

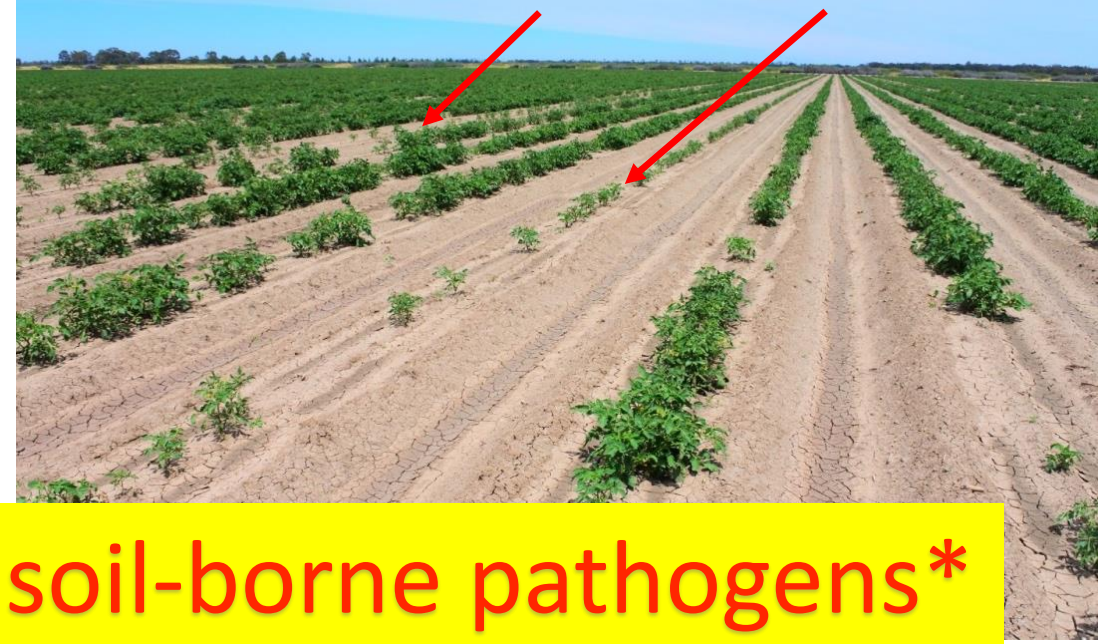
# The diversity, abundance and virulence of soil-borne pathogens contributing to the poor growth of tomato plants in the Australian Processing Tomato Industry

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# Premise of the study: Poor growth



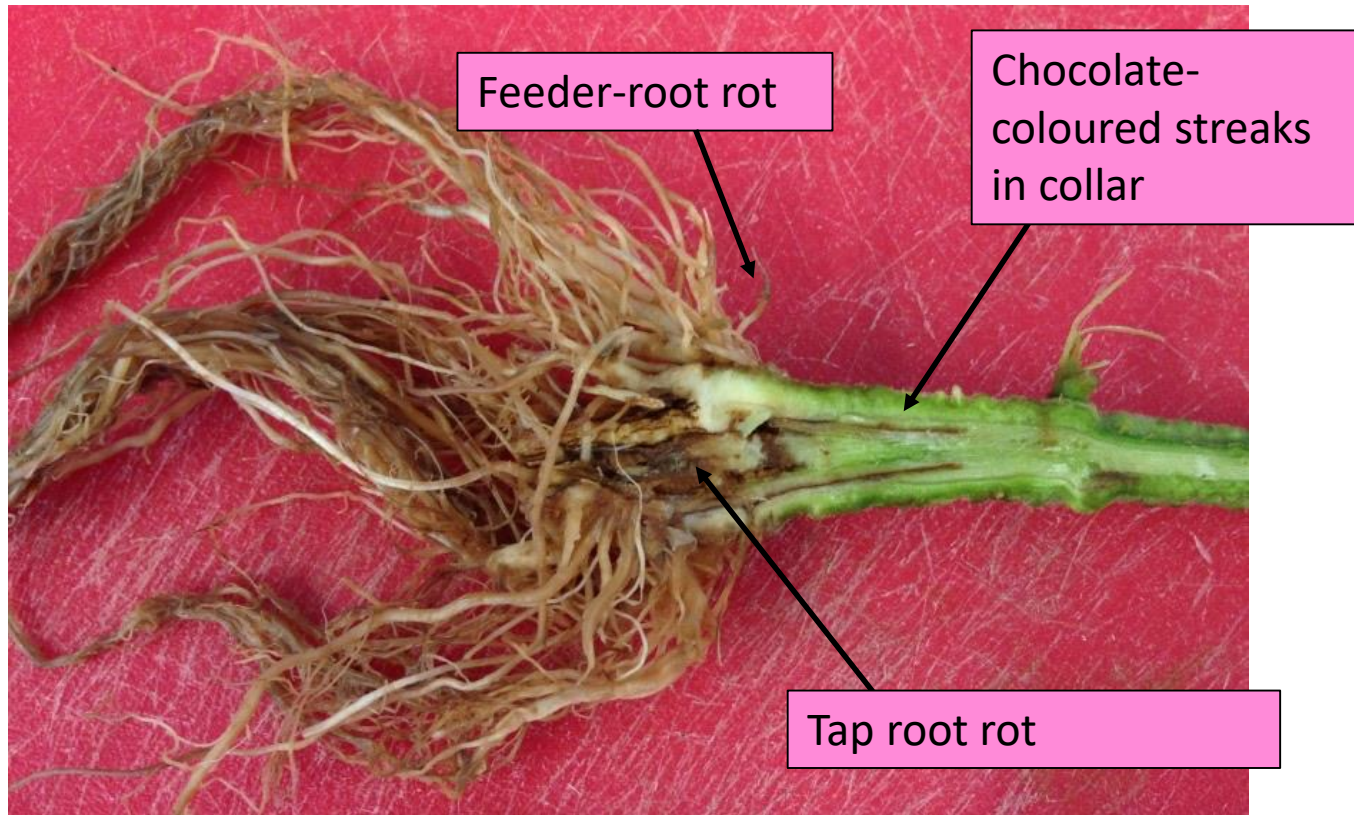
10-15% yield loss from soil-borne pathogens\*



\* Grower estimates

# I. Identification and incidence of important soil-borne pathogens associated with the poor growth of tomato plants

# The two most abundant pathogens



*Fusarium oxysporum*



*Pythium spp.*

# Less abundant putative pathogens and the diseases they cause

Pathogen	Disease caused (in the literature)
Phytophthora nicotianae	Root rot Fruit rot Damping-off
Phytophthora drechsleri	Green fruit rot
Colletotrichum coccodes	Brown root/ black dot Tomato anthracnose Premature senescence
Rhizoctonia solani	Damping-off Fruit rot Foot rot
Alternaria spp.	Leaf spot Early blight
Sclerotinia minor	Sclerotinia stem rot
Plectosphaerella cucumerina	Root and collar rot
Fusarium solani	Foot rot
Fusarium acuminatum	None reported

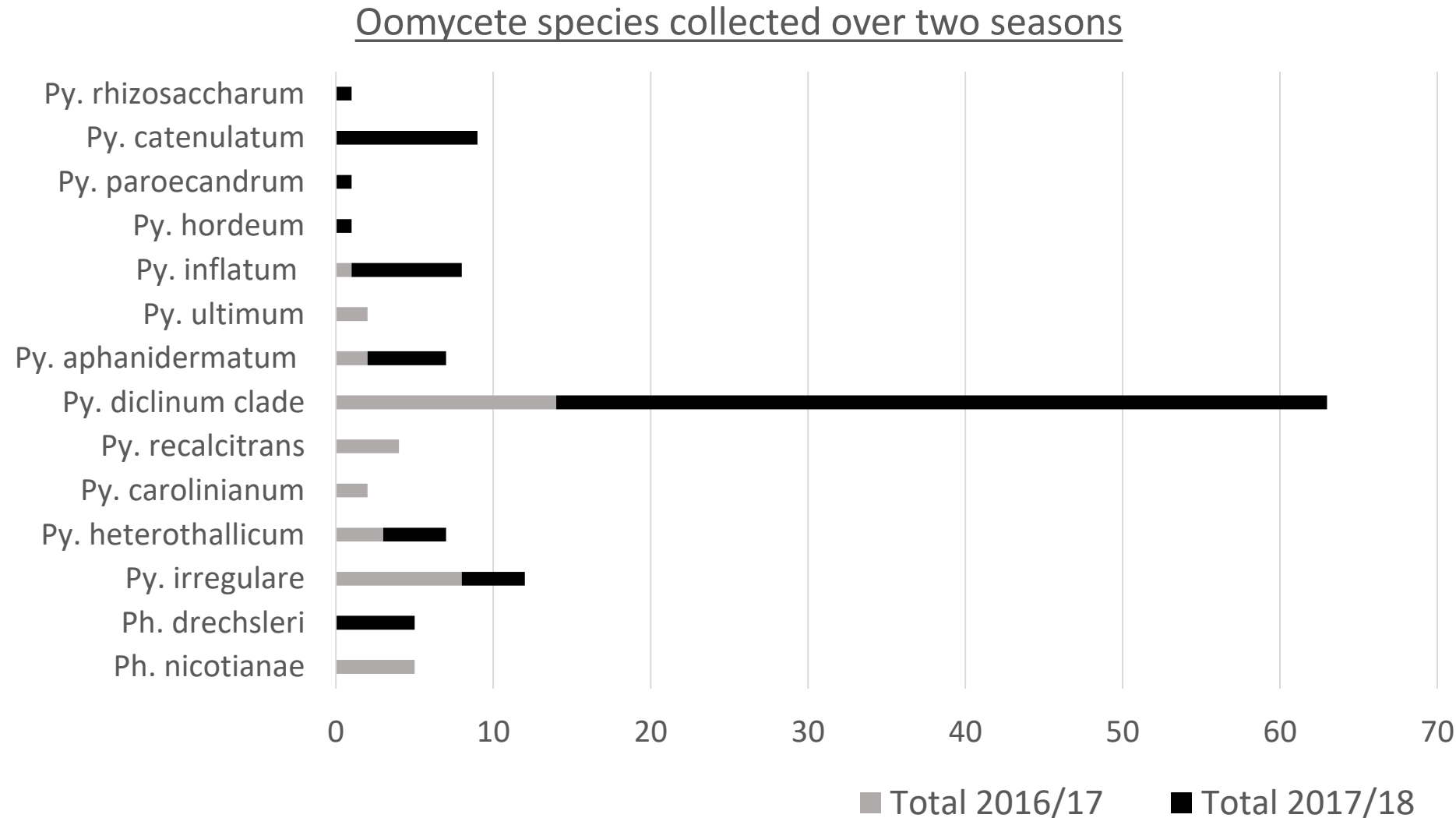
## Surveys have showed us...

- The patho-system now is different from what it was in the past
- The patho-system varies from year to year
- The patho-system here is different to those elsewhere such as California, or even QLD

## II. The diversity, distribution and pathogenicity of Oomycetes associated with yield loss

# Summary of oomycete diversity and incidence

- 143 sequenced
- ID based on ITS, Cox-1, Cox-2 sequences + morphology
- 12 *Pythium* and 2 *Phytophthora* species



# Summary of Oomycete pathogenicity results

Y = causes disease  
N = does not cause disease

Pythium (Py) or Phytophthora (Ph) species	Pre-germination damping-off	Post-germination damping-off	Significantly stunted 2 weeks after inoculation	Significantly stunted 2 months after inoculation
<i>Py. aphanidermatum</i>	Y	Y	Y	N
<i>Py. carolinianum</i>	N	N	N	N
<i>Py. catenulatum</i>	Y	N	Y	N
<i>Py. dissotocum</i>	Y	Y	Y	N
<i>Py. heterothallicum</i>	N	N	N	N
<i>Py. inflatum</i>	N	N	Y	N
<i>Py. irregulare</i>	Y	Y	N	Y
<i>Py. recalcitrans</i>	Y	N	Y	Y
<i>Py. ultimum var. ultimum</i>	Y	Y	Y	Y
<i>Ph. nicotianae</i>	Y	Y	Y	Y
<i>Ph. drechsleri</i>	N	N	N	N

XXXX

### III. Characterisation of the *Fusarium oxysporum* associated with “chocolate streak” disease

# Chocolate streak disease

- “Chocolate streak” symptom observed over 2 seasons at >50% sites
- Looks like Fusarium Crown and Root Rot disease caused by *FORL*?
- *Forl* not reported in Australia



*F. oxysporum* was very virulent in some trials

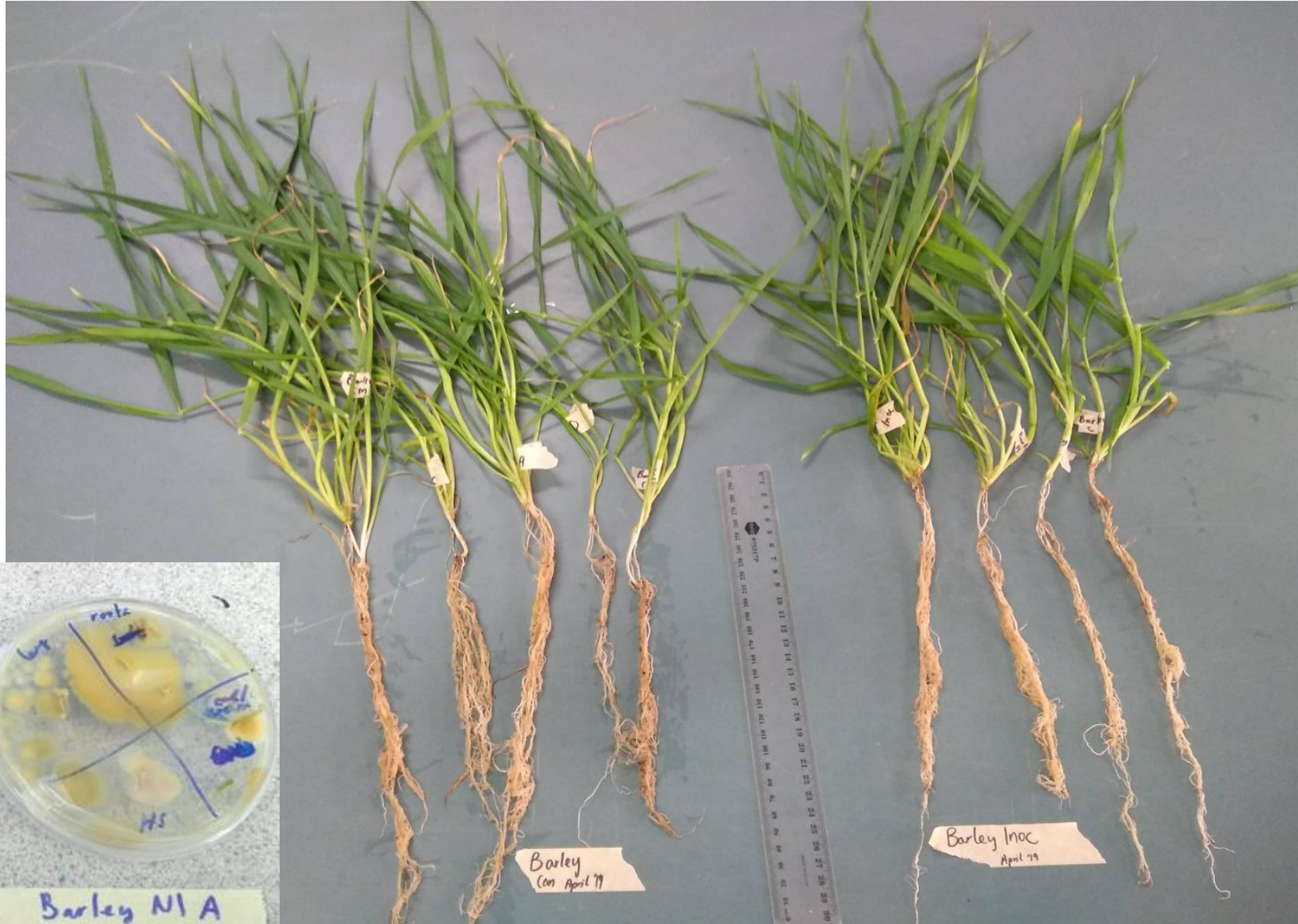


Two months after inoculation, the height, shoot and root weight and tap root length of inoculated plants (right side in both pictures) were all significantly lower than the control plants ( $P < 0.01$ ).

But not so virulent in other trials



# Cryptic hosts of *F. oxysporum*



# Future Research Priorities

## 1. Continued pathogen monitoring

- Known problematic pathogens
- Latent, currently minor pathogens
- Potential new, emerging pathogens



**Leaf with bacterial speck, a troubling disease in the 2018-19 season.**

Image credit:  
<http://www.omafra.gov.on.ca/IPM/english/tomatoes/diseases-and-disorders/bacterial-speck.html>



**Fusarium foot rot, caused by *Fusarium solani*. An uncommon pathogen now but a pending threat?**

Image credit: Demystifying Fusarium diseases, R.M Davis.

# Future Research Priorities

## 2. Targeted management strategies

- Biological controls, e.g. Hanyue's project
- Chemical controls
- Cryptic hosts and crop rotations
- Soil solarisation



# Cryptic hosts of *Fol* in California

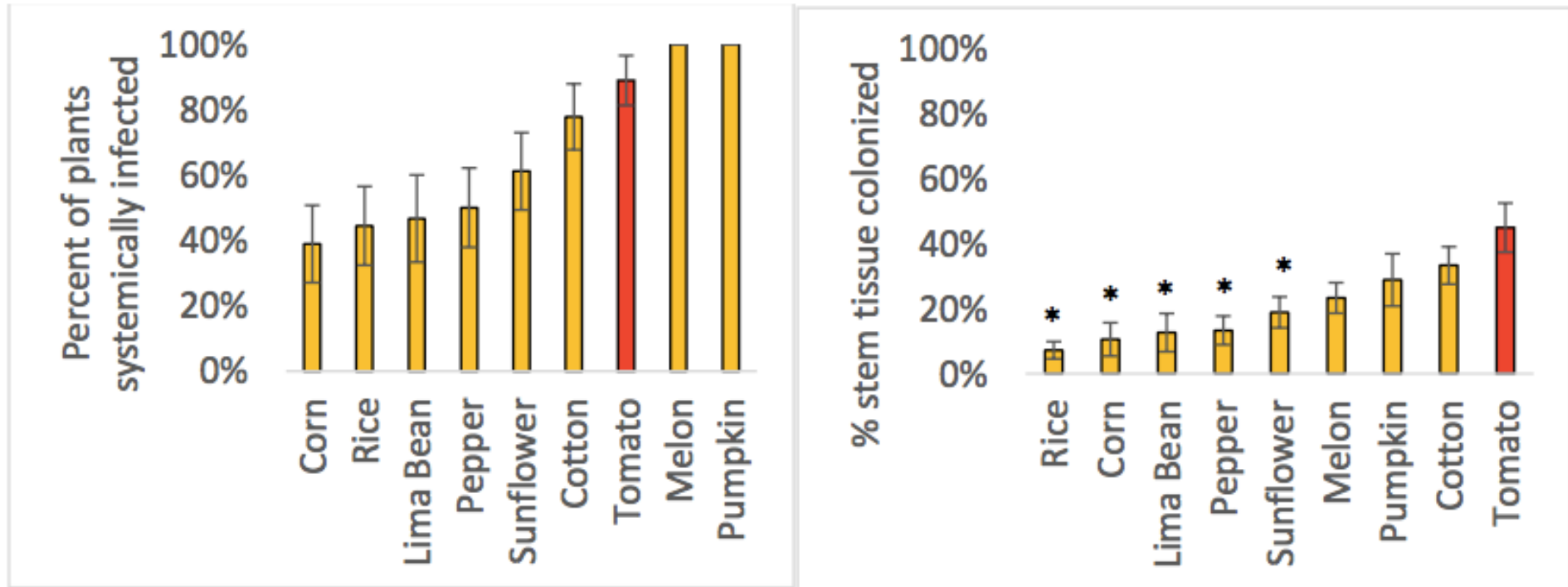


Figure 1. Warm season crops: *Fol* race 3 systemic colonization abilities as evaluated based on (L) percent of plants that *Fol* R3 colonized systemically and (R) extent of stem colonization in infected plants. \*Indicates significantly less colonization than tomato.

# Future Research Priorities

## 3. Disease aetiology

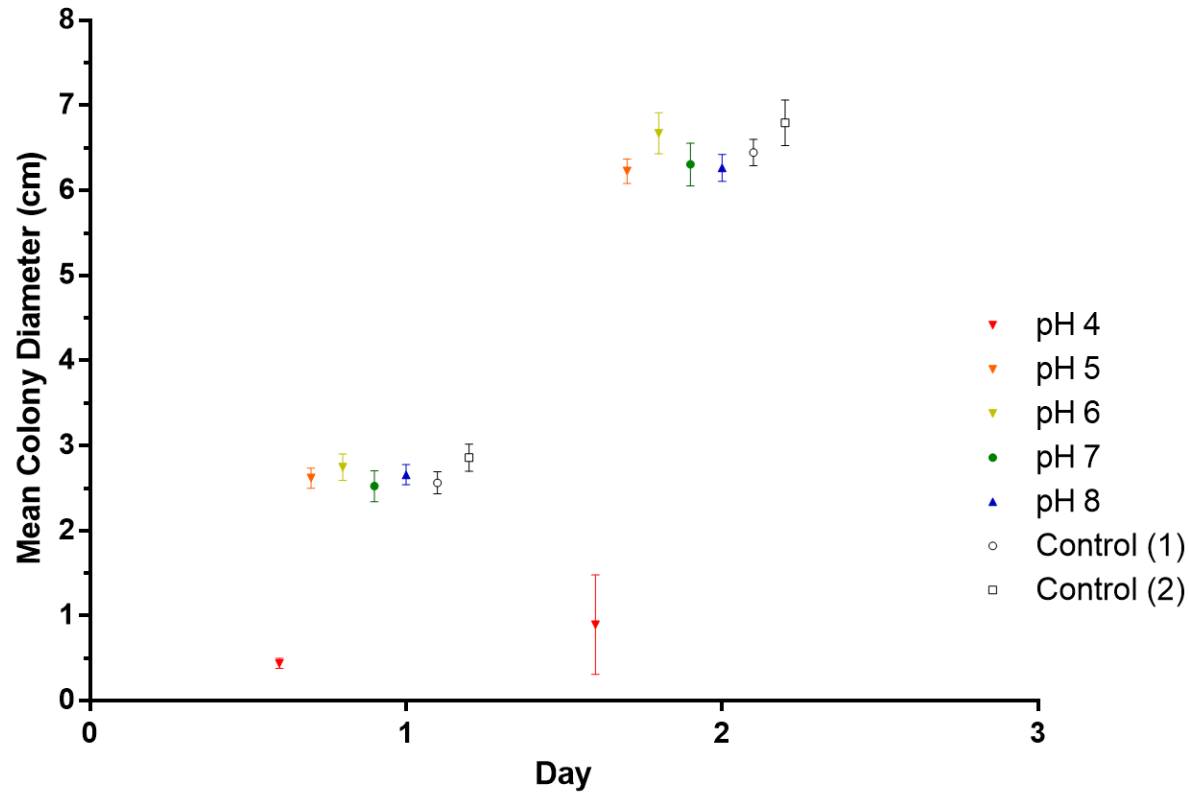
- Interplay between pathogens and various abiotic factors (pH, soil moisture, soil organic content, etc.)
- E.g. Vikesh's project on pH
- Interplay between pathogens and soil biota

Mean (laboratory true mean) soil pH at three sites, near (0cm) and far (45cm) from the emitter.

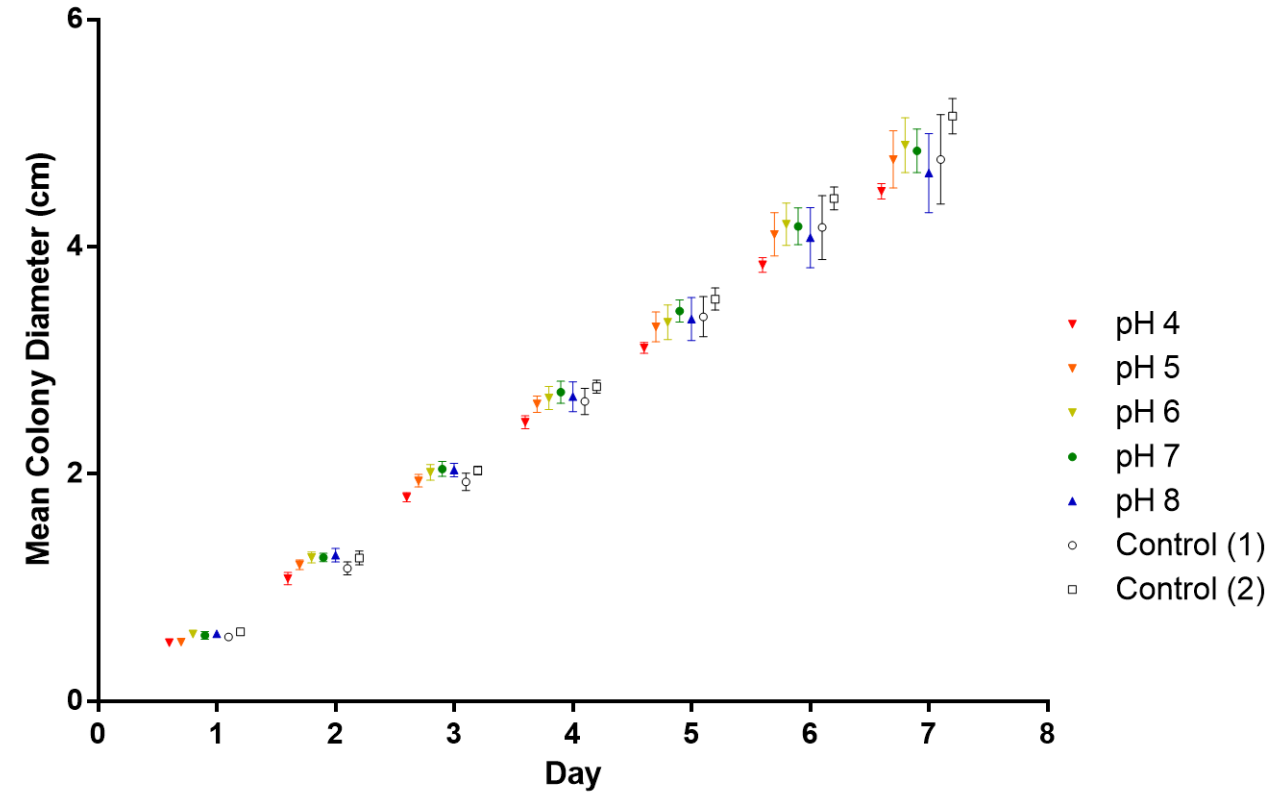
Sites	0cm	45cm
Site 1	5.16	7.66
Site 2	4.97	6.60
Site 3	5.07	6.34

# Effect of soil pH on pathogenicity of *Pythium irregulare* and *Fusarium oxysporum*

Mean Diameter (cm) of *P. irregulare* cultures on PDA over time (days)



Mean Diameter (cm) of *F. oxysporum* cultures on PDA over time (days)



*Pythium irregulare* and *Fusarium oxysporum* growth was not significantly different in pH range between 5-8

## Future Research Priorities

### 4. Characterisation (genetic) of major pathogens

- For the development of PCR-based diagnostic probes
- For population studies, to understand the origin and movement of pathogens
- For breeding of resistant cultivars



# Thank you!

For questions and comments email [callaghan@student.unimelb.edu.au](mailto:callaghan@student.unimelb.edu.au) or [paulwjt@unimelb.edu.au](mailto:paulwjt@unimelb.edu.au)

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