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Biennial Meeting of the National Vegetable Pathology Working Group, Adelaide, Australia, 21-23 April 2004

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A report prepared for
NZ Vegetable & Potato Growers' Federation Inc.

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1 Executive summary

The National (Australian) Vegetable Pathology Working Group (NVPWG) meets every 2 years to exchange information on current vegetable pathology projects and to formulate strategies to address current and new plant disease problems facing Australia's vegetable industries.

The last two meetings of the group have included New Zealand representation. The latest NVPWG meeting was held in Adelaide from 21 to 23 April, 2004, and was attended by 16 plant pathologists, the six State Vegetable Industry Development Officers (IDOs), and representatives from Plant Health Australia (PHA), the Australian Quarantine and Inspection Service (AQIS), and the private research providers ServeAg Ltd and AgWare Consulting Pty Ltd.

The meeting reviewed current HAL-funded projects, New Zealand projects relating to vegetable diseases, current plant pathology trends and issues, and priorities for future research. The State Vegetable IDOs each outlined the current major disease problems for the vegetable growers in their region.

This report lists the HAL-funded vegetable pathology projects currently underway in Australia, and summarises the key recommendations from the NVPWG meeting. The field trip and grower seminar associated with the meeting are also briefly outlined.

Information on the New Zealand vegetable industry and vegetable pathology research in this country was presented to the meeting. The New Zealand industry is characterised by the large number of temperate and sub-tropical crops that are grown, and an increasing overall value (+19% from 2001 to 2003) both from domestic and export sales of most vegetable products. At the same time, there has been a 19% reduction in the number of commercial vegetable growers. The changes in planted area for the major vegetable crops between 2001 and 2003 were: potatoes –10%, onions –22%, greenhouse tomatoes +4%, sweet corn unchanged, and peas +9%. In general, crop yields per unit area have increased over the 2 year period.

Vegetable pathology projects currently underway in New Zealand include (by crop and disease):

- **Potato:** powdery scab, late blight, storage rots, Verticillium wilt, Rhizoctonia canker and black scurf, white mould, potato cyst and root knot nematodes, common scab, soft rot, bacterial ring rot and potato mild mosaic.
- **Onion:** Allium white rot, black mould, downy mildew, neck rot, basal rot, and bacterial soft rot.

- **Squash:** field and storage rots, and viruses causing leaf mosaics and fruit blistering.

- **Tomato:** enhancing crop growth with *Trichoderma*.
- **Carrot:** nematode diseases.
- **Lettuce:** grey mould, lettuce drop, downy mildew, anthracnose, bacterial rots, and virus diseases.
- **Mushrooms:** fungus and virus diseases.
- **Brassicas:** clubroot.
- **Peas:** powdery mildew, downy mildew, Ascochyta blight, Fusarium root rot, Aphanomyces root rot, and virus diseases.
- **Asparagus:** spear rot, rust, stem blight, anthracnose, and Asparagus virus 2.
- **Sweet corn:** head smut and Stewart's bacterial wilt (pest risk analysis).
- **Kumara:** pink rot, and scurf.
- **Taro:** leaf blight.
- **Spinach:** Phytophthora root rot.
- **Tuberous crops:** virus diseases.

Key preliminary recommendations from the meeting relating to particular crops are listed below.

***Allium*:** 1. Carry out a national evaluation of the downy mildew downcast model. 2. Complete a scoping study of pink rot. 3. Continue research on white rot control, particularly if DADS is not registered.

Leafy vegetables (lettuce etc.): 1. Complete a national extension project for lettuce - a roadshow about pests and diseases. This should be developed after a literature review to determine the knowledge gaps. 2. Expand the options for control of lettuce diseases.

Legumes (peas, beans): Support collaboration with the University of Nebraska for screening of lines of beans for resistance to *Sclerotinia*.

Sweet corn: Complete a scoping study on viruses in sweet corn. Include Fusarium diseases and boil smut as components of the Queensland IPM project for sweet corn.

Asian vegetables: 1. Current programmes for pest and disease control in Asian vegetables should be supported with extension and communication strategies. 2. Any gaps in knowledge indicated by these projects should be filled by funding the required research.

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

Brassicas: 1. Support an Australia wide extension programme 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 the UK.

Capsicum: Investigate management of bacterial spot, including seed infection, copper resistance and breeding of resistant varieties.

Tomatoes: 1. Carry out a scoping study to investigate the diseases being carried in tomato seed, particularly spindle tuber viroid, and determine whether there are any appropriate management strategies to reduce this. 2. Undertake studies on bacterial canker, including control in nurseries, management of seedborne infection, disease control and breeding resistant varieties.

Cucurbits and melons: Investigate integrated management of viruses in cucurbits and develop and implement appropriate extension programmes.

Nurseries: Carry out investigations into the feasibility of producing disease-free seedlings in nurseries. Studies should initially be limited to one to two major diseases on a few crops.

Seedborne diseases: Undertake a review/scoping study to develop a strategy to address the issue of healthy seed for the Australian vegetable industry.

Fungicide resistance: Support investigations into alternative chemistries and management of fungicide resistance in vegetable pathogens.

Extension: 1. Develop a broad communication plan relating to diseases and disease management for the vegetable industry. 2. Encourage inclusion of growers on the steering committees for each vegetable disease research project. 3. Ensure, at the planning stages, that IDO's are involved in extension details for each project.

Fumigation: Continue to investigate alternative fumigation technologies, including sustainability as a key component, particularly the effects of long-term use of alternative fumigants on land and people, and the safety of the new technologies.

Diagnostics: 1. Support diagnostic training. 2. Initiate a study to determine the disease and pathogen predictive tests that are currently available, and evaluate their effectiveness. 3. Support the Plant Health Australia (PHA) expertise register, by registration of all appropriate plant diagnosticians. 4. Approach PHA to manage a list serve for plant diagnosticians.

Minor pesticide usage: Continuation of the minor use permit system should be strongly supported, particularly relating to new chemistry for pesticides suitable for use in IPDM programmes.

The NVPWG meetings provide an excellent opportunity for information exchange between the Australian States, and recently, with the inclusion of input from New Zealand, across the Tasman Sea. The main topics covered in the 2004 meeting related to disease problems facing practical vegetable production in both countries; the research reviewed aims to provide the respective vegetable industries with effective disease management strategies across a broad spectrum of vegetable crops. The latest meeting focused on

particular plant disease issues facing growers, and some of these are highly relevant to New Zealand growers. Particular examples are the threats posed by diseases of Asparagus that have recently been identified in Australia but have not yet arrived in New Zealand, and the importance of white rust for Australian Brassica growers.

The New Zealand horticultural industries are viewed by Australian operatives as highly efficient. Unlike New Zealand vegetable industries, the Australian vegetable industry has a high level of support from government, both for research funded through the State Departments of Primary Industries and the well-developed extension network of vegetable Industry Development Officers.

An example of trans-Tasman research collaboration partly instigated through the NVPWG meetings has been the recent Processing Potato Industry Advisory Committee research initiative on soilborne diseases of potato.

2 *Introduction*

The National Vegetable Pathology Working Group (NVPWG) is an informal assembly of plant pathologists, research providers and vegetable Industry Development Officers (IDOs). This group meets every 2 years, and the last two meetings have included representation from New Zealand. The group met at the South Australian Research & Development Institute, the Waite Campus, Adelaide, on 21, 22 and 23 April 2004. The meeting was attended by: plant pathologists from the Departments of Agriculture and Primary Industries of Western Australia, the Northern Territory, South Australia, Victoria, Tasmania, New South Wales, Queensland and Crop & Food Research New Zealand; a representative each from ServeAg Ltd and AgWare Consulting Pty Ltd (private research providers); IDOs from the six Australian States; and representatives of Plant Health Australia and the Australian Quarantine and Inspection Service (AQIS). The meeting included a field trip to view vegetable production in the greater Adelaide region, and a grower seminar to present plant pathology topics of interest to vegetable growers on the North Adelaide Plain.

This report summarises the projects reviewed at the meeting, and briefly outlines the associated field trip and seminar activities. Information presented to the meeting on the New Zealand vegetable industry and the current vegetable pathology projects in this country is also outlined. The main conclusions from the meeting are summarised, and a list of the meeting participants and their contact details is included.

3 Current HAL-funded vegetable pathology projects in Australia

The following list summarises current HAL-funded projects on vegetable diseases, grouped by the State in which the work is being carried out or from which it is co-ordinated. These projects are carried out mainly by plant pathologists in the State Departments of Agriculture or Primary Industries, and by ServeAg. Some of the projects have New Zealand input. Full details of the projects can be obtained from Horticulture Australia Ltd, Level 6, 7 Merriwa Street, Gordon, NSW 2072, Australia; phone, +612 9418 2200; fax, +612 9418 1352; web address, http://www.horticulture.com.au/.

WESTERN AUSTRALIA

VG99015 Improvement in lettuce quality by reduction in losses due to soilborne diseases

Duration: July 2000 to September 2004. Supervisor: Ms Dominie Wright. Principal investigators: Ms Lindrea Latham, Ms Christine Wood, and Dr Calum Wilson. Organisations: Department of Agriculture, Western Australia, and Tasmanian Institute for Agricultural Research.

VG00058 Increasing the competitiveness of the Australian processing pea industry through minimising the economic impact of the Ascochyta fungus

Duration: July 2000 to July 2003. Supervisor: Mr Lloyd Williams. Principal investigator: Mr Lloyd Williams. Organisation: Horticultural Technical Services, Manjimup, WA.

VG00065 Continued development of management strategies for western flower thrips and tomato spotted wilt virus in vegetables

Duration: July 2000 to June 2003. Supervisor: Dr Roger Jones. Organisation: Department of Agriculture, Perth, Western Australia.

VG01015 Surveying vegetable brassica crops for virus diseases in Western Australia

Duration: July 2001 to June 2002. Supervisor: Dr Roger Jones. Principal investigator: Ms Lindrea Latham. Organisation: Department of Agriculture, Perth, Western Australia.

VG01016 Developing and communicating management strategies for controlling carrot virus Y

Duration: July 2001 to June 2004. Supervisor: Dr Roger Jones. Principal investigator: Ms Lindrea Latham. Organisation: Department of Agriculture, Perth, Western Australia.

VG01017 Extension of an integrated management strategy for celery mosaic virus in celery crops in Western Australia

Duration: July 2001 to June 2002. Supervisor: Dr Roger Jones. Principal investigator: Ms Lindrea Latham. Organisation: Department of Agriculture, Perth, Western Australia.

VG02053 Cause of leaf spotting in Chinese cabbage

Duration: November 2002 to November 2003. Supervisor: Mr Dennis Phillips. Principal investigator: Mr John Burt. Organisation: Department of Agriculture, Perth Western Australia.

VG03057 Scoping study on the importance of virus diseases in Australian vegetable cucurbit crops

Duration: July 2003 to Sept 2004. Supervisor: Dr Roger Jones. Principal investigator: Ms Brenda Coutts. Organisation: Department of Agriculture, Perth, Western Australia.

VX00013 Biofumigation - optimising biotoxic Brassica rotations for soil-borne pest and disease management

Duration: July 2000 to June 2003. Supervisor: Mr. John Matthiessen. Principal investigator: Mr John Matthiessen. Organisation: CSIRO Entomology, Perth Western Australia.

HG02059 Identification of the new tospovirus found in imported tulip bulb crops

Duration: December 2002 to July 2003. Supervisor: Dr Roger Jones. Principal investigator: Dr Roger Jones. Organisation: Department of Agriculture, Perth, Western Australia.

PT00034 Communicating the strategies to manage potato virus diseases for Western Australia potato crops

Duration: Dec 2000 to June 2001. Supervisor/Principal investigator: Stewart Learmonth. Organisation: Department of Agriculture, Perth, Western Australia.

PT02047 Virus testing of early generation seed potato crops in Western Australia

Duration: December 2003. Supervisor/Principal investigator: Mark Holland. Organisation: Department of Agriculture, Perth, Western Australia.

PT02048. Developing a pest and disease crop monitoring program for Western Australian seed potato crops

Duration: February 2003 to December 2003. Supervisor/Principal investigator: Mr Mark Holland. Organisation: Department of Agriculture, South Perth, Western Australia

SOUTH AUSTRALIA

VG98102 Production of a CD-ROM on the plant parasitic nematodes of Australia in the vegetable, grains and sugarcane industries

Duration: August 1998 to August 2003. Supervisor: Dr Sharyn Taylor. Principal investigator: Dr. Jackie Nobbs. Organisation: South Australian Research and Development Institute, Adelaide, SA.

VG00013 Managing diseases of leeks

Duration: July 2000 to December 2004. Supervisor: Dr Trevor Wicks. Principal investigator: Miss Catherine Hitch. Organisation: South Australian Research and Development Institute, Adelaide, SA.

VG00014 Managing Alternaria blight in carrots

Duration: July 2000 to October 2003. Supervisor: Dr Trevor Wicks. Principal investigator: Mr Robin Coles. Organisation: South Australian Research and Development Institute, Adelaide, SA.

PT01001 Control of black dot in potatoes

Duration: July 2001 to October 2004. Supervisor: Dr Trevor Wicks. Principal investigator: Mr Robin Harding. Organisation: South Australian Research and Development Institute, Adelaide, SA.

PT02036 Disease Management of potatoes on Kangaroo Island

Duration: August 2002 to December 2004. Supervisor: Mr Robert Peake. Principal investigator: Dr Trevor Wicks. Organisation: South Australian Research and Development Institute, Adelaide SA.

VG02116. VEGEnote series

Duration: Dec 2002 to Dec 2005. Supervisor: Mr Jim Kelly. Principal Investigator: Ms Natasha Wojcik. Organisation: ARRIS.

VG03035 Biennial meeting of the National Vegetable Pathology Working Group, Adelaide, May 2004

Duration: Dec 2003 to May 2004. Supervisor: Mrs Barbara Hall. Principal investigators: Mrs Barbara Hall, Mr Craig Feutrill. Organisation: South Australian Research and Development Institute, Adelaide, SA.

NEW SOUTH WALES

VG02108 Fusarium cob rot management in sweet corn

Duration: Nov 2002 to March 2004. Supervisor: Mr Andrew Watson. Organisation: NSW Agriculture.

VG02115 Managing northern corn leaf blight in processing sweet corn

Duration: October 2002 to June 2004. Supervisor: Mr Andrew Watson. Organisation: NSW Agriculture.

VG03002 Managing bean root and stem diseases

Duration: January 2004 to June 2006. Supervisor: Mr Andrew Watson. Organisation: NSW Agriculture.

VG03003 Scoping study on the management of varnish spot in field and hydroponic lettuce

Duration: July 2003 to June 2004. Supervisor: Mr Andrew Watson. Organisation: NSW Agriculture.

Using milk to control powdery mildew of pumpkins

Duration: June 2002 to June 2003. Supervisor: Mr Andrew Watson. Organisation: NSW Agriculture.

VG00069 Integrated management of greenhouse cucumber and capsicum diseases

Duration: October 2000 to March 2004. Supervisor: Mr Len Tesoriero. Organisation: NSW Agriculture.

VG01024 Improved management of black rot of Brassicas

Duration: July 2001 to April 2004. Supervisor: Mr Len Tesoriero. Organisation: NSW Agriculture.

VG03098 Regional extension strategy for WFT/TSWV in the Sydney region

Duration: Nov 2003 to February 2009. Supervisor: Dr Stephen Goodwin. Organisation: NSW Agriculture.

QUEENSLAND

VG00084 Improving the reliability and consistency of processing beetroot production

Duration: October 2000 to September 2004. Supervisor/Principal investigator: Ms Heidi Martin. Organisation: Queensland Department of Primary Industries and Fisheries.

VG01087 Suppressive soils for biological control of root knot nematodes on vegetable crops

Duration: January 2002 to December 2004. Supervisor/Principal investigator: Dr Graham Stirling. Organisation: Biological Crop Protection Pty Ltd, Moggill, Queensland.

VG02020 Control of sudden wilt in Capsicum

Duration: start: January 2003 to March 2005. Supervisor: Dr Graham Stirling. Principal investigator: Ms Lois Eden. Organisation: Biological Crop Protection Pty Ltd, Moggill, Queensland.

VG02035 Capsicum breeding for tospovirus resistance

Duration: February 2003 to December 2006. Supervisor: Mr D McGrath. Project Team: Mr D Persley, Mr M Sharman, Dr S Garland, Ms L McMichael, Mr IO Walker. Organisation: Queensland Department of Primary Industries and Fisheries.

VG03029 Development of guidelines for sustainable management of powdery mildew in Capsicums

Duration: February 2004 to May 2006. Supervisor/Principal investigator: Dr Chrys Akem. Organisation: Queensland Department Primary Industries and Fisheries.

HG99034 Development and implementation of pest management strategies for fruit and vegetable industries in Queensland

Duration: May 2000 to May 2004. Supervisor: Mr Richard Ross. Principal investigator: Ms Janine Clark. Organisation: Queensland Fruit and Vegetable Growers.

YX00993 Monitoring spread and developing natural resistance to tomato leaf curl virus

Supervisor: Dr Ali Rezaian.

VX02003 Integrated management of new diseases of Asparagus

Duration: February 2003 to September2006. Supervisor: Dr L-H Cheah (Crop & Food Research, New Zealand). Principal investigators: Dr Dean Beasley, Ms Christine Horlock (DPI&F, Applethorpe), Dr Roger Shivas (DPI&F, Indooroopilly). Organisation: Queensland Department of Primary Industries and Fisheries.

CRCTPPI.3e Identification and epidemiology of Tospoviruses in Capsicum and tomatoes

Duration: July 2000 to June 2005. Supervisor: Dr John Thomas. Principal investigators: Dr John Thomas, Dr Denis Persley, Mr Murray Shannan, Ms Lee McMichael. Organisation: Queensland Department of Primary Industries and Fisheries, Indooroopilly.

TASMANIA

VG99002 Improved control of nematodes in carrot production

Duration: May 2000 to March 2004. Investigators: Frank Hay (TIAR), Greg Walker (SARDI), Elaine Davison and Allan McKay (AgWA), Tony Pattison and Jennifer Cobon (DPIQ), Deborah Keating, Martin Mebalds, Lila Nambier (DPI Vic). Organisation: Tasmanian Institute of Agricultural Research.

VG00020 Modelling of spore release and alternative methods of control for *Sclerotinia sclerotiorum* in beans

Duration: July 2000 to September 2003. Investigators: Chris Archer (TIAR), Ziqing Yuan (TIAR), Shane Dullahide (QDPI). Organisation: Tasmanian Institute of Agricultural Research, Newtown Laboratories.

PT00019 Management of tomato spotted wilt virus in potatoes

Duration: February 2001 to 30 October 2004. Investigators: Dr Calum Wilson and Charles Jericho. Organisation: Tasmanian Institute of Agricultural Research, Newtown Laboratories.

PT0102 Evaluation and commercialisation of common scab resistant clones of commercial potato varieties

Duration: November 2001 to July 2004. Investigators: Dr C Wilson, Dr A Eyles, R Tegg (PhD student), A Wilson, Prof A Conner (Crop & Food Research, New Zealand). Organisation: Tasmanian Institute of Agricultural Research, Newtown Laboratories.

PT02013: International R&D workshop and industry extension meetings on common scab disease

Duration: July 2002 to June 2004. Investigator: Dr C Wilson. Organisation: Tasmanian Institute of Agricultural Research, Newtown Laboratories.

PT02037 Strategy for the elimination of viruses (PVS, PVX) from certified potato seed stocks in Tasmania

Duration: December 2002 to March 2004. Investigators: Frank Hay, Susan Lambert, Calum Wilson, Iain Kirkwood (DPIWE). Organisation: Tasmanian Institute of Agricultural Research, University of Tasmania.

VG99057 A survey approach to investigate the soil factors associated with the productivity and sustainability of vegetable production in Australia

Duration: 2000 to 2003. Investigators: Dr. Hoong Pung and Pam Cox (Serve-Ag Research), Dr. Jason Olsen and Steve Jackson (DPI, Queensland), Bill Cotching (DPIWE, Tasmania), Dr. Marcelle Stirling (Biological Crop Protection Pty Ltd), Dr. Phil Moody (DNR, Queensland), Dr. Clive Pankhurst (CSIRO Land and Water), Mark Hickey (NSW Agriculture), Bill Ashcroft (Natural Resources and Environment, Victoria). Organisation: Serve-Ag Research, Devonport, Tasmania

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

Duration: July 2000 to September 2004. Investigators: Dr Hoong Pung & Susan Cross, Serve-Ag Research, Devonport, Tasmania, Dr Richard Falloon, Crop & Food Research, Christchurch, New Zealand. Organisation: Serve-Ag Research, Devonport, Tasmania.

VG01082 An investigation of head rot disease of broccoli crops grown for processing

Duration: July 2001 to September 2003. Investigators: Dr Hoong Pung & Susan Cross. Organisation: Serve-Ag Research, Devonport, Tasmania.

VG02105 Review of new seed dressing technologies for improved disease and insect control in vegetable crops

Duration: 2003. Investigators: Dr Hoong Pung (Serve-Ag Research, Devonport) and John Seidel (Serve-Ag- NSW). Organisation: Serve-Ag Research, Devonport, Tasmania.

PT02016 Common scab threshold on tuber seeds for processing potato crops

Duration: 2002 to 2005. Investigators: Dr. Hoong Pung, Diane Sward, Pam Cox & Susan Cross (Serve-Ag Research), Tony Pitt & Glen Marriot (AgChallenge P/L). Organisation: Serve-Ag Research, Devonport, Tasmania.

VG02088 Use of vegetable transplants to introduce beneficial and biocontrol microbes into the crop environment

Duration: July 2002 to June 2002. Investigator: Mr Ian Macleod. Organisation: Serve-Ag Research, Devonport, Tasmania

VG02087 Evaluation of potential for chitosan to enhance plant disease defence

Duration: July 2002 to June 2004. Investigator: Dr Rachel Walker. Organisation: Serve-Ag Research, Devonport, Tasmania.

VG00048 Development of cultural and biological controls for Sclerotinia diseases of vegetables in Tasmania

Duration: 2000 to 2004. Investigator: Dr Hoong Pung (Serve-Ag Research, Devonport), part of project led by Dr Ian Porter

Managing bean root and stem diseases in Tasmania

Start 2004. Investigators: Dr Hoong Pung (Serve-Ag Research, Devonport), part of project led by Dr. Andrew Watson (NSW).

NORTHERN TERRITORY

[Northern Territory Government funded projects]

Management system for Fusarium wilt of snake beans

Duration: 2001 to present. Supervisor: Mr Barry Condé. Investigators: Mr Barry Condé, Mr Isagani Arao-Arao. Organisation: Northern Territory Dept of Business Industry and Resource Development, Berrimah Agricultural Research Centre, Darwin, Northern Territory.

Management system for Asian/tropical vegetables; tomato leafcurl virus

Duration: 2003 to. Project supervisor: Mr Barry Condé. Investigators: Mr Barry Condé, Mr Isagani Arao-Arao. Organisation: Northern Territory Dept of Business Industry and Resource Development, Berrimah Agricultural Research Centre, Darwin, Northern Territory.

Management system for Asian/tropical vegetables; cucurbit mosaic viruses

Supervisor: Mr Barry Condé. Investigators: Mr Barry Condé, Mr Isagani Arao-Arao, Mr Rex Pitkethley. Organisation: Northern Territory Dept of Business Industry and Resource Development, Berrimah Agricultural Research Centre, Darwin, Northern Territory.

4 Field trip to view activities relating to vegetable production in the greater Adelaide area

In association with the NVPWG meeting, a field trip was organised to allow attendees to see aspects of vegetable production in the greater Adelaide region.

The first visit was to Mr John Mundy's farm where broccoli production is integrated with sheep grazing. This property has had problems with white rust on Brassica crops, and a comprehensive fungicide regime has been instigated to control the disease. The broccoli crop on the farm was inspected and no disease was found.

The trip then progressed to the Adelaide City wastewater treatment site. Adelaide's sewage wastewater is processed and stored in large oxidation ponds, which support very large populations of birds. The water is then passed though a filtration plant, and used on the Adelaide Plain as irrigation water for intensive vegetable production. Details of the water filtration plant and quality monitoring of the processed water were demonstrated.

The large-scale carrot production operations of Mr Barry Nicol were then inspected. Carrots are grown on Mr Nicol's farm on the North Adelaide Plain. Harvested carrots are washed, cooled, sorted and packed using the latest mechanisation technology. This includes a recently installed pallet-packing robot.

The final visit was to the Greenhouse Modernisation Project on the North Adelaide Plain. The project has constructed two modern greenhouse units of Israeli design, in which hydroponic vegetable production (mainly tomato and pepper), with full IPM methods, is carried out on a pilot scale. The project is introducing modern methods of greenhouse vegetable production, using technology transfer seminars and demonstrations to local growers.

5 Growers' seminar

A growers' seminar was held at the South Australia Department of Primary Industries station on the North Adelaide Plain. Some of the participants at the NVPWG meeting gave presentations on topics relevant to the local vegetable growers. The presentations included:

Dr Liz Minchington: "White rust of Brassicas".

Brenda Coutts: "Viruses in cucurbits".

Robin Coles: "Carrot Virus Y in South Australia".

Catherine Hitch: "Leek diseases".

Len Tesiorero: "Black rot of Brassicas and diseases of greenhouse vegetables".

Peter Dal Santo: "Minor chemicals".

6 The New Zealand vegetable industry: value of current vegetable crops and recent trends

Table 2 lists the vegetable crops that are grown in New Zealand, with data for the domestic market and export value for each crop. Also included is the proportional change in the total value of each crop between 2001 and 2003. Overall, there has been a 19% increase in the value of output from vegetable cropping during this period, with almost all crops contributing to this increase. A large majority of the crops showed increases in the value of product, with the proportional increases varying from small (+1% for garlic) to very great (+182% for "other vegetables" (which includes Asian vegetables). Exceptions were for peas (value decreased by 14%), sweet corn (-11%) and Asparagus (-15%).

Table 2: New Zealand vegetable crops by value ($NZ million) in 2003. Crops are listed in order of total value (Kerr et al. 2002; 2004).

Crop	Domestic	Exports	Total	% change 2001-03
Potatoes	300.0	69.4	369.4	+26
Onions	25.0	100.5	125.5	+5
Tomatoes, greenhouse	107.5	5.0	112.5	+39
Tomatoes, field	5.0	2.0	7.0	+125
Pumpkins	100.0	–	100.0	?
Peas	45.0	39.5	84.5	–14
Brassicas	80.3	1.3	81.6	+45
Sweet corn	28.0	51.4	81.5	–11
Squash	9.8	67.5	77.3	+10
Carrots	41.3	16.0	57.3	+13
Capsicums	29.3	24.3	54.6	+24
Mixed & dried vegetables	–	53.1	53.1	+34
Beans	12.8	32.8	45.6	+4
Mushrooms	41.1	3.1	44.2	+51
Cucurbits	41.3	–	41.3	+8
Lettuce	39.1	1.0	40.1	+51
Sweet potato (kumara)	33.8	–	33.8	+45
Asparagus	6.5	16.3	22.8	–15
Silver beet/spinach	13.4	–	13.4	+51
Garlic	6.5	1.5	8.0	+1
Other vegetables [a]	58.6 [b]	9.2	67.8	+182
Total	**1024**	**494**	**1521**	**+19**
Kiwifruit		539		–8
Apples		392		+16
Wine		283		+43

[a] Includes taro, celery, parsnips, spring onions, Asian vegetables (excl. Chinese cabbage), yams, witloof, leeks, vegetable sprouts, shallots, Swedes, and some others.
[b] Estimate

Table 3 lists the numbers of growers in New Zealand involved in production of the six largest (by economic value) vegetable crop types grown in New Zealand in 2001 and 2003. For most of these types there has been a reduction in the numbers of growers, with the greatest reduction (more than one-third) occurring in the number of greenhouse tomato growers. The exception was for sweet corn, for which the number of growers increased slightly during the 2 year period.

The overall number of growers of all types of vegetables in New Zealand was 4670 in 2001 and 3768 in 2003 (Kerr et al. 2002; 2004). This represents a 19% reduction in the number of vegetable growers over that 2 year period.

Table 3: Number of growers for the main vegetable types in New Zealand for 2001 and 2003 (Kerr et al. 2002; 2004).

Crop	2001	2003	Change (%) 2001-03
Potatoes	385	321	–17
Onions	185	150	–19
Tomatoes (greenhouse)	610	390	–36
Brassicas	300	277	–8
Sweet corn	305	326	+7
Peas	730	532	–27

Table 4 summarises the total areas of the six largest vegetable crop types grown in New Zealand in 2001 and 2003. During that period, total crop areas decreased for potatoes, onions and Brassicas, increased for greenhouse tomatoes and peas, and did not change for sweet corn. The overall planted area for all types of vegetables was 55 514 ha in 2001 and 52 887 in 2003, which was a 5% reduction in total planted area during that 2 year period. These changes were accompanied by increased estimated crop yields for potatoes, onions, greenhouse tomatoes and Brassicas, unchanged yield for sweet corn, and decreased yield for peas (Table 5).

Table 4: Planted area (ha) for the main vegetable types in New Zealand in 2001 and 2003 (Kerr et al. 2002; 2004).

Crop	2001	2003	Change (%) 2001-03
Potatoes	11 816	10 611	–10
Onions	7 044	5 488	–22
Tomatoes (greenhouse)	160	167	+4
Brassicas	4 125	3 746	–9
Sweet corn	6 380	6 384	nc
Peas	7 570	8 273	+9

Table 5: Crop volumes (tonnes) of the major vegetables in New Zealand in 2001 and 2003, from sector estimates (Kerr et al. 2002; 2004).

Crop	2001	2003	Change (%) 2001-03
Potatoes	450 000	470 000	+4
Onions	210 000	210 000	nc
Tomatoes (greenhouse)	35 000	40 000	+14
Brassicas	35 000	40 000	+14
Sweet corn	96 500	96 500	nc
Peas	63 000	58 000	–8

Table 6: Yield (tonne/ha) of the major vegetables in New Zealand in 2001 and 2003, from sector estimates (Kerr et al. 2002; 2004).

Crop	2001	2003	Change (%) 2001-03
Potatoes	38.1	44.2	+16
Onions	29.8	38.2	+28
Tomatoes (greenhouse)	218.8	239.5	+9
Brassicas	8.5	10.7	+26
Sweet corn	15.1	15.1	nc
Peas	8.3	7.0	–16

7 Summary of vegetable pathology projects in New Zealand (April 2004)

This summary (Table 7) is based on a survey of plant pathologists throughout New Zealand. Effort has been made to contact relevant plant pathologists to provide a complete picture of the vegetable pathology projects that are currently underway in New Zealand. The completeness of the summary cannot be guaranteed, however, as there may be projects being undertaken, particularly within private companies, for which information is not publicly available.

The projects are summarised in Table 7, which lists projects by crop, pathogen, disease and research aim. The funding agency for each project is also listed, along with the main researchers involved and the research institution in which the project is being undertaken.

Inquiries relating to the projects should be directed to the individuals listed in the table, or can be assisted through contact with the author of the present report.

Table 7: Summary of vegetable pathology projects in New Zealand (April 2004)

Crop	Pathogen, pathogen type	Disease	Research aim	Funding agency*	Researchers	Institution
Potato	*Spongospora subterranea*	Powdery scab	Integrated disease management (chemical control, crop loss assessment, disease resistance, soil nutrients, crop rotation)	FfRST (HAL?)	Richard Falloon Denis Curtin Russell Genet	Crop & Food Research
			Soil/pathogen interactions	FfRST (HAL?)	Richard Falloon Denis Curtin Ros Lister	Crop & Food Research
			Plant resistance	FfRST	Russell Genet	Crop & Food Research
			Marker-assisted selection for disease resistance	FfRST NZ VegFed	Jeanne Jacobs Samantha Baldwin Russell Genet	Crop & Food Research
			Improved detection and field management, verification of molecular detection	NZ VegFed FfRST	John Marshall Sandi Keenan Richard Falloon	Crop & Food Research
	Phytophthora infestans	Late blight	Plant resistance	FfRST	John Anderson Peter Wright	Crop & Food Research
			Develop decision support system for disease management Characterisation of isolates	NZ VegFed	Suvi Viljanen-Rollinson Robert Beresford Peter Jamieson Peter Wright Richard Falloon	Crop & Food Research HortResearch
	Phytophthora erythroseptica *Pythium* spp. *Fusarium* spp.	Pink rot Dry rot Storage rots	Biological control (*Trichoderma*), biofumigation	FfRST	Lian Heng Cheah	Crop & Food Research
	Verticillium spp.	Wilt	Review importance in different potato-growing areas of NZ	NZ VegFed	Suvi Viljanen-Rollinson John Anderson Randy Rowe	Crop & Food Research Ohio State University
	Soilborne pathogens	Powdery scab Common scab Rhizoctonia etc.	Crop rotations and soil health	FfRST (HAL?)	Richard Falloon Peter Wright Bob Fullerton Lian Heng Cheah	Crop & Food Research HortResearch
	Rhizoctonia solani	Black scurf Rhizoctonia canker	Information transfer to growers	NZ VegFed	Richard Falloon	Crop & Food Research
	Sclerotinia sclerotiorum	White mould	Information transfer to growers	NZ VegFed	Richard Falloon	Crop & Food Research
	Globodera rostochiensis *Globodera pallida*	Potato cyst nematode	Plant resistance	FfRST	John Anderson Russell Genet	Crop & Food Research
			Improved detection and quantification in soil using quantitative PCR	FfRST NZ VegFed	John Marshall Sandi Keenan Simon Bulman	Crop & Food Research
	Meloidogyne fallax	Root knot nematode	Pathogen biology and control in processing potatoes	Crop & Food Research NZ VegFed	John Marshall	Crop & Food Research

Crop	Pathogen, pathogen type	Disease	Research aim	Funding agency*	Researchers	Institution
	Virus, bacterial, fungal, protozoan diseases	Various	Pathogen-free seed potatoes	Commercial (four large and several small seed producers and food production companies)		PPRU, Lincoln University Crop & Food Research
	Streptomyces scabies	Common scab	Plant resistance	FfRST	Russell Genet Richard Falloon Farhat Shah	Crop & Food Research
	Erwinia carotovora	Soft rot	Cultural control	FfRST	Peter Wright	Crop & Food Research
			Plant resistance	FfRST	Peter Wright John Anderson	Crop & Food Research
			Breeding for resistance using somatic hybrids	NZ VegFed	Tony Conner	Crop & Food Research
	Clavibacter michiganensis subsp. *Sepedonicus*	Bacterial ring rot	Pest risk assessment	MAF Plants Biosecurity	Peter Wright	Crop & Food Research
	Potato virus Y^N, Y^{NTN}	Potato mild mosaic	Cultivar susceptibility, crop loss assessment	FfRST	John Fletcher Russell Genet Ros Lister	Crop & Food Research
Onion	*Sclerotium cepivorum*	*Allium* white rot	Fungicide control	Commercial	Bob Fullerton	HortResearch
			Disease prediction	NZ Onion Exporters Assn Commercial	Bob Fullerton	HortResearch
			Disease resistance through genetic engineering	FfRST Royal Society of NZ AGMARDT	Colin Eady Alison Stewart Sarah Hunger	Crop & Food Research Bioprotection Centre
			Disease progress in long term rotations	FfRST	Alison Stewart Kirstin McLean	Bioprotection Centre
	Aspergillus niger	Black mould	Effects of soil inoculum and storage conditions	NZ Onion Exporters Assn MAF Sustainable Farming Fund	Bob Fullerton	HortResearch
	Peronospora destructor	Downy mildew	Disease forecasting for improved efficiency of fungicide control	FfRST Commercial	Robert Beresford Peter Wright	HortResearch Crop & Food Research
			Determination of pathogen sensitivity to phenylamide fungicides	NZ Onion Exporters Assn	Peter Wright	Crop & Food Research
	Botrytis cinerea	Neck rot	Develop disease prediction tool for decision support system	MAF Sustainable Farming Fund	Suvi Viljanen-Rollinson	Crop & Food Research
	Fusarium oxysporum	Basal rot	Disease epidemiology, management and control	NZ Onion Exporters Assn	Peter Wright	Crop & Food Research
	Various diseases	Various	Integrated disease management	MAF Sustainable Farming Fund	Suvi Viljanen-Rollinson	Crop & Food Research
	Bacteria	Bacterial softrot	Cultural control (curing and harvesting methods)	FfRST	Peter Wright	Crop & Food Research

Crop	Pathogen, pathogen type	Disease	Research aim	Funding agency*	Researchers	Institution
			Field and storage conditions causing soft rot	NZ Onion Exporters Assn	Peter Wright	Crop & Food Research
Squash	*Colletotrichum coccodes* *Fusarium* spp. *Sclerotinia sclerotiorum*	Field and storage rots	Pathogens and environmental conditions causing storage rots	MAF Sustainable Farming Fund NZ Buttercup Squash Council	Lian Heng Cheah	Crop & Food Research
	Watermelon MV 2 Zucchini YMV	Leaf mosaics, fruit blistering	Disease management and control, using aphid-based prediction	NZ Buttercup Squash Council AGMARDT FfRST	John Fletcher Tim Herman	Crop & Food Research FruitFed Supplies Ltd
Tomato	Various	Various	Enhancing plant vigour with *Trichoderma*	NZ VegFed	Bob Fullerton Mike Spiers	HortResearch
Carrot	*Meloidogyne* sp.		Control for improved quality	NZ VegFed	John Marshall Farhat Shah	Crop & Food Research
Lettuce	*Botrytis cinerea*	Grey mould	Biological control using fungi	Lincoln University	Alison Stewart	Lincoln University
	Sclerotinia spp.	Lettuce drop	Integrated disease management; chemical control, biological control, resistant cultivars	MAF Sustainable Farming Fund	Peter Wright	
	Bremia lactucae	Downy mildew	Integrated disease management; chemical control, spray application technology and strategies	MAF Sustainable Farming Fund	Peter Wright	
	Microdochium panattonianum	Anthracnose	Disease management and control	MAF Sustainable Farming Fund	Peter Wright	
	Bacteria	Bacterial rots	Disease management and control	MAF Sustainable Farming Fund	Peter Wright	
	Viruses		Integrated disease management Chemical control of lettuce big vein virus	NZ VegFed MAF Sustainable Farming Fund	John Fletcher Ros Lister	Crop & Food Research
Mushrooms	*Verticillium fungicola* *Cladobotryum mycophilium* *Trichoderma harzianum* *Mycogone* *Pythium oligandrum*	Fungal diseases of *Agaricus* mushroom	Molecular diagnostics, and disease management methods	NZ Mushroom Growers Federation Commercial	John Marshall Sarah Dodd	Crop & Food Research
	La France virus Virus X		Characterisation of ddRNA and develop PCR for detection and monitoring	NZ Mushroom Growers Federation Commercial	John Marshall	Crop & Food Research
	Rhabditid nematodes	Saprophytes	Vectors of mushroom diseases	NZ Mushroom Growers Federation	John Marshall	Crop & Food Research

Crop	Pathogen, pathogen type	Disease	Research aim	Funding agency*	Researchers	Institution
Vegetable brassicas	*Plasmodiophora brassicae*	Clubroot	Chemical and biological control, biofumigation	FfRST	Lian Heng Cheah	Crop & Food Research
			Disease resistance using genetic engineering	Royal Society of NZ	Colin Eady	Bioprotection Centre
			Infection prevention using biotechnology	Royal Society of NZ	Simon Bulman Tony Conner	Bioprotection Centre
Pea	*Erysiphe pisi*, *Peronospora viciae*, *Ascochyta* complex, *Pythium* spp. *Rhizoctonia*, *Fusarium oxysporum* (Race 1), *Aphanomyces eutiches*, PeaSbMV, Bean YMV, Alfalfa MV, Pea top YV	Various	Resistance breeding	FfRST Commercial	Dave Goulden	Crop & Food Research
	Ascochyta blight	*Ascochyta* complex	Disease prediction Chemical control	MAF Sustainable Farming Fund	Suvi Viljanen-Rollinson Richard Falloon Adrian Russell	Crop & Food Research Plant Research NZ
		Mycosphaerella pinodes, *Phoma medicaginis* var. *pinodella*	Marker assisted selection for disease resistance	FfRST	Gail Timmerman-Vaughan	Crop & Food Research
	Aphanomyces eutiches	Root rot	Biological control with bacteria	Foundation for Arable Research Lincoln University Agrimm Technologies Ltd	Alison Stewart	Lincoln University
	Peronospora viciae	Downy mildew	Pathogen sensitivity to phenylamide fungicides	Serve-Ag (HAL)	Richard Falloon	Crop & Food Research
Asparagus	*Phytophthora megasperma*	Spear rot	Resistance breeding	MAF Sustainable Farming Fund NZ Asparagus Council Private company	Peter Falloon	Aspara Pacific
			Biological control with natural products and fungi	NZ Asparagus Council Commercial	Lian Heng Cheah	Crop & Food research
	Asparagus virus 2		Pathogen-free seed production	Commercial	Peter Falloon	Aspara Pacific
	Puccinia asparagi *Phomopsis asparagi* *Colletotrichum*	Asparagus rust Stem blight Anthracnose	New diseases, Integrated control, cultivar reaction, disease prediction	Commercial NZ Asparagus Council HAL FfRST	Lian Heng Cheah	Crop & Food Research Queensland DPI

Crop	Pathogen, pathogen type	Disease	Research aim	Funding agency*	Researchers	Institution
Sweet corn	*Sphaerotheca reiliana*	Head smut	Fungicide control	NZ VegFed	Peter Wright Bob Fullerton	Crop & Food Research HortResearch
	Pantoea stewartii subsp. *Stewartii*	Stewart's bacterial wilt	Pest risk assessment	MAF Plants Biosecurity	Peter Wright	Crop & Food Research
Sweet potato (kumara)	*Sclerotinia sclerotiorum*	Pink rot	Cultivar susceptibility	FfRST	Peter Wright Steve Lewthwaite	Crop & Food Research
	Monilochaetes infuscans	Scurf	Cultivar susceptibility	FfRST	Peter Wright Steve Lewthwaite	Crop & Food Research
Taro	*Phytophthora colocasiae*	Leaf blight	Resistance selection methods	MFAT	Bob Fullerton	HortResearch
Spinach	*Phytophthora* sp.	Phytophthora root rot	Integrated disease management	NZ VegFed	Lian Heng Cheah	Crop & Food Research
Tuberous crops	Viruses	Various	Elimination of viruses from vegetatively propagated crops	FfRST Commercial	John Fletcher Pam Fletcher	Crop & Food Research

*Funding agencies
FfRST: New Zealand Foundation for Research, Science & Technology
VegFed: New Zealand Vegetable & Potato Growers' Federation Inc.
MFAT: Ministry of Foreign Affairs and Trade
AGMARDT: Agricultural and Marketing Research and Development Trust

8 Key recommendations

***Allium*:** 1. Carry out a national evaluation of the downy mildew downcast model. 2. Complete a scoping study of pink rot. 3. Continue research on white rot control, particularly if DADS is not registered.

Leafy vegetables (lettuce etc.): 1. Complete a national extension project for lettuce - a roadshow about pests and diseases. This should be developed after a literature review to determine the knowledge gaps. 2. Expand the options for control of lettuce diseases.

Legumes (peas, beans): Support collaboration with the University of Nebraska in screening lines of beans for resistance to *Sclerotinia*.

Sweet corn: Complete a scoping study on viruses in sweet corn. Include Fusarium diseases and boil smut as components of the Queensland IPM project for sweet corn.

Asian vegetables: 1. Current programmes for pest and disease control in Asian vegetables should be supported with extension and communication strategies. 2. Any gaps in knowledge indicated by these projects should be filled by funding the required research.

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

Brassicas: 1. Support an Australia wide extension programme 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 the UK.

Capsicum: Investigate management of bacterial spot, including seed infection, copper resistance and breeding of resistant varieties.

Tomatoes: 1. Carry out a scoping study to investigate the diseases being carried in tomato seed, particularly spindle tuber viroid, and determine whether there are any appropriate management strategies to reduce this. 2. Undertake studies on bacterial canker, including control in nurseries, management of seedborne infection, disease control and breeding resistant varieties.

Cucurbits and melons: Investigate integrated management of viruses in cucurbits and develop and implement appropriate extension programmes.

Nurseries: Carry out investigations into the feasibility of producing disease-free seedlings in nurseries. Studies should initially be limited to one to two major diseases on a few crops.

Seedborne diseases: Undertake a review/scoping study to develop a strategy to address the issue of healthy seed for the Australian vegetable industry.

Fungicide resistance: Support investigations into alternative chemistries and management of fungicide resistance in vegetable pathogens.

Extension: 1. Develop a broad communication plan relating to diseases and disease management for the vegetable industry. 2. Encourage inclusion of growers on the steering committees for each vegetable disease research project. 3. Ensure, at the planning stages, that IDO's are involved in extension details for each project.

Fumigation: Continue to investigate alternative fumigation technologies, including sustainability as a key component, particularly the effects of long-term use of alternative fumigants on land and people, and the safety of the new technologies.

Diagnostics: 1. Support diagnostic training. 2. Initiate a study to determine the disease and pathogen predictive tests that are currently available, and evaluate their effectiveness. 3. Support the Plant Health Australia (PHA) expertise register, by registration of all appropriate plant diagnosticians. 4. Approach PHA to manage a list serve for plant diagnosticians.

Minor pesticide usage: Continuation of the minor use permit system should be strongly supported, particularly relating to new chemistry for pesticides suitable for use in IPDM programmes.

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