Mould in tunnel-grown raspberry – can it be predicted?

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TIA is a joint venture of the University of Tasmania and the Tasmanian Government

Problem: Unexpected spoilage due to mould on arrival after transport

Question:

1. What are the main mould pathogens?

2. Can "mould load" be predicted pre-harvest?

3. How does wetness, temperature and humidity vary in tunnels - infection risk

Background

Grey mould (*Botrytis cinerea*) is typically the main problem

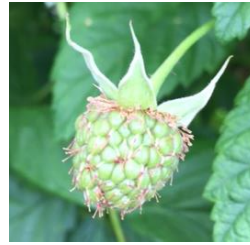Infection usually starts with flowers and remains hidden until post-harvest

Green fruit less susceptible to infection

Little known about infection pathways specifically for raspberry

Susceptible to infection

Latent

Susceptible to infection?

Latent
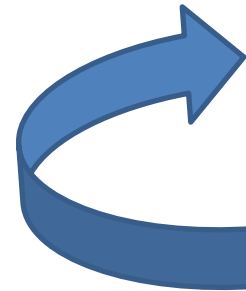
Susceptible to infection?

Latent

Susceptible to infection

Symptoms may develop

Mould can develop

Susceptible to infection

Background – UK studies

Usually lower incidence in tunnels than open field-grown for raspberries (based on UK studies)

Floral infection still high in tunnels

No success in predicting floral infection based on temperature and humidity (amount of inoculum has a big impact)

Xu et al 2012.

Research trial

-6	-3	Harvest	+3	+6	+9
Briefly frozen	Briefly frozen	Briefly frozen			
Incubated at room temp	Incubated at room temp	Incubated at room temp	Incubated at 4 C	Incubated at 4 C	Incubated at 4 C
Assessed after 7 days	Assessed after 7 days	Assessed after 7 days	Assessed after 3 days	Assessed after 6 days	Assessed after 9 days

Trial design

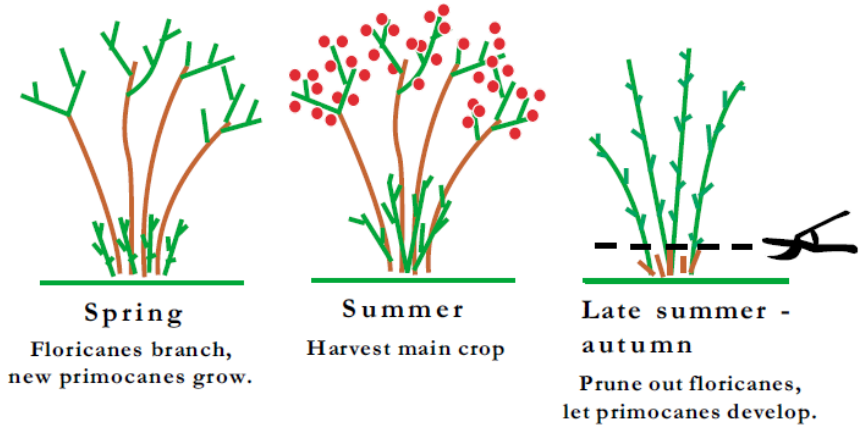4 sampling times (December, January, March, April)

4-5 rows per sampling time

576 fruit per row

(96 x 6 stages)

24 fruit per container

Commercial management of crop, including fungicide program

Spring
Floricanes branch, new primocanes grow.

Summer
Harvest main crop

Late summer - autumn
Prune out floricanes, let primocanes develop.

NSW Agriculture, 2002

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% mould covering each berry

	Treatmen	Row	Container	Incidence		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Average severity
3	-6	B70R11	A	58%	Total	20%	10%	1%	3%	2%	1%	0%	2%	0%	0%	1%	0%	0%	0%	1%	0%	0%	0%	0%	2%	5%	4%	2%	2%	2%
8	-6	B70R11	B	67%	Total	80%	3%	3%	1%	0%	0%	1%	0%	0%	1%	1%	0%	3%	1%	1%	0%	1%	0%	0%	10%	50%	3%	5%	10%	7%
13	-6	B70R11	C	100%	Total	####	100%	####	####	####	90%	100%	80%	5%	70%	20%	####	100%	####	####	100%	100%	10%	90%	100%	####	90%	90%	100%	85%
18	-6	B70R11	D	63%	Total	60%	0%	5%	60%	5%	0%	0%	0%	3%	0%	1%	0%	2%	0%	3%	30%	0%	1%	0%	3%	20%	10%	3%	25%	10%
23	-6	B70R12 (leg)	A	71%	Total	50%	10%	0%	15%	3%	5%	0%	0%	20%	3%	0%	8%	5%	0%	0%	0%	40%	1%	1%	40%	50%	30%	60%	40%	16%
28	-6	B70R12 (leg)	B	67%	Total	5%	0%	5%	3%	10%	0%	0%	5%	5%	0%	0%	10%	0%	0%	10%	15%	2%	3%	2%	90%	15%	10%	20%		9%
33	-6	B70R12 (leg)	C	83%	Total	50%	5%	5%	5%	8%	0%	0%	10%	40%	25%	4%	2%	25%	20%	0%	3%	90%	4%	0%	10%	####	30%	70%	100%	25%
38	-6	B70R12 (leg)	D	100%	Total	####	100%	90%	90%	####	100%	100%	90%	100%	90%	80%	####	100%	####	90%	80%	100%	####	####	70%	####	100%	100%	100%	95%
43	-6	B71R35	A	75%	Total	10%	5%	5%	10%	5%	10%	0%	5%	3%	0%	0%	0%	2%	3%	0%	8%	5%	0%	2%	2%	20%	10%	10%	100%	9%
48	-6	B71R35	B	96%	Total	80%	30%	80%	####	20%	5%	5%	20%	10%	5%	5%	5%	8%	8%	8%	10%	15%	0%	8%	20%	80%	80%	70%	100%	32%
53	-6	B71R35	C	79%	Total	20%	30%	10%	40%	5%	2%	1%	0%	2%	4%	0%	10%	40%	6%	4%	3%	10%	0%	0%	0%	50%	6%	2%	2%	10%
58	-6	B71R35	D	50%	Total	50%	5%	5%	5%	5%	0%	0%	5%	0%	0%	3%	0%	0%	0%	0%	0%	20%	1%	5%	15%	80%	15%	8%	15%	8%
63	-6	B72R80	A	79%	Total	40%	3%	2%	4%	10%	0%	15%	0%	4%	2%	1%	2%	5%	0%	0%	0%	20%	1%	5%	15%	90%	20%	70%	10%	13%

% mould covering each berry

	Treatmen	Row	Container	Incidence		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Average severity
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4	-6	B70R11	A	17%	Botrytis	10%	5%	0%	3%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
5	-6	B70R11	A	50%	Cladosporiu	10%	5%	1%	0%	2%	1%	0%	0%	0%	0%	1%	0%	0%	1%	0%	0%	0%	0%	0%	2%	4%	3%	2%	2%	1%
6	-6	B70R11	A	8%	Penicillium	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%	0%	0%	0%
7	-6	B70R11	A	0%	Other	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
8	-6	B70R11	B	67%	Total	80%	3%	3%	1%	0%	0%	1%	0%	0%	1%	1%	0%	3%	1%	1%	0%	1%	0%	0%	10%	50%	3%	5%	10%	7%
13	-6	B70R11	C	100%	Total	####	100%	####	####	####	90%	100%	80%	5%	70%	20%	####	100%	####	####	100%	100%	10%	90%	100%	####	90%	90%	100%	85%
18	-6	B70R11	D	63%	Total	60%	0%	5%	60%	5%	0%	0%	0%	3%	0%	1%	0%	2%	0%	3%	30%	0%	1%	0%	3%	20%	10%	3%	25%	10%
23	-6	B70R12 (leg)	A	71%	Total	50%	10%	0%	15%	3%	5%	0%	0%	20%	3%	0%	8%	5%	0%	0%	0%	40%	1%	1%	40%	50%	30%	60%	40%	16%
28	-6	B70R12 (leg)	B	67%	Total	5%	0%	5%	3%	10%	0%	0%	5%	5%	0%	0%	10%	0%	0%	10%	15%	2%	3%	2%	90%	15%	10%	20%		9%
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38	-6	B70R12 (leg)	D	100%	Total	####	100%	90%	90%	####	100%	100%	90%	100%	90%	80%	####	100%	####	90%	80%	100%	####	####	70%	####	100%	100%	100%	95%
43	-6	B71R35	A	75%	Total	10%	5%	5%	10%	5%	10%	0%	5%	3%	0%	0%	0%	2%	3%	0%	8%	5%	0%	2%	2%	20%	10%	10%	100%	9%
48	-6	B71R35	B	96%	Total	80%	30%	80%	####	20%	5%	5%	20%	10%	5%	5%	5%	8%	8%	8%	10%	15%	0%	8%	20%	80%	80%	70%	100%	32%

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Main moulds found

Botrytis · Cladosporium · Penicillium · Mucor
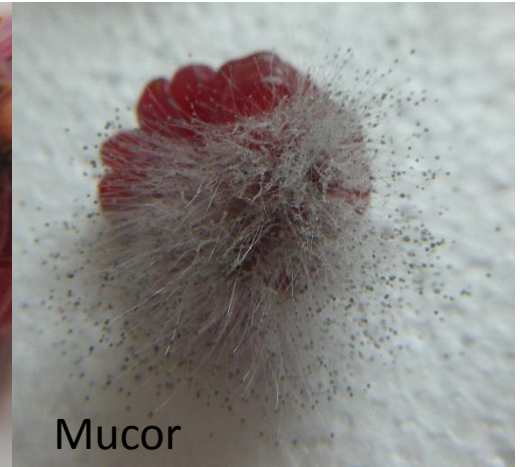
Detection in harvest age, incubated fruit (IxS)

	Dec-16	Jan-17	Mar-17	Apr-17
Botrytis	4.9	23.2	12.1	10.9
Cladosporium	0.9	2.8	2.4	1.5
Penicillium	0.8	1.1	2.2	0.5

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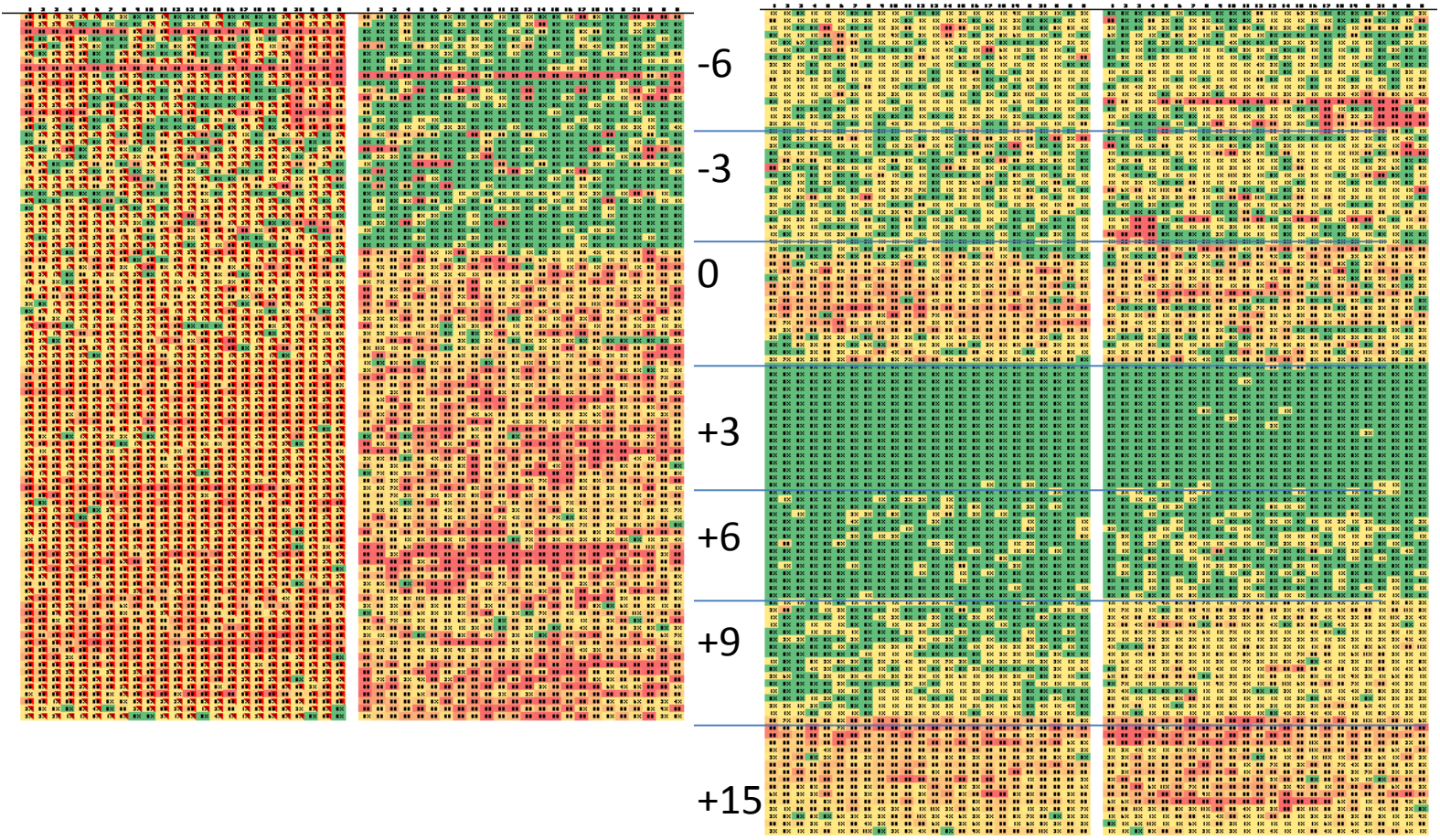
December   January   March   April

-6   -3   Harvest   +3   +6   +9
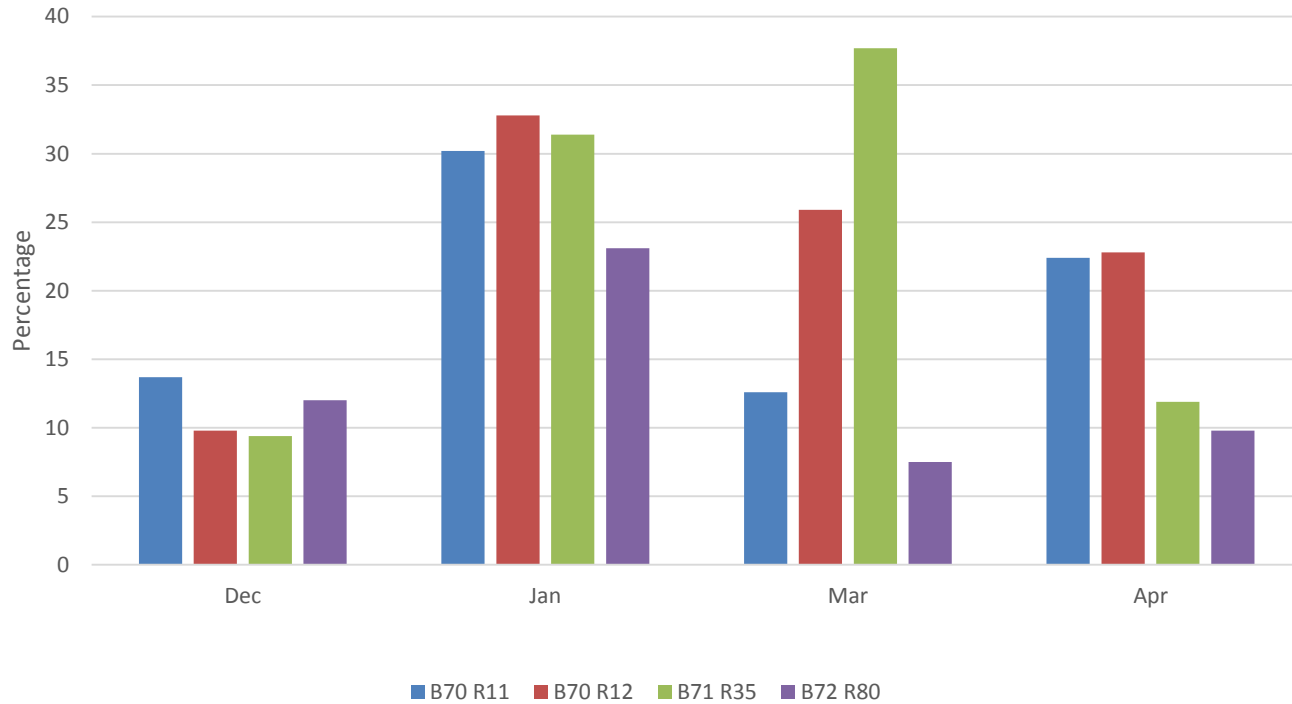
0 & +16

R² = 0.728

0 and +16

R² = 0.3747
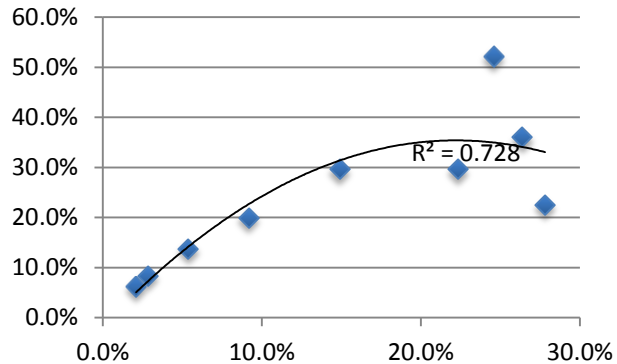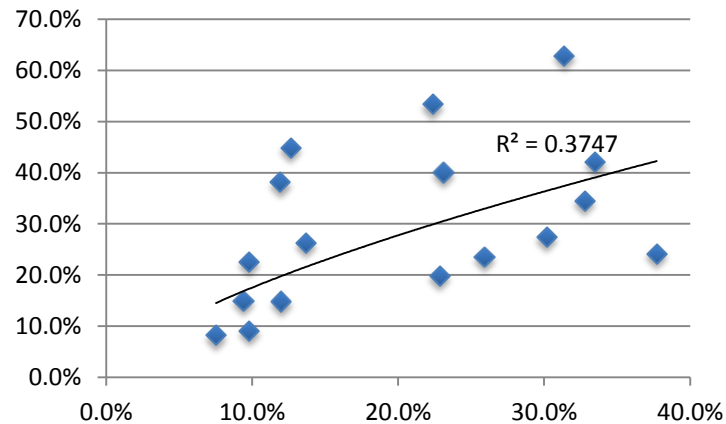
Average percentage of total rot at harvest (0)

Tunnel microclimate

Data loggers

Averages 2 weeks prior to harvest

JAN	Av Temp	Av RH	LW	# days av >18 C and >80% RH
B70R11	18.8 °C			
B70R12	18.0 °C	84.18		4
B71R35	18.6 °C	86.22		9
B72R80	18.7 °C			

MARCH	Temp	RH	LW	# days av >18 C and >80% RH
B70R11	16.7 °C		63.4 %	
B70R12	16.2 °C	84.81	69.9 %	4
B71R35	16.4 °C	82.07	70.7 %	4
B72R80	16.5 °C		65.9 %	

Tunnel microclimate

Cane density – grow through primocane density (March)

Average canes/m
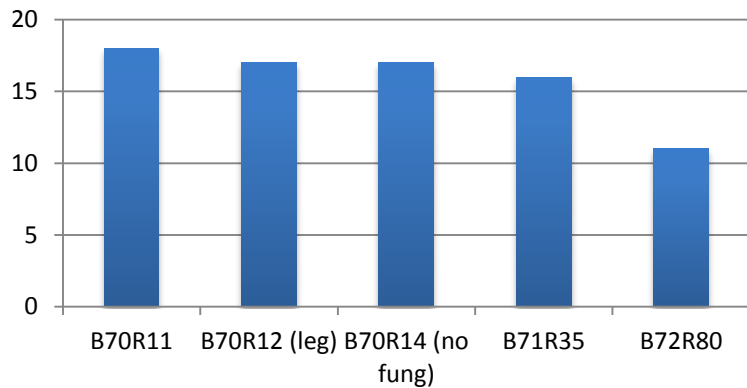
Conclusions

The major pathogen is Botrytis cinerea

With the method used, pre-harvest mould load probably can not predict post-harvest mould
- try again with longer freezing method
- data analysis still underway

Weather data and other tunnel conditions will be further analysed to determine links to mould

On-going studies

Acknowledgements

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