Walnut Blight Management Workshop

Colin Jack
Australian Walnut Industry Association

Project Number: WN12702

WN12702

This report is published by Horticulture Australia Ltd to pass on information concerning horticultural research and development undertaken for the walnut industry.

The research contained in this report was funded by Horticulture Australia Ltd with the financial support of Australian Walnut Industry Association.

ISBN 0 7341 3184 4

Published and distributed by:
Horticulture Australia Ltd
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179 Elizabeth Street
Sydney NSW 2000
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HAL

Horticulture Australia

W12702 Management of Walnut Blight Workshop - 2012

AWIA conducted a seminar and workshop on blight management for Walnut producers at Tatura DPI Research Centre 255 Ferguson Rd Tatura Victoria on 18th August 2012.

The workshop was augmented with presentations from AWIA regarding other Walnut R&D being undertaken with joint funding of HAL and AWIA on 18th & 19th August.

More than 50 walnut growers were in attendance at the workshop.

The purpose of the seminar was to

1. Revisit and revise the material presented to growers in the 2011 Walnut Blight seminar / workshop. This information is made available on the AWIA website.

2. Present updated technical and extension information on blight management to growers by web site, printed material and group learning.

3. Review the methods used by growers during the last season, including spray regime, various chemical configurations and the outcomes of various management practices.

4. Encourage best practice in Walnut Blight Management throughout the Walnut Industry.

Presenters and Speakers were.

Dr Michael Lang – Research Scientist – Walnuts Australia, Tasmanian Institute of Agriculture, UOT.

Dr Lang presented a Review of Walnut Blight Research. (Attached)
Dr Lang undertook a Q&A as part of this session.
Updated Draft June 2013 of Walnut Blight (Attached)

Dr Kathy Evans Senior Research Fellow - Tasmanian Institute of Agricultural Research discussed the impacts of blight on the quality of walnuts.

Mr Colin Jack, facilitated grower discussion of orchard management on spray event timing and frequency, mixes of chemicals, and anecdotal evidence of disease control on each orchard.

Mr John Gallard, Gallard Industries, presentation of orchard pruning and air blasting equipment to assist in mechanical and chemical control of walnut blight. (Attached)

AUSTRALIAN WALNUT INDUSTRY ASSOCIATION

WALNUT WINTER SYMPOSIUM

Saturday 18th August 2012 10.00 AM to 5 PM
at
DPI Research Centre 255 Ferguson Road Tatura, Vic.

This seminar will:

- Update current research in Australia on Walnut Blight control.
- Present the various methods available for orchard management including nutrition and pruning
- Offer growers with a method for measuring quality parameters.
- Provide a forum for questions and answers in relation to Blight and other orchard management.
- Update members on AWIA activities.

PROGRAM

9:30 am Registration and refreshments

10:00 am Welcome and Opening

10:15 am *"Walnut Blight"* **Dr Michael Lang** (Research Scientist – Walnuts Australia)

- Update of current research
- Grower Q&A and interactive session

11:15 am "***Walnut Nutrition – current thinking"*** **Jamie McMaster** (Managing Director and Agronomist, Sustainable Liquid Technology Pty Ltd

12:00 noon ***"Post Harvest and processing technology"*** **Howard Myers**, Goulburn Valley Walnuts

12:30 pm Lunch

1:15 pm ***"AWIA presentation on projects and programs"*** – Carol Kunert, President AWIA, and Colin Jack, AWIA R&D Chair.

1:45 pm "Promoting the Health Benefits of Walnuts" Speaker to be advised

2:30 pm Afternoon tea.

3:00 pm ***"Quality Parameters for Australian Walnuts".*** **Dr Kathy Evans and David McNeil**, (Tasmanian Institute of Agriculture).

4:00 pm ***"Mechanical Pruning and Orchard Equipment".*** **John Gallard,** Gallard Services

5:00 pm Summary and Where to from here.

5:15 pm Close

6:30 pm **Industry Dinner** (at individuals own costs) – Venue to be confirmed

GROWER INTERACTIVE SESSION

Sunday 19th August 2012, 9.00 am – 1 pm

DPI Research Centre, 255 Ferguson Road, Tatura, Vic.

The Australian Walnut Industry Association presents an interactive session for growers utilising the expertise of Harold Adem :-

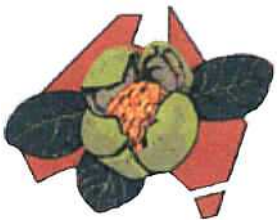
- Understand the importance of orchard spray calibration
- Using 'tools' undertake a practical aspect of calculating spray calibration
- Understand the principles of water budgeting
- Using 'tools' undertake a practical use of a water budget model

PROGRAM

8:30 am	Registration and coffee, tea	
9:30 am	Welcome and Opening	
9:35 am	Session 1:	Practical spray calibration
10:15 am	Session 2:	Water Budget Model application
12:30 pm	Where to from here?	
1:00 pm	Close	

GROWERS ARE ENCOURAGED TO BRING

- **THEIR OWN COMPUTER OR IPAD, AND**
- **ANY DETAILS AND FIGURES RELATING TO THEIR CURRENT IRRIGATION**



HAL
Horticulture Australia

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SYMPOSIUM and INTERACTIVE WORKSHOP

REGISTRATION FORM

Register direct at www.walnut.net.au or complete below.

Business Name: .....

Address: .....

.....**Postcode:** .....

Phone: ..... **Fax:** .....

Mobile:.....

E-mail: .....

Both the symposium and workshop are FREE for AWIA members.

Non Members $50 per day per person

The Seminar dinner is at individuals own costs

AWIA Member	**Yes**	**No**

The following person(s) will be attending the

a)	**Walnut Symposium:**	**YES**	**NO**
b)	**Industry Dinner**	**YES**	**NO**
c)	**Interactive Workshop:**	**YES**	**NO**

NAMES:

....

....

....

RSVP: **Friday 10th August 2012**

RETURN FORM TO: **AWIA PO Box 312 TATURA Vic 3616**

E-mail: sahort@bigpond.com

Signature: ..... **Date:** .....

Sponsored by The Australian Government through Horticulture Australia Ltd and Voluntary Contributions from the Australian Walnut Industry.

PAYMENT.

Both the symposium and the workshop are FREE for AWIA members.

Non Members cost is $50 per day per person

The Seminar dinner is at cost of purchases by the individual

AWIA Member: Yes No

Any dietary requirements?.....

I enclose cheque payable to
Australian Walnut Industry Association Inc.
PO Box 312 TATURA Vic 3616

\Or

To pay direct into AWIA bank account
Australian Walnut Industry Association Inc.
BSB: **013 304** Acct: **259 683 015**
Use reference "seminar" and your name

(ANZ Branch 394 Glenhuntly Rd Elsternwick Vic.)

Walnut blight

‘review of recent research’

Michael Lang

Walnuts Australia

AWIA - 2012

- How does blight develop?
  - A review of current knowledge
- Management of blight?
  - Timing of sprays
  - Penetrants
  - Spray volumes
- Where to next?
- Please ask questions!

How does blight develop?

"a review of current knowledge"

Walnut blight

- The major bacterial disease of walnut fruit worldwide
- Range closely corresponds to walnut cultivation
- Affects flowers, shoots, leaves, buds, and fruits
- Can affect 100% of fruits in Californian cultivars

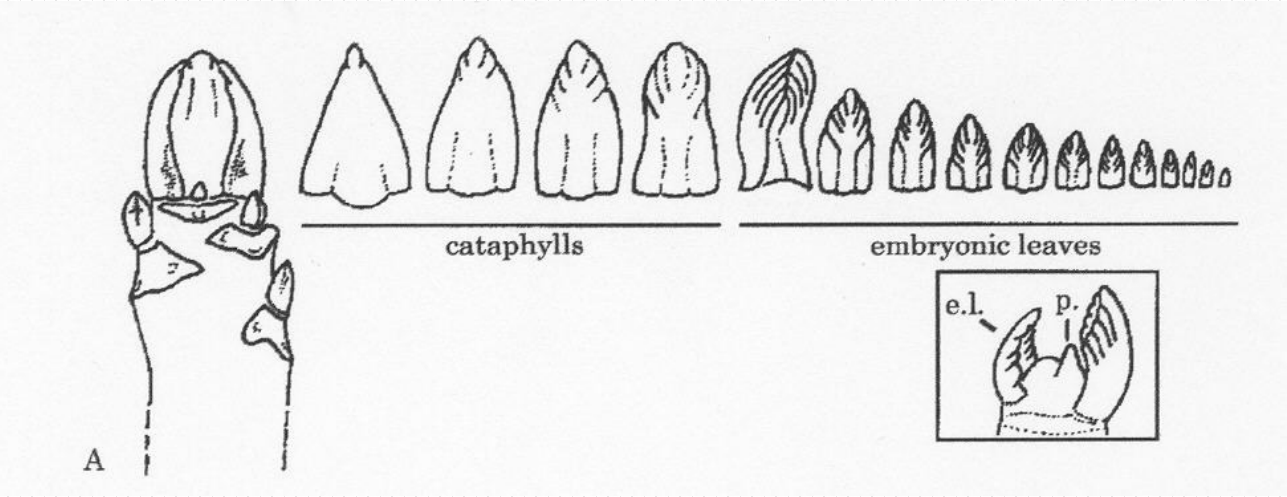


Causal organism

- *Xanthomonas arboricola* pv *juglandis*
  (Xanthomonas campestris pv *juglandis)*
  - motile by single polar flagellum
  - growth between 1-35°C

Disease cycle

- Principal over-wintering sites
  - walnut buds, catkins



Lindow SE, Buchner R, Olsen B, Koutsoukis R. 2004. *Epidemiological approaches to the control of walnut blight disease.* Available from http://walnutresearch.ucdavis.edu/2004/2004_291.pdf

Disease cycle

- Inoculation
  - free moisture
  - infected pollen
- Penetration
  - Stomata
  - host damage

Disease cycle

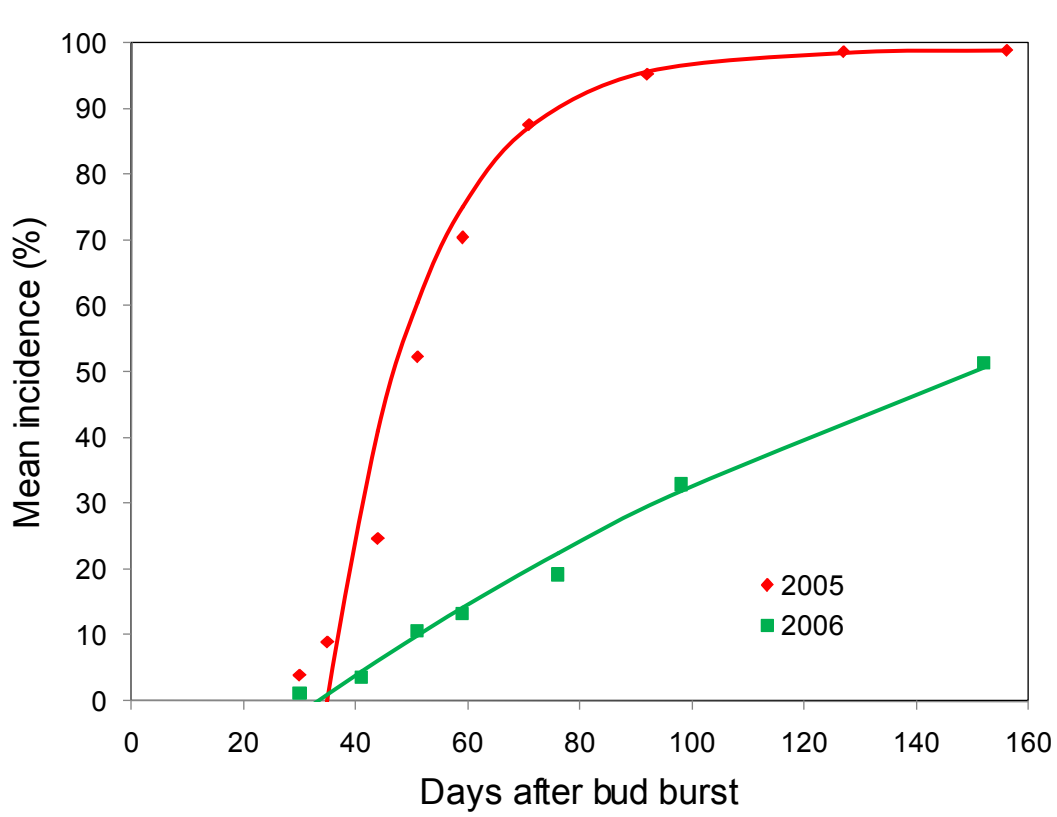
- Infection
  - growth and 'reproduction' of the pathogen in host cells
  - enzymes degenerate cell walls
  - necrosis occurs as cell membranes disintegrate
- Dissemination
  - rainfall and free moisture
  - 'secondary infections'

Environmental factors involved in disease development

- Rainfall and free moisture
  - infection and dissemination
  - duration of surface wetness critical for infection
  - as little as 5 min required for susceptible fruits
- Relative humidity
  - increasing RH within the tree canopy implicated with increased incidence of blight

Environmental factors involved in disease development

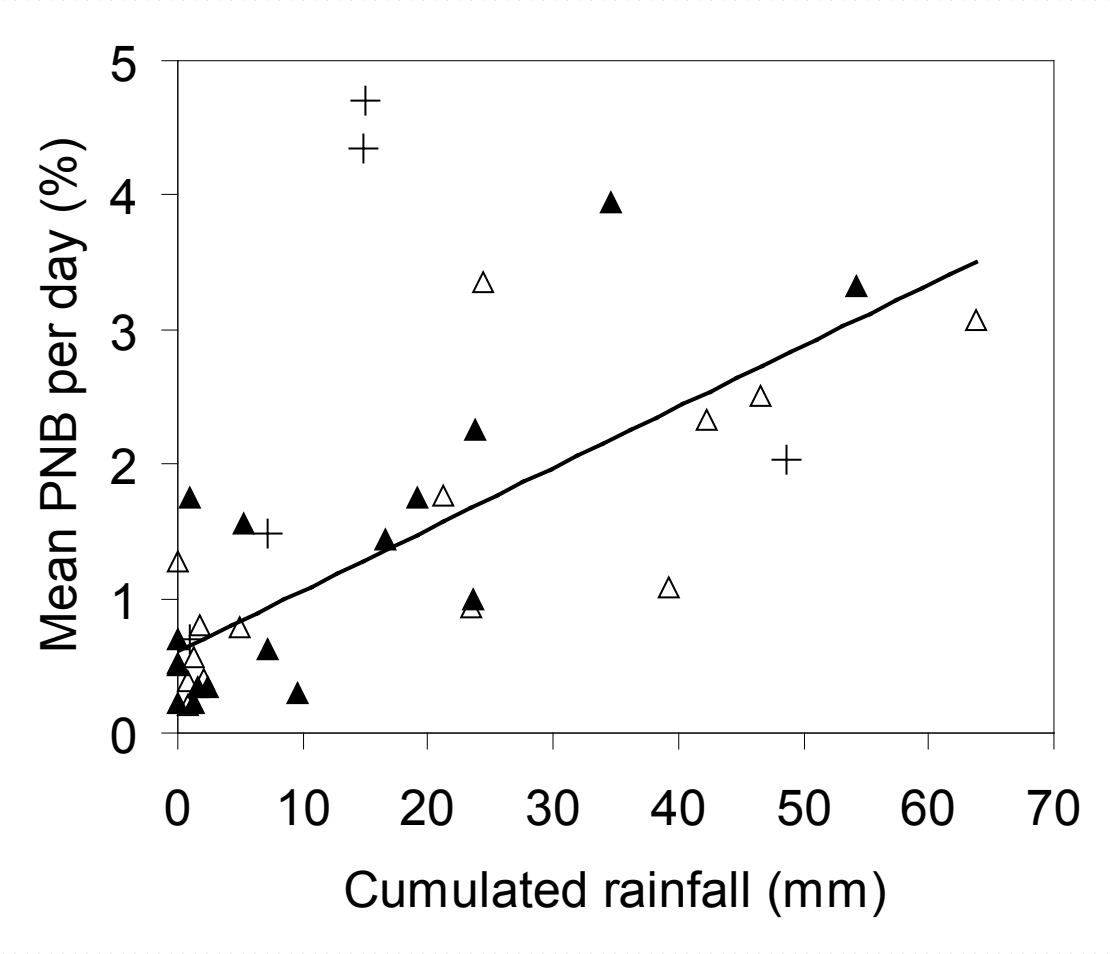
FRANQUETTE - NORTHERN TASMANIA



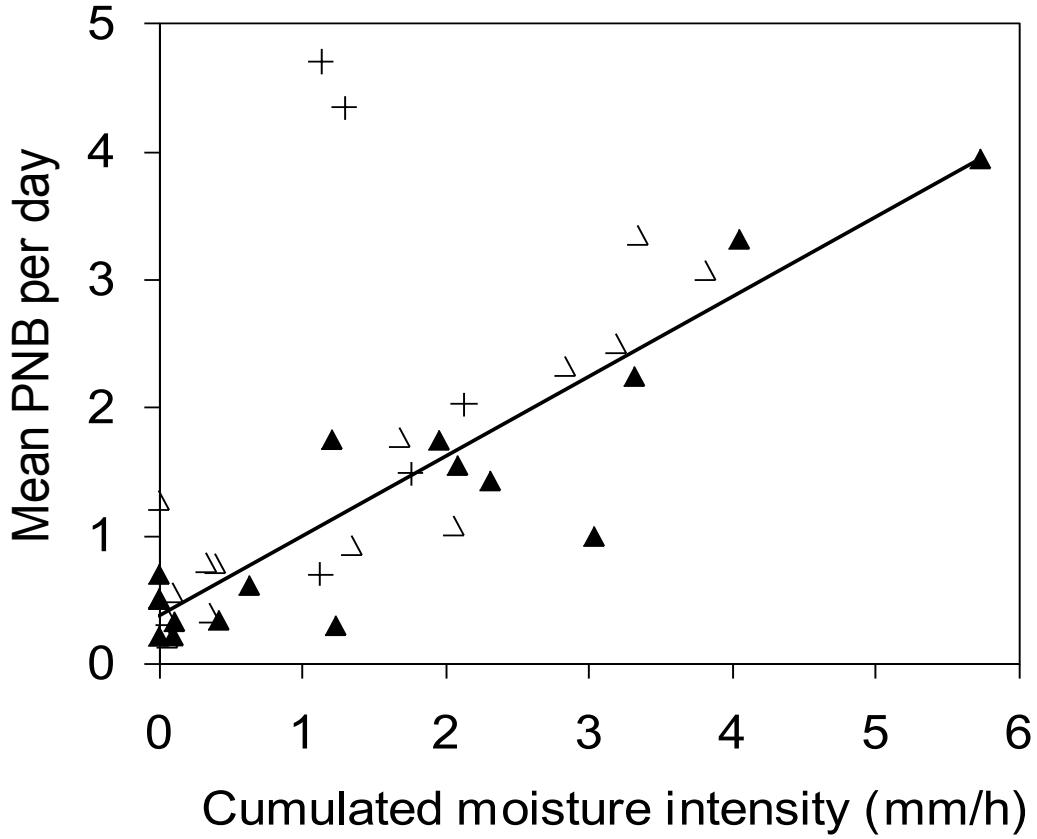
WET YEAR
150 mm in first 85 days

DRIER YEAR
62 mm in first 85 days

Factors involved in disease development in Tasmania

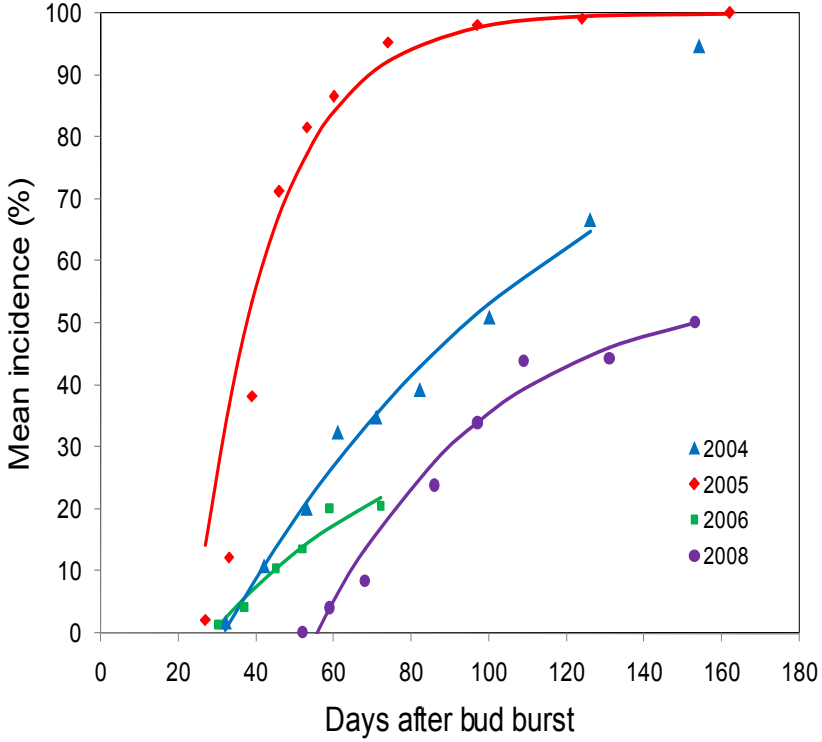


Factors involved in disease development in Tasmania

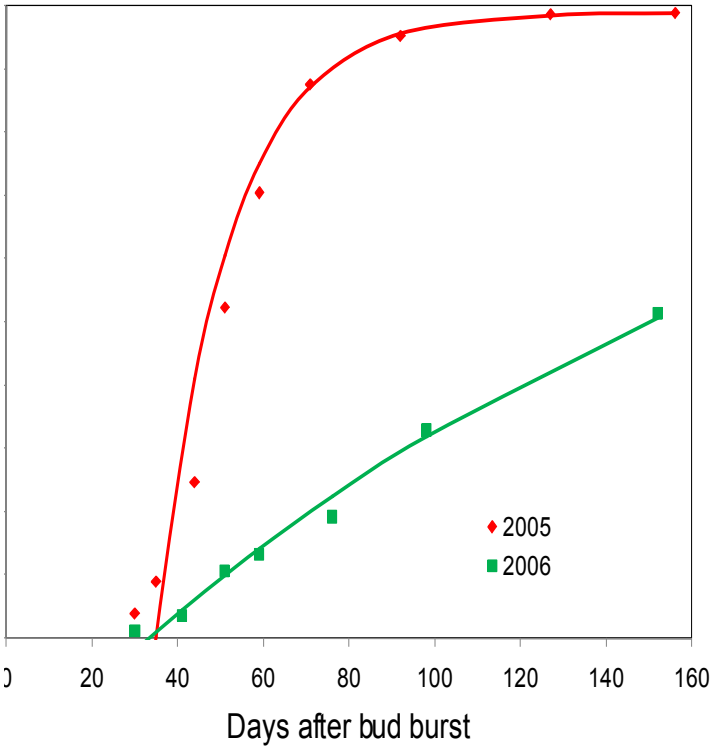


Cultivar susceptibility

Vina



Franquette



How does blight develop 'summary'

- Blight caused by a bacterium
- Bacteria spread by rainfall and wind
- Rainfall a key weather variable
- Disease development varies year to year
- All cultivars susceptible to infection

Management of blight?

'timing of sprays, penetrants, spray volumes'

Spray trials

- Trials conducted over multiple years and sites
- Single-tree plots with products applied with a airmist sprayer
- Calibrated to orchard airblast sprayer



Spray ‘timing’

Treat. no.	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10
1	X	-	-	-	-	-	-	-	-	-
2	X	X	-	-	-	-	-	-	-	-
3	X	X	X	-	-	-	-	-	-	-
4	X	X	X	X	-	-	-	-	-	-
5	X	X	X	X	X	-	-	-	-	-
6	X	X	X	X	X	X	-	-	-	-
7	X	X	X	X	X	X	X	-	-	-
8	X	X	X	X	X	X	X	X	-	-
9	X	X	X	X	X	X	X	X	X	-
10	X	X	X	X	X	X	X	X	X	X
11	-	X	X	X	X	X	X	X	X	X
12	-	-	X	X	X	X	X	X	X	X
13	Non-treated									

Spray ‘timing’

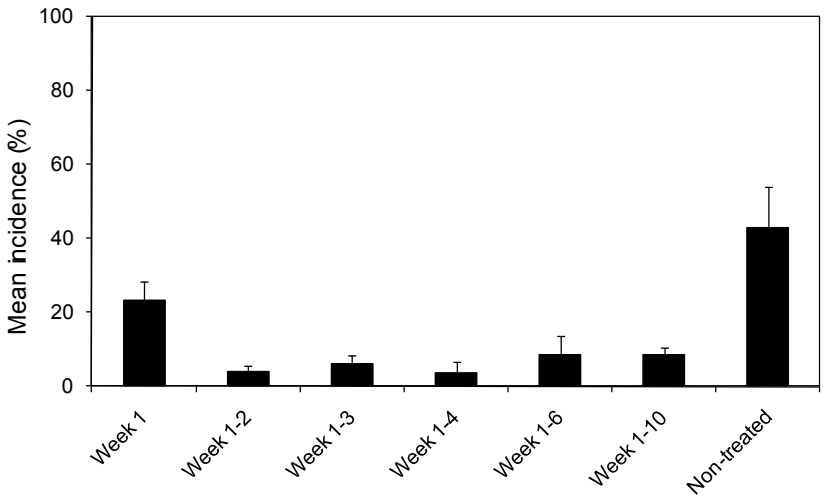
‘Monocyclic’ epidemics

2004-05

- A near 10-fold reduction with two budburst sprays
- Further applications did not improve control

2006-07

- Less than 9% incidence, irrespective of treatment (data not presented)



Mean disease incidence in Vina, Tasmania, 2004-05

Spray ‘timing’

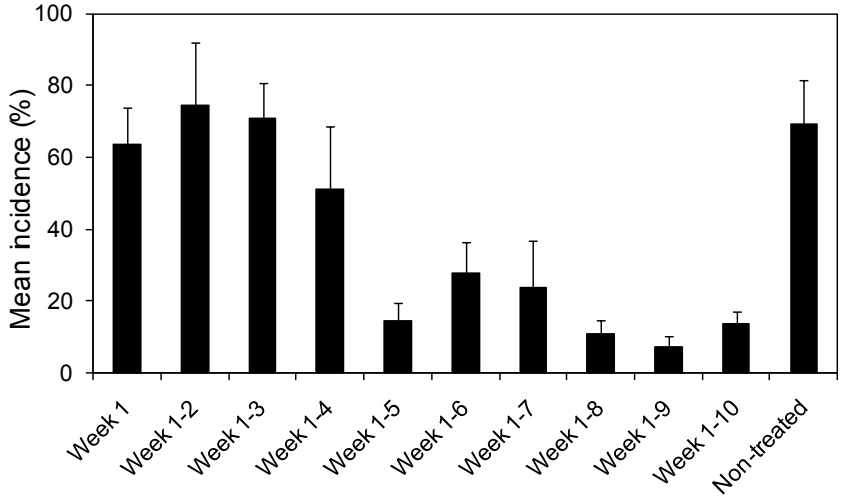
‘Polycyclic’ epidemics

2003-04

- ≤ 4 sprays did not provide satisfactory control

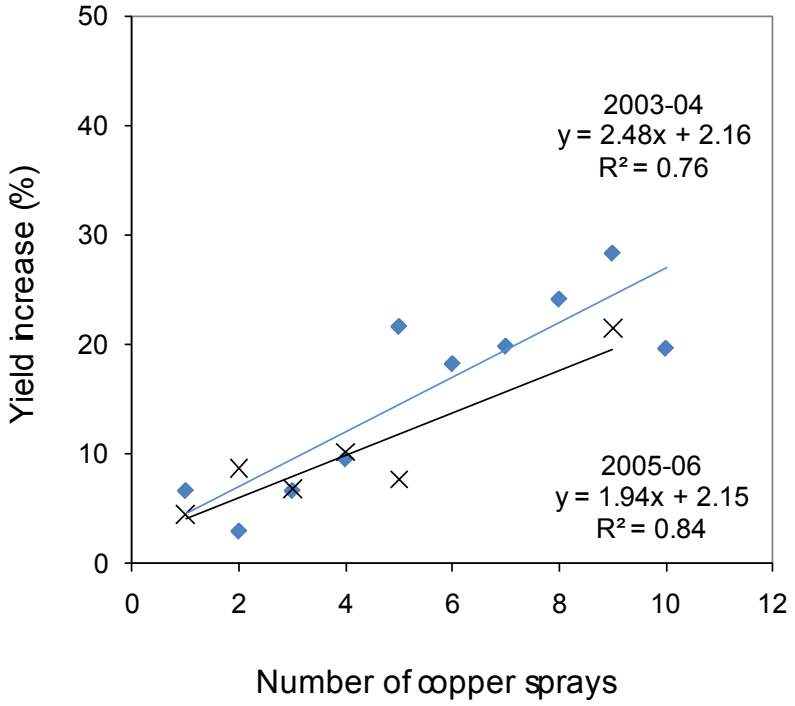
2005-06

- 80% of fruits diseased in non-treated trees (data not presented)
- 3 sprays or less from budburst did not reduce disease incidence



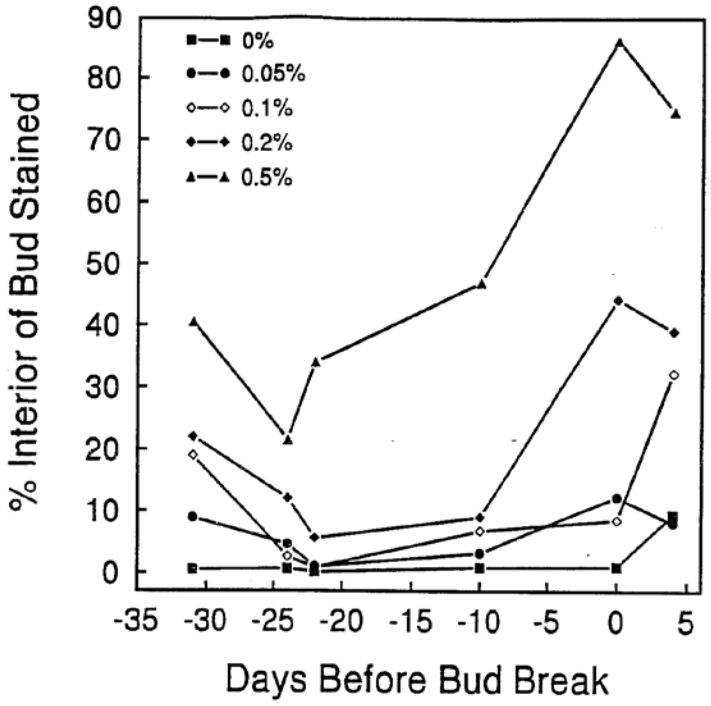
Mean disease incidence in Vina, Tasmania, 2003-04

Spray ‘timing’ ‘crop yield’



Mean percent increase in crop yield with copper-based sprays applied from budburst to ten weeks after budburst in ‘polycyclic’ disease in Tasmania

Spray ‘timing’
‘penetrant’



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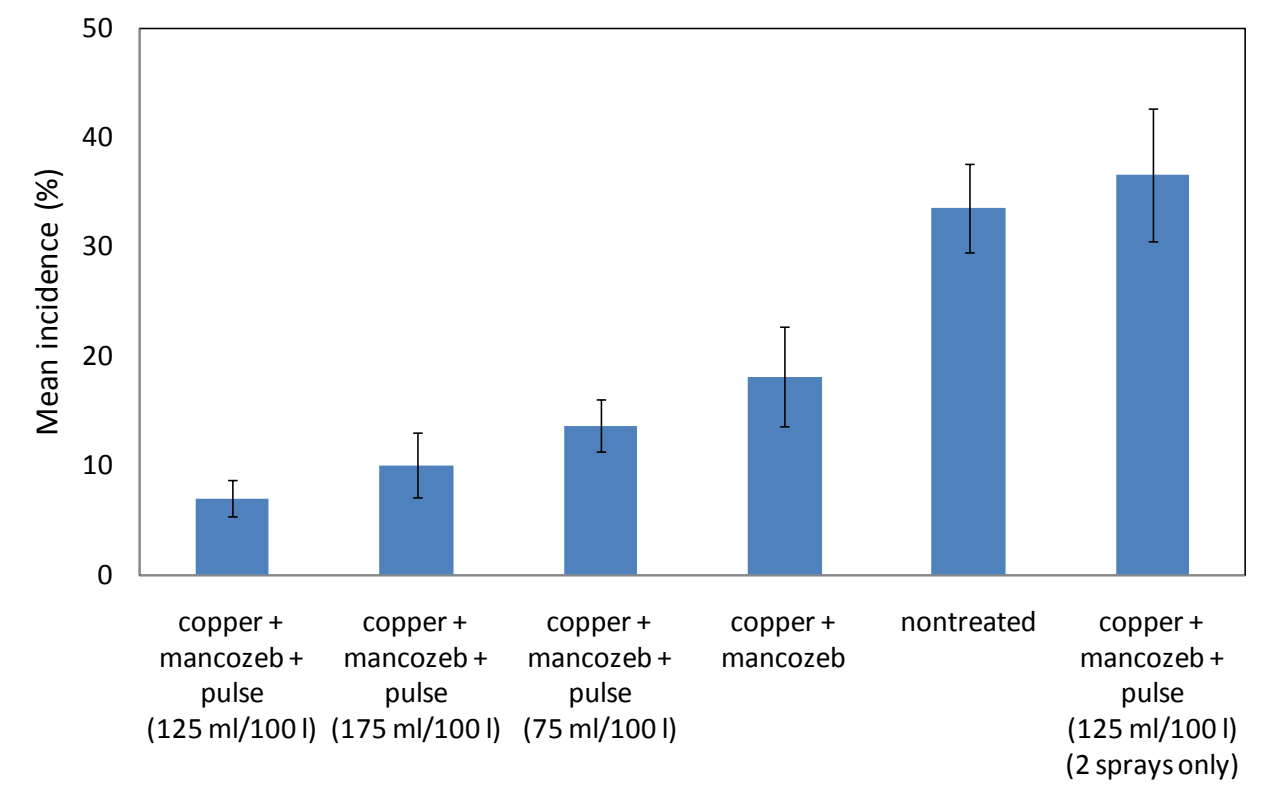
Spray 'timing' 'penetrant''

Treat. no.	Budbreak sprays (four sprays)	Pulse rate (ml/100 l)	In-season sprays
1	copper + mancozeb	-	copper + mancozeb
2	copper + mancozeb + pulse	75	copper + mancozeb
3	copper + mancozeb + pulse	125	copper + mancozeb
4	copper + mancozeb + pulse	175	copper + mancozeb
5	copper + mancozeb + pulse[1]	125	-
6	Non-treated		-

[1]two sprays only

Spray ‘timing’ ‘penetrant’’



Mean disease incidence in Vina with copper-based sprays applied with and without Pulse, in northern Tasmania

Permit no: PER13214

‘5-Mar-12 to 31-Mar-22’

CONDITIONS OF USE

Product to be used:
DUPONT MANKOCIDE DF FUNGICIDE
PLUS OTHER REGISTERED PRODUCTS
Containing: 300 g/kg COPPER
150 g/kg MANCOZEB as their only active constituents.

ALL REGISTERED PRODUCTS
Containing: 750 g/kg MANCOZEB or
800 g/kg MANCOZEB as their only active constituent.

Directions for Use:

- **The following directions for use contain two use patterns, only one use pattern is to be undertaken at any one time.**
- **DO NOT exceed a total or combined maximum of 10 applications per season.**

Crop	Disease	Product & Rate
WALNUTS	BACTERIAL BLIGHT (*Xanthomonas campestris pv juglandis*)	**DuPont Mankocide DF Fungicide (or equivalent):** 500g product/100L water to a maximum of 10kg product/ha.
		Products containing 750g/kg or 800 g/kg Mancozeb: 100g product/100L water to a maximum of 2kg product/ha plus add a registered copper fungicide at rates approved for use on walnuts.

Critical Use Comments:
Apply by airblast sprayer. Apply at beginning of budburst (less than 5% terminal budburst) and repeat at 7-14 day intervals until nut shell formation. Where rainfall events occur use 7 day application intervals but when rainfall is absent use 14 day application intervals.

Use 1,000 – 2,000 L/ha water, with higher water rates for trees greater than 4m height.

Withholding Period:
DO NOT harvest for 1 day after application

Jurisdiction:
TAS, NSW and WA only.
(Note: Victoria is not included on this permit, because their "control of Use" legislation means that a permit is not required to legalise this off-label use in Victoria)

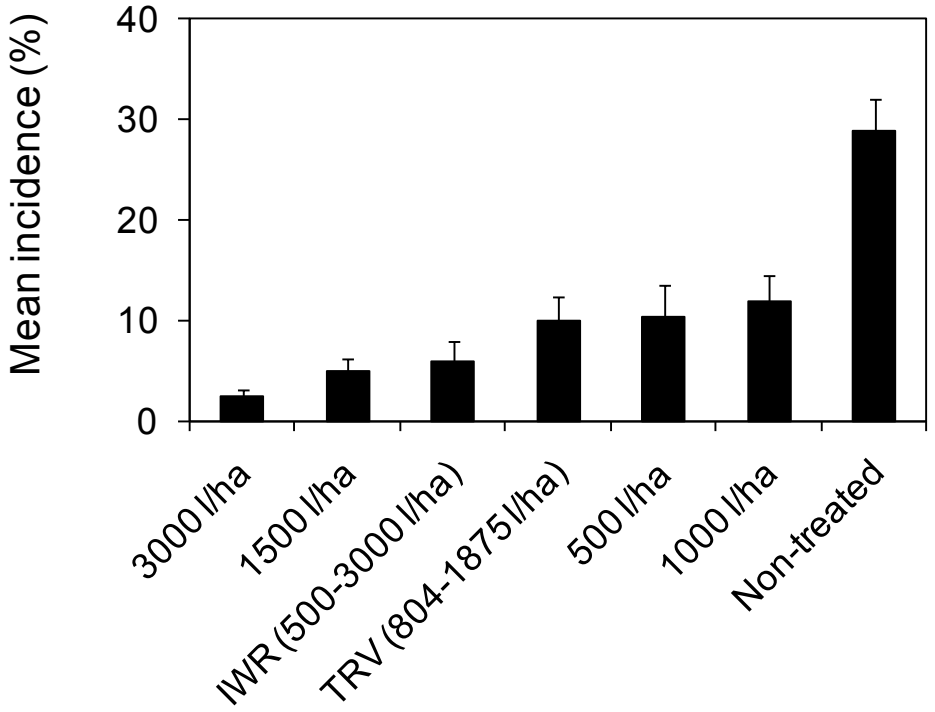
Spray volume

Mankocide® DF (500 g/100 l) applied at various spray volumes (l/ha) from 5% terminal budburst for 10 weeks in northern Tasmania

Tr. no.	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10
1(TRV)	804	804	804	1071	1071	1071	1339	1339	1875	1875
2	500	500	500	500	500	500	500	500	500	500
3	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
4	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
5	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
6(IWR)	500	500	1000	1000	1500	1500	3000	3000	3000	3000
7	Non-treated									

TRV =tree row volume, IWR = increasing water rate

Spray volume ‘incidence’



Mean disease incidence in Vina with Mankocide® DF applied at various spray volumes from budburst for ten weeks in northern Tasmania

Spray volume 'run-off'

- The effect of runoff on copper deposition on walnut is not well understood
- However, multiple studies have been undertaken in citrus i.e.,
  - An increase in spray volume increased the deposition of copper on fruits up to the point of runoff
  - Quantity and quality of deposition reduced after the point of runoff
  - Biological efficacy of copper sprays declined with increasing levels of runoff
  - Differences in deposition between leaf age, surfaces and varieties

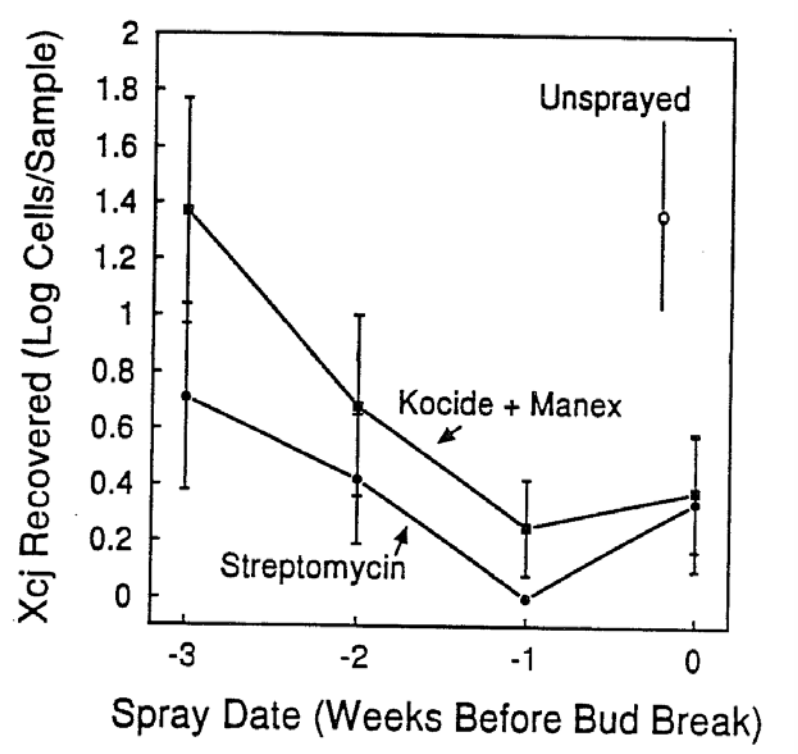
Fourie PH, du Preez M, Brink JC, Schutte GC. 2009. The effect of runoff on spray deposition and control of Alternaria brown spot of mandarins. *Australian Plant Pathology Society* 38: 173-182

Management of blight 'summary'

- Combat disease in the current year
- Reduce potential inoculum for the following year
- Controlling disease a 2 year strategy?
- Timing of sprays important

Where to next?

Spray timing and penetrants?



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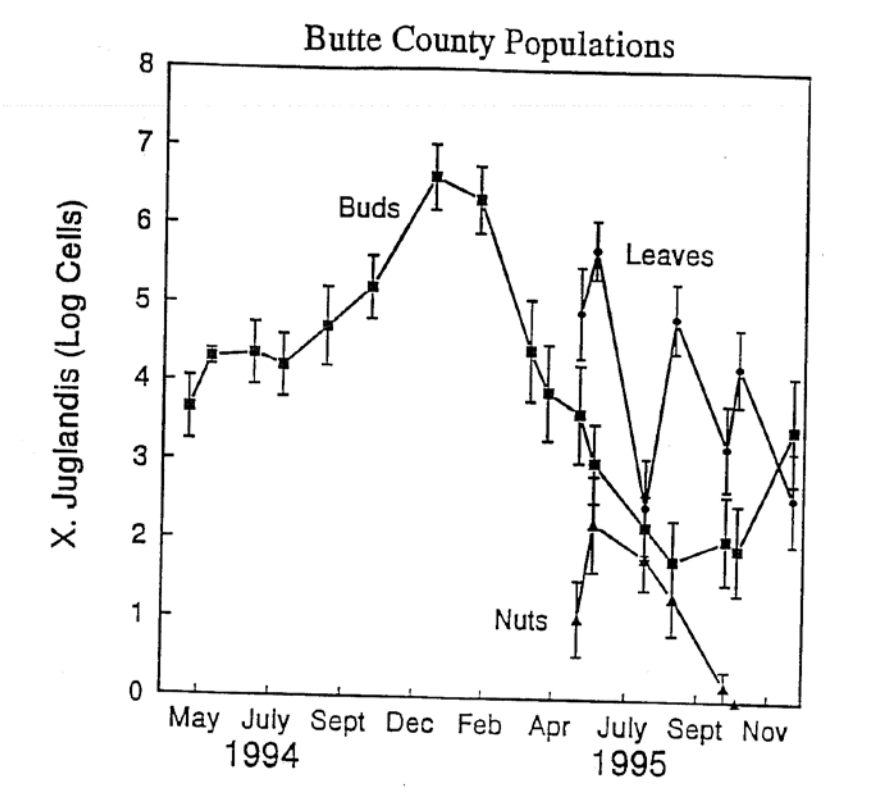
Bud populations?



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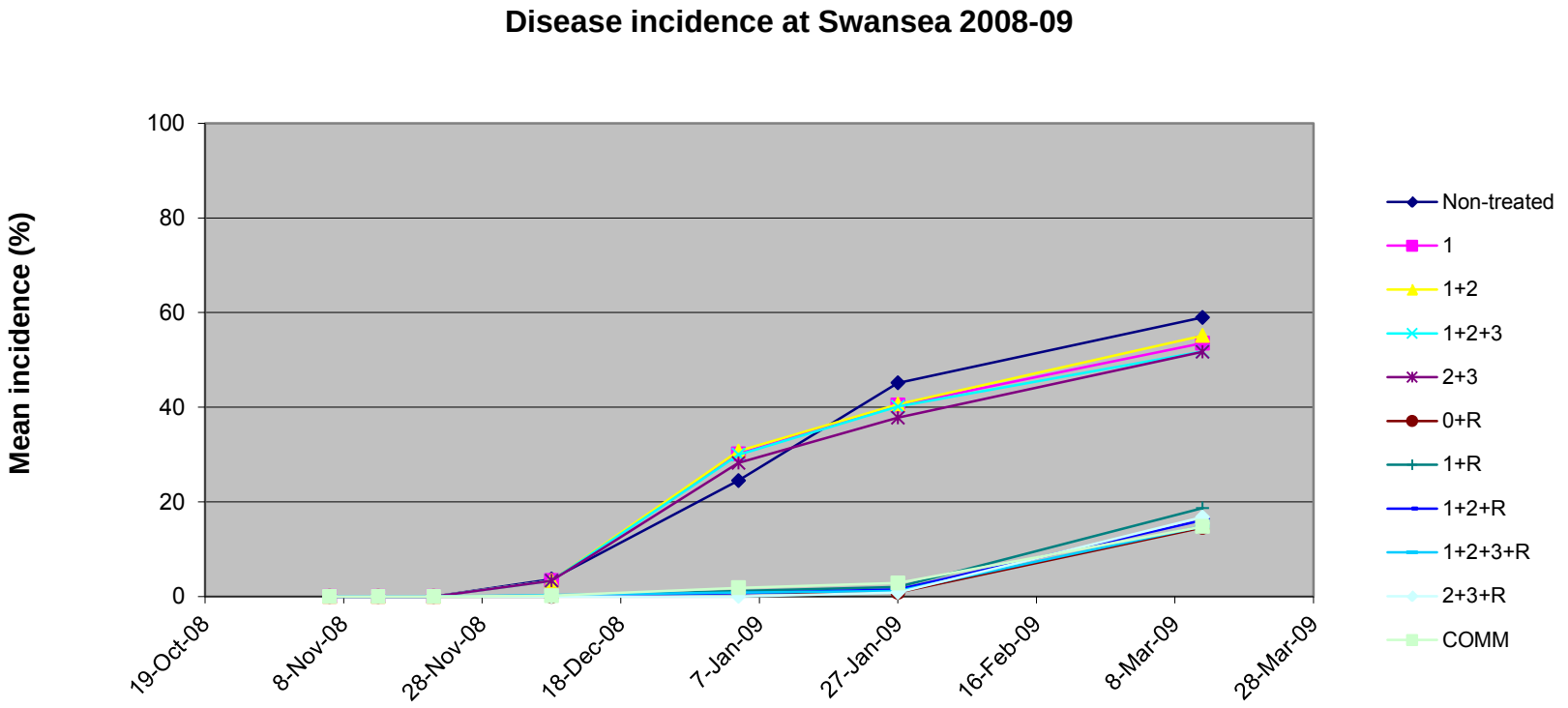
Validation of weather-based spray model?



Conclusions

- Disease development varies from year to year
- Rainfall a key variable in the development of disease
- All commercial cultivars susceptible
- Copper-based sprays necessary for reducing current disease and future inoculum potential
- Increasing spray volumes, up to the point of perceived runoff, may potentially provide greater control of disease?
- A weather-based decision rule for timing sprays being developed
- Further scope to increase control with the addition of penetrants to budburst sprays?

Acknowledgements

- Horticulture Australia Limited
- Walnuts Australia
- Tasmanian Institute of Agriculture
- Joint Venture Orchard growers
- Agronico Pty Ltd
- New Zealand Walnut Industry Group

Thankyou!

Australian *Walnut* *Industry Association*

Horticulture Australia

MANAGEMENT OF WALNUT BLIGHT IN AUSTRALIA

June 30, 2013

Michael Lang

Research Scientist
Walnuts Australia
Tasmania Institute of Agriculture
University of Tasmania

Introduction

Walnut blight, caused by the bacterial pathogen *Xanthomonas arboricola* pv. *juglandis (Xaj),* is present in all walnut growing regions in Australia. The pathogen attacks flowers, shoots, leaves, buds and fruit of all commercial cultivars grown in Australia.

Fruit infections can cause great economic loss through reductions in fruit yield from premature fruit drop, and from reductions in the quality of the in-shell product because of shell staining (Figure 1).

Figure 1: Economic losses associated with walnut blight include kernel rot (left) and shell staining (right)

Symptoms on fruit

The first symptoms consist of dark green, translucent or water soaked areas. As lesions develop, the central areas turn black with a narrow water soaked band surrounding the lesion (Figure 2); the width of the band may vary from one to several mm. The band may disappear entirely, presumably when *Xaj* ceases colonization of healthy tissue.

With ageing, lesions may become depressed, and with high humidity, droplets containing decomposed cellular materials, bacteria and bacterial slime may ooze from lesions.

Infections that occur prior to the formation and hardening of shell tissue may rot or blacken and shrivel the developing kernel (Figure 1).

Later infections are usually confined to the hull; however, the hull can often adhere to the shell, leading to staining on the shell after its removal (Figure 1).

Figure 2: Fruit with water soaking and black lesions typically associated with walnut blight.

Spread of bacterium

Xaj primarily overwinters in the outermost portion of walnut buds and catkins[1,2]. Colonisation patterns during bud and shoot development in spring, suggest that resident *Xaj* can invade and infest internal bud parts and developing fruits[3].

Wind driven rain-splash may be important in the movement of *Xaj* onto developing fruits, given that bacteria are easily suspended into rain-splash and transported onto healthy host tissue[4].

Aerial dissemination of infected pollen from diseased catkins may also transmit the bacterium to pistillate flowers[5]; however, the contribution of infected pollen as an inoculum source in Australia remains unknown.

Epidemic development

Walnut blight epidemics can differ markedly between cultivars, locations and years[6,7] e.g., Figure 3, with damaging epidemics developing when weather conditions are favourable.

Rainfall, and factors associated with rainfall, are important in the development of walnut blight epidemics[6,7] e.g., in Tasmania, greater rainfall during the bud break and shoot elongation periods have been associated with increased rate and incidence of walnut blight[8].

The frequency and duration of dews have been associated with increased incidence of blight on fruits and leaves in California[2]; furthermore, an increase in relative humidity within the tree canopy has been implicated for increased disease incidence on fruits in southern Spain[9].

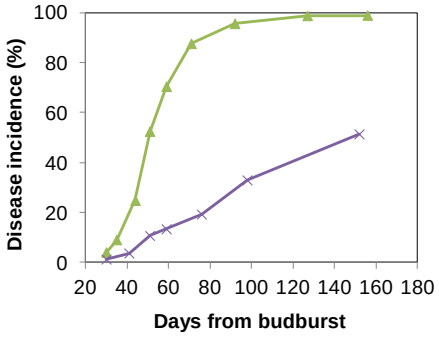


Figure 3: Temporal progression of walnut blight on Franquette fruits in 2005-06 (triangle) and 2006-07 (cross) in Tasmania.

Protective spray programme

The current management strategy is based on multiple copper-based sprays for protecting susceptible plant tissue. However:

1) Copper tolerant strains of Xaj have been identified in Tasmanian walnut orchards[10], and are present in French and Northern Californian orchards with a history of high copper use[11,12].

2) The intensive use of copper sprays may severely impair soil microbial function[13], and may have potential long-term detrimental effects on crop yield in walnut orchards[14].

Research is ongoing to develop methods for managing walnut blight with less copper.

Active ingredients

Copper-based products are more effective than non copper products in reducing blight incidence and yield loss, with bactericidal sanitation treatments, systemic acquired resistance compounds, and antibiotics proving to be either ineffective or unreliable[1,7].

Copper applied alone does not always provide effective control of walnut blight. However, the addition of EDBC fungicides, such as maneb and mancozeb, to copper has increased control of walnut blight in comparison to applications of copper alone, in Californian and Tasmanian orchards[7,15] (e.g., see Figure 4).

These findings indicate the importance of combining amendments with copper-based products to increase the toxicity of copper to the walnut blight pathogen.

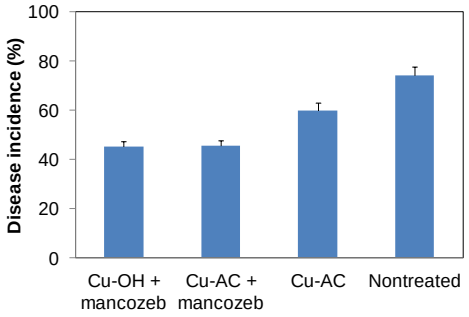


Figure 4: Mean percent Franquette fruits with walnut blight in 2005-06 in Tasmania. Copper treatments: Cu-OH = copper hydroxide, Cu-AC = copper ammonium complex[16].

Copper rates

Copper-based sprays applied at rates lower than label rates provided effective control of blight in low disease pressure years in Tasmania[7]; however, crop yield was significantly reduced in high disease years.

Copper on walnut fruits in Tasmania may have been depleted to sub-lethal levels by heavy precipitation in high disease years[7]. Research is ongoing to determine sustainable copper rates for managing walnut blight.

Spray timing

Reducing the initial inoculum is a suitable strategy for control of walnut blight in low disease years. Early-season copper-based sprays provided adequate control of blight in California, Spain and Tasmania[6,7,17]. In these epidemics, sprays applied from budburst to three weeks after budburst may reduce pathogen inoculum, protect primary infection courts and reduce disease incidence.

In years with high disease incidence, however, multiple copper-based sprays may be required to provide adequate control of walnut blight epidemics[6,7]. In these epidemics, inoculum can be multiplied many times during the growing season, thus requiring further sprays during the growing season.

Disease on fruits when half full-size diameter indicates the likelihood of the subsequent crop yield in Tasmania[18] (Fig. 5), and indicate the importance of controlling the disease from bud-burst to when nuts are half-grown.

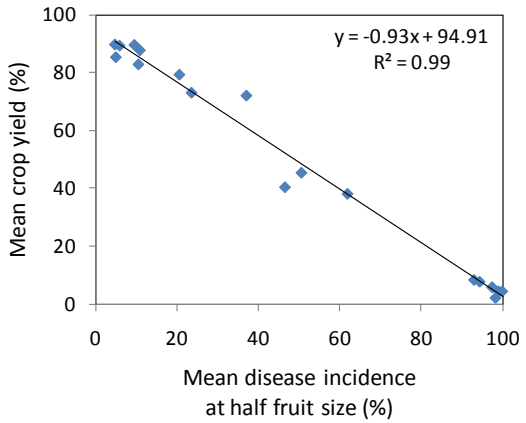


Figure 5: Relationship between disease incidence and crop yield in non-copper treated Vina fruits from 2004 to 2008 in Tasmania[18].

Concluding remarks

The incidence of walnut blight can vary markedly between cultivars, locations and years in Australia, with the development of damaging epidemics when weather conditions are favourable.

Walnut blight has the potential to seriously reduce yield and under conditions conducive to disease development and a conservative protective spray approach is warranted.

The lack of viable control strategies, other than copper-based sprays, for managing the disease has focused research on optimising the timing of copper sprays. Sprays, timed according to pathogen activity, may adequately control walnut blight and limit unnecessary applications of copper.

Acknowledgements

This project was facilitated by Horticulture Australia Limited (HAL) in partnership with the Australian Walnut Industry Association. The Australian Government provides matched funding for all HAL's research and development activities.

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