Pathogenic bacteria and fungi associated with premature drop of walnut in Australia

Michael Lang[1], Kirsty Phillips[1], Emily Thomas[2], Chin Gouk[3]

[1] Webster Limited, 148 Colinroobie Road, Leeton, NSW, 2725, Australia
[2] Charles Sturt University, Locked bag 588, Wagga Wagga, NSW, 2678, Australia
3 Agriculture Victoria, Centre for AgribioScience, La Trobe University Campus, Bundoora, VIC, 3083, Australia
michael.lang@websterltd.com.au

Background

- Fruit disease is a major factor limiting walnut production in Australia, and has significantly reduced crop yields in orchards without effective crop protection.
- Diseases associated with walnut fruit include walnut blight, brown apical necrosis and/or apical necrosis; all these diseases are caused by bacterial and/or fungal pathogens.
- This study identified bacteria and fungi from diseased walnut fruit, and examined crop protection strategies in Australia.

Key findings

1) Microorganisms recovered from diseased fruit

- The walnut blight bacterium, *Xaj*, was detected in the presence of fungal pathogens in 33-38% of samples (Table 1). Only one sample had *Xaj* without fungi (data not presented).
- Irrespective of the region the most frequently isolated fungal pathogens were *Alternaria spp*. A subsample of isolates closely matched reference isolates of *A. alternata and A. daucifolii*. *Fusarium spp.* were isolated from 25-33% of samples, with subsamples closely matched to reference isolates of *F. solani* and *F. oxysporum*. Both *Alternaria* and *Fusarium* were present in 20% of samples (data not presented).
- Fungal pthogens associated with Botryosphaeria blight were detected occasionally. The most frequently isolated organism closely matched reference isolates of *Diplodia seriata.*

Table 1. Number and percent (in parenthesis) of diseased fruit samples with *Xanthomonas arboricola pv juglandis* (*Xaj*), Alternaria, Fusarium and Botryosphaeria in semi-arid (Leeton, NSW) and cool-temperate (Swansea, TAS) regions of Australia.

Location	No. of samples	*Xaj*	Alternaria	Fusarium	Botryos-phaeria
Leeton (NSW)	8	3 (38)	6 (75)	3 (38)	3 (38)
Swansea (TAS)	12	4 (33)	9 (75)	3 (25)	1 (8)

Details of fruit disease and crop protection experiments

Experiments were conducted over two years, 2014-15 and 2015-16, in semi-arid (Leeton, NSW) and cool-temperate (Swansea, Tasmania) regions of Australia. For each experiment single-tree plots (n=4) were selected from uniform areas of the orchard. Two limbs per tree were selected prior to budburst and fruit presence recorded at 1-2 week intervals from fruit set to the onset of harvest. Symptoms of fruit disease were recorded at each assessment. Copper and mancozeb treatments were applied at 7-10 day intervals from 5% terminal budburst to fruit set, and then prior to rainfall from fruit set to shell hardening. Fruits with disease symptoms were collected from orchards and stored at 4°C prior to isolation and identification of microorganisms. Each sample consisted of between 10-50 fruit.

Horticulture Innovation Australia

WEBSTER

This project has been funded by Horticulture Innovation Australia Limited with co-investment from Webster Limited and funds from the Australian Government.

2) Fruit disease

- Disease incidence varied between cultivar, location and year (Table 2, Figure 1), with disease greater in 1) *Vina in the semi-arid region and Chandler ± Vina in the cool-temperate region, 2) the cool-temperate region and, 3) 2015-16.*

Table 2. Standardised area under the disease progress curve (SAUDPC %-day) on fruits in semi-arid (Leeton, NSW) and cool-temperate (Swansea, TAS) regions in 2014-15 (fy15) and 2015-16 (fy16).

Cultivar	SAUDPC (%-day) [1]			
	Leeton (NSW)		Swansea (TAS)	
	fy15	fy16	fy15	fy16
Serr	6.2 c	18.2 a	-	-
Vina	7.7 d	12.7 a	5.6 b	1.9 a
Lara	5.4 bc	1.8 a	0.1 a	0 a
Howard	1.6 ab	5.9 a	0.8 a	0.3 a
Chandler	0.4 a	10.6 a	7.5 b	31.0 b

[1]*Means within each column accompanied by the same letter are not significantly different at P = 0.05.*

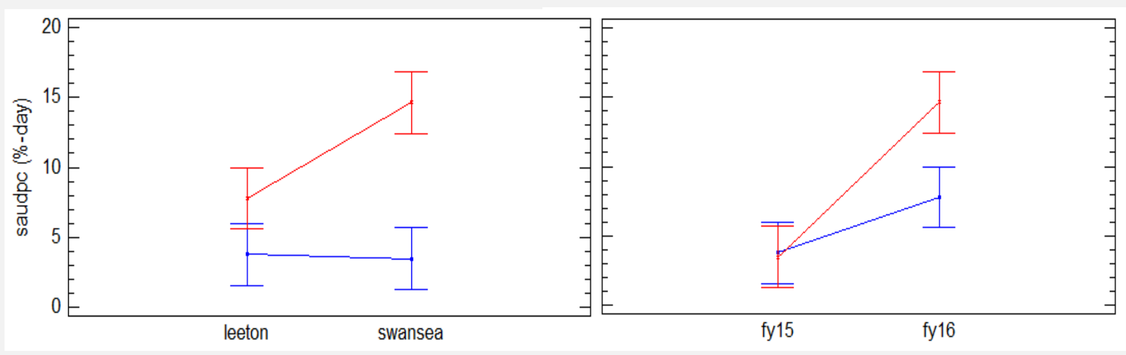

Figure 1. Standardised area under the disease progress curve (SAUDPC %-day) on fruits in the semi-arid (Leeton, NSW) and cool-temperate (Swansea, TAS) regions in 2014-15 (fy15) and 2015-16 (fy16).

3) Premature fruit drop (PFD)

- PFD was positively correlated with observable disease on fruits, with or without crop protection (e.g., Figure 2). Copper + mancozeb significantly reduced fruit disease and PFD, in both the regions.

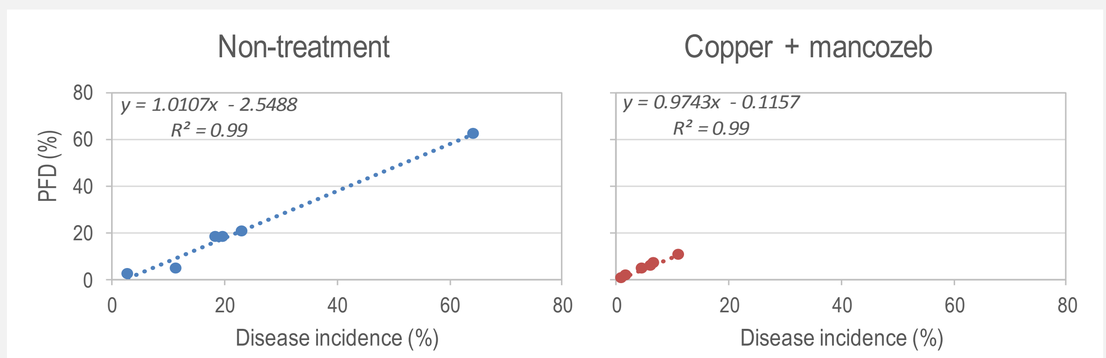

Figure 2. Mean disease incidence and PFD with non-treatment (left) and copper + mancozeb treatment (right) in the semi-arid (Leeton, NSW) region in 2015-16.

Conclusions

- **Fruit disease is caused by bacterial and/or fungal pathogens in semi-arid and cool-temperate regions of Australia.**
- **Disease development influenced by environmental variability between growing regions, fluctuation in weather between years and potential differences in cultivar susceptibility.**
- **Implementation of preventative copper + mancozeb treatments appears critical to reducing fruit disease and crop loss.**