Know-how for Horticulture

Disease management strategies for downy mildew on spring onions and white blister on radish

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Purpose of project:
This project details the outcomes of a 3 year study on developing integrated management strategies for control of downy mildew on spring onions and white blister on bunching brassicas.

Report completed: February 2005

Funding acknowledgments:
The researchers acknowledge the financial support for this project from Horticulture Australia Limited (HAL), AUSVEG, the Federal Government and the Department of Primary Industries, Victoria.

Acknowledgments:
The authors thank the members of the steering committee, Craig Arnott, Peter Cochrane, Geoff Foster, Tony Lamattina, Rocky Lamattina and Karl Riedel for their valuable contribution to this project. The authors thank the growers whom supplied their crops for field trials, reported in this report. The authors also thank the Vegetable Industry Development Officers for their assistance with the project.

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Media Summary

Downing downy mildew in spring onions and white blister on radish

Research has identified new and improved methods for controlling damaging diseases of spring onion and radish crops in Australia. The total national value of the two industries in Australia is estimated at $85 million annually and economic consequences for growers can be considerable.

The diseases, known as downy mildew and white blister, are caused by two different microscopic fungi that infect and kill leaves. The problem is significant because it has curtailed winter production of spring onions and, in many cases, totally prevented growing of radish crops.

The research by scientists at DPI's Knoxfield Centre was supported by funds from the Vegetable Industry, Horticulture Australia and the Department of Primary Industries Victoria.

Three improved control strategies have been developed for downy mildew and offered to growers of spring onions:

1. The use of decision support systems linked to computer models that analyse prevailing temperature, rainfall, relative humidity and predict the need to apply control treatments.

2. New foliar spray schedules have been designed which incorporate the combination of new and old fungicides. When used correctly these can reduce disease to negligible levels and minimise the risk of resistance to fungicides.

3. The use of early morning overhead irrigation as a supplementary control measure, suppresses spore production by the fungus and can be integrated with foliar spray programs.

Research showed some varieties were less susceptible to downy mildew than others. It also found the disease could not be controlled by modification of nutrient treatments, despite nutrient amendments producing a better quality onion.

One specific control strategy was developed for white blister and offered to growers of radish crops:

1. New foliar spray schedules have been designed which incorporate combinations of new and old fungicides. These effectively control disease and minimise the risk of resistance to fungicides.

Limited surveys did not demonstrate seed borne infection by the white blister fungus. The implications are that it is unlikely that epidemics of white blister are caused by planting infected seed. It is more likely that these originate from resistant spores, which survive in soils or from the carry-over of spores from other radish crops. The consequence is that, on the basis of current data, seed treatment by heat or fungicides is not considered a high priority.

Much of the information from the research is presented in a booklet "*A guide to diseases and disorders of bunching vegetables in Australia*" which has been distributed nationally to industry through the Industry Development Officer network.

Technical Summary

Downy mildew and white blister are the main foliage diseases of spring onions and radish respectively. Growers report that these diseases can cause up to 50 –100% losses in a national industry worth an estimated $85 million annually. Some growers have ceased production of spring onion and radish crops because of disease pressure from the two causal fungi – *Peronospora destructor (Berkeley) Caspary and Albugo candida (Pers.) Kuntze,* respectively.

This three year study on downy mildew in spring onions evaluated prospects for the development of Integrated Management Strategies. This involved research on: computer models and decision support systems, fungicides and irrigation scheduling, resistant varieties and nutrition. An economic analysis also appraised the cost effectiveness of proposed treatments for use by growers.

Studies on white blister were more restricted. They targeted the evaluation of fungicides and the risk of transmission of *A candida* in seed.

Recommendations
Three improved control strategies have been developed for downy mildew and offered to growers of spring onions.

1. The use of decision support systems linked to computer models that analyse prevailing temperature, rainfall, relative humidity and predict the need to apply control treatments.

2. New foliar spray schedules have been designed which incorporate the combination of new and old fungicides. When used correctly these can reduce disease to negligible levels and minimise the risk of resistance to fungicides.

3. The use of night time overhead irrigation as a supplementary control measure suppresses spore production by the fungus and can be integrated with foliar spray programs

One specific control strategy has been developed for white blister and offered to growers of radish crops

1. New foliar spray schedules have been designed which incorporate combinations of new and old fungicides. These effectively control disease and minimise the risk of resistance to fungicides.

Spring Onion
Available models were tested for their effectiveness in predicting periods of sporulation and infection by *P destructor* as affected by temperature, moisture and relative humidity. Interpretation of output data from models was used to generate decision support guidelines on when sprays are required in relation to predicted disease risk. In summary these specified that risk was highest when irrigation occurred in the evening prior to midnight.

Complementary experiments evaluated which combinations of new systemic and/or conventional protectant fungicides provided the most effective control of disease while minimising the risk of acquired resistance to fungicides. All treatments controlled disease and some of the most effective were metalaxyl+mancozeb, dimethomorph+mancozeb and azoxystrobin. These reduced damage by up to 99%.

Information derived from models on factors which favour sporulation also provided the basis for experiments on irrigation scheduling, comparing overhead and drip irrigation as potential management practices for disease control. Data showed the potential of overhead irrigation in suppressing sporulation. However the treatment needs to be used with care because its application in autumn and winter can cause saturation of soils.

Experiments on varietal susceptibility, nutrition and adjuvants indicated that none could be used to effectively suppress disease.

An economic analysis compared the costs and effectiveness of calendar spraying operations with strategic spraying based on decision support systems from models. Surprisingly the analysis did not confirm reduced costs associated with strategic spraying, even though between 2 to 5 fewer sprays were used. The use of only the sporulation component and not the infection component of the DOWNCAST model, under drought conditions, when no dowmy mildew was present in the field, may have contributed to lack of an economic benefit. This result needs further consideration especially in the context of environmental issues and the potential problems of residues in produce.

Radish

Evaluation of fungicides confirmed that protectant (chlorothalonil, mancozeb, dichorfluanid) and systemic (metalaxyl) fungicides reduced damage from white blister by up to 80%. Azoxystrobin, metalaxyl/mancozeb, dimethomorph/mancozeb, were more effective and reduced damage by up to 100%.

Limited surveys did not demonstrate seed borne infection by the white blister fungus. The implications are that it is unlikely that epidemics of white blister are caused by planting infected seed. It is more likely that these originate from resistant spores, which survive in soils or from surrounding infected radish crops. The consequence is that, on the basis of current data, seed treatment for white blister, by either heat or fungicides, is not considered a high priority.

Recommendations for future work

- The DOWNCAST model needs to be evaluated on a number of different sites over several seasons to remove site effects and determine its efficacy in a non-drought season.
- Evaluate the infection component of the DOWNCAST model to improve the accuracy of the model under drought conditions.
- Evaluate cheaper chemicals. In a spray program dimethylmorph could be replaced with the cheaper azoxystrobin. Also trial phosphonic acid (new formulation) + mancozeb as this combination had efficacy for downy mildew on *Brassica* seedlings (HRDC, NY506).
- Evaluate fungicides with longer with-holding-periods, such as F5161f (BASF) identified in HAL VG02118. It may be useful as a first spray on 6-week-old spring onions, to reduce the number of fungicide applications.
- Establish a formula to put an economic cost or benefit on fewer sprays applied to crops to reduce exposure of the environment, farmers and consumers to pesticides.

Technical Report

Chapter 1 Introduction

Summary

This chapter reports on the Bunchline Vegetable Industry, production of spring onions and radish and the main foliage diseases on these crops, downy mildew on spring onions and white blister on radish and their respective life cycles. In 2000 the Bunchline Vegetables Industry was estimated to be worth about $85 million. The industry is labour intensive and most crops are hand harvested. Crops produced by bunching vegetable growers are spring onions (shallots), parsley, radish, silverbeet, beetroot, spinach, Dutch carrots, turnips, swedes, endive, bok choi and pak choi.

1.1 The industry

Crops produced by bunching vegetable growers are spring onions (shallots), parsley, radish, silverbeet, beetroot, spinach, Dutch carrots, turnips, swedes, endive, bok choi and pak choi. The industry is labour intensive with most crops being hand harvested. In 2000 the industry was estimated to be worth about $85 million, with Coles holding 20% of the market share, Woolworths 25%, Franklins 10%, fruit shops 25% and food services 20%.

In Victoria the main production area is south east of Melbourne, Devon Meadows, Clyde, Heatherton, Lang Lang and Pearcedale. In New South Wales (NSW) production is predominantly located in the Sydney basin. Production in South Australia (SA) is located mostly on the north Adelaide plains around Virginia with a few growers in the Adelaide hills. Wanneroo and Gingin north of Perth and Hopeland south of Perth are the main production areas in Western Australia (WA). In Tasmania growers are located south of Devonport, Hobart and south east of Burnie. The main production areas in Queensland are the Lockyer Valley and south of Brisbane. Foliage diseases affecting the main crops in the industry are downy mildew on spring onions and white blister on radish.

1.2 Spring onions

Spring onions are probably the major line grown by the bunch-line growers. The most recent estimates of production are in Table 1.1. During 2000 and 2001 Queensland was the major producer of spring onions, followed by Victoria. Nationally in 2000, one major supermarket chain was thought to hold 33% of the market share of spring onions, which was estimated to be worth $10,765,465. From this the value of the national spring onion production could be estimated at $32.3 million.

Spring onions are sold at retail outlets in bunches with no defined number of plants per bunch, although supermarkets have a weight range for bunches. At the farm gate they are sold in bundles, decks, plastic bags, cartons, crates, bins or as per customer requirements. A bundle consists of 5 bunches and a deck consists of 10 bunches. Plastic bags, cartons and crates consists of about 10, 20, and 20-25 bunches, respectively. Bins hold about 400 bunches. Recently in Queensland there has been a move to selling a bunch of spring onions in a plastic sleeve. At the farm gate spring onions are worth about $4-$6 per deck.

The major diseases affecting spring onions are downy mildew and bacterial spot on the foliage and white rot on the roots. At the commencement of this project downy mildew was reported to cause 50-100% crop losses in Victorian spring onion crops.

Chapter 11 Relationships with industry

Craig Murdoch – Vegetable Extension Officer

Summary

This chapter reports on the benefits of a project advisory group for 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 Bunchline Vegetable Industry.

11.1 Background

Industry advisory groups and project steering committees have proved to be an excellent means of accelerating the impact of research and development (R&D) projects. These groups provide an opportunity for researchers to describe their approach and current progress to both vegetable growers and allied support businesses such as crop advisers, nurserymen, seed suppliers and chemical manufacturers. The group member's diverse experience and their special industry networks have encouraged each person to contribute more towards achieving a successful project outcome for growers. The group members have come to appreciate each other's contribution to a better understanding of the many issues concerning bunching vegetable production. Some of the unique benefits of the project advisory group approach have been:

1. Putting a human face to the issues confronting bunching vegetable growers and a shared celebration of progress towards improving long-standing problems.
2. A better understanding of the impact of downy mildew on spring onion crops that could only come through in-depth discussions with group members throughout the course of the project.
3. The opportunity to demonstrate how a combination of research and grower experience can combine to provide a richer understanding of industry issues and their solution.
4. Researchers have the opportunity to deliver preliminary reports to a supportive industry audience and to better prepare for presentations to local and interstate grower groups.
5. Advisory group members, in the course of their daily business, are strong advocates of the value of the R&D levy and have given personal examples to critics & sceptics of this system.
6. Researchers have been invited to several grower properties to inspect other disease problems including leeks, parsley, parsnips broccoli and celery, which may lead to future R&D work.
7. Participating growers have developed better relationships with researchers and those working in the nursery, chemical and seed industries. This has given growers another forum to discuss recurring problems and issues.

The advisory group approach works very well and is now our preferred approach to group involvement with the Vegetable industry. The advisory group model has been successfully applied to other vegetable R&D projects including, Onion White Rot VG01096, *Brassica*-white blister VG02118 and through the Lettuce aphid advisory group under Lettuce Best Practice VG01038.

11.2 Some growers reactions to the project and workshops

TS
Overall excellent event. Some of the leek work inconclusive as yet, met with Liz Oxspring the day before so had already heard about her work. Also already knew about Peter Dal Santo's work but good to hear it first hand. Interested in followup to Oscars work with SUMICLEX and Fowl Manure synergy. Excited about Victor's work with weather stations and disease forecasting especially Septoria leaf spot. "We will probably invest in this approach". Thought the venue was excellent and should be used more. Would have liked even more time to talk with growers and researchers. Could have started earlier say 1pm. TS is definitely interested in any future workshops and would recommend them to other growers.

PC
Really good…good venue…good presentations. A lot of grower interest in weather modelling for disease prediction. Peter Dal Santo's work now familiar to many more growers. Oscar's observations on SUMICLEX and fowl manure need more work as some growers use lots of fowl manure, yet have lots of white rot too. Liz and Narelle's work was also useful.

JK
Very worthwhile day. Venue was a lot better than some of the noisy sheds we've used before. Found much of the information was still "work in progress" rather than hard recommendations. Thought researchers pretty much on the right track and found it interesting to hear their thoughts part way rather than at the end of the work. Found the use of OCTAVE on stem rot of leeks particularly useful as JK had not heard of this approach before. Scientists were still pretty guarded about recommending things though. JK thought the social time in small groups was OK over pizza and that a group discussion could bring out more experiences, we should try it next time !

RL
Excellent venue when there's no field work to look at. Could see and hear well. Break half way was important. Already knew about Peter Dal Santo's work but good to hear it again! The leek diseases were similar or related to those in spring onions, which was interesting. Seemed some overlap with Leeks, Oscar and Liz's work, perhaps the researchers could spend some time together (over dinner) to consolidate their work / findings and avoid unnecessary repetition? A lot of the work was premature and needs to be confirmed in following seasons. RL thought that Oscars work was very important to his business and all spring onion growers / researchers.

DK
Venue was quite good. Liz Oxspring's work was well presented but nothing new that could help him now. Workshop notes excellent, has shown to field workers so they know what problems to look for on leeks. The role of watering times on downy mildew on spring onions was very interesting and DK would like to go to more of these workshops. DK currently has a problem with *Fusarium* in his speedlings and would like to know more about possible entry points for this disease and ways to reduce damage. The only improvement DK could think of was to talk more on ways to control each disease and how diseases survive in the field and gain entry to plants.

ST
Good venue. Happy to stay overtime when learning something. Impressed by turnout, big slice of industry present. Knew about Peter Dal Santo's work from newsletter, but process is far too slow for growers. Met with Liz Oxspring Friday morning and had already heard her story. Impressed with Oscar's work, heading in the right direction. Interested to hear different approaches to controlling diseases and will consider adapting some of these approaches to his business. Regarding the weather station, it may be possible to save a few sprays but the consequences of failure can be $5-10,000. Each grower will have to consider if the gamble is worth it. "You make your own luck".

DC
Great venue, could see and hear everything clearly. Some of the talks were directed at too basic a level and were a bit boring but occasionally something important came up which drew attention. Had heard about Peter Dal Santo's work and was interested to hear him speak. Very interested in Liz Oxspring's work on leeks, have already made a couple of changes to disease control program and is thinking of trying these ideas on a few other problems. Very interested in Oscars work on SUMICLEX and fowl manure. Have successfully changed their mildew management practices with what was learnt from the last workshop. Group discussion may be worth a try but many growers treasure their secrets.

GF
Good venue, very interested in all talks, felt learn't a lot. Liked Peter Dal Santo's work and found the leek story interesting although they haven't enough land to grow leeks. Liz and Narelle's talks were too short, trying to save time. The weather station predictions sound good, worth $1000 or so to give it a try. Would have liked to stay and talk at the end. Improvements?…maybe get the scientists to trim their talks back, some could be told in half the time.

DS
Great afternoon. Much of their business involves export to SE Asia where residue limits are critical. Happy to listen to all the information even though they knew some of it and some info was related to crops he doesn't grow. Have listed the chemicals he uses on each vegetable line and will pass this list on to Patrick Ulloa. Would like to hear more about non-chemical alternatives to control crop diseases as they only use chemicals as a last resort.

J&B E (Western Australia)
A simple change to night irrigation has greatly improved spring onion quality by reducing downy mildew.
"Night irrigation is a winner"

11.3 Changes in knowledge, abilities, skills and aspirations

As you can see from the reactions of growers, the benefits of this research project are as diverse as the industry itself. On a technical level, bunching growers Australia-wide finally have a working understanding of downy mildew and white blister and its control. The growers and their advisers are capable and confident to use a variety of control measures in combination to control these perennial problems whose solution which has eluded them until now. Some growers have benefited from simple changes such as watering the crop only at night. Still other growers have adopted the improved fungicide control strategies developed by the project. Some growers are now using the disease prediction model to help them optimise their disease control strategies and have placed weather

stations in their crops. The industry has voiced its appreciation of this HAL funded project in developing and applying research findings to provided a range of approaches to controlling diseases in bunching vegetable crops and for providing a channel for other HAL funded projects to discuss their findings with industry.

11.4 Industry advisory group

Not all growers are in a position to volunteer for R&D project advisory groups. Growing and marketing vegetables demands a great deal of time and effort. While most are able to attend half-yearly project update events, for the most part only the same few growers are able to serve on project advisory committees.

The approach Department of Primary Industries Victoria have adopted has been to invite private sector crop agronomists and similar "information retailers" to join with researchers and able growers, to plan and discuss bunching vegetable issues first-hand. As mentioned earlier, the resulting advisory group model has proved a huge success.

The advisory group members who have contributed to the success of Bunching Vegetable Project VG01045 are:

Craig Arnott – Market Gardener - Arnotts Vegetable Farms- Clyde

Peter Cochrane - Market Gardener - P.J. & J. Cochrane P/L – Devon Meadows

Geoff Foster - Market Gardener - E.W. & S.K. Foster – Lang Lang

Tony Lamattina - Market Gardener - A. & D. Lamattina & Sons – Clyde

Rocky Lamattina - Market Gardener – A. & D. Lamattina & Sons – Clyde

Karl Riedel – Vegetable Crop Agronomist - E.E. Muir & Sons – Cranbourne

Chapter 12 Publications

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Dal Santo, P., Oxspring, E., Villalta, O., Kita, N., Minchinton, E. and Galea, V. (2003). Controlling diseases of spring onions and leeks. Workshop Notes, Cranbourne TAFE., 28 February 2003. DPI Knoxfield: 25p.

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Kita, N., Minchinton, E. (2003). Latest findings from downy mildew and white blister research. Article for IDO's VegeLink submitted March 2003, 2pp.

Kita, N., Minchinton, E., Nguyen, N., Murdoch, C. and Pierce, P. (2002). An integration of watering times and fungicides will control white blister on radish. Abstract and poster. Collaboration, passion and opportunities, DPI Horticulture Conference 2003. DPI Tatura 26 – 27 August 2003.

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Villalta, O., Geitz, G., Minchinton, E. and Kita, N. (2003). Controlling diseases in spring onions. Workshop Notes, Cranbourne TAFE, 19 September 2003. DPI Knoxfield, 41pp.

Meetings, field days and conferences

Meeting Bunching Vegetables Project. Muirs Cranbourne 25/7/01.

Field day 27/11/01 at P J & J Cochranes, Devon Meadows.
Field day 2/7/02 at A & D Lamattina & Sons, Clyde.
Field day 28/2/03 at Cranbourne TAFE.
Field day 19/9/03 at Cranbourne TAFE.

Workshop, Kemps Creek Sporting and Bowling Club, NSW, 12/8/02
Workshop, Danny DeIeso's Farm, Virginia, SA, 21/8/02.
Workshop, Queensland Clunies Ross Centre, Eight Mile Plain, QLD, 26/8/02.
Workshop, Longford RSL, Longford, Tasmania, 26/2/04.
Workshop, Wynyard, Federal Hotel, Wynyard, Tasmania, 27/2/04.
Workshop, Forth, Forthside Vegetable Research Station, Forth, Tasmania, 27/2/04.
Workshop, Amstel Golf Club, Cranbourne, Vic, 8/7/04.
Workshop, Wanneroo Tavern, Waneroo, WA, 26-27/8/04.

Conference (attendance)
Onions 2002. Yanco Agriculture Institute. 3-5 June 2002.
8th International Congress of Plant Pathology. Sunday 2 to Friday 7 February 2003, Christchurch, New Zealand

Steering committee meetings
25/7/01 Muirs Cranbourne
10/7/02 Amstel Golf Club, Cranbourne
12/3/03 Amstel Golf Club, Cranbourne
24/6/03 Amstel Golf Club, Cranbourne
14/10/03 Amstel Golf Club, Cranbourne
10/3/04 Amstel Golf Club, Cranbourne