Living with soilborne pathogens

Tom Gordon

Department of Plant Pathology

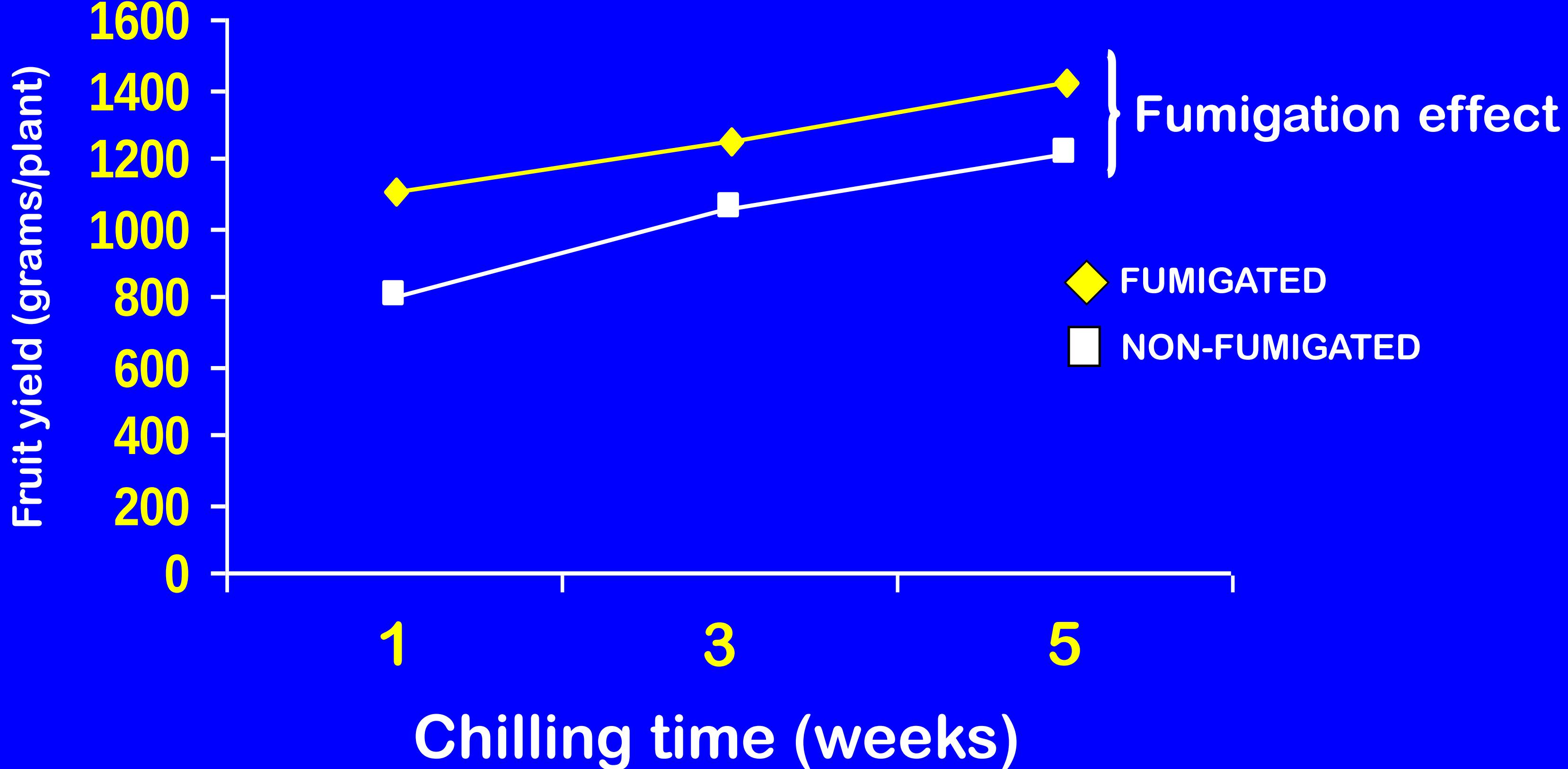
All plants are infected

By fungi that are not pathogenic

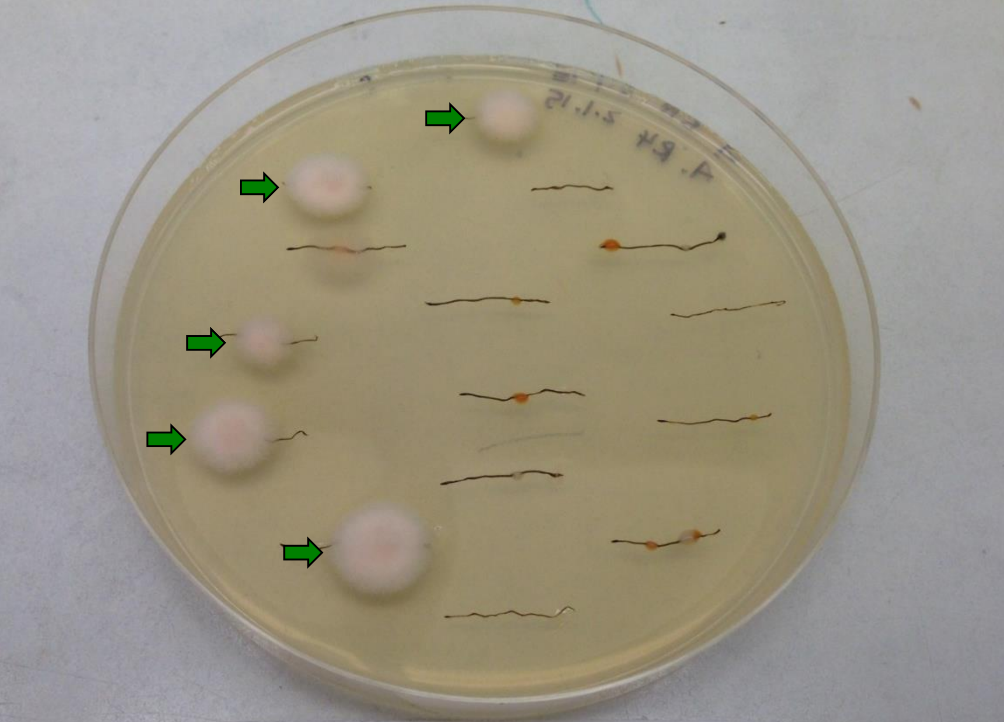
They cause no symptoms

Yield is reduced

Effect of fumigation treatment and chilling on fruit yield of strawberry



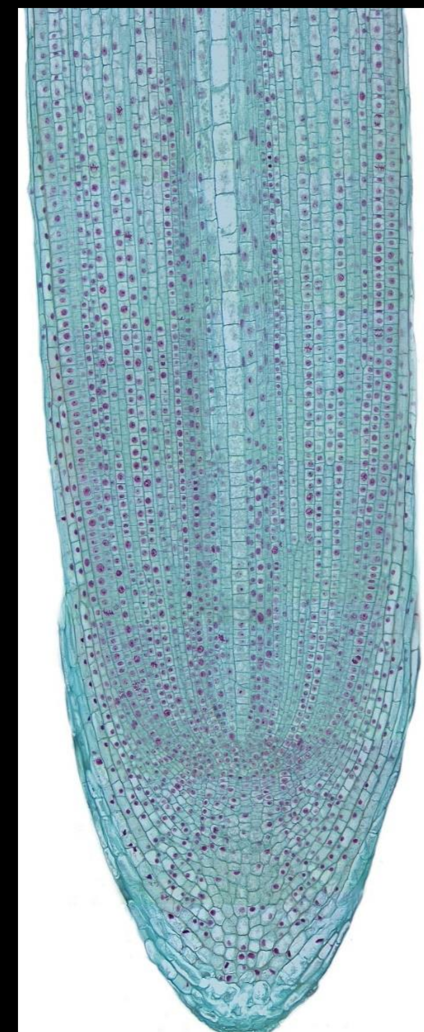
10-15% yield increase by eliminating non-pathogenic fungi on roots



Infection occurs at the root tip

Sugars

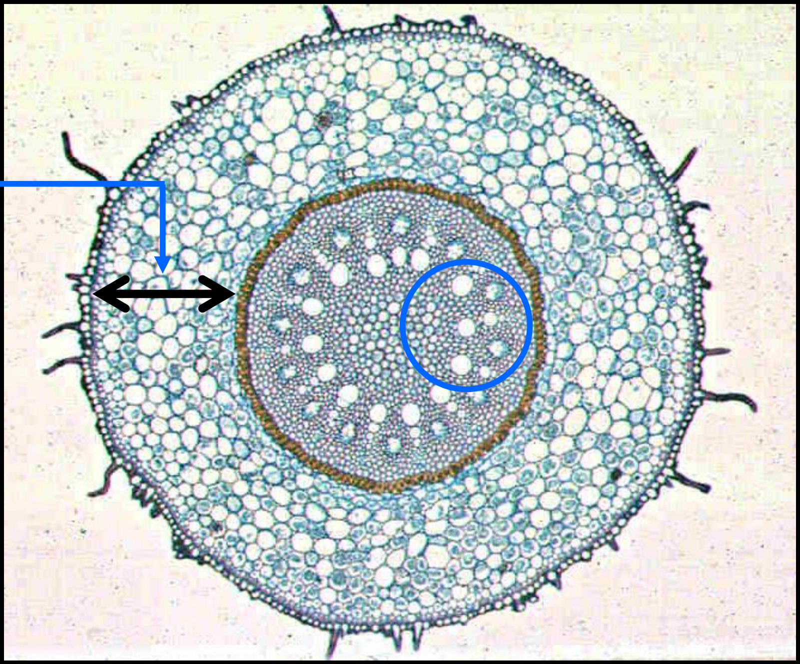
Fusarium oxysporum



Non-pathogenic fungi colonize the root cortex

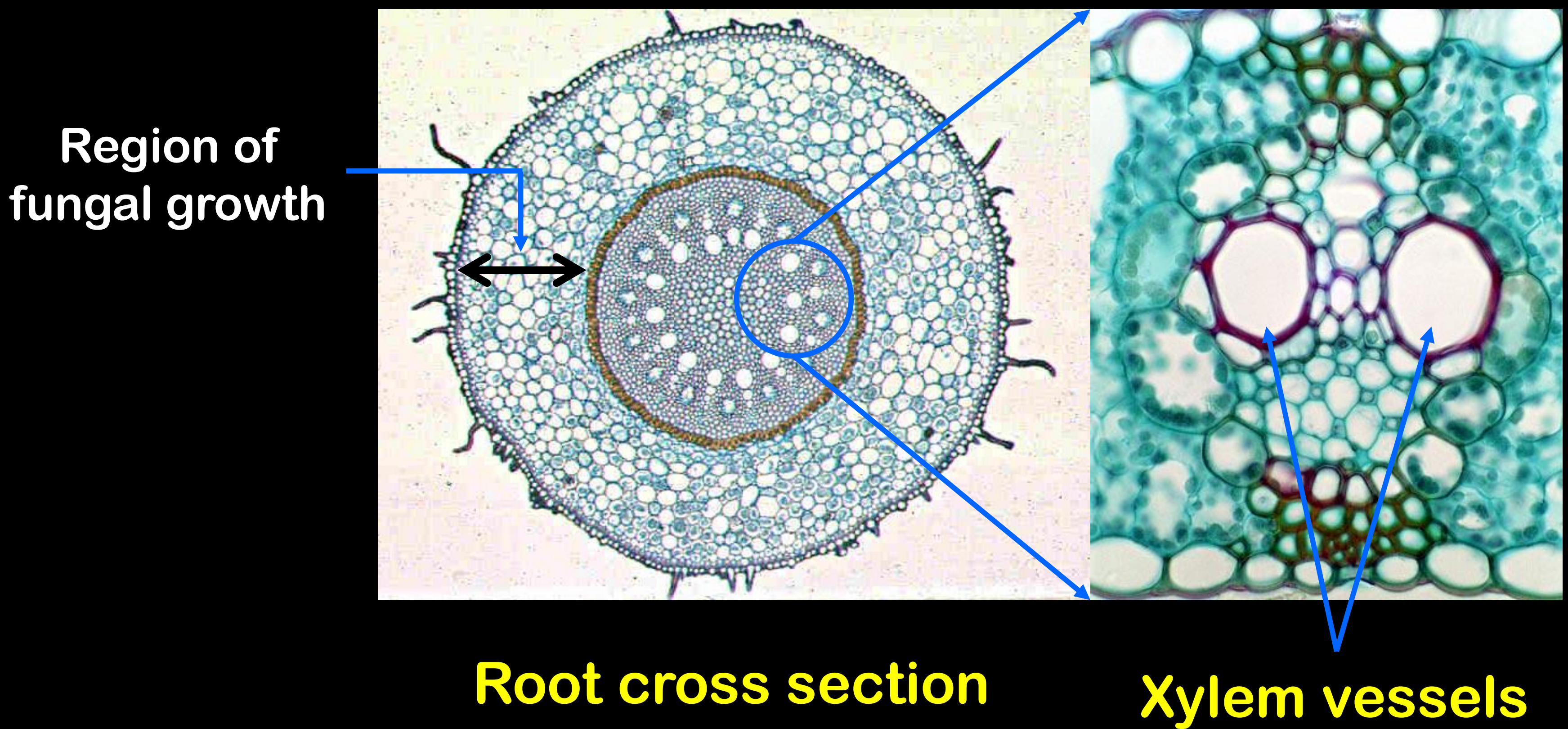
Pathogenic strains of *Fusarium oxysporum*

Region of
fungal growth

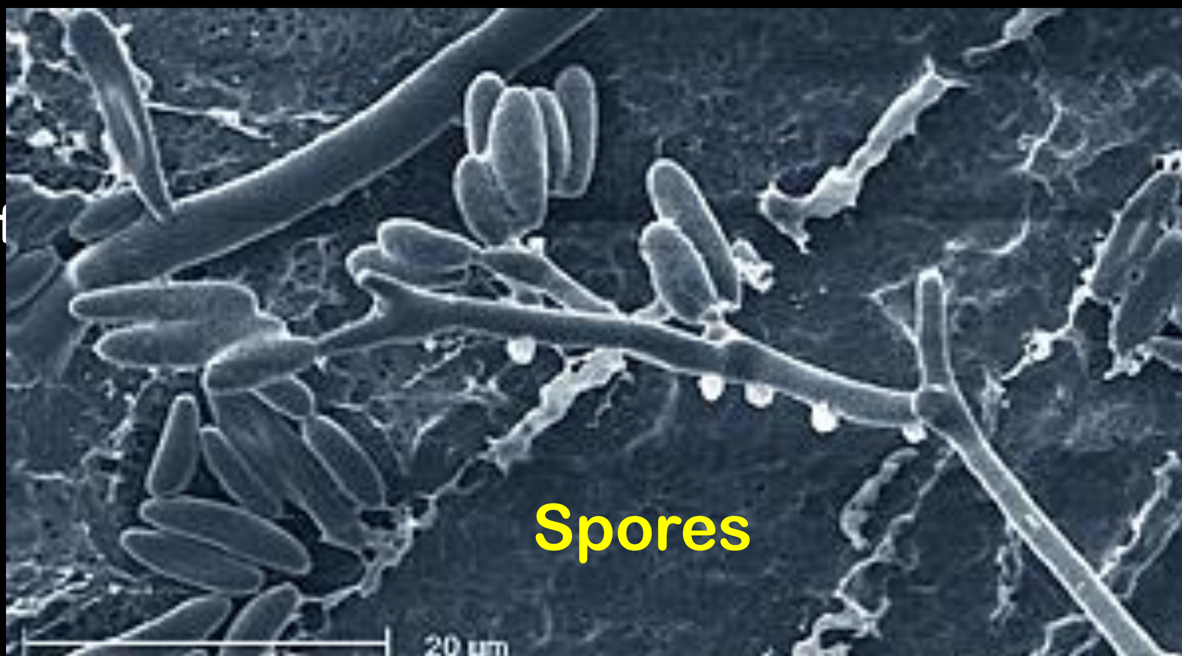


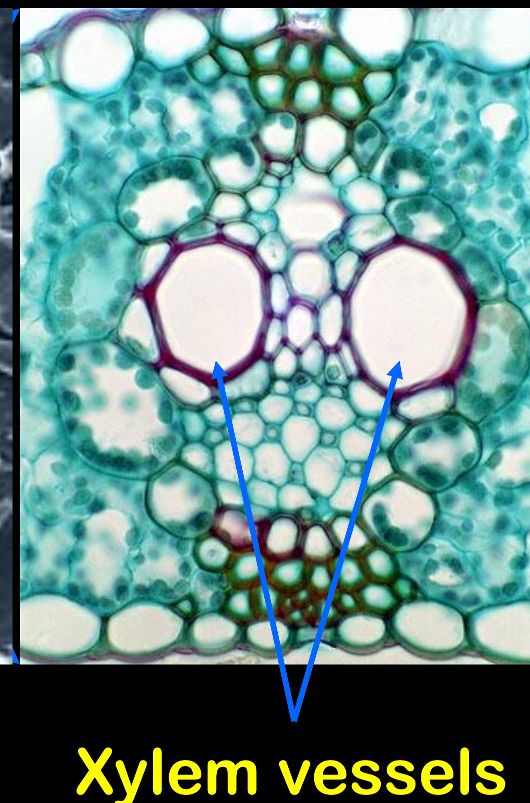
Root cross section

Pathogenic strains of *Fusarium oxysporum*



The pathogen moves into the shoot with water





Occlusion of the flow of water leads to symptoms of Fusarium wilt

DETECTION & CONFIRMATION
of Fusarium Wilt Pathogens:
Challenges, Errors, and Limitations

By: Steven T. Koike | Director, TriCal Diagnostics
Tom Gordon | Professor, University of California at Davis

***Fusarium oxysporum* is common in soil**

Most strains are not pathogenic

Non-pathogenic strains colonize roots

Pathogen ID requires further testing

Fusarium wilt pathogens are host-specific

> 120 host-specific strains

Management

Prevention

No curative measures

Avoid introduction

Sources of inoculum

Infected plants

Management

Avoid introduction

Soil on equipment

Infested field → Clean field

Plants may appear healthy

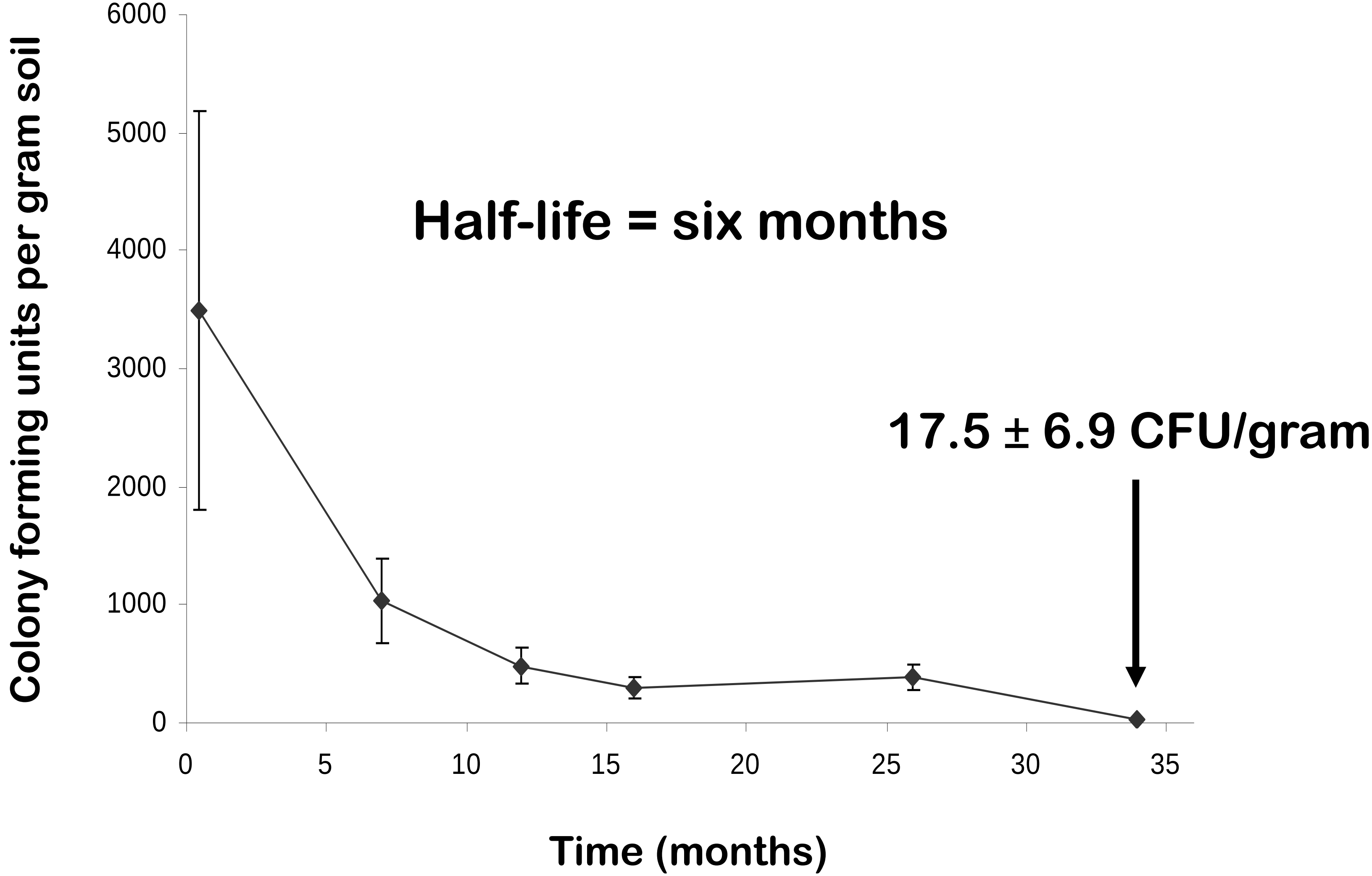
Minimize build-up pathogens

Crop rotation

Growing non-susceptible crops

Attrition of existing propagules

Survival of the pathogen in fallow soil

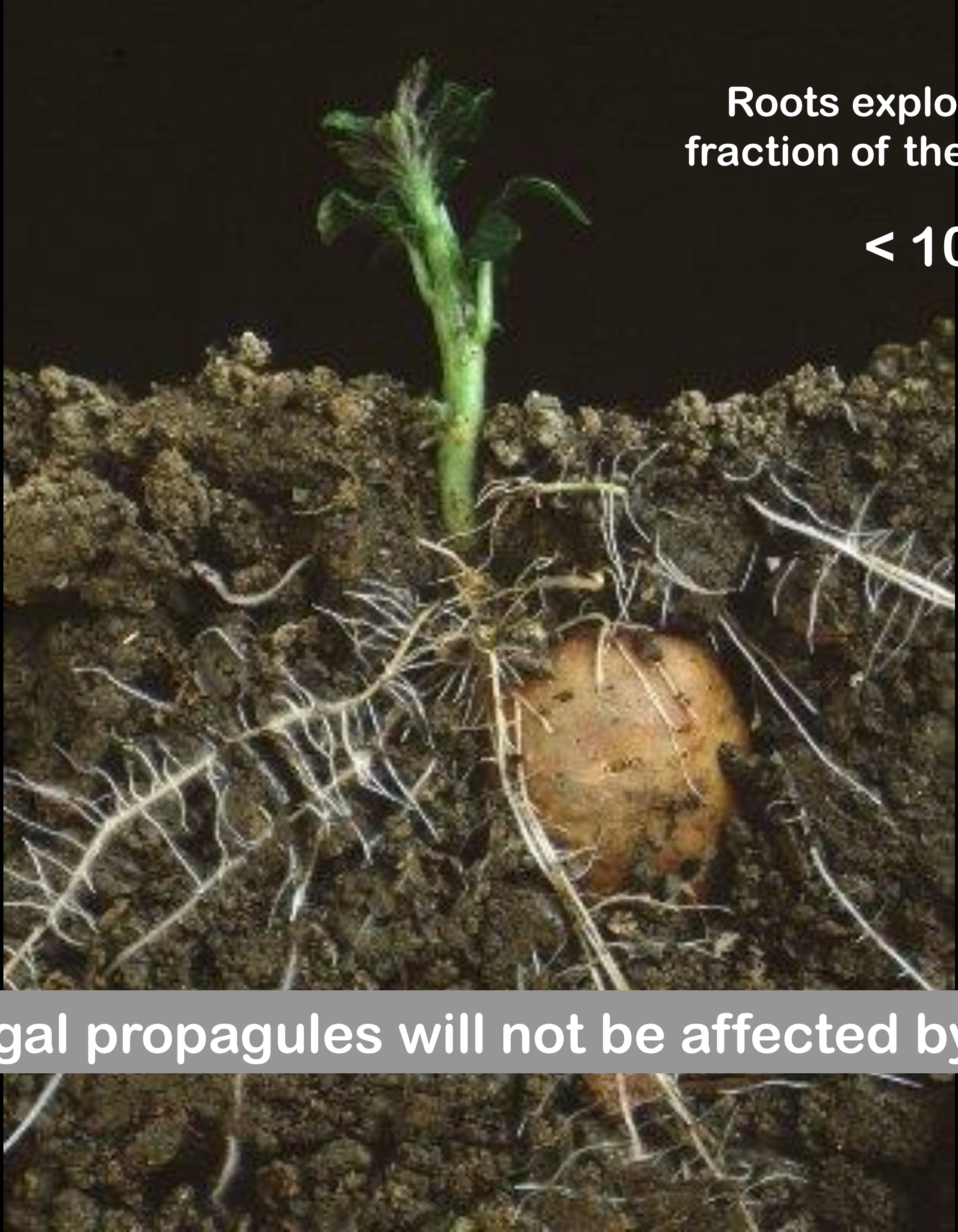


The Fusarium wilt pathogen will infect roots of most crops

Cortical colonies return few propagules to the soil

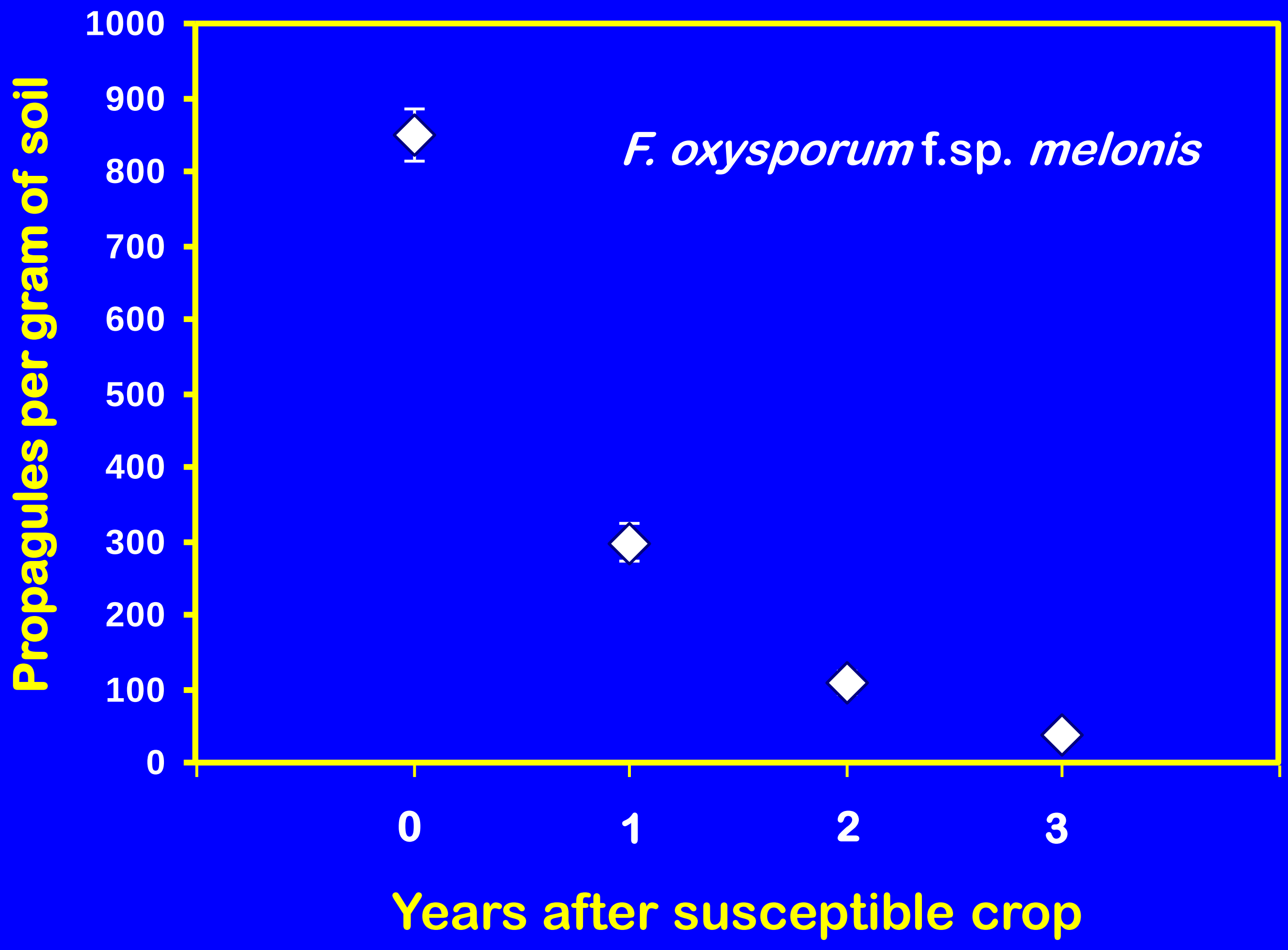
Roots explore a small fraction of the soil volume

< 10%



Most fungal propagules will not be affected by the crop

Pathogen population in soil



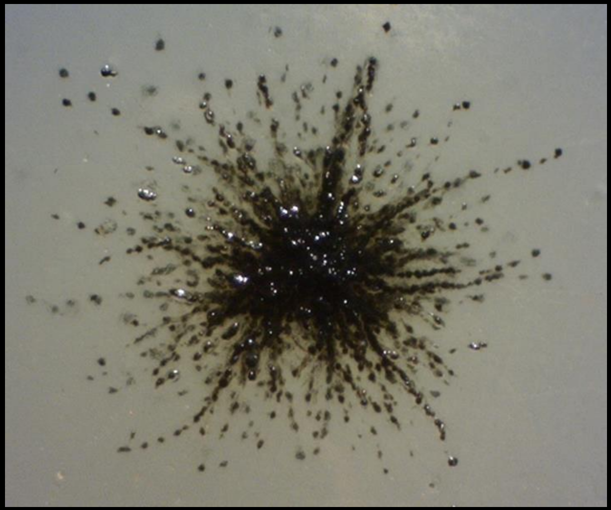
Two or three years out of a susceptible crop may be sufficient to reduce inoculum to levels that will not produce significant damage

If rotation crops do not support extensive development

Cover crops

Cryptic hosts for *Verticillium dahliae*

Common vetch	+
Field pea	+
Hairy vetch	+
Purple vetch	+
Wollypod vetch	+
Fava bean	+



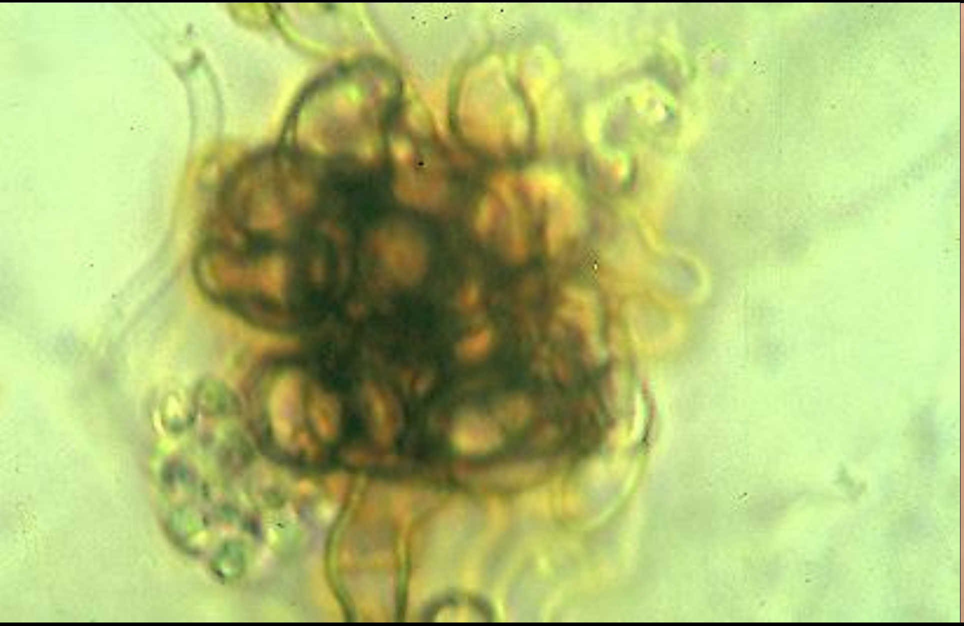
Microsclerotia

Bell bean

Not infected in field trials

What determines the rate of attrition?

Durability of propagules



Verticillium dahliae

Microsclerotia

3-5 years

Fusarium oxysporum

Chlamydospores

1-2 years

What determines the rate of attrition?

Microbial activity

Removes organic matter that
protects pathogen propagules

Warmer is better

Wet is better

Minimize contributions to inoculum in soil

Most inoculum is produced above-ground

Composting will kill pathogens

Most inoculum is produced above-ground

Composting will kill pathogens

Temperature should reach 131°F for ≥ 15 days

Steaming soil prior to planting

Better if done at the end of the season

Promoting decline in inoculum

Solarization to heat soil

Promoting decline in inoculum

Solarization to heat soil

Cover soil with clear plastic tarp

Thermal inactivation of fungal propagules

Favor growth of antagonistic microbes

Adaptation of Soil Solarization to the Integrated Management of Soilborne Pests of Tomato Under Humid Conditions

D. O. Chellemi, S. M. Olson, D. J. Mitchell, I. Secker, and R. McSorley

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Accepted for publication 22 November 1996.

Tarped for 40 – 55 days

Summer in Florida

Control of Fusarium wilt = soil fumigation

100 °F at 12 inches

Anaerobic soil disinfestation

Incorporate substrate

Rice hulls / grape pomace

Tarp and irrigate to achieve anaerobic conditions

Lack of oxygen

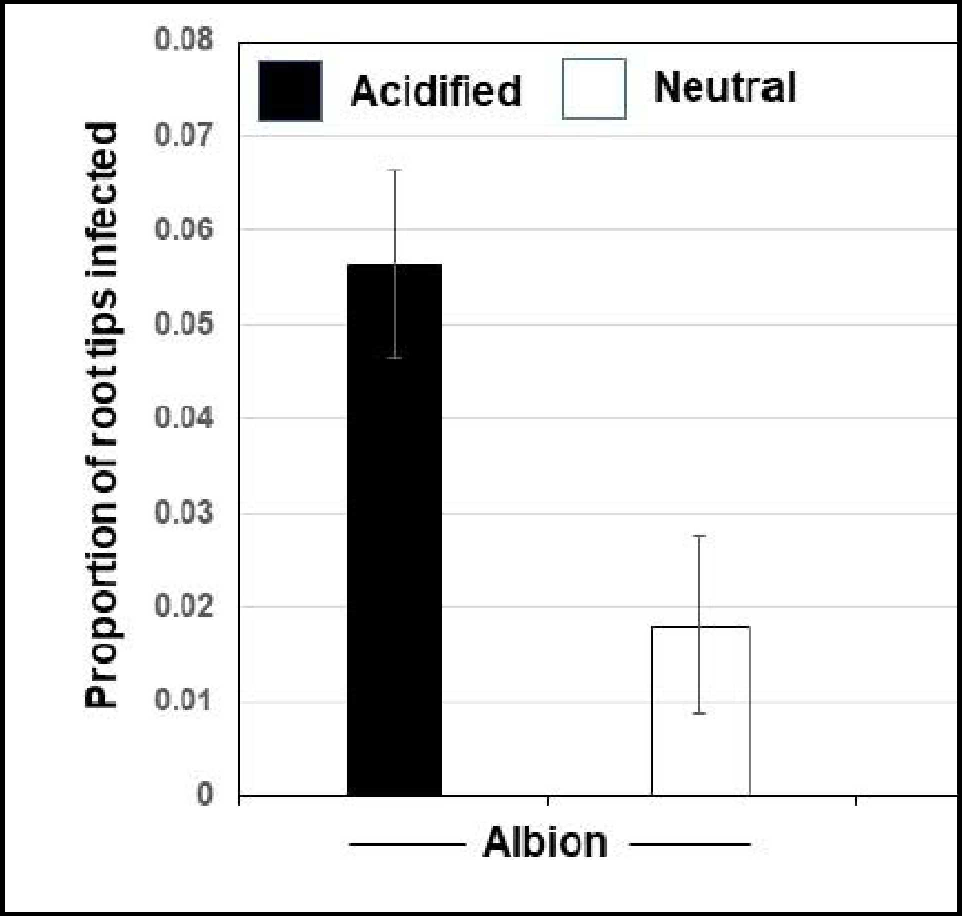
Altered microbial community

Best with high ambient temperatures

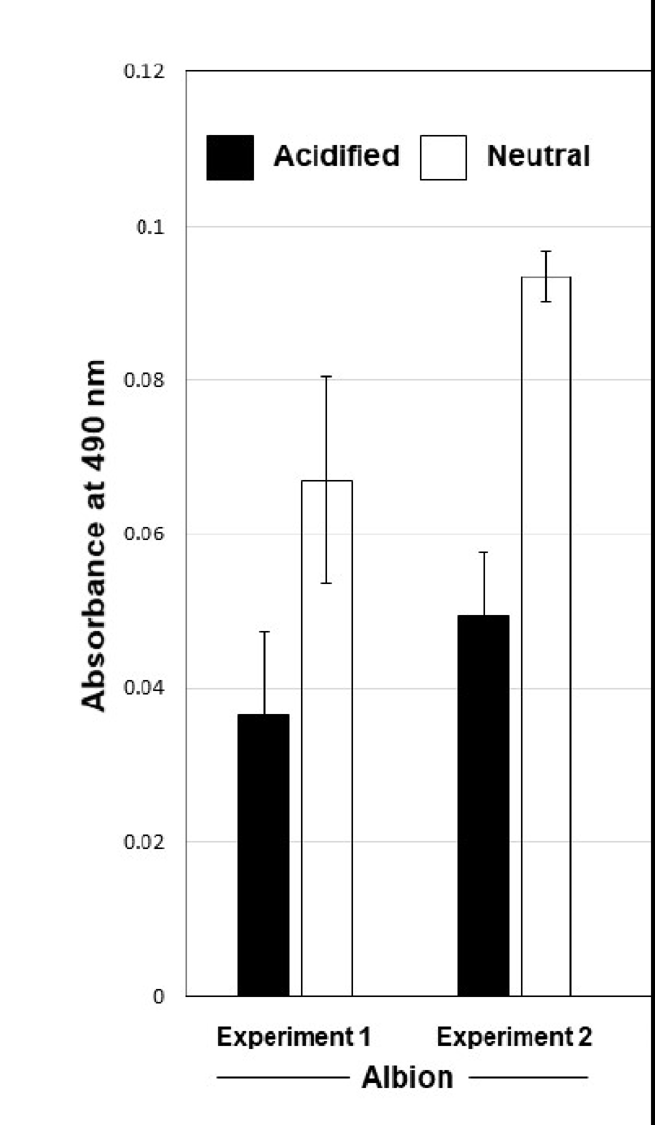
Inhibit the activity of soilborne fungi

pH near neutrality is better than more acidic conditions

A significant effect on frequency of root infection



Fewer infections is associated with a higher rate of microbial respiration



Fewer infections at pH 7.0 because bacteria are more active

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journal homepage: www.elsevier.com/locate/soilbio

Review

Identifying the characteristics of organic soil amendments that suppress soilborne plant diseases

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Best predictors of suppressiveness:

Total microbial respiration

Bacterial biomass

Genetic resistance

Genetic resistance

to Verticillium wilt

Ve gene provides partial resistance

Genetic resistance to Fusarium wilt

Resistance to known races is available

Durability of resistance cannot be predicted

A pathogenic race may be present before the resistance gene it overcomes has been deployed

Movement of pre-existing forms is often the cause of failures in genetic resistance

Independent origin of a new race is possible

Origin of Race 3 of *Fusarium oxysporum* f. sp. *lycopersici* at a Single Site in California

G. Cai, L. Rosewich Gale, R. W. Schneider, H. C. Kistler, R. M. Davis, K. S. Elias, and E. M. Miyao

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Accepted for publication 7 April 2003.

Independent origin of race 3 from race 2 in:

California
Florida
Mexico
Australia

Questions?