positively identified in a commercial production area, a delimiting survey is needed to determine the extent of the outbreak. All hosts including abandoned or volunteer crops, feral and native vegetation within a defined distance would require surveying. Properties associated with an affected one (i.e. residences of personnel working at affected property, properties that share equipment, pickers etc) should be included in the survey. Even production sites and residences beyond the defined area should be surveyed, but to a lesser intensity.

Dr Richard Hamilton (Fosters Wine Group) agreed to share data from a recent vineyard delimiting survey triggered by the detection of the regulated pest, phylloxera, in the middle of a vineyard block. The subsequent activities included isolation of infected section, by removal of all other vines in the block, limitations on all vehicle and personnel movements in and out of vineyard, combined aerial mapping and trapping, monitoring of adjacent vineyards, signage, traceability investigations and assessment of the efficiencies of detection methodologies and their cost-benefits. Satellite infestations were detected (Figure 4 and Figure 5). The data below illustrate the relative costs of undertaking delimiting surveys by various methods (Table 15).

Figure 4 : Position of sampling points in vineyard block around infested area and presence of phylloxera detected with three approaches



Source : Foster's Wine Group 2008 and DPI Victoria.

Figure 5 : Survey and detection points for phylloxera in vineyard, Victoria 2006

Source : Foster's Wine Group 2008.

Table 15 : Detection costs (4 hectares per day)

Survey technique	Frequency	$ (per unit)	Approx cost per ha
Ground survey	3rd row, 5th panel 37 per ha	$55 labour	$110
Emergence traps	25 per ha	$25 laying $50 reading	$150
DNA probe	25 per ha	Test $12 (bulk rate) Labour $25	$325

Back yards: If there are detections in back yards in urban areas then door-to-door delimiting surveys need to be conducted on all hosts of all properties, within a defined radius of the affected hosts. Trace-backs on household hosts, usually expose retail outlets, natural spread (eg. via weather events), and/or human activity as sources of infection. In the event of detection in an urban or peri-urban area that is near a commercial production site, the delimiting surveys will cover a wider area than that required for an urban area only. They will extend into the commercial production site.

Nurseries or retail outlets: When surveying nurseries or retail outlets, inspectors and regulatory officials must be mindful of the ease with which some pathogens/pests can be spread. Strict measures (i.e. minimise handling; equipment dips in 10 % solution of sodium hypochlorite) should be in place to ensure contamination (eg. by viroids, bacteria) is prevented.

All hosts and relatives within such premises must be inspected and all commercial production and home garden sites within a defined distance of the affected premises must be surveyed. Records of sales will also be inspected to identify contact and suspect premises and sources of plant material and seed. Sales to retail chains and subsequent distribution must be traced. For such surveys it is also important to conduct interviews with transport companies as they should have trace-back records on product movement, consignment mix and vehicles, especially if state borders have ben crossed.

Field packing sites and packing sheds: It is possible that some pests and pathogens are harboured in bulk bins of vegetables in packing sheds. Yellow sticky traps in packing sheds may provide useful information on pest presence. If bins are traceable, this may assist with identification of potential point sources and affected properties. Fumigation of affected loads and bins may be required.

11.7 Surveys when a Pest/Disease is Endemic

11.7.1 Regional Protection

In areas where an endemic pest (to Australia) is absent from a particular area, regional protection may be warranted. Regional biosecurity protection plans have been successful in several cases, eg. The Riverland's Fruit Fly Free Area, and OrdGuard in the Ord Irrigation district and Kimberley ranges. This has been discussed earlier in this section.

11.7.2 Regional Management

After the finding that the surveyed pest or pathogen is widespread and beyond consideration for quarantine, containment or eradication, information on effective disease management becomes more critical. If mitigating factors are uncovered, (i.e. highly susceptible variety found, vector not previously known, predisposition due to another pest feeding etc.), a multi-pest survey programme may be relevant. Survey teams may inspect commercial plantings across the state for several diseases or pests. A random weighted sampling protocol can be designed to refine the survey effort for known biases.

Data collection on this scale presents many data management challenges but also presents opportunities to advance the understanding of epidemics, features of geographic zones and the opportunity to validate simulation models (Parnell *et al.*, 2007). Such a system has been introduced in Florida, for citrus greening (and psyllid vector). Their capacity to undertake such surveys was greatly enhanced by the register of citrus growers that had been developed over several years of dealing with incursions (eg. citrus canker). Information was collated on the host cultivar/species composition of every commercial plantation in the state and a software programme written specifically, stratified the random sample weights toward more susceptible plantations. The surveys cover 25% of the citrus area on a rotating three-month basis.

11.7.3 Systems-Based Management On-Farm

In regions where an endemic pest has the potential for economic management, systems may be designed to demonstrate its effective management and therefore its very low risk of transfer in produce exported from the area.

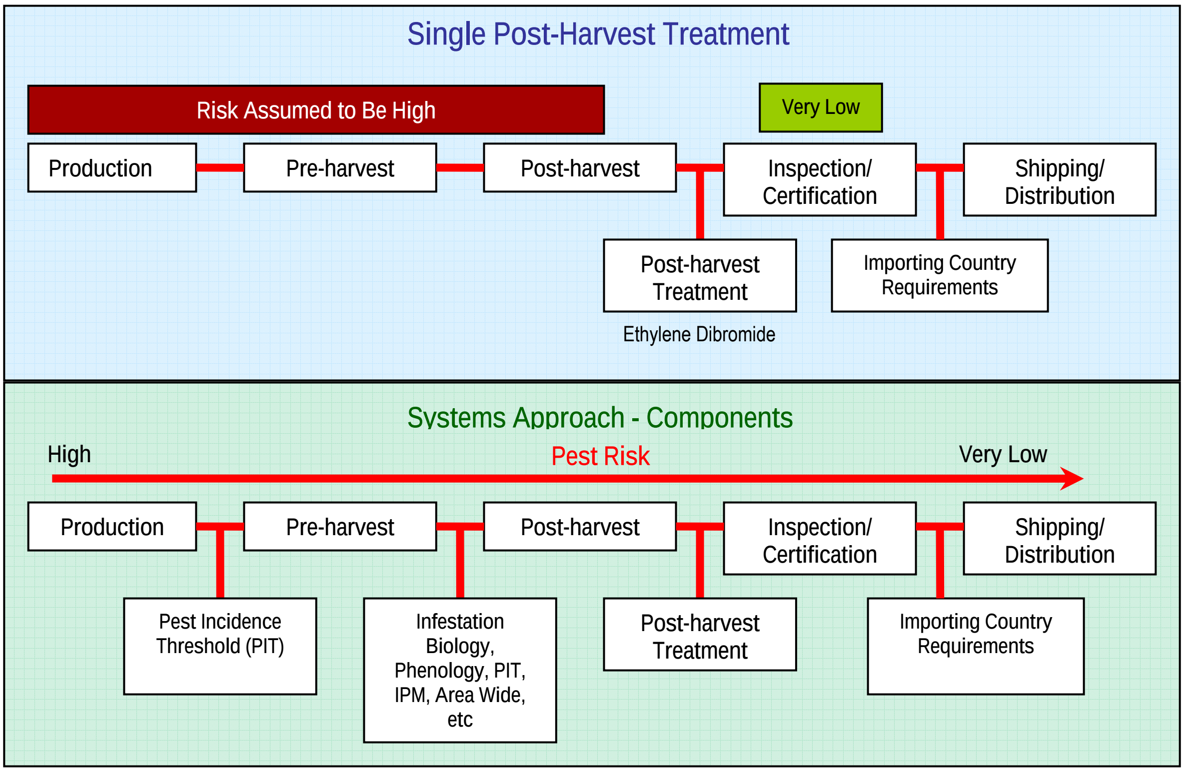
The "systems approach" to pest and disease management, uses familiar tools (eg. surveillance, trapping and sampling), in a more robust management strategy that integrates several forms of endemic pest management. Independently each offers some control, but cumulatively they provide greater assurances about the level of protection routinely achievable. The outcomes reduce risk of the pest reaching the market place, dependence on chemicals alone, and they can also be developed to provide phytosanitary protection in situations where no single measure is available.

Effective systems approaches may also capitalise on the economies of scale to be derived from multiple targets, and cross-industry collaboration. This is particularly important for regions in which a wide range of crops are grown and in on-farm situations where multiple hosts are present at any one time. The optimal and reliable combination of biosecurity measures and actions require prior consideration of the hosts, pests and treatment options (and compatible responses), at various times through a season, pre- and post-harvest. The multi-faceted systems approach is regularly reviewed and provides validation of each action at several stages in the production process. The treatment/action points may also be post-shipment.

The new fruit fly strategies are nationally-supported, systems-based approaches. These and other systems approaches are being increasingly recognised overseas in market access negotiations. The Japanese acceptance of NZ cherries was based on demonstrated effectiveness of their orchard and post-harvest systems approach. A similar programme for Light Brown Apple Moth (LBAM) has been submitted to support table grape access to China.

'A systems approach is usually designed as an option that is equivalent to but less restrictive than other measures'. (ISPM # 14). A schematic comparison of the systems approach and single-treatment approach is given below in Figure 6 .

Figure 6 : Schematic comparison of systems approach and single-treatment approach to pest management



Source: N. Bresolin PHA, 2008

A pre-harvest pest management approach is desirable for many vegetable producers because it would allow greater confidence in field-packed produce, help growers routinely meet domestic quality standards (as well as international standards); and it would increase opportunities to negotiate market access internationally. Although systems-based approaches cannot guarantee pest freedom in shipped produce, the likelihood of this being achieved is greater than under single treatment programmes. The approach also is a documented process that provides outcomes that can be both qualified and quantified.

11.7.4 Systems-Based Approaches - Examples

A generic example of a possible systems-based approach for management of a winged insect is given below (Table 16). The list of traditionally used management options is taken from ISPM # 14, and it has been used here as the basis of justification for the systems-based approach in this case.

Within such a system there are a range of critical control points (or management thresholds) identified to assist the grower in interpretation of the results of monitoring. They use these data to decide when/which cultural and/or chemical means of control may be required. To include such detail in a systems-based approach, the thresholds and epidemiology of the pest must be known.

Table 16 : Generic plan for systems-base control of insect pest

A range of circumstances	Does this apply?
Systems approaches may be considered when one or more of the following circumstances apply:	
• A particular measure is: – not adequate to meet the appropriate level of phytosanitary protection of the importing country – not available (or likely to become unavailable) – detrimental (to commodity, human health, environment) – not cost effective – overly trade restrictive – not feasible	*eg. for discussion in trade negotiations.* *eg. methyl bromide is being phased out, is detrimental to the shelf-life; poses Occupational Health, Safety and Welfare concerns to human health; but satisfies some state legislations.* *eg. IPM-compatible chemicals not available* *eg. Specialised equipment needed to treat produce in this way.*
• The pest and pest-host relationship is well known	*eg. native insect to Australia; extensive research as been carried out on for this pest.*
• A systems approach has been demonstrated to be effective for a similar pest/commodity situation	*eg. the systems approach has been demonstrated and accepted in exporting of cherries and citrus.*
• Possibility exists to assess the effectiveness of individual measures either qualitatively or quantitatively	*eg. individual measures include field and packing house samples, and can be quantified to provide an acceptable degree of confidence; insect /damage visible in most stages.*
• Relevant growing, harvesting, packing, transportation and distribution practices are well-known and standardized	*eg. Need to have good understanding of distribution network; production systems well understood*
• Individual measures can be monitored and corrected	*eg. Spray diaries and trapping results maintained.*
• Prevalence of the pest(s) is known and can be monitored	*eg. Flight patterns can be predicted through pheromone traps, weather conditions, over-wintering population etc.;*
• A systems approach is cost effective (e.g. considering the value and/or volume of commodity).	*eg. Cost and environmental effective and likely to result in better control.*

Other systems approaches may be useful for containment of soilborne insects or nematodes. As in the plans and protocols in place to contain PCN and phylloxera (both regulated pests), consideration is given to the site choice and its topography. Limitations are placed on any activity that introduces or moves infested soil – drainage patterns, vehicle movement, cleaning and washing of vehicles, sampling and trapping may be undertaken, and host-free periods may be enforced etc.

Cultural practices such as crop rotation may or may not be useful in managing the pest (eg. root knot hard to manage with rotation, due to its very wide host range), but resistant cultivars if available should be used in a systems-based approach to nematode management.

Planting dates can be manipulated to avoid either slow host germination and increased susceptibility periods or pest activity peaks, and informed decisions such as these should form part of systems approaches where appropriate. For example from the United States, there are very specific data available on activity temperatures for *M. incognita*, *M. javanica*, and *M. arenaria*. They are inactive in soils cooler that 17.5°C. *M. hapla*, however, is still active at this temperature.

Systems approaches are greatly enhanced by the availability of epidemiology data. With knowledge of underlying populations, susceptibilities, the conditions that promote rapid reproduction and or movement, one may construct damage thresholds which as noted above, trigger the use of available chemical controls. In the case of nematodes however, there are no materials registered for post-plant use on carrots and once tap roots are damaged, control is not feasible. As such the choices of site and planting material are important.

All vegetable industries should be mindful of the future effects of plant breeders' rights, on biosecurity. Proprietary lines and access to them, may affect biosecurity in terms of disease or pest management and the availability of tolerant varieties. Their availability and planting (restricted or general), may affect the potential for pest spread and population increase (and therefore chemical use etc.), within a region.

11.8 Trace-Backs

Survey teams are responsible for trace-back and trace-forward exercises with owners of affected properties, and survey sites. Their interviewing and inspections need to identify:

- The producer and retailer of affect produce or seed (if that is the likely source);
- Any movement of it or progeny from it, from the affected site; and
- Weather events (esp. prevailing winds, storms, cyclones, rain for bacteria; dust storms for some fungi etc)

Records of all trace-back interviews must be formalised (i.e. template form). These are forwarded to the relevant State Quarantine Manager/s, for analysis by AQIS and consultative committees. Information is also used to modify survey areas and to contact suspect premises.

Trace-back analysis is used to help determine a pest/pathogen's original source. It may reveal unauthorised entry of material to a region or into Australia. It is necessary to determine as early as possible if the incursion has resulted from the sale of commercial material, or natural entry and spread, or from human activity, including illegal introductions. The distribution of symptoms provides useful information on potential source/s and nature of the entry. These observations must be recorded. Spatial analysis of affected properties and of blocks within affected plantings may be indicative of the source and nature of entry. Areas of aggregation that are discontinuous with the main cluster are interpreted as indicative of the presence of secondary foci, especially if at a distance from the main cluster of disease, and each other.

12 BIOSECURITY FUNDING

Biosecurity initiatives require investment just like any other insurance, research and/or development programme. Increasing the appreciation and reality of shared biosecurity responsibility, in all areas (eg. research, legislative review and support, surveillance, communication and awareness, preparedness, capacity and capability building etc.) demands a long-term funding strategy and commitment. Significant additional funds however will not be sourced easily from either governments or industry. Until new funding sources are identified and available, efforts (eg. towards national surveillance) must be directed at maximising the benefit derived from current expertise, monitoring and surveillance activities, with new initiatives adding value to these, rather than creating duplication.

If however governments, industries and research providers, clearly identify high risk biosecurity issues in line with the national objectives and strategies, a transparent, comparative evaluation framework based on risk and cost-benefits, the research that justifies priority funding and the beneficiaries who should be contributing to it, will be revealed. Out of this process, future biosecurity funding will be more equitable, targeted and transparently distributed. Under this scenario, there should be less duplication of research (and development) and the available funds have greater potential of being distributed to high risk areas and therefore could result in more timely closure of existing biosecurity gaps of regional and national importance.

The costs of new surveillance, research, human capacity building, training and awareness initiatives are largely unknown but prevention, risk reduction and mitigation measures for particular industries, need not burden the industry themselves initially, and they need not be over-whelming. For example, risk assessments on imported vegetable seed would greatly benefit some vegetable industries. Such assessments would be undertaken by BA. The imposition of phytosanitary evidence (certification or testing) requirements (through ICON) to accompany vegetable seed imports (as recently introduced for tomato seed) would place risk mitigation in the hands of seed producers, pre-border. Similarly, an industry resolution to make post-entry quarantine testing for endemics (and exotics) on vegetative 'seed' material for sowing compulsory, would see the costs of this risk mitigation measure borne largely by importers (who may ultimately pass it on to local producers). The collaborative demand from horticultural industries for increased PEQ testing (at importers' expense) would ultimately drive investment by government, into diagnostic capacity and capability at the border.

It is noted that the citrus industry has always demanded additional testing be carried out by AQIS in PEQ (for citrus and citrus relatives, endemic and exotic organisms). The industry considers this 'insurance' as cost effective, as it is a risk mitigation measure at the border, rather than in production regions. As a biosecurity measure this remains very important to the citrus industry, and it is recommended other industries consider requiring similar levels of testing. Initially at the least the vegetable industry and PHA could advise AQIS of all vegetable 'relatives' (including new ornamental vegetables) and encourage active testing of each of them in PEQ.

There are several potential methods for industry contributing to the funding of biosecurity initiatives. They are not relevant for all industries.

12.1 Funding Biosecurity Initiatives

HAL released their 5-year plan for Market Access Research and Development in 2008 (HAL, 2008a). It calls for $18 million for market access related research and development over the next five years. This should serve to rectify the limited biosecurity research to-date that has been implemented by potential exporters. Biosecurity funding however needs to be secured with an industry commitment, as industry members are identified as the major beneficiaries, along with the community. With such commitment, the partnership in funding, between government and industry, is justified.

The vegetable industry is aware that the RDC structure (with matching government funds) structure will be reviewed by the new government. Their biosecurity research priorities, programmes and outcomes must demonstrate relevance within the model; regional economic, environmental and social sensitivity; and competitive advantages to the industry and public provided through the returns on investment. Funding for surveillance and preparedness (including updating the IBP threat tables, chemical availability assessment for high risk pests; protocol validation, inclusion of weeds, preparation of fact sheets and on-farm biosecurity awareness material etc) has not routinely been available, but these must become high priorities in collaborative R&D, in the national biosecurity interest.

There are areas where government and all horticultural industries need to contribute, eg. pre-border and NAQS surveillance; sentinel hive initiatives; container inspection frequency and technology advancements; water security; climate change and variability; programmes targeted at protection from Varroa mite; and updating of technology used in PEQ (capacity to reduce reliance on visual checks). All are economic beneficiaries of such biosecurity research and activity. The structure and timeframes for contributions to such multi-disciplinary, cross-industry research must be documented and agreed, because the budget for other R&D, and returns on investment, risk being eroded rapidly in some industries, by complex, long-term research projects.

The commitment researchers make to biosecurity will relate to the terms of their funding. Long-term funding commitments allow researchers to establish job stability and to formulate career paths. Without these securities, it cannot be presumed that biosecurity research will be an attractive area for the relevant scientists. The vegetable industries need to ensure their research contributions and communication links with Pollination Australia, PHA, CRCNPB, NAQS, AQIS, BA, sentinel hive programmes, HAL etc. are strong and have a long-term focus that may be articulated to committed researchers.

12.1.1 Sharing the R&D Levy

The mobilisation of resources that resulted from the detection of equine influenza (EI) in horses, was indicative of demands that could be placed on plant industries. Although the citrus canker and 'fireblight' experiences are notable within the plant industries, the resources devoted to those did not match those demanded in the EI case. The plant industries are less well resourced, yet the number of commodities, pests and diseases being managed, and the number of exotic threats confronting plant industries, far outnumber those the animal industries face.

Plant industries have established well-structured levy collections for research and development. It is recommended that industries and PHA consider the legislative changes that would be required to allow a portion of the R&D levy funds each year to be set aside for contingency planning and reserves in case of incursion by those pests for which a contingency plan exists. We see this as not only preferable to raising a new levy, but an incentive for preparing contingency plans, rewarding those industries that proactively address biosecurity and as a legitimate component of industry development.

12.1.2 Cross-Industry Funding

In addition to sharing costs between government and industry, there are opportunities to share costs between industries where a pest will affect the viability and trade opportunities for more than one commodity. AUSVEG and HAL are encouraged to forge a commitment to work collaboratively with the nursery, ornamentals and landscape industries, and also with perennial horticultural industries, PHA and government departments (eg. AQIS, BA, OCPPO). The benefits of consultation and collective pressure, may have been seen in the introduction of compulsory testing (in PEQ) of all alternative hosts of *Xylella fastidiosa* in PEQ. In its absence however, the testing is not being routinely undertaken and international obligations (eg. lack of local evidence) and resource availability, rather than risk, appear to have driven this biosecurity decision.

It is recommended that AUSVEG identify opportunities for the vegetable industries to share surveillance and intelligence, diagnostic skills and facilities, development of protocols or adoption of validated international protocols (esp. those relevant to vegetables, ornamentals, and nursery stock), and the costs of awareness material preparation and its distribution. The peri-urban community, all relevant industries including the pollination industries, transportation and allied industries require targeted awareness material. It is even possible that some locations (i.e. Sunraysia where vegetables, citrus, almonds and grapevines are planted in close proximity that remote sensing undertaken by the grape industry, could be shared at reasonable cost, and to great advantage. The proximity of vegetable production regions to urban areas and other horticultural production, also suggest opportunities to leverage funds through local governments, in the national interest.

12.1.3 Value-Adding

There are a range of biosecurity activities already undertaken by industry, such as passive monitoring and QA programmes. These activities need formal incorporation into on-farm and regional surveillance strategies, and this could be achieved without additional, significant cost to growers or industry. The same occurs in the government sector, where current activities targeting a small number of pests could be expanded to assist several industry programmes with limited additional expense (i.e. trapping and baiting results for more insect pests, rather than just targeted pest). An example is OrdGuard. It has maximised uptake and adoption, by including the region's existing expertise and incorporating the existing initiatives (eg. technical and professional support, NAQS surveillance, consultants, inspectors etc) in the consultation and implementation phases for multiple pests and diseases. Expansion of the NAQS territory, financial support (from government *and* industry), surveillance targets (eg. pollinator threats, esp. bee identity and their pests and diseases) and communication networks (i.e. formal communication links to the northern and southern vegetable industry groups) would add significant value to their already effective programmes.

12.1.4 Pot levy

There are other levy-related suggestions to raise funds for biosecurity. It should be recognised that the 'pot levy' is not a production levy and does not incorporate contributions from all producers in the nursery, garden and landscape industries. However there is justification for its expansion to include field nurseries, seed, bulb, corm and other non-containerised propagation stock. Not only would these groups be brought into the biosecurity awareness network, but also would contribute to its management.

12.1.5 Levy on Imports

A levy on imports has been investigated, and is viewed as 'necessary insurance' by a number of commodity groups aware of the increase in imports originating from countries without well-tested phytosanitary systems and expertise. HAL project AH05019 (Margetts, J. 2006) investigated the potential to extend the existing statutory levies on horticultural produce to imported horticultural produce. There are three Australian precedents (dairy, sugar, and forest and wood products), and several international ones, where charges apply to both domestic and imported products. The report found that it was feasible for import charges to be applied without contravening WTO rules or Australian government's Levy Principle and Guidelines. The case for introducing such a levy however is not sound in the current market climate, primarily due to the impracticality and cost of introducing and collecting it, on the low volumes of imported produce. Changes to the *Primary Industries (Customs) Charges Act 1999* would be required. The imposition of a new import levy could also present disadvantages for the local industry, eg. collection and administration costs, demands for reciprocal access to R&D funds, and potential price and access impacts. A 'carbon tax' off-set on imported produce however has been proposed.

12.1.6 Processing Levy

The potential remains for this to be re-visited by the vegetable industry. In its absence however, it may still be possible to receive biosecurity contributions from all industry members (rather than just levy payers) by a variety of indirect means, eg via increased testing in PEQ, increased demands on seed importers etc. as mentioned above.

For several reasons, it is unwise for onions, potatoes and tomatoes to sit 'outside' the other vegetable industries in terms of biosecurity negotiations, priority setting and funding contributions to advance biosecurity. All vegetable industries need to be contributors to biosecurity discussions, regardless of their membership or levy status.

12.1.7 PHA Funds and Cost Sharing Arrangements for Emergency Plant Pests

Although AUSVEG is not yet a signatory to the EPPRD, PHA can assist member industries in identifying the emergency plant pests that affect multiple commodities, and the pathway presenting the greatest risk, for each. Risk profiles are important in determining reasonable cross-industry funding and cost-sharing arrangements. Without them, as seen in the USA with *Phytophthora ramorum* management (although a very significant pathogen of native vegetation in the USA and Europe), funding and human resources can quickly be mobilised in other directions. All parties need to be mindful of the balance in public good and industry/commercial good, as recognised by the EPPRD cost-sharing arrangements. These identify agreed cost sharing arrangements for managing emergency plant pest incursions, and it is recommended that a similar methodology be adopted for funding of surveillance.

There are four categories of pests in the EPPRD, with cost sharing as in Table 17.

Table 17 : Cost sharing arrangements in the EPPRD

Category of EPP	Government Funding	Industry Funding	Vegetable pests in category
Category 1	100%	0%	
Category 2	80%	20%	Exotic Fruit flies; false codling moth
Category 3	50%	50%	Potato cyst nematode; Colorado potato beetle; PSTVd; *Verticillium dahliae* (defoliating strain)
Category 4	20%	80%	Armyworm; variegated cutworm; asparagus rust; spider mite

Details of how pests are placed into the four categories can be found in the EPPRD or in PLANTPLAN, both available from the PHA website (www.planthealthaustralia.com.au). These are summarised below:

Category 1: Pests that if not eradicated would have high cost to the environment, public or amenity, but have relatively little impact on commercial crops.

Category 2: Pests that if not eradicated may have high environmental and public impact, but also could cause severe economic impacts on regions or the national economy through commercial losses.

Category 3: Pests that if not eradicated would primarily harm the cropping sector particularly through trade restrictions, but may also affect environmental or public amenity.

Category 4: Pests that if not eradicated would have little or no public cost, but would affect cropping sectors through increased costs, or nuisance. There would be little trade implications for these.

These categories could form the basis for funding agreements also, if current funding commitments could be taken into account.

12.1.8 Activation of PHA Funding

The amended Plant Health Australia (Plant Industries) Funding Act 2002, allows member industries to use:

1. The PHA levy or charge to fund their PHA membership. PHA members who use this can nominate to use funding over and above the subscription amount collected by the levy, for 'biosecurity-related purposes'. The 'money' would be utilised as a PHA programme and therefore a limitation could be the necessity to conform with the PHA constitution. A potential advantage however is that it would not go through the normal R&D process, which could simplify the administration of it, and result in the industry itself gaining

greater control of the funding. PHA would administer the funds via a Memorandum of Understanding with the industry peak body.

It is also possible the industry could decide on how money will be kept in reserve and how much can be spent on biosecurity. This could be achieved under the same arrangements, with PHA recognising the industry's agreed position, in the formal arrangements between industry and PHA.

2. The EPPR (Biosecurity) levy, but AUSVEG does not have this one yet. This levy can be set at zero, and activated in the event of an incursion, or set at an operative rate to build up a fund. Most industries (including wine, table and dried grapes) have such a levy set at zero, but the grains industry has activated theirs to provide a source of biosecurity funding.

3. The EPPR levy, once payments and fees for EPP responses are covered, may be used for: "*any other purpose relating to emergency plant pests, within the meaning of the EPPR Deed, that affect, or may affect (see Section 10C, Part 6 of the Act):*

   (a) *the EPPR plant product*; or

   (b) *any other EPPR plant product for which the Member is the relevant Plant Industry Member*"

13 HUMAN CAPACITY BUILDING

Human resources are needed in all aspects of national plant health. Not only are they needed for surveillance and emergency responses, they are needed within governments for drafting and revising harmonised legislation, education and training, preparation of awareness material, diagnostic services, counselling and rural support, technical services, and as both skilled and unskilled labour. There are significant limitations in our human resources and it needs to be reviewed where specialist services and highly-trained personnel are best placed to provide their service, and mentoring opportunities.

As departments of agriculture, most states in the past housed high level technical experts, available to all stakeholders. This is a luxury no state has been able to maintain. The states however that are committed to providing inspections and specialist support have expressed frustration with their resources, reliance on "soft funds', lack of commitment to replacement of key staff, their declining contact with stakeholders, lack of recognition for performing extension or awareness roles, the lack of recognition for biosecurity work (until an incursion demands their time and expertise), and time-consuming paperwork and QA demands.

The potential for centralised services and incorporation of state department and academic expertise in more closely-aligned operational frameworks should be considered in situations where duplication has existed, or where synergy could be derived from specialist expertise, teaching/training and/or mentoring. To some extent this has been/is being trialled in 'research precincts' and in Cooperative Research Centres, but the desired synergy is not always apparent. An example of a framework providing synergy (despite their different funding sources and masters) is within the University of California where United States Department of Agriculture (USDA) specialists (eg. plant pathologists in Department of Plant Pathology; and others in their relevant departments), academic senate staff (eg. plant pathology researchers and lecturers), and Co-operative Extension Service personnel (extension pathology specialists servicing the diagnostic laboratories, and farm advisors) are housed together, work cooperatively (but avoiding duplication), expand the pool of staff for teaching and mentoring of under-graduate and post-graduate students, providing diagnostic services etc.

Industry has the capacity to drive investment in human resources through their funding decisions and demands for specialist services. Training in transferable skills is necessary to service agriculture. The universities might soon consider the merits of providing courses in plant and animal diagnostic technology (as has long been offered for medical technicians), so that skills will be useful in routine detection and diagnostic services, and also in incursion management, much as fire management and SES skills are highly transferable. Government investment is needed in the setting and formalising of standards, and industries need to identify their human capability gaps and priorities, in the biosecurity context.

13.1 Education and Training

The public image of agriculture as either the basis of a valuable education or as the substance of interesting, professional career paths, is very low. Not only has the extensive commentary on the consequences of climate change and drought contributed to this, but also the widely-accepted view that farmers struggle against all odds and their financial returns are far from attractive or guaranteed.

Once, food shortage, water insecurity and increasing food price stories would have signalled strong opportunities for careers in science and agriculture. Today, however the poor long-term career profiles in these areas, are more visible and potential students are not seeing agriculture as a viable career path. Few academic institutions offering training and education in agriculture, expose through their course names and internal department names, the range of training opportunities that exist within their curricula. For example, the universities once had Faculties of Agriculture and clearly visible within them were departments of botany, plant pathology, entomology, crop or animal physiology, nematology, breeding, biochemistry, economics, post-harvest etc. Few, if any university catalogues today mention these words. Instead “applied ecology” and other ‘catch-all’ terminology and super-department names provide little intrigue or guidance to the potential specialist areas of education offered, nor career paths that might arise from an education in agricultural science. Despite the declining supply side, agriculture still provides 17% of the nation’s job opportunities and there is demand for agricultural science graduates (Thomas *et al.*, 2007). Thomas *et al.* (2007) provide a good discussion of the issues facing education in agriculture.

In the last two decades, there has been both a reduction in support for agricultural education and research at all levels, and within the governments of Australia, agricultural portfolios (and the clout of the agricultural sector) have fallen in the hierarchy. Human capacity building should be a requirement of every horticultural investment portfolio, at this time.

13.1.1 Tertiary Education and Research Capabilities

There is little doubt that if school children and prospective tertiary students are not re-engaged with agriculture, that most agricultural industries will not have commodity or discipline experts supporting their efforts in biosecurity in the near future. Nor will they have labour supplies with commitment to their industries, researchers to provide data necessary to address the many challenges facing agriculture, consultants to advise on the uptake of new technologies, diagnostic service providers, taxonomists, entomologists, pathologists etc. People with a commitment to horticulture and to the provision of specialist services are critical components of functional biosecurity. Specifically, there are plant biosecurity deficiencies today in the disciplines of pathology, taxonomy, entomology, residue chemistry and hydrology, epidemiology, breeding etc. The Nairn Review (Nairn *et al.,* 1996) identified that a strong research capacity in agriculture is central to biosecurity preparedness, response capacity and capability. A response to the Nairn Review has been the development of the CRCNPB, PHA and their partnerships. It must be ensured they invest in human capacity building, relevant technology and infrastructure development, and collaborative research.

Several industries have recognised their potential future isolation in terms of human capacity especially in the area of specialist services. They have taken some initiatives to become self-sufficient in terms of their access to expertise. The citrus industry is a good example. They have trained and are supporting a full-time plant pathologist. Other industries are considering similar initiatives through the provision of scholarships, leadership training, and/or paid work experience. The "Russell Model" was coordinated by Dr David Russell (University of Tasmania), and was the successful fore-runner of an Australia-wide programme providing workplace experience for school students, in agricultural enterprises. With some government, industry and university support the programme is now run by the Primary Industry Centre of Science Education.

Contingency and incursion response plans, have within them assumptions that trained personnel (for surveillance, scouting and monitoring, diagnostics, communications, loss assessments, compensation and counselling etc) are readily available to implement them. The equine influenza outbreak provided a good example of the requirement for resources and the diversion of resources that occurred within state departments as a result.

Biosecurity plans have reliance on a network of early detectors. Amongst the group will be a range of skills and awareness of the continuum, but minimal understanding of the specific biology of pests and diseases. Therefore both general and specific awareness training is required, eg. specific training in inspection patterns and sites, symptom expression, sampling procedures and reporting. Such training may be 'accredited' and therefore recognised in general surveillance programmes useful in trade negotiations, and formal incursion management.

13.1.2 Human Resources and Capacity at the Border

Many submissions to the Quarantine and Biosecurity Review and the Cullinan Report into Equine Influenza, support the industry view that resources and capabilities at the border are insufficient to ensure maximum biosecurity. The personnel in number, and their specific training, their equipment, and their slow adoption of best practice diagnostic methodologies, have been raised. The risk-profiling that would allow operational focus on the highest risk sources of produce (regions and/or countries) and the highest risk commodities, would improve industry confidence in biosecurity and the border. A unified approach to protocol development (PHA, SPHDS, University etc.) with associated industry input toward validation on specific hosts, is recommended.

Without consistent training standards, importers and exporters do not necessarily enjoy the application of comparable biosecurity scrutiny for their produce. There is inconsistent quarantine regard for ornamentals and rooted retail plants, floral imports, seed and nursery trade (relative to commercial planting material) and this relates not only to PRAs but also human resources at the border.

Human resource capacity and capabilities are also likely to be affected by the impending closure of CSIRO, Merbein, and the potential location changes of Knoxfield and Eastern Creek quarantine stations. Queensland and Western Australia have also flagged they may withdraw from post-entry quarantine for genetic plant material, in the near future. SA has reduced the range of imported material it handles (to seed lines and 'medium risk' material only) and as such has few scientists assigned to, and adequately trained in post-entry quarantine.

14 COMMUNICATION AND AWARENESS

A high awareness of biosecurity is needed in order to advance surveillance and linkages required between state, regions, local farms, the research community, other sectors and allied industries. Effective communication with all stakeholders along the biosecurity continuum is difficult to achieve. Engagement of growers, processors, importers, exporters, large distribution chains, transporters, governments and regional bodies, in all directions, is not currently achieved.

Effective awareness and communication requires the identification of appropriate target audiences. Biosecurity enhancement relies on the engagement of all citizens, not just those operating and living in rural communities, and messages appropriate for each group. There are obvious target group (eg. producers) but not always obvious means to find and reach them. The less obvious but important target audiences include personnel moving in and out of regional airports; farmers markets and flower markets; 'non-commercial' farms (hobby, turf, pick-your-own, eco-tourist etc); supermarkets and florists who at times discard to the open plant material.

PHA has prepared a draft Biosecurity Communication ToolKit which is at present in the industry input stage. The aim of it is to achieve effective and consistent communication systems so that prevention, risk reduction and mitigation communications can be developed and distributed to all signatories and allied industry personnel.

To enable them to conduct important early detector roles in biosecurity management, growers and the community need heightened awareness of the importance of biosecurity (in market access, environmental and economic viability on-farm and beyond etc); their shared responsibility; the roles and responsibilities undertaken by others (industry organisation, governments); education and training on the threats (fact sheets, DVDs, pest alerts, easily accessible and pictorial resources etc.), the process of reporting, incentives to report, their potential for 'ownership' of protection measures (newsletters relevant, workshops, signage etc.).

14.1 Community and Industry Awareness and Engagement

Good industry relationships with governments (local, State and Commonwealth), the community, peak bodies (in commodities, research and development, infrastructure, natural resource management, conservation of wildlife, flora, fauna etc), allied small businesses and land owners, and allied industries (transporters, contractors, re-sellers, radio and news print journals etc) are vital to the success of biosecurity initiatives, particularly those aimed at early detection of exotic pests, diseases and weeds.

In biosecurity management, the community must be a respected and valued partner, positioned to see their role as important and in the national interest. There are examples of how this has been achieved in some areas. Where communication links are strong, it is likely the community will serve as first detectors for incursions, and valuable scouts in biosecurity or risk mitigation initiatives. Community involvement and support were critical components of the Grapevine Leaf Rust eradication programme, in the Darwin area 2005-2007– the first successful eradication of a rust disease.

Engagement strategies are under development and the vegetable industry because of its complexity (ethnic groups, fragmented production locations, and enterprises mixes) needs to be involved in developing specific engagement strategies useful and appropriate for vegetable growers in peri-urban and rural areas. There are good industry examples of specific awareness material, eg. the NGIA in partnership with HAL has developed BioSecure *HACCP* to outline biosecurity responsibilities and means of assessment of biosecurity threats and preparedness for production nurseries. Farm Biosecurity's "*Secure your farm: Secure your future*" programme is another planned programme. Farm Biosecurity e-news is available from: www.farmbiosecurity.com.au .

Freshplaza (July 2008) reported that the California Citrus Research Board recently mobilised and coordinated help from homeowners, masters gardeners, landscape managers, and growers in the San Diego region to become ‘sentinel scouts’ in the search for the Asian Citrus Psyllid. They encouraged close inspection of host plants (for the bacterium transmitted by the psyllid) like orange jasmine; pruning of citrus trees to stimulate new growth on which psyllids preferentially feed; and the placement of traps and baits to attract the psyllid. It was presumed that if the bacterium that causes ‘citrus greening’, was present in the region, it was likely to be detected in urban backyards first. This industry-driven, community-supported programme followed the detection of a breeding population of the psyllid at the Mexican border.

DAFF and the Bureau of Rural Sciences have recognised the importance of community engagement in biosecurity and to advance this area, organised a National Biosecurity Engagement Forum (September 17, 2008) and science café to generate discussion about the role of ‘community detectives’ in the prevention, detection and reporting of incursions.

14.1.1 Grower Registers

Communication and awareness is greatly enhanced in industries that have a form of grower (and allied industry) register, eg. the cotton industry (where required licensing to use Bt technology forms by default, a grower register), and NSW grape industry.

A recently introduced vineyard identification system in NSW relies upon existing statewide systems intended for livestock identification and tracing, property identification codes (PICs) and the Rural Lands Protection Boards (RLPBs) annual returns of land and stock. The PICs are unique numbers assigned to registered properties over a certain size and they include contact details of the owner/occupier. The RLPB returns are a means of collecting and collating data on the land use. From 2008, the RLPB rate return in NSW will include an additional question relating to the area of property planted to grapevines. This initiative will allow greater communication with the grape community and will result in a vineyard location register that will assist with incursion management should it be required. The initiative resulted from cooperation between the wine industry and state government, and commitment of both to enhance biosecurity preparedness.

It is recommended that the vegetable industry explore other existing systems that could be adapted to achieve a similar outcome, on an annual basis. The diversity and dynamic nature of land in vegetable production and the short-term (less than 12 months) nature of the crops, are recognised complexities. However the enhancement of vegetable industry biosecurity requires greater awareness of the nature and location of producers, and of those to whom communication and awareness material should be directed.

14.1.2 Community Engagement

Biosecurity awareness materials and quarantine campaigns (eg. Steve Irwin campaign) that are accessible to the general community are necessary. Information programmes aim to provide, in multiple ways, information that would increase the chance of a casual (volunteer) observer understanding biosecurity and their role in it, and at best, recognising and reporting something unusual. Such programmes and material include the Community Surveillance and Seasonal Pests campaign; biosecurity checklists; quarantine and detector dog advertisements; Silent Invaders poster; Australia’s Most Unwanted brochure; PHA’s *Seen Anything Unusual Lately*?; the Commonwealth government’s Pest and Disease Images library (PADIL) etc. They provide accessible and accurate pictorial material that focuses attention on biosecurity and quarantine awareness.

Community awareness in peri-urban areas particularly, may require greater investment and commitment from industries, in order to both enhance and manage more specific biosecurity. If the community is not fully informed of biosecurity threats in advance, they risk becoming not only a lost resource in the management of incursions, but a confused party, that may or may not accept chosen incursion management options, or the disruptions to their region and economy (social, environmental and financial costs). Few members of the public are aware that the major cause of reduced bio-diversity and extinctions are invasive species; that weed management costs more than $4.7 billion annually in Australia; or that observant citizens often spot invasive species first (eg. red-bellied slider turtle, European house borer, European wasp, grapevine leaf rust).

14.1.3 Post-incursion Awareness

Plant industries need to ensure that personnel (industry liaison officers) with assigned roles and responsibilities in incursions are well-trained prior to the event. Simulation exercises for viral, bacterial and fungal diseases, winged insect pests etc. are recommended. Farmers must also be encouraged to undertake such training in order to more efficiently conduct their own on-farm surveillance and reporting. The community needs specific awareness material at this time to ensure clarity over quarantine boundaries and what they mean in terms of plant, people and animal movement restrictions.

The best control strategy for many disease incursions, is elimination (and correct disposal) of symptomatic hosts, supported by frequent re-surveys. Once a vegetable (or ornamental) EPP has been detected in a region, growers and community members must be alert, provide cooperation and accurate input to those conducting delimiting surveys, and ideally, accept the inconveniences of the chosen management option, in the interest of efficiency and national and regional biosecurity.

An example of a recently implemented training campaign in Florida used DVD technology to specifically train citrus growers in symptom recognition so that they were qualified to conduct meaningful self-surveys for huanglongbing There are several copies of this DVD held in Australia (QDPI, UWS and Australian Citrus Growers (Mildura) or, it is available along with other relevant titles, from http://www.doacs.state.fl.us/pi/videos.html

Several awareness strategies might be considered, post-incursion:

- Distribution of folders/pamphlets to vegetable growers etc containing information about the importance of the specific EPP - symptom recognition, varietal susceptibility, disease management etc. This may be required in several languages
- Training of additional inspectors
- Distribution of communication material (esp. pictorials) specifically for home gardeners, landscapers, park managers, retail nurseries, supermarkets, distribution chains eg. Bunnings, Woolworths etc.
- Placement of signage in strategic areas, along trade routes and on important boundaries, explaining the pest and the operations
- “Listening posts” for community engagement and feedback, with state department, industry and community champions well-briefed and present
- Free diagnostic checks on suspect material
- Radio, television and print media eg interviews on Country Hour, Landline, ABC Gardening Show etc, to reach plant observers across the whole continuum, from home gardeners to growers and transporters
- Print media eg newspaper advertisements, and journals if print timetable allows.
- On-line information eg advertise useful websites; HAL websites, AUSVEG, PHA etc.

15 BIOSECURITY 'EQUIVALENCE' OF IMPORTED & LOCALLY-PRODUCED FRESH PRODUCE & SEED

15.1 Fresh Produce

Although scepticism exists within the local vegetable sector, there is little evidence to suggest that fresh vegetable produce (for consumption) imported into Australia poses a greater human health or phytosanitary risk, than that produced locally. Imported fresh produce has not been demonstrated to be of a quality less acceptable (scientifically, rather than emotionally) by Australian consumers. Contaminants have been detected, in both locally-produced and imported fresh produce, and Australia in 2005, had 77 food recalls, of which 20 were of imported foods. Of the recalled products most had food labelling errors, while 26 were viewed as microbiological risks (Crossley, 2006). Australia has not however experienced national-wide fresh produce advisories and recalls like those recently reported from the USA (spinach and fresh tomatoes).

It is difficult to determine what if any, microbiologically-based rejections of Australian fresh produce have occurred in any international market, in recent seasons. It is known that almonds were detected to have excessive (for Europe) aflatoxin levels, but few details on fresh produce are made available. There is however high level awareness of the necessity to maintain a high degree of confidence in Australian produce and in fresh produce imported for the Australian consumer. The Australia China Food Safety Workshop (2006) and other forums have been established to increase collaboration with exporters like China on all aspects of food safety.

AQIS recently conducted two surveys of vegetable imports, as commissioned by the former Minister of Agriculture, Fisheries and Forestry, the Hon. Peter McGauran. In the first surveys (AQIS, 2007) chemical residue status and contamination of human health concern (*E.coli* and *Salmonella* sp), were examined in a range of imports (frozen, fresh, dried). Of the 50 samples tested for the presence of chemical residues (139 chemicals screened), there were two detections, one of which (semi-dried tomatoes with Procymidone) was below the MRL. The other detection was of the chemical fenvalerate in garlic, a product not registered for use in this crop (and therefore without an MRL). Although a breach, it is unlikely public health was compromised.

The second report (AQIS, undated) outlined the findings of a survey of fresh vegetable imports, for the presence of *E. coli* 0157:H7 and/or *Salmonella* sp. The samples were collected at four points of entry to Australia (Sydney, Perth, Melbourne and Brisbane). The results were evaluated by FSANZ and they confirmed horticultural products are low food safety risks. They have comparable microbial levels, to Australian produce according to the state government surveys of domestic produce.

Salmonella sp. was not detected in any of the 97 samples tested, which included asparagus, baby corn, *Capsicum* sp., dried mushroom, garlic, snow peas, tomatoes and yams. However fourteen samples, including exotic leaf crops (Cassava leaf, taro leaf, drumstick leaf, paan leaf – from one supplier in Fiji), baby corn (from Thailand), and asparagus (from Thailand), returned a positive for *E.coli*. FSANZ advised that the levels found were of little concern to human health and that the washing and/or cooking of these vegetables prior to consumption were suitable risk mitigation steps. FSANZ recommended that all fruit and vegetables be washed or cooked prior to consumption, regardless of their source. The fresh produce that could potentially carry the pathogenic *E. coli* of most concern (*E. coli* 0157:H7) were also screened. The samples were from Thailand, Peru, New Zealand, Fiji, China, Argentina, Taiwan, USA, the Netherlands, and none had detectable levels of *E. coli* 0157:H7 over a 12 month period.

A study by WA Health (WA Health, 2005) also investigated the microbiological quality equivalence of Australian and imported fresh produce. They examined fruit and vegetables in Western Australian retail outlets, and tested 491 Australian and imported samples of 39 commodities for bacteria known to cause food poisoning. Of the tests undertaken, 31 of the

3,425 samples were rated as 'marginal', 13 were ‘unsatisfactory' and one was considered 'potentially hazardous'. No *Campylobacter* sp., *E. coli* O157:H7 or *Salmonella* sp. were detected. The 'potentially hazardous' finding was from WA-grown produce.

In 2006, the report from FreshTest Australia (FreshTest Australia, 2006) stated that 5,717 samples were tested for chemical residues, microbial contamination and/or heavy metals, across 151 commodities. There were 521,840 analyses, of 4744 samples for residues of any of the 110 detectable analytes. The results indicate that 3.4% were MRL breaches, i.e. detectable levels of unregistered chemicals or detections that exceeded the Australian MRLs. The residue violations from 1,200 samples of imported fresh fruit and veg resulted in 2.4% violations, which was less than that recorded for domestic-origin samples by more than one percent. Microbial testing was conducted on 901 samples (1925 analyses) and 19 samples were in the category ‘marginal to unsatisfactory’.

15.2 Seed

Because interception data are not normally released, it is not possible to determine the phytosanitary and environmental risk equivalence of imported and locally-produced plant material for sowing. The importation of some propagation material, seed and ornamental vegetative material ready for retail sale, is not risk-free.

Pest risk assessments have not been carried out for most imported vegetable seed, and as such it enters Australia with an unknown risk profile. Once in the country, risk must be equated with inoculum levels and the intended growing environment. For example, a cabbage seed lot with only one seed in 10,000 infected with the bacterium *Xanthomonas campetstris* pv *campestris*, will potentially cause economic damage in a planting within a seedling nursery greenhouse in Queensland, but not in a direct-seeded field planting in the drier regions of South Australia.

“Equivalence” therefore for seed tested by standardized methodologies, sample sizes etc. is relevant to the intended growing environment. Seedborne disease epidemiology, if specifically researched across Australian production regions, would allow local marketers and growers to interpret the risk (and equivalence) associated with tolerances for each pathogen and inoculum levels. Tolerances determined without understand of the pest/host epidemiology, are less useful.

Locally-produced seed undergoes field and laboratory inspections. In discussions with Australian seed company personnel, frustration with inspections of seed crops for export, has been expressed. Each inspection is designed and employed to meet an importing country’s import conditions and ‘additional declaration’ requests. However, inconsistent interpretations of the conditions by different inspectors, has resulted in approved and accepted methodologies for one inspection period, not being accepted in the subsequent inspection period. Seed companies have reported to us that at times new AQIS inspectors have been trained ‘on the job’ by the seed companies themselves, as they often have had no prior experience with the crop or region. Most vegetable seed grown in Australia is produced in regions suitable for seed production – i.e. areas with low risk of rain during harvest periods and low pest pressure.

AQIS has negotiated equivalence for some export certification seed testing systems, with the USDA Food Safety and Inspection Service. The major outcome has been the formation of a verification section for microbiological testing. This will increase the confidence placed in testing services by exporters, importers and domestic producers. The accreditation of some international facilities without regular follow-up audits has left some questionable facilities with access to the Australian market, and some pathways open and without necessary safeguards (eg. until recently, tomato seed with PSTVd). The vegetable industry is encouraged to ensure that seed is imported only from direct suppliers of certified and ISTA-tested seed from identified sources, or from reliable local producers that also have certification and testing procedure validations.

Seed health ‘equivalence’, even if determined, would not in itself provide protection for the Australian vegetable industry. It is incumbent on seed companies and growers to establish good relationships with nurseries, as they are often the first detectors of problematic seed, as well as themselves being, a source of risk. Plant handling and hygiene breaches in nurseries have at times caused major seed/seedling problems for downstream users. Nurseries although supported by an accreditation scheme are increasingly 'self-regulating'. It is the opinion of some nurserymen that their industry is insufficiently regulated and audited, especially in the area of hygiene.

It has recently been reported that plant material has entered Australia as cut flowers, without the required pre-shipment treatments, from Africa, India and Malaysia (Australian Flower Industry, 2008). Pest risk assessments have not been carried out for most flower, seed and nursery stock imports. Instead there is reliance on the overseas certifying authority and "approved sources". Therefore the risk associated with untreated flowers is neither quantified nor defined, but is expected to be significant given the propensity for such crops to carry pests and diseases, and the direct entry of such material to retail and commercial outlets without further testing. AQIS has confirmed that most flowers that enter Australia are fumigated.

16 EMERGING THREATS

There are many emerging threats for the vegetable industries and in fact, all horticultural industries. Although not directly related to biosecurity, there are several key emerging threats and issues that the vegetable industries should be preparing to address and invest in. Ideally there will be collaborative research and communication approaches to each, across all horticultural industries.

- Competition for resources - water security; and environmental footprint determination.
- Carbon emissions and response capacity to imposed legislation.
- International influences – Kyoto, Doha round, free-trade agreements; global competitiveness on price; protection of intellectual property (IP) and value-adding to IP; input price increases.
- Public perceptions of horticulture as justified land use – industry reputations; preferred land uses and cropping systems etc.
- Justification for continued public investment in agricultural R&D – the business model for R&D in agriculture, in social, environmental and financial terms.
- Responsiveness to government stakeholder - Increased demands for 'public good' to be articulated, demonstrated and quantified; and for 'market failure' to be demonstrated.
- Introduction of transgenics – appropriately communicating the potential agricultural progress in stabilising world food supplies, nutritional value (i.e. enriched products) and biosecurity threat reduction, to a sceptical public.
- Viability of rural communities - expand traditional 'public good' to include rural community viability, sustainability and contentment.
- Human capacity in agriculture – addressing major skills shortages in labour, growers, researchers, specialist service providers etc.
- Peri-urban protection and urban encroachment. The potential development of 'designated production zones'; community influence over farming systems and practices (and incursion management).

16.1 Emerging Threats to our Biosecurity

There are many threats and gaps in biosecurity that have already been discussed in this review. Their effects would be felt at the international, national, regional and/or individual levels. The following discussion is on emerging threats that have not previously been discussed in this report.

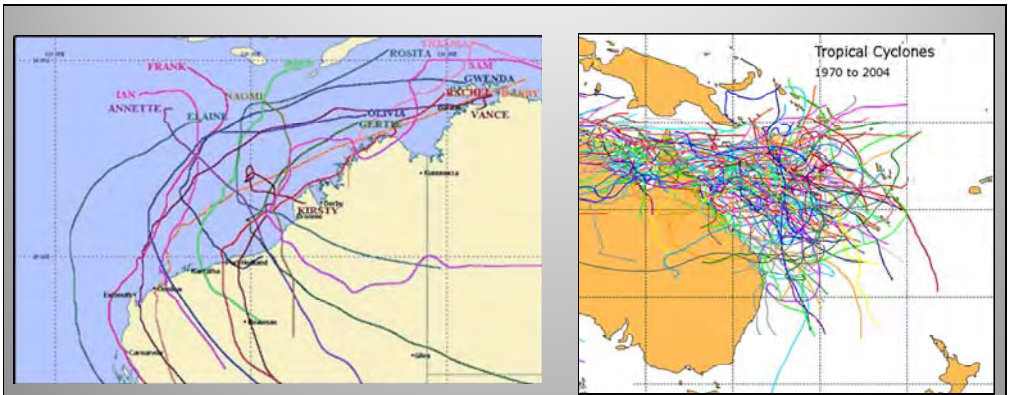
16.1.1 Climate Change and Variability

Although climate has never been static, water security and the predicted rate of temperature change, are now considered serious. It as been determined that the climate variability is sourced primarily in man-made 'greenhouse gases'. Global warming predictions suggest mean surface air temperatures will increase by 1°C and 3.5°C respectively, by 2100. There are also predicted increases in atmospheric carbon dioxide, fewer frost events and chilling periods, unseasonal rains and drought, changes in the intensity and frequency of cyclonic events etc. The impact of such changes will be felt across natural and agricultural systems, and therefore by enterprises and communities dependent on them. The predicted changes will also influence animal and human health threats and conservation efforts.

The predicted severity of the biosecurity effects, are dependent on the links between biological and ecosystem adaptations, movement and biodiversity, and the changes in human activity (gas emissions, intensification and diversification etc.) that affect both the global changes and the micro-climates in which plants, pests and diseases develop. Professor Ross Garnaut's 2008 draft report on climate change identified warmer temperatures as favouring weed and pest species over native flora and fauna (*The Countryman July 17, 2008).* Presumably migrating pests will respond to climate change over a shorter time period than plants will be able to adapt to new habitats and conditions.

There is a need for more epidemiological research into vegetable crop pests and pathogens. This is increasingly necessary as industries prepare for a greater abundance and diversity of pests, and pest/commodity combinations. The research needs are for integration of data on critical weather conditions and biological parameters for key vegetables, their pathogens and pests. Modelling (eg. CLIMEX bioclimatic model) will predict likely geographic shifts in pest and pathogen populations and behaviour, and therefore the changing biosecurity for particular regions (Mika *et al*., 2008). Contingency plans should reflect these expected changes. Collaborative research in these areas is recommended. For example the citrus industry has worked with the Bureau of Meteorology (BOM) to model the potential of cyclonic air movements and jet streams to carry citrus psyllids from Indonesia and PNG, to northern Australia. The BOM data could assist the vegetable industries similarly and it may allow the development of early warning systems for some diseases and vectors, endemic to Australia's northern neighbours. It would also assist in trace back investigations. Figure 6 is an example of the type of data available.

Figure 7 : Air movements with potential to carry and distribute micro-organisms from regions north of Australia



Tracks of severe tropical cyclones - northwest coastline - 1986-87 to 1995-96 (www.bom.gov.au)

Eastern region tropical cyclone tracks for cyclones from 1970-2004 (www.bom.gov.au)

Modeling to assess the risk of wind-borne incursions of *D. citri* could enable the development of an 'early warning' system to alert authorities to a possible incursion.

Source: P. Barkley (Pers. comm.) and BOM: www.bom.gov.au/weather/cyclone/about/cyclones-eastern

Fungi and bacteria are affected by moisture and temperature changes. Viral diseases will be indirectly affected by the movement and behaviour of vectors, and host responses. Hosts have variable responses to moisture – eg. dense canopies or top growth, or premature loss of leaves etc. Many vegetable root pathogens respond to excess or available moisture and are therefore less likely to be problematic in drought and non-irrigated environments. There are other fungi eg. powdery mildews, that prefer dry conditions. Similarly, increased carbon dioxide may affect host physiology and pathogens, and therefore crop debris decomposition rates and the availability of over-wintering sites. It cannot be concluded that inherent resistance will remain unaffected by climate change. Potentially, resistance might be overcome in shorter periods due to the added pressure of adapted pathogens under climate change. It might also be true that the behaviour of systemic pesticides is altered within a physiologically altered host.

Bee, insect and pest behaviour, diversity, distribution, survival and reproduction will change as a result of climate change. Temperature is likely to have the greatest influence over the changes that occur and the most visible effects will be increased incidence and severity of infestations by known pests, rather than revealing previously unseen threats. Crops are likely to be susceptible for longer, while pest reproduction rates will increase under warmer conditions. The warmer environment over a greater area of the globe is expected to allow greater and more diverse populations of weeds, pests and diseases, wildlife (including feral animals) to invade, survive and establish over increasing areas and ecosystem types. The above is also relevant to beneficial organisms and parasitoids, and therefore the impact of climate change cannot be generalised.

It is expected that we will not know the precise impact of climate change on specific pests and cropping systems, until it has progressed to a visible level. The changes will occur slowly but in order to respond effectively, growers should be monitoring trends now. Consistent monitoring and surveillance will provide the earliest indication of the direction of forth-coming changes, eg. flowering dates, first trapping date for insect pests each season, flight patterns, frequency of spraying needed, frost incidences etc. The analysis of trends and management options, will also provide early warning of viability changes for crop production in a particular region.

16.1.2 Exotic Threats to Pollination and Managed Pollination Services

The nature and source of some exotic threats have been mentioned in this report. Those identified for vegetable crops, are listed in the IBP. Others of significance to horticultural nationally are mentioned below.

Pollinator pest and disease incursions are the greatest threats to pollination, and prevention of them is therefore a justified focus of government investment. There are several specific government programmes targeting bee biosecurity and pollination and honey industry protection: the National Sentinel Hive Program and the bee quarantine facility. NAQS surveillance includes exotic bee and bee parasites, in Indonesia, Timor Leste, PNG, and amongst islands in the Torres Strait. Although effective, these programmes are not considered sufficiently comprehensive. There are still some ports not involved in the sentinel hive programme, although 29 ports are active participants. Pre-border insect surveillance and border surveillance by NAQS are inadequately resourced in terms of personnel and expertise, and therefore in the frequency and extent of territory surveyed. Broad community awareness of exotic threats is needed to enhance the ‘alert observer’ numbers, and therefore extent of informal surveillance.

Since a compromised pollination industry would affect horticulture across the country, horticultural industries might consider the benefits of increased research contributions to bee surveillance methods; pollination alternatives; native flora preferences of exotic bees; effects of chemical and wetting agents on bees; future demands on pollination services under variable scenarios related to pest and disease presence; and general biosecurity of pollination etc. More than 90 crop types rely on pollination from bees including fruiting vegetables, almonds, apples, pears, berries, some vegetables and peaches. Incidental pollination is critical to the economics of production of some of these crops. Table 18 illustrates the reliance on pollination for some cucurbit and vegetable crops. Seed crops are particularly reliant on sustainable pollination.

Table 18 : Relative reliance on pollination services in some crops

Crop	Pollination	Predicted in absence of feral *A. mellifera*	
	% total pollination provided by insects	Additional hives/ha needed	Yield loss (%)
Cucumber	100	1-2	0-20
Peas	50	0	0-10
Pumpkin	90	1-2	0-20
Rockmelon	100	1-2	0-20
Watermelon	100	1-2	0-20
Zucchini	100	1-2	0-20

Source: Submission of Tasmanian Pollination Association to the Quarantine and Biosecurity Review, 2008

The biological threats to the pollination industry include foreign bee species which may serve both as vectors for pests and diseases (of bees and hosts plants) and also competitors for *Apis mellifera* (eg. Asian honeybee, Giant Honey Bee, Dwarf bee, African honey bees and/or Africanised hybrids); Varroa mite and other parasitic mites (Asian bee mite; tracheal mites), hive disorders that affect bee viability or honey quality. The loss of native vegetation resources, inadequate community awareness of exotic bees, inadequate insect taxonomic expertise and resources, and the lack of compulsory hive registration also threaten pollination sustainability and the capacity for effective awareness and education to improve it (House of Representatives, 2008).

Exotic bees: The Giant Honey Bee (*Apis dorsata*) has been intercepted at Australian ports and is present in neighbouring northern countries. It is an established host of the Tropilaelaps bee mite which presents a threat potentially equivalent to that of *V. destructor*. African honey bees and the Asian honey bee, have also been intercepted in the past. There have been eight recent interceptions of the Asian honey bee since the first one in Cairns in 2007. The most recent one was in September 2008 in north Queensland, where eradication efforts are now underway. African honey bees are aggressive but the main concern is their ability to interbreed with European honey bees to produce hybridized progeny that are particularly aggressive ‘killer bees’. Some African species are capable of eventually replacing the colonies of European bees.

The Asian honey bee (*Apis cerana*) is a pest in its own right, but it is also the original Varroa host. However it is not considered the likely host on which *V. destructor* could enter Australia. It is considered most likely that *V. destructor* and other mites will enter on *A. mellifera* arriving, legally or illegally, from SE Asia with undetected pathogens. The Asian honey bee is smaller than the European honey bee and it has a different flight pattern.

It is critical that Australia has the taxonomic capability to detect aggressive genes in imported breeding stock, as well as the different bee varieties and hybrids.

Varroa Mite: The mite *Varroa destructor* presents both a food security and biosecurity threat. This mite has the potential to devastate feral and domestic been populations, and pollination. This mite parasitizes adults and larvae in a bee hive by feeding off their blood. It reproduces in the bee brood and may therefore reduce colony viability through direct deaths, or diminishing the colony’s disease resistance for example to transmitted viruses and other pathogens. In the United States, beekeepers have experienced winter bee colony losses of 60% since the arrival of Varroa mite. The apiary industry estimates that an incursion of Varroa mite could create demand for 272,000 hives, at prices as high as $220/hive, in 2011.

The global spread of Varroa mite (now in Indonesia, Papua New Guinea and New Zealand) leaves Australia as the last major country in this region where the mite has not established. In all regions where it has established, feral honey bees have been eliminated and managed pollination services have been severely damaged and unable to meet the demand for pollination services. Growers have incurred significantly higher prices for the pollination services available. It is expected that *V. destructor,* should it enter, would be highly invasive and spread rapidly.

Other bee mites: The Asian bee mite, Tropilaelaps, is considered a significant threat to the honey bee industry. The primary host of this mite is the Giant Honey Bee. It feeds parasitically in a manner similar to that of *V. destructor*. In addition, this mite is capable of killing European honey bee colonies at a faster rate than *V. destructor*. Its entry however is less likely.

Tracheal mites live in the air passages of adult bees and the bees are killed through either introduction of harmful microbes or by suffocation.

In addition to the loss of colonies due to infestations, mites affect the economics of pollination and honey production, because of the necessity to use chemicals in attempts to manage infestations within colonies.

Colony Collapse Disorder: Colony Collapse Disorder (CCD) has left USA (honey) beekeepers in 27 states without active hives. There is a strong correlation between CCD and a virus, Israeli Acute Paralysis Virus (IVAP), but the cause of CCD remains unproven. Other explanations include pesticides; a new parasite or pathogen; and the combination of immune-suppressing stresses such as poor nutrition, limited or contaminated water and the need to move bee's long distances for pollination.

16.1.3 Other Emerging Biological Threats

Other crops and cropping systems: The vegetable industry is exposed to microbiological threats, from other hosts, native and commercial. New ornamental vegetables (as seed or vegetative planting material) may be an emerging threat as no pest risk assessments have been carried out on them.

The loss of trade due to a nearby incursion in an unrelated crop, is not a new threat. It is however emerging as something industries and simulation exercises need to address as a potentially serious and costly threat to vegetable industries which are often grown in 'mixed enterprise and production' regions. The vegetable growers in Queensland experienced such a loss of trade when cane smut was detected. The declared quarantine zone prohibited not only cane movement but also vegetable movement from the region and as non-signatories to the EPPRD, they were not eligible for compensation. The biosecurity commitment of other industries has direct effect on the biosecurity of vegetable industries.

Ants: Ants are considered an 'emerging' threat, because to-date there has been little formal preparedness for ant incursions. This is changing and opportunities for early detections are being recognised. Red imported fire ants, electric ants and yellow crazy ants are threats to urban and commercial production areas. It is expected that more ant pests will enter, and that they will be very difficult to eradicate, once established.

16.1.4 Emerging Regulatory Threats to Biosecurity

Changing import conditions: Australian exporters and regulators might prepare for a period of tightening export conditions. Countries are continually reviewing their import conditions, and now are likely to demand evidence from exporting countries, of pest status. Australia is not well-prepared in terms of pest status data.

New suppliers: The developing world is becoming one of net exporters (esp. India, China). With their development, is an increasing number of chemical suppliers, produce exporters, seed merchants etc. Their development of regulatory, inspection, certification, phytosanitary and quality assurance standards has lagged their enterprise developments. There is no reasonable prospect for AQIS to inspect and accredit new export facilities or seed suppliers for example. There are over 100,000 seed suppliers in China alone.

Chemical availability: Various chemistries in a range of crop protection products useful in vegetables are under review for their effect on consumers and/or non-targets – fish, environment, native vegetation etc. Other chemicals may be restricted for use by vegetable growers because of their identified terrorism threat. Some concern has also been expressed about the lack of resistance management that is regionally-based and regionally-monitored. In vegetable production regions this will become an increasingly important issue.

16.1.5 Emerging Operational Threats to Biosecurity

Awareness: Of greatest concern to the vegetable industries and horticulture in general, is the current lack of biosecurity awareness. Although the market access implications of this (eg surveillance evidence) are generally recognised by industry, there is little recognition of the impact an unaware community may have on biosecurity activities should they disrupt normal life and economic well-being. To-date the public have been supportive of fruit fly networks, border controls and eradication programmes in backyards etc. but the cooperative sentiment should not be taken for granted.

Lack of funding: This is discussed in detail below, but it is inevitable that industry is today expected to contribute more to the advancement of biosecurity throughout the continuum. It is in industry's interest to proactively identify their priority areas of contribution to ensure they will derive the greatest returns on investment.

17 RECOMMENDATIONS AND OPPORTUNTIES FOR ENHANCED VEGETABLE BIOSECURITY

The key drivers for improving 'whole of industry' biosecurity, are improved and standardised competencies in several areas. There are general areas of investment needed, and biosecurity considerations need to be incorporated into each area.

Table 19 is a partially-completed vegetable health strategy template, provided here as an example of how the vegetable industry health strategy should be aligned with the National Plant Health Strategy. This framework once completed by industry (with timelines), should be considered the information included in Tables 20 and 21. In combination, the information provided will allow the vegetable industry to identify the priority investment areas that will advance vegetable health, and the industry's surveillance, preparedness and response capacity.

Table 19 : Elements of the national plant health strategy relevant to vegetable industry biosecurity

Elements	Outcome Sought	Activity (steps)
PREVENTION		
Industry Biosecurity Plans (National Biosecurity Plans)	Commitment and focus of industry and government on emergency response preparedness Integrated biosecurity planning and extension Improved industry and farm biosecurity (through AUSVEG/HAL and in partnership with government and PHA)	Review and update the Vegetable Industry IBP Develop vegetable Biosecurity on-farm Manual Identify surveillance capacity and capability for each priority pest Identify for each pest priority biosecurity activities to mitigate impact of an incursion (eg. breeding, early detection surveys, diagnostic capability, detection technology and methods, cultural options etc) Identify EPPs without clear control/management options in each region
Contingency planning	Emergency vegetable pests covered by generic regional contingency plans (to facilitate response) Specific, integrated contingency plans for EPPs, and horticultural regions of annual and perennial mixed enterprises	Draft contingency plans Review existing plans (OCPPO, PHA etc) – Collate technical information on EPPs Prepare response plans Collaborate regionally to integrate plans for shared EPPs
Pest risk assessment	Consistent pest risk assessments in priority areas (in ISPM #2 framework) Increased seed biosecurity - traceability and testing pre-shipment – ie. more ICON requiring Phytosanitary certificates	Request PRAs for imported seed (by industries reliant on imported seed) Request audits of all 'certified' or 'approved' premises and producers (granted PEQ time or testing reductions)
PEQ	An effective and efficient PEQ system to facilitate safe entry of seed, vegetative planting material; and control specimens for research Protocols internationally and nationally validated Recognition of pesticide resistant and/or new pathogen strains as threats	Identify expectations, needs, benefits and demands for PEQ – current and future Increase PRAs (esp. for seed) and request PEQ testing and resource prioritisation to higher risk sources (countries) and commodities Adoption of latest technology esp. for import testing; detection of exotic strains; pesticide resistant strains
DETECTION		
Surveillance	A national approach to surveillance leading to sharing of data, effective and efficient recording and reporting of Australia's vegetable health status	Invest in detection technology research – collaborative across RDCs Develop and integrate surveillance activities in partnership with PHA and government. Communicate regularly with pre-border and border authorities Increase industry contribution to general surveillance and on-farm surveillance; human capacity building. Develop protocols for priority pests/diseases.
National Surveillance Strategy	A vision and direction for the definition of Australia's plant health status, including development and implementation of tools and methods	Complete national vegetable health strategy template in National Plant Health Strategy format Promote and motivate regional and on-farm surveillance Provide adequate training and resources for surveillance
Tools – extension to industry	All plant industries use the national reporting tool to register routine and ad hoc surveys	Extend NPSRT tool to representative vegetable industries (with PHA and OCPPO assistance)
Reporting	Application of BioSIRT for routine and emergency surveillance data as part of emergency response and preparedness capacity building	Implement BioSIRT – introduce for routine (eg. fruit fly) and other surveillance and reporting

Elements	Outcome Sought	Activity (steps)
Domestic Quarantine and Market Access	Planned DQMAWG activities and outcomes completed effectively and efficiently	Assist DQMAWG. Encourage focus on priorities of harmonisation of interstate trading conditions and science-based treatments and/or regulations
DIAGNOSTICS		
SPHDS	Adopted PHC-endorsed SPHDS protocols after peer review SPHDS activities and outcomes completed effectively and efficiently, in collaboration with NZ, EPPO if needed	SPHDS focus on development and implementation of a national laboratory accreditation system Support the drafting and validation of national diagnostic protocols Contribute resources for international peer review of protocols Plant Health experience register development with links to the Australasian Plant Pathology Society database Use CABI for seedborne diseases
Diagnostic reference specimens	Live organism (for positive controls or research) PRAs Positive controls available for rapid verification of EPPs in Australia Validated national diagnostic standard for all categorised EPPs	Request BA and AQIS approve rapid passage for evaluation of import requests for reference specimens (eg. essential for the validation of diagnostic protocols) Drive development of new facility/containment protocol as repository for reference material
National Diagnostics Strategy	A vision and direction for the delivery of diagnostic services that underpin Australia's plant health status, including development and implementation of innovative tools and methods	Implement revised/validated PEQ protocols in all diagnostic serivces Drive increased diagnostic capability– for increased testing frequencies, esp for viruses, seed Drive support for sharing of PEQ and interception data in useful format. Increase industry self-sufficiency with incentives for education in the disciplines Develop the strategy, as an element of the National Plant Health Strategy, to optimise Australia's long term diagnostic capacity and capability that is appropriately resourced
Packaging for diagnostic samples	Confidence in risk-based packaging and transport of plant material	Analyse impact of revised Australian standard Ensure systems in place for traceability Identify 'risk packaging' for vegetables Seek modification of standard for plant specimens based on risk
Financial framework	Consistent, effective and efficient reporting of financial accounting, (as per Deed obligations – once a signatory)	Finalise financial framework for applications in emergency response
Review Schedule 13	Pests list in Schedule 13 consistent with the definitions of an EPP	Update Schedule 13 on regular basis. Re-consider status of C-LA and PSTVd
Training	All components of industry familiar with operational role and responsibility in preparedness and emergency. All roles undertaken with commitment and high level of competency	Training gaps identified and addressed Awareness gaps identified and addressed Simulation exercises prepared to ensure roles and responsibilities in an emergency response are understood Response capacity gaps identified across government and industry, regionally
MANAGEMENT OPTIONS - ENDEMIC & EXOTIC PESTS		
National Plant Health Status and biosecurity report	A comprehensive and readable 'map' of Australia's plant health status	Vegetable industry awareness of gaps and exposures in biosecurity HAL R&D funded generation of residue data to support retention of uses Requests for compulsory reporting of residue detections, in all states

Elements	Outcome Sought	Activity (steps)
National approach to management of vegetable pests	Effective and efficient management and control of established endemic pests and diseases Systems approaches and (some) ICAs accepted internationally	Establish and maintain guidelines for area status – PFA, ALPP etc Science-based management options known for all endemics and exotics Systems approaches validated and applied where appropriate - documentation of evidence supportive of market access for commodities
Key pests and industry cross linkages (not only vegetable industries)	Planning and R&D coordination across sectors; shared roles identified Hosts and Non-hosts identified for EPPs	Shared threats reviewed – nature and sources Collaborative pollination and bee protection / biosecurity Collaborative research into pollination alternatives Collaborative research into shared pest management and prevention options Management options for non-hosts and alternative hosts (other than vegetables) known, and integrated management options documented
Pests and vectors Impact on vegetables? Some vegetables now a "fruit fly host"	Minimised trade and production disruption Completion of the APVMA reviews of dimethoate and fenthion Identified alternative post-harvest treatments that allow market access confidence	Collaborative research into vector detection and management options Research into predicted capabilities of endemic vectors, for EPPs Collaborative development of alternative treatment data (eg. irradiation) APVMA readiness for chemicals suitable for EPP management
Irradiation	Irradiation as a phytosanitary measure in Australia? Acceptance of irradiation in cases with clear biosecurity cost-benefit? Identified alternatives for post-harvest disinfestation and their relative (to irradiation) effectiveness	FSANZ risk analysis to allow application of irradiation on an expanded range of fruit and vegetables DQMAWG develop ICA processes for application and regulation of application of irradiation Jurisdictions complete regulation review and outline implementation of irradiation as a treatment
Methyl Bromide alternatives	Alternatives for MB identified and aligned with management option gaps Australia's use of MB (for QPS) is reduced	Finalise analysis of stocktake data and launch the MBAIS database Develop of alternatives filled through appropriate R&D Maintain watching brief on international actions that may impact the availability and use of MB
COMMUNICATION & AWARENESS		
Regional and community biosecurity	Regional biosecurity with identified economic units (eg by EPP response; recovery period etc)	Develop material to extend biosecurity planning and preparedness to regional, peri-urban and local communities
Peri-urban	Demonstrable biosecurity awareness in peri-urban areas (eg. changed n risk behaviour)	Extension of biosecurity messages Active biosecurity measures taken by farmers, land holders, nurseries, packers etc in the peri-urban fringes Auditable assessment of awareness designed
Seed producers, importers, propagators and nurseries	Biosecurity plans that accommodate specific input for enterprises using true vegetable seed or vegetative seed	Promote benefits of accreditation to nursery and transplant producer Engage, and outline communication expectations

Elements	Outcome Sought	Activity (steps)
Allied industry – eg. national distributors, chemical importers and re-sellers, transporters, pollination industry	Prepare awareness material Ensure relevant audit material is available, and suitable traceability manifests	Collaborate with RDCs and other industries to prepare material and key messages Communicate incentives to undertake biosecurity initiatives
INFORMATION & DATA MANAGEMENT		
Survey of information to support plant/vegetable (and alternate host) health activities	Nationally-consistent approach to the collection, collation, recording and reporting of data to assist in biosecurity planning and operations Data accessible and current with responsibilities to update known	Jurisdictions and industries identify information needs, purposes and infrastructure for recording, collating and reporting surveillance and diagnostic outcomes Consider national data input – eg AusBioSEC initiative Evaluate efficacy of ABIN as a vehicle to facilitate a national approach
Survey information to support production region area freedom, site freedom, area of low pest prevalence	Regionally-coordinated protocols and templates with on-farm surveillance underpinning the data	On-farm surveillance Self-audits undertaken
COLLABORATIVE R&D & INNOVATION		
Cooperative Research Centres, RDCs, private consultants, Universities, contractors	Collaborative research and resources in high priority cross-agency and industry areas – with adoption likely No duplication of high priority research	Integrated R&D priorities Shared research resources to maximise returns on investment (eg protocol preparations and validations – eg with other industries, EPPO, NZ)
AUSVEG and CRCNPB (and across-RDCs) plant health work plans	Strong and effective links between end users and researchers Risk-based research decisions	Review and provide comment on pre-proposals circulated by CRCNPB; national research framework, AusBIOSEC, other RDCs
EDUCATION & TRAINING		
National Biosecurity Curriculum	Tertiary/post-secondary curricula that attracts and trains biosecurity staff with highly relevant and transferable skills	Human resources capacity increased - High level specialist skills and transferable technical skills supported by industry, committed to industry. Engage in the development of technical and practical curricula Ensure relevance of graduates; clear career path
Succession planning	Planned mentoring and controlled knowledge transfer to minimise loss of corporate and technical knowledge and expertise	Provide opportunities for interaction between agencies, in research and extension – as per University of California
Incursion recovery	Planned process that accommodates social, financial and environmental disruption - agreed in advance	
REGULATIONS		
State and territory governments under plant protection/health legislation, Federal Quarantine Act 1908	Updated Act. Quarantine and PFA zones reflecting national, not state commitment National 'maps' of PFAs, ALPP	Cooperate with state jurisdictions and DQMAWG. Request scientific justification for state (and international) regulations
Review plant health legislation – all states and territories	Transparency in regulation, smooth transition into new regulations	Contribute to reviews Review and provide comment, as appropriate, on regulation changes
International Plant Protection Convention – Strategic Objectives	Strong contribution of Australia in the IPPC Delivery of the strategic objectives	Provide comments to Australian secretariat on draft standards Contribute to Australia's position (eg. implementation of the Convention in Australia, as appropriate)

Elements	Outcome Sought	Activity (steps)
Intra- and Interstate Import policy and movements	National approach to border and regional quarantine and movement *Harmonised* regulation that recognises bio-geographic variation in risk profiles. (Not necessarily *uniform* legislation). Internationally-accepted protocols for maintenance of area freedom and property freedom, in wide use	Contribute, as relevant, to development or review of national quarantine policy Contribute, as relevant, to development or review of domestic quarantine policy (state legislation changes)
RISK ANALYSIS & PRIORITY SETTING		
International trade analyses	Risk minimised through recognition of all pathways, and consistent PRAs	
Inter- and Intra-state analyses	Science underpinning all state regulations	
POLICY		
National Plant Health Strategy	Adopted strategy to lead the development and implementation of Australia's plant health system into the future Strategy for effective management of endemic and exotic pests that affect market access (eg fruit flies)	Contribute and define forward strategies and drivers for vegetable industry
Approved facilities and sources	Routine auditing of certified or approved sources	Discriminating review of industry risk associated with approved sources

Table 20 : Strategies and actions for Government and Industry, to enhance vegetable biosecurity

Strategic Direction	Performance Objectives	Government	Industry
Revised legislation and framework	• Harmonised legislation relevant to biosecurity • Harmonised terminology for biosecurity • Harmonised interpretation of ICAs • Harmonised inspections for domestic and export – duplication removed	• Review Quarantine Act • Expand NAQS territory • Prepare directives to ensure quarantine zones reflect national commitment, ahead of state borders • Review, edit and draft appropriate legislation • Work with DQMAWG (PHC) • Review import permits to ensure traceability of produce and seed	• Awareness and education: of international and state obligations and ALOP • Articulate non-compliance costs and effects
Governments and Industry committed to Plant Health	• Biosecurity and agriculture profiles increased • General awareness of pests & diseases, and other non-biological threats (pesticide resistance; pesticide availability) • Awareness of activity and resources devoted to clean agriculture • Awareness of quarantine and biosecurity systems and of continuum • Awareness of sources and nature of risk Awareness of management and control options	• Prepare lists of pest, weed and disease threats with photos; readily accessible • Continue quarantine campaigns • Release details of recent incursions and cost of their management • Promote ICA acceptance internationally • Identify pest types suited to systems approaches; give case studies • Dictate uptake of endorsed, validated protocols (i.e. SPHDs, EPPO, other) by all diagnostic labs • Recognise pesticide resistance as a threat • List new threats and how being addressed (organic seeds, ornamental seeds, herbal medicines) • Prepare a QA system for surveillance strategies – ensure compliance is auditable	• Contribute to bee and pollination biosecurity • Distribute major pests and disease lists and photos, posters etc • Identify market access biosecurity impediments • Identify biosecurity food safety threats • Identify chemical and regulatory threats to biosecurity • Articulate necessity for on-farm surveillance and community awareness. • Support 'evidence acquisition' in all forms, including trade statistics • Support validation of protocols and insist on peer review; maximise collaboration with NZ, EPPO
Community involvement	• Visible pro-activity in community in relation to pests, diseases and weeds • Engagement with community validated through a simulation exercise? Recognition through awards? • Peri-urban issues understood	• Expand engagement and KPIs for it • Introduce national campaigns with messages adaptive for regional uptake • Identify means of increasing data capture points, or value-adding to existing ones (i.e. expand national trap networks; record results for all insects trapped)	• Include the community at some level in all biosecurity communication • Engage all allied industries • Prepare awareness material • Contribute to rural community functions/events through awareness literature • Develop more community partnerships

Strategic Direction	Performance Objectives	Government	Industry
Effective Risk Assessment	• Completed PRAs for vegetable seed and vegetative seed • New threats/risks understood - source and nature, entry pathways and spread potential; include non-biological ones (chemicals, regulations), climate change, water insecurity etc • Specific identification of peri-urban threats	• Alert peri-urban and urban areas to threats through national campaigns • Drive awareness of abandoned crop, waste removal threats • Prioritise high risks (biological and non-biological) and identify those without clear eradication or control options • Increase risk assessment and system synergy between food safety and biosecurity	• Pressure BA for PRA vegetable seeds and new ornamental vegetable seeds • Identify high risk EPPs and risk mitigation gaps; link into biosecurity plans • Support risk assessment prioritisation process
Increased and optimised surveillance	• Surveillance strategies and purposes outlined • Passive surveillance activities and reporting documented • Active surveillance regionally. Suitable for input to coordinated national surveillance Evidence for Area Freedom, Property freedom, Area Low Pest Prevalence Strategies to maintain area freedom status known and undertaken	• Link and participate with PHA/OCPPO/AQIS • Increase commitment to NAQS • Prepare high risk and high priority surveys – for Market Access and for general Biosecurity • Facilitate regional survey (and reporting templates) development for regions with multiple enterprise mixes. • Facilitate cross-government and cross-industry funds and resource sharing, for surveillance • Articulate on-farm incentives to survey, report and record	• Increase contributions and communication with NAQS, sentinel hive programmes etc • Identify surveillance gaps – on-farm; regional; area status (known not to occur) for market access and high priority pests/diseases • Identify pests/diseases suited to systems approaches • Lead all producers and allied personnel – industry champion of biosecurity? • Promote and lead collaboration • With PHA prepare on-farm biosecurity manuals with adaptive clauses, fact sheets etc • Link into national surveillance & data management schemes

Strategic Direction	Performance Objectives	Government	Industry
Emergency response capability	• Contingency Plans for all high risk threats – biological, chemical and food safety • Preparedness roles and expectations of growers, community, allied industries articulated • Peri-urban threat assessment • Hosts, vectors and alternative hosts known • Biosecurity critical control points known • Cost-benefits of prevention options • Specialist services and capabilities (eg. diagnostic) • Human capacity assessment (mobilisation potential , training needs etc)	• Develop contingency plans for high risk pests and diseases, chemical threats • Chemical needs assessment (for high risk pests) – work with APVMA and other industries • Share interception data from border (AQIS) • Consider benefits of registered production districts • Identify potential climate change impacts on host susceptibility, epidemic potential, passive and active spread for key endemic and exotic pests/disease	• Sign EPPRD • Prioritise high risks endemic and exotic, and chemical and input security • Contingency plans for commodity and region, considering also resistance management • Adopt and implement updated IBP that include biosecurity and risk mitigation measures • Chemical needs – with IPM compatibility, effective WHPs, "worldwide" registration and IR4 synergies investigated • Ensure chemical availability process is operating for EPPs • Human capacity and capability incentives for vegetable industry (scholarships?) • Drive the demand for diagnostic capability • Identify training gaps and priorities • Formalise and distribute recording templates • Contact lists for all response personnel (including media spokesperson)
Risk minimisation and compliance	• Border and intra-state controls supported by science, relevant and strong • AQIS capacity increased – inspection number, technology, personnel, resourcing • Import data verification increased • Pest risk assessments for vegetable seeds • Testing for endemics in PEQ • Seed Analysis certificates include health status • Residue chemists available and working with suitable equipment	• Border controls maintained with science backing • Increase NAQS territory, financial support • ICAs recognised widely and consistently interpreted • Enforce residue reporting to state authorities • Prioritise resources to high risk areas or high non-compliance • Prioritise PRA needs • Commence PRAs on vegetable seeds for crops 100% reliant on imported seed • Ensure traceability intelligence is conveyed to authorities and industry • Identify risk areas outside normal industry and government spectrum – markets, roadside stalls, craft shows, pick-your-own etc. • Support biosecurity compliance development – self-audits and formal audits • Engage AQIS in data release and interception trend discussions	• Sign EPPRD • Identify unjustified trade restrictions • Promote the 'continuum' and on-farm IBPs, QA and surveillance; self-audits • Promote need for certified seed and increased import requirements • Engage AQIS in increased PEQ testing and data release discussions • Increase involvement in NRs and request reporting of residues • Formalise spray diary submissions • Formalise and distribute recording templates • Request that seed is sold with documented health status, and full traceability

Strategic Direction	Performance Objectives	Government	Industry
Effective Research and Development	• Improved diagnostic capabilities • Validated protocols in routine use • Human capabilities fostered and increased • Surveillance methods and packages - by purpose and location, available • Understanding of potential endemic vectors of EPPs and alternative hosts • Cost-benefits of control options including public good • Increased risk assessment for seed, ornamentals and nursery stock	• Link research priorities to risk • Collaborate with agencies and industries to identify cost effective, value-adding biosecurity research to which multiple industries contribute (water efficiency, post-harvest control options, trapping locations and result capture; validating protocols) • Prioritise biosecurity research for national adoption potential rather than commercialisation • Increased PEQ inspection/testing capacity	• Prioritise and support research to close biosecurity gaps (eg protocol validation, seed risk analyses, uptake of on-farm surveillance) • Validate systems approaches for range of pest types and priority market access pests/diseases • Reward training and professional development in biosecurity (insurance benefits? preferred supplier?)
Adequate resources and capabilities	• Human capabilities - known and available • Human capacity – mobilisation preparedness • Equipment suitable for potential tasks • Funding readily accessible • Diagnostic systems verified for high risk pests – collaborative approach –eg NZ, EPPO	• Funding for biosecurity development and enhancement increased • Identify economies of scale in food safety and biosecurity surveillance and best practice management systems • Facilitate formal training of diagnosticians; liaise with universities for course and mentoring options. • Facilitate validation of protocols for all EPPs • Review technology gaps and timeframes for their introductions • Force collaboration to avoid duplication	• Prioritise funding to avoid duplication, low risk production pests, • Support biosecurity research suited to wide adoption • Support GPS resources for surveillance • Cost-benefit analyses for EPPs and costed management options • Identify economies of scale for food safety and biosecurity surveillance • Distribute case study information and economic data to demonstrate prevention vs. eradication costs and resources
Database and information management	• Agreed templates for reporting, inspecting and sampling (+ handling samples, recording sample locations etc) for vegetables. • Agreed mechanisms for surveillance data submission, entry and sharing • Agreed investigation and traceability steps • Agreed timetables for systems (and standards etc) reviews • Scheduled review responsibility for international databases (i.e. CABI seedborne diseases)	• Facilitate centralised data entry into accessible database (on-going) • dissemination of agreed, consistent standards • methods for database and information management	• Grower database/register development • Increase data capture points • Formalise and coordinate acquisition of results • Introduce system of licensing or other that would result in grower register • Prepare awareness material

Strategic Direction	Performance Objectives	Government	Industry
Effective Communications	• Educated and aware continuum - community, industry, Governments • Collaboration across government, industry and community – valued partnerships • Training delivered at all levels • Understanding of international and national developments and obligations • Communication material i.e. pest/disease; non-biological threats, identification kits (fact sheets, posters etc); on-farm packages • Community plans for response to incursions and surveillance	• Support and promote education and awareness • Commission preparation of training modules • Identify awareness gaps • Communicate to the national audience, with identifiable regional messages • facilitate simulation exercises • Promote submission of "something unusual" samples with zero/reduced fees to government laboratories • Identify the incentives to report – through case studies, rewards for alert citizens etc	• Increase education and awareness contributions from all research projects • Identify the gaps in communication network (ethnic groups, minor crops, remote areas?) • Research the most effective communication methods; how to engage the industries • Facilitate release of on-farm biosecurity packages to all growers, and self-audit schedules • Drive diagnostics capacity growth nationally • Foster specialist service providers and increase communications with them, and from them (embrace them within vegetable industry) • Identify roles and responsibilities and communicate them clearly • Ensure key industry and allied personnel are known and can be reached with targeted and blanket communication

Adapted from: PIRSA's Hort Plant Health Consultative Committee Draft 5 yr Strategic and Operational Plan 2008-2013 March 20088

Table 21 : Research themes and their priority in biosecurity enhancement

Research Context	Biosecurity Relevance	Research and Development Priorities
Vegetables and society	• Supporting the link of secure production and processing activities to rural communities and their well-being • Community engagement • Valued preparedness	*Develop and communicate*: Industry statistics Industry engagement and partnership strategies Statistics on pollination economics and security
Vegetable production	• Performance measures • Cost-benefits - Input, output; produce supply and quality • Optimised sustainability • Impact management • System management	*Invest in*: *collaborative* Information acquisition and collection (as above) Surveillance training incentives and reporting motivation Development of area freedom and maintenance of area freedom protocols Costed management options Systems approach feasibility and validation Cost-effective quality and niche produce and performance indicators *Identify:* Non-sustainable and non-competitive sectors Resource use efficiency and opportunities to share Pollination needs and alternatives
Environmental monitoring and manipulation	• Preparedness and response - early detections • Preparedness and response - technological capacity • Prevention and risk minimisation - cultural, seasonal, varietal tools • Climate change predictions for pests, diseases, weeds • Detection and diagnostics	*Invest in: collaborative* Monitoring - maximize returns from monitoring networks Systems approach validation (as above) Integrated technical solutions Surveillance and response strategies – coordinated regionally Reporting suitable as input to centralised database Data collation capacity within regional and national schemes *Facilitate:* Information coordination and sharing – from/to multiple sources Technical skills capacity building
Driving regional and on-farm biosecurity	• Surveillance - value-adding to existing systems • Awareness • Response capacity • Data managed and accessible • Specialist resources - needs analysis	*Invest in and develop:* On-farm/enterprise biosecurity linked to surveillance and best practice/QA packages Consistent surveillance and reporting structures Recording templates and self-audit forms. Data collation capacity within regional and national schemes Funding support for specialist training and mentoring
Distribution of vegetables	• Distribution logistics and critical control points • Post-harvest; packaging, handling; transport – critical controls • Food safety and biosecurity risk reduction • Stepped approach to excellence - with checks/controls; effective technology and human inputs	*Communicate*: Continuum to address threats to environment and product integrity Roles and responsibilities Critical control points in input and produce supply chain *Invest in:* Trialing of post-harvest alternatives

Research Context	Biosecurity Relevance	Research and Development Priorities
Optimised market performance	• Accessible market intelligence • Current database: market requirements, biological, regulatory, legal • Evidence supporting market access • Knowledge of competitors – relative strengths/weaknesses • Competitive advantage in top quality and niche produce • Input security	*Invest in*: Intelligence and evidence gaps – and collaborative approaches to close them Data acquisition and management Building partnerships in community, industry and government Impediment solutions – surveillance incentives, systems approaches, pathway closures, regulatory consistency, chemical and water security, post-harvest alternative treatments etc *Communicate:* Roles and responsibility Capability requirements Solution continuum - between industry, regions, governments
Facilitated Innovation	• Industry unity – in focus, and commitment to national biosecurity • Commitment to awareness and education, capacity building • Focus on adoption • Industry proficiency (meeting expectations?) • Industry self-sufficiency	*Invest in:* Development of national focus on biosecurity Surveillance motivation Proficiency and capability development (technology, systems, human resources with expertise) Research based on risk and industry gaps (in continuum) and adoption potential Provision of training and education incentives in vegetables *Develop:* Leadership. Foster : unity, confidence, self-reliance, mentoring
Supportive policy framework	• National industry focus • Collaboration and coordination cross-agency, cross-industry • Value-adding framework without duplication • Visible leadership potential -Champion the 'continuum' • Directed and focused structural changes	*Invest in:* Policy development that supports biosecurity initiatives and their international acceptance - (diagnostic protocols; systems approaches, evidence acquisition and sharing; updated import conditions; consistent legislation; government-industry communication) *Demonstrate:* Leadership with national focus on biosecurity Structural change benefits and motivation in national interest

18 PRIORITY AREAS OF INVESTMENT TO ENHANCE VEGETABLE BIOSECURITY

Biosecurity is important to the future growth and sustainability of the vegetable industry. As outlined above, there are many facets to biosecurity, and therefore a range of strategies and initiatives are required to fully address plant biosecurity in the vegetable industry, within regions and across the nation. Through enhanced capacity to predict, prepare for and respond to threats, the impact of pests, diseases and weeds will be reduced, and the sustainability, cost-effectiveness and viability of vegetable industries will be increased.

To achieve this however requires considerable investment and leadership. The Commonwealth government has recently committed $5.4 million over four years toward quarantine research and preparedness for horticultural industries. The vegetable industries must ensure they are committed, visible and active participants in this programme.

The vegetable industries are encouraged to prioritise the recommended research and development themes and to identify those for which collaborative approaches are necessary and have clear benefits (eg. regional biosecurity planning; resource-and data-sharing; surveillance technology and economies-of-scale; pollination and post-harvest alternatives; human capacity and diagnostics development – protocols and capabilities; communication and awareness material development etc.). Neither industry nor government has the capability or resources to manage biosecurity, in isolation.

The biosecurity strategies already agreed by HAL are: Biosecurity Planning; Risk Analysis; Risk Mitigation and Reduction; and Market Access Protection. Within each are initiatives that span the continuum. The HAL biosecurity mission appears in-line with those recommendations made above. A recent presentation by Kim James outlines the HAL focus and it is summarised in Appendix 9.

The vegetable industries will immediately have to invest more money, and with a longer-term commitment, to biosecurity. There are existing biosecurity gaps in the vegetable industries and within the rural communities increasingly relied upon as community 'detectives' in early detections and plant biosecurity support. The notable gaps are in biosecurity awareness, commitment and understanding of the shared responsibility; regional collaboration across industries in surveillance planning, technology development and response capacities – eg. data collection and collation, consistent diagnostic tools, protocols and capabilities; and in the tools and expertise available to prepare for, manipulate, or manage realised or potential pest threats. It is therefore reasonable to conclude that the major areas requiring increased investment are:

- **Coordinated regional and national surveillance** (underpinned by on-farm and regional plans, research and technology development, and increased AQIS-NAQS resources)
- **Coordinated data acquisition and sharing mechanisms** (that include research and intelligence on direct and indirect threats – input security, pests presence and absence, weather events, regulatory changes etc. pre-border to post-border)
- **Human capacity building** (and the research commitment and educational incentives, training and schemes necessary to underpin and advance it)
- **Communication** (that is outcome-focussed and regionally-targeted; regularly evaluated for effectiveness and reach; and clear and consistent in its articulation of the economic [and social] necessity for engagement and participation, by each targeted sector).

19 HAL PROJECTS

It has not been possible to determine the value-to-date of HAL projects in the above areas, as they have not been made available for this review.

It is however apparent that an increased commitment to and investment in biosecurity is necessary across horticultural industries. The biosecurity of vegetables is multi-faceted and it is therefore also necessary for leadership to be shown in identifying the priorities for collaborative, biosecurity investment, planning and research by industries that share production regions with vegetable industries.

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http://www.daff.gov.au/content/output.cfm?ObjectID=8EF5A934-CF58-41B5-8F26AAEC1FB4B552 (export forms)

http://www.daff.gov.au/content/output.cfm?ObjectID=D2C48F86-BA1A-11A1-A2200060A1B00633 (EXDOC website)

http://www.aqis.gov.au/phyto/asp/ex_search.asp (PHYTO search)

http://www.aqis.gov.au/icon32/asp/ex_topiccontent.asp?TopicType=Quarantine+Alert&TopicID=21452 (Quarantine Alert PQA0552)

http://www.daff.gov.au/aqis/quarantine/naqs/zones (NAQS zone map)

http://www.finance.gov.au/comcover/getting-wired/docs/NAQS_presentation.pdf (NAQS zone map)

Vegetable Industry Statistics (March, April, 2008)

http://www.ausveg.com.au/assets/contentitems/public/6777/ImportOriginUpdateJul-Dec07.pdf

http://www.ausveg.com.au/assets/contentitems/public/6777/SummaryImportProductUpdateJul-Dec07.pdf

http://www.ausveg.com.au/assets/contentitems/public/6777/SummaryExportProductUpdateJul-Dec07.pdf

http://www.ausveg.com.au/assets/contentitems/public/6777/ExportDestinationUpdateJul-Dec07.pdf

Australian Food Statistics

www.daff.gov.au/foodinfo

Weather - Bureau of Meteorology

http://www.bom.gov.au/weather/cyclone/about/cyclones-eastern.shtml#history (Cyclone track maps)

http://www.bom.gov.au/weather/cyclone/tc-history.shtml (Cyclone track maps)

Crop Management and Food Security

Commercial Vegetable Production Guides
http://hort-devel-nwrec.hort.oregonstate.edu/vegindex.html.

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European Union Quarantine Websites

http://www.eppo.org/QUARANTINE/listA1.htm
http://www.eppo.org/QUARANTINE/listA2.htm
http://www.eppo.org/QUARANTINE/Alert_List/alert_list.htm

(Use above for the "Alert list" which names pests that may present risk to European Plant Protection Officer (EPPO) countries)

International Plant Protection Convention

https://www.ippc.int/IPP/En/default.jsp (for Adopted International Standards for Phytosanitary Measures - ISPMs)

Seed Testing

International Seed Testing Association (ISTA). http://www.seedtest.org

International Seed Federation – World seed trade statistics: www.worldseed.org/statistics

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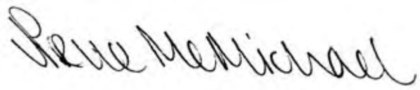
SCHOLEFIELD ROBINSON
HORTICULTURAL SERVICES PTY LTD



PRUE McMICHAEL
Plant Pathologist\Principal Consultant
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Appendix 1

The HAL Brief and Review Consultation List

Know-how for Horticulture™

Vegetable Biosecurity and Quarantine Gap Analysis

Proposal Brief for VG07087
February 2008

Project Description

Horticulture Australia Limited (HAL) seeks assistance to assess the national vegetable biosecurity and quarantine program for current status and possible gaps including:

1. Examination of what biosecurity measures are currently in place for the industry in national import movements and recommendations to minimise the risk of incursions of exotic pests and diseases;
2. Examination of what quarantine measures are in place currently for the industry in national export movements and recommendations to improve market access and trade;
3. Examination of the biosecurity and quarantine measures currently in place for the industry in interstate movements and recommendations to improve interstate movement of produce while minimising the risk of incursions of exotic pests and diseases;

The review is to use a framework that can be examined in conjunction with

a) the existing Plant Health Australia (PHA) Vegetable Biosecurity Plan, launched in May 2007 by the Federal Government and
b) current Australian vegetable industry production and trade.

We invite qualified consultants or experienced researchers to submit a written proposal of your company credentials and an outline of how you would undertake this research proposal.

Background

The Australian vegetable industry is estimated to be worth over $2.75 billion and HAL, on behalf of the Commonwealth Government, have collectively invested over $60 million dollars in vegetable related research since 2001. The vegetable sector is multi-faceted; with many businesses are geographically spread and supplying a variety of products to meet domestic and overseas consumer demand. As such, there is an interest in indentifying any potential biosecurity and quarantine risks that may threaten industry production.

There is an acknowledgement that the vegetable industry's R&D program has not adequately addressed biosecurity matters in the past. As the global community becomes a reality, the Australian vegetable industry would like to be proactive in positioning themselves to address such issues. The needs and capacity of the industry is to be taken into consideration, as are any relevant existing programs or initiatives.

Communicating the outcomes of this project is not part of this process and will be considered separately.

Project Detail

HAL requires the national vegetable program biosecurity and quarantine activities be reviewed and recommendations for action developed. Areas of review and needs assessment to be addressed include:

1. Examination of what biosecurity measures are currently in place for the industry in national import movements and recommendations to minimise the risk of incursions of exotic pests and diseases;
2. Examination of what quarantine measures are in place currently for the industry in national export movements and recommendations to improve market access and trade;
3. Examination of the biosecurity and quarantine measures currently in place for the industry in interstate movements and recommendations to improve interstate movement of produce and to minimise the risk of incursions of exotic pests and diseases;
4. Identification of current biosecurity gaps and recommendations to improve biosecurity for the Australian vegetable industry;
5. Identification of any regional or on-farm biosecurity or quarantine measures or good practice that can be adopted and the best means for funding and activating such activities;
6. Recommendations in relation to an additional role for biosecurity education and awareness; and how can it be best achieved (refer to HAL industry development review project)
7. An evaluation in relation to how well the levy payers interests have been served to date and/or could be improved in the future;
8. Identify any public benefit that has been or may be created by the review and recommendations

This project will build the case for where industry biosecurity and quarantine efforts are best directed to maximise future investment. Consultation with relevant industry personnel, commercial and government organisations would form a critical part of the assessment process. Development of projects to address the identified issues or program gaps and their prioritisation is also required. Opportunities for leveraging of funding with interested parties are to be explored.

Two base documents will be available from HAL to assist applicants:

1. The Plant Health Australia (PHA) National Vegetable Industry Biosecurity Plan (available on CD), and
2. Summaries of Australian vegetable industry production and trade (5 year production, export and import figures by state, volume and value), available on e-mail.

These base documents for the project above are available on request from:
Ms. Karen Symes, Horticulture Australia Ltd, Sydney (contact details later in this document).

Terms of Reference

The successful person will have skills in the following areas:

Essential

- Biosecurity, trade and quarantine awareness and understanding of existing protocols.
- Suitable statistical and analysis experience, and
- Effective desktop research skills.

Desirable

- advanced computer skills.
- knowledge of Research and Development Corporation (RDC) operations, and
- familiarity with horticulture as an industry.

The project providers will need to liaise with:

- Kim James and Lucy Keatinge, Horticulture Australia Limited
- Other staff and steering committee members, as required
- AUSVEG as the peak industry body for the Australian vegetable industry
- Vegetable exporters and importers
- National and state biosecurity and trade legislators

Project Outputs

Outputs:

- Final report that includes assessment of current status, critical issues, identification of key strategies and recommendations for areas of improvement.
- Milestone reports (as required).
- Industry presentations (as required).

Outcomes:

- State of play currently with import/export requirements (biosecurity and quarantine).
- Identify biosecurity deficiencies and provide recommendations to improve this situation.
- Identify any quarantine and biosecurity gaps that require addressing and rank these as to industry impact and attainability.

Draft Timetable

Detail	Summary/points	Finalised by
1. Select service provider/s	Service Provider selected on basis of selection criteria following release of proposal brief	14 March 2008
2. Initial project briefing and HAL project R&D contract	Provide service provider with an initial briefing and answer questions regarding analysis requirements	28 March 2008
3. Brief progress report	Reporting of project progress to HAL	Monthly (email) and if required a meeting or teleconference
4. Final report	Final report submitted to HAL	14 June 2008

Project Management Responsibilities

The successful project providers will report to Kim James, Portfolio Manager-Biosecurity, HAL

Mr. Kim James
Portfolio Manager – Biosecurity and Market Access R&D

Project Support

Project support will be available from HAL Sydney via:

Ms. Lucy Keatinge
Industry Services Manager – Vegetables

Resource Allocation to the Project

The project providers will provide their own administrative support, including word processing and printing requirements. The project providers will be responsible for the collation of data and the analysis of the results.

The HAL contacts will provide assistance in accessing relevant HAL documents and appropriate HAL and industry representatives as may be agreed to.

The project provider's personnel allocated to the project cannot be changed throughout the project without the concurrence of HAL.

General Conditions of Contract

Horticulture Australia Ltd expects that:

- Confidentiality will be maintained at all times.
- All intellectual property (including but not limited to the copyright in all reports) developed, as the result of a project, will remain the property of HAL.
- The project is undertaken in an impartial, objective and professional manner.
- EEO principles will be applied in both the selection of personnel for the project and in the conduct of the project.
- The project provider has insurance cover for property damage and public risk, public liability and accident or injuries to employees of their company.
- Any areas of potential conflict of interest be identified at the time of the project provider's response to the brief and updated during the course of the project should potential conflicts arise.
- The project provider's contract may be terminated or the work content reduced, with a fair and reasonable monetary adjustment determined by HAL, subject to the service provider/s being given notice in writing.
- Any material provided by HAL for this project will be used only for this project and remains the property of HAL.
- A formal Research Agreement will be entered into at the commencement of the project. The general conditions as stated in the brief and the specific conditions as stated in the Research Agreement will apply.
- The decision as to which, if any, proposal will be pursued further will be made by HAL at its absolute discretion. No legal relations with regards to any proposal will arise unless a legal agreement with HAL has been executed.

Service Provider's Proposal

The service provider's response to the brief must address:

1. Methodology:
   a) Demonstration of a detailed understanding of the project requirements.
   b) A detailed description of the proposed methodology to address the specific project outcomes and associated timeframes.
   c) All information required to complete the proposal application form on the HAL database.

2. Costing and payment schedule:
   a) A total job cost with breakdown of anticipated costs for each major phase or milestone of the project, including allocation of the consultant's time, material and other costs including administrative support, downloading of the submission, requested resubmissions following acceptance of tender, legals, travel, meeting attendance and presentations, project updates, final reporting. All costs to be presented and noted as GST exclusive.

   b) A detailed outline of project payment details including:

      Proposal Title: Vegetable biosecurity and quarantine gap analysis
      Proposal Number: VG07087

Milestone: 101 (the first milestone)
Date:

- Description: Agreement signed and IP arrangements in place
- Criteria: Agreement signed and returned to Horticulture Australia Ltd

$ Amount:

Milestone: 190 (the final milestone)
Date:

- Description: Final report received by Horticulture Australia Ltd
- Criteria: All necessary reports complying with Horticulture Australia's requirements received and approved by Horticulture Australia Ltd. (Report to be submitted in HAL milestone format to milestones@horticulture.com.au) by the due date.

$ Amount:
(Note the final payment must be at least 25% of the total project value)

3. Qualifications of Service Providers (background section):
   a) A statement of the names, role, qualifications and experience of personnel allocated to the project must be provided.
   b) Details of the experience of both the organisation and personnel nominated for this project must also be provided.
   c) Contact details for all personnel nominated for involvement in the project.
   d) Clearly identify the project leader, the main contact for correspondence.

Criteria for Selection

The various criteria for selection will include:

- Competence of the service provider to undertake the work.
- Cost-effectiveness and value for money (provide relevant information in budget justification, proposed budget and other sections of the proposal).
- Ability of the service provider to undertake the work in a timely and effective manner.
- Past history in the field of research (provide relevant information in background section of the proposal).
- Appropriateness of methodology.
- Quality of proposal.
- Other criteria considered applicable by HAL.

Lodgement of Response

To respond to this brief please submit a proposal including acknowledgment that all terms and conditions stated in this brief are accepted.

Full proposals addressing the submission criteria will need to be prepared and submitted by e-mail to:

Ms. Karen Symes
Horticulture Australia, Sydney
E: karen.symes@horticulture.com.au

The closing date for proposals is 5 p.m. (EST) Friday 29th February, 2008.

Other:

The successful applicant will be required to complete a normal HAL R&D Proposal online prior to issue of the project contract. More information including how to submit a proposal, is available at www.horticulture.com.au

If you have any questions of HAL please contact:

Mr. Kim James
Portfolio Manager – Biosecurity and Market Access R&D
Horticulture Australia Limited
T: 08 6389 1407
F: 08 6389 1412
E: kim.james@horticulture.com.au

Or

Ms. Lucy Keatinge
Industry Services Manager – Vegetables
Horticulture Australia Limited
Level 17, 179 Elizabeth Street, Sydney NSW 2000
T: 02 8295 2300
F: 02 8295 2399
E: lucy.keatinge@horticulture.com.au

CONSULTATION

Australia – Written or phone contact

General Biosecurity

Colin Hanbury (HortGuard AgWA)
David Anderson Ausveg Chair
Jim Turley (Exec Officer Vegetables WA)
Kim James (HAL Biosecurity)
Ryan Wilson (PHA)
Sharyn Taylor (PHA)
Stephen Winter (Market Access Committee – HAL)

Biological

Alan McKay (AgWA)
Andrew Watson (pathology – NSW National Vegetable Industry Centre)
Anthony Wicks (PEPICC)
Barbara Hall (SARDI)
Sumich, WA)
Boomaroo Nurseries
Craig Murdoch (IDO – Victoria)
Gary O'Neill (Elders – National Seed Manager)
Growcom (Jan Davis)
Jo Slattery (PHA)
Len Tesoreiro (Pathology - NSW Ag)
Lois Ransom (Chief Plant Protection Officer)
Matthew Needham (Pacific Seeds)
Peter Smith (Seed Services PIRSA)
Richard Knowles (Seminis)
Sandra McDougall (entomology -NSW National Vegetable Industry Centre)
Shashi Sharma (AgWA)
Stephen Morris (Post-Harvest Laboratory)

Chemical and Regulatory

David Beardsell (DPI Vic)
David Cartwright (PIRSA)
Denis Hamilton (Biosecurity Queensland)
Ian Reichstein (DAFF – NRS)
Kevin Bodnaruk (AKC Consulting)
Noel Wilson (Kimberley region District Mgr)
Peter Dal Santo (Agaware)
Rob Schwartz – BA
Roger Toffolon (NSW-Biol and Chemical Risk Mgt)
Satendra Kumar (NSWAg)
Shashi Sharma (AgWA)
Stuart Smith (NT)

International – written or phone contact

Arnie Tchanz: USDA-APHIS
Dennis McGee: Author *Plant Pathogens and the Worldwide Movement of Seeds*
Gene Miyao: (UC Davis Co-operative Extension - Tomato specialist farm advisor)
Mike Davis: (UC Davis Extension Specialist – Vegetable Pathology)
Rick Bostock: (UC Davis Pathology professor; Director, Western Plant Diagnostic Network)
Trevor Suslow: (UC Davis – post-harvest pathology and food safety)
TS Woods: Principal, E.G. Mahler and Associates, Pennsylvania USA.

In-person meetings

Growcom, QLD	Mark Panitz	Leanne Usher
Biosecurity Queensland	Mike Ashton Plant Biosecurity (Gen Mgr)	Sandra Baxendell Chemical use and food safety (Gen Mgr)
AQIS/DQMAWG	Roberta Rossely	
AQIS (Canberra)	Mike Robbins	Jack Simpson
BA (Canberra)	Nasir Mahmood	David Letham

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Appendix 2

Seedborne and Transmitted Pathogen List (Irvine, 2005)

SEEDBORNE VIRUSES

List of exotic seedborne/seed transmitted pathogens and pathogens whose transmission has not yet been established and their association with major vegetables crops grown in Victoria. This list has been compiled as an overview from the literature available and not a comprehensive list.

Pathogen	Crop	Type	Status in Australia		Source	Comments
			Exotic	Seedborne		
Acidovorax avenae subsp citrulli	Pumpkin, Cucumber	B	Y?	Y	CRCTPP	Pathogroups
Alternaria burnsii	Cumin	F	Y	Y	NZ Bio	Grown with veg?
Artichoke Italian latent virus	Cucumber, Bean, Chicory	V	Y	Y?	VIDE	Not established
Artichoke yellow ringspot virus	Bean, Cucumber	V	Y	Y	VIDE	
Asparagus virus 2	Asparagus, Spinach	V	Y?	Y	VIDE	Not surveyed
Beet cryptic III virus	Beet	V	Y	Y	ICTV	
Beet leaf curl virus	Beet, Spinach	V	Y	Y?	VIDE	Not established seed.
Beet necrotic yellow vein virus	Beta and Spinach	V	Y	Y?	EPPO	Hitchhiker pathogen
Carrot temperate virus 4	Carrot	V	Y	Y	ICTV	
Chicory yellow mottle virus	Chicory, possibly Celery, Brassicas, Cucumis, Lettuce, Bean	V	Y	Y	VIDE	
Cladosporium oxysporum	Tomato, Capsicum	F	Y	Y?	Plant Disease 1997.	Not established seed.
Cladosporium variabile	Spinach	F	Y	Y	Phytopath 2002	
Clavibacter michiganensis subsp sepedonicus	Beta spp	B	Y	Y	EPPO	
Colletotrichum panacicola	Ginseng	F	Y	Y	Plant Health Canada	
Cowpea mild mottle virus	Bean, Tomato, Eggplant	V	Y	Y?	EPPO	Some reports positive seed
Cucumber green mottle mosaic virus	Gourd	V	Y	Y	VIDE	
Cucumber leaf spot	Cucumber	V	Y	Y	VIDE	
Cucumber pale fruit Vd	Tomato?, Cucumber	Vd	Y	Y?	ICTV	Hop stunt strain
Cucumber vein yellowing	Zucchini, Cucumber	V	Y	Y?	VIDE	Not established
Curtobacterium flaccumfaciens pv betae	Red beet	B	Y	Y	Agarwal/Sinclair	
Eggplant mosaic virus	Capsicum, Cucumis, Vigna, Solanum	V	Y	Y	VIDE	
Erwinia carotovora	Capsicum, Garlic, Tomato, Onion, Cabbage, Cauliflower, Leeks, Melon, Asparagus, Lettuce, Chicory, Horseradish	B	Y	Y	Int J System Bacterio 1987,1992.	Subspecies; betavasculorum, wasabiae, odorifera.
Erwinia persicina	Bean, Cucumber, Tomato	B	Y	Y	Plant Disease 2005	
Erwinia stewartii	Corn	B	Y	Y	USDA ARS	
Erysiphe cichoracearum	Chicory, Artichoke (common in Aust on lettuce)	F	Y	Y?	CABI	Not established
Fusarium oxysporum f.sp apii	Celery	F	Y	Y	Agarwal/Sinclair	
Fusarium oxysporum f.sp.lactucae	Lettuce	F	Y	Y	Phytoparasitica 2004	
Heterodera glycines	Beans	N	Y	Y	EPPO	Seedborne soybean.

Pathogen	Crop	Type	Status in Australia		Source	Comments
			Exotic	Seedborne		
Heterodera goettingiana	Pea, Broad Bean	N	Y	Y	Agarwal/Sinclair	
Hoja de perejil	Tomato	M	Y	Y?	Seedquest	Not established
Kyuri green mottle mosaic virus	Cucurbits	V	Y	Y?	Springer	Tobamovirus
Leek white stripe virus	Leek	V	Y	Y?	ICTV	Unknown trans
Maize chlorotic mottle virus	Corn	V	Y	Y	VIDE	
Melon necrotic spot virus	Cucurbit, Vigna	V	Y	Y	VIDE	
Myrothecium roridum	Cucurbit	F	Y?	Y?	Pl. Disease 2005	On watermelon.
Nematospora coryli	Bean, (found on citrus)	Y	Y	Y?	CABI	Not established
Obuda pepper virus	Capsicum	V	Y	Y?	Springer	Tobamovirus
Oidium neolycopersici	Tomato	F	Y?	Y?		Not established
Ourmia melon virus	Cucumber, Pumpkin, Melon	V	Y	Y	Springer	Tobamovirus
Pantoea ananatis	Onion	B	Y	Y	Pl Disease 2002	
Paprika mild mottle virus	Capsicum	V	Y	Y	Springer	Tobamovirus
Parietaria mottle virus	Tomato, Spinach, Basil, Bean	V	Y	Y?	VIDE	Not established
Parsnip mosaic virus	Carrot, Parsnip, Spinach,	V	Y	Y?	VIDE	Unlikely seed
Pea early browning virus	Pea, Bean	V	Y	Y	VIDE	
Pepino mosaic virus	Tomato	V	Y	Y? Not transmitted	VIDE	Research ongoing
Pepper ringspot virus	Capsicum, Tomato	V	Y	Y?	VIDE	
Peronosclerospora philippinesis	Corn	F	Y	Y	USDA	
Peronosclerospora sorghi	Corn	F	Y	Y	USDA	
Phytophthora capsici	Pumpkin, Tomato, Capsicum, Cucumber, Chillies, Eggplant	F	Y	Y	Agarwal/Sinclair	
Potato andean latent virus	Cucumber, Tomato	V	Y	Y?	VIDE	Seedborne potato
Potato spindle tuber Vd	Tomato, Capsicum, Pepino	Vd	Y	Y	ICTV	
Potato virus T	Beet, Bean, Pea, Spinach	V	Y	Y?	VIDE	Seedborne potato.
Prunus necrotic ringspot virus	Cucumber	V	Y	Y	CMI	In Aust other hosts
Pseudomonas lacrimans	Cucurbits	B	Y	Y	Agarwal/Sinclair	P.syringae pv lacry?
Pseudomonas mediterranea	Tomato	B	Y	Y?	Plant Path	Was P. corrugata?
Pseudomonas solanacearum	Capsicum	B	Y	Y	CMI (79)	In Aust on tomato
Pseudomonas syringae pv apii	Celery	B	Y	Y	Agarwal/Sinclair	
Pseudomonas viridiflava	Radish, Parsnip	B	Y	Y	Agarwal/Sinclair	In Aust on other hosts
Pythium tracheiphilum	Lettuce	F	Y	Y?	Seedquest	Not established
Ramularia coriandri	Coriander	F	Y	Y	NZ Bio	Grown with veg?
Raspberry ring spot virus	Solanacae, Beet, Spinach	V	Y	Y?	VIDE	Not verified
Sclerophthora rayssiae	Corn	F	Y	Y	USDA	
Southern bean mosaic virus	Pea, Bean	V	Y	Y	VIDE	
Spinach latent virus	Spinach	V	Y	Y	VIDE	
Spinach temperate cryptic virus	Spinach	V	Y	Y	ICTV	
Tobacco mosaic strains	Legumes, Solanaceae	V	Y	Y	Springer	Tobamovirus

Pathogen	Crop	Type	Status in Australia		Source	Comments
			Exotic	Seedborne		
Tobacco rattle virus	Capsicum, Beet, Spinach	V	Y	Y	VIDE	On Vic exotic list
Tomato apical stunt Vd	Tomato	Vd	Y	Y?	EPPO	Israel. PSTV strain?
Tomato black ring virus	Tomato, Beet, Allium	V	Y	Y	VIDE	
Tomato bushy stunt virus	Tomato, Capsicum	V	Y	Y	VIDE	
Tomato chlorotic dwarf and tomato planta macho Vd	Tomato	Vd	Y	Y?	NCBI	Viroids related to PSTV?
Tomato chlorotic spot virus	Tomato, Lettuce	V	Y	Y?	VIDE	If tospovirus seed unlikely.
Tomato fruit yellow ring virus	Tomato	V	Y	Y?	Seedquest	If tospovirus seed unlikely
Tomato top necrosis virus	Tomato	V	Y	Y?	ICTV	Nepovirus
Turnip vein clearing virus	Crucifers	V	Y	Y?	Springer	Tobamovirus
Verticillium dahliae	Spinach, Lettuce	F	Y	Y	Pl Disease 2005	In Aust other hosts.
Xanthomonas axonopodis pv allii	Onion, Garlic, Leek, Chive, Welsh onion	B	Y	Y	Int J Syt Env Micro 2003	
Xanthomonas campestris pv cucurbitae	Cucumber, Bean	B	Y	Y	Agarwal/Sinclair	
Xanthomonas campestris pv raphani	Radish	B	Y	Y	Agarwal/Sinclair	
Youcai mosaic virus	Crucifers	V	Y	Y?	Springer	Tobamovirus

V = Virus, F = Fungi, B = Bacterium, N = Nematode, P = Protozoan, Y = Yeast, M = Mycoplasma/Phytoplasma, Vd - Viroid
(sourced, APPD 2005, EPPO alerts, ICTVdB, VIDEdB and CABI searches, Cunnington 2003, Agarwal 1997, Springer Index 2001, Seedquest, FCGP)

VIDEdB	- Virus Identification Data Exchange database (Australia).
ICTVdB	- International Committee on Taxonomy of Viruses database.
CABI	- International publishing of CAB science abstracts.
CMI	- Commonwealth Mycological Institute
EPPO	- European Plant Protection Organisation
APPD	- Australian Plant Pest Database
FCGP	- Farmer Cooperative Genome Project (USA)
USDA ARS	- United States Department of Agriculture, Agriculture Research Service

F:\SRHSDATA\Clients\HAL\Vegetable Biosecurity 2008\Report\Appendices\A2 Seedborne viruses.doc

Appendix 3

Fertiliser Working Group Aims

CONTROL OF CONTAMINANTS AND PROHIBITED SUBSTANCES IN FERTILIZERS

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ABSTRACT

A national working group was established to develop standards for contaminants in fertilizer in Australia after press reports in 2002 about contaminated industrial waste in fertilizer.

Repeal of fertilizer registration in 1995 had inadvertently moved safeguards against the disposal of industrial waste as rtilizer, where the driving economic force is the disposal cost.

The project will identify prohibited substances (the negative st) not to be included in fertilizers, e.g. waste asbestos, and ermitted contaminants (the positive list) and their recommended uideline limits. Guiding principles include: contaminant levels n fertilizers and their annual loading per unit area should be as low as reasonably achievable (ALARA principle); and fertilizers should not be treated as vehicles for waste disposal.

Australia's agricultural and pastoral lands are valuable assets to be protected against contamination, but conversion of waste or by-product materials to genuine fertilizers should not be precluded.

The project aim is to have: a list of prohibited substances, a list of contaminants and guideline limits and transparent evaluation procedures.

1 INTRODUCTION

Industrial wastes are being recycled as fertilizer ingredients. Unfortunately, they sometimes contain persistent and toxic contaminants that accumulate in the soil and may enter crops and food-producing animals.

In Australia, State fertilizer legislation has generally been aimed at the manufacture, sale and use of fertilizers intended to improve the nutrient status or the condition of the soil. The legislation generally has not been framed to control the disposal of industrial waste under the guise of fertilizer, where the driving economic force is the disposal cost of wastes.

In 2002, it became a public issue with press reports about imported wastes containing high levels of cadmium and lead being brought into Australia for use as fertilizer. A Fertilizer Working Group was established to recommend a national approach to the control of contaminants in fertilizers.

2

FERTILIZER REGISTRATION (before 1995)	AFTER REPEAL OF FERTILIZER REGISTRATION (after 1995)
• The composition and label of each product were examined and approved before it might be offered for sale.	• A product may be offered for sale if it meets the labelling requirements, complies with fertilizer standards and, like other goods, satisfies consumer protection legislation.
• Products offered for sale were sampled and analysed for comparison with their declared composition.	• Products offered for sale are no longer routinely sampled and analysed.
• Fertilizer standards for maximum permitted concentrations of lead, cadmium and mercury were based on their occurrence in raw materials.	• No additional standards.

3 BENEFICIAL PRODUCTS FROM INDUSTRIAL AND MINING WASTES

Fertilizers (and soil conditioners) are ideal targets for recycling and reusing wastes.

1. Content of plant nutrients (N, P, K, Ca, Mg, S …) or trace elements (Zn, Cu, Se, B, Mo …..) can be used as evidence that the material supports plant nutrition.
2. Physical properties or neutralizing capacity can be used as evidence that the material is a soil conditioner.
3. Fertilizers are used in large quantities.
4. There are no standards for maximum content of most contaminants.
5. The end user cannot easily observe that the product contains contaminants.
6. While it is described as a waste it is regulated. When it becomes a beneficial product it generally is not.
7. The high costs of waste disposal provide an incentive to convert the waste to a beneficial product that can be sold.
8. Recycling is seen as an environmentally responsible action in reducing the load on land fill capacity.

4 THE PROPOSALS

1. Some wastes (**prohibited substances**) should not be allowed as fertilizer ingredients, e.g. asbestos waste and radioactive wastes.
2. Use the **concentration comparison** approach for initial screening. The concentration of a contaminant in a fertilizer is acceptable if it is no higher than the existing concentration in the soil (dry weight or ash weight).
3. Use the **critical load model*** for contaminants that require further investigation. For sustainability, the time to reach the critical concentration must be a long time – suggested 70-100 years. The results should be acceptable loadings or acceptable concentrations for permitted contaminants.
4. **Priority production systems** for study:

Horticulture	Viticulture
Sugar cane	Cereals
Dairy	Aquaculture
Beef and sheep	

5. **Priority contaminants** for investigation: F, Ni, Hg, Pb, Cu, As, B, Se, Zn, Cr (note that Cd has already been investigated), POPs, radioactive material, and contaminants related to individual waste types such as sewage sludge, red mud and municipal solid waste.

* A critical load model is a dynamic mass balance model aimed at a critical soil concentration based, for example, on ecological health.

5 CONCLUSIONS

The aim is for the project to provide:

1. A list of substances that are prohibited ingredients in fertilizers.

2. A list of contaminants permitted in fertilizers and their guideline limits in various fertilizers or their maximum permitted annual loading rates per unit area.

3. Transparent evaluation procedures, evaluations and data requirements.

Acknowledgement

The background information collected and the ideas suggested by the Fertilizer Working Group of the Australian Product Safety and Integrity Committee are gratefully acknowledged.

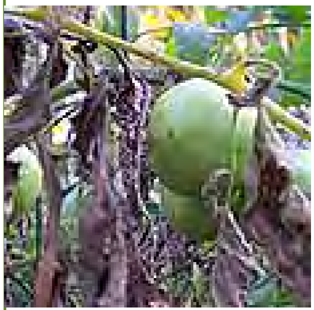
Appendix 4

Check-list for Crop Sabotage

Queensland **the Smart State**

Malicious Damage to Crops

What to do when you suspect crops have been sabotaged



If you are a primary producer who has been threatened with, observed or discovered evidence of **intentional damage** on your farm, how should you respond?

First, eliminate disease, accident or natural forces as the cause of the damage. If these can be ruled out and you determine that the cause is unusual, unknown, or you suspect a chemical agent, you may need help in responding to the incident.

Second, respond in a way that ensures the protection of both your community and your business by referring to this step-by-step checksheet.

Respond to the Danger

1	**Prevent further harm** ☐ ensure the **immediate** safety of yourself, your staff and your neighbours ☐ prevent site access ☐ shut down irrigation and drainage systems ☐ alert adjacent and downstream neighbours who may also be affected
2	**Phone the local police** ☐ contact your local police or call (07) 3364 6464 or visit www.police.qld.gov.au
3	**Report the incident to the Department of Primary Industries and Fisheries** ☐ phone 13 25 23 and ask to speak to the “Chemical Use & Food Safety” section ☐ the DPI&F will assist in identifying the problem and help you advise all relevant agencies
4	**Preserve the evidence** ☐ seek Police advice before disturbing the site or collecting evidence and samples ☐ make detailed notes describing the event, the extent of the damage and the plants affected ☐ take photos of damage without entering or disturbing the site

Protect your business

5	**Contain the damage** ☐ try to identify and halt the source of the contamination ☐ cease the further application of agricultural inputs, eg soil, water, chemicals and mulch ☐ contain further release of agricultural outputs, eg water, waste and harvested food
6	**Seek advice** ☐ **Legal** a solicitor may be able to advise on the civil scope and/or liability issues ☐ **Industry** consider seeking advice and support from industry associations ☐ **Technical** investigate the need for independent lab testing
7	**Mitigate risk** ☐ isolate any potentially contaminated crops or food products ☐ consider the need to recall potentially contaminated food already in the supply chain
8	**Reputation Management** ☐ consider informing neighbouring properties and local industry bodies ☐ consider advising agencies that may have concerns or be willing to offer support

Queensland Government
Department of Primary Industries and Fisheries

Regulatory Advice

Contamination events can be extremely complex and may trigger investigations by many different agencies. Listed below are just some of the agencies that may need to be involved.

In the first instance, you should contact the Department of Primary Industries and Fisheries, who will be able to advise and assist with the cross-agency notifications and liaison.

Dept of Primary Industries and Fisheries

To report biosecurity, pesticide residue and contaminant events.
Phone: 13 25 23
www.dpi.qld.gov.au

Dept of Natural Resources and Water

To report impacts on water resources or state land.
Phone: 13 13 04
www.nrw.qld.gov.au

Queensland Health

To report public health issues, food recalls and food borne illnesses.
Phone: 07 3234 0111
Web: www.health.qld.gov.au

Environmental Protection Agency

To report on events impacting on air, water and soil quality, wastes or pollution.
Phone: 1300 30372
Web: www.epa.qld.gov.au

Safe Food Queensland

To report incidents impacting on food safety.
Phone: 07 3253 9800
Web: www.safefood.qld.gov.au

Technical Advice

External tests and certifications may be required in order to confirm that contamination has occurred, to map the extent of the contamination and to create a plan to mitigate the damage,

Initially, you should contact the Department of Primary Industries and Fisheries' Biosecurity unit and speak to an officer in the Chemical Use & Food Safety section for advice on how best to proceed.

If you seek further assistance, second options or independent testing, there are many commercial organisations that will perform analytical and testing services.

National Association Testing Authorities

Provides a list of certified Australian labs competent in testing, measurement, inspection and calibration.
Phone: 02 9736 8222
Web: www.nata.asn.au

Local crop consultants

Many local consultants can assist with diagnosis, analysis and assistance with sample collection.

Collecting samples

Crop and food samples need very specific handling to provide accurate testing results. Before collecting any specimen samples, you must contact the specific testing laboratory for detailed instructions on the:

1. collection of plant, water or soil sample
2. preparation of the sample
3. transportation of the sample
4. written information required
5. expected results and turn-around time

Be prepared – keep your chemicals safe

Keep your farm chemicals safe and make your chemical records easy to reference. In an emergency, you need to quickly see if anything is missing and easily locate product information in the case of suspicious activity.

Make a separate chemical records system. Keep invoices, receipts and a detailed inventory of all chemicals and fertilisers including the product name, container description, formulation type, batch numbers, manufacturer's name and expiry date.

To assist with chemical recordkeeping, the DPI&F publishes *Infopest* a comprehensive guide to all agricultural and veterinary chemicals and Material Safety Data Sheets. Updated in March, July and November of every year, *Infopest* can be ordered as a single version or in an annual subscription. Purchase details available at www2.dpi.qld.gov.au/infopest/

The DPI&F also produces the *Agricultural Chemical Users' Manual* which contains information on agrichemical safety, transport, storage and disposal. Download free at: www2.dpi.qld.gov.au/health/17084.html

Appendix 5

Currant-Lettuce Aphid State Regulations, 2005

Summary of Interstate Lettuce Aphid Regulations 3 June 2005

	NSW	QLD	SA	WA
Area Free – All Primary and Secondary Hosts	Certified Area by VIC For Seedlings - Inspected and found free of lettuce Aphid PHC	N/A – State Freedom only	Product originates from and was grown from a specified part of a state or territory wherein lettuce aphid is not known to occur as determined by surveys PHC	N/A – State Freedom only
Loose Leaf Lettuce Only (Salad mix)	Within 10km of a known detection; The lettuce must be separated from the plant into individual leaves, thoroughly washed and inspected; or Fumigated with Methyl Bromide; and Inspected after treatment and found free of Lettuce Aphid PHC	It has been separated from the plant into individual leaves, thoroughly washed and inspected for freedom from lettuce aphid by a Plant Standards Officer PHC	Processed according to the nationally accepted protocol for lettuce aphid PHC *See Interim Arrangements Until Approval on an ICA: Monitoring Inspection and Treatment of Processed Lettuce*	Processed according to the nationally accepted protocol for lettuce aphid PHC *See Interim Arrangements Until Approval on an ICA: Monitoring Inspection and Treatment of Processed Lettuce*
Head Lettuce and Other Head Vegetables	Within 10km of a known detection; Confidor treated transplants; or Direct sown resistant variety; or Fumigated with Methyl Bromide; and Inspected after treatment and found free of Lettuce Aphid PHC	See Host plants (Primary and Secondary)	See Host plants (Primary and Secondary)	Prohibited – State Freedom only
Host plants (Primary and Secondary)	N/A – See specific columns	Fumigated with Methyl Bromide PHC	Fumigated with Methyl Bromide PHC	Fumigated with Methyl Bromide PHC
Secondary host plants (including nursery stock, cut flowers / foliage and cuttings)	N/A – See specific columns	See Host plants (Primary and Secondary)	Treated within 7 days of export with 200g/L of imidacloprid as per the Label constraints PHC	Treated within 7 days of export with 200g/L of imidacloprid as per the Label constraints PHC
Lettuce seedlings / transplants	Within 10km of a known detection Treated with Confidor and inspected and found free of Lettuce Aphid PHC	See Host plants (Primary and Secondary)	Propagated and treated in accordance with protocols approved by the Chief Inspector, Primary Industries and Resources South Australia. PHC	See Host plants (Primary and Secondary)

Summary of Interstate Lettuce Aphid Regulations   3 June 2005

	NSW	QLD	SA	WA
Plants of Petunia spp., and Nicotiana Spp.	Within 10km of a known detection Treated within 7 days of export with 200g/L of imidacloprid as per the Label constraints; or Fumigated with Methyl Bromide; And Inspected after treatment and found free of Lettuce Aphid PHC	See Host plants (Primary and Secondary)	See Secondary host plants (including nursery stock, cut flowers / foliage and cuttings) Or See Host plants (Primary and Secondary)	See Secondary host plants (including nursery stock, cut flowers / foliage and cuttings) Or See Host plants (Primary and Secondary)
Commercially grown *Asteracea* Spp. Excluding *Cichorium*, *Crepis*, *Cynara*, *Lactuca*, *Lapsana* and *Sonchus* spp.	Nil	See Host plants (Primary and Secondary)	See Secondary host plants (including nursery stock, cut flowers / foliage and cuttings) Or See Host plants (Primary and Secondary)	See Secondary host plants (including nursery stock, cut flowers / foliage and cuttings) Or See Host plants (Primary and Secondary)
Commercially grown *Cichorium*, *Crepis*, *Cynara*, *Lactuca*, *Lapsana* and *Sonchus* spp.	See Head Lettuce and Other Head Vegetables	See Host plants (Primary and Secondary)	See Secondary host plants (including nursery stock, cut flowers / foliage and cuttings) Or See Host plants (Primary and Secondary)	See Secondary host plants (including nursery stock, cut flowers / foliage and cuttings) Or See Host plants (Primary and Secondary)
Seeds of Host plants excluding *Hieracium* Spp.	Nil	See Host plants (Primary and Secondary)	See Secondary host plants (including nursery stock, cut flowers / foliage and cuttings) Or See Host plants (Primary and Secondary)	See Secondary host plants (including nursery stock, cut flowers / foliage and cuttings) Or See Host plants (Primary and Secondary)
Seeds of *Hieracium* Spp.	Prohibited – a declared noxious weed and prohibited from being grown in NSW	See Host plants (Primary and Secondary)	See Secondary host plants (including nursery stock, cut flowers / foliage and cuttings) Or See Host plants (Primary and Secondary)	See Secondary host plants (including nursery stock, cut flowers / foliage and cuttings) Or See Host plants (Primary and Secondary)

* All consignment for interstate movement must include the name and address of the grower and property on which the consignment was grown and the name and address of the packing house.
** NT Currently have no restriction in place for the movement of Currant Lettuce Aphid Host Materials.
****Victoria is following up on Baby Leaf Lettuce, Cover Spraying options.

Host Listing – Currant Lettuce Aphid

Scientific Name	Common Name(s)
Primary Hosts:	
Means the winter hosts of the Currant-lettuce aphid sexual form and includes:	
Ribes spp.	currants (includes black, red and white) and gooseberry
Ribes alpinum	
Ribes aureum	white currant
Ribes uva-cripsa	gooseberry
Ribes nigrum	black currant
Ribes rubrum	red currant
Secondary Hosts:	
Means host of the currant-lettuce aphid asexual form and includes:	
Cichorium spp.	
Cichorium endivia	endive
Cichorium intybus	chicory
Crepis capillaris	hawk's beard
Cynara scolymus	globe artichoke
Hieracium spp.	hawkweed
Lactuca sativa	lettuce
Lapsana spp.	nipplewort
Nicotiana spp.	tobacco
Petunia spp.	garden petunia
Scrophularia spp.	figwort
Sonchus spp.	annual sowthistle, spiny sowthistle

Appendix 6

CHOICE Media Release on Residues in Strawberries

www.choice.com.au

choice **MEDIA RELEASE**

MOST CONVENTIONALLY GROWN STRAWBERRIES CONTAIN PESTICIDE RESIDUES - SOME AT CONCERNING LEVELS

Calls for regular testing after three samples breach limits

Consumer advocate CHOICE is calling for independent, comprehensive and regular testing of fruit and vegetables for pesticide residues after its tests showed poor pesticide practices in Australia.

Analysis of strawberries from 31 growers across most states revealed almost all conventionally grown strawberries contained some residues. Three contained levels above the maximum limits set by Food Standards Australia New Zealand.

Seventeen of the samples had residues from more than one pesticide and four had traces of four different chemicals in and on their flesh.

Four of the 31 samples came from organic farmers, all of which should be free of any pesticides, as their growing methods insist. But one set of organic strawberries did contain tiny amounts of a fungicide, which may be attributed to spray drifting from another field.

"Analysis shows strawberries are more likely to have pesticide residues than other fresh fruit, and washing doesn't necessarily remove them. Some pesticides are systemic, which means they penetrate through the fruit," said CHOICE media spokesperson, Christopher Zinn.

CHOICE says that while pesticides are generally thought to be safe at very low levels, some experts are concerned about long-term exposure to a "cocktail" of different chemicals on a daily basis.

Currently the only independent testing for residues in food is done by some state governments and the number and types of tests are limited. The produce industry has its own testing regime called FreshTest but the results aren't made public.

"Our findings highlight the need for national testing on a regular basis, as happens in other nations such as the UK. There's no doubt that without treatment strawberries would be considerably more expensive, as yields would be lower, but pesticides can be applied without enough care," said Mr Zinn.

"In the meantime if you want to minimise your exposure to pesticides it's best to stick to organic strawberries. It would be a shame to avoid them altogether as – apart from being delicious – they're richer in antioxidants than many other fruits."

For an interview or further information please contact Christopher Zinn on (02) 9577 3245 or 0425 296 442 or e-mail czinn@choice.com.au.

CHOICE 57 Carrington Road Marrickville NSW 2204 Phone 02 9577 3333 Fax 02 9577 3377 www.choice.com.au

Appendix 7

OrdGuard Pest Lists and NAQS High Risk List

APPENDIX 2. ESTABLISHED DISEASES (CURRENTLY FOUND IN THE ORIA OF WESTERN AUSTRALIA)

In conjunction with the Department's specialists, the OrdGuard Management Committee should identify the highest priority established diseases.

Scientific name	Host	Host common	Disease	References?
Aspergillus niger	*Allium cepa* L.	Onion, Shallot	Black mould	S
Pestalotiopsis palmarum	*Anacardium occidentale* L.	Cashew	Associated with leaf spot	S
Aspergillus niger	*Arachis hypogaea* L.	Peanut	Crown rot	S
Botryodiplodia theobromae	*Arachis hypogaea* L.	Peanut	Collar rot	S
Colletotrichum capsici	*Arachis hypogaea* L.	Peanut	Leaf spot	S
Cercosporidium personatum	*Arachis hypogaea* L.	Peanut	Deighton late leaf spot	S
Macrophomina phaeseolina	*Arachis hypogaea* L.	Peanut	Stem rot	S
Puccinia arachidis	*Arachis hypogaea* L.	Peanut	Rust	S
Rhizoctonia sp.	*Arachis hypogaea* L.	Peanut	Root rot	S
Sclerotium rolfsii	*Arachis hypogaea* L.	Peanut	Stem rot	S
Rhizopus stolonifer	*Artocarpus heterophyllus Lam*	Jackfruit	Lind fruit rot	S
Curvularia sp.	*Asparagus officinalis* L.	Asparagus	S. Associated with stem blight	SK
Rhizoctonia sp.	*Brassica nigra*	Mustard	Root and collar rot	S
Xanthomonas campestris pv. Campestris	*Brassica nigra*	Mustard	Black rot	S
Macrophomina phaseolina	*Carthamus tinctorius* L.	Safflower	Stem rot	S
Phytophthora nicotianae	*Carthamus tinctorius* L.	Safflower	Water house root & Stem rot	S
Rhizoctonia sp.	*Carthamus tinctorius* L.	Safflower	Damping-off	S

Scientific name	Host	Host common	Disease	References?
Sorosporium brefeldianum	*Cenchrus elymoides* F. Muell.	Pasture plant	Floral smut	SK
Rhizoctonia sp.	*Cicer arientinum* L.	Chickpea	Root rot	S
Cercospora citrullina	*Citrullus lanatus*	Watermelon	Leaf spot	S
Oidium sp.	*Citrullus lanatus*	Watermelon	Powdery mildew	S
Fusarium oxysporum	*Citrullus lanatus*	Watermelon	Wilt	S
Botryodiplodia theobromae	*Citrus sinensis* (L.) Osb	Sweet orange	Dieback	SK
Pestalotiopsis palmarum	*Cocus Nucifera* L.	Palm	Frond spot	SK
Ascochyta cucumis	*Cucumis melo* L.	Rockmelon/Cantaloup	Gummy stem blight	S
Botryosphaeria ribis	*Cucumis melo* L.	Rockmelon/Cantaloup	Fruit rot	S
Macrophomina phaseolina	*Cucumis melo* L.	Rockmelon/Cantaloup	Fruit rot	S
Oidium sp.	*Cucumis melo* L.	Rockmelon/Cantaloup	Powdery mildew	S
Pseudocercospora cubensis	*Cucumis melo* L.	Rockmelon/Cantaloup	Downy mildew	S
Fusarium solani	*Cucumis melo* L.	Rockmelon/Cantaloup	Root rot	S
Pseudocercospora sp.	*Glycine Albicans* Tind & Crav n		Leaf spot	SK
Cercospora canescens	*Glycine max*	soy bean	Leaf spot	S
Xanthomonas campestris pv. glycines	*Glycine max*	soy bean	Bacterial pustule	S
Rhizoctonia solani	*Glycine max*	soy bean	Root rot	S
Colletotrichum capsici	*Glycine max*	soy bean		S
Macrophomina phaseolina	*Glycine max*	soy bean	Charcoal rot	S
Phakopsora pachyrhizi	*Glycine max*	soy bean	Rust	S
Pseudomonas syringae pv.phaseolicola	*Glycine max*	soy bean	Halo blight	S

Scientific name	Host	Host common	Disease	References?
Potyvirus	*Glycine max*	soy bean		M&P
Xanthomonas campestris pv. *malvacearum*	*Gossypium barbadense*	sea island cotton	Bacterial blight	S
Alternaria gossypina	*Gossypium hirsutum*	cotton	Leaf and boll spotting	S
Botryosphaeria ribis	*Gossypium hirsutum*	cotton	Root rot	S
Colletotrichum gloeosporioides	*Gossypium hirsutum*	cotton	Anthracnose	S
Fusarium solani	*Gossypium hirsutum*	cotton	Root rot	S
Macrophomina phaseolina	*Gossypium hirsutum*	cotton	Root rot	S
Phoma sorghina	*Gossypium hirsutum*	cotton	Petiole lesion	S
Rhizoctonia solani	*Gossypium hirsutum*	cotton	Root rot	S
Xanthomonas campestris pv. malvacearum	*Gossypium hirsutum*	cotton	Bacterial blight	S
Ramularia gossypii	*Gossypium hirsutum*	cotton	Grey mildew	S
Pseudocercospora abelmoschi	*Gossypium hirsutum* L.	cotton	Leaf spot	SK
Alternaria helianthi	*Helianthus annus*	sunflower	Leaf spot	S
Macrophomina phaseolina	*Helianthus annus*	sunflower	Root and stem rot	S
Puccinia helianthi	*Helianthus annus*	sunflower	Rust	S
Rhizopus sp.	*Helianthus annus*	sunflower	Head rot	S
Macrophomina phaseolina	*Lablab purpueus*	lablab bean	Stem rot	S
Cercospora canescens	*Lablab Purpureus* (L.) Sweet.	Pasture crop	Leaf spot	SK
Xanthomonas campestris pv. mangiferaeindicae	*Mangifera indica*	Mango	Black spot	S
Colletotrichum gloeosporioides	*Mangifera indica*	Mango	Anthracnose	S

Scientific name	Host	Host common	Disease	References?
Asterina sp.	*Mangifera indica* L.	Mango	On leaves.	SK
Cercospora zebrina	*Medicago sativa* L.	Pasture crop	Leaf spot	SK
Colletotrichum musae	*Musa acuminata*	Banana (Cavendi/Goldn)	Anthracnose	SK
Deightoniella torulosa	*Musa acuminata*	Banana (Cavendi/Goldn)	Black leaf spot	SK
Fusarium sambucinum	*Musa acuminata*	Banana (Cavendi/Goldn)	Associated with root rot	SK
Fusarium semitectum	*Musa acuminata*	Banana (Cavendi/Goldn)	Associated with root rot	SK
Fusarium solani	*Musa acuminata*	Banana (Cavendi/Goldn)	Associated with root rot	SK
Pythium myriotylum	*Musa acuminata*	Banana (Cavendi/Goldn)		SK
Phyllosticta musarum	*Musa acuminata*	Banana (Cavendi/Goldn)	Associated with root rot	SK
Cucumber mosaic virus	*Musa acuminata Colla*	Banana	Infectious leaf streak	SK
Guignardia musae	*Musa x cult. Cavendish*	Banana		QDB
Pseudocercospora musae	*Musa x cult. Cavendish*	Banana		QDB
Bipolaris oryzae	*Oryza australiensis*	Australian rice	Browm spot	S
Entyloma oryzae	*Oryza australiensis*	Australian rice	Leaf smut	S
Alternaria padwickii	*Oryza sativa*	Rice	Leaf spot	S
Alternaria sp.	*Oryza sativa*	Rice	Browning of glumes	S
Aspergillus sp.	*Oryza sativa*	Rice	Seed infection	S
Bipolaris oryzae	*Oryza sativa*	Rice	Brown spot	S
Exserohilum rostratum	*Oryza sativa*	Rice	Leaf spot	S
Cercospora oryzae	*Oryza sativa*	Rice	Brown leaf spot	S
Curvularia sp.	*Oryza sativa*	Rice	Leaf spot & discoloured grain	S
Entyloma oryzae	*Oryza sativa*	Rice	Leaf smut	S

Scientific name	Host	Host common	Disease	References?
Gibberella zeae	*Oryza sativa*	Rice	Foot and root rot	S
Nicrospora oryzae	*Oryza sativa*	Rice	Leaf spot & discoloured grain	S
Phyllosticta oryzina	*Oryza sativa*	Rice	Associated with leaf spot	S
Sclerotium sp.	*Oryza sativa*	Rice	Leaf sheath stem rot	S
Colletotrichum lindemuthianum	*Phaseolus vulgaris*	Butter bean	Anthracnose	S
Botrytis cinerea	*Phaseolus vulgaris*	Butter bean	Grey mould	S
Periconia saraswatipurensis	*Phaseolus vulgaris*	Butter bean	Associated with leaf spot	S
Graphiola phoenicis	*Phoenix dactylifera*	Date palm	False smut	S
Pseudocercospora sawadae	*Psidium guajava* L.	Guava	Leaf spot	SK
Fusarium moniliforme	*Saccharum officinarum*	Sugarcane		S
Phyllosticta sp.	*Saccharum officinarum*	Sugarcane	Leaf spot	S
Pseudomonas rubrilineans	*Saccharum officinarum*	Sugarcane	Red stripe	S
Xanthomonas campestris	*Saccharum officinarum*	Sugarcane	Associated with red stripe	S
Curvularia brachyspora	*Saccharum officinarum*	Sugarcane		S
Nigrospora sacchari	*Saccharum officinarum*	Sugarcane		QDB
Colletotrichum gloeosporioides	*Santalum lanceloatum* R. Br.	Sandalwood	Leaf spot	S
Pseudocercospora sp. Aff. *Cercospora santalacea*	*Santalum lanceloatum* R. Br.	Sandalwood	Leaf spot	SK
Alternaria sp.	*Sesamum indicum*	Sesame	Leaf spot	S
Rhizoctonia sp.	*Solanum melongena* L.	Eggplant/ Aubergine	Root rot	S
Bipolaris papendorfii	*Sorghum bicolor*	Grain/sweet sorghum	Leaf spot	S
Bipolaris sorghicola	*Sorghum bicolor*	Grain/sweet sorghum	Leaf spot	S

Scientific name	Host	Host common	Disease	References?
Botryodiplodia theobromae	*Sorghum bicolor*	Grain/sweet sorghum	Associated with leaf spot	S
Cercospora sorghi	*Sorghum bicolor*	Grain/sweet sorghum	Grey leaf spot	S
Colletotrichum graminicola	*Sorghum bicolor*	Grain/sweet sorghum	Anthracnose	S
Curvularia clavata Jain	*Sorghum bicolor*	Grain/sweet sorghum	On seeds	S
Curvularia eragrostidis	*Sorghum bicolor*	Grain/sweet sorghum	Associated with leaf spot	S
Curvularia geniculata	*Sorghum bicolor*	Grain/sweet sorghum	Associated with stem rot	S
Curvularia lunata	*Sorghum bicolor*	Grain/sweet sorghum	Associated with leaf spot	S
Curvularia lunata var *aeria*	*Sorghum bicolor*	Grain/sweet sorghum	Associated with leaf spot	S
Curvularia pallescens	*Sorghum bicolor*	Grain/sweet sorghum	Associated with leaf spot	S
Curvularia penniseti	*Sorghum bicolor*	Grain/sweet sorghum	Associated with leaf spot	S
Curvularia sorghina	*Sorghum bicolor*	Grain/sweet sorghum	Hypersensitive flecking	S
Curvularia verruculosa	*Sorghum bicolor*	Grain/sweet sorghum	Associated with leaf spot	S
Exeserohilum rostratum	*Sorghum bicolor*	Grain/sweet sorghum	Assoc with grain & leaf spot	S
Exserohilum turicum	*Sorghum bicolor*	Grain/sweet sorghum	Leaf blight	S
Fusarium culmorum	*Sorghum bicolor*	Grain/sweet sorghum	Associated with root rot	S
Fusarium dimerum	*Sorghum bicolor*	Grain/sweet sorghum	Associated with root rot	S
Fusarium moniliforme	*Sorghum bicolor*	Grain/sweet sorghum	Root rot stem rot	S
Fusarium moniliforme var. *subglutinans*	*Sorghum bicolor*	Grain/sweet sorghum	Root rot	S
Fusarium oxysporum	*Sorghum bicolor*	Grain/sweet sorghum	Root rot	S
Gloeocercospora sorghi	*Sorghum bicolor*	Grain/sweet sorghum	Zonate leaf spot	S
Macrophomina phaseolina	*Sorghum bicolor*	Grain/sweet sorghum	Charcoal rot	S

Scientific name	Host	Host common	Disease	References?
Periconia circinata	*Sorghum bicolor*	Grain/sweet sorghum	On roots	S
Periconia macrospinosa	*Sorghum bicolor*	Grain/sweet sorghum	On roots	S
Phoma sorghina	*Sorghum bicolor*	Grain/sweet sorghum	Assoc with grain & leaf spot	S
Pleospora infectoria	*Sorghum bicolor*	Grain/sweet sorghum	Associated with leaf spot	S
Rhizoctonia solani	*Sorghum bicolor*	Grain/sweet sorghum	Root rot	S
Sphaeronaema macrorostratum	*Sorghum bicolor*	Grain/sweet sorghum	Associated with leaf spot	S
Sporisorium sorghi	*Sorghum bicolor*	Grain/sweet sorghum	Covered smut	S
Ustilago ewartii	*Sorghum interjectum Lazarides*		Floret smut	SK
Ustilago ewartii	*Sorghum plumosum*	Plume sorghum	Floret smut	SK
Puccinia levis	*Sorghum plumosum*	Plume sorghum	Rust	S
Uredo sp.	*Sorghum* spp.		Leaf rust	SK
Ustilago ewartii	*Sorghum* spp.		Floret smut	SK
Ustilago porosa	*Sorghum* spp.		Inflorescence smut	SK
Puccinia levis	*Sorghum stipoideum*	Annual native sorghum	Leaf rust	SK
Pseudomonas rubrilineans	*Sorghum stipoideum*	Annual native sorghum	Red Stripe	SK
Sclerophthora macrospora	*Sorghum stipoideum*	Annual native sorghum	Crazy top	SK
Sporisorium sorghi	*Sorghum stipoideum*	Annual native sorghum	Covered smut	SK
Uredo sp.	*Sorghum stipoideum*	Annual native sorghum	Leaf rust	SK
Ustilago ewartii	*Sorghum stipoideum*	Annual native sorghum	Floret smut	SK
Ustilago porosa	*Sorghum stipoideum*	Annual native sorghum	Floret smut	SK
Cercospora sorghi	*Sorghum sudanense*	Sudan grass	Grey leaf spot	S
Colletotrichum sp.	*Sorghum sudanense*	Sudan grass	Anthracnose	S

Scientific name	Host	Host common	Disease	References?
Exserohilium turcicum	*Sorghum sudanense*	Sudan grass	Leaf blight	S
Ustilago porosa	*Sorghum timorense*	Sorghum	Smut	S
Ustilago ewartii	*Sorghum timorense*	Sorghum	Floret smut	SK
Colletotrichum graminicola	*Sorghum x almum* L. Parodi	Sorghum	Red leaf spot.	SK
Gloeocercospora sorghi	*Sorghum x almum* L. Parodi	Sorghum	Zonate leaf spot	SK
Phyllachora andropogonis	*Sorghum x almum* L. Parodi	Sorghum	Tar spot	SK
Sugarcane moasic virus	*Sorghum vulgare*	Sorghum		M&P
Sphaeotheca fuligenea	*Vigna mungo*	Mung bean		QDB
Sphaeotheca fuligenea	*Vigna radiata* (L.) Wilczek	Mung bean		QDB
Oidium sp.	*Vigna radiata* (L.) Wilczek	Mung bean	Powerdy mildew	S
Cercospora canescens	*Vigna radiata* (L.) Wilczek	Mung bean	Leaf spot	SK
Xanthomonas campestris pv. phaseoli	*Vigna radiata* (L.) Wilczek	Mung bean	Common blight	S
Peronospora trifoliorum	*Vigna radiata* (L.) Wilczek	Mung bean	Downy Mildew	SK
Colletotrichum gloeosporioides	*Vitis vinifera* L.	Wine grape	Fruit spot	SK
Sphaceloma ampelinum	*Vitis vinifera* L.	Wine grape	Anthracnose	S
Phytophthora megasperma	*Vitis vinifera* L.	Wine grape	Root rot	S
Oidium sp.	*Vitis vinifera* L.	Wine grape		QDB
Cercospora	*Vitis vinifera* L.	Wine grape		QDB
Triposporium sp.	*Vitis vinifera* L.	Wine grape	Sooty mould	SK
Peronosclerospora maydis	*Zea mays*	Corn	Downy Mildew	S
Puccinia sorghi	*Zea mays*	Corn	Leaf rust	S

Scientific name	Host	Host common	Disease	References?
Pyrenochaeta terrestris	*Zea mays*	Corn	Stem lesions	S
Virus	*Zea mays*	Corn		M&P

References

S: Shivas R, G 1989

SK: Shivas R, G 1995

M&P: Mclean & Price 1984

QDB: Quarantine data base

Still waiting on unpublished diseases isolated from Ord APL

APPENDIX 3. REGIONAL BIOLOGICAL THREATS TO THE ORD REGION OF WESTERN AUSTRALIA

The OrdGuard Management Committee will identify a short list (6) of regional threats considered to be of the highest importance to the region.

Key regional threats to the Ord Region of Western Australia (selected by the community as top threats) can be found in Table 3.

Common name	Scientific name	Primary host crop	Alternate hot crop	Presence in Australia	Threat category
Sliverleaf whitefly	*Bemisia tabaci* B type	Poinsettia	Pph	WA (not ORD) and NT, Qld and NSW	A
Mediterrnean fruit fly	*Ceratitis capitata*	Peach	Pph	WA (not ORD) and SA	A

APPENDIX 4. REGIONAL/INTERSTATE KEY PESTS [THREATENING THE ORIA WITHIN AUSTRALIA (NOT PRESENT IN WESTERN AUSTRALIA)]

The OrdGuard Management Committee will identify a short list (6) of regional threats considered to be of the highest importance to the region.

Common name	Scientific name	Primary host crop	Alternate hot crop	Presence in Australia	Threat category
Whitefly, Spiralling	*Aleurodicus disperses*	Banana	Pph	Qld	A
Scale, transparent	Aspidiotus destructor	Coconut	Pph	NT, Qld	B
Lesser Qld Fruit fly	*Bactrocera neohumeralis*	All fleshy fruits	Pph	NT, Qld	B
Queensland Fruit fly	*Bactrocera tryoni*	All fleshy fruits	Pph	NT, Qld, NSW, Vic, SA	A
Red banded mango caterpillar	*Deanolis sublimalis*	Mango	-	Torres Strait	B
Banana scab moth	*Nacoleia octasema*	Plantain, banana	Selected palms	Qld	B
Mango seed weevil	*Sternochetus mangiferae*	Mango	-	NT, Qld, NSW	B
Crimson spider mite	*Tetranychus limbardinii*	Cotton	Pph	NSW	B

APPENDIX 5. NATIONAL/INTERNATIONAL PESTS (THREATENING THE ORIA FROM OUTSIDE AUSTRALIA)

The OrdGuard Management Committee will identify a short list (6) of regional threats considered to be of the highest importance to the region.

Common name	Scientific name	Primary host crop	Alternate host crops	Presence in Australia.	Threat category
Cucumber beetles (various species)	*Acalymma vittatum* *Diabrotica* spp.	Cucumber	Melon, pumpkin, watermelon	No	B
Giant African snail	*Achatina fulica*	Cucurbits	Pph; breadfruit, papaya, peanut	No	B
Citrus blackfly	*Aleurocanthus woglumi*	Citrus	Pph	No	B
Coconut leaf moth	*Artona catoxantha*	Coconut	Sago palm, banana	No	C
Melon fly	*Bactrocera cucurbitae*	Cucurbits	Pph	No (Torres Strait)	A
Oriental fruit fly (complex)	*Bactrocera dorsalis*	All fleshy fruits	Pph	No	A
Papaya fruit fly	*Bactrocera papayae*	Papaya	Pph	No (Torres Strait)	B
Lesser cucurbit fly	*Didacus ciliatus*	Squash	Small fruit	No	B
Peel feeding caterpillar	*Platynota rostrana*	Beans	Winged bean	No	C
Comstock mealy bug	*Pseudococcus comstocki*	Stone fruit	Banana, pears, lemon	No	B
Mango pulp weevil	*Sternochetus frigidus*	Mango	Bachang	No	B

HIGH RISK NAQS LIST

NAQS Target List for Plant Pathogens

Diseases Caused by Fungi		
Pathogen	Common Name	Commodity
Cercospora zeae-maydis	Grey leaf spot	Maize
Cladosporium cucumerinum	Cucurbit scab	Cucurbits
Claviceps sorghi	Ergot	Sorghum
Cryphonectria cubensis	Cryphonectria canker	Eucalypts & Cloves
Elsinoë fawcettii	Common citrus scab, sour orange scab	Citrus
Fusarium oxysporum f. sp. cubense 'tropical race 4'	Panama disease of bananas	Banana
Fusarium oxysporum f. sp. vasinfectum	Rootrot, fusariosis	Cotton
Guignardia bidwellii	Black rot of grapevine	Grape
*Guignardia musae**	Banana freckle (on clones within the Cavendish sub-group)	Banana
Hemileia vastatrix	Coffee rust	Coffee
Magnaporthe grisea	Rice blast disease	Rice
Monosporascus cannonballus	Monasporascus root rot and vine decline	Cucurbits
Mycosphaerella eumusae	Eumusae leaf spot	Banana
*Mycosphaerella fijiensis**	Black Sigatoka	Banana
Oidium tingitaninum, O. citri	Citrus powdery mildew	Citrus
Phakopsora euvitis	Grapevine rust	Grapes
Puccinia heliconiae		
Puccinia psidii	Eucalyptus rust, Guava rust	Genera include eucalypts, syzygiums, melaleucas, callistemons, guavas, jaboticaba
*Stagonospora sacchari**	Leaf scorch of sugarcane	Sugarcane
Subramanianospora vesiculosa	Casuarina blister bark	Genera within the Casuarinaceae
Synchytrium phaseoli	False rust, wart	Legumes
Tilletia barclayana	Kernel smut	Rice
Diseases caused Oomycetes		
Pathogen	Common Name	Commodity
Peronosclerospora philippinensis	Philippine downy mildew of maize	Maize, sorghum
*Peronosclerospora sacchari**	Downy mildew of sugarcane	Sugarcane, sorghum, maize
Peronosclerospora sorghi	Downy mildew of sorghum	Sorghum, maize
Phytophthora colocasiae	Taro leaf blight	Taro
Phytophthora infestans	Potato late blight	Potato
Phytophthora ramorum	Sudden oak death	Genera include Myrtaceae (eucalypts), Quercus (oaks), Castanopsis, Lithocarpus, Fagus, Nothofagus, Rhodondendron.
Pythium carolinianum	Corm and root rot	Taro, Cotton
Diseases caused by Bacteria		
Pathogen	Common Name	Commodity
*'Candidatus Liberibacter asiaticus'**	Huanglongbing , Citrus greening	Citrus
Banana blood disease bacterium	Blood disease of bananas	Banana
Pantoea stewartii subsp. stewartii	Stewarts disease, bacterial wilt of maize	Maize
Pseudomonas syzygii	Sumatra disease	Eucalypts, syzygiums
R. solanacearum race 2 biovar 1*	Moko disease of bananas	Banana
R. solanacearum race 2A biovar 1	Bugtok disease of bananas	Banana
Ralstonia solanacearum race 1 of Eucalyptus spp.	Bacterial wilt	Eucalypts
Xanthomonas albilineans	Leaf scald of sugarcane, maize etc	Sugarcane, maize
Xanthomonas citri subsp. citri	Citrus canker	Citrus
Xanthomonas citri subsp. malvacearum	Bacterial blight	Cotton

Diseases caused by Viruses		
Pathogen	Common Name	Commodity
Banana bract mosaic virus (genus Potyvirus)	Banana bract mosaic	Banana
Banana bunchy top virus (genus Babuvirus)	Banana bunchy top	Banana
Bean common mosaic virus (genus Potyvirus), peanut stripe strain	Peanut stripe	Peanuts
Citrus tristeza virus (genus Closterovirus)	Citrus tristeza	Citrus
Cotton leaf curl bigeminivirus	Cotton leaf curl	Cotton
Fiji disease virus (genus Fijivirus)	Fiji disease of sugarcane	Sugarcane, sorghum
Maize dwarf mosaic virus (genus Potyvirus) Strains: - MDMV-A, MDMV-D, MDMV-E, MDMV-F	Maize dwarf mosaic	Maize, sorghum, sugarcane
Papaya ringspot virus type P (genus Potyvirus)	Papaya ringspot virus, PRSV	*Carica* spp. (papaya) and cucurbits
Rice tungro bacilliform virus (genus Tungrovirus) and Rice tungro spherical virus (genus Waikavirus)		Rice
Sorghum mosaic virus (genus Potyvirus)	Sorghum mosaic	Sorghum, maize
*Sugarcane mosaic virus (genus Potyvirus) **	Sugarcane mosaic	Sugarcane
Diseases caused by Viroids		
Pathogen	Common Name	Commodity
Coconut cadang-cadang viroid	Cadang cadang	Palms
Diseases caused by Phytoplasmas		
Pathogen	Common Name	Commodity
Lethal yellows phytoplasma	Lethal yellows	Palms
Sugarcane whiteleaf phytoplasma	Sugarcane whiteleaf	Sugarcane
Diseases of Unknown Etiology		
Pathogen	Common Name	Commodity
Ramu stunt*	Ramu stunt of sugarcane	Sugarcane

*Identified under Schedule 13 – Categorised EPPs (Emergency Plant Pests)

NAQS Target List for Invertebrates

Species	Common Name	Host
Adoretus compressus	Rose beetle	Maize, sorghum, sugarcane, cocoa
Agonoxena argaula	Coconut flat moth	Palms
Agrotis segetum	Turnip moth	Polyphagous, incl., grapes, cucurbits, maize, cotton
Aleurocanthus woglumi	Citrus blackfly	Citrus, mango, palms, banana
Aleurolobus barodensis	Sugarcane whitefly	Sugarcane
Amblypelta cocophaga	Coconut bug	Coconut, mango, eucalyptus spp.
Amrasca biguttula biguttula	Indian cotton leafhopper	Cotton, sorghum, maize
Artona catoxantha	Coconut leaf moth	Coconut, sugarcane
Asterolecanium pustulans	Oleander pit scale	Highly polyphagous, incl., cotton, grape, coffee
Aulacaspis yasumatsui	Asian Cycad Scale	
Aulacophora indica	Leaf beetle	Cucurbits
Batocera rubus	Branch borer	Mango
Bruchophagus muli	Gall wasp	Lime
Ceratovacuna lanigera	Sugarcane woolly aphid	Sugarcane
Chilo auricilius	Sugarcane internode borer	Sugarcane, rice
Chilo infuscatellus	Shoot borer	Sugarcane, sorghum, rice
Chilo partellus	Spotted stalk borer	Sugarcane, maize, rice
Chilo polychrysus	Dark headed rice borer	Sugarcane, maize, rice
Chilo sacchariphagus	Spotted borer	Sugarcane, maize, rice, sorghum
Chilo terrenellus	Stem borer	Sugarcane

Species	Common Name	Host
Chlumetia transversa	Mango shoot borer	Mango
Chondracris rosea	Cotton or citrus locust	Cotton, banana, sugarcane, rice, maize
Citripestis eutraphera	Mango fruit borer	Mango
Citripestis sagittiferella	Citrus fruit borer	Citrus
Coccus celatus	Wax scale or coffee green scale	Citrus, coffee, *syzygium* spp., *casuarina* spp.
Coptotermes formosanus	Termite	
Darna trima	Nettle caterpillar	Palms
*Deanolis sublimbalis**	Red banded mango caterpillar	Mango
Deporaus marginatus	Mango leaf cutting weevil	Mango
*Diaphorina citri**	Asian citrus psylla	Citrus
Dysmicoccus neobrevipes	Pineapple mealybug	Cucurbits, banana
*Erionota thrax**	Banana skipper	Banana
Eumetopina lavipes	Island sugarcane planthopper	Sugarcane
Helopeltis spp.	Mirids	Highly polyphagous, incl., mango, coffee, avocado, *eucalyptus* spp.
Henosepilachna pusullanima		Cucurbits
Hindola fulva	Tube-building Spittlebug	Vector (Sumatra disease of cloves)
Hindola striata	Tube-building Spittlebug	Vector (Sumatra disease of cloves)
Homalodisca vitripennis	Glassy-winged sharp shooter	Vector (Pierce's disease)
Hypomeces squamosus	Gold dust weevil	Maize, citrus, cotton, rice, sugarcane
Hypothenemus hampei	Coffee berry borer	Coffee
Liriomyza huibdodbrensis	Pea leaf miner	Highly polyphagous incl., cucurbits, cotton, brassicas
Liriomyza sativae	Cabbage leafminer	Highly polyphagous incl., cucurbits, cotton, brassicas
Lymantria ninayi	Tussock moth	Conifers
Odoiporus longicollis	Banana stem weevil	Bananas, plantains
Orthaga euadrusalis	Mango leaf webber	Mango
Orycetes rhinoceros	Rhinoceros beetle	Palms
Oxymagis horni	Lonicorn beetle	Eucalyptus spp.
Parabemisia myricae	Bayberry whitefly	Polyphagous incl., grapes, cucurbits
Parasa lepida	Blue-striped nettle grub	Mango, cotton, bananas, palms
Parlatoria ziziphi	Black parlatoria scale	Citrus, coconut, mango
Perkinsiella vastatrix	Sugarcane planthopper	Sugarcane, sorghum, maize
Perkinsiella vitiensis	Sugarcane planthopper	Sugarcane
Phyllophaga helleri	June beetle	Maize, rice, sugarcane, sorghum
Planococcus lilacinus	Coffee mealybug	Mango, citrus, coffee
Prays endocarpa	Citrus pock catapillar	Citrus
Procontarinia matteiana	Mango leaf-gall midge	Mango
Pyrilla perpusilla	Sugarcane leaf hopper	Sugarcane, sorghum
Rastrococcus pinosus	Mango mealybug	Mango, citrus, coffee
Rastrococcus iceryoides	Mango mealybug	Mango, grapes, cucurbits, cotton, legumes, acacias
Rastrococcus invadens	Mango meal bug	Mango, citrus, coffee
Rhynchophorus bilineatus	Black palm weevil	Coconut, cocoa
Rhytidodera simulans	Mango branch borer	Mango
Scapanes australis	Rhinoceros beetle	Coconut, sugarcane
Scirophaga excerptalis	Sugarcane top borer	Sugarcane
Scirophaga nivella	Top borer	Sugarcane, rice
Sesamia grisescens	Pink Stalkborer	Sugarcane
Sesamia inferens	Purple stem borer	Grasses incl., sugarcane, cotton, maize, sorghum, rice

Species	Common Name	Host
Setora nitens	Nettle grub	Coconut, banana, citurs, cocoa
Stauropus alternus	Lobster caterpillar	Acacias, mango, coffee, tea
*Sternochetus frigidus**	Mango pulp weevil	Mango
Tetramoera schistaceana	Grey borer	Sugarcane, gramineae
Thrips flavus	Flower thrips	Highly polyphagous incl., cucurbits, brassicas
Trichoplusia ni	Cabbage looper	Highly polyphagous incl., cucurbits, cotton, maize, sorghum
Xylosandrus compactus	Black twig borer	Highly polyphagous incl., mango, avocado, cashew
Yamatotettix flavovittatus		Vector of sugarcane white leaf phytoplasma, sugarcane
Zeuzera coffeae	Red borer	Highly polyphagous incl., grapes, cotton, eucalyptus spp., citrus, coffee
Mites		
Species	Common Name	Host
Tetranychus piercei	Red spider mite	Cotton, Bananas
Tetranychus truncatus		Highly polyphagous incl., cucurbits, grapes, cotton, brassicas, maize + 60 other hosts
Bees & Bee Parasites		
Species	Common name	Host
Acarapis woodi	Honey bee tracheal mite	*Apis mellifera*
Apis cerana	Asian honeybee, Eastern hive bee	
Apis Dorsata	Giant honeybee	Vector *Tropilaeleps.clareae*
Apis Florea	Dwarf honeybee	
Tropilaelaps clareae	Mite	*Apis mellifera*
Varroa destructor	Mite	*Apis mellifera*
Culicoides		
Species	Comments	
Culicoides nudipalpis	Disease vector (Bluetongue)	
Culicoides orientalis	Disease vector (Bluetongue)	
Environmental		
Species	Common name	Host
Aedes albopictus	Mosquito	Vector (Human disease)
Anoplolepis gracilipes	Yellow crazy ant	
Cryptotermes dudleyi	Termite	Dry wood
Heterobostrychus aequalis	Oriental wood borer	Polyphagous
Quadrastichus erythrinea	Erythrina gall wasp	Erythrina species
Snails		
Species	Common name	Comments
Achatina fulica	Giant African snail	Major pest of vegetable and horticultural crops.
Fruit Flies		
Species name	Common name	Nearest known location
Bactrocera atrisetosa		PNG (Central Province)
Bactrocera carambolae	Carambola fruit fly	Sumbawa, Indonesia
Bactrocera correcta	Guava fruit fly	Thailand
Bactrocera cucurbitae	Melon fly	PNG (Daru, Western Province)
Bactrocera decipiens		PNG (New Britain)
*Bactrocera dorsalis**	Oriental fruit fly	Vietnam
Bactrocera kirki		Tonga
Bactrocera latifrons	Malaysian fruit fly	Malaysia
Bactrocera occipitalis		Sabah Malaysia
Bactrocera papayae	Asian papaya fruit fly	PNG (Western Province) & northern Torres Strait

Species	Common Name	Host
Bactrocera passiflorae	Fijian fruit fly	Fiji
*Bactrocera philippinensis**		Philippines
Bactrocera tau		Java, Indonesia
Bactrocera trilineola		Vanuatu
Bactrocera trivialis		PNG (Western Province)
Bactrocera umbrosa	Breadfruit fly	Torres Strait , PNG, Indonesia
Bactrocera xanthodes		Fiji
Bactrocera zonata	Peach fruit fly	Thailand

NAQS Target List for Weeds

Family	Genus species	Common name	Habitat/crop
Acanthaceae	*Asystasia gangetica subsp. micrantha*	Chinese violet	Rubber, coffee and other crops, oil-palm plantations, environmental weed.
Acanthaceae	*Blechum pyramidatum*	Browne's blechum, green shrimp plant, blackweed	Pastures, gardens, disturbed areas, rainforest understoreys.
Araceae	*Lasia spinosa*		Agricultural weed, rainforests, swampy sites.
Asteraceae	*Austroeupatorium inulaefolium*		Rice, plantations and perennial crops, savannas, swamps, disturbed forests, roadsides.
Asteraceae	*Bidens biternata*	Yellow flowered blackjack, five leaved blackjack	Disturbed and cultivated areas, paddy fields.
Asteraceae	*Chromolaena odorata*	Siam weed	Coconuts, rubber, tobacco, sugar cane, pastures, oil-palm, fruit, maize, forest edges, clearings and river flats.
Asteraceae	*Lagascea mollis*	Acuate, doll's head, silk-leaf, velvet bush	Crop fields, waste places.
Asteraceae	*Mikania micrantha*	Mile-a-minute	Rubber, coconut, oil palm, banana, cocoa, forestry crops, pastures, rice.
Boraginaceae	Cordia curassavica	Black sage	Environmental weed
Capparaceae	*Cleome rutidosperma*	Fringed spiderflower	Rubber plantations, orchards, maize, cotton, cucurbitaceae family (cucumbers, squash, melons), environmental weed.
Convolvulaceae	*Ipomoea wrightii*	Palmleaf morning glory	Disturbed and cultivated areas.
Cyperaceae	*Bolboschoenus maritimus*	Sea clubrush, saltmarsh bulrush, puruagrass, prairie rush	Rice, bogs, shores, saline soils.
Cyperaceae	*Cyperus virens*	Green flatsedge	Wet pastures, marshes and roadside ditches.
Cyperaceae	*Eleocharis congesta*	Spikerush	Irrigated and tidal rice fields, marshes.
Cyperaceae	*Fimbristylis umbellaris*	Globular fimbristylis	Rice, pastures; swamps.
Cyperaceae	*Schoenoplectus juncoides*	Rock bulrush, hardstem bulrush	Rice, lowland swamps, open wet places.
Elatinaceae	*Bergia capensis*	Bergia	Irrigated and rainfed rice fields, swamps, wet grasslands.
Equisetaceae	*Equisetum ramosissimum subsp. debile*	Branched scouringrush	Tea, rice, toxic to livestock.
Eriocaulaceae	*Eriocaulon truncatum*		Rice, wetlands, swamps, riverbanks, floodplains.
Euphorbiaceae	*Croton hirtus*	Croton	Disturbed land, roadsides, gardens, pastures and cultivated areas. Invades orchards, tea plantations, rice, tobacco, peanuts, sugarcane and vegetable crops.
Fabaceae	*Mucuna pruriens*	Velvet bean, cow itch	Grasslands, bushland, riverine forests, abandoned cultivation
Haloragaceae	*Myriophyllum spicatum*	Eurasian watermilfoil	Serious weed of lakes
Lamiaceae	*Clerodendrum chinense*	Stickbush, glory bower, Honolulu rose, Spanish jasmine	Disturbed forests, roadsides, gardens, pastures, plantations, environmental weed.
Lamiaceae	*Hyptis brevipes*	Lesser roundweed	plantation crops, orchards, vegetables rice; secondary forest, and disturbed sites in areas of high rainfall.

Family	Genus species	Common name	Habitat/crop
Lamiaceae	*Leucas aspera*	Pansi-pansi, Feng chao cao	Fields, dandy grasslands, wasteland, roadsides, overgrazed areas.
Lamiaceae	*Pogostemon auricularia*		Rice, moist, disturbed sites.
Limnocharitaceae	*Limnocharis flava*	Sawah-lettuce, velvetleaf, yellow bur-head	Wetlands, fresh water pools, rice paddies, irrigation ditches, environmental weed.
Loganiaceae	*Spigelia anthelmia*	Worm grass	Disturbed sites.
Lythraceae	*Rotala indica*	Indian toothcup	Rice fields, river banks, ditches and waterlogged grasslands.
Malvaceae	*Urena sinuata (Syn Urena lobata subsp. sinuata)*	Burr mallow, caesarweed, Congo jute, hibiscus burr, pink burr, pink Chinese burr, urena burr	Pastures, roadsides and waste land, invades disturbed areas.
Melastomataceae	*Clidemia hirta*	Koster's curse, soap bush	Cultivated areas, pastures, plantations and disturbed areas.
Melastomataceae	*Miconia calvescens*	Miconia, velvet tree	Coastland, disturbed areas, natural forests, planted forests, riparian zones, scrub/shrublands, urban areas, wetlands.
Mimosaceae	*Falcataria moluccana*	Batai, bataiwood	Forests, pastures and open areas.
Mimosaceae	*Neptunia oleracea*	Water-mimosa	Aquatic floating weed of damp sites. Often cultivated.
Mimosaceae	*Neptunia plena*	Water dead and awake, water sensitive	Wetlands, swamps and marshes, water-logged or flooded areas.
Mimosaceae	*Pithecellobium dulce*	Madras thorn	Pastures, poor soils in dry climates, environmental weed.
Myrtaceae	*Rhodomyrtus tomentosa*	Downy rose myrtle	Environmental weed; pastures, rangelands and untended areas.
Nyctaginaceae	*Boerhavia erecta*	Erect tar vine	Maize and annual crops, disturbed forests, pastures, cultivated land, roadsides and foreshores.
Oleaceae	*Ligustrum robustum*	Ceylon privet, Sri lankan privet, tree privet	Environmental weed, agricultural areas, disturbed areas, natural forests, planted forests, riparian zines, scrub/shrublands, urban areas.
Onagraceae	*Ludwigia prostrata*		Wet sites such as rice paddies, flood plains and streamsides.
Orobanchaceae	*Aeginetia indica*	Ye gu	Parasitizes bamboo shoots and crops such as rice, maize and sugarcane. Grassy lowlands, wet, swampy ground, forests, roadsides
Piperaceae	*Piper aduncum*	Spiked pepper, false kava	Kava crops, grazing land, abandoned gardens.
Poaceae	*Aristida adscensionis*	Six weeks three-awn, annual bristle grass, six weeks needle grass	Dry open ground.
Poaceae	*Coix lacryma-jobi*	Job's tears	Serious weed of waterways, rice
Poaceae	*Digitaria fuscescens*	Common crabgrass	Tobacco, vegetables, rubber, rice, pastures, disturbed sites, roadsides, coastal dunes, dry forests.
Poaceae	*Digitaria horizontalis*	Jamaican crabgrass	Fields, waste places.
Poaceae	*Digitaria insularis (Syn. Triachne insularis (L.)* Nees	Sour grass	Soybean, plum, guarana, rubber, passionfruit, maize, pineapple, cotton, pastures, rangelands, fallow land.
Poaceae	*Echinochloa glabrescens*	Barnyard grass	Rice, maize, wetlands, fallow ground.
Poaceae	*Echinochloa stagnina*	Barnyard grass	Rice, maize.
Poaceae	*Eragrostis ciliaris*	Gophertail, gophertail lovegrass, woolly love grass.	Dry places, found along rocky or sandy shores and in open ground.
Poaceae	*Eragrostis japonica*	Japanese lovegrass, pond lovegrass	Arable lands and rice fields.
Poaceae	*Eriochloa polystachya*	Carib grass	Rice, riverbanks,swamps, drains and ditches, suppresses other vegetation.
Poaceae	*Imperata conferta*	Cogongrass, lalang jawa	Coconut, roadsides, hillsides, streams and trails in dense or open forest.
Poaceae	*Ischaemum timorense*	Centipede grass	Cloves, cocoa, rubber, coconut, oil palm, sugarcane and rice plantations; weed of roadsides, ditches, forest margins.

Family	Genus species	Common name	Habitat/crop
Poaceae	*Leptochloa chinensis*	Asian sprangletop, Chinese sprangletop, red sprangletop	Rice, sugarcane, vegetables, cotton, corn.
Poaceae	*Leptochloa panicea*	sprangletop	rice, cotton, soybeans, peas, sugarcane, maize, peanuts, pastures.
Poaceae	*Miscanthus floridulus (*Syn. *Saccharum floridulum* Labill. *& Miscanthus japonicus Andersson*	Miscanthus, giant Chinese silver grass, Japanese silver grass	Slopes, valleys and grassy places.
Poaceae	*Panicum dichotomiflorum*	Bluegrass, fall panic grass, fall panicum, smooth witchgrass, western witchgrass	Naturalised in mesic, disturbed areas.
Poaceae	*Saccharum spontaneum*	Wild sugarcane, wild cane, serio grass, fodder cane	Waste areas, fallow fields, marshes, banks of streams and ponds, sand dunes, along railways or highways, and in or around fields.
Poaceae	*Sacciolepis interrupta*		Rice, irrigation channels and wetlands
Poaceae	*Urochloa glumaris (*Syn. *Brachiaria paspaloides* (J. Presl) C.E. *Hubb.*	Common brachiaria, Thurston grass	Orchards, tea, coffee, rice, lawns, roadsides, disturbed sites.
Poaceae	*Urochloa plantaginea (*Syn. *Brachiaria plantaginea* (Link*) Hitchc.*)	Alexander grass, marmalade grass, plantain signal grass	Disturbed sites.
Poaceae	*Zizania latifolia*	Manchurian water rice, Manchurian zizania, water bamboo, rice grass	Coastland, estuaries, lakes, marine habitats, riparian zones, water courses, wetlands.
Rhamnaceae	*Maesopsis eminii*	Umbrella tree, musizi	Grasslands, disturbed areas within forests
Rhizophoraceae	*Rhizophora mangle*	American mangrove, mangrove, red mangrove	Coastland, range/grasslands, riparian zones, wetlands.
Rubiaceae	*Diodia sarmentosa*		Coffee, tea, leucaena, *Stevia* sp. plantations.
Rubiaceae	*Paederia foetida*	Skunk vine	Sugarcane, pastures, secondary forests, waste places and cultivated land
Salviniaceae	*Salvinia cucullata*	Chok huu nuu	Slow-moving freshwater bodies, rice fields, shallow pools.
Salviniaceae	*Salvinia natans*	Floating watermoss	Rice, irrigated fields, ditches and shallow pools
Scrophulariaceae	*Limnophila sessiliflora*	Ambulia, Asian marshweed, shi long wei	Ponds, swamps, rice fields, wet places along streams.
Scrophulariaceae	*Striga asiatica*	Asiatic witchweed, red witchweed	Maize, millet, rice, sorghum, sugarcane, sunflower, tomatoes, some legumes
Solanaceae	*Solanum viarum*	Tropical soda apple	Agricultural areas, riparian zones, rural/disturbed, water courses
Turneraceae	*Piriqueta racemosa* (Syn *Piriqueta ovata* (Bello) *Urb.*)	Rigid stripeseed	Waste places, road sides, dry fields.
Verbenaceae	*Stachytarpheta indica*	Blue porterweed, blue rats tail, light blue snakeweed, vervain	Crops, pastures, plantations, roadsides and wastelands.
Violaceae	*Hybanthus attenuatus*		Rice, a wide diversity of annual crops, pastures, waste places.

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Appendix 8

Resources for Pest-Free Area Establishment (Jorgensen, 2006)

Potential resources for establishing a PFA

Table 2.1 Preparing a PFA Proposal

(The proposing organisation has overall responsibility)

Component	Resource organisation or individual	Outputs
Defining the PFA.	State department, proposing organisation, IPHRWG technical working group.	Map(s). Written description of boundaries.
Developing the surveillance system.	State department, proposing organisation, IPHRWG technical working group, specialist biometrician.	Definition of purpose. Choice of survey method/s. Development of surveillance program. Choice of survey method(s).
Surveying.	State department, proposing organisation, consultants, contractors.	Reports on surveys and survey program.
Pest biology.	Pest specialists – state department, CSIRO, universities, consultants.	Detail on the organism, identification methods, life cycle, multiplication, dispersal, survival, effect of climatic conditions, effect of pesticides, host lists, host susceptibility, symptoms.
Pest mapping.	Pest specialists – state department, CSIRO, universities, consultants.	Maps showing pest distribution.
Pest prevalence.	Pest specialists – state department, CSIRO, universities, consultants.	Selecting a method, obtaining reference information and predicting the prevalence.
Host biology.	Plant specialists – state department, CSIRO, universities, consultants.	Information on biological factors affecting the pest.
Host mapping.	Plant specialists – state department, CSIRO, universities, consultants.	Maps showing the distribution of hosts.
Risk analysis.	Pest specialists – state department, CSIRO, universities, consultants. Risk analysis specialists – AFFA, consultants.	Assessment of risks of missing the pest in surveillance.
Assessing the confidence achieved.	Risk analysis specialists – AFFA, consultants.	Confidence resulting from different survey methods and pest prevalence.
Reporting.	Proposing organisation.	Interim and final reports.

Source: Jorgensen *et al.* (2006)

Appendix 9

Presentation to Canberra National Biosecurity Engagement Forum (Kim James, Sept 2008)

National Biosecurity Engagement Forum

Canberra – Wednesday 17 September 2008

Introduction - By way of introduction my name is:

Kim James – and I am the Biosecurity and Market Access R&D Manager for Horticultural Australia Ltd (HAL)

Today I have been asked to provide an industry perspective relating to biosecurity and the Australian horticultural industry.

As background - HAL is a national research, development and marketing organisation that works in partnership with the horticulture sector to invest in programs that provide benefit to Australian horticulture industries.

HAL works with more than 40 horticultural industries across Australia and these industries produce hundreds of product lines.

Biosecurity is a global concern

In recent years biosecurity has emerged as a major global, national, regional and on-farm issue.

As the world becomes globalised we are seeing greater international trade and tourism resulting in an increased risk of serious plant and animal pests entering Australia.

Pests and diseases are already costing Australia billions of dollars annually, mainly in terms of costs of control, lost production and loss of trade.

On a national level it is apparent that a number states and industries are now strengthening their biosecurity policy and/or investment in biosecurity.

What is bioisecurity?

From my perspective, biosecurity is the protection from risks posed by plant and animal pests and diseases through actions such as planning, preparedness, surveillance, detection, exclusion, eradication and control.

Biosecurity is also about the protection of the environment; protection of our horticultural industries and associated communities and regions as part of the biosecurity continuum – i.e. Pre-border biosecurity; Border biosecurity; and Post-border biosecurity.

In addition, biosecurity is also about ensuring we maintain our plant health status to retain our existing trade and to gain and improve market access in national and international markets.

Vision and mission for Australian horticultural industry Biosecurity

Our biosecurity **Vision** for Australian horticulture is for:

- Strong, viable and sustainable Australian horticultural industries that are well prepared for invasive pests via the proactive development and implementation of ongoing industry biosecurity programs.

Our **Mission** focuses on:

- Protecting the viability of horticultural industries by implementing measures to minimize the risk of serious pests becoming established in Australia and minimising the impact should incursions occur.

HAL biosecurity strategies

The HAL biosecurity plan recommends various common strategies be developed by our horticultural industries

The four key biosecurity strategies are:

Biosecurity Planning, Risk Analysis, Reducing the risk of impact, and Protecting market access.

The first strategy – Biosecurity Planning

Examples of biosecurity planning Research and Development (R&D) include:

- Pest list information
- Biology, ecology & plant hosts
- Pest Risk Assessments
- Geographic distribution & spread of pest threats
- Use of risk analysis tools to evaluate economic impact
- Pest categorization research
- Quarantine & pathway entry research
- Codes of practice, accreditation & Quality Assurance Schemes
- Planning International scientific preparedness

The second strategy - Risk Analysis

Examples of biosecurity risk analysis R&D or actions include:

- Plant Health Australia (PHA) industry membership ($20m+industry value)
- Biosecurity funding arrangements and/or PHA levies in place
- Emergency Plant Pest Response Deed (EPPR) signatory
- Formation of the peak industry body (PIB) biosecurity management group

- Develop Industry Biosecurity Plans (IBP)
- Annual review of IBP
- Industry Incursion Management Plans (IMP - pest specific or pest generic)
- Regional & On-Farm Biosecurity Plans (RBP and OFBP)
- Industry communication & awareness

The third strategy - Reduce the Risk of Impact

Examples of reducing the risk of impact R&D include:

- Pest trapping, surveillance & monitoring programs
- High quality diagnostics & pest identification
- Impact management research & technologies
- Education and training
- Grower awareness
- Training to manage a pest incursion
- Reduce the damage from eradication or containment
- Environmental & impact planning

The fourth strategy - Protect Market Access

Examples of protecting market access R&D include:

- Pest control R&D to maintain trade
- Effective Disinfestation methods to kill pests
- A Systems Approach to controlling pests of quarantine concern

  E.g. Proof of Area Freedom, Areas of Low Pest Prevalence (ALPP) & Area Wide management (AWM) in line with international standards e.g. the International Plant Protection Convention (IPPC)

- Pest control data packages for trade negotiations
- Integrated Pest Management (IPM) programs to reduce chemical use & Maximum Residue Levels (MRL's)
- Harmonization of regulatory procedures
- Sanitary and Phytosanitary (SPS) and quarantine requirements

Maintaining the biosecurity continuum is very important

1. **Pre-Border Biosecurity** (International)
   - Identifying exotic pest threats; managing quarantine risk offshore; undertaking offshore R&D where pests are endemic.

2. **Border Biosecurity** (National and State)
   - Implementing effective quarantine for people, plants, animals and trade.

3. **Post-Border Biosecurity** (State and Regional)
   - Minimising risk of regional and farm pest entry and establishment; and preparing for timely detection, minimised spread and rapid response to emergency pests.

As we are discussing horticulture and regional Biosecurity today I would like to spend a couple of minutes discussing:

Post-Border Biosecurity

It is important to have a coordinated national approach to biosecurity and research priorities for the environment; including weeds, invasive marine species and animal & plant pests.

Protecting the impact on the environment from any biosecurity incursion should be a high priority for all Australians (e.g. Red fire ants in Queensland).

AusBIOSEC – Offers a national framework approach to managing pests and diseases with predominantly environmental impacts and protecting biodiversity and the environment. Also the PHA EPPRD refers to the environment.

Increased biosecurity awareness to protect our environment is essential.

Post-Border Biosecurity - The region

Australia has many key production regions that need protecting and most regions would benefit from a pro-active regional biosecurity planning approach.

Increased biosecurity awareness in all major production regions will only strengthen our defence against unwanted pest and disease incursions (e.g. The Ord River Irrigation Area in WA).

Peri-urban biosecurity awareness is also important due to its proximity to border entry points and lifestyle farmers near built up areas.

Communication and awareness should be included as cornerstones of any regional biosecurity program.

Post-Border Biosecurity – The Community

Strong regional communities usually benefit from sustainable and profitable horticultural industries.

Community ownership, engagement and involvement are essential for successful pest control or eradication programs (e.g. fruit fly control in the Riverland region – i.e. the whole community benefits from the trade generated by the Fruit Free Area Freedom within this region).

A whole of community approach is normally required for successful pest control programs (e.g. a regional fruit fly trapping program usually involves cooperation of people in townships and on farms).

Post-Border Biosecurity – On farm

Farm biosecurity refers to measures designed to protect a farm from the entry and spread of harmful and unwanted pests and diseases. Growers have a key role to play in protecting their farm from exotic pests and diseases.

Early detection and response can reduce the cost and the impact on a farm and in turn the community, the region and the industry. It will also increase the likelihood of successful eradication if there is an incursion.

On-farm prevention biosecurity strategies could include: signage at the front gate, regular surveillance for pests and the adoption of biosecurity best practice to; monitor the movement of people, plants, animals, machinery, equipment, vehicles, seed, plant material and regular monitoring of crop hygiene, etc.

Conclusion

Strong regional biosecurity is essential; it will greatly assist the Australian horticultural industry and protect national and international trade. We look forward to working closely with all concerned with this project over the next four years.
Remember – "Biosecurity is Essential and Biosecurity Matters!"

Thank you for listening - I hope the biosecurity engagement forum is a success.