



Know-how for Horticulture

**Scoping study to
investigate
management of
root-rot diseases in
parsley**

Dr. Elizabeth Minchinton
VIC Department of
Primary Industries

Project Number: VG04025

Horticulture Australia Project No:

VG04025

Project Leader:

Dr Elizabeth Minchinton

Contact Details:

Department of Primary Industries,
Primary Industries Research Victoria, Knoxfield Centre
Private Bag 15, Ferntree Gully DC, Victoria 3156

Tel: (03) 92109222

Fax: (03) 9800 3521

Email: liz.minchinton@dpi.vic.gov.au

Project Team:

Desmond Auer¹, Heidi Martin², Len Tesoriero³, Fiona Thomson¹,
Lindsay N. Trapnell⁴, Leif Forsberg², Savitri Nadesan¹ and
Slobodan Vujovic¹

Address:

¹ Department of Primary Industries,
Primary Industries Research Victoria, Knoxfield Centre,
Private Bag 15, Ferntree Gully DC, Victoria 3156.

² Queensland Department of Primary Industries and Fisheries,
80 Meiers Rd Indooroopilly, Queensland 4068.

³ New South Wales Department of Primary Industries,
EMAI, RMB 8, Camden NSW 2570.

⁴ Principal Consultant, Farmanomics Research and Consulting,
PO Box 286, Benalla, Victoria 3671.

Purpose of project:

This project details the outcomes of a 12-month scoping study of root rot of parsley which investigated primary causes and treatments for root rot in the states of NSW, Queensland and Victoria.

Report completed: April 2006.

Disclaimer:

This publication may be of assistance to you but the State of Victoria and its officers do not guarantee that the publication is without flaw of any kind or is wholly appropriate for your particular purpose and therefore disclaims all liability for any error, loss or other consequence which may arise from you relying on any information in this publication.

Any recommendations contained in this publication do not necessarily represent current Horticulture Australia policy. No person should act on the basis of the contents of this publication, whether as to matters of fact or opinion or other content, without first obtaining specific, independent professional advice in respect of the matters set out in this **publication**.

© State of Victoria, Department of Primary Industries, 2006



Primary Industries Research Victoria

Knoxfield Centre

Table of Contents

Media Summary	2
Technical Summary	3
Chapter 1	4
Parsley diseases	
Chapter 2	24
Surveys for parsley diseases in Queensland, 2005	
Chapter 3	35
Surveys for parsley diseases in New South Wales, 2005	
Chapter 4	40
Surveys of parsley diseases in Victoria, 2005	
Chapter 5	50
Victorian field trials for the identification of the causal fungi and their control options	
Chapter 6	67
Nutrient evaluation of parsley trial No 2	
Chapter 7	75
Economic analysis of field trial No 2 on parsley during autumn-winter 2005...	75
Chapter 8	79
Technology transfer and recommendations	
Acknowledgments.....	87

Media Summary

Parsley root rot woes controlled

Scientists have identified the cause and control of a root rot disease that severely affects Victorian parsley crops. The disease can cause up to 100% crop losses.

Root rot attacks seedlings and mature plants, generally at the soil line causing a spongy, dull brown rot and a massive loss of roots. It results in the complete collapse of the shoot system.

Field trials conducted on a commercial crop of parsley in Victoria identified two fungicides which completely controlled the disease. These fungicides are from different chemical groups, therefore their use should conform to management of chemical resistance strategies.

Parsley root rot in Victoria was associated with the water mould fungi *Pythium* and *Phytophthora*. The disease is prevalent during the late autumn and winter, especially after heavy rains when soil temperatures are low. Eight-week-old crops are highly susceptible.

Surveys of parsley crops in Queensland, New South Wales and Victoria indicated that a similar disease occurs on parsley in Queensland during periods of warm wet weather. Root rot was of lesser importance on parsley crops in New South Wales.

In laboratory trials conducted in Queensland and New South Wales, a bacterium and a number of fungi, other than water moulds, caused collar rot, root rot and crown rot.

The cause and control of root rots in Queensland parsley crops now needs to be addressed as well as the control of fungi other than water mould, which cause collar and crown rots.

Information resulting from this research is being presented in a poster on parsley diseases and in a notebook that will be distributed nationally to industry through the Vegetable Industry Development Officer network.

This research was led by scientists at the Department of Primary Industries Victoria Knoxfield Centre, in collaboration with Queensland Department of Primary Industries and Fisheries and New South Wales Department of Primary Industries. The project was facilitated by Horticulture Australia Limited (HAL) in partnership with Federation of Potato and Vegetable Growers Australia Limited (AUSVEG) and was funded by the National Vegetable Levy. The Australian Government provides matched funding for all of Horticultural Australia's Research and Development activities. The researchers gratefully acknowledge the financial support of the Department of Primary Industries through Primary Industries Research Victoria.

Technical Summary

Growers reported that root rot of parsley caused up to 100% crop losses in Queensland and Victoria for a number of years. In Victoria the problem is worse in late autumn through winter when conditions are cool and wet. In Queensland growers reported root rot was worse during the wet season. Some Queensland growers have established hydroponic production to avoid crop losses and maintain production through the wet season.

This 12 month scoping study:

- Surveyed parsley crops in the major cropping regions of Queensland, NSW and Victoria to identify the main diseases affecting production in Australia,
- Identified the causes of root rot in Queensland, NSW and Victoria by conducting pathogenicity tests (Koch's postulates) on fungi isolated from root lesions,
- Established management strategies to control root rot in Victorian parsley crops and in so doing identified the types of organisms responsible for the disease.

The method of parsley production varies between the states. In Queensland it is either hydroponically grown and hand harvested by removal of older foliage, or in-ground and mechanically harvested, with either trickle or overhead irrigation. Victorian crops are direct seeded, overhead irrigated and hand harvested by cutting all the foliage at ground level. NSW crops are either direct seeded or transplants, overhead irrigated and hand harvested.

Systematic surveys of 31 parsley crops in Queensland, NSW and Victoria showed that root rot and collapse of in-ground parsley plants was the main concern of growers in Queensland and Victoria, but to a lesser extent in NSW. The major foliage disease was Septoria leaf spot, which was more common in field-grown crops than in hydroponically grown crops and more common in Victoria than elsewhere. Leaf blight caused by *Alternaria petroselini* was reported for the first time in Australia, where it caused economic losses to hydroponic parsley crops in Queensland. Root knot nematodes, *Meloidogyne* species, were observed on parsley in NSW and Queensland but not in Victoria.

Pathogenicity tests were conducted on bacteria and fungi consistently isolated from diseased parsley roots in the three states. A Queensland isolate of *Fusarium solani* caused collar rot, whilst *Fusarium* species from NSW regions were only weakly pathogenic producing root browning. The most significant pathogen in NSW crops was *Rhizoctonia solani* which was very pathogenic and caused collar rot. A *Sclerotinia* species isolate from NSW produced a watery petiole and crown rot. *Streptrophomonas maltophilia* was the only pathogenic bacterium producing a crown and root rot of parsley in Queensland.

Isolates of *Pythium* and *Phytophthora* species from Queensland were not pathogenic despite *Pythium* species being consistently associated with root rot and losses in hydroponic parsley. NSW isolates of *Pythium* and *Phytophthora* species were associated with reduced root mass, root browning, collapse of plants and low rates of mortality. In Victoria pathogenicity of *Phytophthora inundata*, *P. megasperma* and *Pythium sulcatum* was established. All caused stunting, chlorosis, wilt and a dull, soft, brown root rot. *P. sulcatum* caused a rapid rot of lateral roots, whilst *P. megasperma* produced a slower rot of the tap root. Pathogenicity was not established for a *Pythium* sp., *P. oligandrum*, *P. intermedium*, *P. ultimum*, an isolate from the *P. diclinum* 'group' and two unidentified *Phytophthora* isolates. *Pythium oligandrum* is known to be a mycoparasite and therefore may have been beneficial.

This project identified that Oomycete fungi from the family Pythiaceae, were the most likely cause of crop losses in Victorian grown parsley. In a field trial, two applications of a metalaxyl fungicide and weekly applications of phosphonic acid after appearance of symptoms, controlled the disease by 87 and 98%, respectively.

Chapter 8

Technology transfer and recommendations

Summary

This chapter reports on the benefits of a project advisory group established to steering research projects. This group increased communication and cooperation between growers, researchers and allied support businesses and resulted in an accelerated impact of research and development within the parsley industry. Recommendations for future research are presented.

8.1 Introduction

The research reported herein is the result of collaboration between industry advisory groups and project steering committees. These groups consisted of vegetable growers, crop consultants and chemical resellers, with diverse experiences which they brought to the project. The groups provided an opportunity for researchers to describe their approach and current progress thus promoting the impact of research and development projects. They also enabled growers and allied industries to ensure their needs are being met by the research project. The advisory group approach worked very well and is DPI's preferred method of involvement with the Vegetable Industry.

This interaction and collaboration with growers, vegetable industry development officers (IDOs) and from subcontracting sections of work to industry experts has been of enormous benefit to the project. The herb growers in north Queensland were identified through contacts with parsley growers in Queensland. The IDOs identified parsley growers in other states. The advisory committee encouraged the researchers to promote the results of the research to growers nationally in industry publications. The outcomes of research have been taken up in Victoria and extended to other crops, such as Dutch carrots, with one grower reporting production more than doubled, from 8–10 decks to 25 decks.

8.2 Industry advisory group

The Department of Primary Industries Victoria has taken the approach of inviting growers and private allied support business representatives to volunteer their time and join with researchers to plan and discuss parsley disease issues first hand. Not all growers are in the position of being able to volunteer their time due to the demands of growing and marketing vegetables and consequently the researchers are extremely grateful to those who were able to contribute.

The advisory group members who supported project VG04025 were:
Craig Arnott – Market Gardener – Arnotts Vegetable Farms – Clyde.
Kevin Clark – Market Gardener – Sims and Clark Pty Ltd – Cranbourne.
Peter Cochrane – Market Gardener – P.J. and J. Cochrane Pty Ltd – Devon Meadows.
Rocky and Tony Lamattina – Market Gardeners – A. D. Lamattina & Sons – Clyde.
Karl Riedel Vegetable Crop Agronomist – E.E. Muir & Sons – Cranbourne.

8.3 Some grower reactions to the field day

Feedback from the Parsley Field Walk held at 3.00 pm on 5 August 2005 at Peter Cochrane's farm, 1435 North Road, Devon Meadows, was attended by 13 growers and industry representatives and is reported here.

CP

Field day was very good, very impressed with the results, easy to follow and see what works and what doesn't. Material given to attendants was good and easy to follow. It is worth extending this project to other states (parsley growing) for instance NSW to help their growers.

KC

Field day was excellent. I thoroughly enjoyed that trial. We covered a number of different treatments some that worked and some that didn't. It will help me save time and money. Time was ok, however, I preferred meetings/field days towards end of the day rather than in the middle.

BB

Very interesting field day and very good. Only comment is that I like to see some follow up work on a couple of fungicides working "backwards" to see what they do to the plant, eg, the way Rovral was worse than control. Friday afternoons are not the best day for Field days.

TL

Field day was very good. Results are clear, easy to distinguish between treatments. Like to see follow up trial to confirm these results. Time, set up everything was good.

GF

The field day was good it gave us a chance to view results at first hand. The booklet was easy to follow and made it very helpful and easy to understand. It also gave us the opportunity to talk to the other growers and industry reps and hear their opinions. It will be interesting to see some final results, if there are any changes in the chemical's performance as the crop gets older?

Simple pathogenicity trials were conducted by inoculating young stems of *Viburnum tinus* with each species of *Phytophthora*. After 2 weeks, *P. hedraiaandra* caused lesions 2–3cm long, spreading below the point of inoculation. The fungus was readily re-isolated from the leading edge of the lesion. *Phytophthora inundata* caused no visible symptoms on the plants. This was surprising, as this fungus has been recorded from a wide range of woody plants. Brasier *et al.* (2003) noted *Viburnum* bushes with root necrosis growing near *Salix* with diseased roots containing *P. inundata*, but fungal isolations from the *Viburnum* plants were not undertaken.

Acknowledgements

We thank Arthur de Cock (CBS) for helpful discussions on *P. hedraiaandra*.

References

- Brasier CM, Sanchez-Hernandez E, Kirk SA (2003) *Phytophthora inundata* sp. nov., a part heterothallic pathogen of trees and shrubs in wet or flooded soils. *Mycological Research* **107**, 477–484.
- de Cock AWAM, Lévesque CA (2004) New species of *Pythium* and *Phytophthora*. *Studies in Mycology* **50**, 481–487.
- Schwingle B, Smith J, Blanchette R, Blanchette B, Gould S, Pokorny J (2005) *Phytophthora* species on woody plants in Minnesota nurseries and a first report of *P. hedraiaandra* in the United States. American Phytopathological Society Annual Meeting, Austin, Texas, July 30–August 3. Poster 288.

***Accepted March, 2006.**

To be published in the April 2006 edition of Australasian Plant Pathology.
In press: *Australasian Plant Pathology* **35(3)**: xxx–xxx.

8.4 Publication list

- Anon (2006). Solution found for parsley root rot. *Vegetables Australia* **14**: 23.
- Dent, M. (2005). Parsley root woes in study. *Good Fruit and Vegetables* **15** (10): 18.
- Cunnington, J.H., Jones, R.H., de Alwis, S. and Minchinton, E.J. (2006) Two new *Phytophthora* records for Australia. In press, *Australasian Plant Pathology*.
- Martin, H., Tesoriero, L., Minchinton, E. and Anderson, A. (2005). New study tackles parsley root woes. *Good Fruit and Vegetables* **15** (11): 7
- Minchinton E. (2005). Parsley R&D project set to roll. *Good Fruit and Vegetables* **15** (10): 18.
- Minchinton E. (2005). Vic: Control found for parsley rot. *Good Fruit & Vegetables* **16**:12.
- Minchinton, E. (2005). Breakthrough. Geelong Advertiser, 4/10/2005, p30.
- Minchinton, E. (2005). Parsley Growers Check Their New R & D Project. Victorian VegeLINK **21**: 5.
- Minchinton, E. (2005). Parsley root rot control method. Colac Herald, 3/10/2005, p10.
- Minchinton, E., Tesoriero, L., Martin H., Forsberg, L., Nadesan, S., Thomson, F. and Vujovic, S. Parsley Root Woes. Werribee Expo 5–6 May 2005 (Poster).
- Minchinton, E.J. (2005). New controls for parsley root rot disease. Victorian VegeLINK **23**: 4.
- Minchinton, E.J. (2006). Solution found for parsley root rot. *Vegetables Australia* **1** (4): 23.

Meetings:

- Victoria, Cranbourne, steering committee, 1/2/2005. Notes on ‘Management of parsley root diseases’.
- Queensland, Biloela 9/2/2005. Notes on ‘Management of parsley root diseases’.
- Victoria, Cranbourne, final workshop, TBA (May 2006)
- Queensland, Biloela, final workshop, TBA (May 2006)
- Queensland, Stanthorp, final workshop, TBA (May 2006)

Field day:

- Victoria, Devon Meadows 5/8/2005. Notes on ‘An invitation to a field walk on parsley dieback’.

8.5 Recommendations

The major findings of the project were that parsley root rot which occurs in Victoria crops during winter can be adequately controlled with Ridomil Gold 25G[®] (metalaxyl) or Agri-Fos 600[®] (phosphonic acid). However, the use of metalaxyl may only be a short-term solution due to resistance and degradation in sandy soils. Weekly applications of phosphonic acid may be too expensive.

The cause of the root rot in Victoria was associated with at least one *Pythium* sp and also possibly *Phytophthora* spp., with similar species causing root rot in NSW. Root rot was not associated with *Fusarium* or *Rhizoctonia* species in Victoria, but they have proved to be weak pathogens in warmer areas, such as NSW.

Possible areas of future research:

- (i) Determine if control measures identified for parsley crops affected by root rot during cool wet winters in Victoria will also control root rot in Queensland during the wet season.
- (ii) Complete analysis of pathogenicity tests (Koch's postulates).
- (iii) Determine predisposing factors to root rot, such as pH, salinity and soil water potential.
 - McCracken (1984b) reported that rotating with barley, possibly due to application of lime, appeared to provide some relief from root rot of parsley.
 - Salinity is reported to make plants more susceptible to root rot and it is difficult to distinguish root rot symptoms caused by salinity from those caused by fungi (The Connecticut Agricultural Experiment Station, 2006).
 - The prevalence of the disease after heavy rains suggests that the duration of high soil water potentials may be predisposing plants to disease (Kraft and Roberts, 1969; Pieczarka and Abawi, 1978).
- (iv) Investigate beneficial organisms such as commercial formulations of *Pythium oligandrum* as an alternative to metalaxyl.
- (v) Determine if the avirulent *Fusarium oxysporum* isolated in Victoria has potential as a mycoparasite.

8.6 References

- Kraft, J.M. and Roberts, D.D. (1969). Influence of soil water and temperature on the pea root rot complex caused by *Pythium ultimum* and *Fusarium solani* f. sp. *pisi*. *Phytopathology* **59**: 149–152
- McCracken, A.R. (1984). A root rot disease of parsley associated with *Pythium paroecandrum*. *Record of Agriculture Research* **32**: 47–53.
- Pieczarka, D.J. and Abawi, G.S. (1978). Influence of soil water potential and temperature on severity of *Pythium* root rot of snap bean. *Phytopathology* **68**: 766–772.
- The Connecticut Agricultural Experiment Station (2006). <http://www.caes.state.ct.us/Plantpest/handbookFiles/pphP/pphpars.htm>. Last accessed 2006.

Acknowledgments

This project was facilitated by HAL in partnership with AUSVEG and was funded by the National Vegetable Levy. The Australian Government provides matched funding for all HAL's R&D activities. The researchers gratefully acknowledge the financial support of the Department of Primary Industries, Primary Industries Research Victoria.

The authors thank the members of the advisory group, Craig Arnott, Peter Cochrane, Kevin Clark, Karl Reidel and Rocky and Tony Lamattina for their valuable contribution to this project. The authors thank Peter Cochrane and Rocky and Tony Lamattina for providing field sites and maintaining the field trials. All the growers participating in the surveys in Queensland, New South Wales and Victoria are thanked for their patience and contributions to the project. Peter Carr, Robert Dimsey, Jacky Edwards, Robert Holmes, Fiona Thompson and Dr Keith Leamon are thanked for their useful comments on the final report.