



National Vegetable Industry IPM Pathology GAP Analysis

Horticulture Australia VG06092

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Purpose of project:

This project details the outcomes of a 12-month study to determine priorities for funding projects on the development of successful 'best practice' projects to increase on farm adoption of IPM for pathology issues.

Report completed: May 2007

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Primary Industries Research Victoria

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APPENDIX 1. SUMMARY OF KEY OUTCOMES FROM STATE MEETINGS

~~NSW IPM GAP MEETING – 6TH FEBRUARY 2007~~

~~TECHNOLOGY TRANSFER~~

~~SCLEROTINIA ON LETTUCE~~

~~DOWNY MILDEW ON LETTUCE~~

~~CHEMICAL RESISTANCE~~

~~VIRUSES~~

~~SEEDLING HEALTH~~

~~TASMANIA IPM GAP MEETING: DEVONPORT – 9TH FEBRUARY, 2007~~

~~PRIORITIES ACROSS PATHOGENS~~

~~SA IPM GAP MEETING: ADELAIDE – 13TH FEBRUARY, 2007~~

~~SA IPM GAP MEETING: VIRGINIA – 26TH FEBRUARY 2007~~

~~VIC 1. IPM GAP MEETING: CRANBOURNE – 28TH FEBRUARY~~

~~VIC 2. IPM GAP MEETING: BAIRNSDALE – 2 FEBRUARY, 2007~~

~~WA IPM GAP MEETING – 28TH FEBRUARY, 2007~~

~~APPENDIX 2 – AGENDA AND WORKSHOP PARTICIPANTS~~

~~(PRELIMINARY WORKSHOP, KNOXFIELD 29TH & 30TH NOV)~~

~~APPENDIX 3 – INDUSTRY SURVEY OF PRESENT CONTROL OF PATHOGENS~~

1. Media Summary

A series of eight national workshops attended by over 150 growers, researchers and agricultural consultants have led to the development of a \$2 million research program to address development of new IPM strategies for the key disease problems in vegetable crops throughout Australia. The top six pathogens which workshop participants prioritised as causing the greatest losses throughout the industry were Sclerotinia, viruses particularly tomato spotted wilt and cucurbit viruses, downy mildew, Fusarium, Pythium and powdery mildew. Crop loss from these pathogens ranged between 5 to 100% depending on the region and the climatic conditions. The estimated cost in lost production from these diseases to industry was \$100 million.

Six key sub program areas have been proposed to the industry advisory committee for funding from 2007 onwards for up to 3 years. The key sub program projects cover areas of chemical resistance management, the use of IPM compatible pesticides, development of best practice IPM programs for foliar, soilborne and viral diseases, a technology transfer program to deliver 'holistic' IPM packages for outdoor and greenhouse vegetables, and an innovation program that looks at new technologies that could improve use of IPM on farm. The sign off on the program will be made by the Vegetable IAC during July 2007.

2. Introduction

The Australian vegetable industry has significant annual investment in pest and diseases research and development programs. These programs are directed towards the sustainable management of a large range of plant disease issues caused by fungi, nematodes, viruses and insects that cause over \$100 - 150 million of loss annually to the production of vegetable crops.

Under the current funding structure, a research and development levy is collected from all growers. This money is matched 1:1 by the federal government and further funding is sourced from state governments or the private sector supporting various proposals. The process is managed by Horticulture Australia Limited who call for research submissions on behalf of the vegetable industry annually. Research submissions are reviewed by industry leaders (key growers supported by industry development officers, exporters and other industry representatives) who allocate funds to priority projects. Traditionally urgent disease problems that limit productivity or quality are given priority funding (eg. clubroot of brassicas during the late 1980s and early 1990s, celery mosaic virus during the late 1990s and, more recently white blister of brassicas and white rot of spring onions). However, no coordinated approach to pathology research and development exists under the current structure. Researchers receive limited guidance from the vegetable industry aside from those within their circle of contacts during the project development phase. Equally, industry leaders face the daunting task of prioritising a multitude of research submissions within a poorly defined framework.

Many of the industry's disease issues have been around for a long time, however, since project outcomes are not collated in a readily available format, most growers could not hope to be aware of all of the projects conducted in the last 20 years let alone be familiar with their outcomes.

In 2006 a series of workshops was conducted by Sandra MacDougall to evaluate priorities for IPM management of insect pests of the major vegetable crops. At a meeting of stakeholders in Sydney in March 2006, it was identified that this program needed a complimentary program to address the key pathology issues that needed to be addressed throughout Australia. In July 2006, this project was commissioned to review vegetable pathology (disease) research conducted in the last 20 years. It also was to establish the current situation with uptake of pathology IPM, identify gaps in knowledge and make recommendations to industry for strategic short and long term investment priorities in vegetable IPM. Its brief was to conduct a series of meetings and reviews of past research to establish the key priorities that needed to be addressed in pathology. The primary outcome of the project was to develop a set of R, D and E priorities that were clear, concise and adequately reflected the needs of the industry in addressing IPM pathology issues. Another outcome was to develop a process for setting priorities for R and D which avoided the frustration to stakeholders of the ad hoc approach that previously existed. The program was to provide a structure which ensured collaboration and integration of IPM programs into a systems approach for pest and disease control on farm.

3. Methodology

The project used a series of workshops in each State of Australia, a database and knowledge from industry, researchers and other agrochemical representatives and consultants to develop a program for investment into R, D and E in pathology in the vegetable industry.

3.1 Strategic Priority Setting using Expert Information

It was recognised from the beginning of the project that there were two parallel approaches that could be taken to the process of identifying gaps in pathology research and development and setting research priorities.

The first utilises the knowledge held by current experts in the field (Fig 1, Part B). It seeks to source information from pathologists working with the pathogens, growers seeking to implement research findings and other members of the industry, including crop consultants and resellers, working directly with growers to manage their pathogen problems. This method provided accurate and up to date information, however, the information provided is subjective and open to influence by one or two vocal participants (influential growers, agricultural consultants or research providers). This process is often biased towards addressing the short term priorities that exist because of the influence of short term problems on farm, ie drought, climate, epidemics, etc. The consistency of information across States meant that information from this process proved to invaluable for setting up the priorities of the whole program.

Both approaches were used in parallel (Fig 1.)

3.2 Strategic Priority Setting using Structured Databases

This approach (Fig 1, Part A) involved a rigorous review of past research in HAL projects, past reports from National Vegetable Pathologist Research Meetings in 2003 and 2005, the development of decision making databases with the growers and agricultural consultants and a science database. This approach provided an objective summary of the available information, the success of the research programs and a longer term view of the likelihood of R, D and E to achieve effective outcomes.

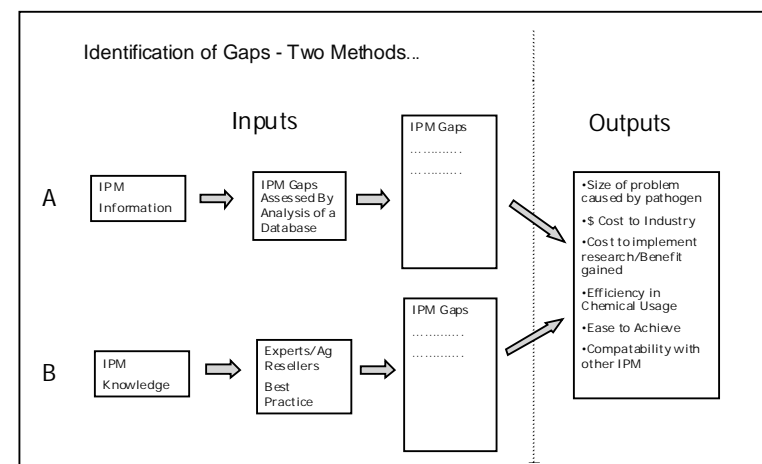


Fig 1. A diagrammatic representation of the two approaches taken to develop the priority research and technical transfer requirements of the National IPM pathology program

Review of background material – April 2006

The following background reference material was available at the onset of the project. This material was reviewed by the project team and the results (a series of priority issues) were presented to the Vegetable Industry Advisory Committee at a meeting held in the HAL offices, Sydney in April, 2006.

1. Coutts J, Purdon L and McDougall S. (2006). IPM Stocktake Survey. NSW Department of Primary Industries and Coutts J & R.
2. National Vegetable Pathology Working Group Meeting – Minutes. Brisbane Convention Centre, South Bank Brisbane. Monday 8th May, 2006.
3. McDougall S, Burfield T and Watson A (2006) IPM Stocktake data files (entomology/pest based). NSW Department of Primary Industries.

IPM Pathology Gap Analysis: July 2006 to May 2007

National workshop for pathologists and crop consultants to set key sub projects of the program

A two day workshop was conducted at the Department of Primary Industries, Knoxfield centre in November 2006. Key pathologists from each state and Northern Territory attended both days. They were joined by key crop consultants on the second day (see Appendix 1 – workshop agenda and attendees).

Prior to the workshop two surveys (one for the pathologists and one for the consultants) were developed (Appendix 2 and 3). The pathologists were sent both surveys. They were asked to complete the 'pathology' survey alone based on their own knowledge of the industry. They were also asked to take the 'industry' survey out to key chemical resellers, growers and other industry representatives to get their opinion before the workshop. The consultants were only sent the 'industry' survey and were asked to complete this before attending the workshop.

National Industry Workshops

Six pathology sub-program areas were developed from the preliminary workshop conducted at Knoxfield, Victoria and the review of background material. These sub-program areas including, key research activities, target pathogens and preliminary funding priority guidelines were summarised and a document prepared for use as prerequisite reading material for industry workshop attendees.

A series of eight industry workshops were then held to ensure that the priorities set were representative of the industry needs nationally:

- Victoria (DPI, Baimsdale) - February 1st, 2007 (Preliminary workshop)
- New South Wales (Panthers Leagues Club, Bathurst) – February 6th, 2007
- Queensland (DPI, Gatton Research Station) – February 7th, 2007
- Tasmania (DPIWE, Devonport) – February 9th, 2007
- South Australia (Waite Campus) – February 13th, 2007
- Western Australia (Waneroo Tavern) – February 14th, 2007
- South Australia (Virginia Horticultural Centre) – February 26th, 2007
- Victoria (Amstel Golf Club) – February 28th, 2007

Workshop participants (over 150) included key growers, consultant, chemical resellers, and researchers from the relevant Departments of Primary Industries, National Universities, CSIRO and private sector providers. The aim of the industry workshops was to brainstorm pathology priorities of regional importance, align these with the sub-program areas determined during the preliminary workshop, identify points of significant difference and modify the sub-program areas accordingly.

Each workshop was facilitated and followed a structured development process (see Appendix 2). The key tasks were to determine key priority problems, the % loss, the cost to the industry and then the areas where industry felt IPM research and delivery would benefit the industry.

Pathology Research and Development database

As part of the information review a database of past projects was developed using Microsoft Access 2003. The database contains summaries of pathology projects conducted within the last 20 years. It includes, without being restricted to, Horticulture Australia Ltd funded projects. The database contains project summaries, identifying information (such as project title, project number, chief investigator etc) and categorises each project according to the IPM tools researched or developed, the pathogen, crop and/or region/s studied (Appendix 4).

The database was used during the project as a source of reference material. In particular it was used during the formulation of the key research activities within each subprogram areas. Beyond the project it will exist as a stand-alone database for industry to use to review in detail past information and avoid unnecessary duplication of R and D. Present work is being targeted to see if it can be linked into the AusVeg website databases for use by all stakeholders nationally and internationally.

4. Results

4.1 Review of background material

The following priority research areas were identified as the key issues to be addressed at the past meetings of the National Vegetable Pathology Workshops held in 2003 and 2006:

Fungicide resistance management

- Development of resistance management strategies for major pathogens to maximise the longevity of existing chemistries. Strategies similar to that for the insect pest diamond back moth needed (eg. white blister). Nurseries should be included since they may be applying several fungicide applications for a single pathogen.
- Investigate the extent of resistance for several pathogens (eg. pathogens of cucurbits, copper resistance issue for bacterial spot of capsicum and black rot of brassicas)
- Investigate alternative chemistries for major pathogen groups (eg. Powdery mildews, downy mildews, white blister and Botrytis).

Seed borne diseases

- Undertake review/scoping study to develop a strategy to address the issue of healthy seed for the Australian vegetable industry. Identify key diseases of concern.
- Seedling project to address seedling health, nursery best practice – production of disease free seedlings.
- Develop methods of testing and managing seedborne diseases (issue for root crops, tomato, capsicum and brassicas to a lesser extent).
- Tomato project addressing potato spindle tuber viroid and bacterial canker.

Extension

- Develop and implement Brassica model for other key commodities (beginning with lettuce and carrot). Consider setting aside dollars to fund similar commodity based roadshows with associated printed materials on a regular basis, perhaps every 3 years.

Diagnostics

- Review predictive and diagnostic tests available world-wide, their availability, effectiveness and ease of use, determine the practicality of in-field diagnostic tests and validate for Australian conditions.
- Develop diagnostic tests (eg. for soilborne diseases of root crops)
- Develop sampling strategies for collection of soils for diagnostic testing. How to collect a sample that will give a good reflection of the disease present in the field. One sample or many? How many? etc.
- Collect field data to correlate test result with disease outcomes in a range of soils and conditions. Determine thresholds for disease (ie. ground truth these tests).

Best practice

- Network pathologists, entomologists, agronomists etc for each major commodity group to develop 'best practice' guidelines for the commodity. Identify key recommendations for each major pest/disease issue within the commodity and test these against what is known for other pests and pathogens that affect that commodity. Are we sending conflicting recommendations. Identify best practice – this will most likely be a compromise outcome for all pest/pathogens. Prepare guidelines as summary sheets.

New chemistry

- Investigate new chemistry to increase the available arsenal available to combat pathogens. Ability to control some important pathogens restricted to only one or two groups. Resistance is inevitable. Liaise with the outputs from the Minor Use program conducted by Agaware and Peter Dal Santo (AH04009).

4.2 Database of Past Pathology Research

Project information was gathered for the database using various methods. Searching the HAL website for media summaries in the vegetable industry, using lists of current HAL research projects, emailing researcher from the various countries DPI's and universities, as well as collecting from previous IPM investigations. Over 180 research projects were reviewed, 61 of them were found to be relevant to the vegetable pathology IPM analysis.

The media statements and project summaries were then reviewed and then categorised using predetermined IPM research areas (see *IPM Tools for pathogens* in Appendix 4). Other relevant research areas were also categories against the project summary including location, pathogen and crop. This information was recorded in the form of Keyword descriptors and enabled cross-tabulations to be created for investigating, for example, disease by IPM tools, or crop by IPM tools. An example of the user interface that was created for entering data is shown in Figure 2.

Fig 2. User Interface for adding an IPM Tool into the database



A frequency table of the IPM tools by crop is shown in Table 1. Currently, discussions are underway with Tony Burfield and representatives from AusVeg to look at incorporating this information into a format accessible to Growers.

Table 1 - Table of the Number of Existing Research Projects (by Vegetable Group) that have Outcomes Related to the IPM Tools Categories.

Pathogens	Alliums	Asian Veg	Brassica	Cucurbits	Leafy Veg	Legumes	Root Crops	Solanca	other*
Diagnosis & Detection			3		2	1	1	1	
Key Disease information				1		1		1	1
Sampling & decision making strategies					2	3			2
Seedling health			2		3	1	1		2
Cultural management strategies		1	4	3	5	4	2	1	4
Biological control				1	3		1	1	
Chemical control			2	2	5	3	3	2	1
Other non-chemical tools	1		6		2	3	1	3	1
Complete management guidelines			3		5	2	1	2	2
Resources			3		1		1	2	
TOTAL Number of research projects	1	1	11	5	12	9	7	8	7

* 'other' consists of beetroot, rhubarb, sweet potato and sweet corn.

4.3 IPM Pathology Gap Analysis

4.3.1 National Workshop to Determine Program Structure

Six sub-program areas were proposed at the National workshop of key stakeholders in November 2006. A summary of key outcomes from this workshop is shown in Appendix 2. Key research areas are detailed below. The key pathogens identified as important from crop loss in the industry are shown in Table 2. The key drivers that growers need to consider in order to take up further IPM practices are shown in Table 3. The present grower use of IPM for pathology issues is extremely low as most growers still mostly calendar spray and do not base spray schedules on the first sign of diseases or use predictive tools to monitor the pathogen loads in soil (Table 4). A structure for the program (Fig. 3), detailed breakdown of the projects commissioned to satisfy the program (Fig. 4) and the relationship of the IPM Pathology Program with the other HAL programs and its place within the wider field of IPM pest management (Figs. 5) are provided. A description of each of the sub program areas and the relevant research projects that have been commissioned are shown below.

4.3.2 Vegetable Industry IPM Pathology Program

The outcome from the eight State workshops which addressed the key priorities for research and technical transfer are shown in the following 6 sub program areas. A summary of key outcomes from these workshops and the growers surveys is shown in Appendix 1 and 3. Within each sub program area are the key areas that the sub program addresses and the projects that have been commissioned to address these key problems. Note, it was a prerequisite for each stakeholder interested in submitting projects that they showed the linkages to the rest of the IPM pathology program especially the sub program 5 which was to deliver the outcomes on farm.

Sub program 1: Chemical Use

Key Research Areas:

- Review of IPM compatibility of pesticides
- Impact of pesticide withdrawals
- Reducing chemical footprint
- Resistance management of fungicides

Key Research Projects To Be Considered for Funding from 2007:

Project A (12 months, up to \$75000)

Prepare IPM, market access and environmental profiles for existing fungicides in conjunction with AgAware.

Develop best practice IPM pesticide programs for the following priority pathogens:

- Sclerotinia, Downy mildew, Fusarium, Pythium, Powdery Mildew, Rhizoctonia

Project B (2 yrs, up to \$100 000/yr)

i) Screen key pathogens for resistance to the major chemical groups used for control, eg. Azoxystrobin, metalaxyl, dimethamorph (white blister), azoxystrobin, iprodione, procymidone, boscalid (Sclerotinia), copper (bacteria), metalaxyl (Downy in lettuce), iprodione, procymidone (botrytis).

ii) In consideration of site history determine the effect of repeated use of multicrop fungicides on the same pathogen population.

iii) Provide results to and liaise with AgAware to develop and report on improved resistance management programs for the pathogens above.

iv) Determine the most effective copper formulations to manage bacterial pathogens.

Sub-program 2: Integrated Soilborne Disease Management (Focus Sclerotinia, Pythium & Fusarium)

Key Research Areas: (Priorities on Sclerotinia, Fusarium, Pythium and Rhizoctonia)

- Non-chemical controls
- Seedling health
- Sampling, forecasting and detection
- Benchmark parameters for pathogen management
- Host Resistance

Key Research Projects To Be Considered for Funding from 2007:

Project A – Integrated management of soilborne pathogens (Sclerotinia on beans, lettuce, carrots, celery & other)

(3 yrs, up to \$375, 000/yr)

- Develop strategies that eradicate soilborne inoculum and/or prevent infection in the field with particular emphasis on crop rotations, organic amendments, crop residues, germination stimulants.
- Develop amendments (organic and biocontrols) that can be added to the speedling trays that are as effective as chemical controls.
- Investigate potential to forecast ascospore phase for *Sclerotinia sclerotiorum* (beans, carrots)
- Evaluate cultural practices, i.e. – Planting density, plant architecture, leaf wetness and soil humidity parameters conducive to *Sclerotinia sclerotiorum* infection and develop irrigation and cultural practices accordingly (beans, carrots).
- Screen international varieties for resistance (particularly beans).
- Deliver an extension package to improve best practice management of sclerotinia. This will include improved fungicide placement and timing.

Project B - Fungicide alternatives for soilborne diseases (Rhizoctonia, Pythium, Fusarium, Sclerotinia in conjunction with project A) (3yrs, up to \$350 000/yr)

i. Identify natural soil factors (chemical and biological) that are associated with inoculum reduction and disease suppression.

ii. Develop fungicide alternatives (physical, chemical, organic and biological) with potential for inoculum reduction and disease prevention for the key soilborne pathogens.

Project to include a review of fungicide alternatives (physical, chemical, organic and biological) for the control of soilborne pathogens and development of an understanding of the mechanisms of pathogen control.

Project C (1yr, 20,000)

(Rhizoctonia in beans, lettuce (and carrots)

- A review be conducted (in conjunction with PPR and D program) to identify effective early fungicide spray programs for rhizoctonia diseases and the use of crop rotations and organic amendments to reduce pathogen loads in soils and subsequent disease in vegetable crops

Sub-program 3: Integrated Foliar Disease Management

Key Research Areas:

- Non-chemical controls
- Seed Health
- Aerial sampling, detection and modelling
- Benchmark parameters for pathogen management (Downy, Powdery and Leaf spots)
- Host Resistance

Key Research Projects To Be Considered for Funding from 2007:

Project A – Fungicide alternatives for foliar diseases (3 yrs, up to 250 000/yr)

Develop IPM strategies, (ie. fungicide alternatives) to manage the following key foliar pathogens:

- Powdery mildew
- Downy mildew
- Anthracnose
- White blister

This will include a review of fungicide alternatives (physical, chemical, organic and biological) for the control of foliar pathogens, studies on host pathogen interactions and the development of an understanding of the mechanisms of pathogen control.

Project B – Benchmarking parameters for pathogen management (downy mildew, powdery mildew, septoria, white blister) (3 yrs, up to 300 000/yr)

- i. Develop methods for aerial sampling, detection and modelling of foliar pathogens with focus on pesticide reduction (link with VG 05054, VG 06047, VG 04013)
- ii. Determine the influence of nutritional status, irrigation and moisture on disease development.
- iii. Develop benchmark parameters for pathogen management.

Sub-program 4: Integrated Viral Disease Management

Key Research Areas:

- Technology transfer
- Alternate hosts
- Sources of epidemics
- Vector Management
- Host Resistance

Key Research Projects To Be Considered for Funding from 2007:

Project A: Improved IPM management of viral pathogens (3 yrs, up to 200 000/yr)

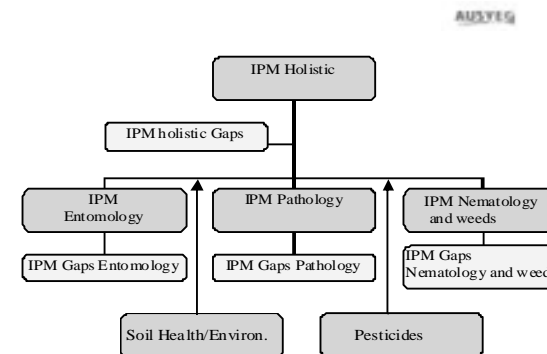
i) Develop extension package to promote the effective management of virus diseases of vegetable crops (in conjunction with VG 6022). Consider whole farm approach to virus control which includes an,

- understanding of methods of virus transmission (eg. persistent vs non-persistent) and
- management of alternate hosts
- means to control vectors
- use of resistant or tolerant varieties

ii) Study epidemics to determine alternate source and identify risks.

iii) Review previous survey information to determine gaps in knowledge of the spread and importance of key viruses of vegetable crops, particularly the extent of crop loss.

Sub-program 5: Communication and Extension program



Schematic representation of the disciplines needed for a holistic IPM program

Key Issues:

- Commodity based (except viruses) NOT project based
- Should draw together and package information from across the entire IPM program. In particular must link chemical use sub-program and with the other HAL IPM programs.

Each package to include:

- National Workshops, field days and training events
- Published material (eg. factsheets)
- Scout and consultant training
- Where possible, 'best practice programs' linking pest and disease outcomes to be developed and presented for commodities.
- Role for industry development officers to coordinate (each taking on the commodity that they are responsible for within HAL industry groups)

Key Research Projects To Be Considered for Funding from 2007:**Project A: Best practice production models (lettuce, brassicas, cucurbits) (2 yr, up to 100 000/yr)**

- To utilise national IPM experts (pathology, entomology, nematology, weed sciences) to develop whole farm holistic packages which identify and deliver to industry the best practice strategies for successful implementation of IPM on farm.

Project B: Greenhouse hygiene (2 yr, up to 100 000/yr)

- Deliver extension program to improve management of soilborne and foliar pathogens by managing crop debris, production practices, hygiene and minimising pathogen contamination in greenhouse water sources.

Project C: To update and improve distribution of IPM information packages to industry (1 yr (10,000))

- Update Diseases of Vegetable Crops (DPI Q)

Sub Program 6: Novel Strategies and New Technologies**Key Research Areas:**

- New production systems
- Emerging Technologies

Project A (Up to 3 years, 100,000/yr)

To use new DNA technologies to provide a greater understanding of host pathogen relationships and improve disease control on farm without the use of pesticides.

Project B (1 yr, 25,000)

To review use of predictive and diagnostic tests available world-wide, identify and validate those with potential for use on farm in Australia.

(Identify novel production systems to minimise the impact of diseases)

Driver for this work to be reducing costs, increasing productivity or minimising environmental impact of production. It is anticipated that a maximum of 3 years funding could be sought from the trust and that at the end of this time, if appropriate, the technology or idea developed would be further researched through sub-programs 1-4. Applications for funding to the trust must include an annual 'stop/go' clause to enable Horticulture Australia and the research provider to opt out of further work if the novel strategy/new technology is deemed inappropriate for Australian conditions, too difficult to implement etc. Appropriate stop/go points could include completion of a review, preliminary trials etc.

Table 2 Priority Pathogens across Australia as determined by industry at National workshops in 2007. (10 = Top priority to 5 = Lowest priority of the key pathogens)

Pathogen/ Disease	Key crops	VIC ^A	TAS	QLD	SA ^A	NSW	WA	Total
Sclerotinia	Lettuce (Sm) Brassica (S.s.) Beans (S.s) Carrots (Ss)	10	10	8	-	5	10	43
Viruses^B	Lettuce, Cucurbits, Celery, Carrots, Capsicum, Brassicas	5 CeMV CarVY TSWV TuMV	-	10 TSWV CaCV WMV	6 TSWV CMV CarVY LBVV	10 TSWV LMV TuMV	7 TSWV ZYMV LBVV	38
Downy mildew	Lettuce Brassicacae seedlings	9	7	-	9	7	-	32
Fusarium	Melons Capsicums Snow peas	-	-	9	7	8	8	32
Pythium	Beans, Peas, Carrots, Brassicas	-	-	-	10	9	9	28
Powdery mildew	Greenhouse e Cucumbers, Cucurbits	-	6	7	-	6	5	24
Rhizoctonia	Brassicas	-	8	5	5	-	6	24
White blister	Brassicas Proc. Broccoli (Tas)	7	9	-	-	-	-	16
Botrytis		-	5	-	8	-	-	13
Clubroot	Brassicas	8	-	-	-	-	-	8
Anthraxnose		6	-	-	-	-	-	6
Sclerotium	Caps, Beans, Eggp, carrot	-	-	6	-	-	-	6

A - Data from two workshops combined; B - Viruses were considered as a single group therefore the priority rating was not for one particular virus, however the key viruses for the respective crops are shown below the table

Table 3 Priorities that would drive growers to adopt of IPM for pathology issues on farm

(10 = Top of the key priorities, 5 =Lowest of the key priorities)

IPM driver	VIC 1	VIC 2	TAS	QLD	SA 1	SA 2	NSW		WA	Total
							(Greenhouse)	(Greenhouse and open)		
Reduce cost of treatment (eg. Reducing spray number)	7		8	8	7		10		6	46
Improved disease control		10	9		10	10				39
Chemical failure (mainly due to resistance)	10	8			8	9				35
Chemical loss (withdrawal or deregistration)		7			9	8			10	34
Public image	6	4					9		7	26
Chemical residues restricting market access	5	5			6	7				23
Reduce dependence on chemicals		9		7						16
Reliability of production			5	9						14
Environmental issues		6							8	14
Reducing crop loss	8								5	13
Increasing profit			10							10
Efficiency of production				10						10
Lack of available chemicals	9									9
Meet QA requirements									9	9
Stop the need to calendar spray			7							7
Ability to pre-empt disease			6							6
Improved crop quality									4	4
Increasing suite of available methods of control		3								3

Notes: Growers were asked to nominate what would 'drive them' to use IPM on their farm. The responses were listed in priority order by group consensus at each workshop. Their responses have been allocated a score where 10 was the highest priority, 9 the next highest priority etc. The number of priorities nominated at each workshop varied.

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Table 4 Current use of IPM and effectiveness of current method to control key pathogens (ie. Those pathogens that were considered top priority at State meetings)

No IPM: Calendar = sprays at regular or routine intervals (ie. weekly or at the start of the crop).

Some IPM: First sign = Controls applied at first sign of disease, Predictive = grower monitors pathogen/weather conditions to decide on treatment.

Effectiveness of Current Treatment: Y=Effective, N=Not effective, Y/N = predominantly effective, N/Y = predominantly not effective, Y & N refers to equal numbers of yes and no responses.

	Current method of control		Method of application		Efficacy			
	Greenhouse/hydro	Field	Greenhouse/hydro	Field	Greenhouse/hydro	Field	Field	Field
Sclerotinia		Fungicides		Calendar			Y/N	N
Viruses	Insecticides	New land (escape)	Calendar	Calendar or first sign	N	N	N/Y	N
	Resistant varieties	Insecticides						
		Resistant varieties						
Downy Mildew	Fungicides	Fungicides	Calendar or first sign	Calendar or first sign	Y	N	N/Y	N
	Resistant varieties							
Fusarium	No control (WA)	No control (QLD)	Calendar	na	N/Y	N	N	N
	Fumigation	Cultural						
	Fungicides							
Pythium	No control (NSW/WA)	Fungicides	Calendar or first sign	Calendar (Preventative)	N	N	Y & N	N
	Cooling towers	Fumigants			(occasionally Y)			
	Fungicides							
Powdery Mildew	Fungicides	Fungicide (1 product)	First sign	Calendar	N (due to resistance)	N	Y	N
Rhizoctonia	Fungicides	Seed treatment (fungicide)	Calendar	Seed treatment, first sign or predictive (based on weather)	Y	N	N	N
		Fungicides						
		Biologicals						
Botrytis	Fungicides	Fungicides	Calendar or first sign	Calendar (at flowering beans)	Y/N	N	Y & N	N
White blister		Fungicides		Calendar		(resistance)	Y & N	N
								(resistance)
Clubroot		Lime		Calendar (Preventative)			N	N
		Fertiliser					(resistance)	
		Fungicide						
Anthracnose		Fungicides		Calendar (if weather conducive to disease)			N	N
Sclerotium		No controls (capsicum and eggplant)		na			N	N
Leaf spots		Fungicides		Calendar or predictive (eg after hail)			Y	Y

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5. Recommendations

Feedback during the National workshops conducted as part of the project indicated that growers and other stakeholders were impressed with project and the strategic priorities established. Feedback received by HAL from a key stakeholder was that 'this is the best mechanism for calling for projects, I have seen so far. The description of what is required, in the main is comprehensive, and the budget guidance is exactly what is required for us to be able to design a project to meet the requirements within the timeframe stated. The process used to develop the proposed vegetable industry R, D and E program was considered to be an excellent model for development of future strategic direction of research programs.

As a result of the process, the industry supported the proposed program structure and endorsed the commissioning of the \$2 million research program. The period for submission of research proposals was 4 weeks and at the time of conducting this report the final approval of the program had not been ratified by the incoming IAC, This meeting will be held on the 4th July. In respect of the outcome from this meeting, it is recommended that the National Vegetable Industry consider the proposed Vegetable Industry Pathology program, as a framework for development and funding of future research programs.