

Fusarium wilt of strawberry

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Collaborators:

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Mark Bolda

Steve Knapp

Glenn Cole



Fusarium wilt

Verticillium wilt

Macrophomina crown rot





Fusarium wilt



Verticillium wilt

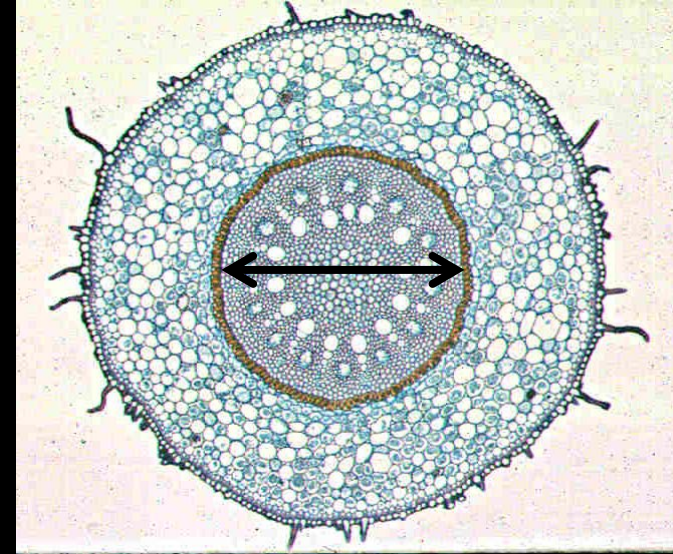
Macrophomina crown rot

Fusarium oxysporum





Fusarium wilt

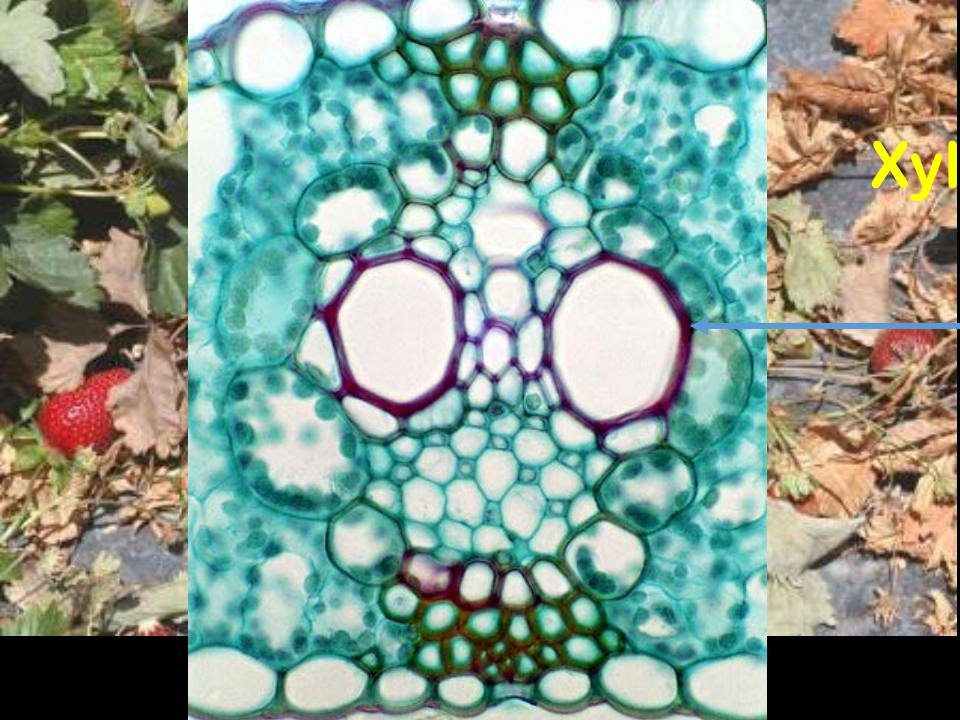


Root cross section



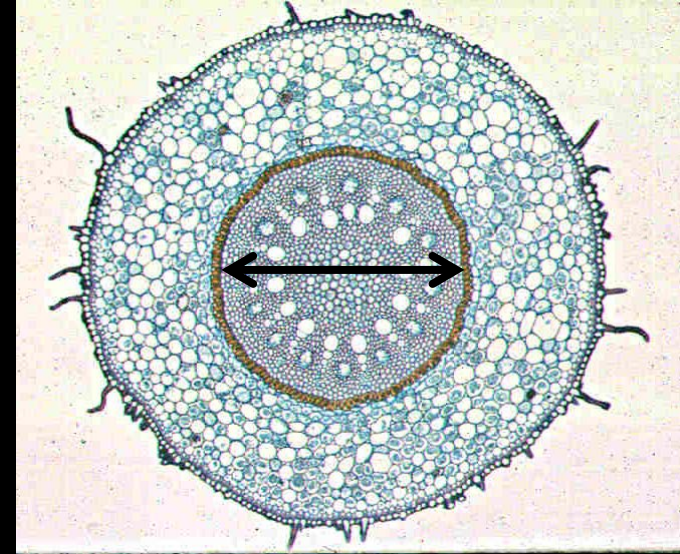
Fusarium oxysporum





Xylem

Fusarium wilt

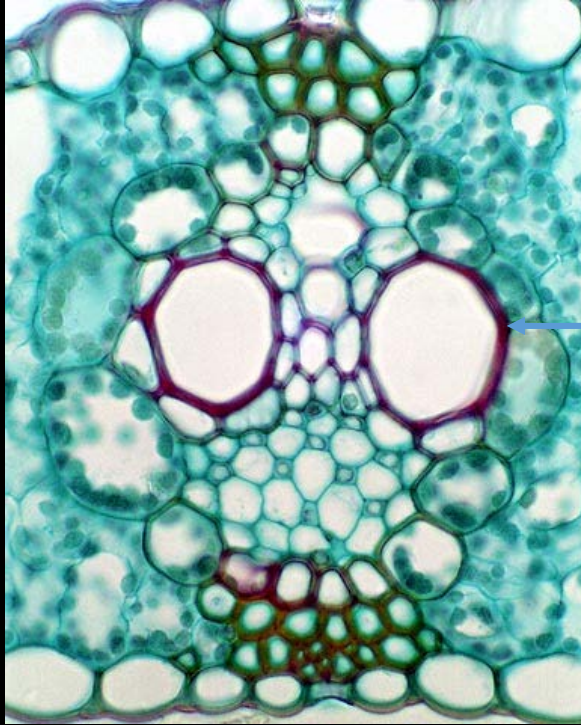


Root cross section

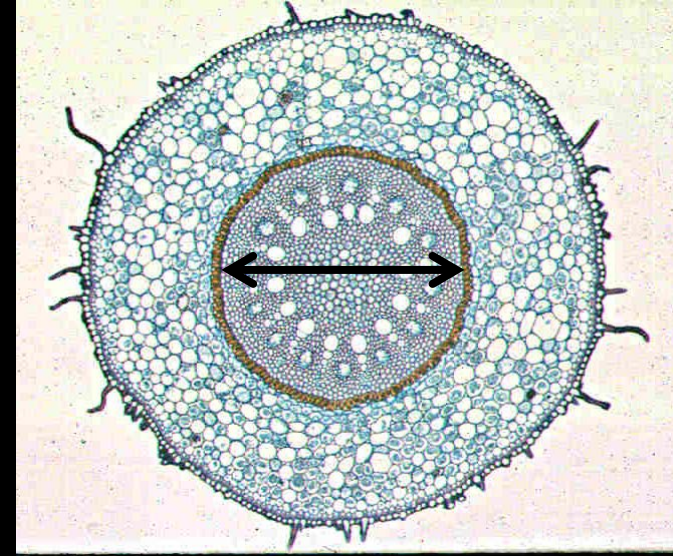


Fusarium oxysporum

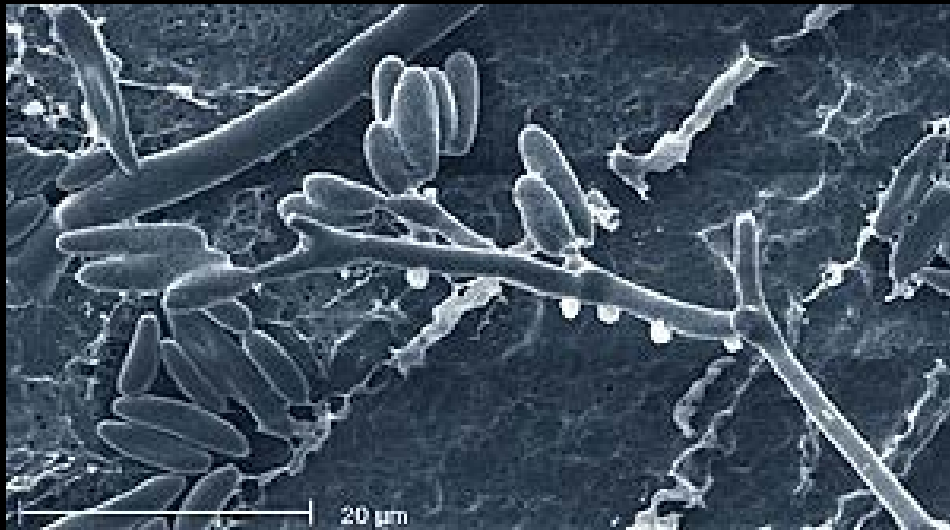




Xylem



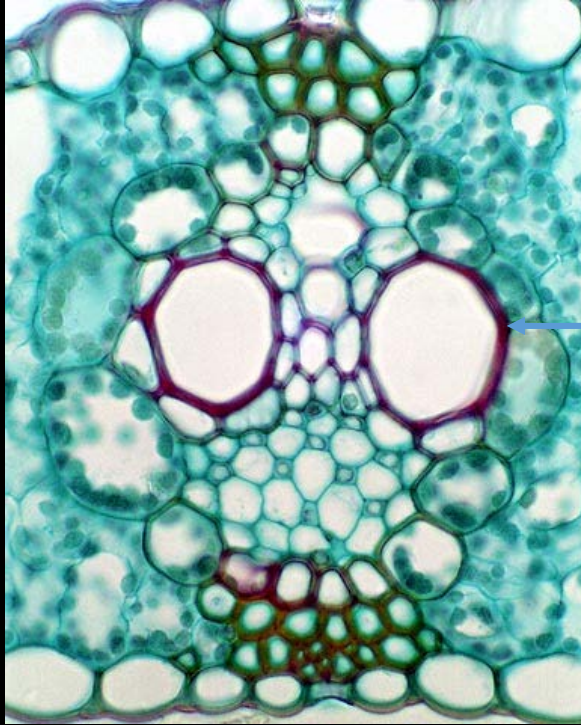
Root cross section



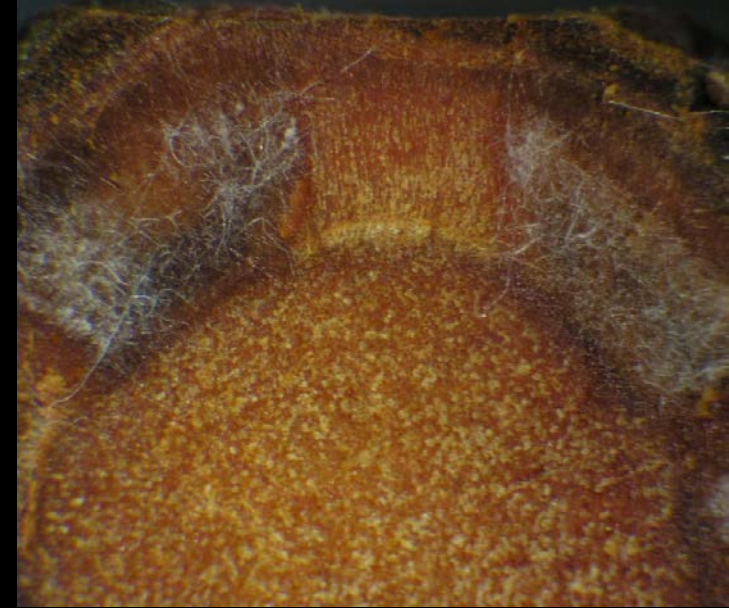
Fusarium oxysporum

Spores carried
upward in xylem vessels

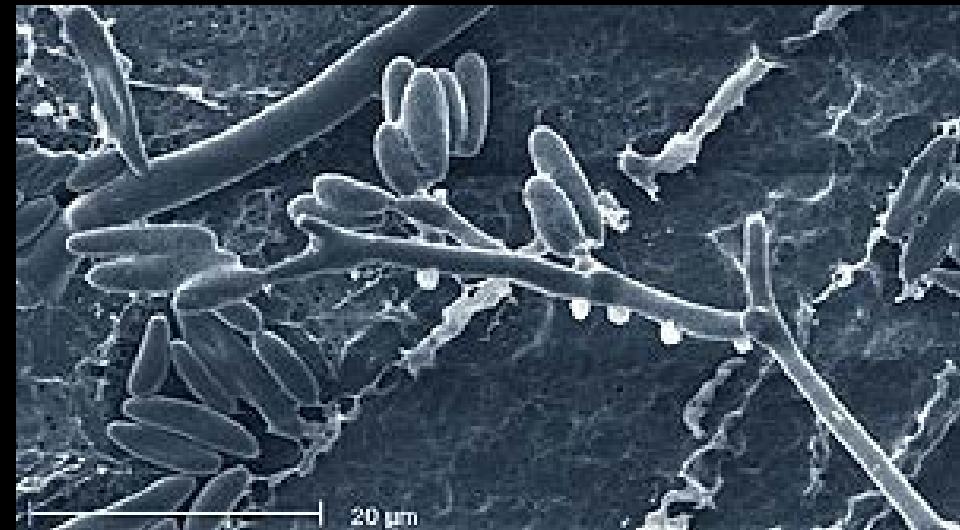




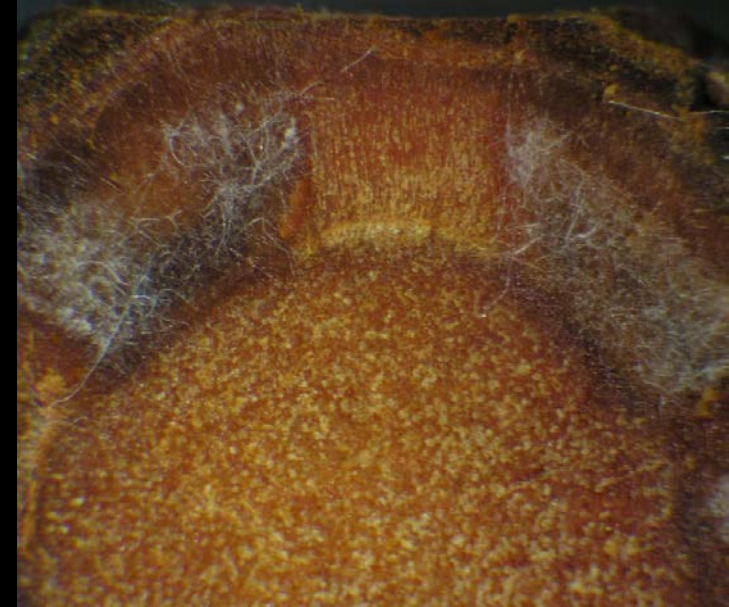
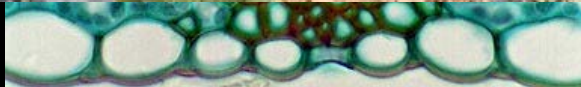
Xylem



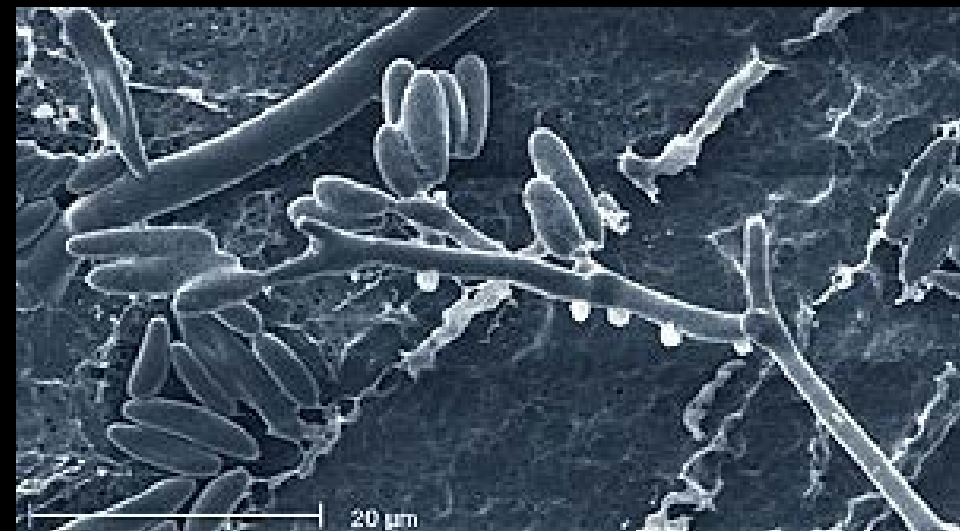
**Colonized
vascular tissue**



**Spores carried
upward in xylem vessels**

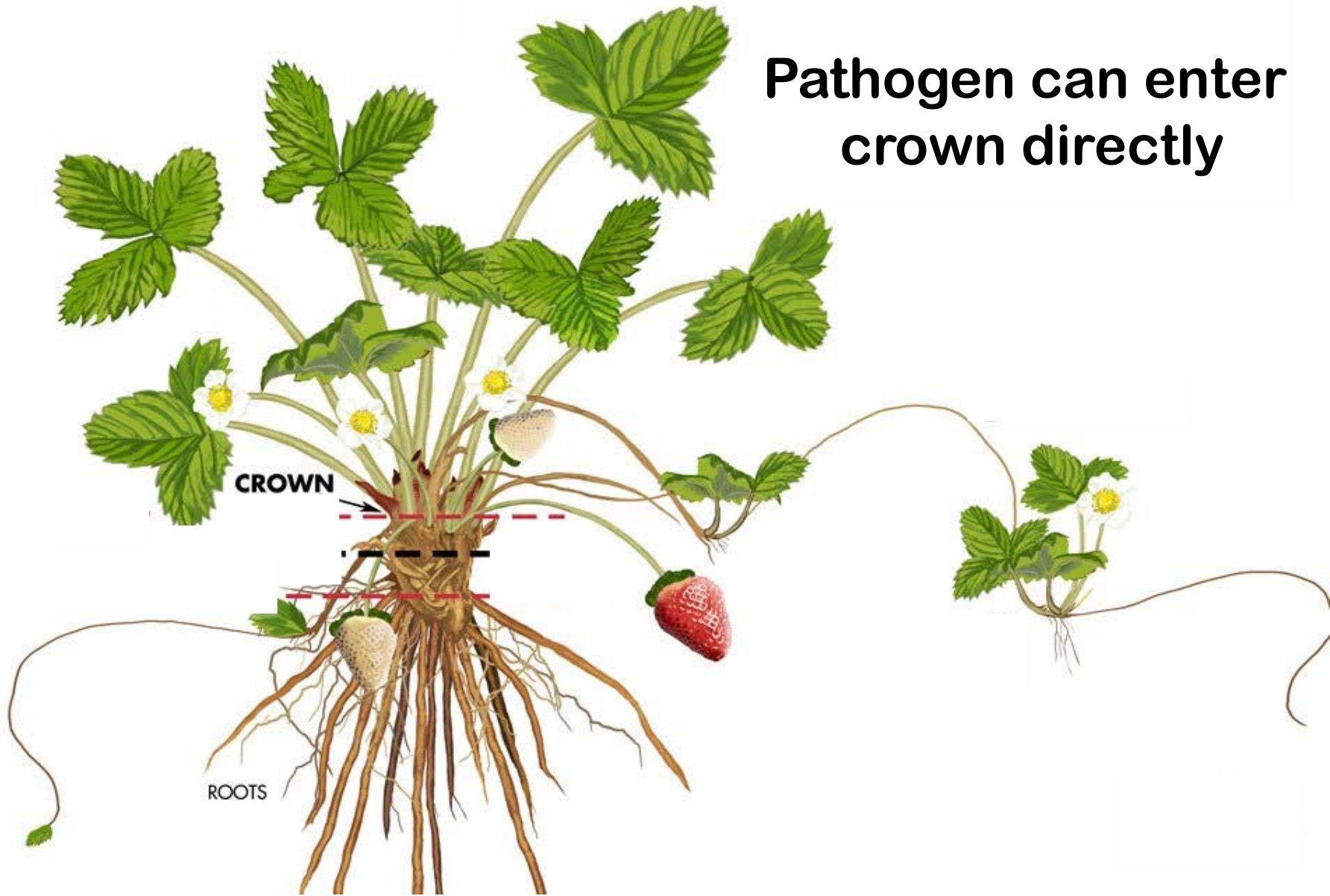


**Colonized
vascular tissue**



**Spores carried
upward in xylem vessels**

**Pathogen can enter
crown directly**





Macrophomina

Photo credit: Steven Koike

Management

Avoid introduction

Soil on equipment

Clean plants

Transmission of *Fusarium*
to daughter plants



Transmission of *Fusarium* to daughter plants





Inoculation

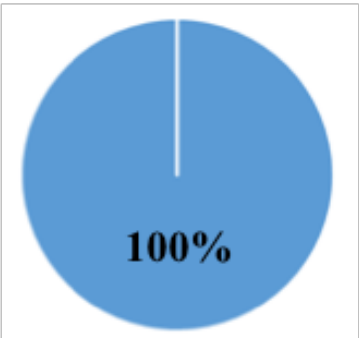
Infected

Remain vigorous

Albion

 = Infected
 = Not Infected

Mothers



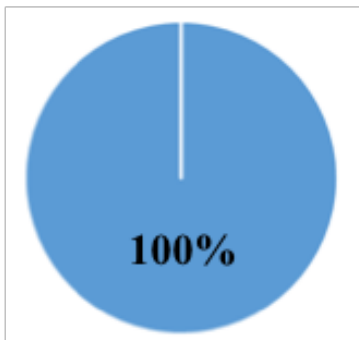
1st Stolons



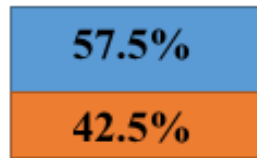
Albion

■ = Infected
■ = Not Infected

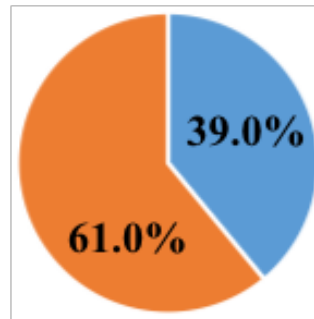
Mothers



1st Stolons



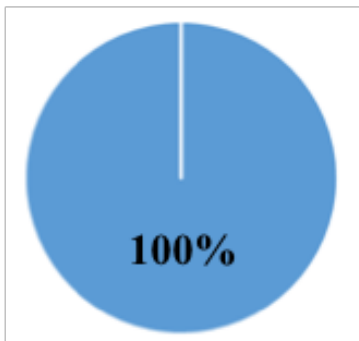
1st Daughters



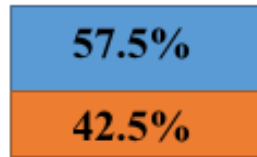
Albion

■ = Infected
■ = Not Infected

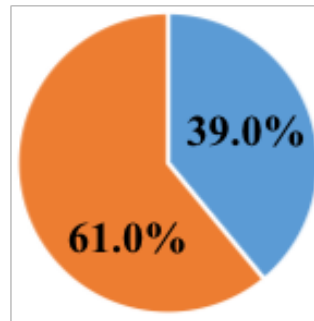
Mothers



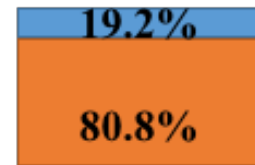
1st Stolons



1st Daughters



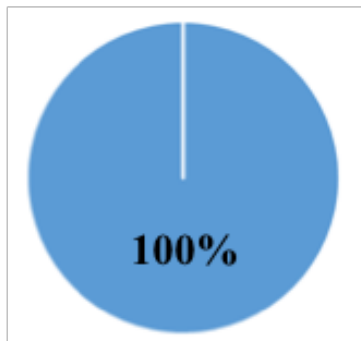
2nd Stolons



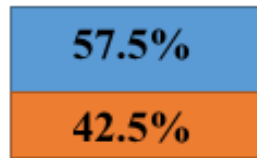
Albion

■ = Infected
■ = Not Infected

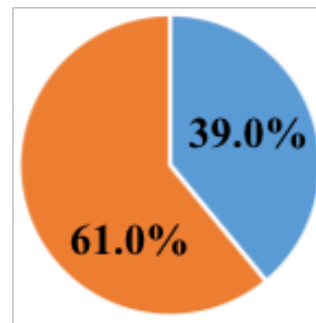
Mothers



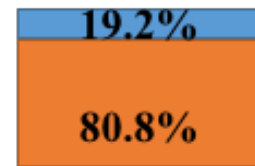
1st Stolons



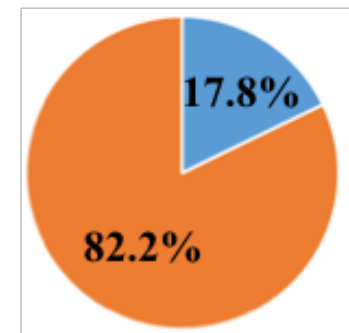
1st Daughters



2nd Stolons



2nd Daughters



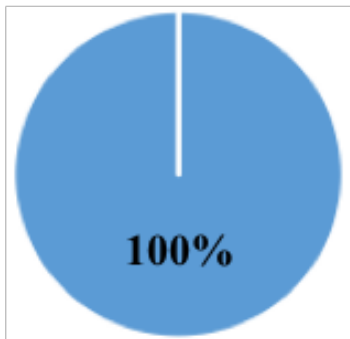
Symptomless



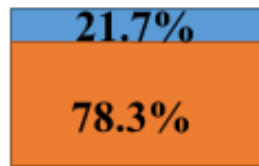
Monterey

■ = Infected
■ = Not Infected

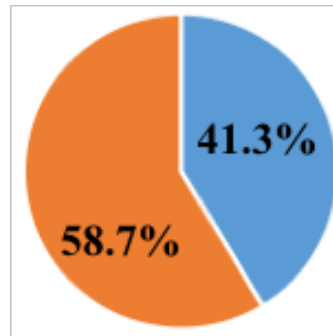
Mothers



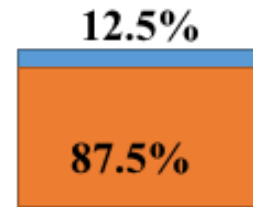
1st Stolons



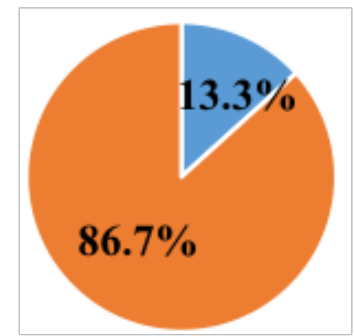
1st Daughters



2nd Stolons



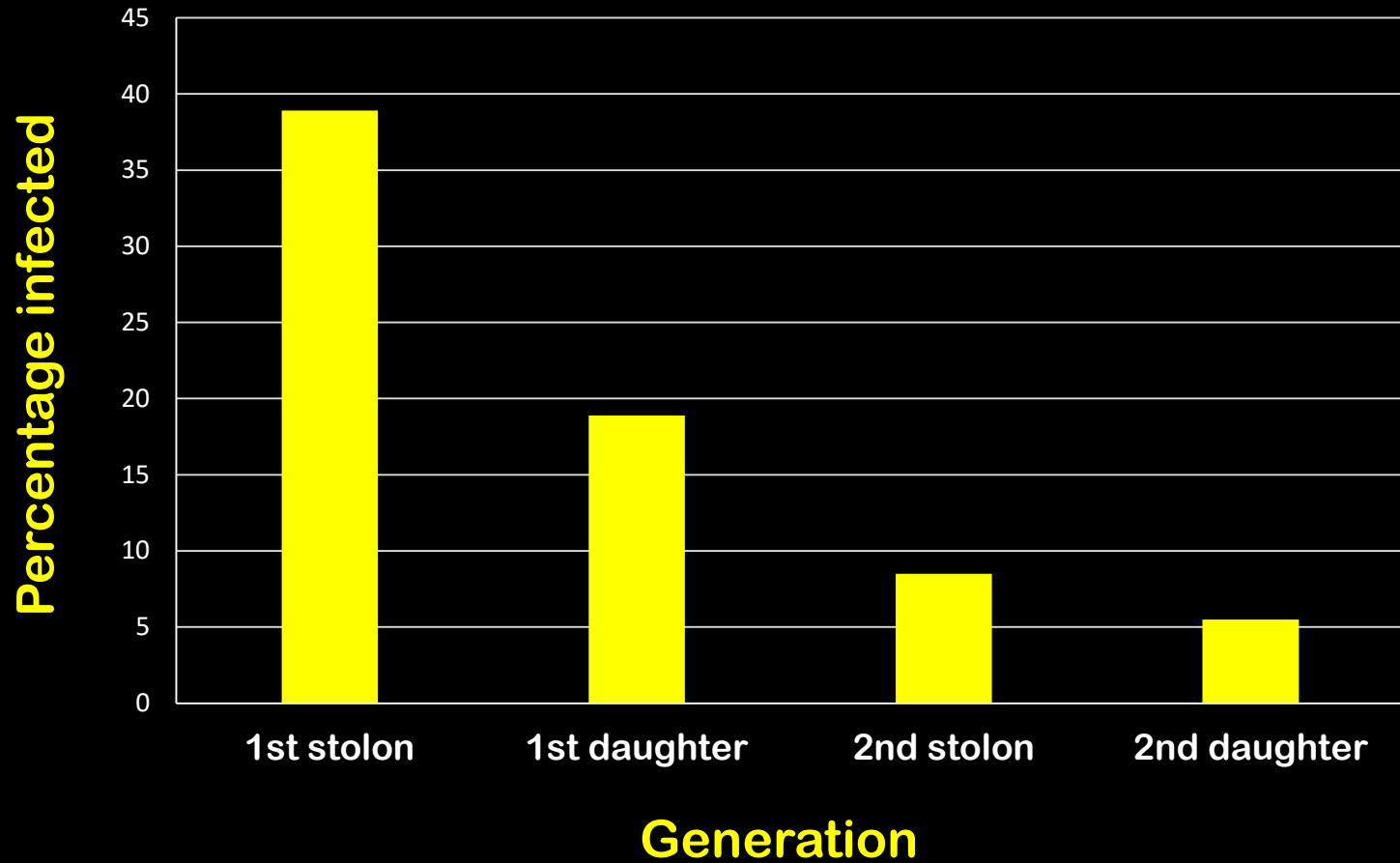
2nd Daughters



Symptomless



San Andreas



Infected daughter plants appear healthy



Transmission of
Verticillium dahliae
through stolons





Infected daughter plants



Show no symptoms

Disease may develop
in fruit production field

Prevention of infection
in nurseries is critical



Management

Avoid introduction

→ Reduce inoculum levels in soil

Pre-plant fumigation

Flat fumigation to treat the entire field



Bed fumigation

Incomplete treatment

**Mortality is not evenly
distributed across beds**

Crop rotation

Inoculum levels decline when other crops are grown

Rotation crops do not support pathogen development

Colonization of rotation crops



Colonization of rotation crops

Broccoli

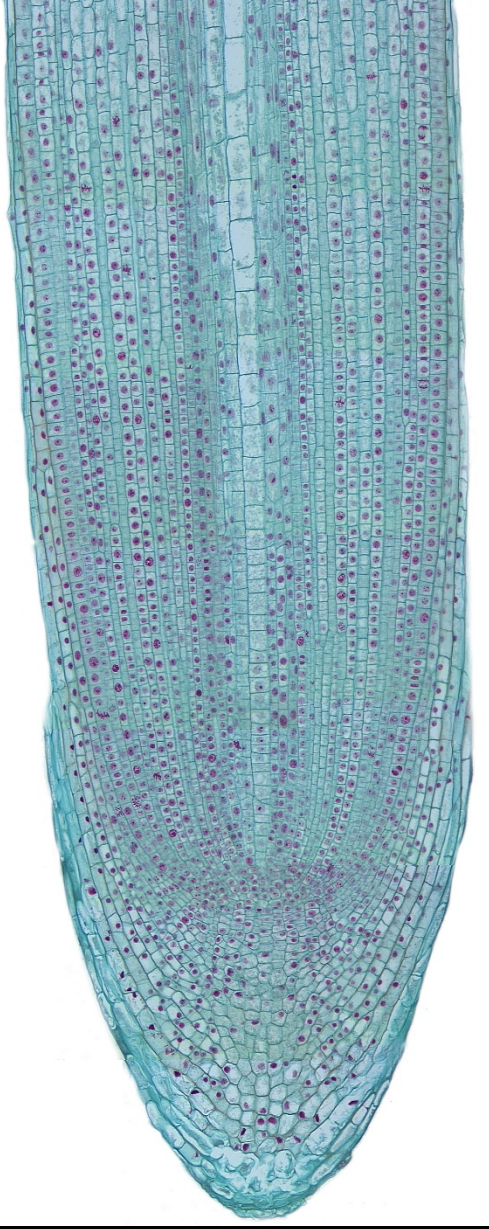
Lettuce

Spinach

Cilantro

Wheat

Raspberry

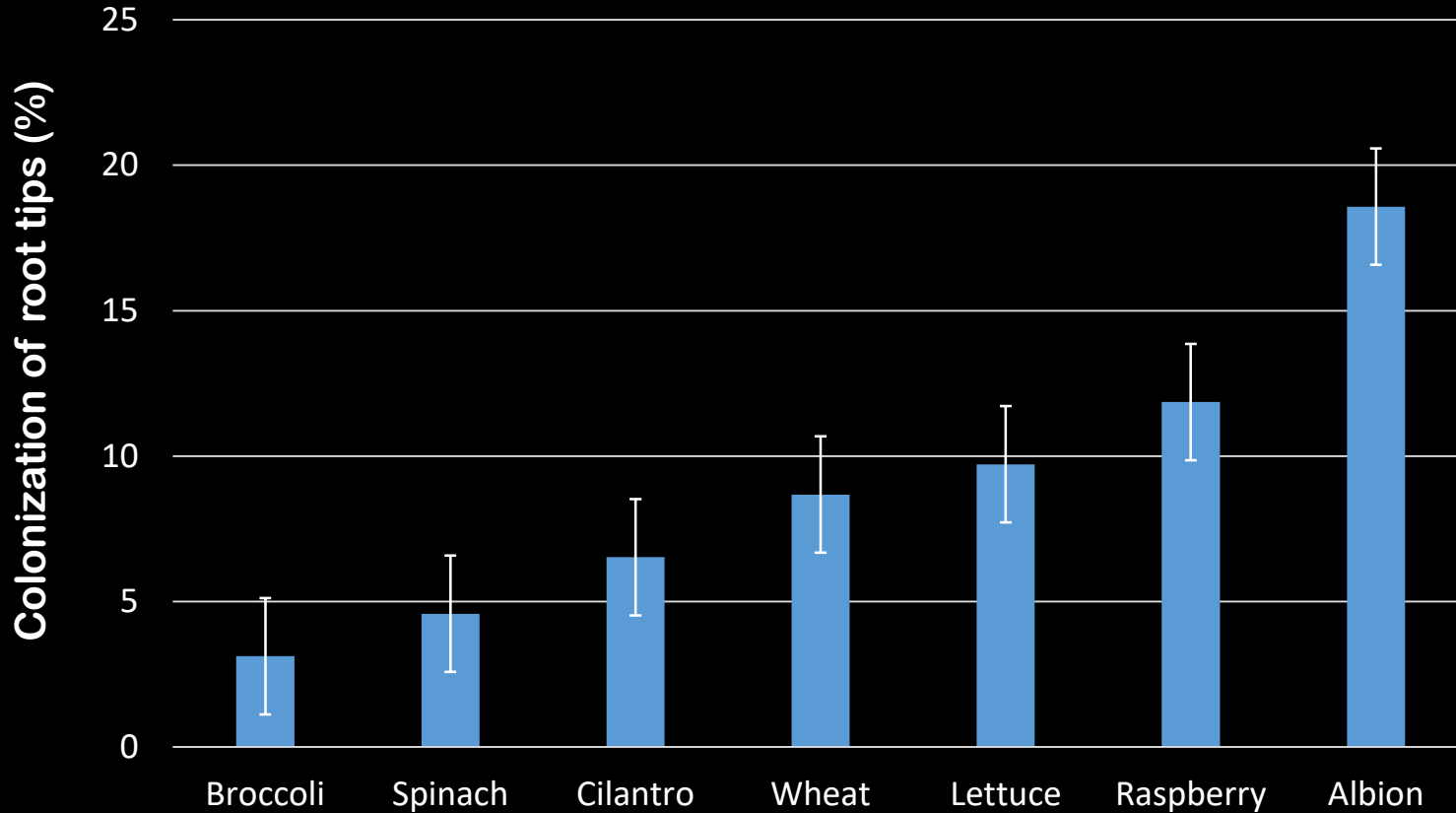


Root tip



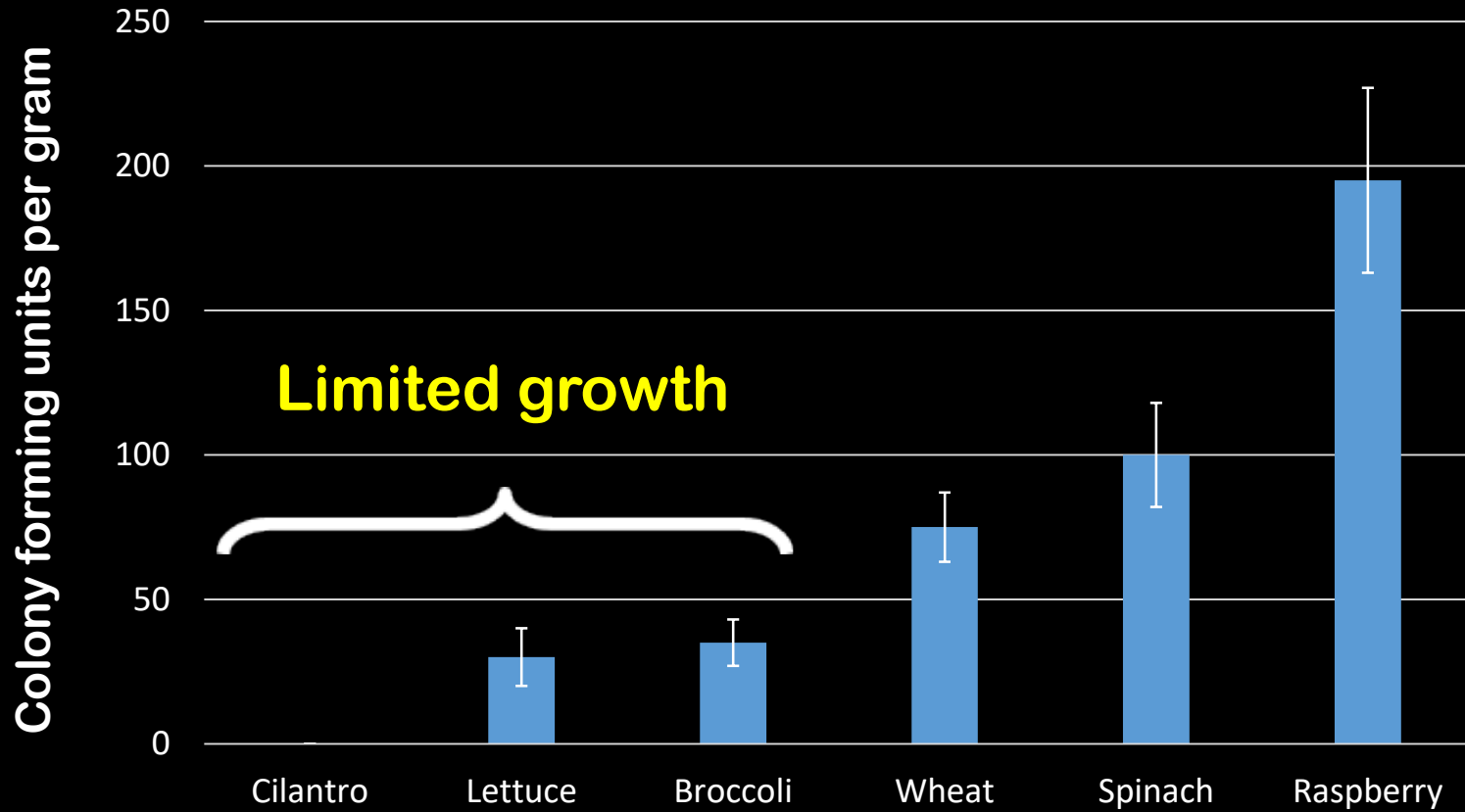
Percentage of root tips infected

Percentage of root tips infected



Extent of colonization?

Pathogen biomass in root cortex

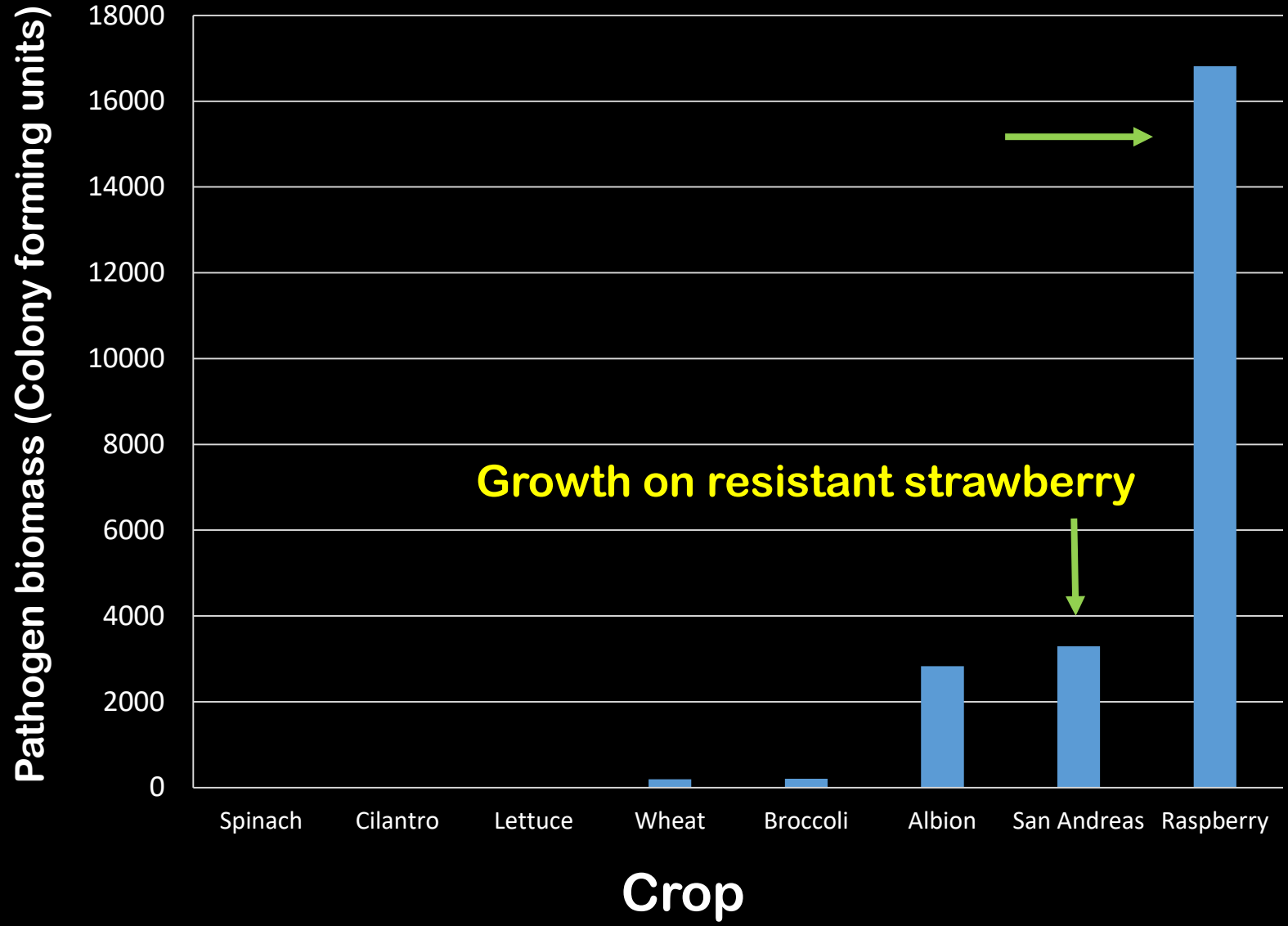


Persistence in crop residue

Pathogen biomass per unit weight of residue

Amount of residue

F. o. fragariae in crop residue



Management

Avoid introduction

Reduce inoculum levels in soil

→ Reduce efficacy of inoculum

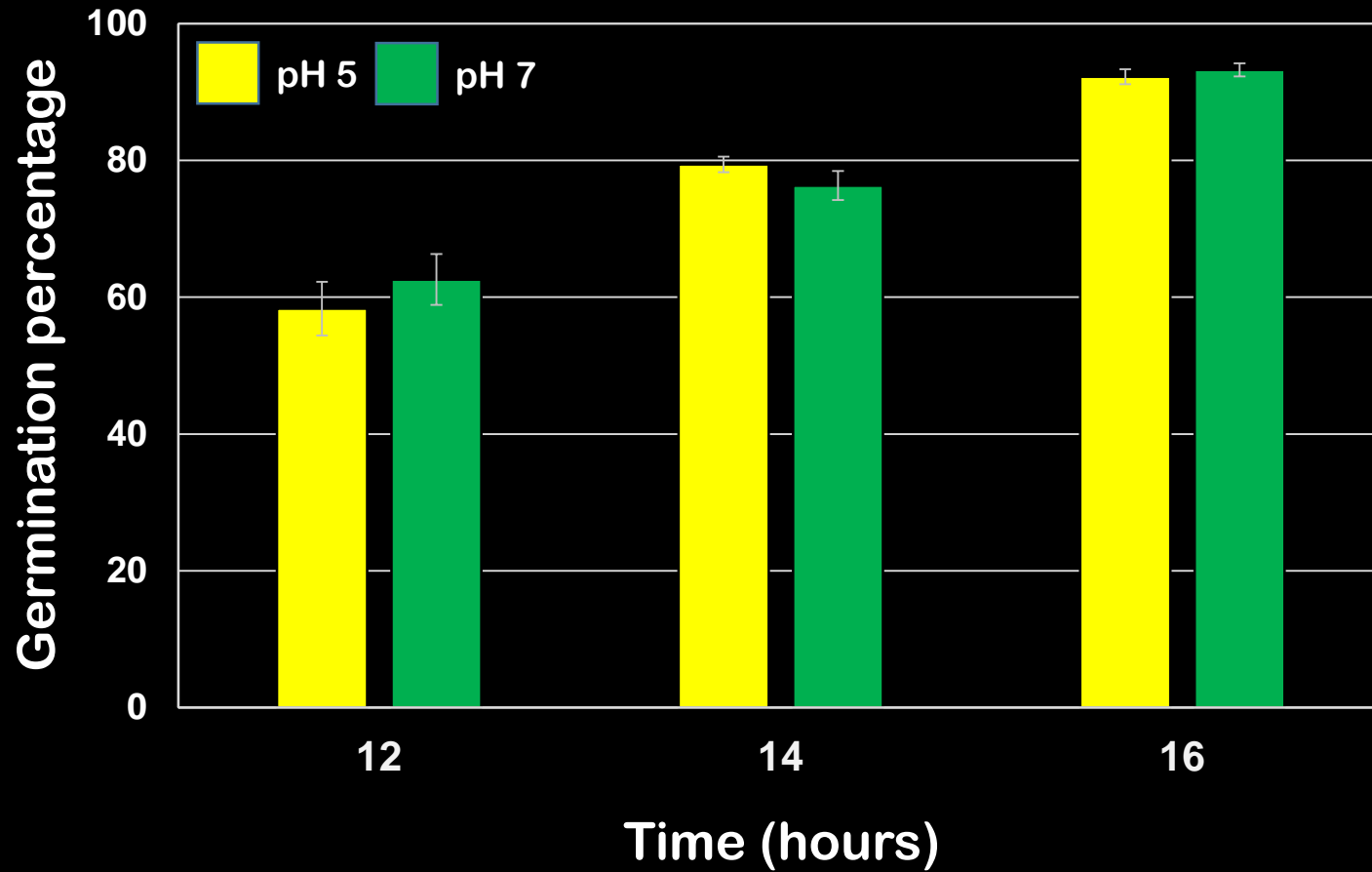
The effect of soil pH on Fusarium

Spore germination

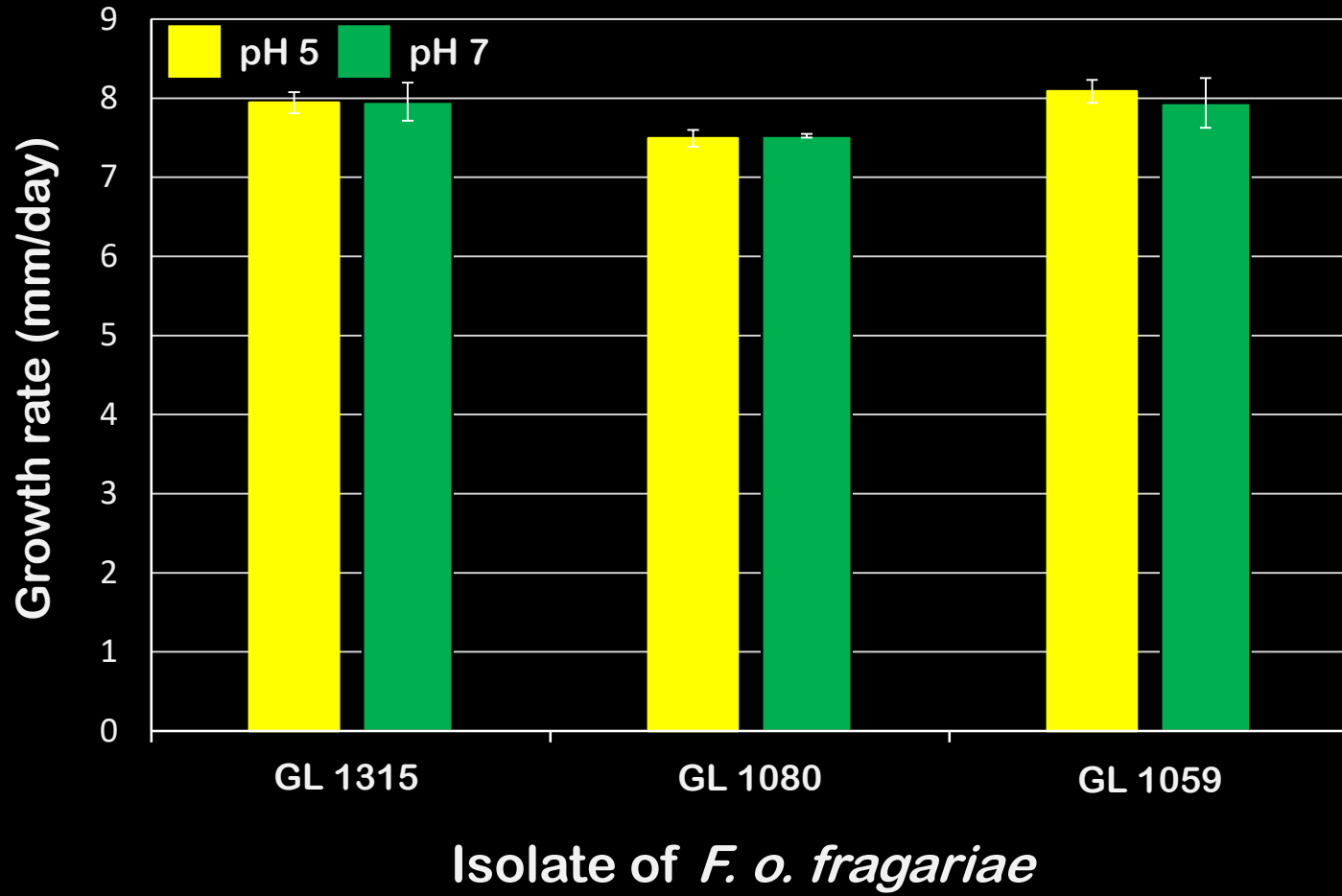
Growth

Root infection

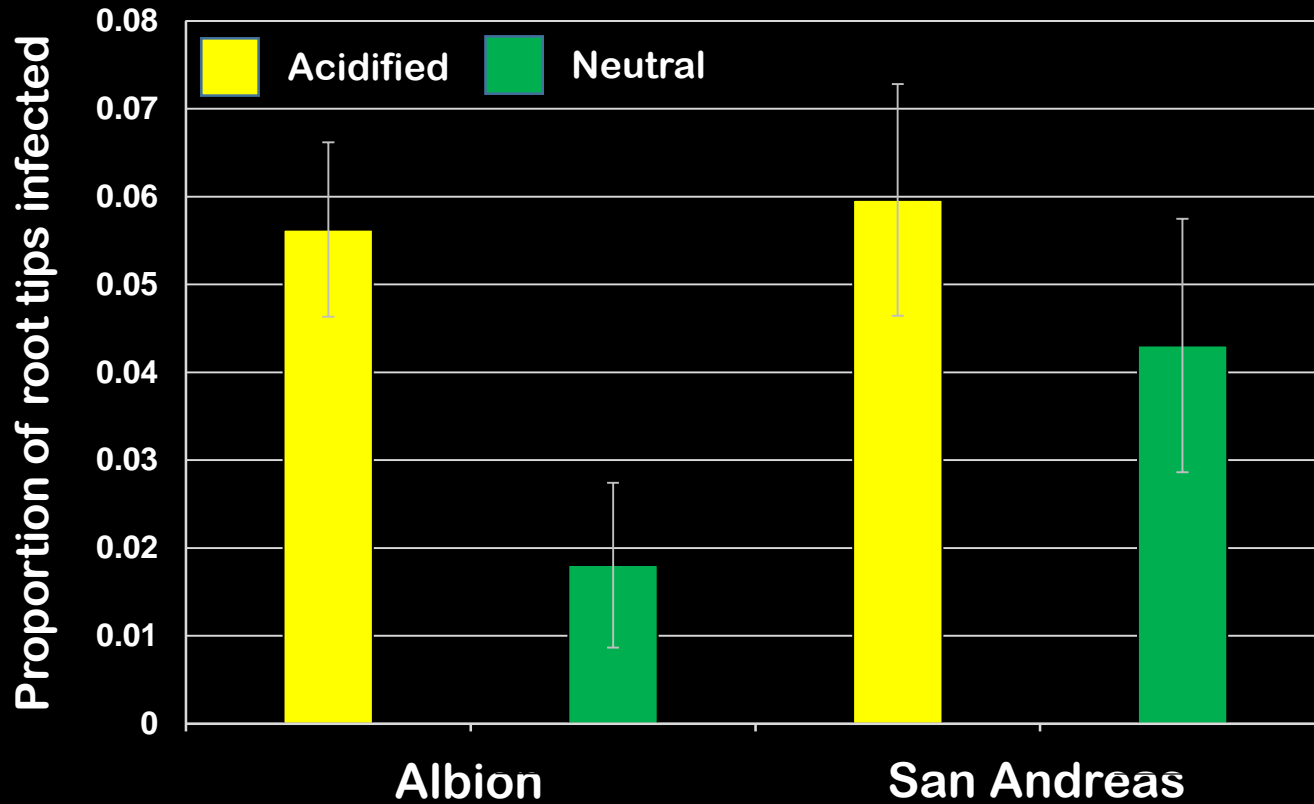
The effect of pH on spore germination



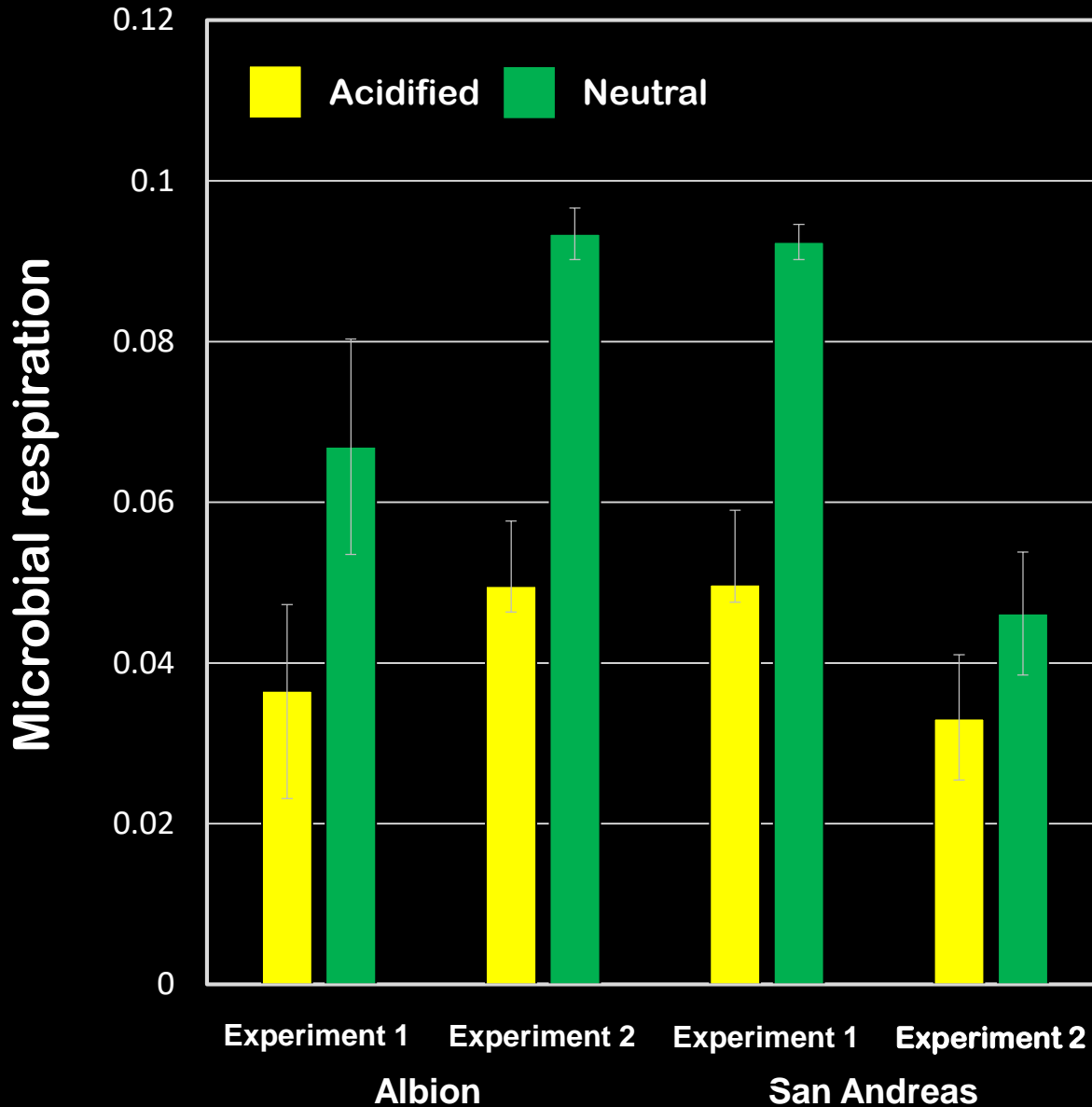
The effect of pH on growth



The effect of soil pH on root infection



Bacterial respiration is higher in neutral soils

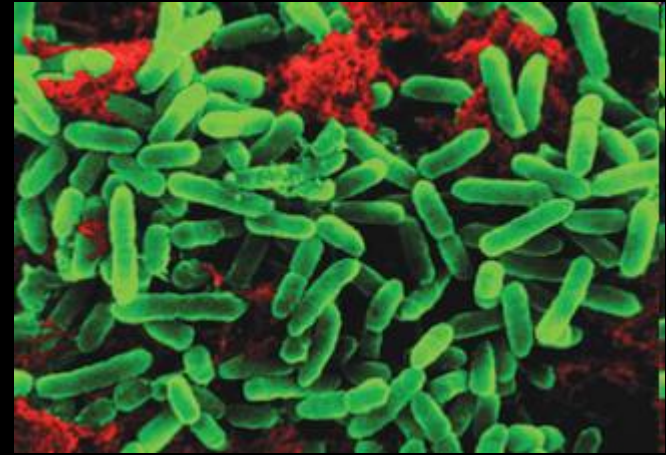


Fusarium oxysporum



2010/08/10 16:52:42

Picture: 0108 - 20100610_165242.bmp



In soil fungi compete with bacteria

pH near neutrality
favors bacteria over fungi

Elevate microbial respiration

Soil amendments

That do not support pathogen growth

Anaerobic soil disinfestation

Rice hulls at 9 tons per acre

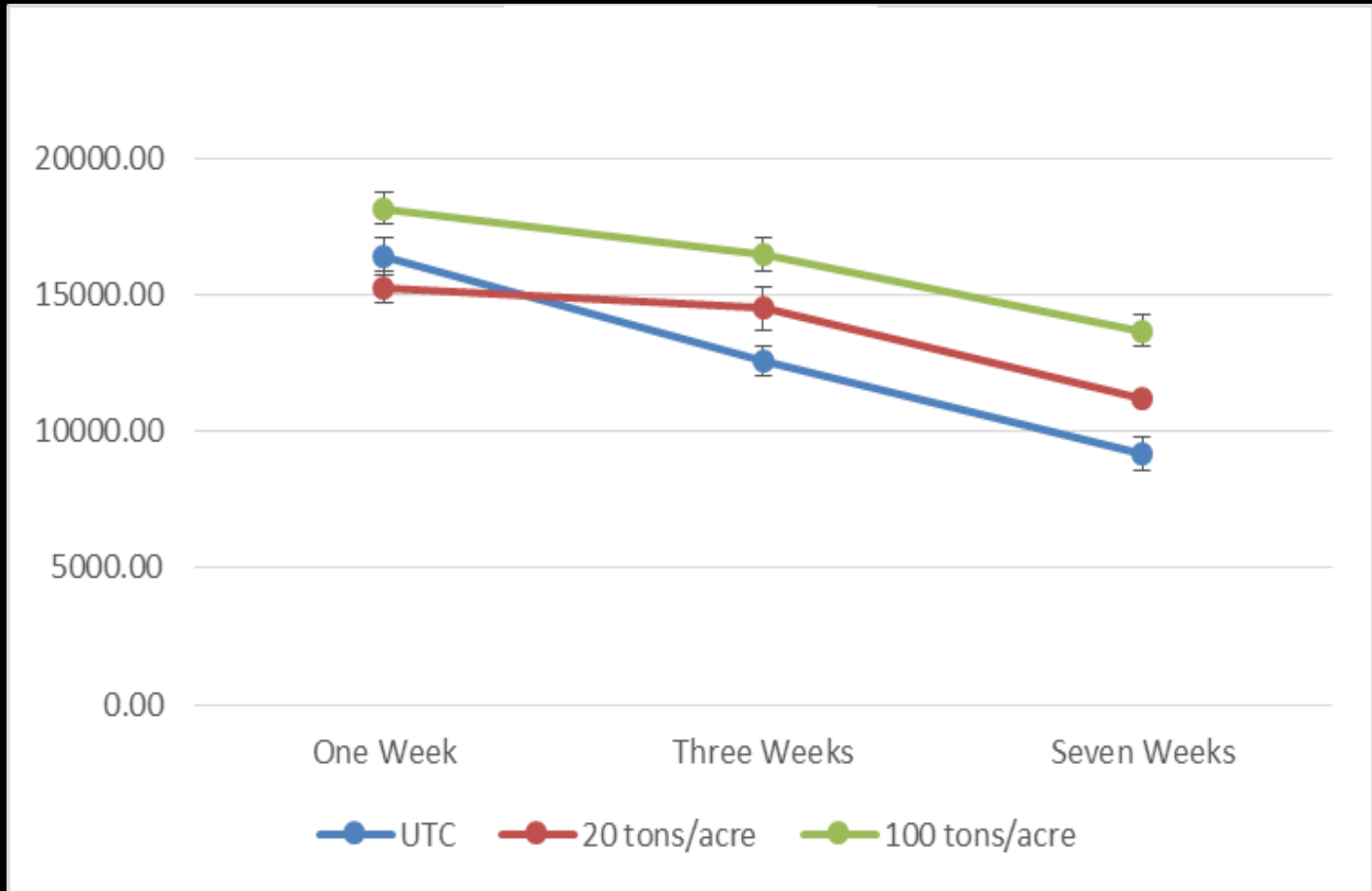
cool conditions
Day/night = 77/64°F

+ 310%

Compost

Compost

Survival of *F. o. fragariae* in soil





Blackberry

Fusarium wilt

Fusarium oxysporum

**Effect of blackberry
pathogen on strawberry**

Albion

Monterey

San Andreas

Portola

Petaluma

Susceptibility of strawberry to blackberry pathogen

1 – 5 scale



Susceptibility of strawberry to blackberry pathogen

1 – 5 scale

Cultivar	<i>F. o. mori</i>	<i>F. o. fragariae</i>
Albion	3.0	5.0
Monterey	2.1	5.0
San Andreas	1.0	1.0
Portola	1.0	1.0
Petaluma	1.0	5.0



OC Monterey Plant 4



MONTEREY
AM-S1 2

Management

Disease resistance

The Population of *Fusarium oxysporum* f. sp. *fragariae*, Cause of Fusarium Wilt of Strawberry, in California

P. M. Henry, S. C. Kirkpatrick, C. M. Islas, A. M. Pastrana, and J. A. Yoshisato, Department of Plant Pathology, University of California, Davis 95616; S. T. Koike, University of California Cooperative Extension, Salinas 93901; O. Daugovish, University of California Cooperative Extension, Ventura 93003; and T. R. Gordon, Department of Plant Pathology, University of California, Davis

Abstract

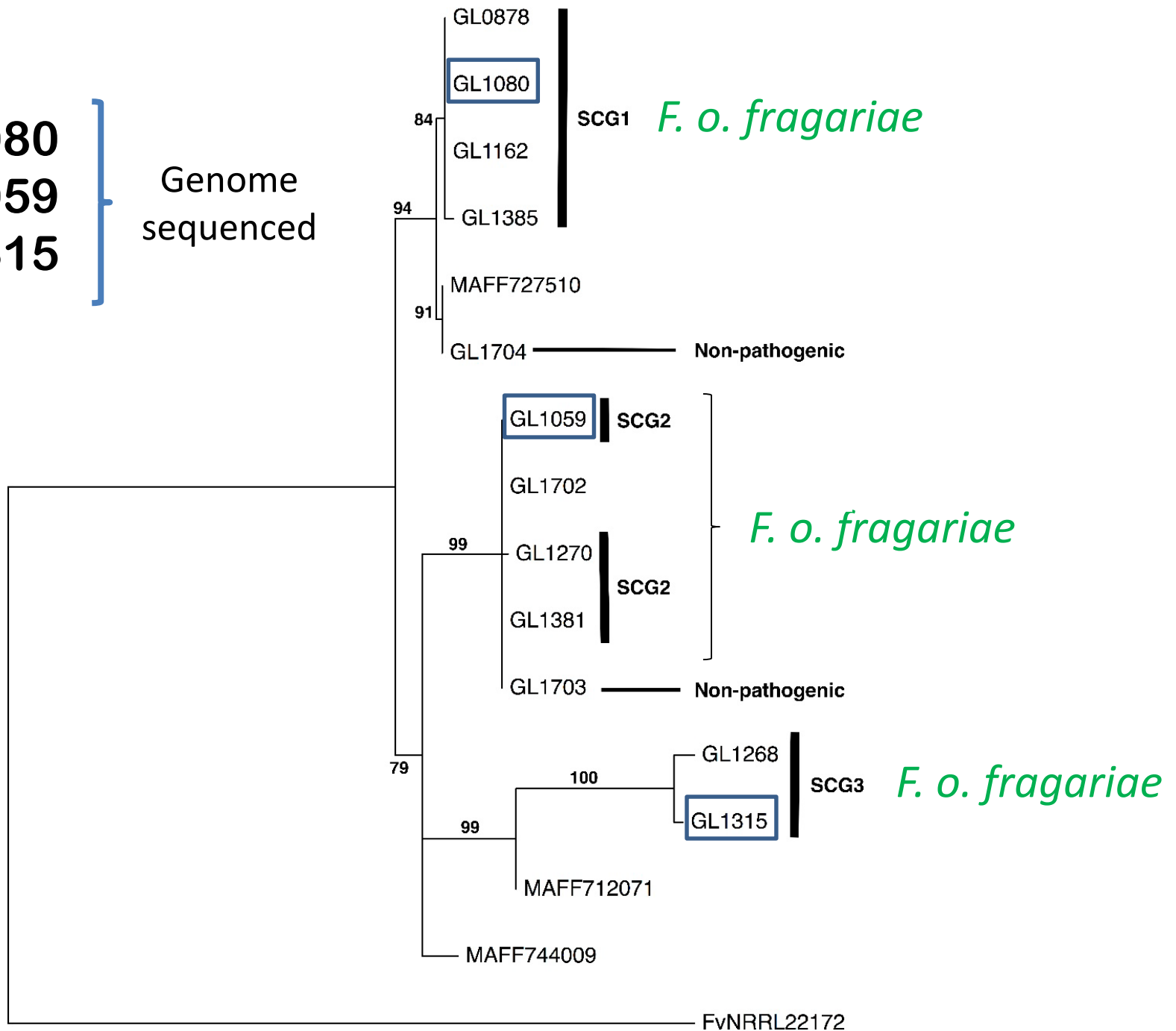
The objectives of this study were to investigate the structure of the population of *Fusarium oxysporum* f. sp. *fragariae* in California and to evaluate methods for its detection. Fifty-nine isolates of *F. oxysporum* f. sp. *fragariae* were obtained from diseased strawberry plants and their identity was confirmed by pathogenicity testing. The full nuclear ribosomal intergenic spacer (IGS) and elongation factor 1- α gene (EF-1 α) were amplified by polymerase chain reaction (PCR) and sequenced to elucidate phylogenetic relationships among isolates. IGS and EF-1 α sequences revealed three main lineages, which corresponded to three somatic compatibility groups. Primers designed to detect *F. oxysporum* f. sp.

fragariae in Japan amplified a 239-bp product from 55 of 59 California isolates of *F. oxysporum* f. sp. *fragariae* and from no nonpathogenic isolates of *F. oxysporum*. The sequence of this PCR product was identical to the sequence obtained from *F. oxysporum* f. sp. *fragariae* isolates in Japan. Intensive sampling at two locations in California showed results of tests based on PCR and somatic compatibility to be in agreement for 97% (257 of 264) of isolates tested. Our findings revealed considerable diversity in the California population of *F. oxysporum* f. sp. *fragariae*, and indications that horizontal gene transfer may have occurred.

Three strains of *Fusarium oxysporum* f. sp. *fragariae*

GL 1080
GL 1059
GL 1315

Genome
sequenced



0.005 substitutions/site

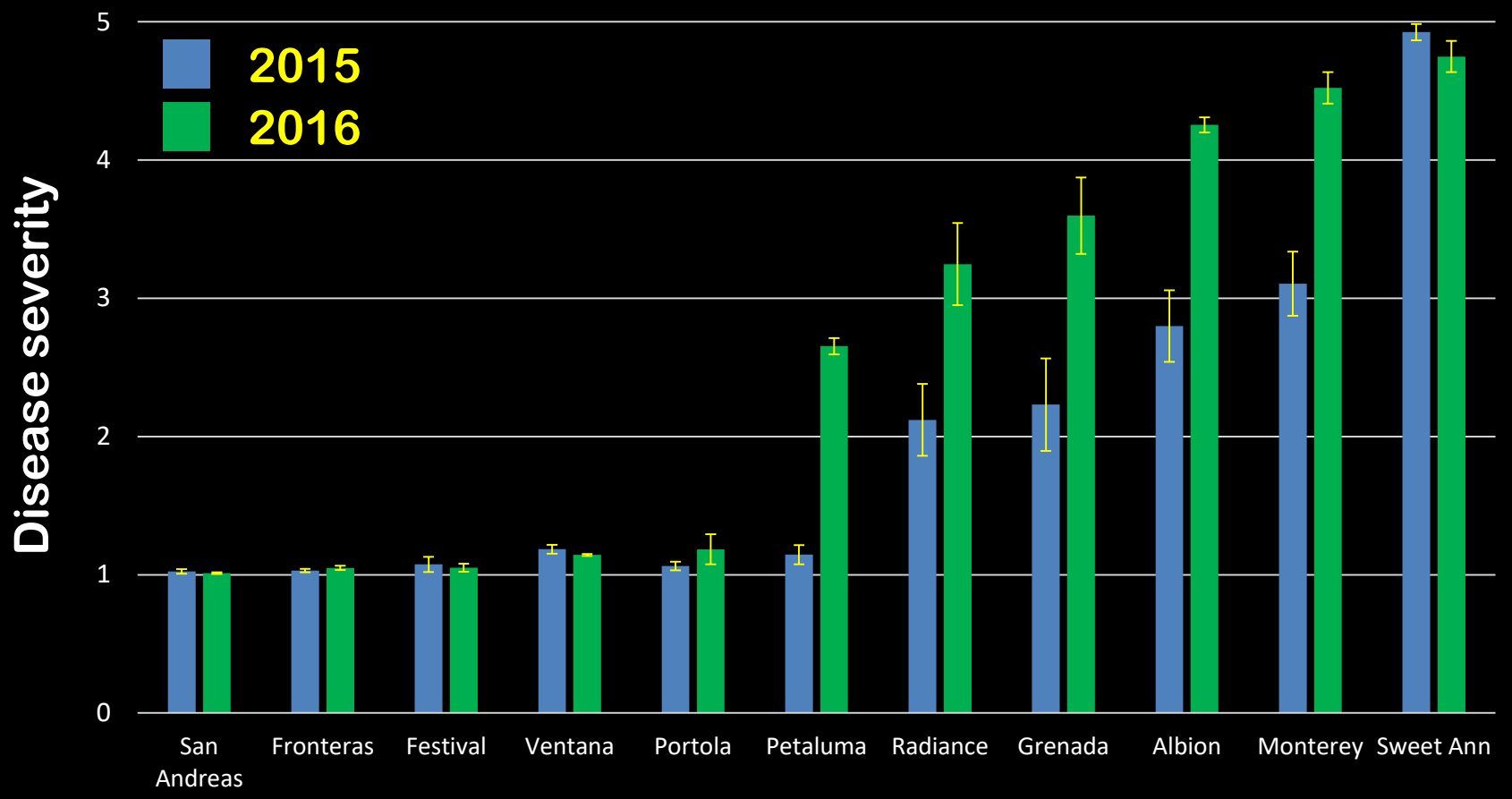
Multiple introductions



Naturally infested field



Susceptibility to Fusarium wilt



Susceptibility to Fusarium wilt

San Andreas
Portola
Fronteras



Highly resistant

Ventana



Resistant

Monterey
Albion



Susceptible

Global occurrence of Fusarium wilt



Strain differences in the Fusarium wilt pathogen



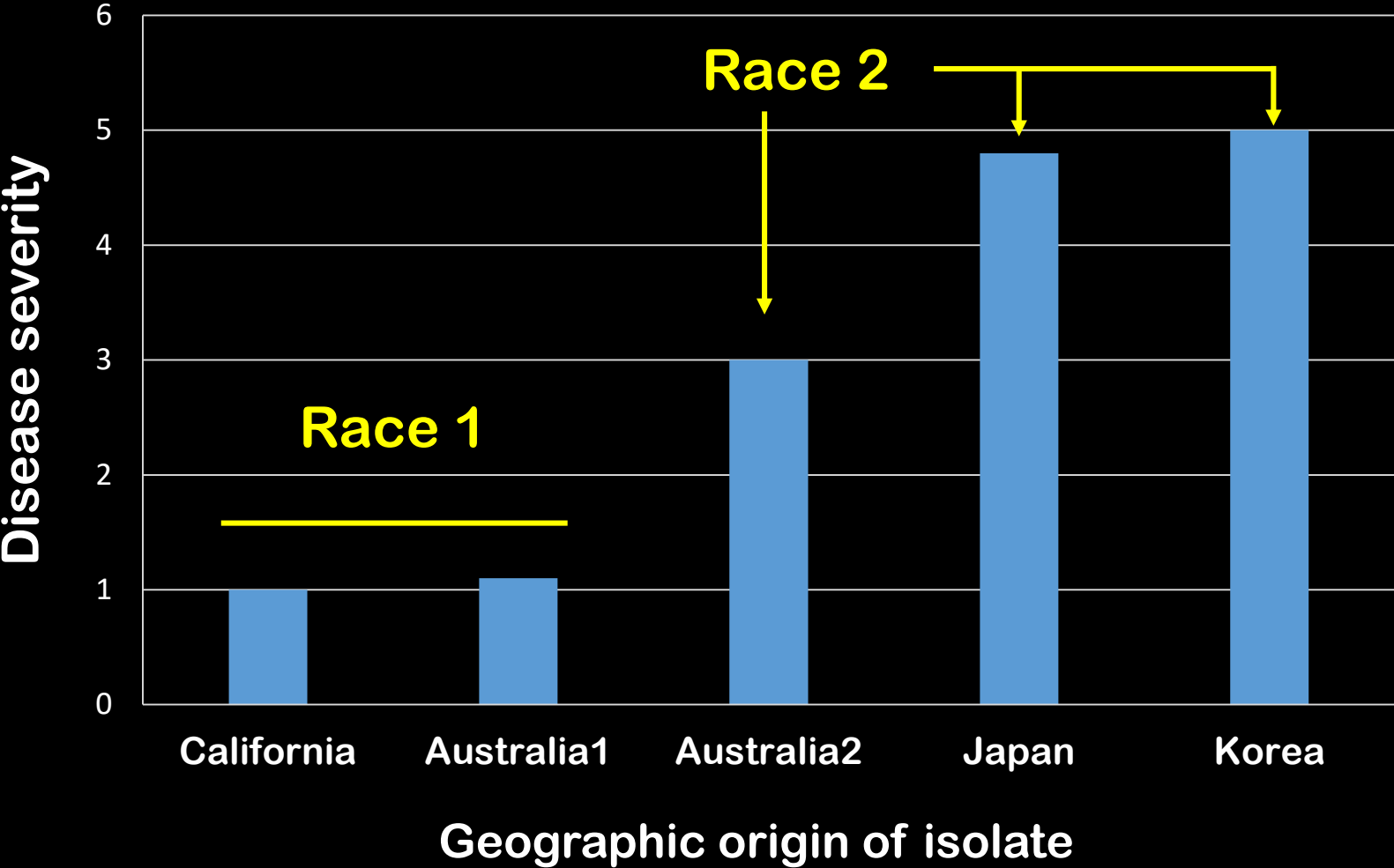
Yellows



Collapse

Independent origins

Pathogenicity of *F. o. fragariae* on San Andreas



Identify genes for resistance to race 2

Management of soilborne pathogens

Reduce inoculum levels

Avoid introductions

Disease resistance



Thanks

california
STRAWBERRY COMMISSION

