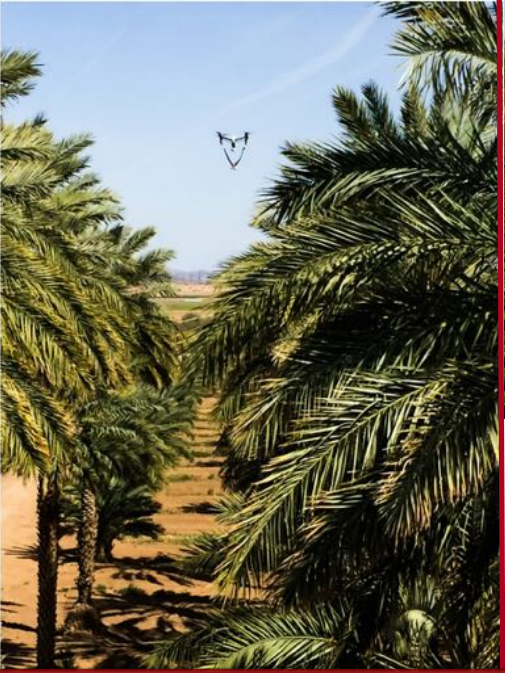


COLLEGE OF AGRICULTURE AND LIFE SCIENCES

Yuma Center of Excellence for Desert Agriculture

"Solutions to Desert Agriculture's Pressing Problems"

The Center Of Excellence Seminar Series

DesertAgSolutions.org

WELCOME!

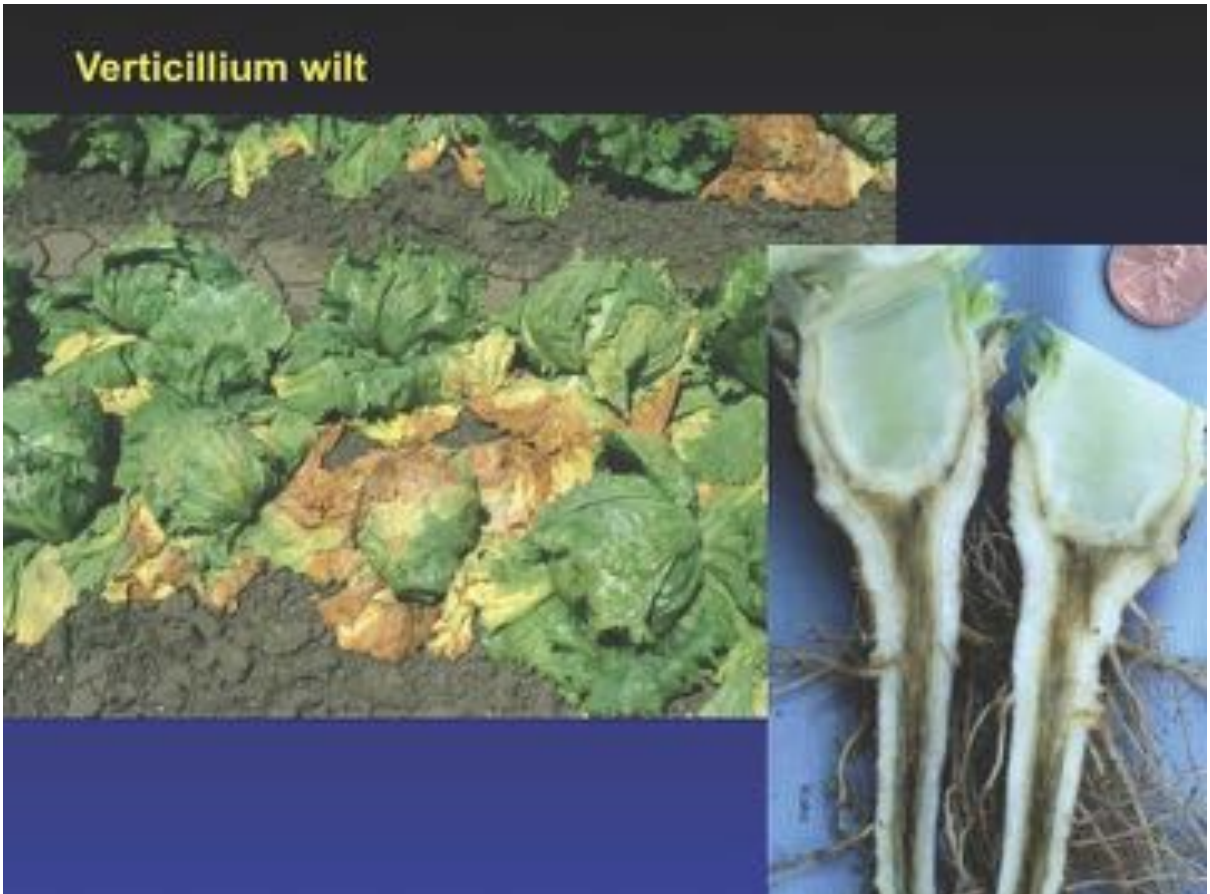
New Developments in Advancing Management of Fusarium Wilt of Lettuce

Fusarium wilt of lettuce in Arizona: challenges, insights, updates, and advances

Barry Pryor
University of Arizona School of Plant Sciences

Symptoms

Symptoms

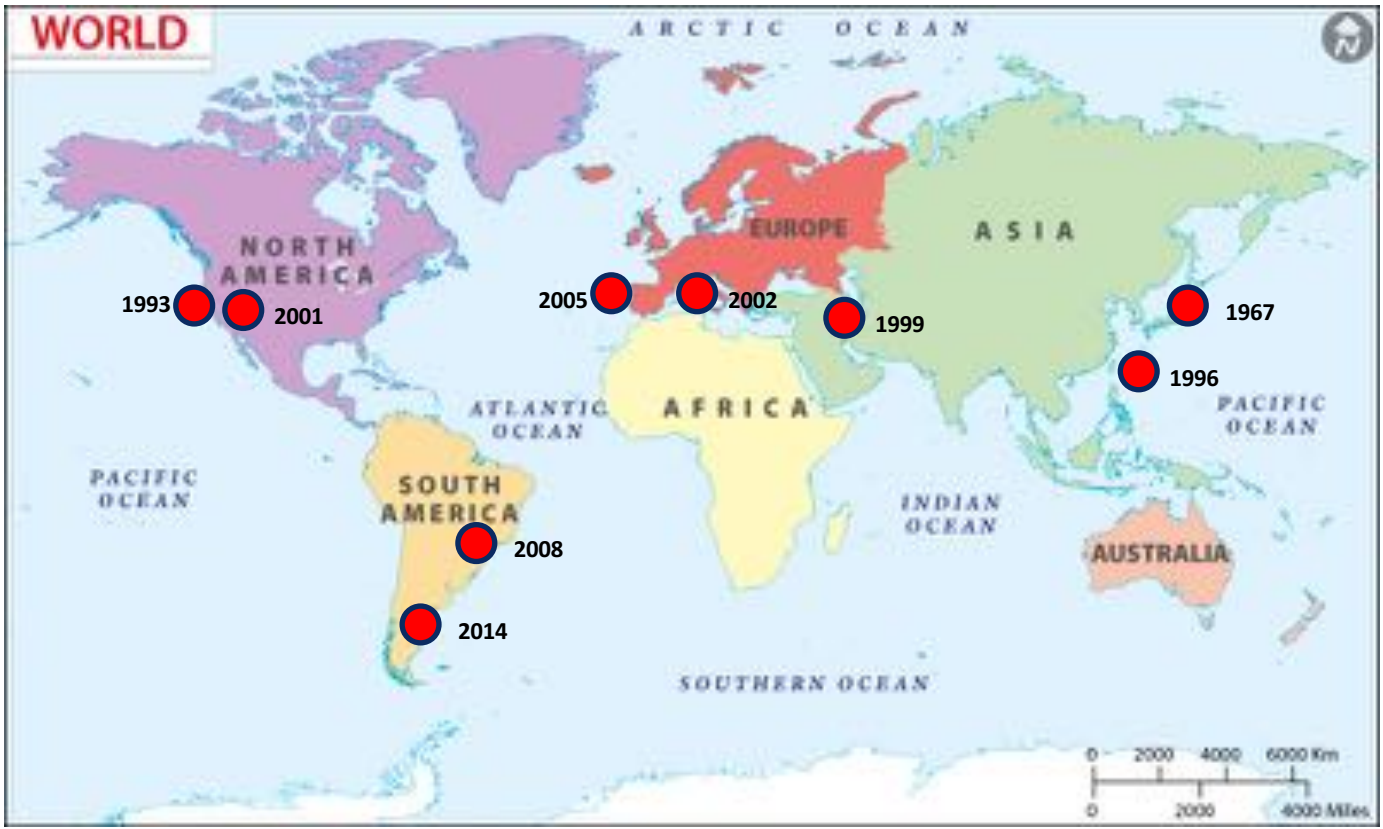


Challenges in field diagnoses of soilborne fungal diseases

Symptoms	Pythium	Sclerotinia	Botrytis	Fusarium	Verticillium	Thielaviopsis
Small, stunted plants	yes	yes	yes	yes	no	yes
Wilted leaves	yes	yes	yes	yes	yes	no
Yellowed leaves	yes	yes	yes	yes	yes	no
Collapsed plants	yes	yes	yes	yes	yes	no
Decayed crowns	no	yes	yes	no	no	no
Vascular discoloration	no	no	no	yes	yes	no
Rotted root system	yes	no	no	no	no	no
Brown bands on roots	no	no	no	no	no	yes

Koike, 2015

Worldwide spread of *Fusarium oxysporum* f.sp. *lactucae*

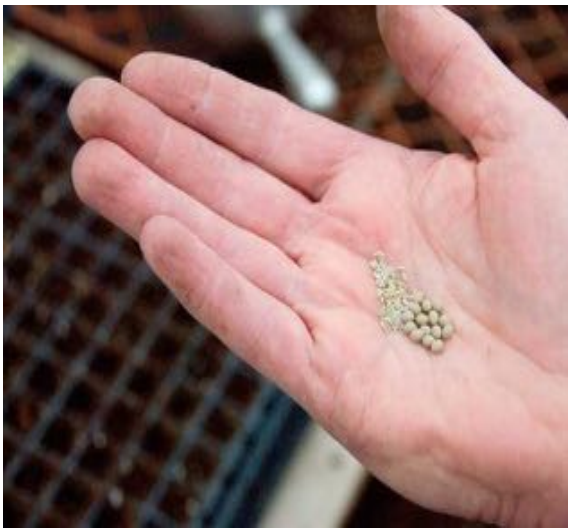


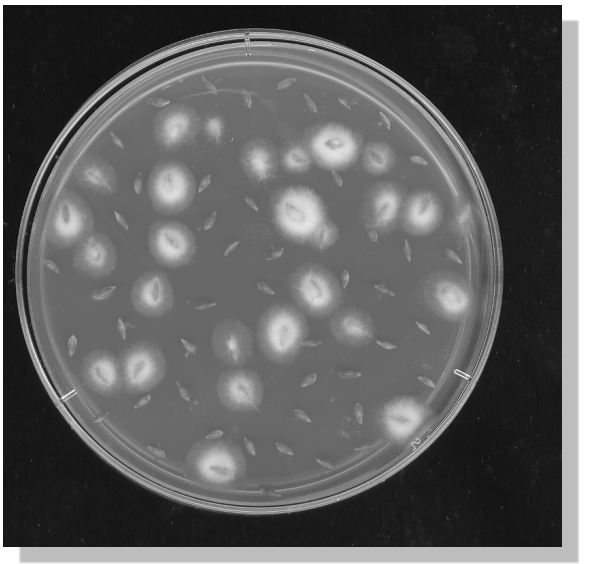
Possible modes of transmission

- **Transmission via contaminated seed**
- **Common mode of transmission for many plant pathogenic fungi**
- **Previously recorded for *F. oxysporum* specific to different hosts**
  - **f.sp. *subglutinans***
  - **f.sp. *nicotianae***
  - **f.sp. *melonis***
  - **f.sp. *vasinfectum***

Results of seed testing in Arizona

Per lot: Direct plating = 1,500 seeds. PCR = 5,000 seeds.





88 seed lots tested

0 % infestation

Greenhouse study

Determine if *lactucae* can become seedborne under artificial conditions

Infect seedlings of "tolerant" cultivars by soil drench or by root-dip

Grow plants to maturity and harvest seed

Assay for presence of *lactucae* along the stem, inflorescence panicles, and in/on seed.

Conclusion from seed transmission studies

1. Infection along the stem is highly restricted towards the flower panicles

2. Seed does not become internally infected

3. Seed easily becomes infested when mixed with infected plant debris during threshing. Seed is contaminated externally.

Results of seed testing in Italy

Garibaldi et al 2004, University of Torino

9 of 27 commercial seed lots were infected

Seed contamination occurs at seed surface

All isolates are Race 1, which is found in all other areas.

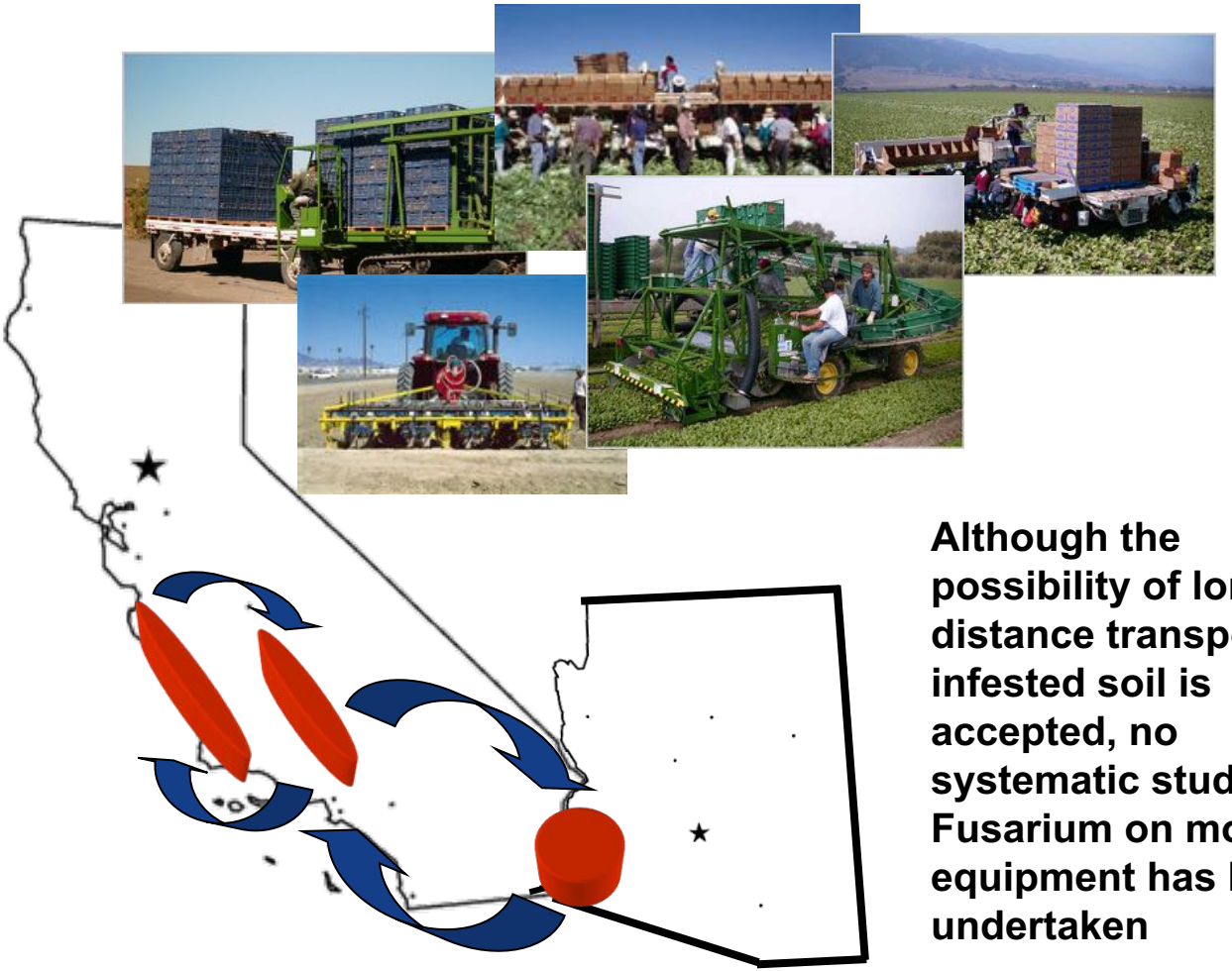
Management of seedborne inoculum

Hot water treatment
Chlorine
Aerated steam
Hot,dry air
Fungicides
- **conventional, organic, biological**

Efficacy, potential phytotoxicity
- **infected vs infested seed**
- **volume of seed treated**
- **parameters during testing**
- **pathogens, cultivars, seed quality**
- **drying seed**
- **Shelf-life**

Possible modes of transmission

- **Transportation of pathogen via contaminated soil**
- ***Fusarium* spp. are well known as a soil inhabitants capable of soil-borne movement**
- **Proximity between Arizona and California results in significant movement of equipment between regions**



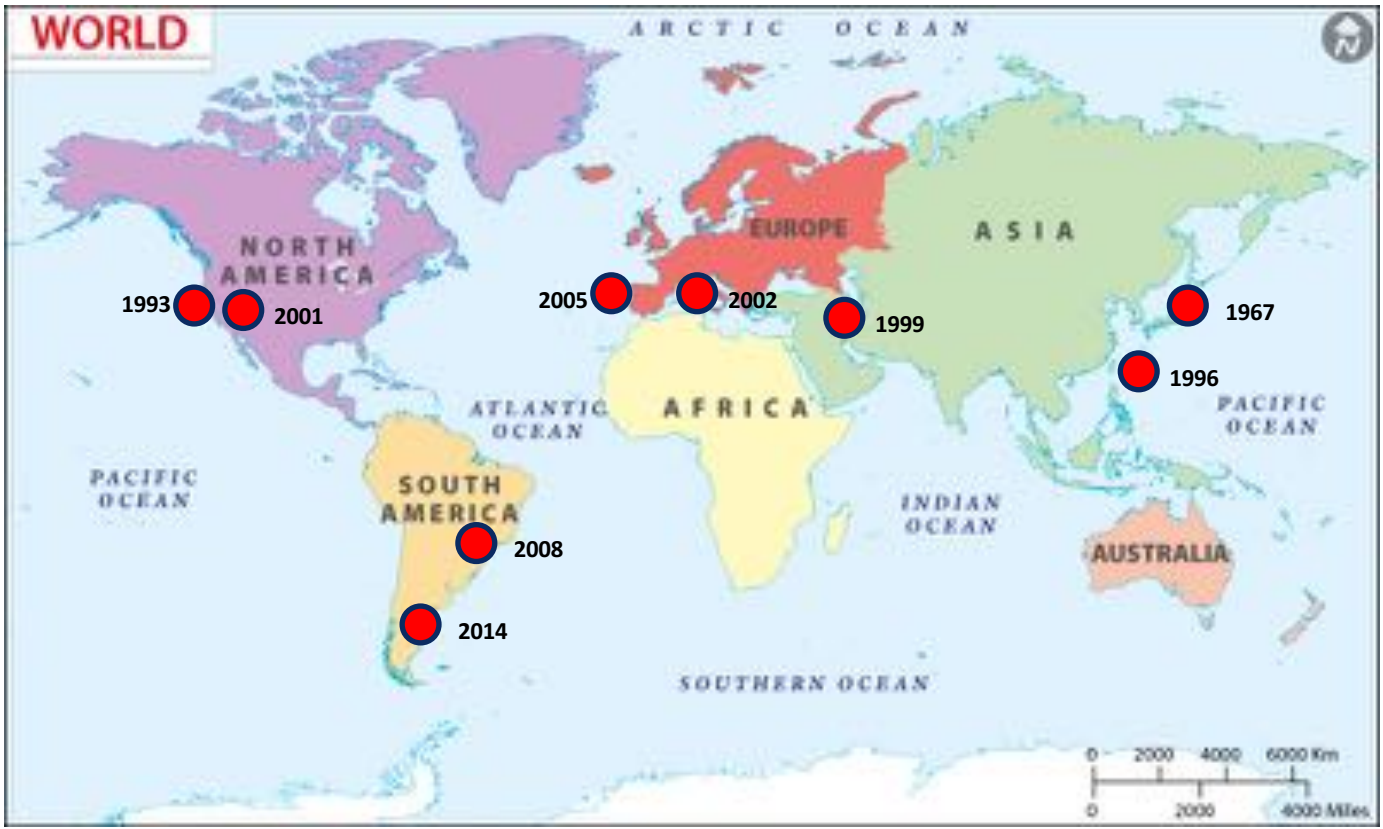
Although the possibility of long distance transport of infested soil is accepted, no systematic study of Fusarium on mobile equipment has been undertaken

Diversity of Fusarium genotypes in AZ match that of CA

Fol haplotypes in Arizona

Year	Genotype	# of Fields	Primers						
			1	2	3	4	5	6	7
2001	1	30	A	A	A	A	A	A	A
2001	1	02	B	B	C	C	E	C	B
2002	1	03	A	A	A	A	A	A	A
2003	2	08	A	A	A	A	A	A	A
			A	A	A	A	B	B	A
2004	5	05	A	A	A	A	A	A	A
			B	A	A	B	C	A	A
			A	A	A	A	B	B	A
			A	A	A	B	C	A	A
			B	B	C	C	E	C	B
2005	3	06	A	A	A	A	A	A	A
			A	A	A	B	C	D	A
			C	A	A	B	C	D	A

Worldwide spread of *Fusarium oxysporum* f.sp. *lactucae*



Management of soilborne inoculum

Solarization to reduce soil inoculum levels

Solarization performed during July and August

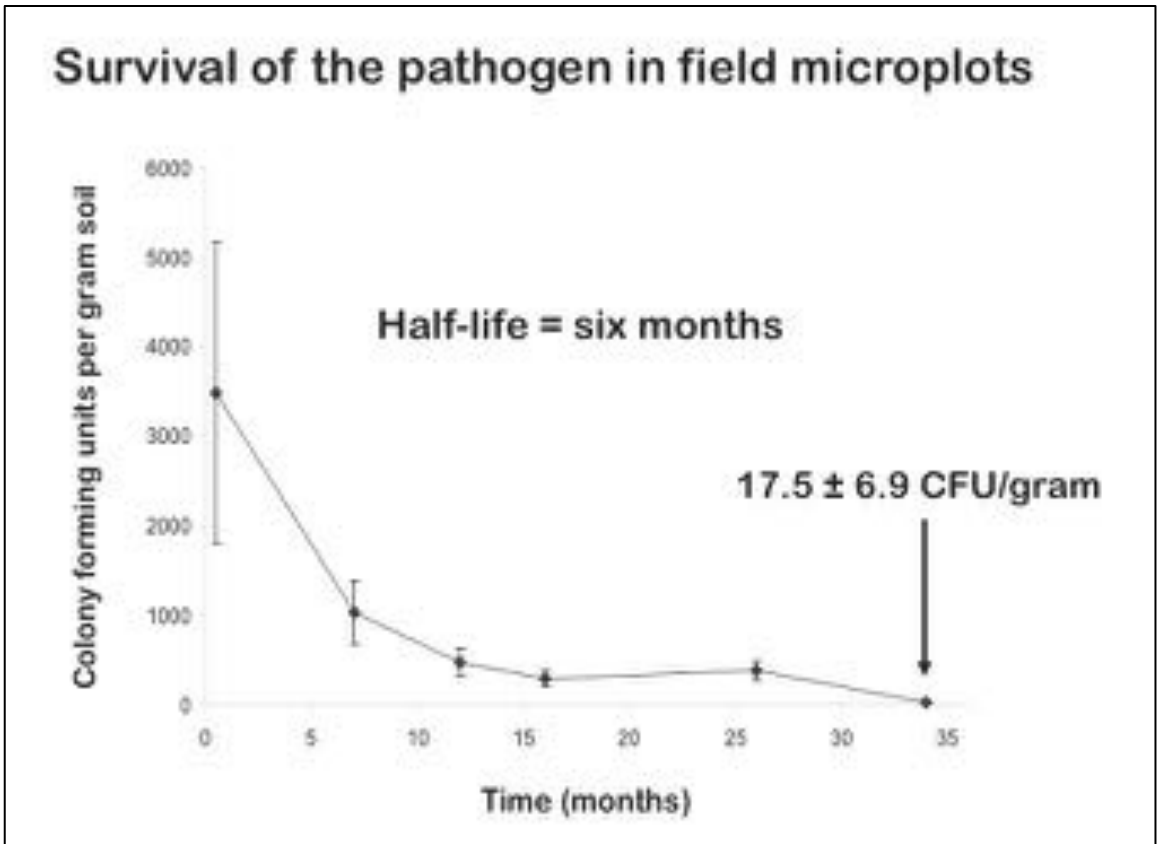
Plots planted to susceptible crisphead cultivar

Year	% Disease reduction
2004	42
2005	81
2006	98
2007	67

Reduction in Fusarium wilt due to solarization

Matheron et al 2015

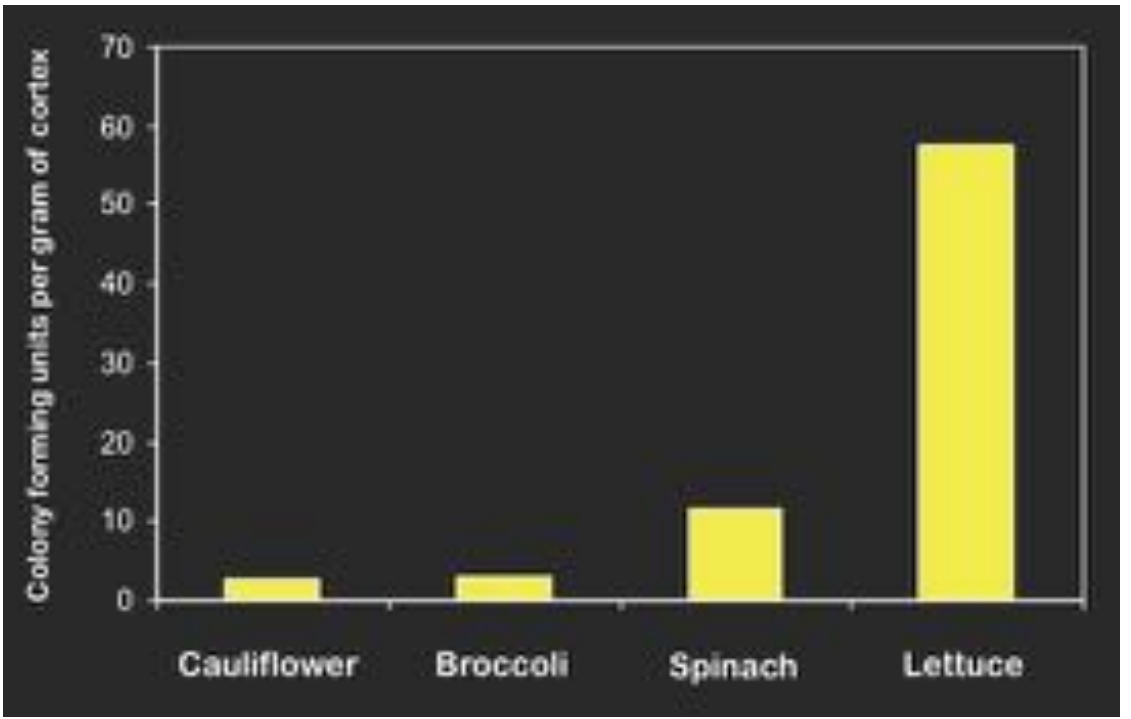
Dry fallow to reduce soil inoculum levels



Gordon et al 2015

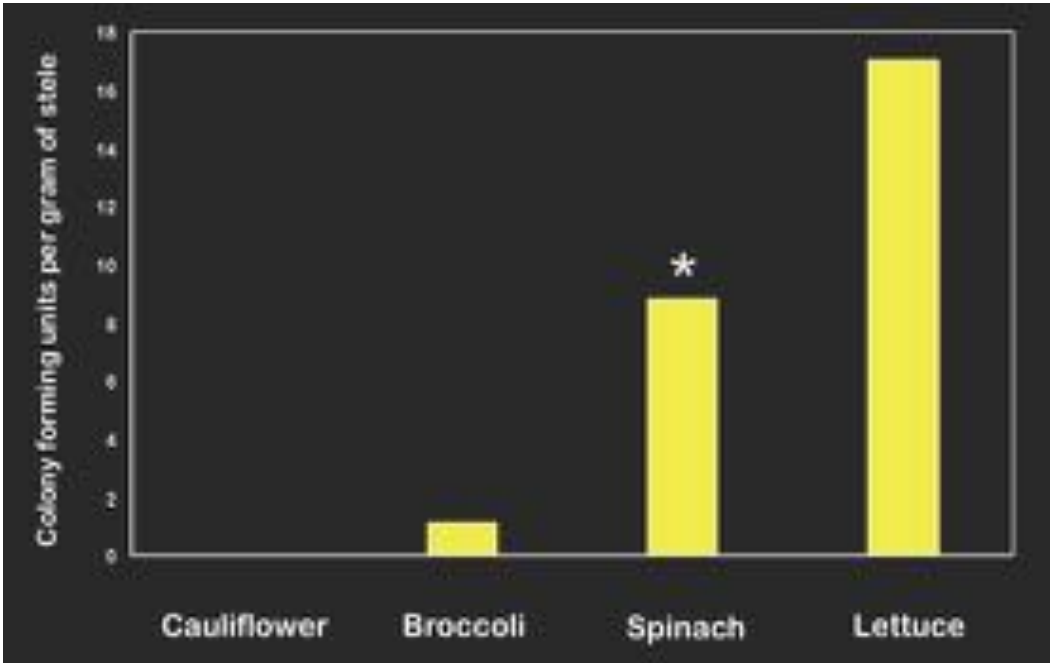
Crop rotation to reduce soil inoculum levels

FOL will colonize the roots of other crops



Gordon et al 2015

Colonization of vascular stele



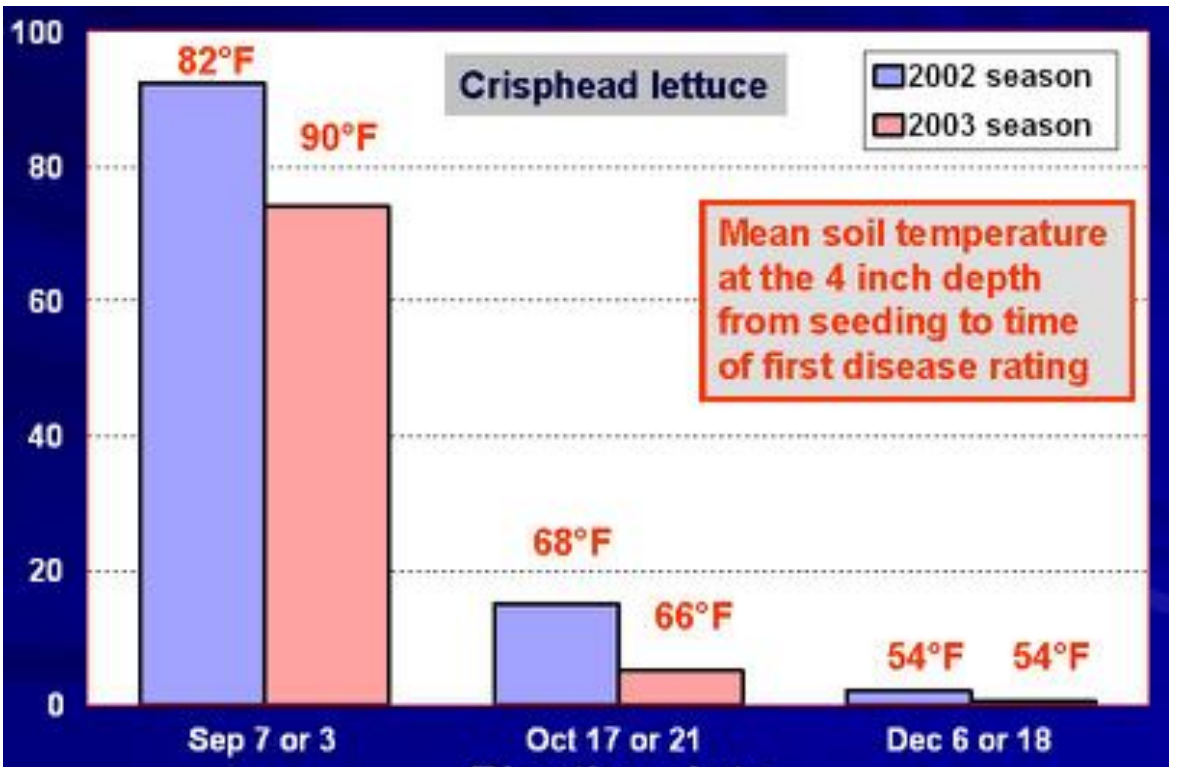
Gordon et al 2015

Fol will colonize the vasculature of other plants, even resistant lettuce cultivars (cryptic infections).

Cauliflower and broccoli are colonized to a lesser extent.

Management of Fusarium wilt by planting date

Incidence of Fusarium wilt at crop maturity at different planting dates



Matheron et al 2015

Continued research on FOL management

Funded through the Arizona Department of Agriculture Specialty Crop Block Grant Program

2016-2017 project objectives include:

1. **Rapid DNA detection by isothermal PCR and LAMP techniques**

2. **Multi-spectral analysis of plant stress**

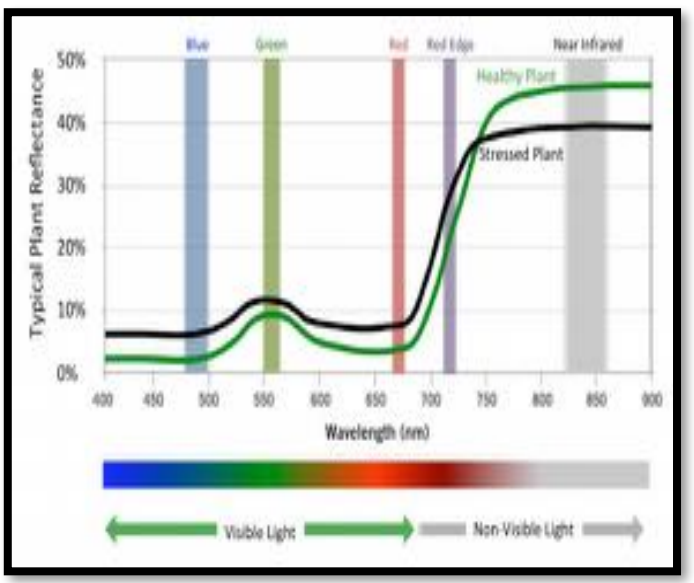
3. **Chemical and biological product evaluations.**

Objectives 1 and 2. Greenhouse trials

In collaboration with Dr. Murat Kacira, Department of Agricultural and Biosystems Engineering

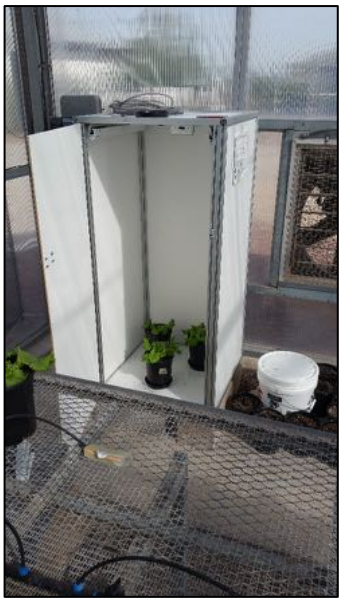
- ✓ **Randomized Complete Block Design with 3 blocks**
- ✓ **7 treatments:**
  - **Water stress level 1**
  - **Water stress level 2**
  - **Fusarium inoculum level 1**
  - **Fusarium inoculum level 2**
  - **Sclerotinia inoculum level 1**
  - **Sclerotinia inoculum level 2**
  - **Control (no water or biotic stress)**
- ✓ **DNA analysis 1X per week (destructive)**
- ✓ **Multi-spectral readings 3X per week (non-destructive)**

MicaSense RedEdge Camera



- **Multispectral imaging camera designed specifically for use with plants**
- **Captures 5 different spectral bands targeted at agricultural applications**
- **Captures small portions of the Blue, Green, Red, Near Infrared and Red Edge wavelengths**
- **These small bands allow the camera to be more sensitive to agricultural properties**

Imaging system



Water stress

Biotic stress

Experiments are in progress!
The first set of these experiments is currently underway .
Experiments will continue for another two months. Stay tuned!

Management Summary

- ✓ Use pathogen-free seed
- ✓ Know the history of the field
- ✓ Use the most resistant varieties available
- ✓ Avoid susceptible varieties in warm planting windows
- ✓ Remember soil inoculum can increase on all varieties and in other non-lettuce crops
- ✓ Broccoli and cauliflower are better rotation crops
- ✓ Inoculum can be moved with soil: use good field sanitation practices