# National Vegetable Plant Pathologists Meeting, Brisbane, 2006

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NSW Department of Primary Industries

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Know-how for Horticulture™

**VG 05039 (August 2006)**

# National Vegetable Pathology Working Group Meeting-Brisbane, May 2006

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Horticulture Australia Project VG 05039

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This report covers the activities undertaken during the National Vegetable Pathologists Working Group meeting in Brisbane in May, 2006.

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# MEDIA SUMMARY

The National Vegetable Pathology Working Group met in Brisbane at the Brisbane Convention Centre on Monday 8th May, 2006. Attendees included at least one vegetable plant pathologist from each state and a representative from Horticulture Australia.

The meeting;

1. Discussed current vegetable plant pathology projects.
2. Reviewed outcomes of the previous meeting in Adelaide 2004.
3. Developing vegetable plant disease research priorities for the Australian industry.

Recommendations since 2004 included new R&D projects on snow peas, brassicas, carrots, cucurbits, sweet corn and Asian vegetables.

The priority areas considered for further new research were;

- Seed health and its role in plant disease spread needs to be further investigated.
- Disease management in seedling nursery plants needs further investigation.
- Fungicide resistance needs to have ongoing monitoring. This is a high priority to provide industry with baseline data for future fungicide efficacy.
- Reducing carry over of diseases such as *Sclerotinia* between crops is needed to enable reduced fungicide use and a more integrated approach to disease management.

On the following day a meeting was undertaken with entomologists to discuss common issues across both disciplines. This meeting highlighted issues such as;

- The need for integrating both plant pathology and entomology in projects. This would be improved if funding was allowed for the developmental phase of projects to allow an improved definition of the projects scope, methods and outcomes.
- The need to improve the project development/implementation process through having regular gap analysis for each product group at least every three years. Involving members from various groups such as product group representatives, scientists, minor-use office, consultants, growers and other industry players.
- Improving pest and disease surveillance through the availability of funding for active surveillance.

# TECHNICAL SUMMARY

In 1997 a group of vegetable plant pathologists attended a meeting at Knoxfield to discuss issues relating to vegetable diseases. Meeting participants agreed that there was an ongoing need to strategically address plant pathology activities within Australia's vegetable industry. It was proposed that a National Vegetable Pathology Working Group (NVPWG) be established as a technical committee under the proposed Australian Plant Health Council.

The proposed working group would meet annually before the end of July and would have a role in indicating priority areas of research and development to national funding bodies, as well as identifying areas of new work. After 1998 the meetings were held every two years.
The meetings were previously held in;

| | |
|---|---|
| Melbourne | 1998 |
| Brisbane | 2000 |
| Perth | 2002 |
| Adelaide | 2004 |

The meeting covered in this report is the National Vegetable Pathology Working Group which met in Brisbane at the Brisbane Convention Centre on Monday 8$^{th}$ May, 2006. Those that attended consisted of at least one vegetable plant pathologist from each state and a representative from Horticulture Australia.

The meeting;

1. Discussed current vegetable plant pathology projects.
2. Reviewed outcomes of the previous meeting in Adelaide 2004.
3. Developing vegetable plant disease research priorities for the Australian industry

Areas had been covered from recommendations since the last meeting in Adelaide (2004) included new R&D projects on snow peas, brassicas, carrots, cucurbits, sweet corn and Asian vegetables.

The priority areas considered for further new research were;

- Seed health and its role in plant disease spread needs to be further investigated.
- Disease management in nursery plants needs further investigation.
- Fungicide resistance needs to have ongoing monitoring. This is a high priority to provide industry with baseline data for future fungicide efficacy.

Issue that arose from general business included;

- Emerging disease issues – work needs to be undertaken in Qld for tomato yellow leaf curl virus. TYLC might affect beans, chilli, capsicum, potatoes.

- National *Sclerotinia* project to develop alternative disease management options to reduce the reliance on persistent use of an ever diminishing list of fungicides.

- Government funding for plant pathology research in the Northern Territory has been dropped.

- The numbers of plant pathology staff in states is dropping-this needs to be addressed by states and/or industry.

- Considered that having meetings every two years was good, but there is a need for a more formal way of inputting outcomes into industry plans.

- The one day meeting format was considered too short for the NVPWG meeting and attendees suggested returning to the format of previous meetings i.e. two and a half days.

On the following day a meeting was undertaken with entomologists to discuss common issues across both disciplines. This meeting highlighted issues such as;

- The need for integrating both plant pathology and entomology in projects. This would be improved if funding was allowed for the developmental phase of projects to allow an improved definition of the projects scope, methods and outcomes.
- The need to improve the project development/implementation process through having regular gap analysis for each product group at least every three years. Involving members from various groups such as product group representatives, scientists, minor-use office, consultants, growers and other industry players.
- Improving pest and disease surveillance through the availability of funding for active surveillance.

# INTRODUCTION

This group was initiated at a meeting in 1997 at the Institute for Horticultural Development Knoxfield. Meeting participants agreed that there was an ongoing need to strategically address plant pathology activities within Australia's vegetable industry. It was proposed that a National Vegetable Pathology Working Group (NVPWG) be established as a technical committee under the proposed Australian Plant Health Council.

The meeting referred to in this report was held in Brisbane before the Ausveg Conference. The NVPWG meeting was followed by a Vegetable IPM workshop with entomologists the following day. The agenda for both are below.

National Vegetable Pathology Working Group Meeting
Brisbane Convention Centre,
Monday 8th May

Aim:

1. To discuss current vegetable plant pathology projects.
2. To review the outcomes of the previous meeting in Adelaide 2004.
3. To assist the vegetable industry through developing vegetable plant disease research priorities.

Agenda:

10:00 Welcome
Introduction.
Discussion on projects from states.
Review last meeting recommendations.

12:30-13:30 Review last meeting recommendations (cont).

General business
New Disease issues
*Sclerotinia*-management
Tomato yellow leaf curl virus.
Northern Territory issues.
Other business.

5pm Finish

Vegetable IPM Workshop
Brisbane Convention Centre
Tuesday 9th May

*Aim:*
1. Improve integration of pathology & entomology recommendations
2. Share experience and understanding on selected topics
3. Improve between group interaction

*Participants*
Entomologists, pathologists, extension officers & consultants

*Agenda*:

Tuesday 9th

8:30 Welcome
8:35 IPM Stocktake presentation (Brad Wells)
9:05 Vegetable Biosecurity threats (Debra Eaton, Ryan Wilson PHA)
Discussion
10:15-10:45
Integrating Pathology & Entomology in IPM
13:30 Prioritise minor use chemistry (Peter Dal Santo)
14:00 Prioritise chemistry for beneficial toxicity testing
14:20 Pest & Disease surveys
14:50 Project development/implementation process
15:10 Virus management options
15:50 Biosecurity threats cont.
16:30 Revisit 10 crop Best Bet IPM
17:00 Finish

# DISCUSSION

*ATTENDEES*

Chrys Akem (DPI & Fisheries, Queensland), Alison Anderson (Vegetable IDO), Barry Conde (DPI & Mines, NT), Peter Dal Santo (AgAware), John Duff (DPI & Fisheries Queensland), Barbara Hall (SARDI), Liz Minchinton (DPI, Victoria), Ian Porter (DPI, Victoria), Hoong Pung (Serve-Ag Research, Tasmania), Andrew Taylor (Department of Agriculture and Food, WA), Andrew Watson (NSW DPI), Trevor Wicks (SARDI), Leanne Wilson (HAL),

*WELCOME AND INTRODUCTION*

A brief introduction was conducted that covered the history of the National Vegetable Pathologists Working Group.

In 1997 a group of vegetable plant pathologists attended a meeting at Knoxfield to discuss issues relating to vegetable diseases. Meeting participants agreed that there was an ongoing need to strategically address plant pathology activities within Australia's vegetable industry. It was proposed that a National Vegetable Pathology Working Group (NVPWG) be established as a technical committee under the proposed Australian Plant Health Council.

The proposed working group would meet annually before the end of July and would have a role in indicating priority areas of research and development to national funding bodies, as well as identifying areas of new work.

The meetings were previously held in

| | |
|---|---|
| Melbourne | 1998 |
| Brisbane | 2000 |
| Perth | 2002 |
| Adelaide | 2004 |

*CURRENT NATIONAL PLANT PATHOLOGY PROJECTS.*

These were presented by members from each state. The projects have been included in Appendix 1.

Table 1. Projects current or recently finished by commodity. Based on the list in Appendix 1

| Commodity | Number of projects |
|---|---|
| Brassicas | 5 |
| Greenhouse vegetables | 1 |
| Parsley | 1 |
| Onions | 2 |
| Cucurbit | 4 |
| Carrot | 1 |
| Lettuce | 2 |
| Capsicums | 2 |
| Cucumber | 1 |
| Asian vegetables | 1 |
| Sweet corn | 1 |
| Beans | 1 |
| Snow peas | 1 |
| Peas | 1 |

Table 2. Number of projects based on disease categories. Based on Appendix 1.

| Disease issue | Number of projects |
|---|---|
| Soil borne diseases | 4 |
| Green house foliar | 1 |
| White blister | 2 |
| White rot | 2 |
| Downy mildew | 1 |
| Fusarium wilt | 4 |
| Viruses | 5 |
| Powdery mildew | 3 |
| Leaf blight (sweet corn) | 1 |
| Bacteria | 2 |

General discussion on projects included:

- **National projects.** There have been problems with the approval of national projects. Previous submissions have been rejected because they do not address an issue that covers all Australia. However when these submissions are modified to do so they are then rejected due to cost
- **Cross Commodity projects.** There needs to be some scope for projects to cover more than one commodity e.g. sclerotinia on lettuce and beans.

*REVIEW OF LAST MEETING'S RECOMMENDATIONS*

General comments made before going through the recommendations are listed below.

- **Adoption of previous meetings recommendations.** Jonathan Eccles, when with HAL, asked for clear guidelines and priorities from the NVPWG meetings. This has been achieved from previous meetings however priorities need to be acted on. However they appear to be lost in the system. The priorities that come out of this meeting need to really be incorporated into the vegetable R&D plan. Strategies are developed but they don't include priorities that come out of this meeting – go to expense to organise the meeting and growers ask for it to happen, so the priorities should be valued.

- Therefore it was suggested that when the NVPWG group puts together priorities they need to be communicated back to the product groups. It therefore must be considered who is going to undertake this role. HAL and/or Ausveg.

- It was suggested that the priorities from the NVPWG meeting need to feed into the gap analysis project that will be running in 06/07 (Ian Porter). This project is to provide recommendations to HAL and industry as to what the vegetable IPM pathology research priorities are in the short (07/08) and long term.

- It has been suggested that it is important that we provide industry (product groups, IAC etc.) with a clear, concise version of what the priorities are, and therefore feeding the priorities through the gap analysis project is the best option rather than bombarding industry with priorities from a number of different sources.

The section numbers and priorities referred to below are those from the last meeting (Adelaide 2004) and therefore not changed.

Meeting discussion on these points has been included at the end of each section.

*6.1 ALLIUM*

***High priority:***

- Downy mildew - excellent predictive Downcast Model working well with spring onions in Victoria. Small weather stations out there not costing a lot of money. Would like to extend the work from Victoria and get interstate growers to evaluate it as well. May need 12 months more of dollars for national evaluation of the downy mildew model.

- White rot. If DADs does not get registered, and that appears to be a possibility, there is still not good control for white rot, so more work is required.

- Pink root. This is a little talked about disease that can cause significant yield losses. A scooping study is required to determine the extent of the problem and the economic impact.

***Other issues to be considered:***

- The leek project finishes in December. While there should be good management strategies in place for *Fusarium*, there will not be enough time to finish the bacterial blight studies. Possibly require another 6-12 months.

- *Botrytis* – need to determine source of infection - may be seed? Need more management work. Current strategies revolve around one fungicide, which puts it under a lot of pressure.

- Iris yellow spot virus. Has been found in WA and NSW, and thought not to cause major problems. However it may be more widespread. There is a possibility it was in SA this year, and caused significant problems with *Stemphylium* on affected leaves, and subsequent bacterial breakdown of bulbs in storage.

- Post harvest issues with *Aspergillus*.

- Fungicide resistance.

- Seed health.

- Predictive disease models to reduce fungicide use.

***Recommendations:***
1. National evaluation of downy mildew Downcast Model
2. Scoping study of pink rot
3. Definite continuation of white rot if DADS not registered.

*Meeting 2006 points discussed/decided.*

*As the onion industry have their own levy and not included in "Vegetables" issues from above were not discussed.*

*6.2 LEAFY VEGETABLES (LETTUCE ETC)*

***High priority:***
- *Sclerotinia* leaf rot - lots of information out there already, but nor being used. Victoria found many problems linked to poor fungicide application. Need a national extension program.

- Fungicide availability for lettuce. Removal of benomyl has left a gap in fungicide possibilities with lettuce disease, eg. *Septoria* leaf spot, *Stemphylium* leaf spot. Also caused additional problems with resistance management in controlling *Botrytis* and *Sclerotinia*.

***Other issues to be considered:***
- Jelly butt – A nutritional problem, possibly also linked to early *Pythium* infection.

- WFT and TSWV – should be addressed by a forthcoming project almost signed off. Mostly now an extension issue to get the information out there.

- Corky root detection. This disease is a problem in direct seeded lettuce and is difficult to detect. Damage can be severe but is usually very sporadic. The diagnostic test is very slow - a three week process. Needs a faster test.

- Lettuce big vein a problem in WA. Should be treated as a nursery issue.

- Biosecurity paper on lettuce mosaic virus (LMV) testing of imported seed. Biosecurity are recommending that the current LMV testing on imported seed be stopped, as it is already in Australia and there are no requirements for testing of domestic seeds. This topic is part of the whole issue of seed health. We feel that all seed, imported or domestic, should be tested and certified virus free.

***Recommendations:***

1. National extension project for lettuce- a road show about pests and diseases. Prepared after a literature review to determine where the gaps in our knowledge are.
2. Expanding options for control of lettuce diseases.

*Meeting 2006 points discussed/decided.*

*An issue arose regarding the extension of project information especially related to above.*

- *There was concern that project information, once the project had finished was not getting out to growers, especially when new growers came into an industry. Ways around this were suggested such as extension pathologists.*
- *This appeared to be a problem with* Sclerotinia *in lettuce. There is a lot of information out there, but is it being adopted by industry?*
- *There are problems with the removal of registration of sumisclex for* sclerotinia *control.*
- *Further work on biocontrols for* sclerotinia *should be considered.*
- *There is a lot of work going on with the lettuce aphid-probably not much funding left for disease research.*

Sclerotinia *was still considered to be the major disease issue with lettuce*

### *6.3 LEGUMES (PEAS, BEANS)*

***Disease issues that need addressing:***

- Fusarium wilt of snow peas. Some growers use *Trichoderma* successfully.

- Pimple pod virus of snow pea. Only a problem after first pick, damages rest of crop.

- Resistance screening happening for breeding *Sclerotinia* resistant varieties in dried beans. University of Nebraska offering screening across the world, possible involvement with NSW, Vic, Tas and Qld.

***Recommendations:***

1. Support collaboration with University of Nebraska in screening resistant lines for Sclerotinia.

*Meeting 2006 points discussed/decided*

- *There is a project currently on snow pea wilt based with DPI NSW*

### *6.4 SWEETCORN.*

***Disease issues that need addressing:***

- *Fusarium* head rot

- Boil smut

- Virus infections – high plains virus just detected in Qld.

***Recommendations:***

1. Scoping study on viruses in sweetcorn
2. Fusarium and boil smut to be included as components of Qld IPM project. .

*Meeting 2006 points discussed/decided.*

- *Part of a current project (Improved IPM systems in the Australian Sweet Corn Industry VG 05035) managed by QDPI is addressing gaps in disease issues for sweet corn.*

*6.5 ASIAN VEGETABLES.*

***Disease issues that need addressing:***

- There is a lot of current work on Asian vegetables. National collaboration is required to ensure no areas are being overlooked or duplicated. New project commencing in NSW to detect gaps in knowledge. Queensland also has a project to run meetings nationally on chemical use, permits for minor chemical use etc.

- Turnip mosaic virus is in leafy Brassica, and can affect cabbages also.

- Some growers of crops such as bitter melons, hairy melons, luffas, save their own seed and have disease issues. Education and extension is needed to solve that problem.

- Fusarium wilt of snake beans is a serious problem in the NT. Production is down by at least 50%. At its peak, snake beans in the NT were worth $2 million. This was reduced to $0.5 million due to the Fusarium wilt. Breeding work is in progress to produce a snake bean resistant to Fusarium wilt.

***Other issues to be considered:***

- How do you classify Asian vegetables? Funding is mostly through RIRDC, however HAL is also involved in some areas.

***Recommendations:***

1. That current programs for pest and disease control in Asian Vegetables be supported with extension and communication strategies.
2. That any gaps in knowledge indicated by these projects be filled by funding the required work.

*Meeting 2006 points discussed/decided*

- *Asian vegetables appear to be covered with current projects (Appendix 1).*
- *New project on gap analysis soon to be approved.*

*6.6 ROOT VEGETABLES*

***High priority:***

- Education and communication. Manual of pest and diseases for growers, packers etc. A Ute guide and posters would be good.

- Seed borne diseases. Particularly of carrots. Major problem with introducing diseases into new areas. No control over seed at the moment, so need to introduce a testing/certification scheme to clean up seed and ensure all seed (imported and domestic) can be disease free. Also need to research measure to ensure seed is disease free – control in paddock of seed drops, seed coatings etc.

- Soil borne diseases are a major issue in root crops – they not only reduce yield but affect marketability of crop. Cavity spot and nematodes are two of high concern. Diagnostic tools are vital to work in this area, with sensitive and rapid tests needed, particularly for research tools.

***Other issues to be considered:***

- CVY still an issue in SA. Insecticides are the focus of control by growers at the moment, and there is concern about resistance occurring in aphids. However in WA, Gaucho has been used in canola crops, and there is no sign of resistance yet. In WA control measures are focused on prevention of infection, with rotating crops and introducing fallow breaks rather than chemicals. This appears to be now an extension issue. SA growers still want work done, and a lot are doing their own aphid monitoring but not very effectively. Should the current monitoring system be upgraded or continued? WA growers been told chemicals don't work and are shown what to use so they don't ask for chemicals anymore. Need education – possibly a Vegnote?

- Victoria having agronomy and root disease issues with parsnips. Need a general review of knowledge and problems - parsnip scoping study.

- Seed diseases of sweet potato - vegetatively propagated, so need scheme to introduce disease free planting material. .

- New varieties of carrots available - need to test them against common diseases to determine susceptibility. Maybe seed testing needs to be done, marketability of new commodity, trial and education to other growers.

***Recommendations:***

1. Develop and publish a Ute guide and packing shed poster for IPDM of carrots.
2. Investigate methods of testing and managing seed borne diseases.
3. Develop more sensitive tools for detecting soil borne problems and investigate integrated management strategies for control, particularly in carrots, parsnip and beet.

*Meeting 2006 points discussed/decided*

- *Considered that VG 02090 The carrot manual (WA) is addressing point one.*

*6.7 BRASSICAS*

***High priority:***

- Education and communication Australia wide regarding white blister. Some more work required on inoculum potential and soil carry-over.

- Extension program is needed with clubroot. There is also a requirement for a robust predictive test for use in nurseries, similar to that used in UK. There is a possibility of collaboration with UK in this.

***Other issues to be considered:***

- Turnip mosaic virus –a sporadic disease, but education needed for growers to improve their hygiene. Possibly best as fact sheets or veg notes.

- Nematodes in brassicas a significant problem in NSW and WA, as brassicas are hosts of root knot nematode. Control measures required.

- The black leg/*Pythium*/*Rhizoctonia* crown rot complex has cause significant economic losses in mature brassicas in Qld and SA. An investigation into the cause and timing of infection and management of the problem is required. Possibly initially a scoping study?

- Downy mildew in seedlings – education needed on management, including chemical sprays and irrigation timing.

- Concerns about resistance to copper occurring with black rot control.

***Recommendations:***

1. Support an Australia wide extension program for Brassica diseases, particularly white blister and clubroot.
2. Investigate inoculum potential and carryover of white blister spores in soil and plants.
3. Develop a grower- friendly predictive test for clubroot in conjunction with UK.

*Meeting 2006 points discussed/decided*

- *This area covered by SA project and projects in Victoria and Tasmania.*
- *Still needs significant input in extension*

*6.8 CAPSICUM, TOMATO, CUCURBITS*

### 6.8.1 Capsicum

***High priority:***

- Bacterial spot is a serious problem, and several areas to improve management need addressing. Including the seed borne infection, copper resistance, and breeding resistant varieties.

***Other issues to be considered:***

- Powdery mildew in the field. Serious concerns about fungicide resistance, and management strategies to reduce possibility of occurring. Need to breed mildew resistant varieties.

- *Phytophthora capsici* a potential biosecurity issue. Will decimate capsicum production and will also affect melons.

- Virus management extension needed, as well as breeding resistance varieties.

- Nematode management.

***Recommendations:***

1. That management of bacteria spot of capsicum is investigated, including seed infection, copper resistance and breeding of resistant varieties.

*Meeting 2006 points discussed/decided*

- *Ongoing issue not being addressed.*

### 6.8.2 Tomatoes

***High priority:***

- Bacterial canker. This disease is seed borne, so need to investigate control of seed infection. Resistance is present in some fresh market varieties, so need to incorporate this into processing varieties in a breeding program. This is also a major nursery problem, spreading with grafting and pruning. Management issues need to be communicated, with emphasis on hygiene and clean planting material. There is a commercially available detection kit that needs to be validated.

- Tomato leaf curl – a serious threat for NSW and QLD. It is in NT and both TLCV and silver whitefly have been found at Mossman. Programs are needed to investigate both virus and white fly control, with a breeding program for resistance to the virus.

- Seed-borne diseases in tomatoes are an issue. A scoping study needs to be undertaken to look at what diseases coming in with tomato seed. Seed companies need to be involved.

***Other issues to be considered:***

- Management of powdery mildew. Need extension on all aspects of control including chemicals available, application technology, application timing and resistance management.

- Nematodes in field grown tomatoes, particularly cherry tomatoes in the Sydney basin. Also a problem in SA.

- Potato spindle tuber viroid – issues exist with trade between states. WA has had two outbreaks that are different strains. Viroid is possibly seed borne. There needs to be a systematic study to show it is seed born and what treatments can be used. Need to investigate whether the viroid is external or internal on the seed.

- Hydroponic tomatoes – needs a separate study on hygiene issues, particularly on reusing rock wool. Other countries reuse their rockwool after sterilising it – is that feasible for Australia?

- *Botrytis* in hydroponic systems is a big problem across Australia in greenhouses. Limited number of fungicides registered – need to look at chemicals available as well as bio control agents to get some alternatives to chemicals to prevent resistance issues.

***Recommendations:***

1. That a scoping study be undertaken to investigate the diseases being carried in tomato seed, particularly potato spindle tuber viroid, and determine whether there are any management strategies to reduce the outbreaks.
2. That studies into bacterial canker be undertaken, including control in nurseries, seed borne infection management and breeding resistant varieties.

*Meeting 2006 points discussed/decided*

- *This is still an issue.*
- *One question was raised regarding the availability of seed dressings to reduce bacterial canker.*
- *New greenhouse project in SA will address some of these issues in cucumber and capsicum, however only foliar diseases being studied.*

### 6.8.3 Cucurbits & melons

***High priority:***

- Viruses – extension and research into insecticides seed dressing, and resistant and tolerant varieties needed. IPVM

***Other issues to be considered:***

- Sudden wilt, *Fusarium*/*Pythium* complex. *Fusarium* in cucumber more pathogenic to rockmelons, however most breeding programs are breeding for resistance to rockmelon *Fusarium*. Need to include all the *Fusarium* in the breeding program.

- Benomyl dips no longer available. Waiting on permit for alternative. Need research into alternatives for post harvest rot control.

- Powdery mildew – fungicide resistance work needed

- Need more information on the other soil borne root diseases in melons.

***Recommendations:***

1. That management issues regarding integrated management of viruses in cucurbits be investigated and extension programs be undertaken.

*Meeting 2006 points discussed/decided*

- *A project may be put up by WA on viruses in cucurbits.*
- *Powdery mildew project (QLD) approved.*
- *Concern was expressed that fungicide resistance testing is currently non existent.*

*6.9 NURSERIES*

***High priority:***

- Accreditation scheme for nurseries. The NIASA scheme currently running does not cover all the disease management issues, and it is possible that such could never cover all aspects. However it could be used as a base model, and added too.

  However first the parameters need to be determined – are we looking at seed testing, limited chemical usage, advice on chemicals or certifying plants free of disease? Many growers are losing confidence in nurseries and growing their own seedlings, which can be a disaster for some problems like white blister. Some growers will take seed they have purchased and the get nurseries to produce seedlings.

The ideal would be for nurseries to set up some sort of accreditation scheme, with accredited nursery producing disease free seedlings. How do we ensure that? Work is needed to determine whether it is feasible to expect disease free seedlings in nursery. Target some of the main diseases first, and work out the main problems to see if they can be certifiably managed in a nursery so the grower can come and buy that crop with assurance that it is disease free.

***Other issues to be considered:***

- Nurseries treat their seedlings with a lot of different products; these may then be reapplied in the field again and get another potential dose. Could cause serious problems with resistance strategies, as some fungicides have a maximum of two applications per crop, and they are getting two in the nursery and two in the field. Possible to have arrangement where different products are used on seedlings that what growers use.

***Recommendations:***

*1.* Undertake investigations into the feasibility of producing disease free seedlings in a nursery. Studies should be initially limited to 1-2 major diseases on a few crops.

*Meeting 2006 points discussed/decided*

*This issue needs addressing.*

*6.10 CROSS INDUSTRY ISSUES.*

***Seed borne diseases***

Considered to be a priority issue. A lot of diseases are appearing in crops since seed treatments have been stopped on some seed – growers have asked for untreated seed at the treatment reduces the vigour of the plant. There are also problems with fungicide resistance occurring in pathogens of treated seed. At least 6500 seeds are on the permitted import list, with few or no restrictions.

We need to determine what are the tolerances and detection levels for pathogens in seed, and what their levels are in seed currently imported or grown domestically. There are not many restrictions on imported seed, so often pathogen levels are unknown.

We also need to know what is more important to industry, as if certification schemes are implemented, it may affect access to seed. These need to look at access to seed as well as quality and health. Pathogen free seed is not necessarily healthy or will grow good crops. Therefore need to address both health from a disease aspect and agronomic aspect. Any seed treatments must not affect the viability and vigour of the seed and plant.

Standards need to be uniform, and apply to imported as well as domestically produced seed. There cannot be different standards. Long term studies and investigations are needed on a crop by crop basis.

***Recommendations:***

*1* That a review/scoping study be undertaken to develop a strategy to address the issue of healthy seed for the Australian vegetable industry, involving workshops with key people – researchers, key growers and seed companies.

*Meeting 2006 points discussed/decided*

- *This is an important issue that needs addressing.*
- *Hot water treatment can severely reduce viability.*
- *Growers don't appreciate seed being such a big area of concern.*
- *Project to identify key diseases needed. A suggestion was that this could be included in the proposed plant pathology gap analysis project.*
- *There should be a seed/seedling project considered. That also covers 6.9 above.*
- *Much discussion about clean seed and getting projects funded in this area.*
- *What crops really need work in this area? Have to do this with the industry there.*
- *Peter Dal Santo– seed health critical but then also nursery practices. Maybe just need to talk to nurseries about their fungicide programs.*

***Fungicide Resistance***

This is a major issue with many pests, including insects, bacteria, and fungal diseases. It will need to be investigated either on a pest basis, as the implications are similar for one disease over a range of crops.

There is much concern in many crops with resistance management and finding alternative chemistries or bio controls.

These include:

- Powdery mildew: cucurbits, tomatoes, capsicum, leafy vegetables and legumes.
- Downy mildew: onions, lettuce, Brassica, legumes and cucurbits.
- *Botrytis*: all crops.

***Recommendations:***

1 That investigations into alternative chemistries and management of resistance be supported.

*Meeting 2006 points discussed/decided*

- *High priority issue to be addressed.*
- *We have no baseline sensitivity for new fungicides. An option is that they must be carried out with registration of the fungicides. However this will add to the cost and who should pay, chemical company and/or industry?*
- *A project needs to be put up on fungicide resistance testing. This had already been done by NSW DPI but it was rejected.*

*6.11 EXTENSION.*

*Summary of talk by Dominic Cavallaro, Managing director of Cavallaro Horticultural Services, Virginia, SA.*

- Extension is an important link from research. In SA there used to be four dedicated government extension officers in vegetables, one in Virginia, two in the Adelaide Hills and one in Murray Bridge. Now there are none. Researchers put information out there and hope the information gets to growers.

- In Virginia there are about 1000 growers with at least 30 different cultures, and it is very hard to get into that network. The complication with the different cultures is there are also many different languages, apart from the major ones of English, Cambodian and Vietnamese. So information needs to be in their language. This is hard in Vietnamese, where a technical language does not exist. Therefore translators have to make up a word, and this can be a minefield in getting information out to these communities.

- Local politics can also cause problems. You can either be part of it or fall foul, and sometimes you are not even aware you have a problem.

- The industries are under a lot of pressures, and it is expected that a lot of smaller growers will be leaving the industry in the next 12months – These pressures include QA, pushed by Woolworths. For example with chemical safety, growers are to be audited; they can't just attend a training course.

- With all these pressures, we as researchers have to try and get them to focus where they want research dollars going. So keep the following in mind:
  - Growers are reactive not proactive - they are busy working on their properties and don't have time to look ahead.
  - They are competitive and reluctant to share info – start to look at paying for their own research so they can make that extra dollar and stay in the marketplace.
  - They want easy solutions – "Give me a chemical".
  - Bigger organisations will buy their extension and research.
  - Research can be with or without AusVeg/HAL.

***Issues to be considered:***

- Concern regarding lack of grower awareness. For example in the greenhouse industry, it would be lucky if 50% of them knew about HAL, the levy and research. They need a dedicated extension officer to hold groups and develop the rapport. This should be a joint responsibility by the industry and government. The state government talk about fee-for-service "user pays", but only about 20% can afford consultants.

- Is there a place in vegetables to have extension as separate project? Do we need a second Tony Burfield in the vegetable industry? Many extension programs are specific, but need a generalist to tackle all issues. A website was suggested as one forum. The IDO's put as much as they can in print, and either direct mail, email or publish in state Veglink columns – but you are never going to reach everyone. People must have a need for the information before they seek it – that's why research is usually driven reactively.

- Currently there is a lot of training in some areas in the Northern Adelaide Plains (irrigation management, soil and plant nutrition). A lot of footslog goes into marketing these, and they have large numbers turning up. Part was talking to them and getting them to understand that training is relevant to their business. The research fraternity is missing out on information from the community and their needs. Many researchers approach extension in the wrong way – need demonstrations not just papers.

- The most successful projects have growers' steering committees, and ones with a roadshow. However there is often a problem is getting growers to those meetings.

- All projects that need to be extended should be funded to the extent that they need for a positive outcome. Don't cut the extension budget. Extension needs to be on a project by project basis, and the IDO must be involved, and a grower steering committee. Projects are becoming state focussed because of budget cuts, but extension must be national.

- Do we want a website for the NVPMG? Anything from this group goes there. All outcomes will be linked.

***Recommendations:***

1. That a broad communication plan be developed for the industry.
2. That growers be on the steering committees formed for each project.
3. That IDO's be involved in extension details for each project in the planning stages.

*Meeting 2006 points discussed/decided*

- *The Brassica model (VG 04014-Victoria) was considered a successful one and should be used for other crops.*
- *Lettuce and carrot were the two suggested.*
- *Viticulture research to practice manuals could be the model for vegetables.*

*6.12 FUMIGATION*

***Issues to be considered:***

- Need continued evaluation of new technologies – include long term use, safety and long term effects of the product – sustainability. All fumigants are under review by the EU, and many will not get through. Australia and the world will have to follow.

- SA growers have not applied for a methyl bromide extension. A methyl bromide update is published regularly, and will be distributed to the IDO's in PDF form to be forwarded to the industry.

- An education program is needed for growers and contractors, so growers get the right information. They have a reliance on MB as it is very forgiving, and the new products are not as generous if not used properly. Fumigators in Northern Adelaide Plains say there should be no problems with the changeover – but issues may not arise until the next year or so.

- Lots of growers will end up in controlled production (non soil).

***Recommendations:***

1. That alternatives technologies continue to be investigated, but must include sustainability as a key component, defined as is the effects of long-term use on land and people, the safety of the technology.

*Meeting 2006 points discussed/decided*

- *Considered that the new soil health project will assist in addressing this issue.*

*6.13 DIAGNOSTICS*

***Issues to be considered:***

- Herbarium material is the only concrete record we have of plant diseases, and it becomes a library. People need to collect them and save specimens, both dried and the culture, in a recognized collection.

- There is a lack of diagnosticians in Australia, and the current workforce is aging. PHA undertook a survey and published a report two years ago, which highlighted this.

- Projects need to be implemented that improve the skills in bacteriology and mycology. Nematologists were very difficult to find 10 years ago, but with projects undertaken in nematology, there is now a lot more expertise.

- HAL and other funding bodies should support training for pathologists to update and maintain skills and bring in new people, including workshops, conferences, training days, visits to other labs overseas, and bringing scientists here from overseas.

- Try to avoid the fortress mentality with biosecurity and diagnostics. PHA is involved in the activity to coordinate diagnostics, but only in Australia, which ignores the diagnostic capability in New Zealand. For example when lettuce aphid appeared, NZ was ignored as a place where there was a diagnostic expert. Need to sometimes go beyond the borders and not be so insular. Make a recommendation to PHA that its expertise register be accessed to people by NZ.

- Networking between diagnosticians is critical. A list server similar to that in USA would be an advantage. Perhaps PHA could assist in this area. CRC Weeds had a similar arrangement and may be able to assist.

- There are many predictive tests available for many diseases, and these need to be validated for Australia conditions.

***Recommendations:***

1. That diagnostic training be supported.
2. That a study be initiated to look at what predictive tests are available, and evaluate their effectiveness.
3. That PHA's expertise register be supported and people log on and fill in details.
4. That PHA is approached to manage a list server for diagnosticians.

*Meeting 2006 points discussed/decided*

- *Number 4 is being addressed by PHA.*
- *The practicality of diagnostic tests needs to be carried out.*

## General business

Items that were discussed under the heading of general business included the following.

- Emerging disease issues – work needs to be undertaken in Qld for tomato yellow leaf curl virus. Might affect beans, chilli, capsicum, potatoes.

- National *Sclerotinia* project to look beyond fungicides if not as a total control issue but as an integrated approach.

- Government funding for research in NT has been dropped.

- Peter Dal Santo ran through the gap analysis for pesticides.

- The numbers of plant pathology staff in all states is dropping.
- Considered that having meetings every 2 years was good, but need a more formal way of inputting results into industry plans.

# TECHNOLOGY TRANSFER

This project will be extended through the availability of the final report and by feeding into the Vegetable Pathology Gap Analysis Project.

# RECOMMENDATIONS

Some important issues from the discussion that should be addressed include.

- Emerging disease issues – work needs to be undertaken in Qld for tomato yellow leaf curl virus. TYLC might affect beans, chilli, capsicum, potatoes.
- National *Sclerotinia* project to develop alternative disease management options to reduce the reliance on persistent use of an ever diminishing list of fungicides.
- Government funding for plant pathology research in the Northern Territory has been dropped.
- The numbers of plant pathology staff in states is dropping-this needs to be addressed by states and/or industry.
- Considered that having meetings every two years was good, but there is a need for a more formal way of inputting outcomes into industry plans.
- It is recommended that these meetings continue on a yearly basis.
- The one day meeting format was considered too short for the NVPWG meeting and attendees suggested returning to the format of previous meetings i.e. two and a half days.

# ACKNOWLEDGEMENTS

We thank Horticulture Australia for providing funding for this meeting and to the Ausveg group organising the vegetable conference for assisting with room bookings etc. Thanks to Alison Anderson for assisting with organising the meeting and assisting with minutes. Thanks to Sandra McDougall for organising the IPM meeting. Thanks also to Leonie Napier (NSW DPI) for assisting with formatting.

# APPENDIX 1

## CURRENT STATE PLANT PATHOLOGY VEGETABLE PROJECTS

**South Australia**

**VG05005—scoping study to determine the soil borne diseases affecting Brassica crops**

**Summary of work being done in state**
Brassica stem canker is a widespread disease caused by a complex of several fungi. It has been found in SA, Qld, WA and Victoria. While it is worst in cauliflower, it also affects Brussels sprouts, broccoli and red cabbage. Management strategies to control this disease have not been developed and require further research. This disease complex has not been described overseas, and was first observed in SA in 2000.

**Symptoms**
Many different symptoms—main ones are superficial scurfing/russetting on lower stem, discrete lesions of various sizes (can cover up to 25% of stem) and dry rot and collapse of plant. Both the scurfing and the discrete lesions often progress to complete stem rot (see attached symptom table).

**Causes**
Five pathogens known to be involved—*Rhizoctonia* (so far AG2.1, 2.2 and 4), *Phoma, Fusarium, Sclerotinia, Pythium*. Seven hundred isolates of these and other fungi have been isolated and are being tested for pathogenicity on Brassica seedlings.

**Crop loss**
Crop loss from plant collapse more severe in Spring. Many plantings over 90% infected by harvest, but affected plants could still be harvested depending on time of year. All cauliflower cultivars surveyed were affected. The disease was first observed 6–8 weeks after planting and increased as plants mature, both in number of plants affected and amount of disease on each plant. Major problem on new ground not previously planted to Brassicas. Disease not observed in nursery seedlings, and in nursery / pre field planting treatments with fungicides for *Rhizoctonia* have minimal effect on disease levels.

**State project team**
Catherine Hitch, Barbara Hall Trevor Wicks

**Other collaborators**
Growers—Frank Mussolino and Dominic Cavallaro

**Funding source**
HAL

**VG05094—Sustainable integrated control of foliar diseases in Greenhouse Vegetables**

**Summary of work being done in state**
Project not yet started. Will be surveying to determine the foliar disease most prevalent in greenhouse crops, investigating effective management strategies and extending the information to the industry through training manuals

**State project team**
Barbara Hall, Trevor Wicks, Dominic Cavallaro and new appointee—Dr Kaye Ferguson

**Other collaborators**
Greenhouse industry Virginia Hort centre Tony Burfield

**Funding source**
HAL

**Victoria**
**VG04025 scoping study to investigate management of root-rot diseases in parsley**

**Summary of work being done in state**
Severe outbreaks of root rot disease have devastated parsley crops and caused up to 100% crop losses in two of the three main production areas, Queensland and Victoria. This scoping study identified the causes of parsley crop losses in Victoria, NSW and Queensland. It developed management strategies for root rot in Victoria.

Systematic surveys of 31 parsley crops in Queensland, NSW and Victoria identified dieback (root rot and plant collapse) as the main disease affecting crops in Queensland and Victoria, but to a lesser extent in NSW. The major foliage disease was *Septoria* leaf spot. Leaf blight caused by *Alternaria petroselini* was reported for the first time in Australia where it caused economic losses in a Queensland crop.

Pathogenicity was confirmed for a Queensland isolate of *Fusarium solani* and a NSW isolate of *Rhizoctonia solani* both causing collar rot. Victorian isolates of *Phytophthora megasperma*, *P. inundata*, *Pythium sulcatum, P. ultimum* and *P. diclinum* caused stunting, wilting and root rot with varying degrees of severity. The bacterium *Strentrophomonas maltophilia* isolated in Queensland was pathogenic causing crown and root rot.

A field trial in Victoria confirmed that Oomycete fungi were responsible for root rot symptoms and metalaxyl (one application at planting and the other at eight weeks) or phosphonic acid (applied weekly at first sign of the disease) improved yield by nearly 100%.

**State project team**
Dr Elizabeth Minchinton (project leader) Des Auer Savitri Nadesan and Solbodan Vujovic

**Other collaborators**
Heidi Martin QDPI & F Len Tesoriero NSW DPI

**Funding source**
HAL AUSVEG and DPIVic

**VG05045 identification of the extent and cause of parsnip canker**

**Summary of work being done in state**
All major parsnip growers have reported severe losses of up to 80% from parsnip canker, which renders the crop unsaleable and in the worst cases entire crops have been abandoned. This project will identify the extent and cause of parsnip canker.

Systematic surveys are being conducted seasonally on parsnip crops largely in Victoria, but also in WA and Tasmania to determine the incidence of disease and to collect plant material with canker symptoms. Classical plant pathology studies will isolate and identify organisms found in association with cankers and test their ability to cause cankers (Koch's postulates). A field trial to complement Koch's postulates will be undertaken, using selective fungicides which will differentiate groups of pathogens that may be causing the disease.

**State project team**
Dr Elizabeth Minchinton ( Project leader) and Des Auer

**Other collaborators**
None at present.

**Funding source**
HAL and AUSVEG

**VG04013 management strategies for white blister (rust) in Brassica vegetables**

**Summary of work being done in state**
In the summer of 2001/02 *Albugo candida* caused an epidemic of white blister on broccoli and cauliflower crops in Victoria and since them has spread throughout Australian *Brassica* vegetable crops. The project is currently identifying:

- Management strategies including evaluation of resistant cultivars and the $Brassic_{spot}$ disease predictive model.
- Separation of *A. candida* races using molecular tools, which will have implications for seed health testing.

Three cultivar trials each containing 12 cultivars, are in progress in WA, Tasmania and Victoria to evaluate the resistance or tolerance of broccoli cultivars to white blister. Field days for these trials are expected from May onwards.

In Victoria the $Brassic_{spot}$ disease predictive model successively predicted the occurrence of white blister in three crops and subsequently reduced the number of spray by three per crop for control of the disease. It is currently being trialled by growers in WA, NSW, SA, Tasmania and Victoria. The model is predicting a higher risk for summer crops than for winter crops.

Molecular tools have separated race Ac 9 (*Brassica oleracea* broccoli) from, Ac 7 (*B. rappa*), Ac 4 (*Capsella bursa-pastoris* shepherds purse) and Ac 6 (*Cardamine hirsuts* hairy bittercress).

**State project team**
Dr Elizabeth Minchinton (project leader), Dr Rober Faggian, Joanna Petkowski and Des Auer

**Other collaborators**
Dr Roy Kennedy Warrick HRI UK

**Funding source**
HAL, AUSVEG and DPIVic

**VG 04014 Better Brassicas – a coordinated approach to the dissemination of Brassica disease R & D**

**Summary of work being done in state**
Communication and extension material has been prepared and delivered to growers nationally. Major achievements have included the production of three editions of a Brassica disease newsletter, a series of ten clubroot factsheets, a shed poster, and a series of four white blister notes and the presentation of these materials to growers in a series of 11 brassica disease roadshow events held nationally.

**State project team**
Caroline Donald Denise Wite Sally-Ann Henderson Elizabeth Minchinton and Joanna Petkowski.

**Other collaborators**
Vegetable IDOs in each state Rachel Lancaster WA Leigh James NSW also various ‘experts’ who accepted invitations to speak on their topic of expertise at regional roadshow events.

**Funding source**
HAL and Vic DPI

**Tasmania**

**VN05010: onion white rot—tebuconazole efficacy**

**Background**
Onion white rot (OWR) is reducing yields by at least 30% and infesting wider areas within most onion growing regions. Tebuconozole is registered for use in Tasmania for early onion crop protection when applied at sowing. Variable control is now being reported with the use of this treatment. Research is required to determine the reason/s for the variable control of OWR provided by tebuconazole.

**Objectives**
This project will review all of the studies on tebuconazole efficacies on OWR in Australia and elsewhere, conduct laboratory and field studies to determine the cause of the variation in OWR control by tebuconazole lime super treatment in some paddocks, and provide the relevant information to enable the reliable, consistent and effective use of pre-plant tebuconazole applications.

**Work undertaken to date and outcomes**

- References on overseas research studies on tebuconazole resistance and degradations by soil microbes were collated and reviewed. Loss of efficacy by tebuconazole for onion white rot control had only been reported in Pukekohe, New Zealand, where onion production is intensive and sown with little or no non-Allium break crops. Elsewhere, studies indicated that the application timing and methods for tebuconazole treatments are highly critical to its efficacies for white rot control. Enhanced degradation of tebuconazole was reported following six to eight multiple applications on peanuts for *Sclerotium rolfsii* control in the USA. In recent studies in the USA, the half-life of tebuconazole in soil was found to vary substantially depending on regional soil variations.
- In this project, soil samples were collected from paddocks where severe white rot occurred in the 2004/05 and 2005/06 seasons, in order to test for the dissipation rate of tebuconazole in the soils. The soil samples were treated, and samples are taken at regular intervals to determine the tebuconazole dissipation rates in different red Ferrosols collected in Tasmania.
- Different strains of *Sclerotium cepivorum* were isolated from infected crops that had been applied with the tebuconazole-lime super treatment at sowing. No fungicide resistant strains were detected in in-vitro tests that were conducted to determine the sensitivity of the different strains of *S. cepivorum* to tebuconazole.

**Principle investigator**
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**Funding**
HAL Project (2005—2008)

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**VN05007 onion white rot control—new fungicide options**

**Background**

Procymidone has been registered for white rot on onions and garlic. In 2004, procymidone was reclassified as Schedule 7 (dangerous poison) by the APVMA in Australia due to safety concerns, and severe restrictions were put on its use, storage and handling. There is no suitable registered replacement for procymidone. Tebuconozole is registered for use in Tasmania for early onion crop protection when applied at sowing. Its use in other states has not been supported due to phytotoxicity concerns. Therefore, this project aims to determine the most effective fungicide options for providing sustainable management of onion white rot (OWR). OWR is reducing yields by at least 30% and infesting wider areas within most onion growing regions. Fungicide options are limited and more alternative fungicides and effective control methods are required for long-term viability of the industry.

**Objectives**

This project will evaluate and identify new fungicides for post-plant application and generate data to support new product registration.

**Work undertaken to date and outcomes**

- References from overseas research studies on new fungicide options for white rot control were collated and reviewed. Briefly, fungicides that have been tested for white rot control in Australia and overseas include azoxytrobin, pyraclostrobin, boscalid, dichloran, iprodione, procymidone, tebuconazole, cyproconazole and triadimedol. Apart from effective fungicides, soil temperatures, pathogen activity, and fungicide application methods have been shown to be critical in optimising white rot control.
- After consultations with various agchem companies in Australia, seven different fungicides belonging to different chemistry groups were identified as potentials for initial screening trials to compare their efficacies for onion white rot control in this project.
- Two field trials were conducted at Kindred and Forth in Tasmania to examine the effectiveness of late fungicide applications, and to compare tebuconazole with six different alternative fungicides (azoxystrobin, triadimedol, boscalid, tolyfluanid, fenhexamid and a new compound TADS15620). Testing for the seventh fungicide, a new carboxamide compound has to be re-scheduled due to changes in its formulation.
- In the Kindred trial, where white rot occurred late at close to harvest, there was a significant difference in the percentage of marketable onions between the treatments. Azoxystrobin and triadimedol caused the greatest increase in the percentage of marketable onions, followed by tebuconazole and a high rate of boscalid. In the Forth trial, where white rot occurred earlier during bulking, there were no significant differences in the white rot control or percentage of marketable onions between the treatments.
- Plans are made to conduct two field trials, with early fungicide applications, for white rot control.
- Onion white rot incidence and soil temperature data from old fungicide trials studies conducted in 1994/95, 1995/96 and 1996/97 were collated and sent to research collaborators in New Zealand for use to help develop a disease prediction model to optimise post-plant fungicide applications.

**Principle investigator**

Dr Hoong Pung Serve-Ag Research Pty Ltd

**Funding**

HAL Project (2005-2008)

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**VG04061 developing alternate pesticides to control white blister disease in Brassica crops**

**Background**

White blister (*Albugo candida*) is a fungal disease that first became commercially important in Australia in 2002 when many broccoli and cauliflower crops in Victoria were affected. Despite quarantine restrictions on the interstate movement of broccoli and cauliflower plant material, the disease is now widespread throughout southern Australia (including WA, SA, Vic, Tas and NSW). No fungicides are currently registered for control of white blister on brassica crops. Short-term permits have been issued for chlorothalonil and metalaxyl use in NSW, Tas and WA, and their further approved use will then be dependent on full product registration. However, the high cost associated with efficacy and residue trials essential for full product registration poses a serious impediment for the product manufacturers. Therefore, this project proposes a cost sharing arrangement, through voluntary contributions from various agricultural chemical companies, in order to expedite national product registrations for white blister control on broccoli.

**Objectives**

This project will generate all necessary efficacy and residue data in various states according to the protocols approved by APVMA, and under GLP, to support product registrations for white blister control. In addition, this project will develop an appropriate fungicide spray program to prevent the development of fungicide resistance from long-term usage.

**Work undertaken to date and outcomes**

Six field trials had been conducted in Victoria and Tasmania in 2004/05 and 2005/06 to determine the efficacies of alternative fungicides, spray timing and to develop suitable fungicide spray programs for white blister control (*Albugo candida*). Fungicide actives examined in the efficacy trials included azoxystrobin, metalaxyl, pyraclostrobin, copper, mancozeb, chlorothalonil, phosphorous acid and boscalid. The first three actives were found to be highly effective against *A. candida*, while the last four actives have little or no effect. Copper, applied on its own, was effective in preventing head infections, but poor in preventing leaf infections. All trial information and results had been compiled into reports that meet the APVMA formats. Residue trials are currently being conducted to generate data that is necessary for fungicide registrations.

**Principle investigator**

Dr Hoong Pung Serve-Ag Research Pty Ltd

**Funding**

Voluntary contributions from ag-chem companies, with matching funds from
HAL (2004–2007).

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**VG04024 facilitating the introduction and registration of new crop protection products for intensive horticulture**

**Background**

The global trend in crop protection is for larger companies to bring fewer products to market. These products are targeted towards specific markets of global significance, for example rice, cotton, corn or cereals. This trend is further compounded in Australia due to the dominance of broadacre agriculture in the crop protection market. As a consequence, there has been limited development of new products for vegetable industries. These new crop protection products developed recently are more specific to the target, have improved environmental profiles and are safer to the user, and would offer a number of benefits to the Australian vegetable industry if they were available.

Projects dealing with existing chemical review are helping to maintain registrations of 'old' products, while the 'minor use' program has extended existing registered products to new crops. However, there is currently no program to facilitate access to new products for the smaller crops. Without a mechanism for facilitating access to a broader range of new products for intensive crops, management options available to growers will diminish. An initiative to assist the registration of new products for vegetable crops in Australia needs to be developed.

**Objectives**
To explore available products with reference to industry needs and current IPM initiatives, leading to the development of integrated packages of practices and new pesticides for effective long-term pest management.

**Work undertaken to date and outcomes**
The companies contacted range from the traditional multinational agrochemical companies, ANZ companies whose mission is to source, develop and distribute specialty crop protection products that do not interest larger companies as well as small international companies specialising in unique crop protection control measures (for example bio-pesticides, plant defence boosters, pheromones, etcetera) to consulting companies that are regularly involved with crop protection matters from around the world.

A recent Agrow Review 2004 confirmed that fewer pesticide active ingredients were introduced to the world market in 2004 than in 2003 and this continued the decline seen in recent years. There were three main factors identified for this decline, rising costs of meeting data requirements, ongoing chemical industry consolidation and the shrinking agrochemical market. There were no new active ingredients presentations at the British Crop Protection Council Congress in 2004, and only new formulations at other scientific meetings, indicating that the research pipeline is also suffering from low throughput. Unfortunately, this decline will also affect the availability of agrochemicals to intensive horticulture in Australia. Therefore this project has been timely and will be of great benefit. Importantly, most of the new active ingredients are fungicides and insecticides, which Australian horticulture generally requires.

**Principle investigator**
Mike Hanlon Serve-Ag Research Pty Ltd

**Funding**
HAL Project (July 2004–Oct 2006)

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**VG04021evaluation of new seed dressing technologies for improved disease and insect control in vegetable crops**

**Background**
Seed treatment is the most cost-effective disease and pest control method on seed and seedlings, applied at a stage when they are most vulnerable to attack by pathogens and insect pests. In a scoping study (VG02105), we found that, in Australia and overseas, most registered seed dressings for vegetables are based on old chemistry, while in contrast, a wide array of new chemistry is registered in broad-acre crops. Broad-spectrum chemicals used for the past 40 years are increasingly seen as out-moded.

Scientists and chemical companies have been looking at developing more sophisticated chemicals with greater accuracy at targeting the disease-causing organisms and at the same time protecting the beneficial, friendly insects found in and around crops. In many instances, the use of new systemic seed treatments (new chemistry) has the potential to provide more effective control of many vegetable seed, soil and air-borne diseases and insect pests, compared to old seed treatments. But, because vegetable seeds are a very small market compared to broad-acre crops, like wheat and canola, the Australian vegetable industry and researchers have to take a pro-active role in ensuring that new seed dressing products that have been developed for use in broad-acre crops are also used for the benefit of the vegetable industry.

**Objectives**
This project aims to investigate and develop the use of new seed dressings for vegetables in Australia.

**Work undertaken to date and outcomes**
Safety tests of twelve new dressing formulations have been completed in 2005 and 2006, on pea, bean, cauliflower and pumpkin seeds. Initial pathogenicity tests in pot trials were conducted to evaluate the efficacies and different application rates against Pythium, Fusarium and Rhizoctonia species on pea, bean, cauliflower and pumpkin. Field trials are currently being conducted in Tasmania and Queensland to further evaluate the performance of potential new seed dressings that were identified in the initial screening studies.

**Principle investigator**
Dr Hoong Pung Serve-Ag Research Pty Ltd

**Funding**
Voluntary contributions from agchem companies, vegetable levy and HAL (2005–2007)

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**VG00031 management of downy mildew disease of pea crops and its possible resistance to metalaxyl**

**Principle investigator**
Dr Hoong Pung Serve-Ag Research Pty Ltd

**Project investigators**
Dr Hoong Pung Serve-Ag Research Devonport Tasmania.
Dr Richard Falloon Crop & Food Research Ltd Christchurch New Zealand.

**Background**
Downy mildew (*Peronospora viciae*) can cause severe losses in peas grown for processing. Yield losses of up to 20%, or even unharvested crops, may result from severe downy mildew infections. In Australia, seed treatment with metalaxyl (Apron) is currently being used to control downy mildew on pea seeds and provide early protection from the soilborne and airborne inoculum of the pathogen. In recent years, however, downy mildew resistance to metalaxyl has been confirmed in America and New Zealand. This has raised concerns in the Australian processing pea industry, as almost all seed is imported from New Zealand. The incidence and severity of downy mildew on Australian pea crops also appears to be increasing in recent years. It is not known if the current use of metalaxyl seed treatment still provides adequate downy mildew control and whether resistant strains of P. viciae are also present in Australia. As the metalaxyl seed treatment constitutes a high proportion of the pea seed cost, adding about 10% to the total seed cost to the industry, these questions need to be addressed.

**Objectives**
This project aims to determine whether *P. viciae* strains in Australia are resistant to metalaxyl, if metalaxyl treated seed is providing adequate disease control on seeds and young seedlings, if there are alternative products for the control of metalaxyl resistant downy mildew, and whether there are other methods of managing downy mildew.

**Project outcomes**
Final report completed, and project findings were extended nationally to related pea crop producers (for example garden pea, snow pea and sugar snap pea) with the production and circulation of an industry brochure. Many of the project's findings have already been adopted by the processing pea industry in Tasmania during the project in 2002 and 2003. The use of alternative seed treatments, and Agri-Fos + Penncozeb or Agri-Fos + Bravo foliar applications are already industry standards for downy mildew management.

**Seed and seedling infection control**

- This project established that a significant proportion of isolates of P. viciae from pea crops in northern Tasmania had became partially resistant or resistant to metalaxyl. Therefore, the strategies for seed treatment should include alternating metalaxyl or phenylamides with chemicals that have different modes of action, or using metalaxyl in mixtures with nonphenylamide chemicals such as cymoxanil or fosetyl-Al, which can protect seedlings from infection by metalaxyl-resistant isolates. Aliette Super and Wakil seed treatments, which contain fosetyl-Al and cymoxanil, respectively, are therefore suitable alternatives to the Apron + P-Pickel T seed treatment.

**Field downy mildew control**

- Agri-Fos + Penncozeb + and Agri-Fos + Bravo, have been shown to be the most consistent and effective foliar treatments for field downy mildew control. Each product on its own had little or no effect on the disease. The product mixture provides growers with a cost effective and affordable method for managing field infections of the two major pea diseases. Chlorothalonil (Bravo™) and mancozeb (Penncozeb™) are already registered for use on peas. Phosphorous acid (Agri-Fos™) is also a fertiliser and therefore chemical residue on plants from its use is not an issue.

**Funding**
HAL Project—4 year project (completed in 2004 / 05)

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**Workshop to develop research, development and extension priorities for nematode control in vegetable crops**

**Summary of work being done in state**
Nematodes are widespread within agricultural soils and can cause major losses in yield and quality of a variety of vegetable crops. Nematodes are seen as a major issue by the industry and this proposal was given a high priority ranking by the Tasmanian Potato and Vegetable ARAC. Despite many years of research, the vegetable industry is still heavily reliant on the use of nematicides for nematode control. Nematicides are costly, are amongst the most hazardous of agrichemicals and have been shown to be prone to enhanced biodegredation following continual use. In addition, many nematicides have been phased out. This project will support a meeting of nematologists and industry representatives to establish priorities for research, development and extension in vegetable nematology for the future. The meeting will be held over two days in Tasmania in July 2006.

**State project team**
Dr. Frank Hay Tasmanian Institute of Agricultural Research University of Tasmania
P.O. Box 3523 Burnie Tasmania 7320. Ph. 03643 04907

**Funding source**
Horticulture Australia Ltd

**Northern Territory (NT)**

**Title**
Snake bean *Fusarium* wilt

**Summary of work being done in state**
Investigations into snake bean Fusarium wilt and its management in the NT

**State project team**
Barry Conde

**Funding source**
NT Government

**Title**
Basil Fusarium wilt

**Summary of work being done in state**
Investigations into basil *Fusarium* wilt and its management in the NT

**State project team**
Barry Conde

**Funding Source**
NT Government

**Title**
Cucurbit viruses

**Summary of work being done in state**
Investigations into cucurbit viruses and their management in the NT

**State project team**
Barry Conde
Other collaborators

**Funding source**
NT Government

**Title**
Cowpea / snake bean virus

**Summary of work being done in state**
Determination of the identity of a virus of cowpeas / snake beans in the NT

**State project team**
Barry Conde
Other collaborators: Virologists at ANU

**Funding source**
NT Government

**Title**
Watermelon and cucurbit powdery mildew

**Summary of work being done in state**
Investigations into powdery mildew of watermelon and other cucurbits and its management in the NT

**State project team**
Shamsul Bhuiyan and Barry Conde

**Funding source**
NT Government

**Western Australia**

**VG02090 the carrot manual**

**Summary of work being done in state**
This project will summarise the latest production information and integrate with it relevant research findings in a practical form of value to carrot producers. The Manual will cover a wide range of topics including; nutritional/health value of carrots, crop rotation, seed, varieties, crop scheduling, planting densities, weed control, fertiliser programs and crop nutrition, irrigation scheduling and water quality, pests and diseases and their control, factors affecting yield and quality, harvesting, postharvest handling, growing for export markets, biosecurity, quality assurance and a section on preparing crop budgets.
Project to finish in 2006/07.

**State project team**

**Project leader** Allan McKay Research Officer amckay@agric.wa.gov.au Key Personnel: Elaine Davison Plant Pathologist edavison@agric.wa.gov.au

**Funding source**
AusVeg and HAL

**Lettuce Big Vein Management**

**Summary of work being done in state**
In January 2006 a PhD student began to look into management aspects of Lettuce big vein disease caused by *Mirafiori lettuce virus* and *Lettuce big-vein virus*. The interaction between the viruses and the vector *Olphidium brassicae* will also be examined. Lettuce big vein is an issue for vegetable nurseries in Western Australia as it causes loss of yield and quality.
**State project team** Dr Roger Jones Principal Plant Virologist rjones@agric.wa.gov.au A/Professor Martin Barbetti mbarbetti@cyllene.uwa.edu.au

**Funding source**
ARC Linkage grant

**PT04004 PCN area freedom for WA—evaluation of the current status of Potato Cyst Nematode (*G.rostochiensis*) in WA**

**Summary of work being done in the state:**
PCN (*G.rostochiensis*) has not been detected in WA since 1989, despite continual testing. As a result it is the aim of this project to determine whether WA can be considered to have area freedom from PCN through a state-wide survey. The survey will involve intensive 5m by 5m sampling of the 6 original sites where PCN was detected in the late 1980s, to determine if eradication was successful. Further soil sampling of 50% of the remaining properties in the Perth potato growing area and 25% of all other potato growing areas in WA will occur. Sampling has began and will continue for two years. Soil will be analysed by using a modified Fenwick Can and molecular techniques to determine if any cysts are present in the soil.

**State project team** Project leader: Dr Vivien Vanstone Research officer- Nematologist vvanstone@agric.wa.gov.au Key Personnel: Ms Sarah Collins Technical Officer. scollins@agric.wa.gov.au
**Other collaborators**: Dr John Marshall Crop and Food Research Lincoln New Zealand. marshallj@crop.cri.nz

**Funding source**: HAL and Potato Growers Association of WA

**HAL projects completed since the previous vegetable pathologists meeting in 2004**

**VG03057 scoping study on the importance of virus diseases in Australian vegetable cucurbit crops.**

**Summary of work completed**
Five viruses are known to infect cucurbits in Australia but the distribution in Northern Australia needed to be determined. A survey was done to determine the incidence and distribution of viruses in WA (Broome, Carnarvon, Kununurra and Perth), NT (Darwin and Katherine) and Qld (Ayr, Bundaberg, Clare, Giru, Mareeba, Rockhampton and Wowan). Viruses tested for were *Cucumber mosaic virus* (CMV), *Papaya ringspot virus-cucurbit strain* (PRSV), *Squash mosaic virus* (SqMV), *Watermelon mosaic virus* (WMV) and *Zucchini yellow mosaic virus* (ZYMV).

Widespread infection with viruses was found in vegetable cucurbit crops in WA, NT and Qld resulting not only in damaging yield losses but also in serious fruit quality downgrades and rejections.

Overall, in WA and NT, 43 vegetable cucurbit growing farms and 172 crops were sampled. 72% of farms and 56% of crops sampled were virus-infected. Worst affected areas were Darwin and Carnarvon, and affected were Katherine and Perth. ZYMV and PRSV were the most widespread viruses, each being detected in 5 and 4 out of 6 cucurbit growing areas respectively with infected crop incidences of <1-100%. SqMV was detected in 2 cucurbit growing areas. WMV and CMV were found in 3 and 4 out of 6 cucurbit growing areas respectively, but generally at low incidences in infected crops (<1-8%).

In Qld, virus infection was found in 17/20 farms and 78% of crops. PRSV was the virus most frequently detected, occurring in every crop found virus-infected regardless of cucurbit type or location in the state with infection up to 100% in mature crops. ZYMV was found in crops in the Ayr, Clare and Giru areas of north Qld with infection up to 100% in individual crops. A low incidence of WMV was found in Giru and Bundaberg, while CMV nor SqMV were detected in vegetable cucurbit types but CMV was found in bitter melon in Bundaberg.
Project completed December 2004.

**State project team** Project leader: Ms Brenda Coutts Research officer Plant Virologist. bcoutts@agric.wa.gov.au Key Personnel Dr Roger Jones Principal Plant Virologist. rjones@agric.wa.gov.au Other collaborators
Key Personnel: Mr Denis Persley Plant Virologist. Denis.Persley@dpi.qld.gov.au Key Personnel: Ms Lee McMichael Plant Virologist. Lee.McMichael@dpi.qld.gov.au

**Funding source**
HAL

**PT03064 support for seed potato sales to Sri Lanka: determining the constraints to production.**

**Summary of work completed**
Potato yield in Sri Lanka is low compared with Australia. Poor quality seed has been identified as a major limit to yield. However it has been shown that even with good quality seed yield may not improve substantially unless optimum agronomic practices are adopted. Yields need to be increased substantially to cover the cost of seed, maximise profit and increase international competitiveness.

Management of micronutrients such as copper, zinc and possibility iron and manganese, to avoid excess application, is needed to increase yields in Sri Lanka. We found that farmers' capacity to identify pest and disease may also be crucial to increasing yield. Time of planting in both Badulla and Nuwara Eliya is also important in maximising yield. Improved management of diseases such as late blight will also lead to improved yield.

The surveys showed that yield could be increased to at least twice the national average (26 versus 13 t/ha) by improved agronomic practices in each growing region. A longer-term goal would be to improve yields to 40 t/ha which is considered close to the potential for Sri Lanka. Project completed in 2005.

**State project team:** Project Leader, Dr Ian McPharlin imcpharlin@agric.wa.gov.au Mr Peter Dawson pdawson@agric.wa.gov.au Mr Andrew Taylor ataylor@agric.wa.gov.au Other collaborators Dr Fazal Sultanbawa CIC agribusiness fazal@cicagri.com
Mr Brian Dickson Western Potatoes Ltd brian@westernpotatoes.com.au

**Funding source**

HAL CIC agribusiness and Western Potatoes Ltd

**First Records in WA since last NVPWG in 2004**

*Colletotrichum dematium* detected on Spinach in 2004
*Capsicum chlorosis virus* (CaCV) detected on Capsicum in 2004
*Bean common mosiac virus* (BCMV) detected on Beans in 2004
*Pseudomonas syringae* detected on Celery in 2005
*Leptosphaeria* sp. detected on Broccoli in 2005
*Pythium tracheiphilum* detected on Lettuce in 2005
*Phoma lycopersici* detected on Tomato in 2005

**Plant disease issues that have recently been a problem**

- Parsnip leaf spot caused by *Phaeospora cresc*entium was a problem in Wanneroo 2004.
- *Rhizoctonia solani* still considered an issue for Brassica growers.
- Ring spot (*Mycosphaerella brassicicola*) has been particularly bad for Brassica growers this season as a result of the mild wet summer in WA.
- White blister (*Albugo candida*) has also been prevalent as a result of the weather.
- Sclerotinia rot has also been an issue this season on leafy green vegetables (lettuce etcetera).
- Irrigation water and potential for transporting pathogens has also become a problem in glasshouse and hydroponic set ups in WA.

Queensland

**Development of guidelines for sustainable management of powdery mildew in capsicums**

**Summary of work being done in state**

- Field surveys to determine prevalence of the disease in capsicum growing regions of the State; this has been completed.
- Investigations into sustainable options for control – A number of options have been investigated in field trials and are now being evaluated with grower participation.
- Farmer participation in integrated management options. This is currently in progress using control options identified earlier.
- Best package options—this will be identified and demonstration plots set up in coming season in preparation for project outcome adoption.

**State project team** Dr Chrys Akem Project Leader Mr Ross Wright Collaborator
Ms Zoe Baron Project Assistant other collaborators Ayr Research Station Farm Manager
Two capsicum growers Burdekin

**Funding source**

HAL Industry levy matched funding

**Management of powdery mildew in field and greenhouse cucurbits**

**Summary of work being done in state**
Project field work will soon commerce this season. The following shall be investigated:

- Pathogen diversity and resistance—fungicide resistance to current pathogen populations shall be investigated.
- Epidemiological studies—parameters that encourage disease epidemics shall be investigated in controlled and field conditions.
- Disease forecasting and threshold levels—a forecasting system shall be developed using the epidemiological parameters identified. Threshold levels shall also be established to decide on management actions.
- Alternative control strategies—to supplement fungicide sprays, other options for control such as resistance and activators shall be investigated.

**State project team** Dr Chrys Akem Project Leader Dr Gerry MacManus Research Leader
Mr Ross Wright collaborator Ms Zoe Baron Research Assistant other collaborators
Mr Andrew Watson NSW DPI Mr Les Tesoriero NSW DPI Dr Jennifer Joppling University of Sydney

**Funding source**
HAL industry levy matched funds

**New South Wales**

**VG00069 integrated management of greenhouse cucumber and capsicum diseases**
Completed

**Summary of work being done in state**
A number of important diseases of greenhouse cucumbers and capsicums have been identified in this project through surveillance activities in major production areas of Australia. Of particular note was the first detection in Australia of a root and stem rot similar to the fungus *Fusarium oxysporum* f.sp. *radicis-cucumerinum*. This disease is now known to occur in all other major greenhouse cucumber production areas of the world and is considered to be one of the primary causes of crop losses. When affected plants were analysed further in this study, *Fusarium* was found to occur in combination with any of ten species of another root pathogen, *Pythium*. In many cases combinations of these pathogens were shown to accelerate disease development, hastening the onset of wilting symptoms and resulting in increased mortality.

Other highlights of the disease surveillance were the detection of the fungus, *Alternaria alternata* causing a leaf spot disease. Previously, another species of this fungus (*A. cucumerina*) was the only fungus causing a similar leaf disease on cucumbers in Australia. Plants sprayed for Downy Mildew with the strobilurin fungicide, Amistar®, were observed to have also been controlled of Alternaria Leaf Spots. An extension to the existing label or specific permits for these diseases is recommended.

Virus-like disease symptoms were observed in several NSW and SA crops. Plants were sometimes stunted, leaved displayed downward rolling and yellowing between veins. These symptoms could have easily been confused with certain nutritional disorders, but a number of observations of crops suggested they were caused by an infectious agent. Laboratory diagnosis revealed that a virus is responsible and is consistent with Beet pseudo-yellows virus. This virus is transmitted by greenhouse whiteflies and is known to occur in greenhouse cucumber crops overseas.

Several trials were conducted to evaluate the efficacy of chemical and biological controls for the root rot diseases. Economical control was achieved with chemical drenches of benomyl with either furalaxyl, or propamocarb. However, these chemicals have no current registrations or permits for use as drenches on cucumbers. Furthermore, benomyl was recently withdrawn from sale in Australia and has been shown to be incompatible with several biological controls (including certain predatory insects and mites). Alternative chemicals for control of *Fusarium* have been identified but need evaluation and permits for their use sought. Biological control of these diseases with a product containing the fungus, *Trichoderma harzianum*, was variable. In some bioassays and on-farm trials this product appeared to reduce disease severity of *Fusarium*. In some cases plant losses were halved with these treatments. However, *Trichoderma* afforded no suppression of a root rot disease caused by *Pythium aphanidermatum*. In contrast, a biocontrol product with the bacterium *Bacillus subtilis* as its active ingredient, did reduce symptoms of *P. aphanidermatum*, but had no effect on *Fusarium*. Combinations of these two biocontrols appeared to be incompatible and did not suppress disease in any of the on-farm trials where both *Fusarium* and *Pythium* were present. Similarly, a biostimulant (fulvic acid) failed to suppress these diseases in any on-farm trials. Another feature of these trials was that chemical and biological treatments were not effective when applied after disease symptoms had appeared (i.e. as curatives). In contrast, the best efficacy of these products was achieved when the first drench was applied to seedlings (i.e. as preventatives).

Various cultural controls for these diseases were identified in this project. Disease incidence and severity were reduced when environmental stresses were minimised, and vice versa. For example, extremes in temperatures were more conducive to the development of *Pythium* root rots. On one hand, high temperatures (>30oC) were associated with root rots caused by *P. aphanidermatum* and *P.deliense*, whereas low temperatures (<10oC) were conducive to disease expression by *P. irregulare* and an unidentified *Pythium* sp. In contrast, greenhouse structures with regulated environmental controls had much lower levels of these diseases. High moisture levels in the root zone were also strongly associated with increased incidence and severity of *Pythium* and *Fusarium* diseases, particularly in combination with temperature extremes.

Poor on-farm hygiene and sanitation enabled these diseases to spread rapidly. Even where new substrate media (sawdust and cocopeat) were used, these pathogens spread rapidly and resulted in approximately one-third of plants dying within sixteen weeks of transplanting. *Fusarium*, in particular, was shown to spread aerially from typical pink spore masses that formed on affected stems. This is consistent with overseas experience with this disease. Spread of *Fusarium* and *Pythium* was demonstrated with fungus gnats (sciarid flies). This exacerbated damage caused by their larvae feeding on cucumber roots and was often associated with the greatest losses in surveyed crops and some greenhouse trials. Handling infected plants was also identified to spread *Fusarium*, particularly via spores from the pink masses that cover affected stems. Wounds on stems facilitated *Fusarium* infections. Fresh cuts after pruning or picking fruit, and growth cracks on lower stems, were common infection points.

This project has identified a serious disease complex responsible for big losses in greenhouse cucumber production. Chemical, cultural and biological management strategies for this disease have been identified. We have commenced evaluation of chemical and biological options, but further work is needed to overcome their current limitations. Chemicals that are biorational (compatible with other IPM practices) and microbial biocontrols that work more consistently and with greater efficacy need to be developed urgently. Technical summary

**State project team**
Len Tesoriero other collaborators Horticulture Australia Ltd (HAL)

**Quality assurance for improved management of black rot of Brassicas: improved detection and disinfestation in seed; management protocols for seedling and field production.** Completed.

**Summary of work being done in state**

Black rot of Brassicas can cause severe crop losses when only one seed among 10,000 is infected with the bacterial pathogen, *Xanthomonas campestris*. The culturing techniques employed in the detection of *X. campestris* from infected seed are time-consuming and labour intensive. A molecular assay based on the polymerase chain reaction (PCR) has been developed to provide a rapid and sensitive means for screening Brassica leaves and seed for the black rot pathogen.

Recent reclassification of this species resulted in the number of pathovars of *X. campestris* being amended from over 140 to just six. This includes only those pathovars that cause disease on crucifers; *X. campestris* pvs. *aberrans*, *armoraciae*, *barbarae*, *campestris*, *incanae* and *raphani*. Diseases of Brassica described as black rot and leaf spot have been attributed to pathovars *campestris*, *armoraciae*, *aberrans* and *raphani*. The validity of these distinct pathovars remains uncertain, as suggested by the inclusion of isolates belonging to pathovars *aberrans* and *raphani* within races of *X. campestris* pv. *campestris* (Vicente *et al*., 2001).

The genetic target for a PCR assay would ideally be both necessary and sufficient to cause disease, since this ensures its presence in all pathogenic strains (and absence in non-pathogens). We selected a target gene encoded within the hypersensitive response and pathogenicity (*hrp*) cluster, *hrpF*, whose product is predicted to form part of the plant/bacterial interface (Büttner *et al*., 2002; Rossier *et al*., 2000), and is therefore a potential determinant of host-specificity. PCR primers that detect the *hrpF* locus were designed that effectively differentiate pathovars of *X. campestris* from other *Xanthomonas* sp. and other genera that may occur on Brassica. We did encounter two strains designated *X. campestris* pv. *campestris*, isolated overseas from radish (a crucifer but not a Brassica), that were not detected by this assay; however, their extended maintenance in culture collections may have resulted in the loss of pathogenicity.

An internal control is included to concurrently detect a target unique to the Brassica seed itself (the ITS region), to reduce the incidence of false negative PCR results that may arise from amplification inhibitors within the seed. Despite this, there is the potential for false negatives to occur when the test seed batch carries very few *X. campestris* cells, particularly in combination with large numbers of other microorganisms or high concentrations of PCR inhibitors. The *X. campestris* PCR assay is readily able to detect the target gene directly from infected Brassica leaves and stems, and from extracts of seed washings, with greater speed, selectivity and sensitivity than is possible by existing plating techniques or serological assays.

Three available regimes for the disinfection of Brassica seed infected with *X. campestris* were evaluated. These were treatment with bleach and heat, treatment with copper and heat, and a commercial option. Each was assessed for its efficacy against *X. campestris*, its effect on germination, and ease of performance.

The bioassay is a very useful gauge of the presence of *X. campestris* in seed, providing a true indicator of the persistence of the pathogen following treatment but is labour and time intensive. The PCR assay permits the sensitive detection of *X. campestris*, but does not offer a means to discriminate between the DNA from living and dead pathogens. Selective plating was also used. The results from the plating of seed washes onto selective media were consistent, with all treatments leading to a reduction in the overall microbial load.

*X. campestris* colonies were observed from untreated seed washes and from seed treated with bleach and Incotec. However, the absence of any growth for seed washes from the copper-treated samples suggested that residual copper may be inhibiting microorganisms on the selective media (supported by the observation of a blue tint in the washes of copper treated seed batches). The plating assay results indicated that the most effective treatment was copper, then bleach and the commercial treatment. All options were superior to untreated controls. The bioassay confirmed the presence of black rot in seven of the eight samples.

Despite the prolonged use of copper-containing compounds to control the bacterium in *Brassica* field crops, copper resistance does not appear to have emerged in either Australian or foreign isolates of *X.*

*campestris*. The maximum $CuSO_4$ concentration tolerated by the *X. campestris* strains surveyed, 0.2 mM, is considered to reflect the sensitivity of these isolates to copper. Whilst it is fortunate that *X. campestris* field isolates are sensitive to copper, there is certainly the potential for resistance to develop, particularly via the acquisition of copper resistance plasmids. Vigilance is necessary to ensure the future efficacy of copper-based control measures against *X. campestris*.

**State project team** Deb Hailstones Dorothy Noble L Tesoriero R Cother T Berg

**Funding source**
HAL

**VG03109 regional extension strategy for managing western flower thrips and tomato spotted wilt virus in the Sydney Region**

**Summary of work being done in state**
Objective: To provide technology transfer services to improve the ability of vegetable growers in the Sydney Region to implement IPM strategies and a business plan to develop a commercial service to facilitate the technology transfer within and beyond the project. The focus of the project is on insect vectors and their associated viruses with particular emphasis on western flower thrips (WFT) and tomato spotted wilt virus (TSWV).

**Methodology**
An IPM vegetable industry liaison officer would be employed for a term of five years to: Stage 1 o Conduct industry needs analysis to determine current pest and disease management practices, and knowledge and understanding of IPM as a precursor for annual benchmarking. o Identify target group(s) of growers for project collaboration. o Identify key contacts within the target cultural groups. o Conduct systematic state-wide survey of current status of virus and insect vectors. o Develop customised training based on industry and target group needs. o Design and test individual pest management systems with individuals within the target group. o Identify site specific issues, work through these on an individual basis. o Develop commercialisation process. o Utilise key contact points such as chemical and fertiliser suppliers and the Sydney Markets to provide WFT identification and sticky trap tuition opportunities for growers. Stage 2 o Identify common issues within group (hygiene, maintenance) and work through these issues on a group basis. o Transfer technology (issues arising and solutions developed) through extension and training activities to a larger group in a sequential manner. o Set up of demonstration farms to extend examples of best IPM practice. o Extension services. i) Workshops. ii) Farm visits. iii) Provide diagnostic services. o Regularly publish information, outcomes and media updates in a variety of national industry outlets. i) IDO newsletter. ii) Columns in Good Fruit and Vegetables, Vegetable Platter. iii) National WFT newsletter. iv) Reports to national coordinator. o Develop procedures to commercialise IPM extension services. i) Prepare business plan. ii) Develop partnerships with commercial enterprises to take over IPM extension services. Stage 3 o Phase in commercialisation. o Publish information developed out of addressing the issues as they progress. o Develop a step-by-step IPM guide (a 'What to do when' guide). o Produce training and extension resources for industry. i) Develop an interactive CD ROM. o Develop IPM training for enterprises allied with this industry.

**Progress**
Initial steps towards development of a commercial IPM service will occur in the first year of the project.

**Implication**

o Arising from the industry funded research program, there is a lot known about WFT/TSWV management, but very little of this is being adopted by growers. o Lack of knowledge in the identification and seasonal activity of insect vectors and viruses in vegetable crops in the Greater Sydney Region. o Lack of availability of technical support services for pest and disease management for vegetable growers in the Greater Sydney Region. o Inappropriate use of chemicals.

**State project team**

Steve Goodwin Sandra McDougall Marilyn Steiner Stacey Azzopardi Len Tesoriero

**Funding source**

HAL

**Integrated management strategies for diseases and pests of Asian vegetables**

**Summary of work being done in state**

- Identify the important diseases and pests causing losses of Asian vegetables in the major production regions across Australia.
- Develop and evaluate effective disease and pest scouting/monitoring and integrated management strategies with growers that range from traditional market garden, broadacre and high value intensive production.
- Facilitate adoption of sustainable disease and pest management strategies for Non English Speaking Background (NESB) growers in NSW and Victoria (with extension activities linking to other states and territories).
- Crop surveillance and laboratory diagnostics will be used to identify, validate and update records of the key diseases and pests in Asian vegetables across the major Australian production areas. Targeted surveys and ongoing monitoring of crops will determine the relative impact of different diseases and pests on yield and quality. Crop scouting methods will be refined, evaluated and correlated with damage levels. Field trials will assess and demonstrate a range of improved management strategies. Topics include: efficacy testing of biorational chemicals; crop monitoring and scouting, successful application of biological controls; various changes to cultural practices; and cultivar evaluation for resistance/tolerance to pests and diseases. Existing translated information on disease and pest recognition and IPM will be collated and resource-gaps will be filled.
- Asian vegetable production in Australia is a growing and dynamic industry sector. It has expanded rapidly over the last decade and has a current value of over $135 million p.a. Expansion has been driven by consumer demands, as Australians are embracing Asian vegetables and cuisine. There is also an international market for these commodities and therefore potential for greater exports.
- Asian baby leaf vegetables are becoming a key component of a number of minimally processed salad and stir-fry mixes. For Harvest Fresh Cuts (HFC), a major producer of minimally processed vegetables, baby leaf makes up 35% of total salad sales with a processed value of $14M and Asian baby leaf vegetables are a major component of the minimally processed baby leaf product. Currently the farm gate value for Asian baby leaf vegetables is $1M and growing at 30% per year, while the farm gate value nationally is around $10M with most going to the food service industry. Minimally processed salads are a rapidly expanding high value and intensive industry.
- Growers of Asian vegetables, processors, exporters and the wider community will all benefit from this project. The project will increase productivity for growers, reduce crop losses and provide more continuity of supply for processors and consumers. Economic benefits are difficult to quantify, but several there have been several examples in Asian vegetable production where correct diagnosis and application of the effective management strategies has saved whole crops. In other words, there is a potential to reduce losses and increase sales by 20-60%. Food safety will also be improved as there will be less reliance on pesticides. These benefits will become more noticeable as food products are increasingly scrutinised for chemical residues. Use of IPM strategies will also reduce production impacts on the

environment, and decrease risks to farm workers and the surrounding community. This latter point is especially relevant in the peri-urban areas of production.

**State project team** Len Tesoriero Dr Stephen Goodwin Mr Leigh James
Dr Victor Rajakulendran

**Funding source**
RIRDC and HAL VG04032

**VG03003 Varnish Spot of lettuce—a scoping study**
Completed 2005

**Summary of work being done in state**
Varnish spot is a bacterial disease that causes brown lesions around the midrib on lettuce (Lactuca sativa L.) leaves quite commonly under outside leaves which show no symptoms. Varnish spot of lettuce is caused by Pseudomonas cichorii. The disease has been found in other countries including Italy, Turkey, Brazil, North America and is common in Australia. This project was established to find the awareness and seriousness of this disease across the lettuce growing regions of Australia.

Growers and others in the industry were visited, met with at industry information nights and meetings or called by telephone to obtain information on varnish spot. In response it was found that the majority of growers had seen the disease and were able to distinguish it from other bacterial rots such as those caused by *Erwinia*. All states had growers that were affected by varnish spot. It was previously thought that only some states had this disease. Most growers surveyed had minor losses from varnish spot but some growers recorded large losses such as $200,000, $145,000 and $40,000. These growers were in three different states. It appears that varnish spot can affect a lettuce sporadically or totally wipe out a planting. One hydroponic grower had also recorded heavy losses as a result of infection by Pseudomonas cichorii.

Processors reported that it was an issue for lettuce processed for hearts, with one processor recording a 3% loss from this disease. Seed companies agreed that most states had the disease with one company having problems with varnish spot on some varieties in 2005.

Previous research on this disease shows that it can infect through stomata and epidermal hairs. The bacteria can survive in lettuce residue so crop rotation has been suggested as a control option. But reports through this project have indicated that varnish spot has occurred on blocks that have not had lettuce for up to three years. Other sources of inoculum include seeds, transplant and insects. Some growers in the survey considered water sources as a possible source of bacteria; this has been supported with overseas information. Other hosts of P. cichorii include chicory cabbage, cauliflower, celery tobacco and endive. Numerous weed hosts could also exist.

A possible management plan for varnish spot would include the following:

- Water used for seedlings should be tested for varnish spot bacteria. Transplants should be inspected for signs of disease and infected transplants destroyed.
- Irrigation should be carried out to minimize leaf wetness duration and especially reduced to a minimum within three weeks of harvesting.
- Fields are rotated for 4–5 years between lettuce crops or other hosts of the pathogen causing varnish spot.
- Hosts should not be planted in adjacent fields.
- Plant less susceptible lettuce varieties.
- Lettuce should be planted in fields with well-drained soil and good air movement to promote rapid drying.

Future research on this disease would need to:

- Investigate and develop inoculation methods to reproduce varnish spot artificially for use in field and laboratory trials.
- Developing a quick diagnostic test for P. cichorii and other fluorescent pseudomonads that contribute to lettuce browning.
- Investigate varietal differences to varnish spot.
- Investigate through trials the efficacy of copper treatments with the aim of controlling varnish spot but also to reduce any sensitive reactions to the copper compounds.
- Examine weeds for their potential as a source of P. cichorii inoculum.
- Examine seeds, transplants, alternate hosts and insects as possible sources of inoculum.
- Investigating and develop water testing methods for P. cichorii.

**State project team** Andrew Watson

**Funding sources**
NSW DPI/ HAL

**VG 02108 Fusarium cob rot of sweet corn.** Completed 2005.

**Summary of work being done in state**
*Fusarium* ear (cob) rot is caused by the *Gibberella fujikuroi* species complex which includes *F. verticillioides* (previously referred to as *F. moniliforme*), *F. thapsinum*, *F. proliferatum* and *F. subglutinans* and or *Gibberella zeae* (*F. graminearum*). Members of the *Gibberella fujikuroi* species complex infect corn, sorghum and millets and are capable of producing mycotoxins such as fumonisins which can be toxic to horses and have been linked to cancer in humans. *Gibberella zeae* also causes stalk and cob rot of corn, causes head blight of wheat and overseasons on sorghum and grasses. Members of the *Gibberella fujikuroi* species complex survive from season to season in residue and seed and can enter plants through roots, stalks, insect damaged cobs and silks. These fungi can also be endophytes and plant stress can influence stalk and cob rot disease expression.

As a result of a serious cob rot outbreak in the Dubbo area of New South Wales in 2002, a disease survey was undertaken of sweet corn in 2003 to find the common endemic and endophytic Fusarium species associated with this crop. The survey included collection of 50 plants from three crops just before harvest from the main areas growing sweet corn including Dubbo, Bathurst, Cowra and Whitton for processing sweet corn. The Sydney Basin was surveyed to represent fresh market sweet corn. Stem and peduncle (shank) pieces were plated onto *Fusarium* selective media. Single spore isolates were plated onto carnation leaf agar for identification. Cob characteristics were also collected such as Fusarium infection, poor end fill (where the kernels haven't filled to the end of the cob), Helicoverpa damage and poor pollination. Those cobs that were healthy were also counted. Seed borne *Fusarium* from a number of common varieties were also investigated. Glasshouse trials were undertaken to find if the disease could be reproduced. Variety trials were undertaken with the same seed that had been planted in the year with the problem.

Weather conditions during the growing period were examined for the Dubbo area. The season was cooler than normal with periods of very high rainfall recorded in February through to early March. These events could have contributed to the stress factors that can contribute to outbreaks of this disease.

There was no serious outbreak of cob rot of sweet corn in the season covered by this project. However in February 2003 a serious problem occurred with cob rot in maize in the Riverina. Some aspects of the outbreaks had similarities. Weather conditions at both sites in both years received rainfall events just prior to harvest times. In February 2004 some sweet corn crops in the Murrumbidgee Irrigation Area were rejected because of brown staining of kernels and subsequent infection by *Fusarium*. The brown stained kernels turn black when processed. Extreme heat before harvest could have contributed to this outbreak. A fungus called *Tilletiopsis* was also found on many cobs on the surface of the kernels. Thrips were also common.

*Fusarium* species found in the survey of processing sweet corn included in decreasing frequency *F. verticillioides, F. subglutinans, F. proliferatum* and *G. zeae*. The dominant species in Bathurst was F.

subglutinans and in other areas F. verticillioides. Similar results were obtained when either stems or peduncles were used for isolation. Seeds of different varieties yielded the same range of *Fusarium* species. The dominant species found on fresh market sweet corn was the toxin *producing F. verticillioides.*

A field trial was undertaken in 2004 to evaluate water stress on the expression of Fusarium on sweet corn. Significantly there were more cobs with brown stained kernels in Golden Millennium than Jubilee.

**State project team** Andrew Watson NSW DPI Lester Burgess Sydney University Brett Summerell Botanic Gardens

**Funding source**
HAL

**VG 03002 managing bean root and stem diseases** Finishes 2007

**Summary of work being done in state**
**Objective**
To assess current disease issues facing the bean industries in New South Wales, Tasmania and Queensland. Improve the current understanding of these diseases and prepare a brochure describing these diseases. Develop field trials including variety trials, chemical trials and seed dressing trials to control soil borne diseases.

**Methodology**
This project is a national project with the main area of work being covered in New South Wales, Queensland and Tasmania. This project will link with an Integrated Pest Management (IPM) project on beans based in Queensland. Disease diagnostics will be undertaken to gain an understanding of the current relevant disease issues. Previous work in the area will be collated and extended to growers. Where soil borne diseases are a threat to production various field trials will be established covering seed dressings, chemical application and various other soil amendments.

**Implication**
This project is aimed at the sustainability of bean production across three states of Australia. It will provide the industry with support on disease detection, identification and management. Disease surveys to examine current root/stem diseases have been completed in the three states with the main diseases being

Fungi isolated from beans in Tasmania were identified. The fungi included *Fusarium solani, F. oxysporum, F. compactum, F. culmorum, Thielaviopsis basicola* (black root rot), *Pleiochaeta setosa* (brown spot), *Pythium irregulare, P. acanthicum and Rhizoctonia solani.*
Isolates identified from the visit to Queensland included, *Fusarium solani, F. oxysporum, F. compactum, F. culmorum, Pythium sp., Rhizoctonia solani, Sclerotium rolfsii* (Sclerotium stem rot) and *Macrophomina phaseolina* (charcoal rot).
Fungi isolated from NSW included *Rhizoctonia solani, Fusarium oxysporum, F. solani, Pythium irregulare, P. acanthicum, Sclerotium rolfsii* and *Aphanomyces*. In subsequent pathogenicity tests *Aphanomyces* was found to be the major cause of disease on the north coast of New South Wales.

Seed dressings have been shown to offer some assistance in control in this region. It has become apparent that seed dressings that may be effective in one region may not be as effective in another region, this needs to be verified.

*Aphanomyces* is a very difficult fungus to work with, being very difficult to isolate from plant material. Its role in bean disease control in QLD and Tas. will be further investigated.

**State project team** Andrew Watson Len Tesoriero Meryl Snudden Lee Brown other collaborators Hoong Pung Serve Ag

**Funding source**
HAL

**VG 05029 Fusarium Wilt of snow peas.** 2005–2008

**Summary of work being done in state**
Snow pea production across Australia is valued at $12m. Fusarium wilt is a threat to production. Fusarium wilt of snow peas will be investigated in this project with the main task of identifying races of the fungus concerned. Snow pea varieties with resistance to the races identified will then be trialled on growers' properties and in glasshouse trials. Other methods of disease control will be investigated such as seed treatments. To date surveys have shown that the disease is present in QLD, NSW and Victoria.

**State project team** Andrew Watson Ameera Yousiph Sydney University Edward Liew Botanic Gardens

**Funding source**
HAL

**VG 02115 managing northern corn leaf blight in processing sweet corn** Finishing 2006.

**Objectives**
To develop best practice in controlling leaf blight, examining such factors as variety selection, stubble management, irrigation practices, and weather effects including leaf wetness. Other diseases will also be assessed as to their impact on the sweetcorn industry. Current spray recommendations will be reviewed. Chlorothalonil a protective fungicide is the only recommended fungicide available for this disease. Alternative fungicides could include curatives. Field trials will test such chemicals

**Methodology**
The current international methods for controlling leaf diseases of sweetcorn will be evaluated and the advantages of using any predictive models in the Australian situation investigated.
It is intended to undertake a grower survey to establish the extent of disease problems of sweet corn in the Lachlan Valley, NSW. This will also identify grower cooperators for field trials. The main disease of concern is Turcica leaf blight and field and glasshouse trials will be undertaken to establish alternatives to chlorothalonil. The field trials will be carried out on grower properties in the Lachlan valley. Some curative fungicides, if successful in controlling the disease, would give more flexibility in a disease control program. Yield loss assessments will also be carried out. The project will also use extension activities to improve grower understanding of the disease and its control. The effect of disease on different varieties (where grown) will be measured as a guide to differing varietal susceptibility. Boil smut is becoming more of an issue in this growing region and its industry effects will be evaluated

**State project team** Andrew Watson and Tony Napier

**Funding source**
HAL and Voluntary Contribution from Western Rivers Horticultural Council.

# APPENDIX 2

## 2006/07 VEGETABLE PRIORITIES IN PLANT HEALTH

**Background**

Integrated pest management (IPM) is the integration of non-chemical and chemical tools for the management of economically damaging pests (including insects, mites, disease, nematodes, and weeds) for sustainable vegetable production while at the same time, addressing the needs of the supply chain. HAL and AUSVEG have started a strategic planning exercise to identify the strengths and weaknesses in the resources, gaps and opportunities from past IPM research, development and extension investment. This process has required consultation and workshops with growers, researchers, consultants and extension workers from the vegetable industry, reviewing resources in major and minor crops, identifying the IPM gaps in 10 minor vegetable crops which were not well supported by pest management strategies. From this process, immediate priorities for IPM funding in 2006/07 were determined. The aim of this exercise is to develop priorities in research, development and extension for future work that avoid fragmentation and duplication while increasing integration of all pestmanagement practices so that true IPM can be increasingly understood and practiced. A key consideration was finding ways to overcome the problem of low industry demand for commercial IPM (or advisory) services together with a shortage of skilled providers to promote and service a growth in demand. While this is a continuing process, certain priorities have already been identified. The investment priorities for plant health in the vegetable industry include:

**1. To determine the impact of pesticides on the key beneficials in vegetable crop production**

**Project rationale**

There is a need to have independent and quality information concerning the real impact of pesticides upon key beneficials utilised in IPM. Industry has access to charts from the cotton industry as well as the vegetable industry but these simple guides are based upon the impact on adult beneficials and often don't include the impact of those pesticides upon maintaining beneficial populations.

**Scope of the project**

- Determine the impact of key, commercially available pesticides, especially those pesticides suggested as IPM 'friendly', on population establishment and maintenance of key beneficials in vegetable production.

**2. IPM Gap analysis in Asian vegetables**

**Project rationale**

There are limited options for the management of pests in Asian vegetable crops due to the small size of the industry. RIRDC have funded projects which have determined the pest and diseases which infest Asian vegetables. An analysis on available and key gaps in IPM tools for Asian vegetables is required to provide the information to help these growers undertake IPM in their crops.

**Scope of the project**

- Determine the IPM tools available for growers of Asian vegetables
- Determine the gaps required to provide IPM strategies for growers of Asian
- vegetables
- Integrate this work with the Minor Use Coordinator who will be conducting the
- pesticide gap analysis for Asian vegetables
- Communication of this work will be through AUSVEG

**3. IPM Advisory Service for Tasmania**

**Project rationale**
Unless there is a continuous IPM support service available to growers, it is unlikely that IPM will be successfully adopted. Most states, other than Tasmania, already have a commercial IPM advisory service developed and the availability of this service to growers has significantly improved the adoption of IPM. Therefore, in order to assist in the adoption of IPM by Tasmanian growers, the development of a commercially viable IPM advisory service is essential.

**Scope of project**

- Project should focus on demonstrating current and future IPM strategies to growers in field and glasshouse production systems, thereby increasing grower's confidence in IPM and creating a support base for a future commercial advisory service.
- Project should also focus on training, developing and accrediting those who will be in charge of the commercial advisory service at the end of the project.

**4. IPM advisory, mentoring and training for Australian vegetable growers**

**Project rationale**
There is a clear need to bring all pest management strategies together around improved decision making with compatible treatment options for both insects, mites, diseases, weeds and nematodes. A key consideration is to find ways to overcome the problem of low industry demand for commercial and independent IPM (or advisory) services together with a shortage of skilled providers to promote and service a growth in demand.

**Scope of the project**
Scoping study to determine interested agricultural consultants to provide training, mentoring and offering / developing IPM advisory services throughout Australia. Determine network for existing IPM consultants.

**5. IPM compatible options for the management of the key pests Rutherglen bug, thrips, Silverleaf whitefly and other sap sucking insects.**

**Project rationale**
Present control methods for the control of difficult pests, such as Rutherglen bug, thrips, Silverleaf whitefly and other sap sucking insects generally have long term detrimental impacts on IPM in vegetable crops. There is a need for the vegetable industry to investigate IPM compatible options to improve the adoptions of IPM.

**Scope of the project**
Scoping study of Australian and international information sources to determine IPM compatible pest management options for the control of Rutherglen bug, thrips, Silverleaf whitefly and other sap sucking insects. Information to include available data, management practices and costs if possible.

**6. IPM gap analysis for pathology**

**Project rationale**
Although the IPM gap analysis project (VG05043) included both entomology and pathology, it mainly focused on entomology and a number of pathology issues were not investigated. As a result, it is necessary for an additional IPM gap analysis to be conducted to focus solely on pathology.

**Scope of project**

- The project must link in with the current IPM audit project (VG05043) in order to ensure that the proposed project is properly focused and won't replicate work that has already been done in the current project.
- The project needs to have a national focus and should include the involvement of all the key vegetable pathologists in Australia.
- The project should focus on a range of pathogens and vegetable commodities and should seek information from relevant horticulture and non-horticulture industries where ever possible (crops to include all the crops addressed in project VG05043. These being beans, beetroot,

carrots, capsicum, celery, chinese cabbage, cucumber, pumpkin, sweet potato, zucchini as well as brassicas, lettuce, processing tomatoes and sweet corn)

- The outcome of this project should make clear recommendations to the vegetable industry on IPM pathology priorities for the 07/08 Industry Call.

**7. Soil health in vegetable production**

**Project rationale**

Soil health includes the biological, chemical and physical components of the soil and thus the management of soil health has a major influence on the productivity of soil grown crops. Soil health is particularly an issue in terms of its role in dealing with soil borne diseases and pests for example nematodes, above and below ground insects. Through a better understanding and proper management of soil health, these diseases and pests can be controlled in a more sustainable way, without negatively affecting productivity.

**Scope of project**

- Investigate what has been done in other industries for example strawberries, potatoes, non-horticulture etcetera both in Australia and overseas that can be applied to the management of soil health for the Australian vegetable industry.
- The project should include the trialling of different management options to improve soil health and manage soil borne pests and diseases in a number of vegetable commodities.
- Integrate project with other soil health and pest management projects which have been completed or are currently being conducted
- It is important that all proposals demonstrate the following:
- Driven by IPM principles rather than just chasing new chemical permits. This includes the understanding of the impact of the practice upon other important pests and beneficials.
- Seek to cover more crops and their needs with minimum duplication and fragmentation of effort.
- Build on previous work in a strategic manner and support maintenance of prior gains
- Be aware of drivers for IPM adoption by taking into account the impact of emerging consumer and community requirements, and matching these drivers to grower's needs for tools and strategies that provide effective and affordable ways to protect their crops
- Link required technology solutions to uptake strategies that improve industry outcomes
- Integrate with other researchers in this area so that research outcomes can be implemented into national approaches.
- Measure the cost effectiveness of work done and its quantifiable benefits to industry, including what is the position of the industry now, why change and what proportion of the industry are likely to benefit from this work.
- Link or integrate farm practices with supply chain requirements including product specification protocols for domestic and export markets
- Utilise the network of information/research generated by other agricultural industries
- Communication to growers and advisors needs to be integrated with the AUSVEG
- communication strategy, including AUSVEG web site and Vegetables Australia magazine.

# APPENDIX 3

**VEGETABLE IPM WORKSHOP**

Brisbane Convention Centre, Brisbane
Tuesday 9th May

*Aim:*

4. Improve integration of pathology & entomology recommendations
5. Share experience and understanding on selected topics
6. Improve between group interaction

*Participants*

Chris Akem (DPI&F Qld), Garry Artlett (Growcom), Greg Baker (SARDI), Kevin Bodnaruk (consultant), Alan Boulton (NSW DPI), Sonia Broughton (DAFWA), Tony Burfield (SARDI), Barry Conde (NT Gov), Peter Dal Santo (AgAware), Peter Deuter (DPI&F Qld), Rob Dimsey (Vic DPI), John Duff (DPI&F Qld), Debra Eaton (PHA), Barbara Hall (SARDI), Lionel Hill (TasDPIW), Grant Herron (NSW DPI), Dijana Jevremov (SARDI), Iain Kay (DPI&F Qld), Sandra McDougall (NSW DPI), Liz Minchinton (Vic DPI), Ian Porter (Vic DPI), Hoong Pung (Serve Ag), Bronwyn Walsh (DPI&F Qld), Andrew Watson (NSW DPI), Brad Wells (HAL), Rob Weppler (Biological Services), Trevor Wicks (SARDI), Leanne Wilson (HAL), Ryan Wilson (PHA).

WORKSHOP NOTES

1. IPM Research Funding direction presentation
2. Vegetable Biosecurity
3. Integrating entomology & pathology in IPM
4. Project development/implementation process
5. Minor use chemistry presentation
6. Prioritising chemistries for testing against beneficials
7. Virus management
8. Pest and disease surveys

The Workshop took the form of presentations and facilitated discussion and working groups with a report back to the group. The following outlines notes from the report back session with recommendations from the group to …..

**3. Integrating Entomology & Pathology**

Where have ento/pathology recommendations worked well:

Asian vegetable IPM

– Len Tesoriero & Victor Rajakalendran NSW DPI & Rob Dimsey (VIC DPI) RIRDC & HAL funding
- Project network
- Separate projects initially
- Do surveys in crop together

Sweetcorn
- disease & insect issues –
- Ento -& Path (Andrew Watson, Ross Wright)

Citrus IPM QLD

- 30 year + history
- Strong collaboration between DPI Ento (Dan Smith) & a consultant in training (Dan Papacek) & Golden Mile Orchards
- VC from Growcom
- => very successful

Reveg by design

- dealing with managing 3 thrips and TSWV
- Ento led but virologist employed for service delivery

Living Mulches aim to increase beneficials in capsicums

- Outcome was Not an improvement in beneficials
- But reduced wind blasting

Key features for successful integration

- Good collaboration requires trust, respect & integrity
- Clarity of roles within project
- Broad team – ento, path, agron, growers, advisers/consultants
- Walk the talk – demonstrate it in the field, ground truth
    - Challenges the robustness of recommendations
    - Will show up conflicts in advice
- Involve growers in development stage as reference group.
    - Mostly happening as steering committees on most projects and strongly encouraged
- Problem definition workshop – clarify issues and areas of agreement or disagreement and methods for resolution
- Involve extension/communication officer in role of GP

Example of poor integration of entomologists and pathologist in a project was the WFT project (1995?). Disciplines/States? went their own way without resolving different perspectives and made completely conflicting recommendations for WFT management eg .

Example of conflict

- Onions – Hasten® – wetter with insecticide– strips wax leading to entry site for diseases
- Disease host plants/nectar source/beneficial source
- Soil management
- Fungicides/beneficials

Recommendations to improve integration

- Entomology & pathology meetings held in conjunction
- Seek funding for the development phase of projects to allow for involvement of broad range of interests & expertise to properly define project scope, methods and outcomes
- Recommend HAL fund more projects using a–stop –go funding model or having the requirement to seek comments from a broad range of disciplines at various points in the project life.
- Combined Brassica meetings with Brassica product group seen as very useful

## 4. **Project Development/implementation process**

Industry Priority Setting

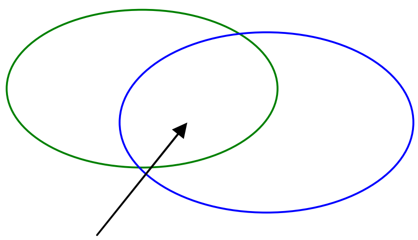
IDOs talking to industry but not getting good input from growers

- Was questioned whether industry was not aware of process – seems unlikely
- Was also questioned whether some IDOs also not aware of or actively seeking input to assist with priority setting.
- Priorities usually short term interests

- Tas. already having an annual process with growers, IDO and researchers
- Citrus annual meeting is an example of a successful commodity working group
    - Researchers report and present to IDO and growers on state basis then state responses go up to national committee

Some state departments have their own processes & priority setting where as others their priority is to get external funding so their overlap is more towards the industry priorities.

Res Provider Priorities/Capabilities



area of common priorities Industry priorities

Need industry stakeholders and research/extension providers to work together to identify areas of common interest and define longterm priorities. May be helpful in Providers clarify their capabilities.

Was a request for more formal process for getting VCs

<u>Recommend</u>

1. having regular Gap analysis – for each Product group - at least every 3 years during the Nov- May period (prior to annual HAL priorities being set]
- Have presentations of current or previous projects at meeting
- Involve Product group reps, scientists, minor-use office, consultants and industry players involved in priority setting
- Process will give greater cohesion between product groups and research groups
- Have Product group reps then consult back with industry

2. Was raised that some projects were rejected after a VC was withdrawn and request made that providers have opportunity to negotiate with reduced budget (Leanne says that is current practice)
3. Return Concept Development Proposals, however without requirement for a firm budget
4. Suggest State Dept leaders in Science & Policy (or senior scientists familiar with project submissions) attend IAC or Product group meetings to present state projects & outcomes
- then research agencies are able to get immediate feedback and talk to counterparts when other states have related projects
5. Fund project development phase
6. Look at funding longer term projects
7. Feedback after project rejection with option resubmitting following year

Note that the time for researchers to respond to priorities or feedback from IAC is considerably shorter than time to wait on AUSVEG and HAL processes.

**5. Minor-Use process – Peter Dal Santo**

The current wish-list approach to the minor-use permit program is neither efficient nor desirable. Currently adopting a more strategic process for prioritising chemistry-crop-pest permit applications.

Looking by crop at pests, diseases and weed problems, what is currently available, what is its future i.e. is it being reviewed, what chemical options are there and how do they fit with IPM, what is likelihood for resistance to develop, what are international trade ramifications etc. Plan to then put up a series of permits for crops or groups of crops so that current problems we are experiencing with resistance to spinosad is avoided if possible.

See *Gap analysis flow chart*.doc

- Have conducted strategic chemical planning with Tasmania, WA, SA and on 18-19th May with NSW.
- Peter and Kevin are generating a database of pesticide options for pests, diseases and weeds and their IPM, resistance and international trade fit.

**Registration process – International perspective – Kevin Bodnaruk**

- All western countries are experiencing similar problems with minor use registrations.
- Most western countries are also reviewing the registrations of the older chemistry. They are re-looking at the Acceptable Daily Intake (ADI) calculations for ‘at risk’ groups in the community and will de-register or modify registrations of products that exceed the maximum ADI levels.
- USA is leading talks on a multi-country minor-use registration process
- APMVA are now more willing accept internationally generated data for toxicity packages and are looking keenly at developments towards data sharing for minor use permits
- Using the ADI calculations Methomyl is likely to loose registration for post harvest dipping, and potentially other uses.

**6. Common Chemistry for testing against Beneficials**

The group listed pesticides that were either new or commonly used that were nominated for testing against some common generalist beneficials and some specialist predators or parasitoids found in vegetable IPM or minimal spray cropping systems. It is noted that the relative importance of the beneficials varies between regions and cropping systems.

Insecticides

Methoxyfenozide
Abamectin
Spinosad
Imidacloprid
Emamectin
Indoxacarb
Primor
Oils
Thiocloprid
Acetamiprid
Pyriproxyfen
Thiamethoxam

Fumigants

Fenhexamid
Metham sodium

Fungicides

Iprodione
Boscalid
Azoxystrobin
Pyraclostrobin
Chlorothalonil
Metalayxl
Mancozeb
Copper
Metriam

Herbicides

Glyphosate
Diquat
Paraquat

Beneficials of interest

*Generalists*

Brown Lacewing
Hippodamia
11 spotted Lady
Predatory mites
Damsel bugs
Spiders

*Specialists* (50+ parasitoids)

DBM parasitoids
Trichogramma spp.
Eretmocerus spp.
Encarsia formosa
Aphid parasitoids
Fungal antagonists
Bacterial antagonists

Pesticide impacts on Beneficials are important to a wide range of industries

- Potential for Multi- industry funding

- Wine grapes & Cotton potential major partners to horticultural industries

International information can assist

- MAFF in UK rating for beneficials
- Koppert
- Biobest

Noting that different strains can vary in their susceptibility or tolerance of insecticides and clearly closely related species can also differ in response.

## 7. Issues of common interest -Virus management

No Virologists present so need to involve them in future discussions

Virologists: Dennis Persley (QLD) John Thomas (QLD), John Randles (SA), Daniele Giblot-Ducray (SA), Callum Wilson (Tas), Brendan Rodoni (VIC), Fiona Constable (VIC), Roger Jones (WA), Brenda Couttes (WA)

## 8. Pest & Disease surveillance

- During the IPM stocktake discovered that we have a poor idea of what pests and diseases are problems except for crops in areas with active research programs.
- No longer have the people on the ground in each crop/region/state

Recommend

- Have some funding allocated for active surveillance
- 0.5 FTE/state/year – industry funded – ongoing – multiple people
- experienced people that target specific crops, visiting and questioning industry/resellers/ field officers and conducting field surveys
- want a local with experience
- not policemen
- presence, incidence and frequency of pests & diseases
- need to tie in with biosecurity surveys
- As well as conducting active surveillance the person should be involved with training
    - reseller/consultant networks often have lots of information - varying degrees of quality of information
    - work with resellers/consultants in improving identification skills in return for information
    - have formal agreement with consultants to provide information

- pooling information/database & fed into priority setting of industries, biosecurity
- publicise free identification of potential exotics at diagnostic labs – charge only when specific identification is required of a non-exotic. Most labs have this system but not well known by industry or resellers.
- potentially having training/surveying roadshow (team of paths, ents, horts).