Fusarium wilt of strawberry

Tom Gordon

Department of Plant Pathology

Collaborators:

Oleg Daugovish
Steve Koike

Fusarium wilt

Verticillium wilt

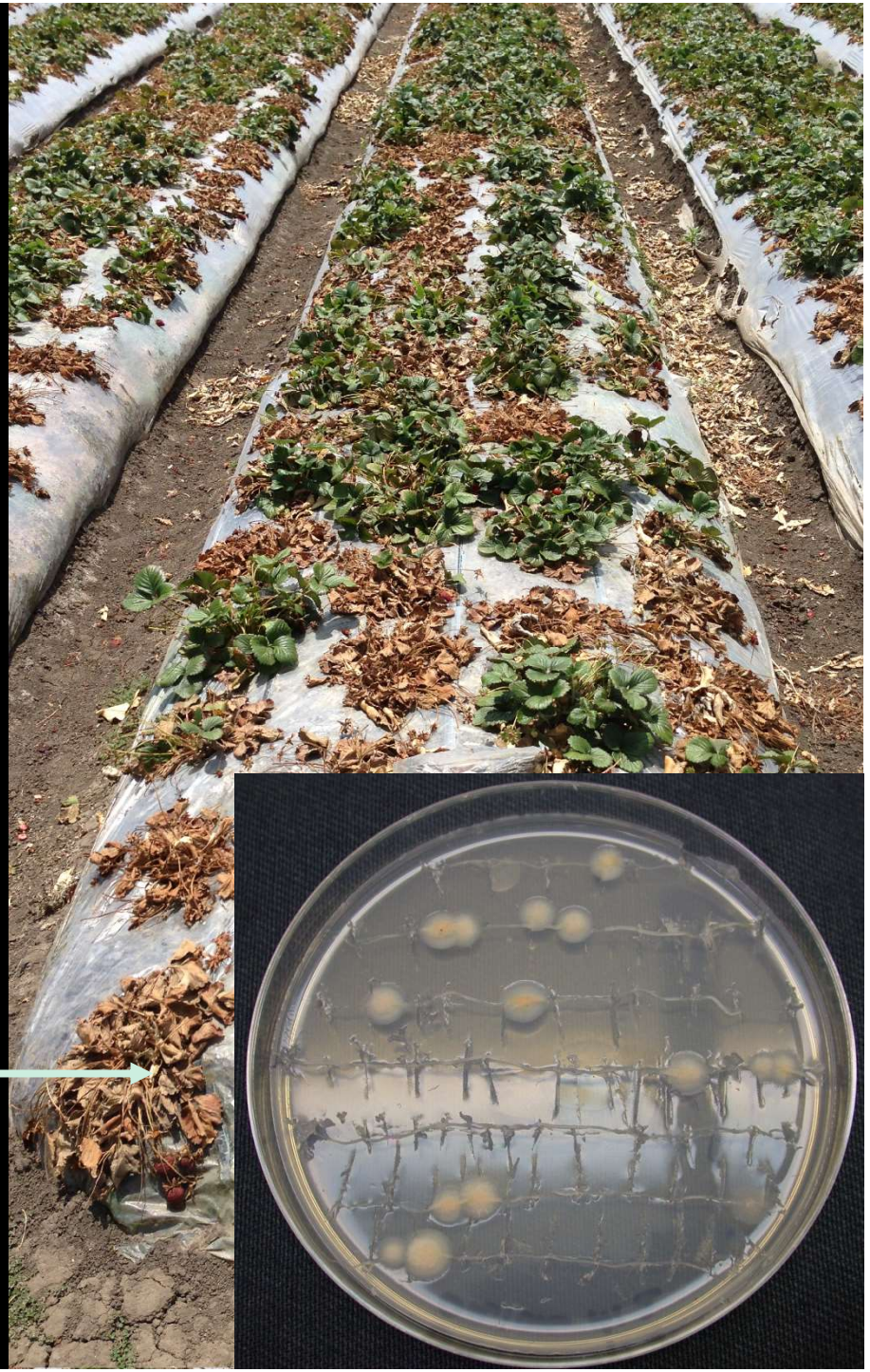
Macrophomina crown rot

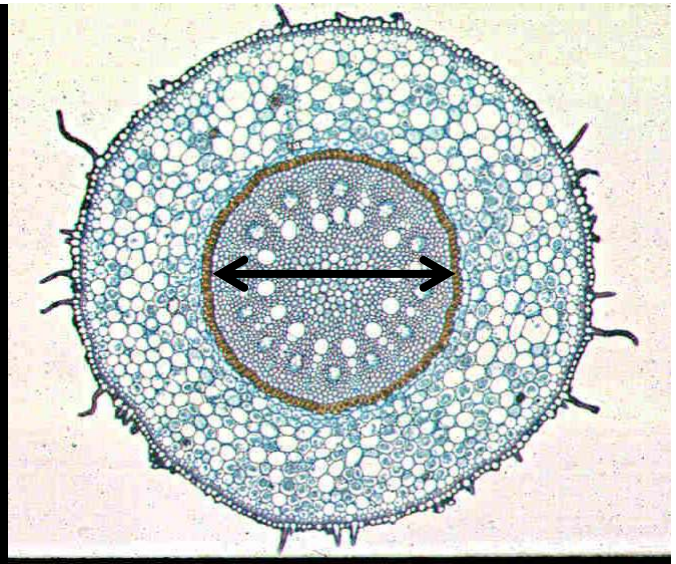
Fusarium wilt

Verticillium wilt

Macrophomina crown rot

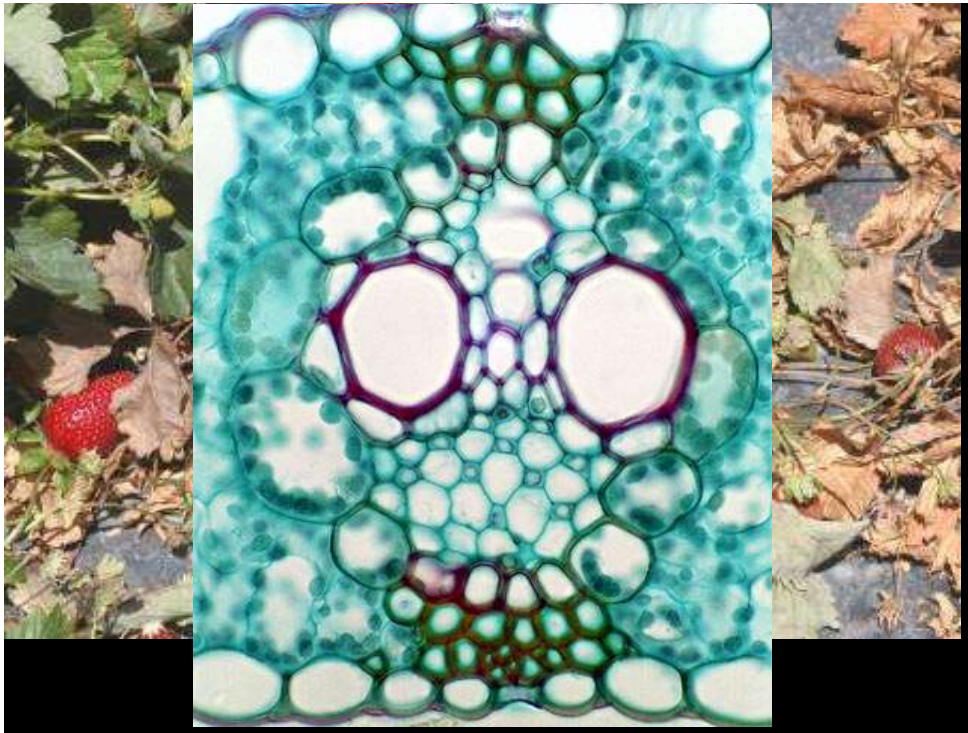
Fusarium oxysporum



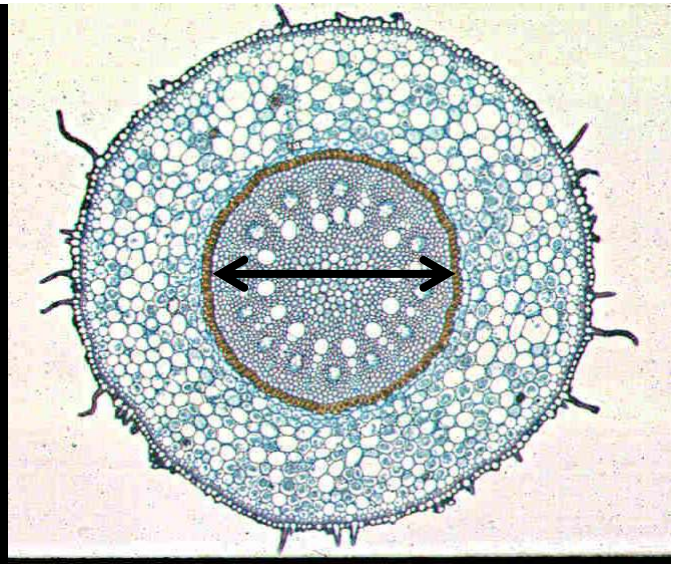


Fusarium wilt

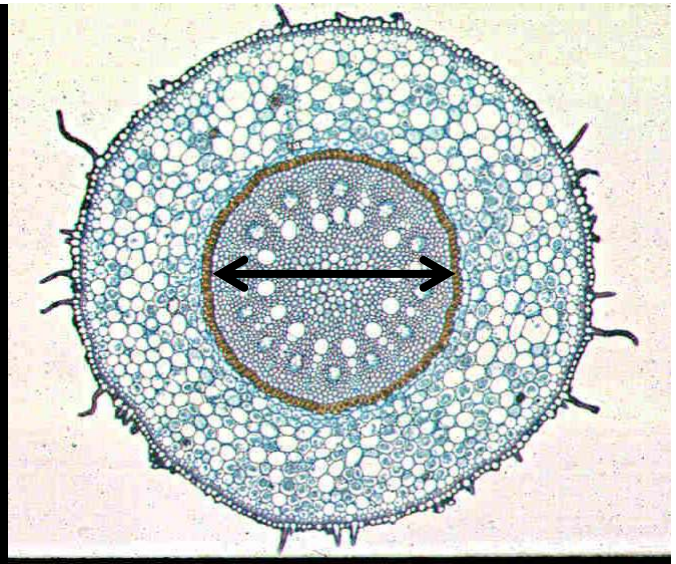
Fusarium oxysporum

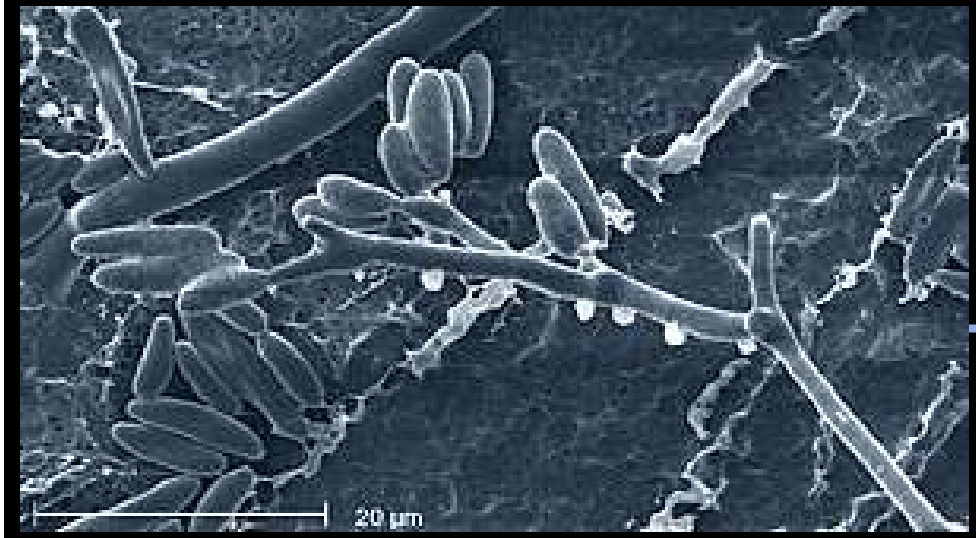


Fusarium wilt



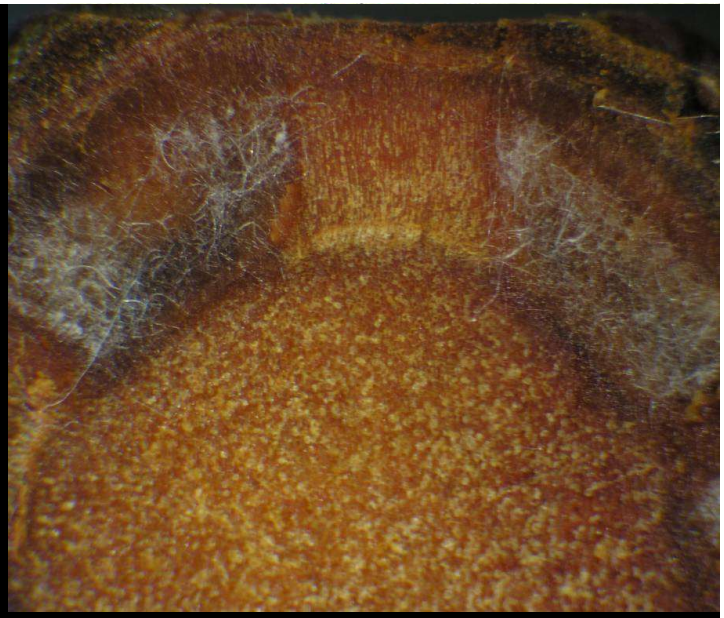
Fusarium oxysporum



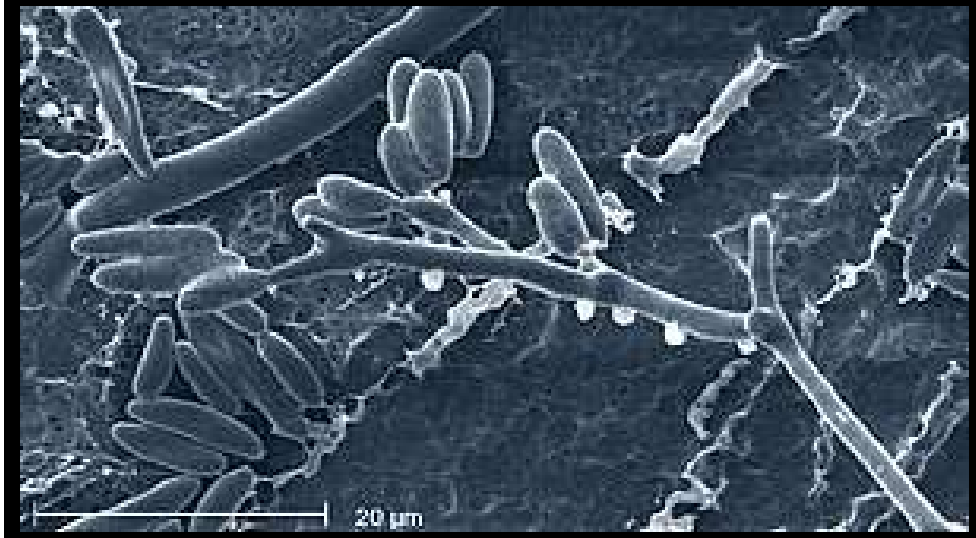


Fusarium oxysporum

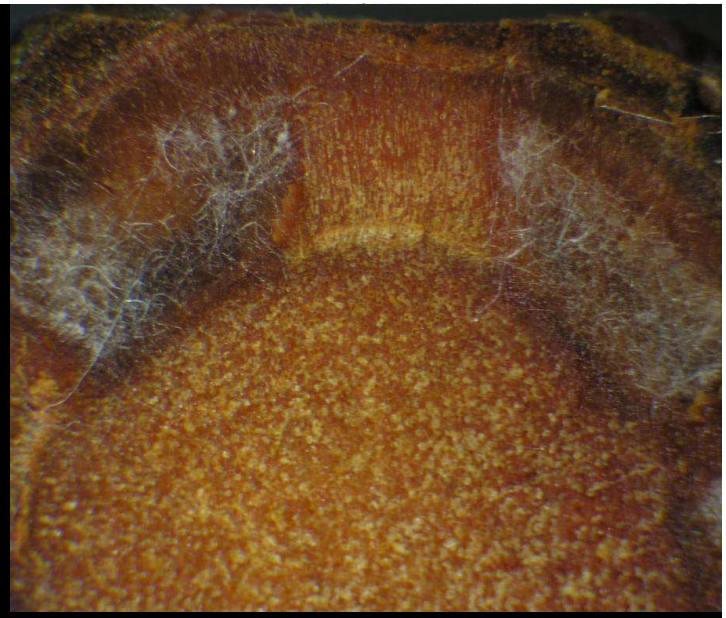
Microconidia carried upward in xylem vessels



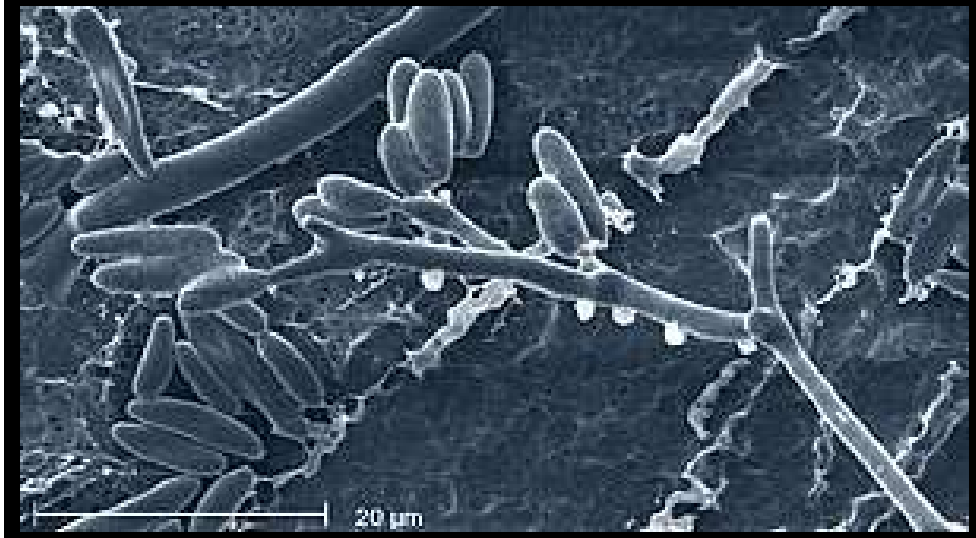
Colonized
vascular tissue



Microconidia carried
upward in xylem vessels



Colonized
vascular tissue



Microconidia carried
upward in xylem vessels

Introduction to California

Source of introduction to California?

?

California
2008

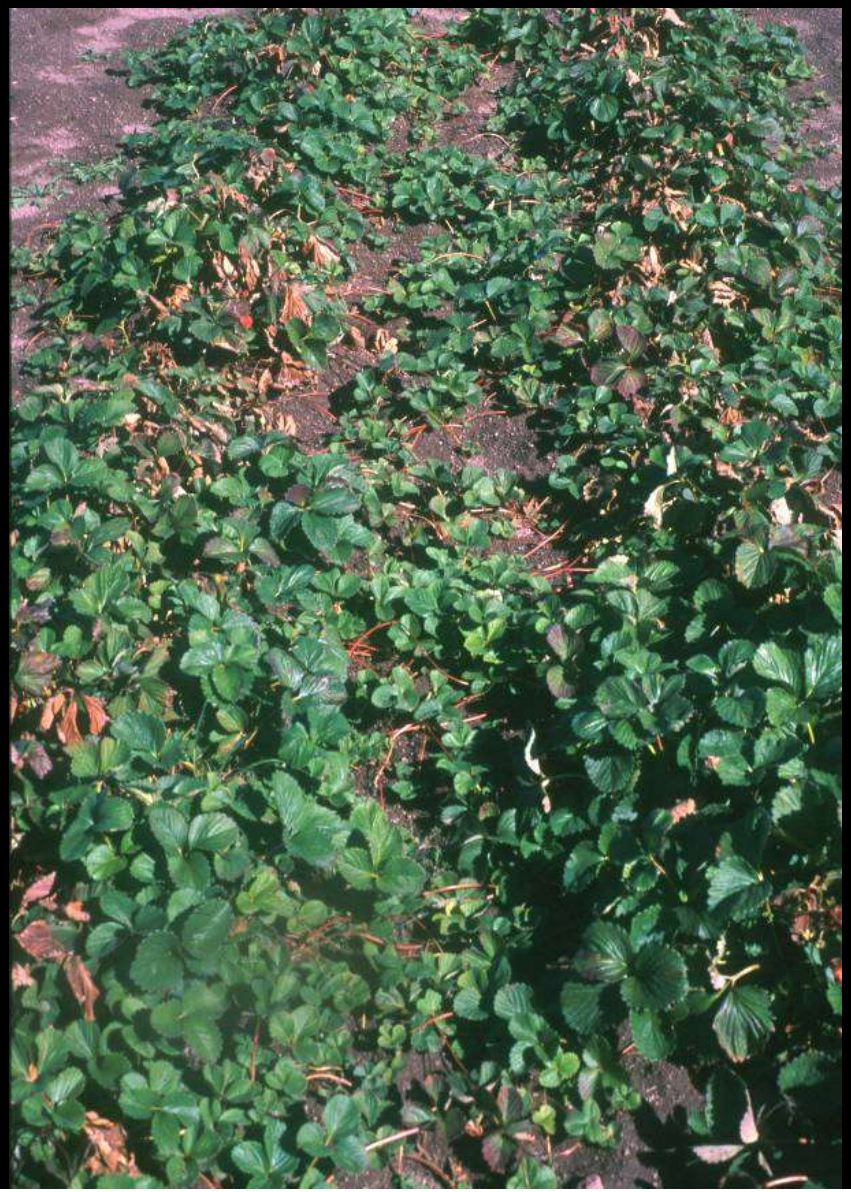
Management

Avoid introduction

Soil on equipment

Clean plants

Verticillium wilt in high elevation nurseries



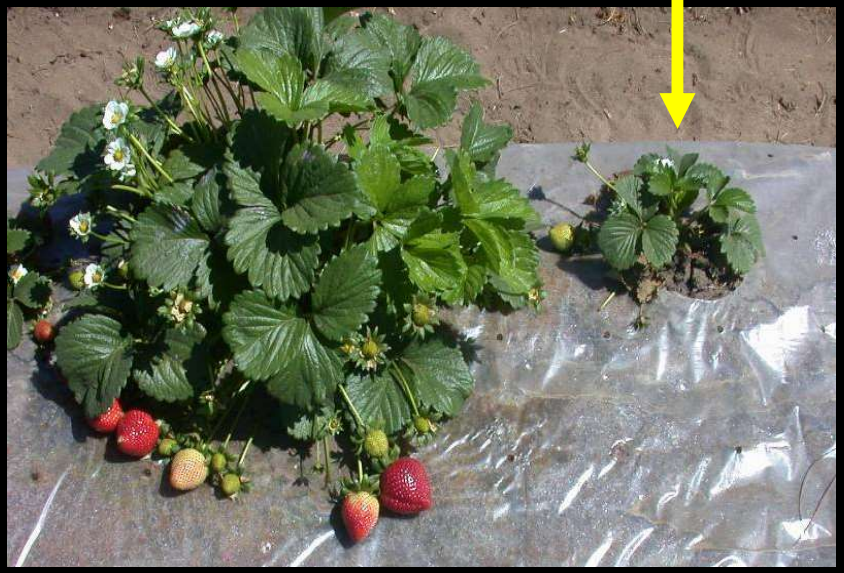
Mother plants may show
show symptoms only
late in the season

Overgrown by
daughter plants

Infected daughter plants

Show no symptoms

Disease may develop
in fruit production field



Transmission of *Fusarium* to daughter plants

Will daughter plants remain symptomless?

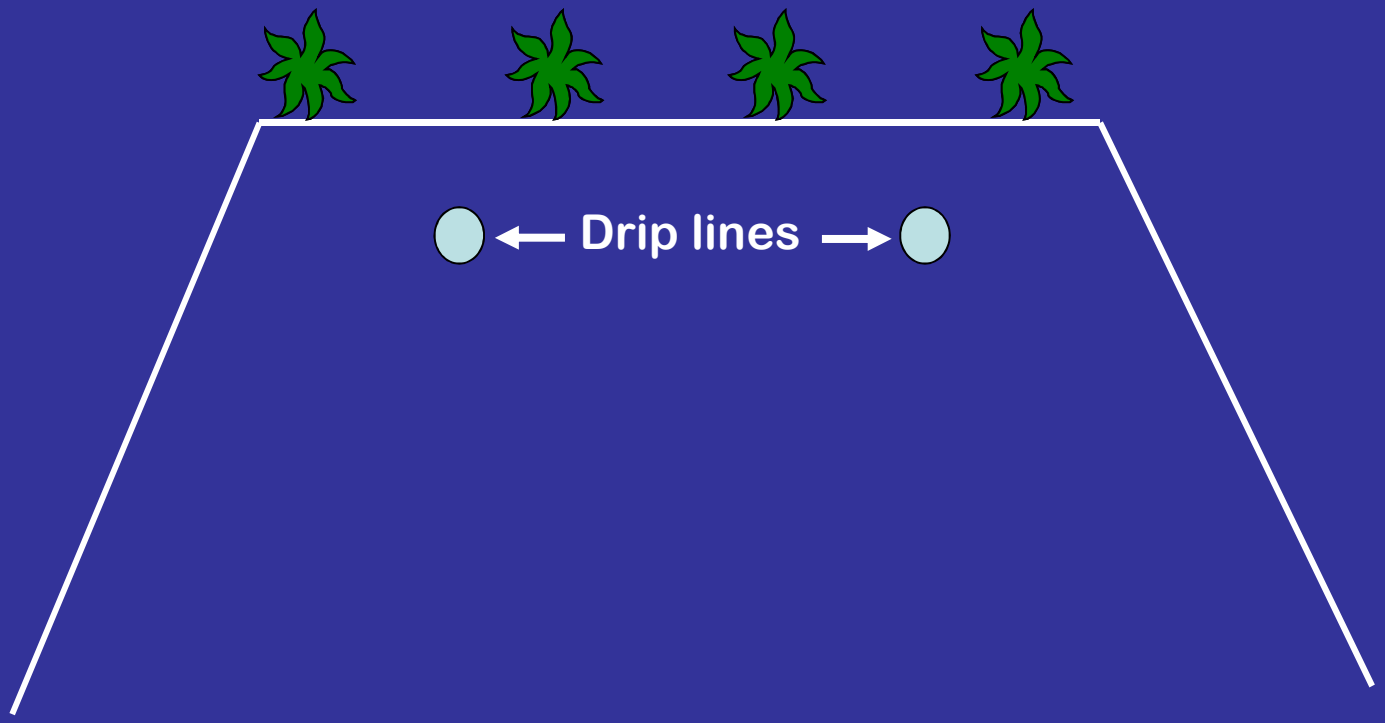
Management

Reduce inoculum levels in soil

Pre-plant fumigation

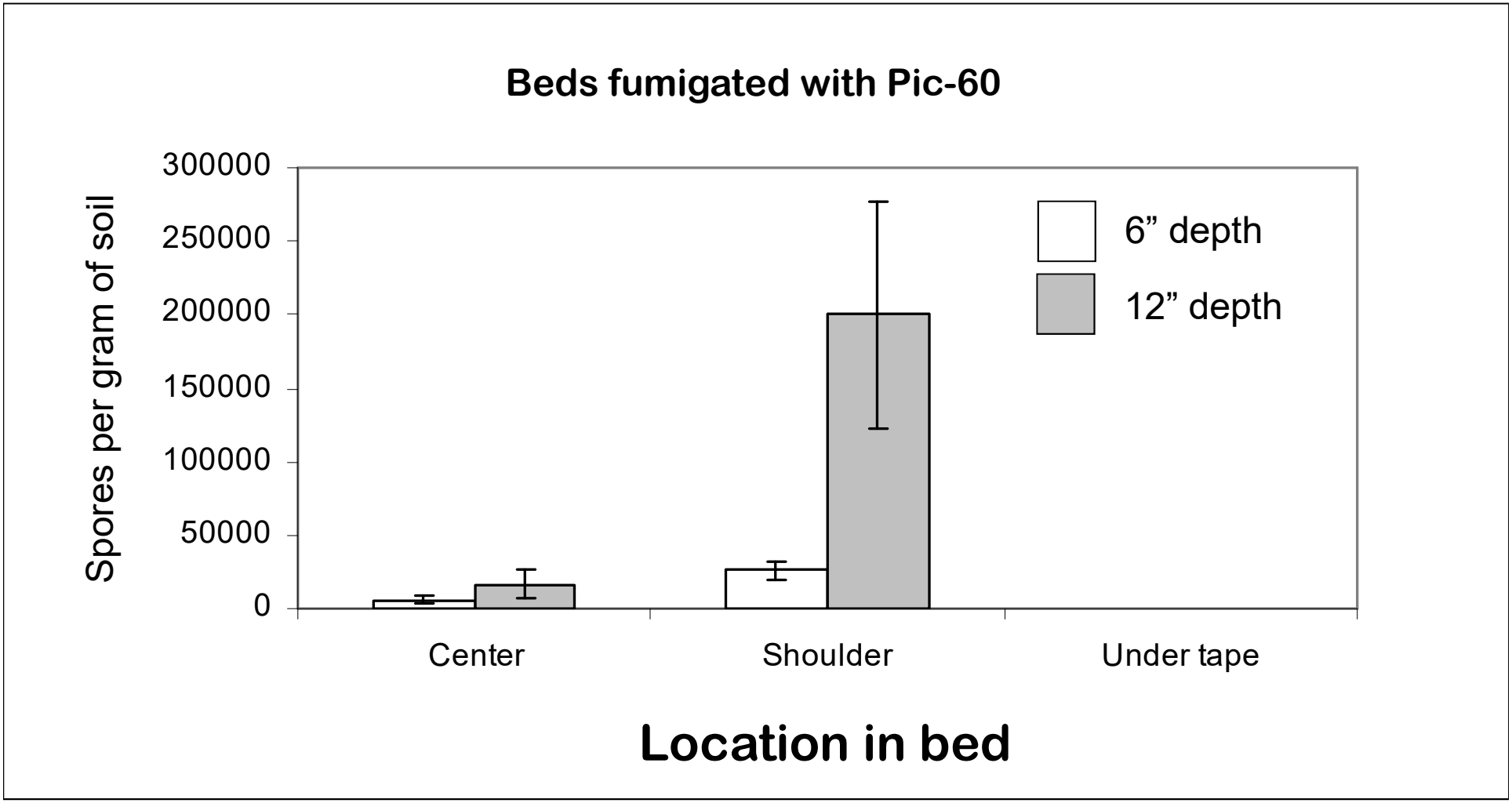
Flat fumigation to treat the entire field

Bed fumigation



The soil is not uniformly exposed to the fumigant

Mortality is not evenly distributed across beds


Beds fumigated with Pic-60
Spores per gram of soil
300000
250000
200000
150000
100000
50000
0
6” depth
12” depth
Center
Shoulder
Under tape
Location in bed

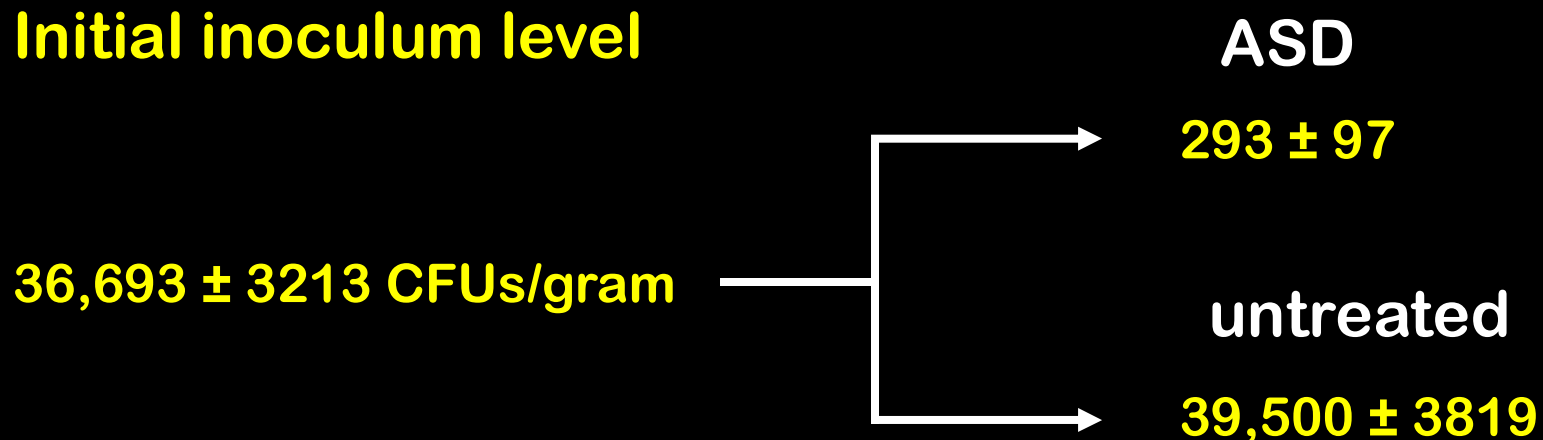
Anaerobic soil disinfestation

Effect on survival of *Fusarium oxysporum*

Day/night temperature of 28/20 °C = 82/68 °F

Duration of anaerobic conditions = 10 days

Effect of ASD on survival of *Fusarium*



99% reduction in inoculum

Effect of temperature and duration on efficacy of ASD

Minimum requirement for effective treatment

Crop rotation

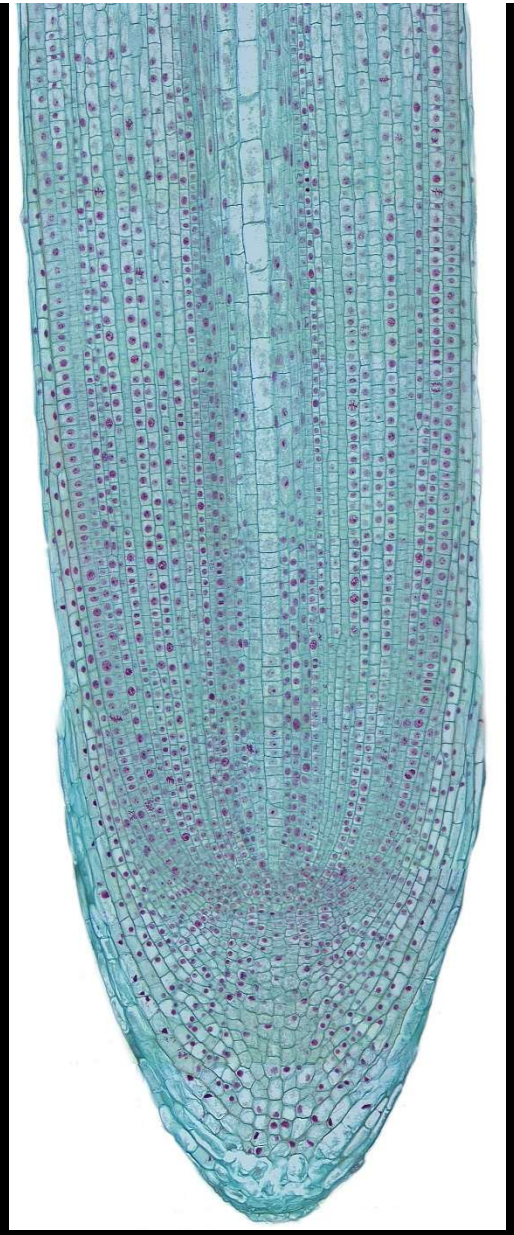
Inoculum levels decline when other crops are grown

Rotation crops do not support pathogen development

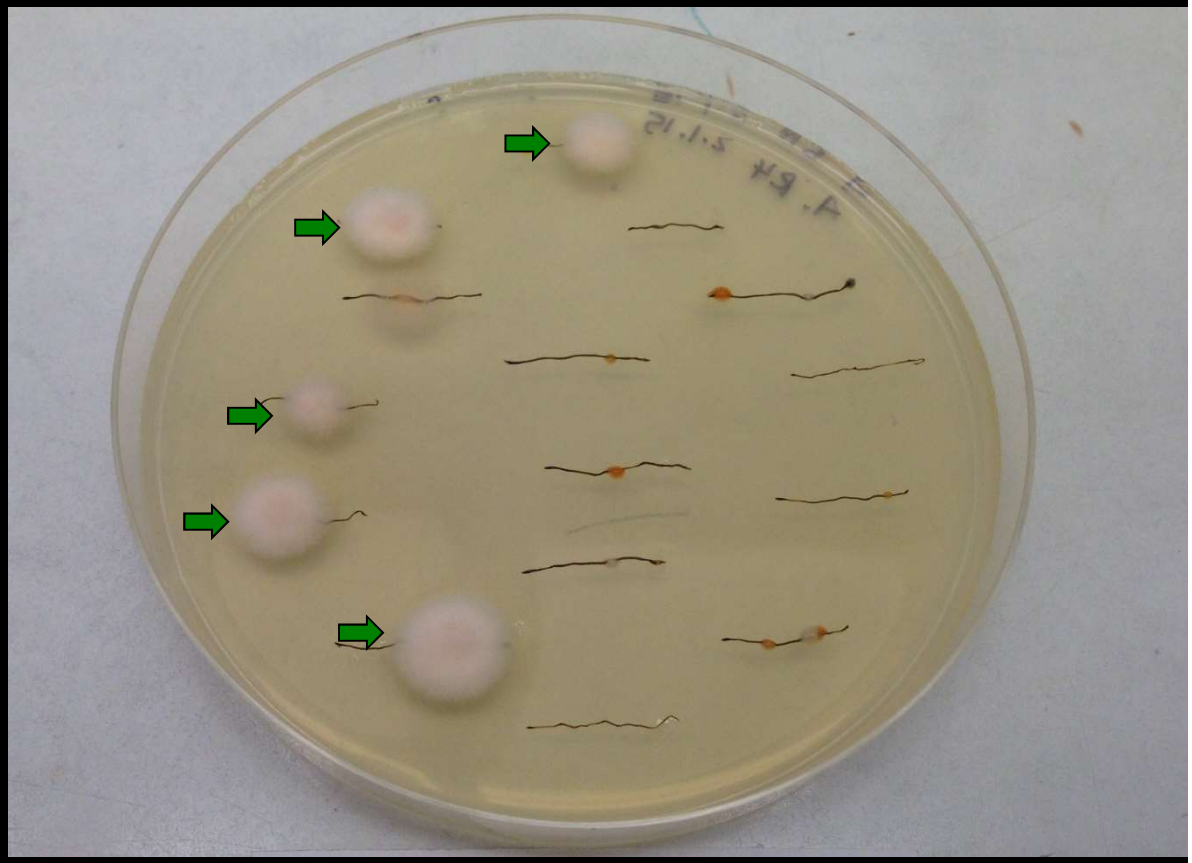
Colonization of rotation crops

Colonization of rotation crops

Broccoli
Lettuce
Spinach
Cilantro
Wheat
Raspberry

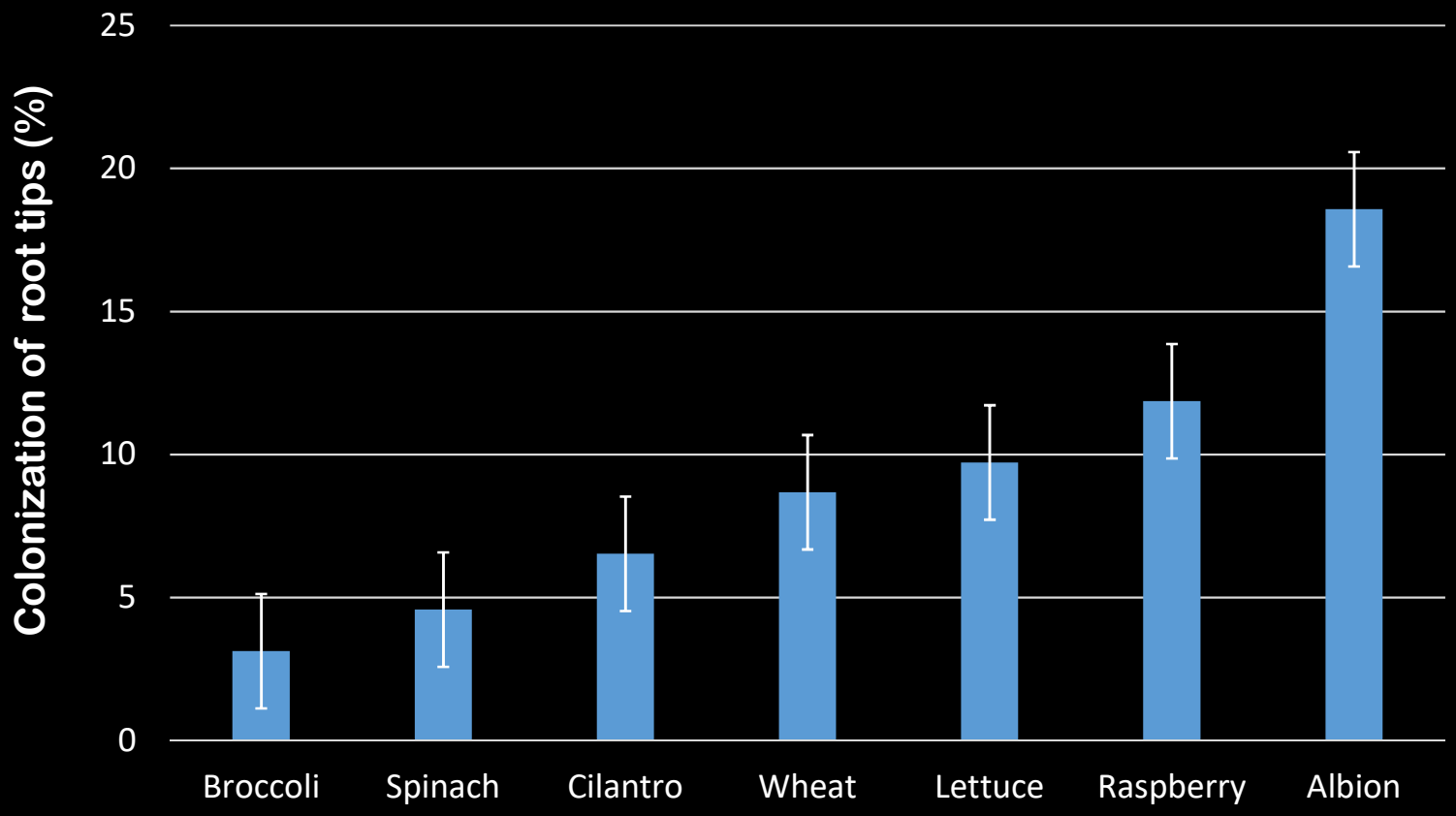


Root tip

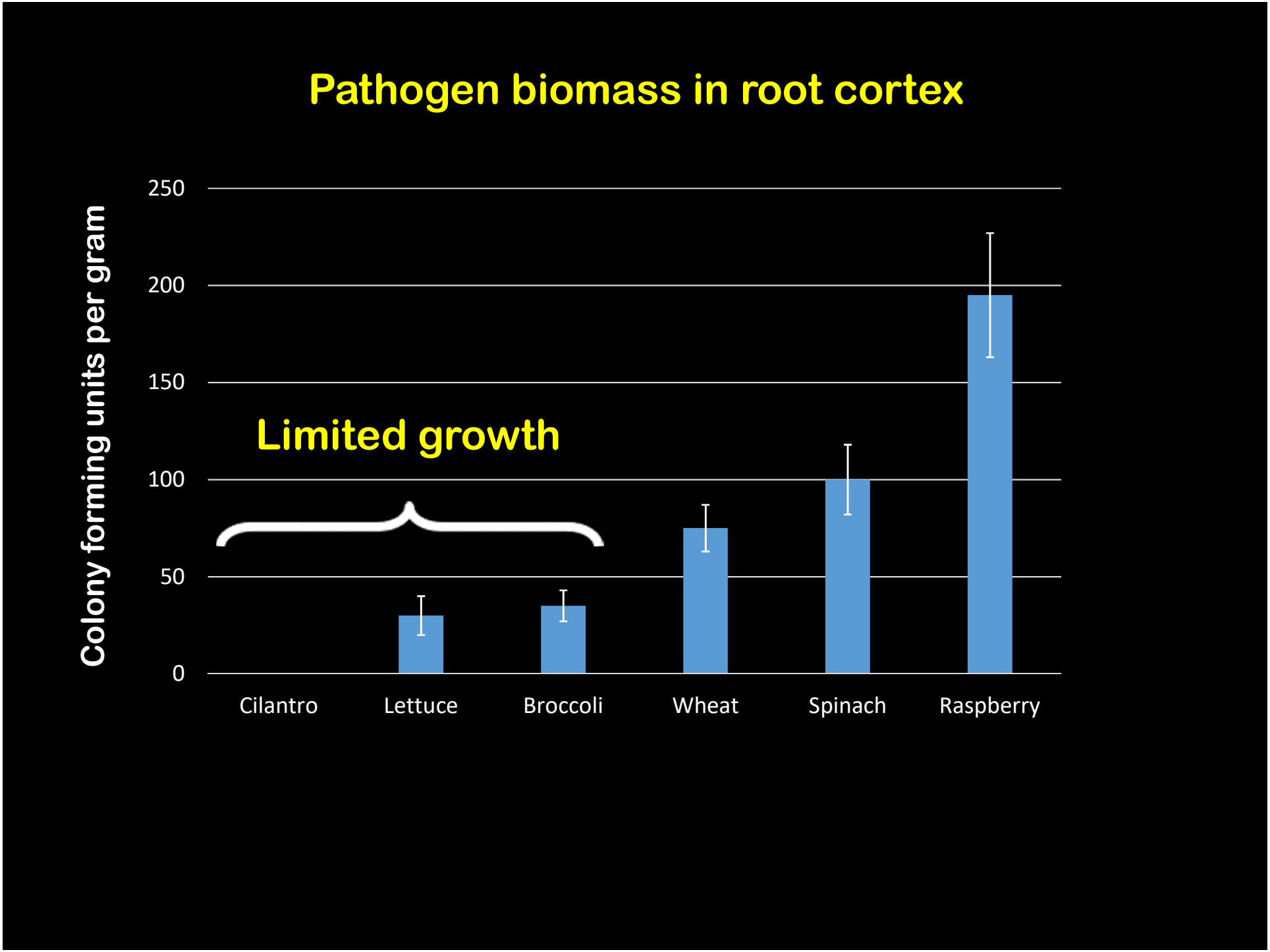


Percentage of root tips infected

Percentage of root tips infected



Extent of colonization?


Pathogen biomass in root cortex
Colony forming units per gram
250
200
150
100
50
0
Limited growth
Cilantro
Lettuce
Broccoli
Wheat
Spinach
Raspberry

Blackberry

Fusarium wilt

Fusarium oxysporum

Is the blackberry pathogen damaging to 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

Susceptibility of strawberry to blackberry pathogen

1 – 5 scale

Susceptibility of strawberry to blackberry pathogen

	1 – 5 scale	
Cultivar	*F. o. mori*	
Albion	3.0	
Monterey	2.1	5.0


Plant 4
MONTEREY
AM_S1
2

Susceptibility of strawberry to blackberry pathogen

1 – 5 scale

Cultivar	*F. o. mori*	*F. o. fragariae*
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

Management

Disease resistance

Effective against all strains of the pathogen

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

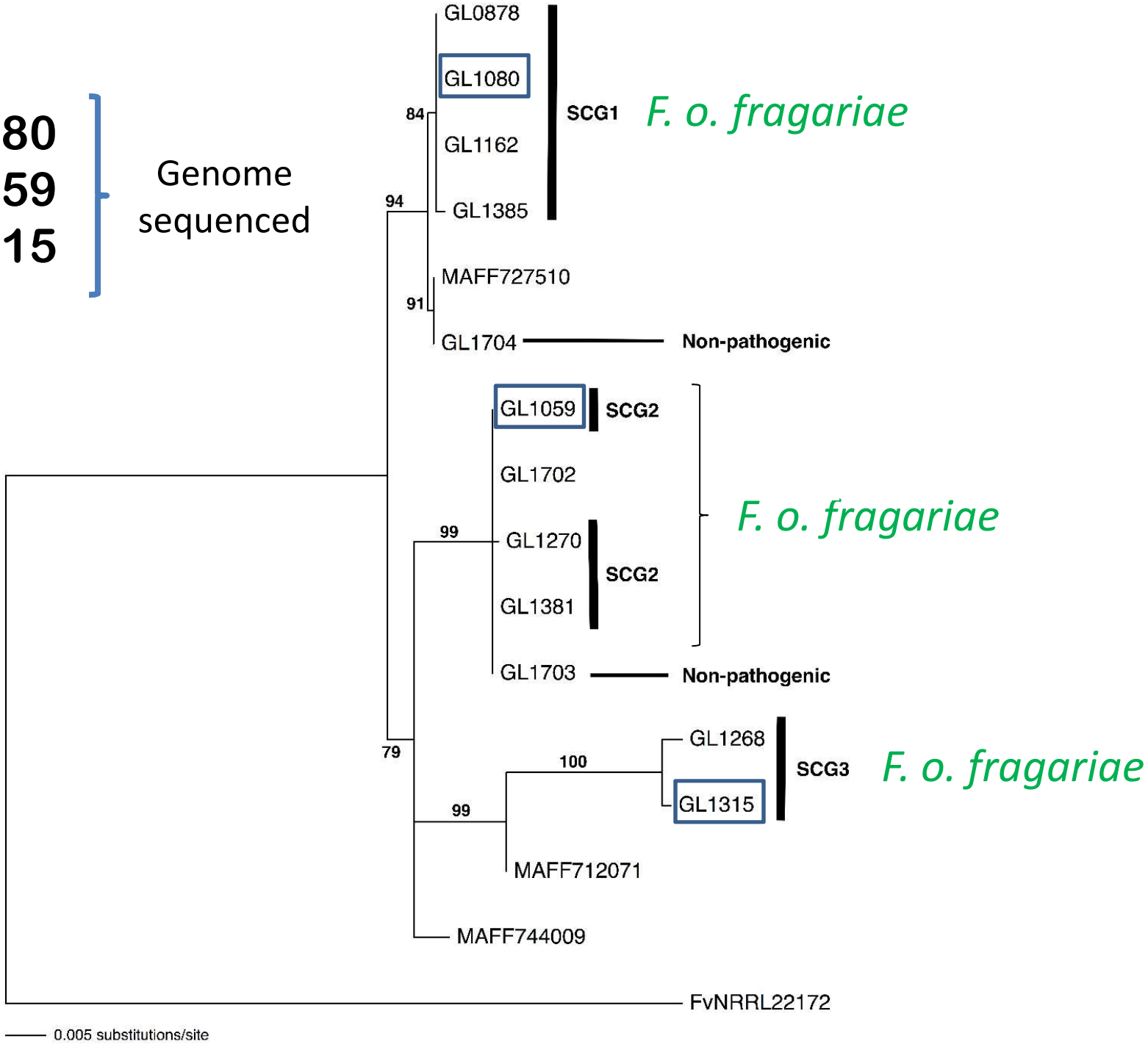
Abstract

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-1α) were amplified by polymerase chain reaction (PCR) and sequenced to elucidate phylogenetic relationships among isolates. IGS and EF-1α 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

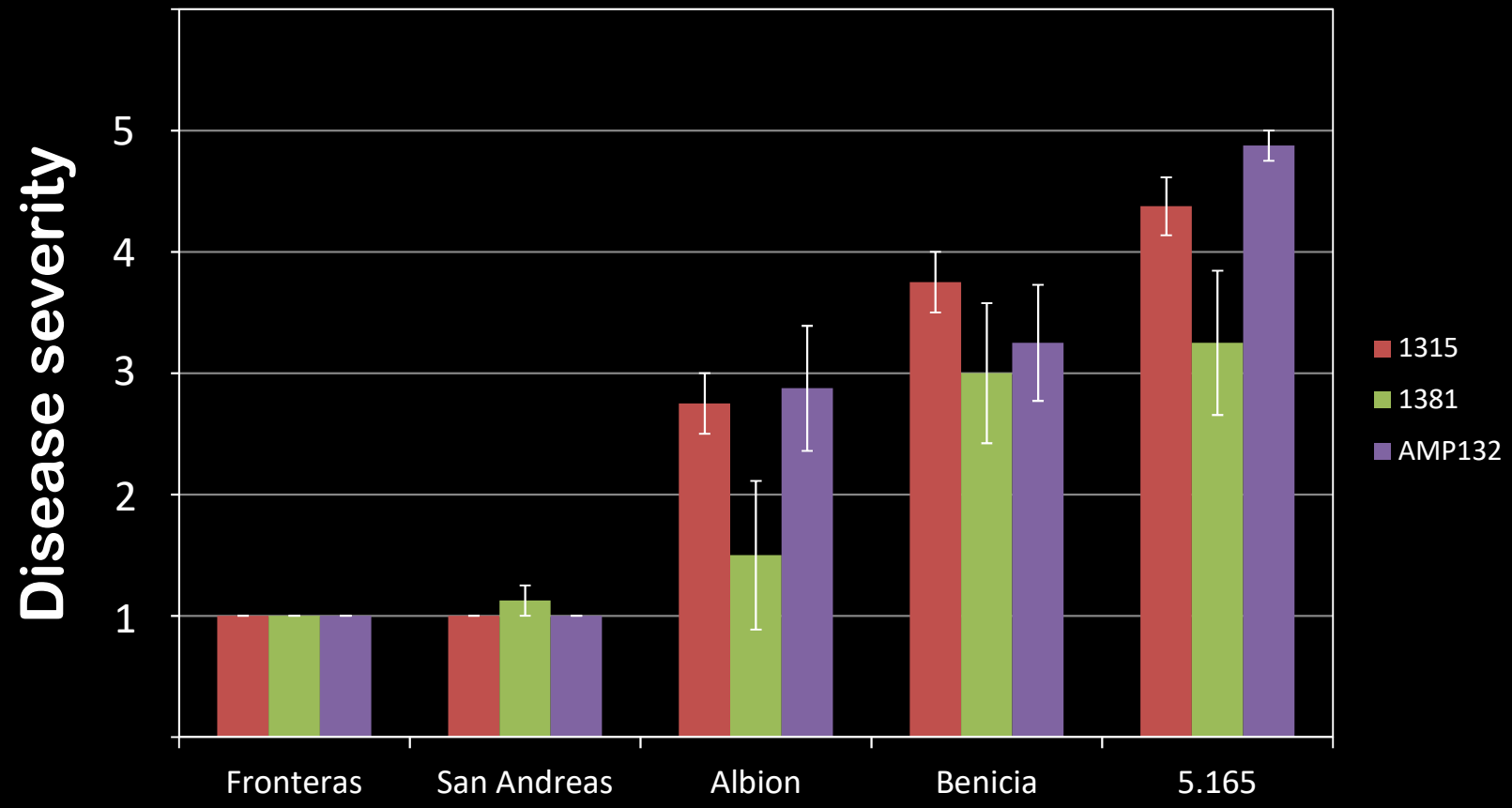


Do *F. o. fragariae* strains differ in virulence?

Genotype * strain test

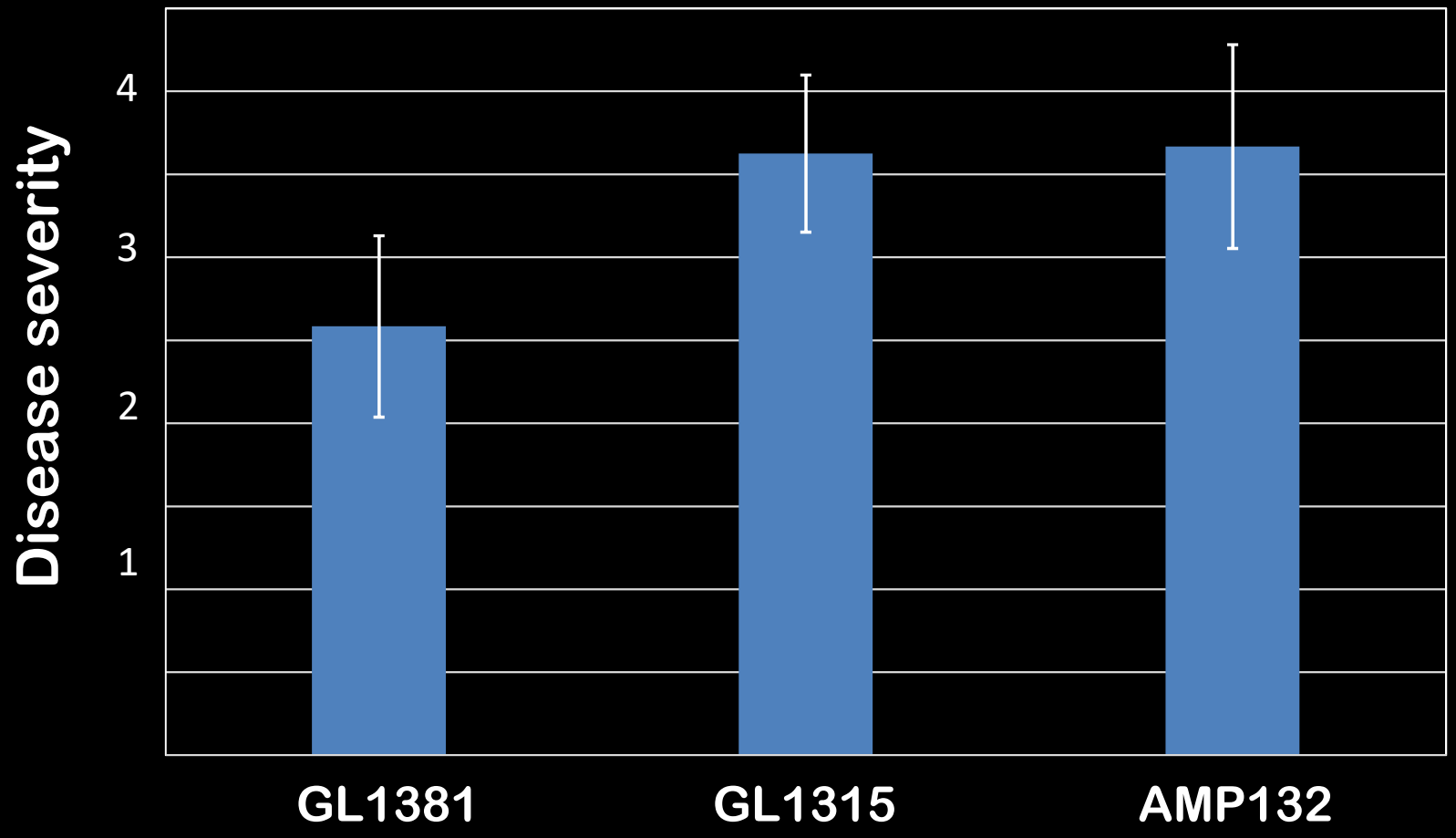
Albion	
Benicia	GL 1315
Fronteras	GL 1381
San Andreas	AMP 132
5.165	

Genotype * strain test



Strains differ in virulence

Genotype * strain test



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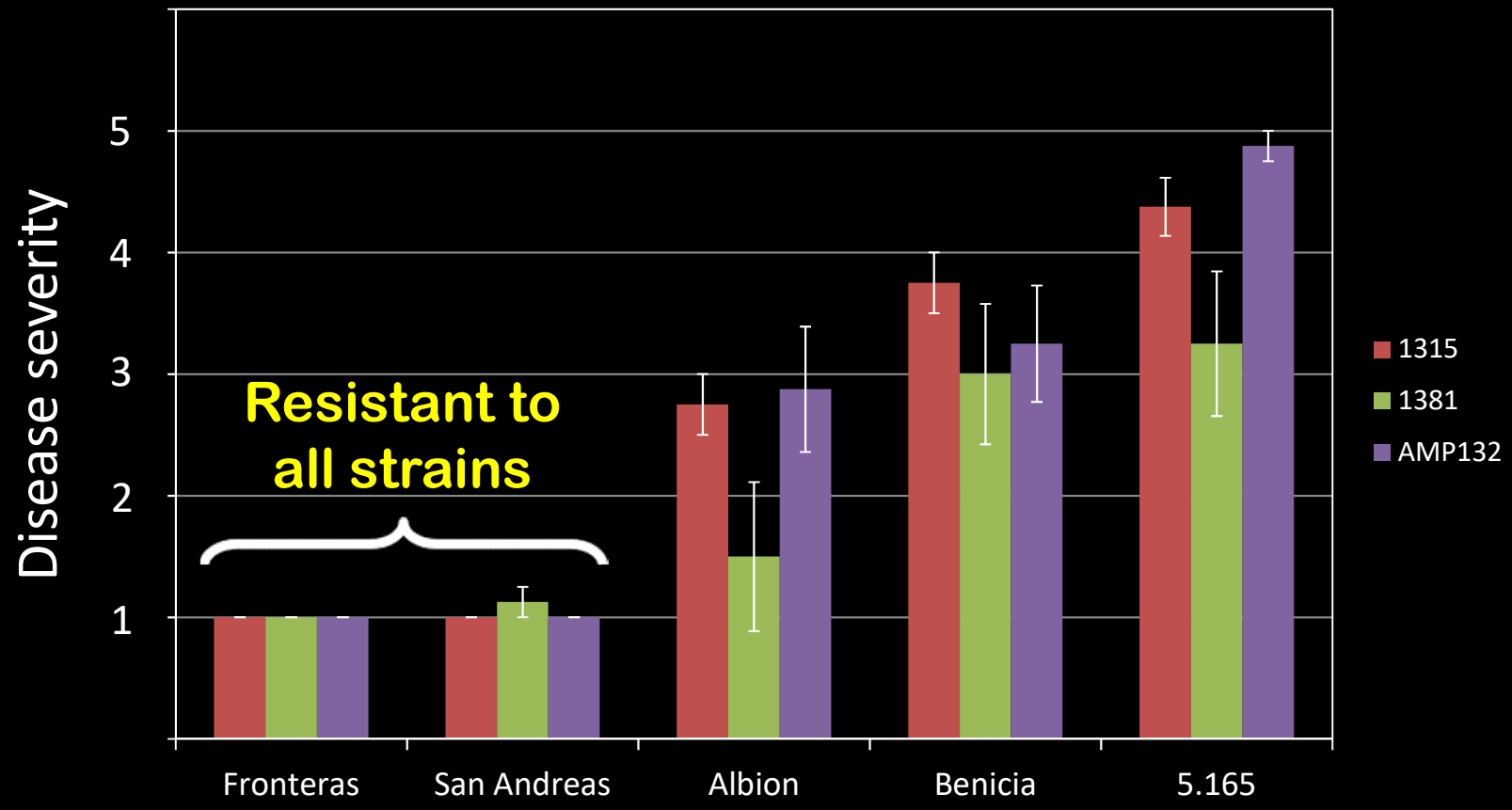
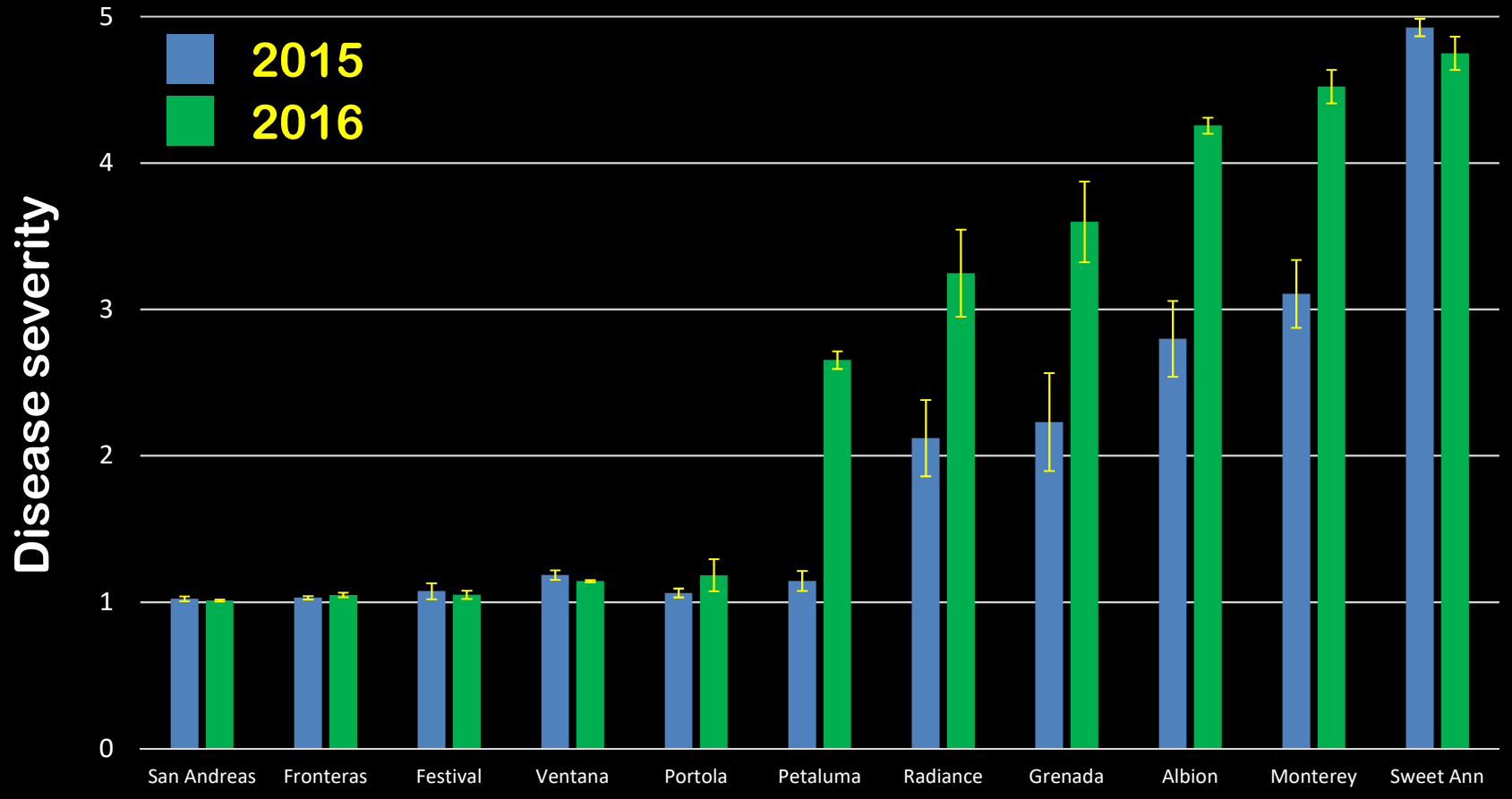
Genotype * strain test



Strains differ in virulence


Naturally infested field

Susceptibility to Fusarium wilt



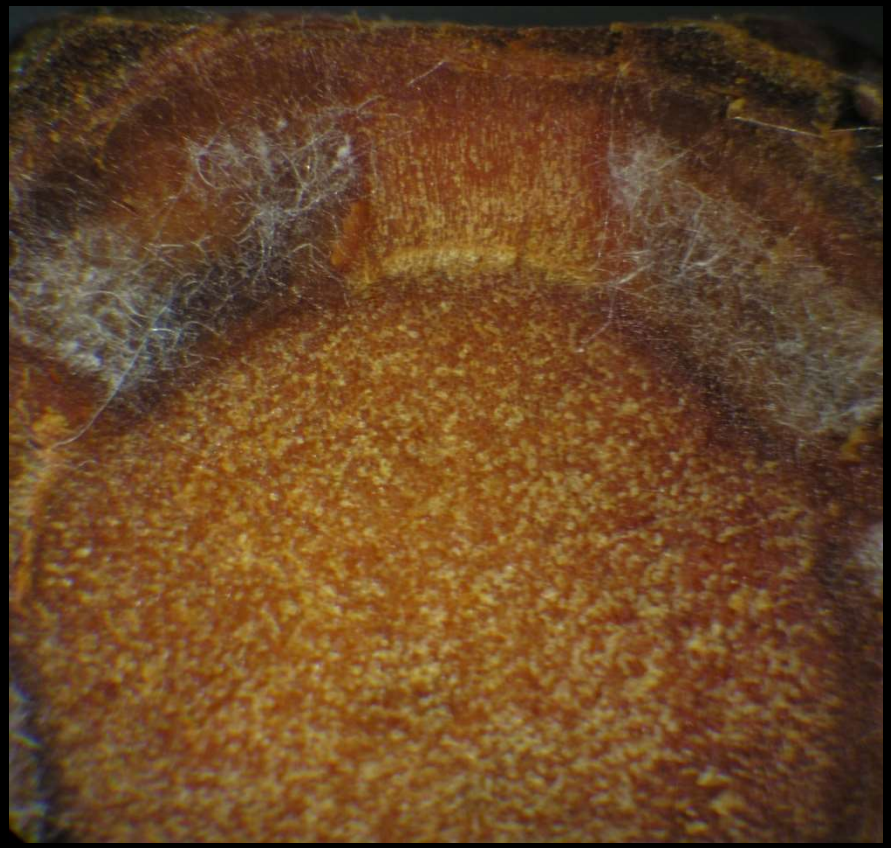
Susceptibility to Fusarium wilt

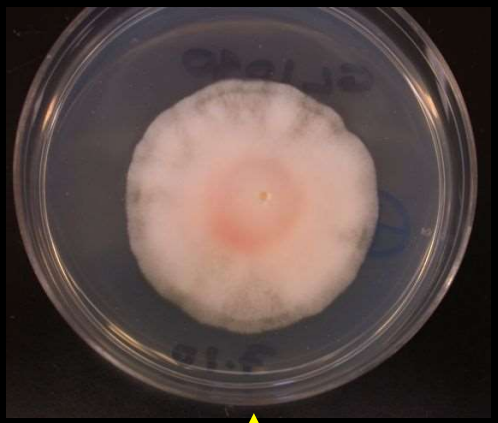
San Andreas Portola Fronteras	Highly resistant
Ventana	Resistant
Monterey Albion	Susceptible

Susceptibility to Fusarium wilt

San Andreas Portola Fronteras	Highly resistant
Festival Ventana Safari	Resistant
Monterey Albion	Susceptible

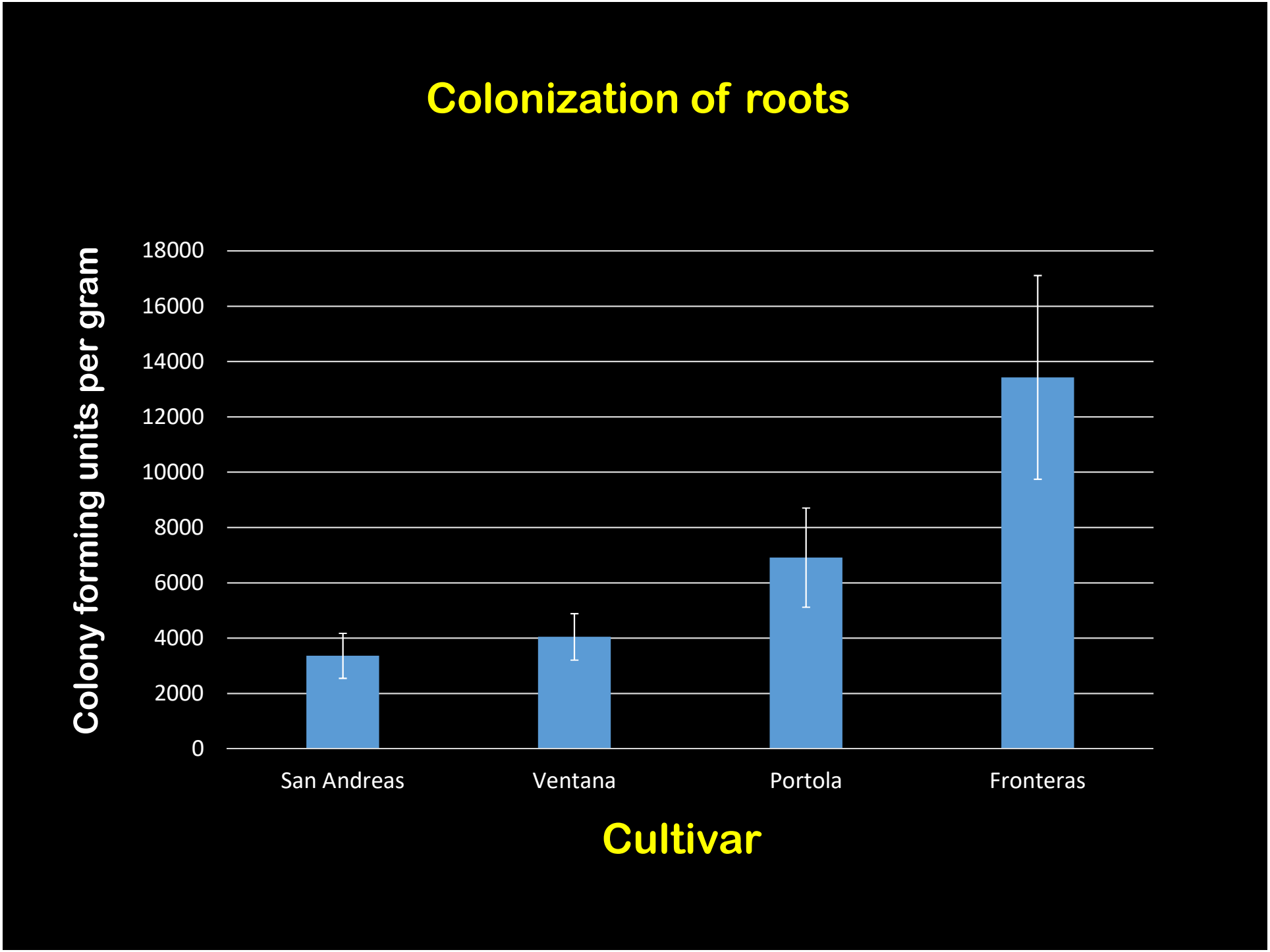
Pathogen can colonize resistant crops

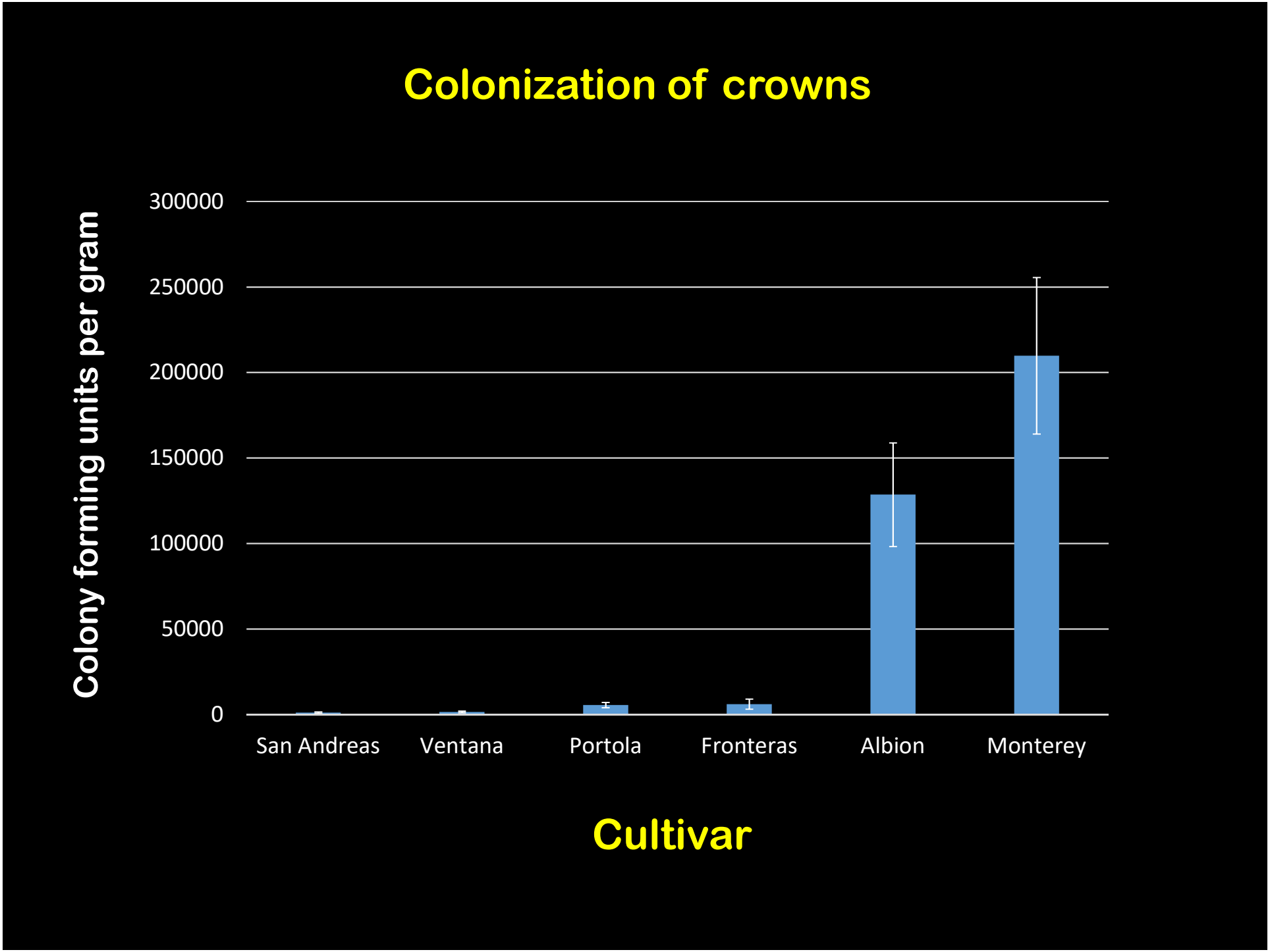


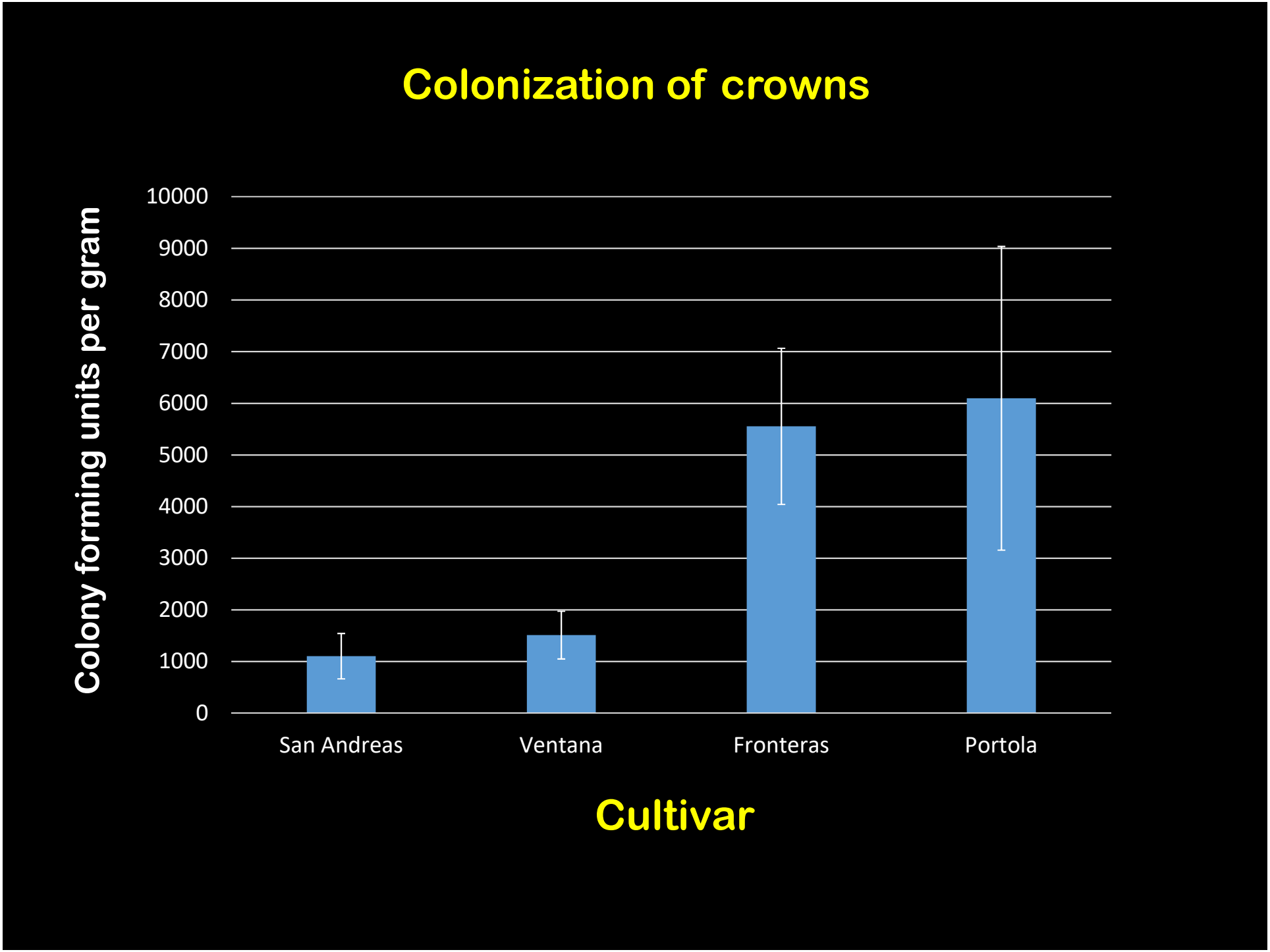


May allow inoculum build-up in soil

Colonization of roots


Colonization of roots
Colony forming units per gram
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
San Andreas
Ventana
Portola
Fronteras
Cultivar


Colonization of crowns
Colony forming units per gram
300000
250000
200000
150000
100000
50000
0
San Andreas
Ventana
Portola
Fronteras
Albion
Monterey
Cultivar


Colonization of crowns
Colony forming units per gram
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
San Andreas
Ventana
Fronteras
Portola
Cultivar

Resistance may be overcome

Risk is proportional to pathogen growth and reproduction

Suppression of pathogen populations still important

Management of soilborne pathogens

Reduce inoculum levels

Avoid introductions

Disease resistance

Thanks


california
STRAWBERRY COMMISSION
CALIFORNIA STRAWBERRIES
A HEALTHY INDULGENCE
WESTERN SARE
Sustainable Agriculture Research & Education
HANSEN TRUST
ASI
AGRICULTURAL SUSTAINABILITY INSTITUTE AT UCDAVIS
Lassen Canyon Nursery Inc.
THE STORKAN HANES MCCASLIN RESEARCH FOUNDATION
Sierra-Cascade Nursery
"Quality Strawberry Plants"