Soilborne problems affecting strawberries

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Collaborators:

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Macrophomina phaseolina

Fusarium oxysporum

Verticillium dahliae

Where do they come from?

Resident in soil

Colonizer of a previous crop

Pathogen = cause of disease

Growth on another crop but not a cause of disease

Where do they come from?

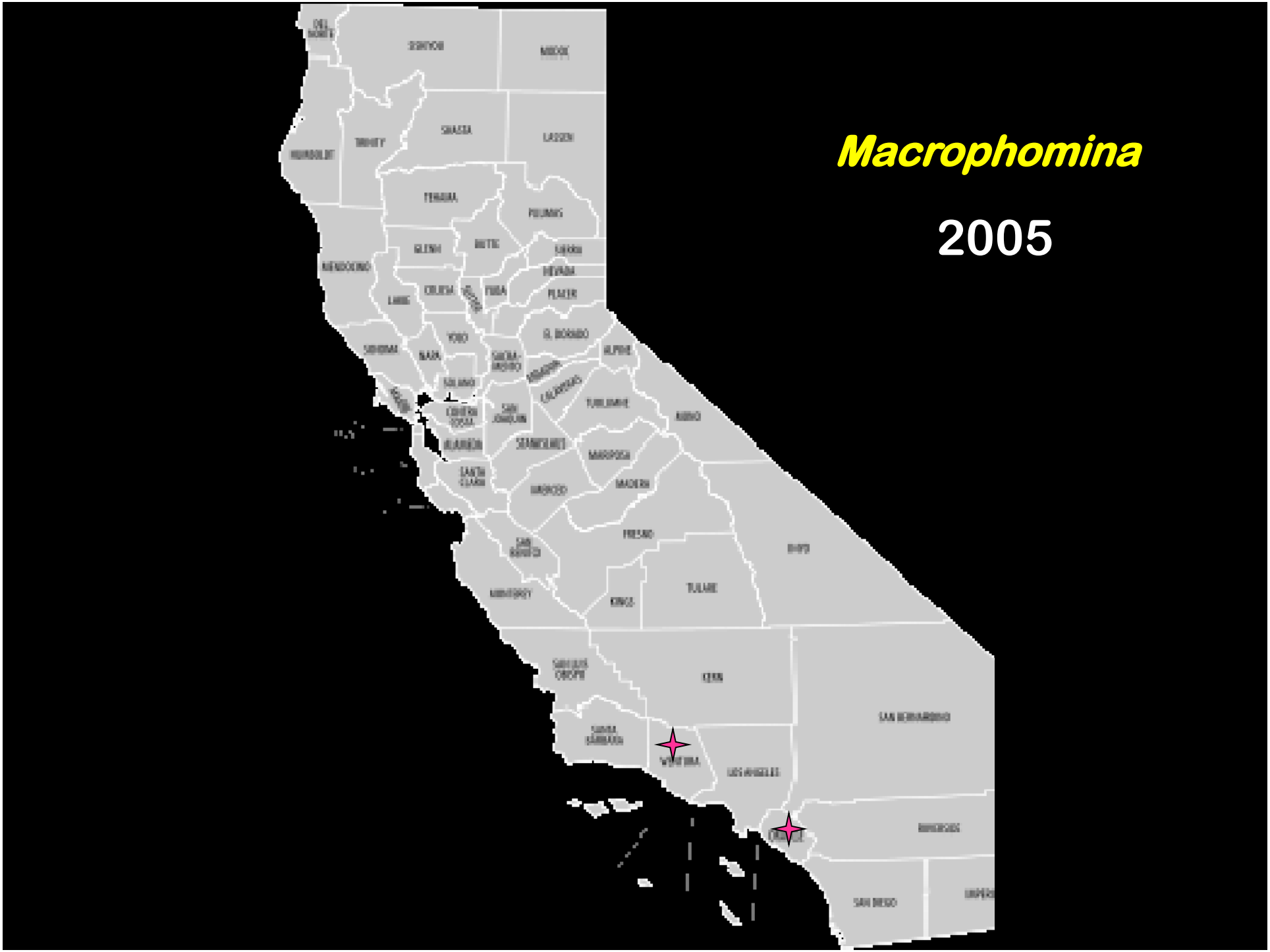
Resident in soil

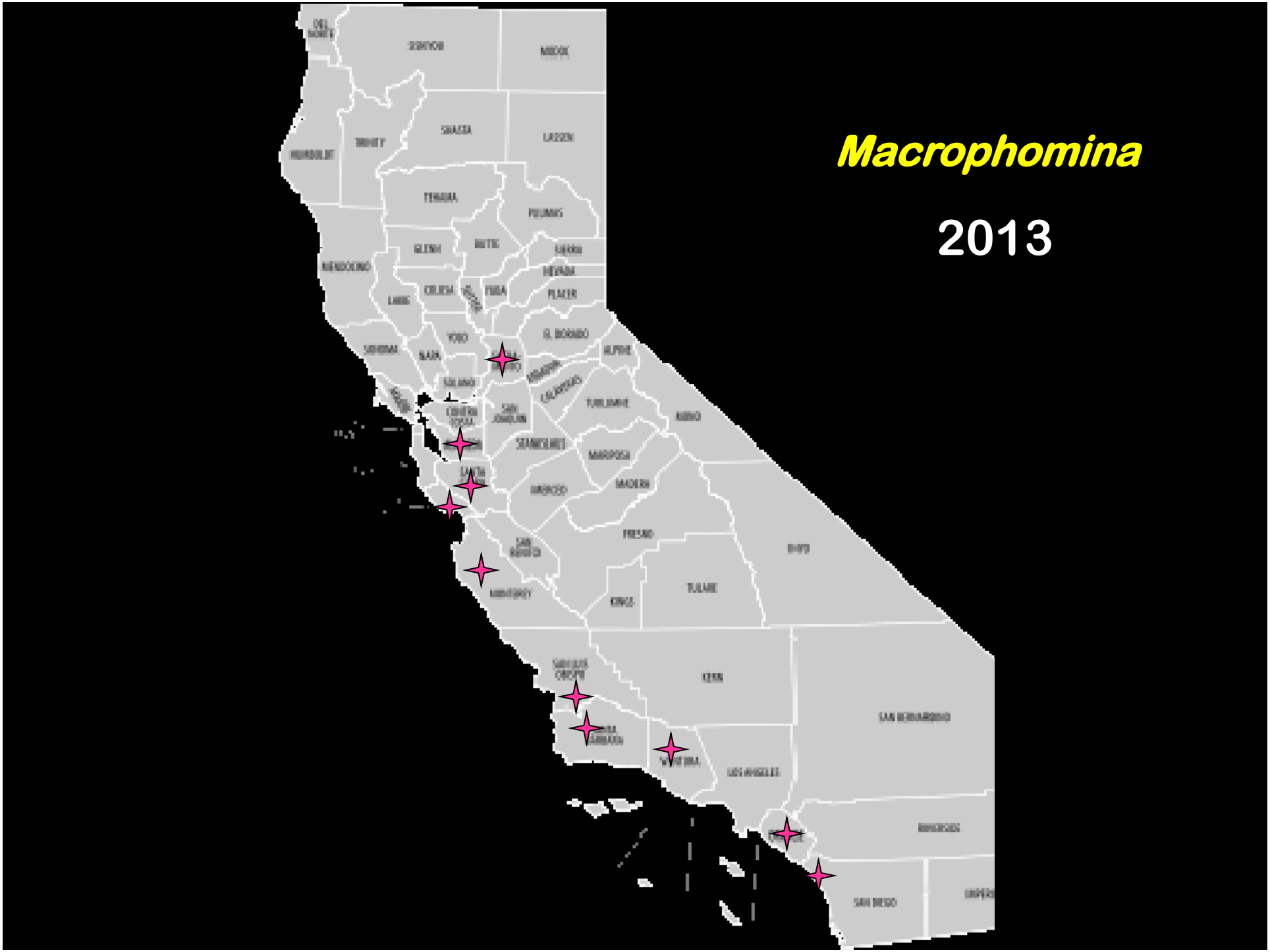
Moved with soil from another location

Introduced with infected plants

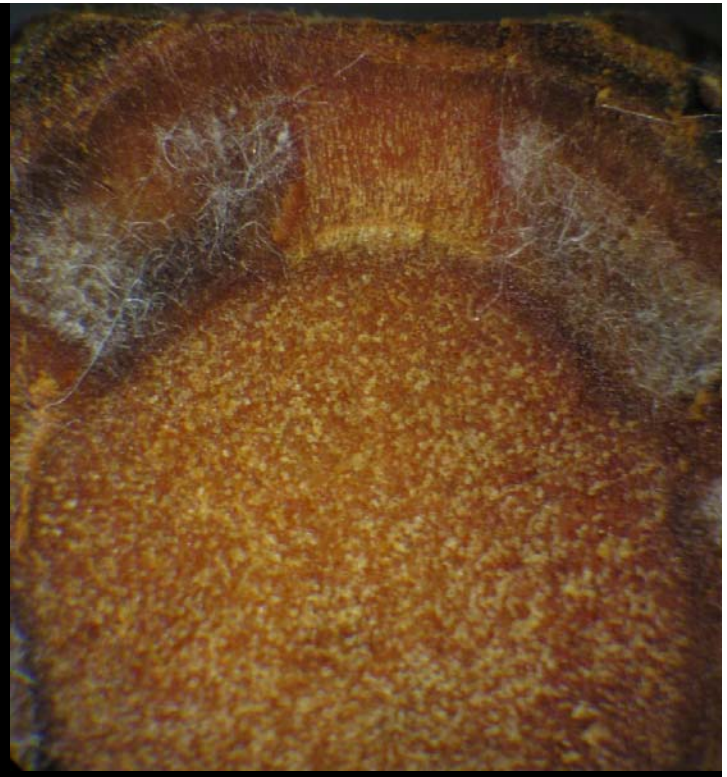

Verticillium wilt

Macrophomina


Macrophomina
2005


Macrophomina
2013

Fusarium wilt



Fusarium oxysporum

Management

Avoid introduction

Soil on equipment

Management

Reduce inoculum levels in soil

Pre-plant fumigation

Flat fumigation to treat the entire field is best

Efficacy of fumigants

Methyl Bromide:Chloropicrin 2:1 @ 350 pounds/acre

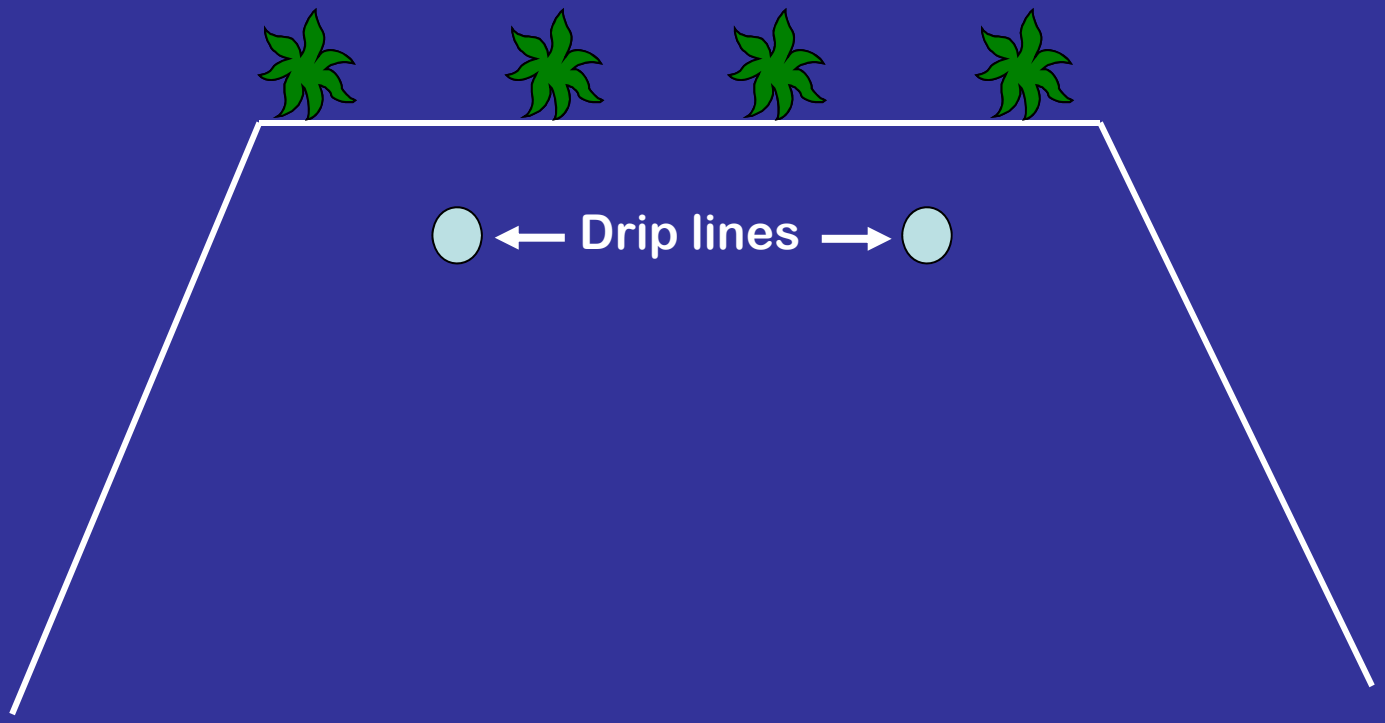
Chloropicrin @ 400 pounds/acre

Telone (1,3-Dichloropropene)

Metam sodium

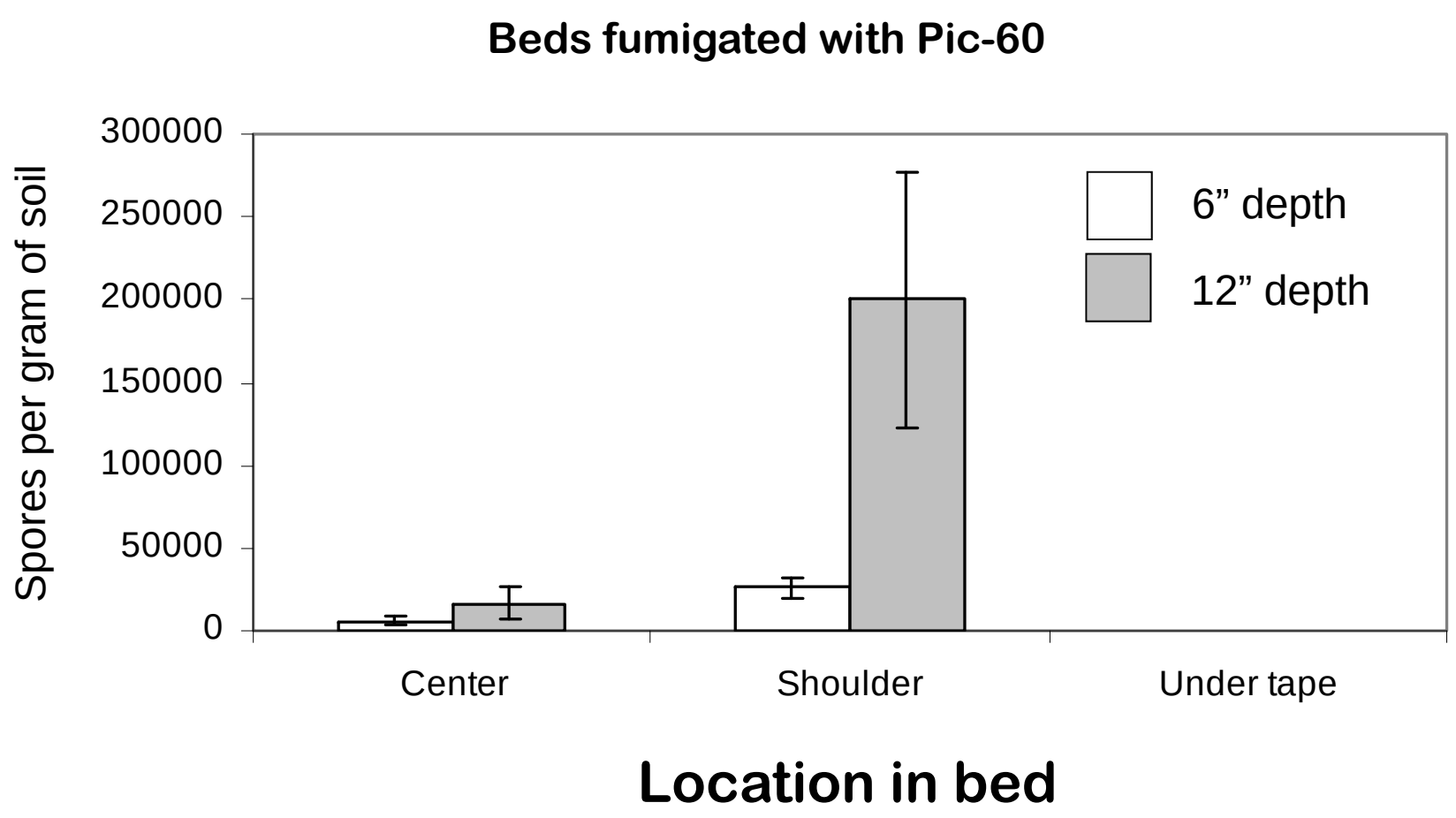

More than one cycle of fumigation may be required

Bed fumigation



The soil is not uniformly exposed to the fumigant

Survival of the Fusarium wilt pathogen



Effect of inoculum depth on onset of disease

Top 4 inches

4 – 6 inches

6 – 8 inches

12 – 14 inches

Six weeks after planting

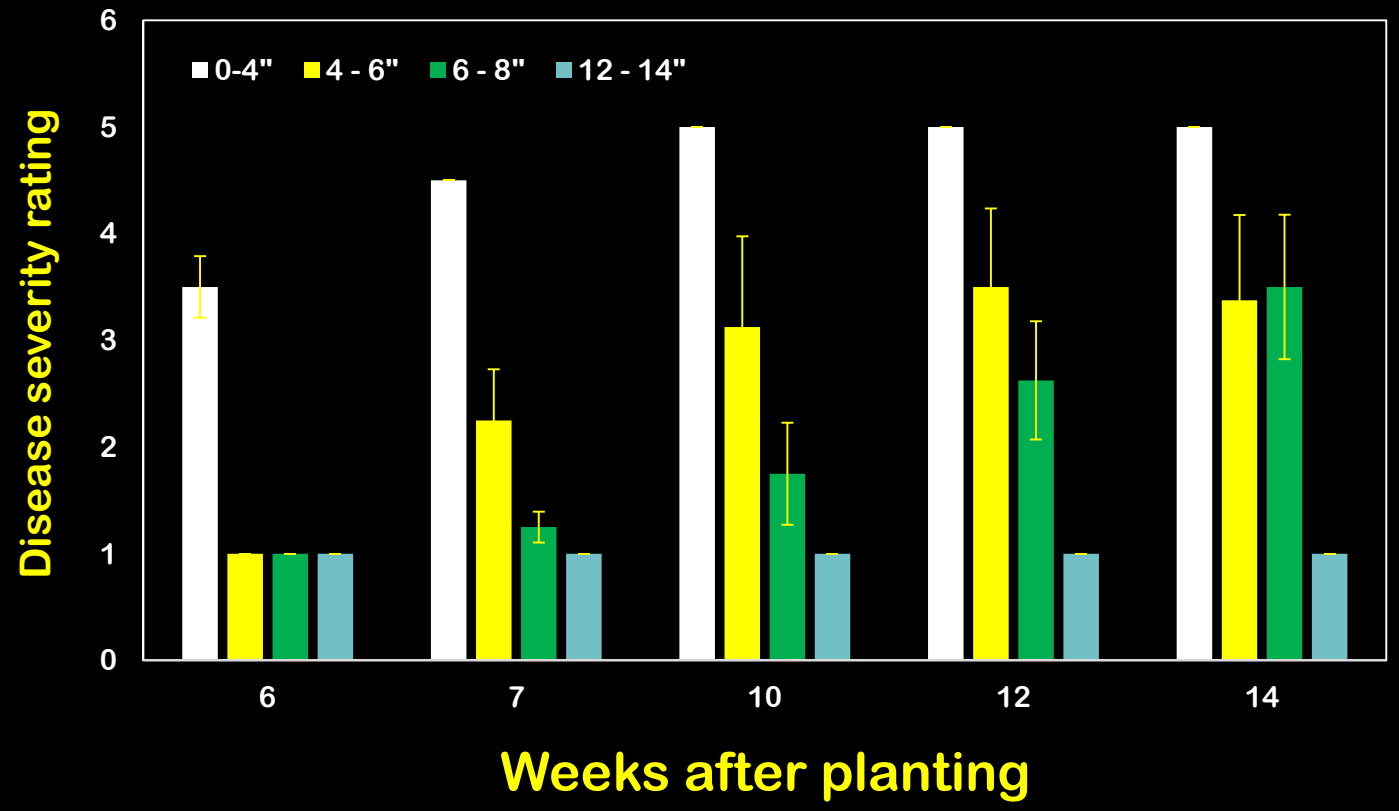
Plants show symptoms of disease when inoculum is in the top 4 inches of soil

No symptoms if inoculum is below “4

Nine weeks after planting

Rating scale: 1 - 5

Effect of inoculum depth on disease severity



Disease severity rating scale: 1 – 5;
1 = healthy and 5 = dead

Inoculum below 12”

14 weeks after planting

Inoculum below 12”

Plants are infected

Management

Reduce inoculum levels in soil

Crop rotation

Inoculum levels decline when other crops are grown

Fusarium wilt

Specific to strawberry

Macrophomina

Wide host range

Known hosts to Macrophomina

Sunflower

Bean

Corn

Pepper

Cantaloupe

Tomato

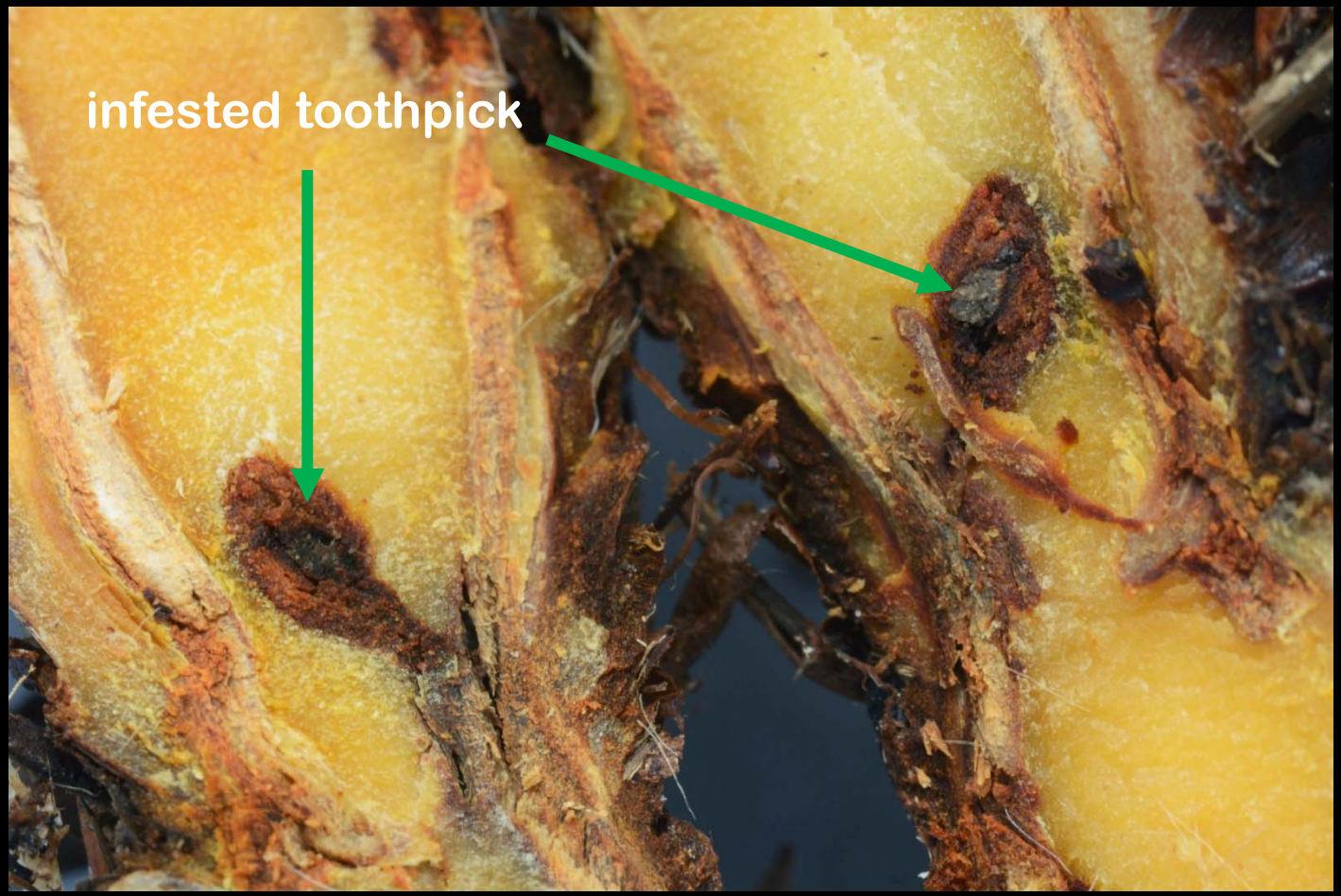
These crops were inoculated with isolates from strawberry

Crown inoculation with infested toothpicks

Toothpicks are colonized by *Macrophomina*

Toothpick inserted in crown of the plant

Inoculated strawberry crown



Inoculated strawberries

Plants inoculated with Macrophomina from strawberry

Sunflower

Bean

Corn

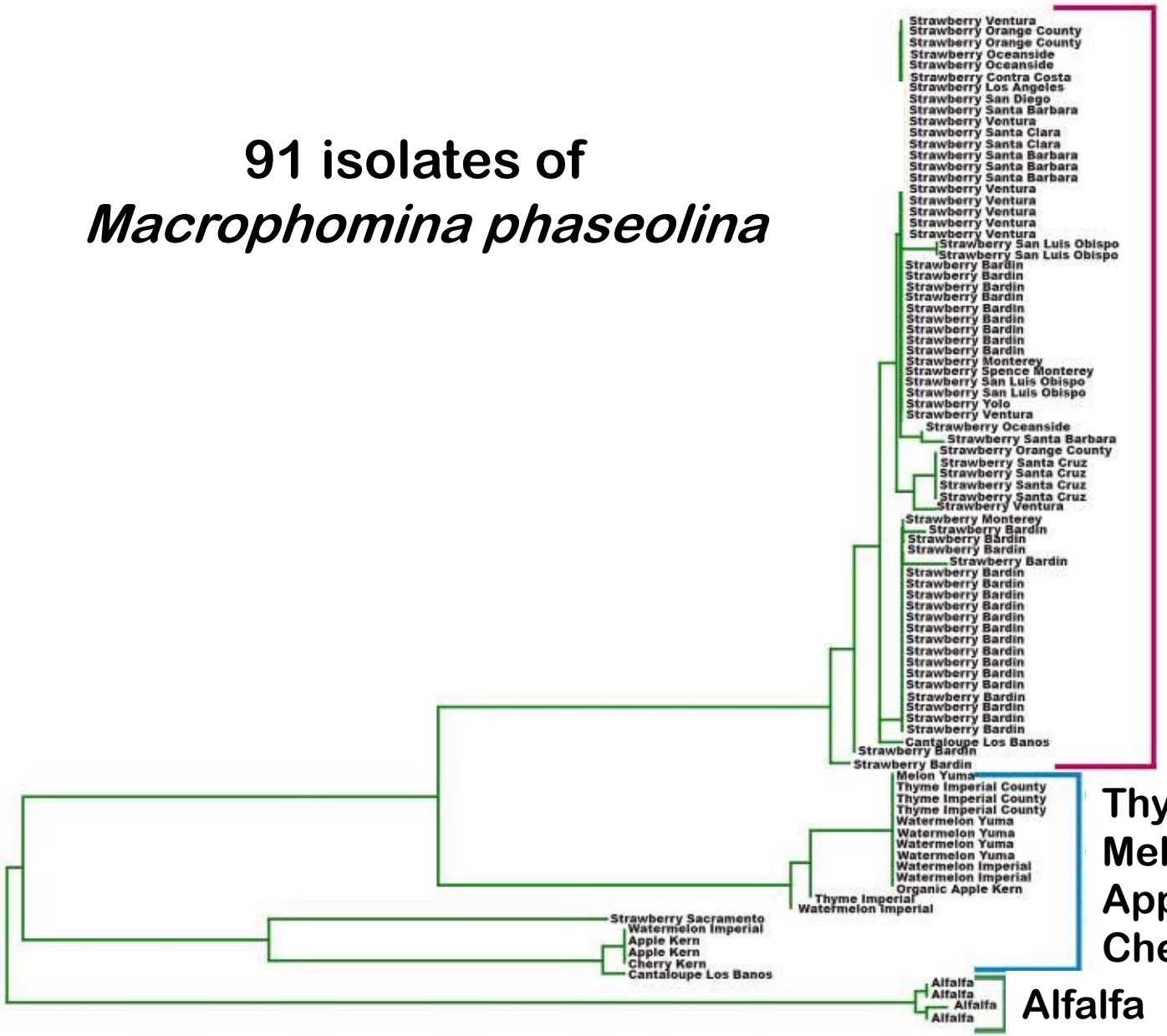
Pepper

Cantaloupe

Tomato

Symptoms developed only on cantaloupe

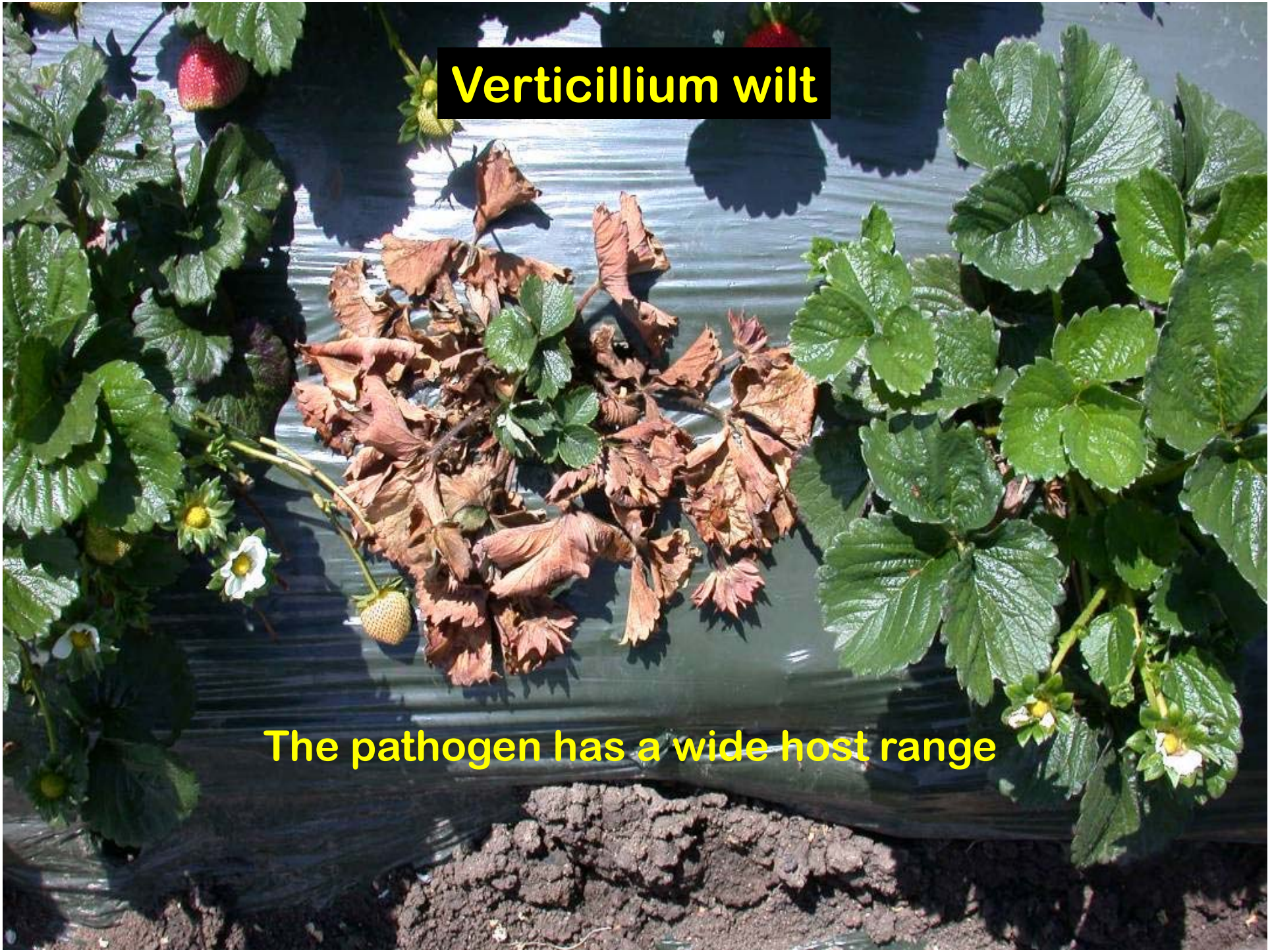
91 isolates of *Macrophomina phaseolina*



Frank Martin, USDA-ARS

Macrophomina

Strawberry pathogen may have a limited host range


Verticillium wilt
The pathogen has a wide host range

Crops to avoid because they are susceptible to Verticillium

Lettuce

Potatoes

Both can tolerate high levels of inoculum

Legumes

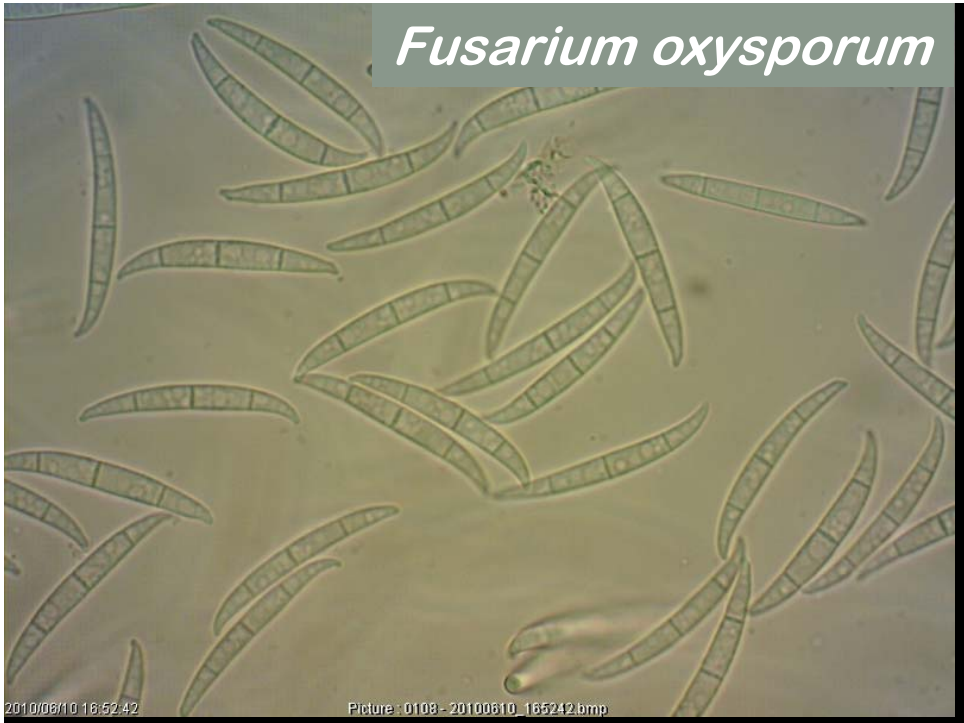
Infected plants are symptomless

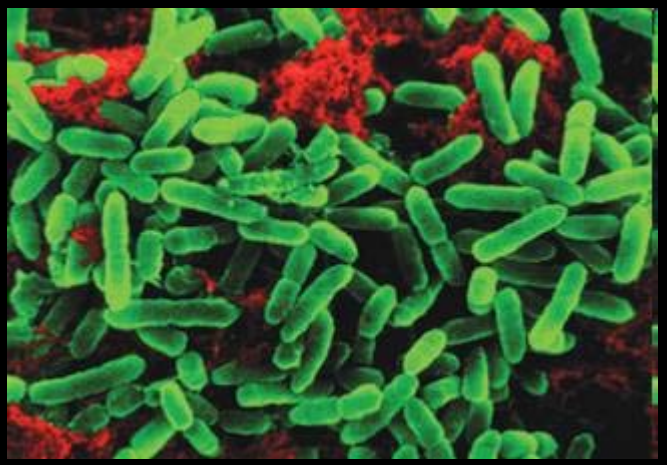
Management

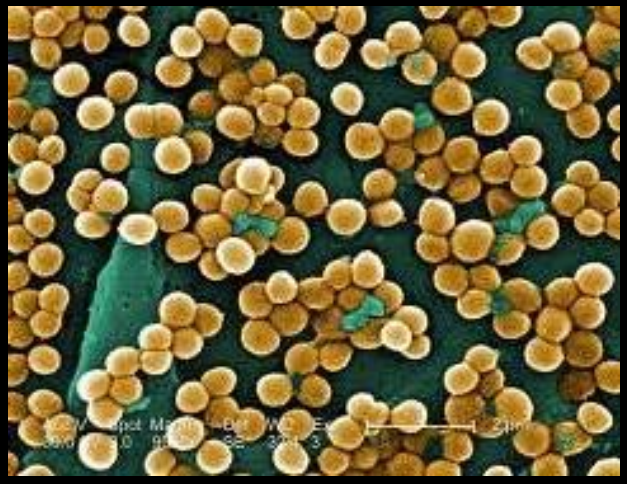
Suppressing pathogen activity in soil

Effect of soil pH on Fusarium wilt

Elevating pH to 7.0 reduced severity of Fusarium wilt of tomato







In soil fungi compete with bacteria

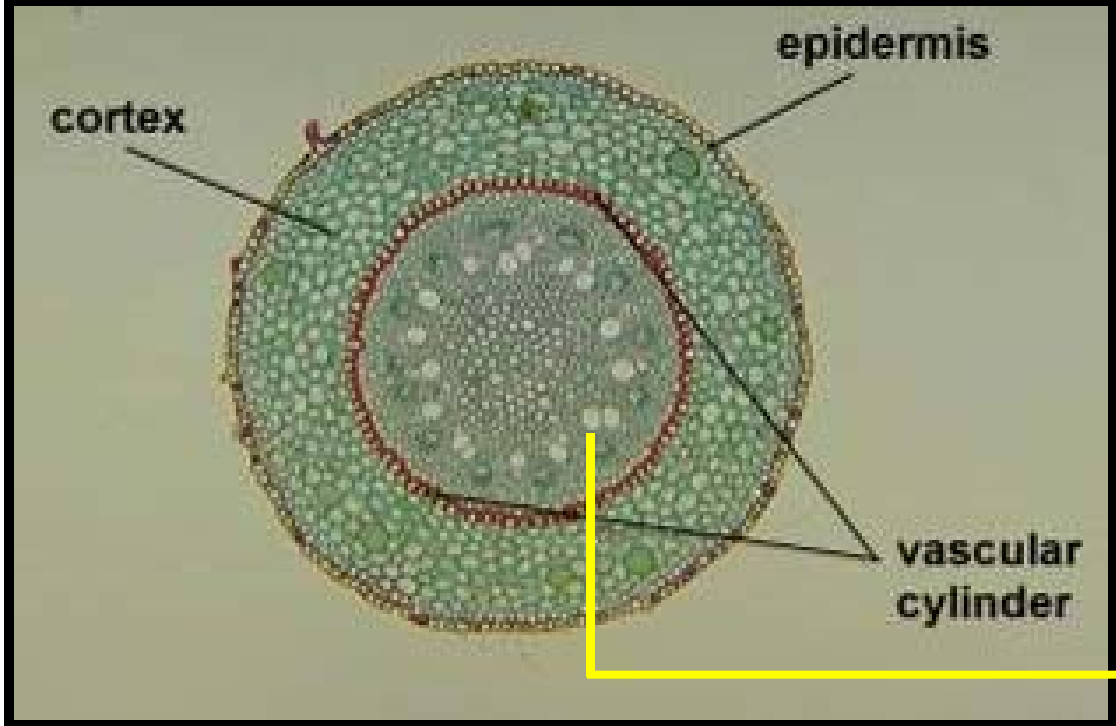
Acidic soil tends to
favor fungi over bacteria


Soil was taken from a field naturally
infested with *Fusarium oxysporum*


Soil was adjusted to pH to 6.0 or 7.0


Frequency of root infection was determined
PH 7.0

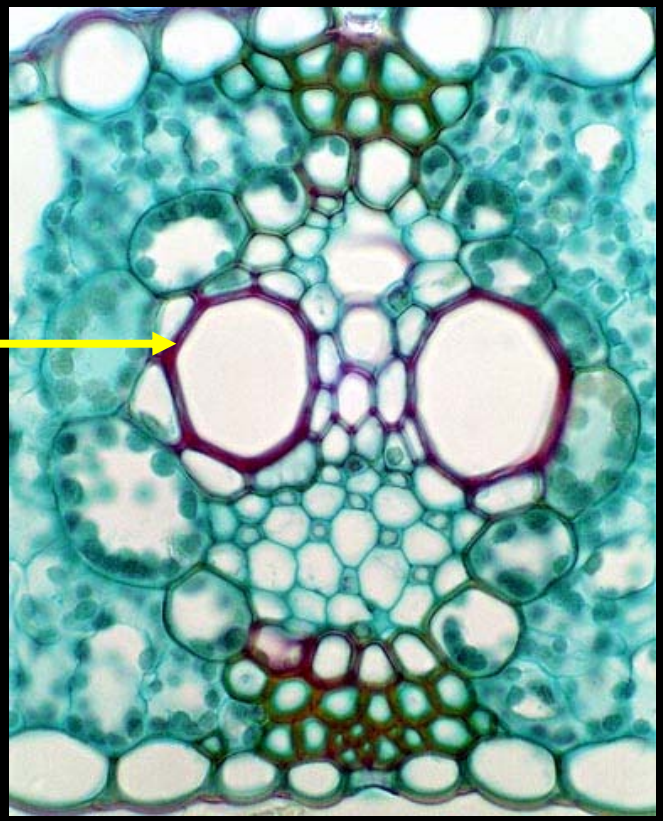
Frequency of root infection



Most infections remain within the root cortex

Less than one in a thousand root infections extends into the water conducting tissue

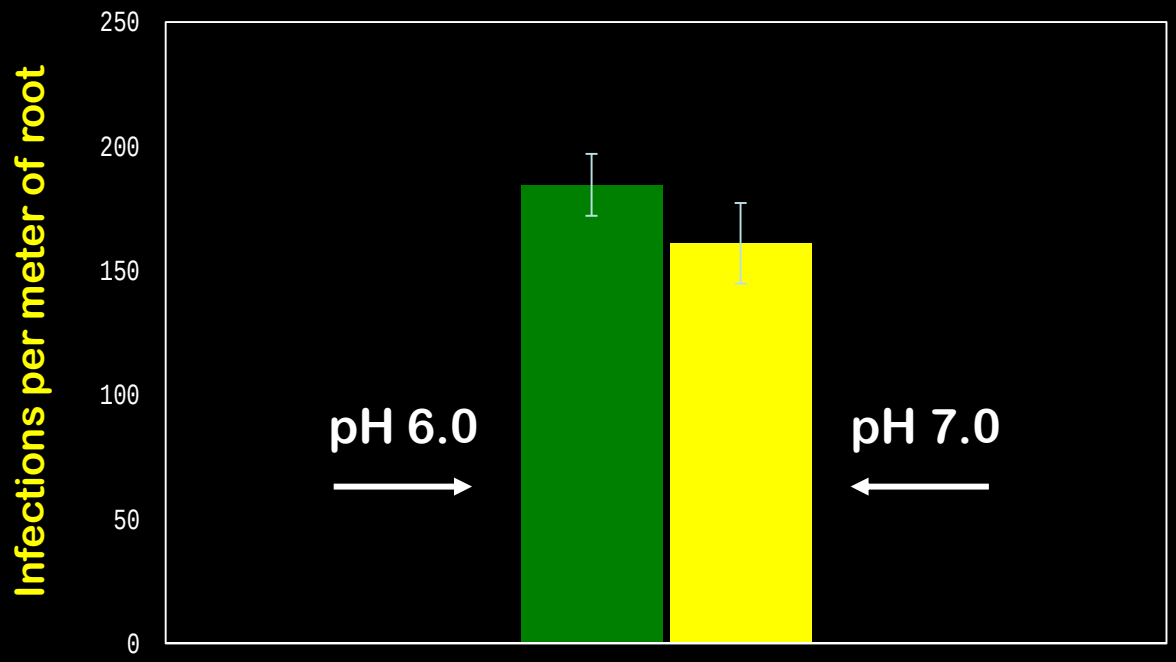
Disease requires entry into water conducting tissue



Number of root infections per unit root length

Fewer root infections means a lower risk of disease

Effect of pH on infection of strawberry roots



Very high inoculum levels may minimize the effect of soil pH on infection frequency

Management of soilborne pathogens

Avoid introductions

Reduce inoculum levels

Reduce infection rates

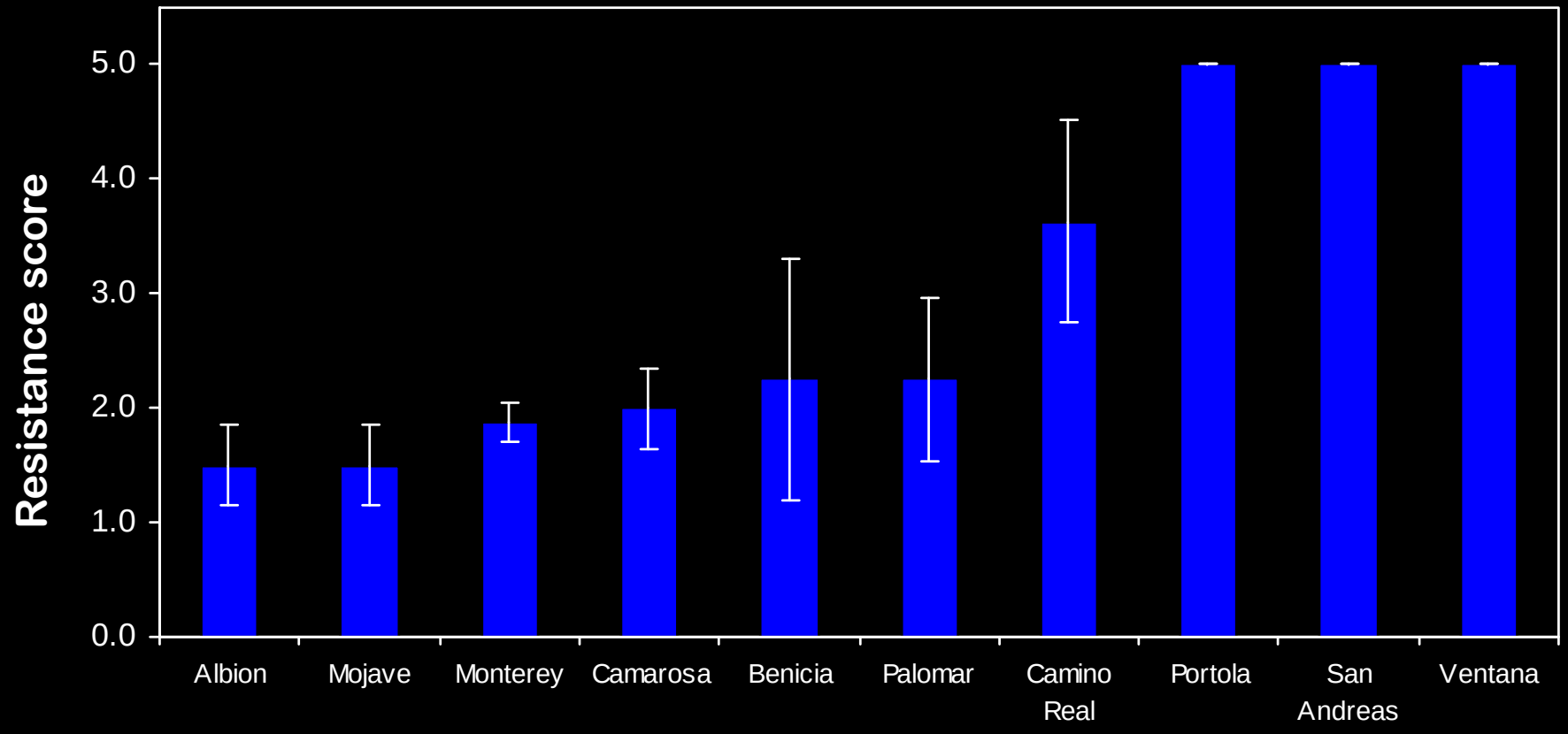
Disease resistance

Differences in susceptibility to Fusarium wilt

Camarosa

Ventana

Currently grown UC cultivars



1 – 5 Scale; 1 = Susceptible, 5 = Resistant


San Andreas
Albion
Soil naturally infested with Fusarium wilt pathogen

Screening for resistance to Macrophomina

Detect differences among genotypes

Differences are heritable

Results correlate with field susceptibility

Differential susceptibility to Macrophomina

Modest gains accumulate over time

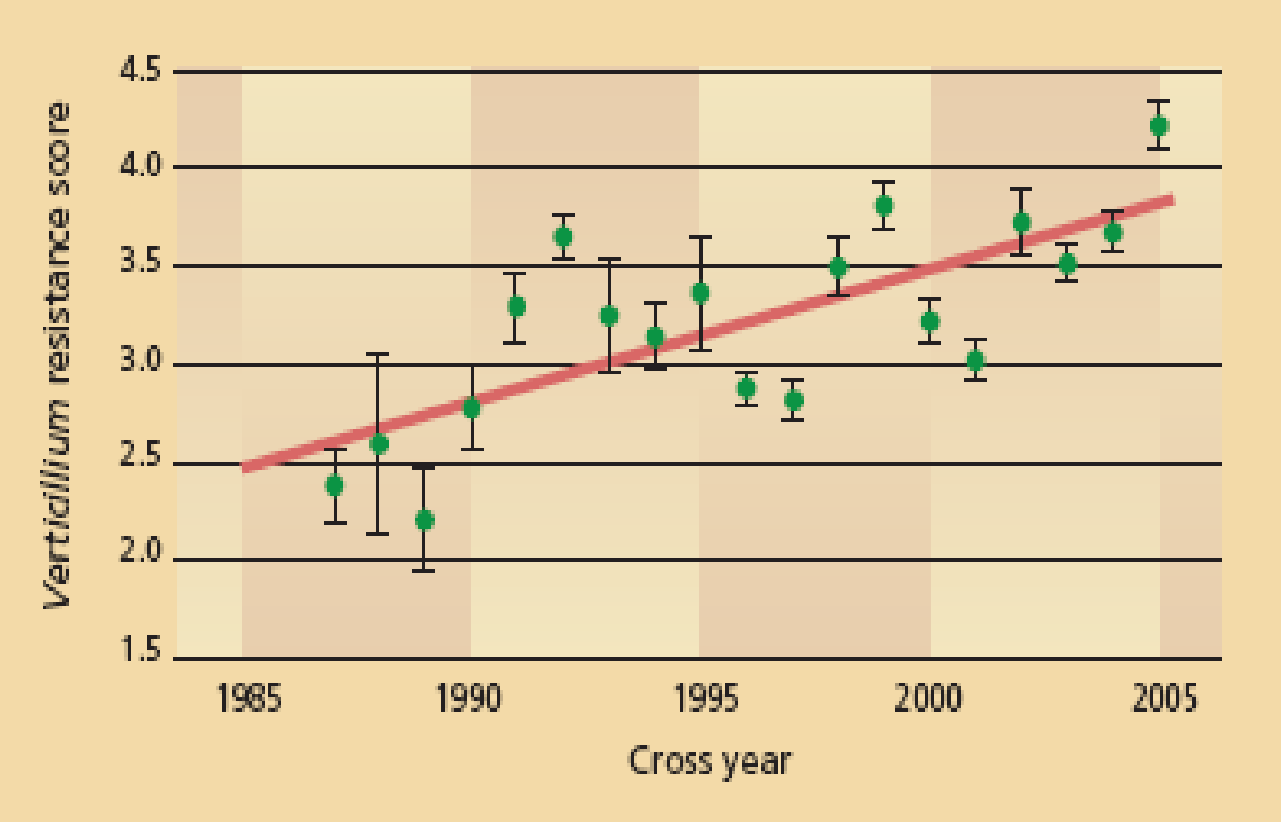


Fig. 1. Changes in the mean *Verticillium* resistance score (1 = severely diseased, and 5 = no symptoms of disease) in genotypes from cross years 1987 (original germplasm) to 2005, ± standard error.

Management of soilborne pathogens

Avoid introductions

Reduce inoculum levels

Disease resistance

Thanks

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