Quick management tips for fusarium wilt

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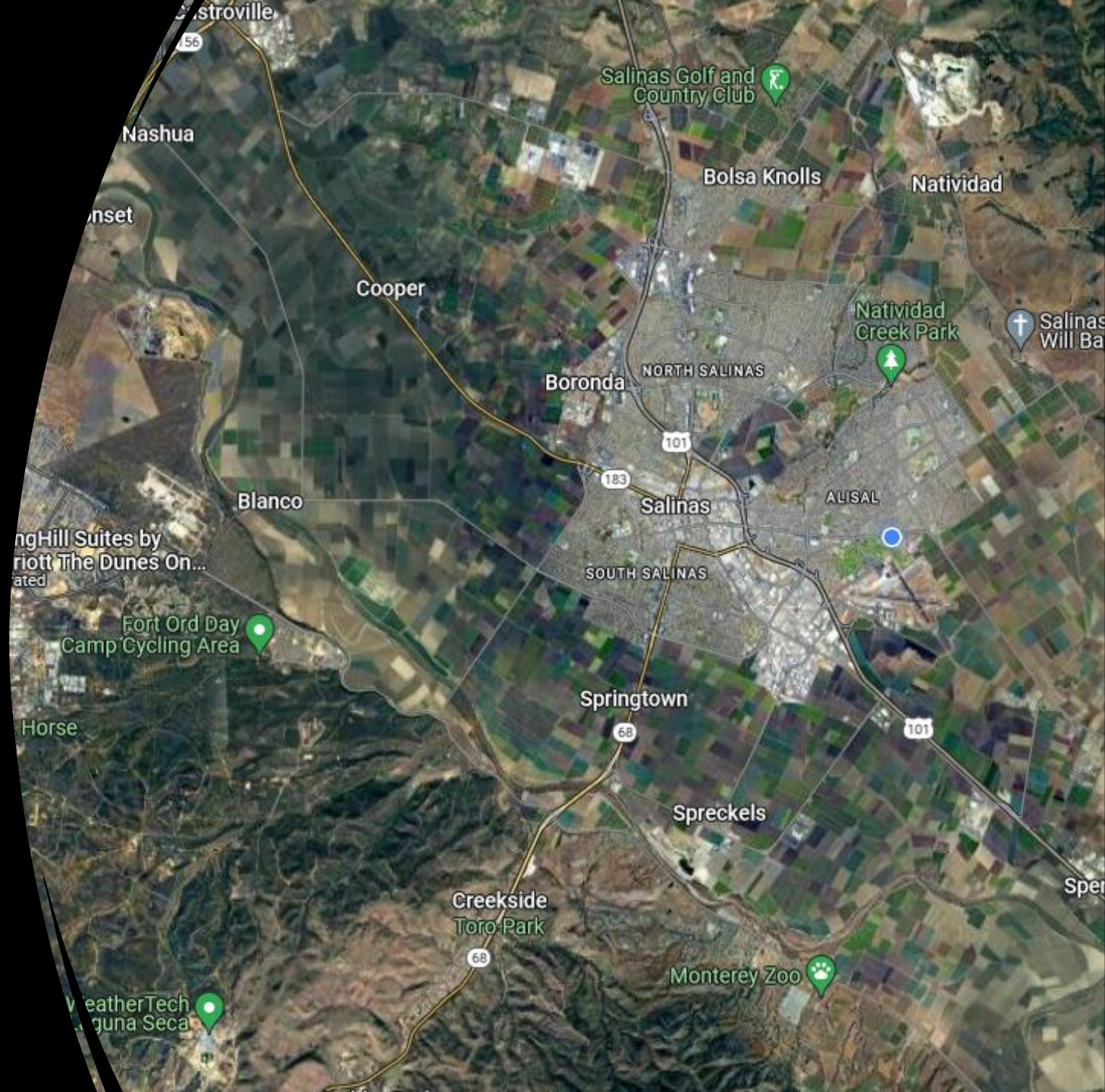
Introduction

- Part of “big ag”
- Strawberry, leafy greens, and brassica production
- Lots of concern about fusarium wilt (warming climate?)



Our lab

- Focuses on strawberry pathogens
- Current focus on fusarium wilt
  - Epidemiology – aerial dispersal?
  - Genetic resistance

Fusarium oxysporum

- Causal agent of fusarium wilt
- Mostly non-pathogenic
- Common in soil and as root endophyte
- Only some strains can cause disease
- Many common crops are affected
- **Individual strains = narrow host range**

(I'll be calling it FO or fusarium for simplicity)

Melon

Chickpea

Banana

Lettuce

Cotton

Tomato

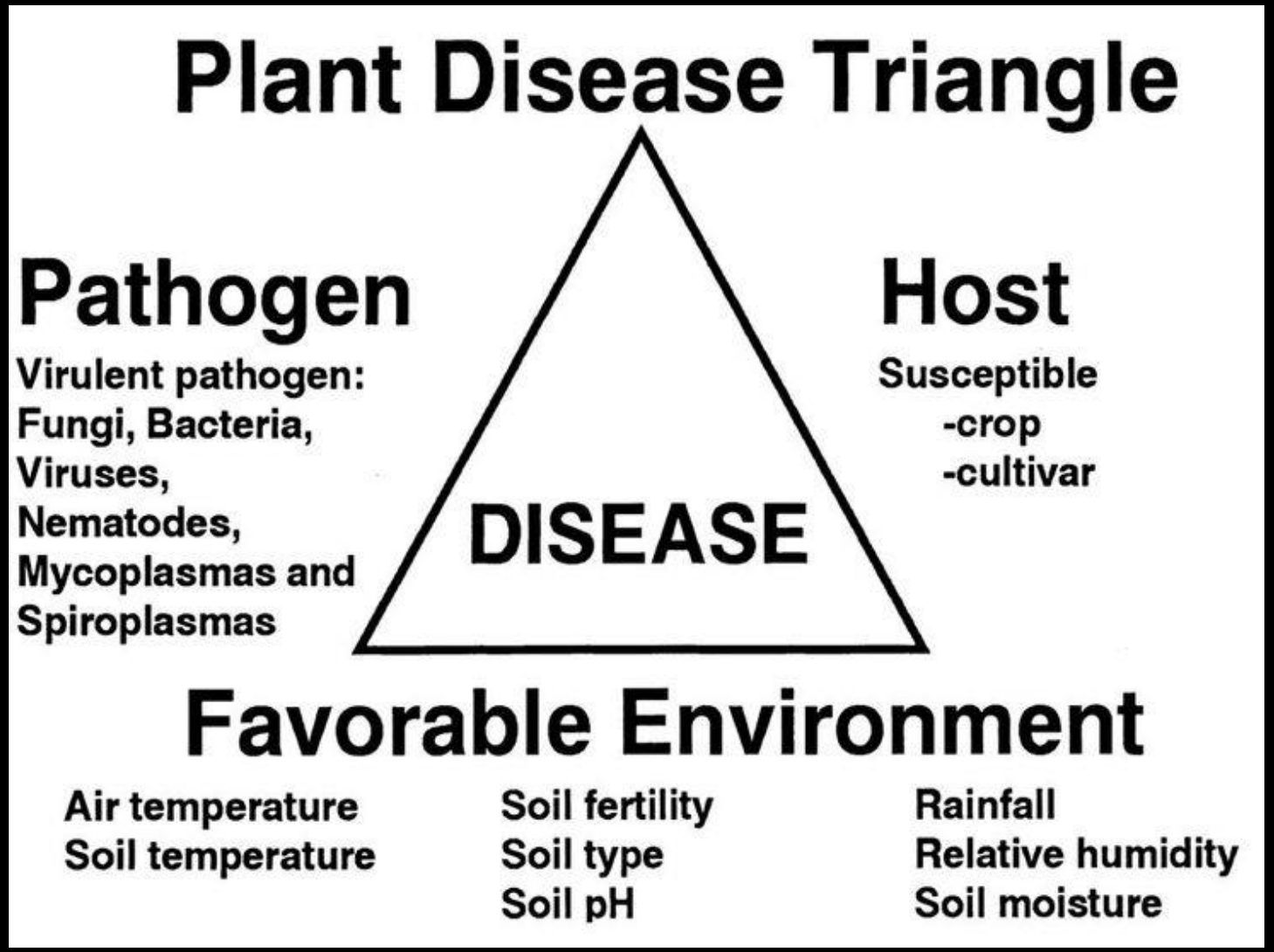
Diagnosis

- Important to get a correct diagnosis
- Many soilborne diseases look similar, but IPM can be different.
- Look for the maximum specificity from a lab test
  - Get the race if possible!
- Remember, *Fusarium oxysporum* is common and has a narrow host range/ is non-pathogenic

The pathogen is diverse, which means outcomes are too!

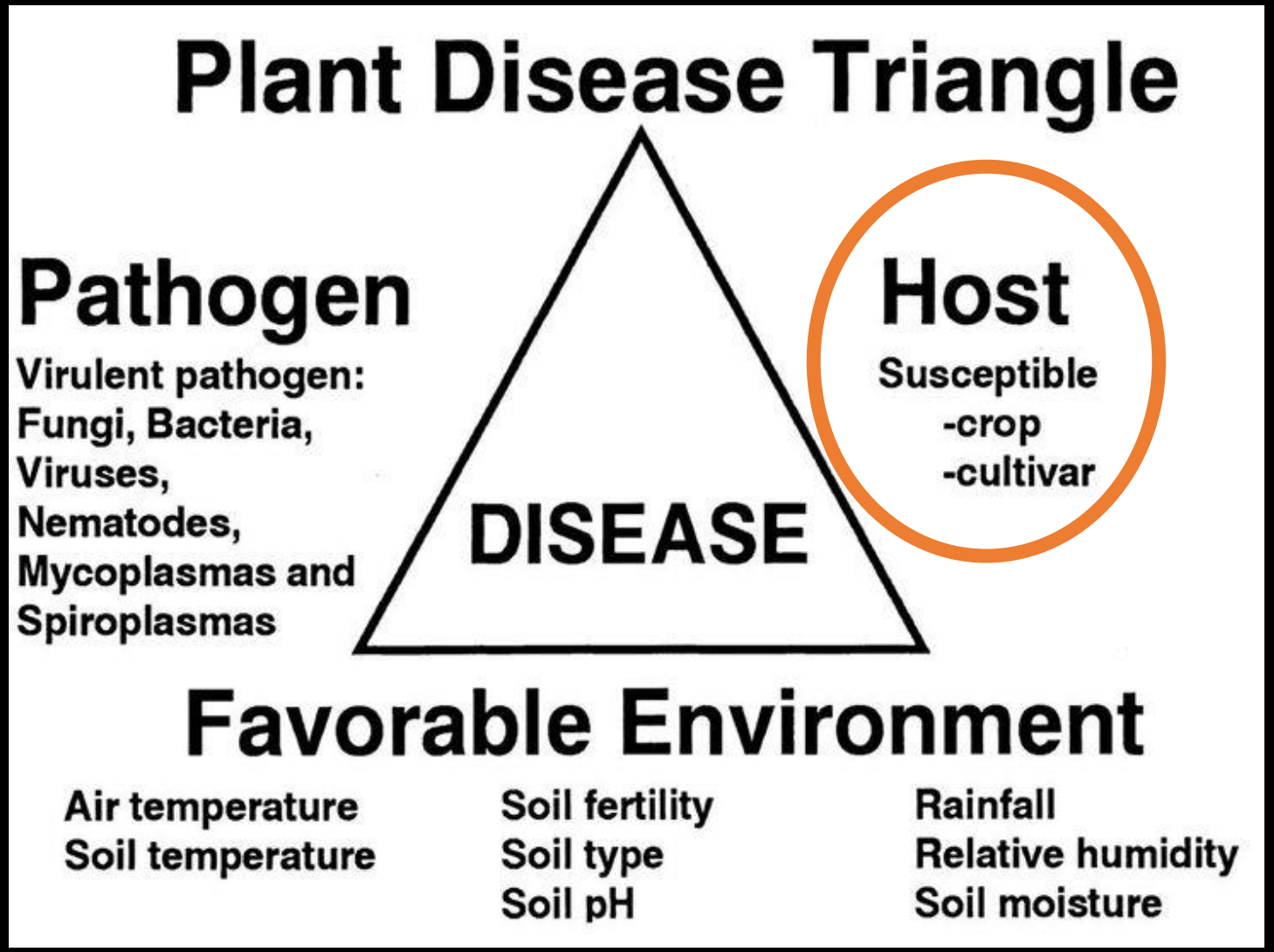
- Context dependent – My goal is to introduce many tactics so you can evaluate what works for you

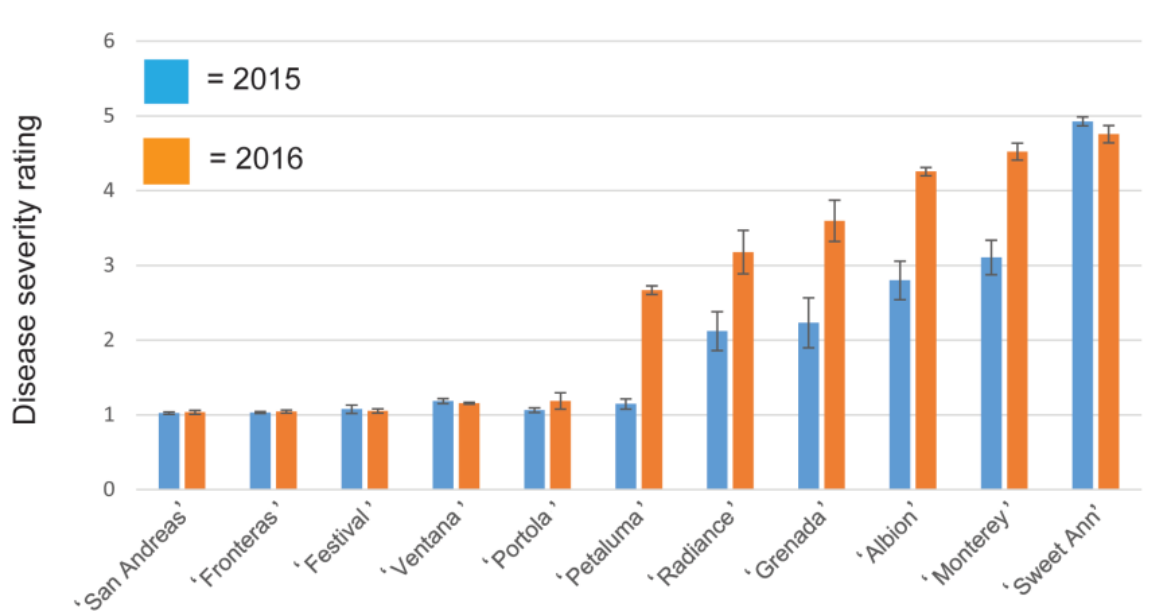
Disrupt the disease triangle!



Krupinsky et al. 2002

Disrupt the disease triangle!



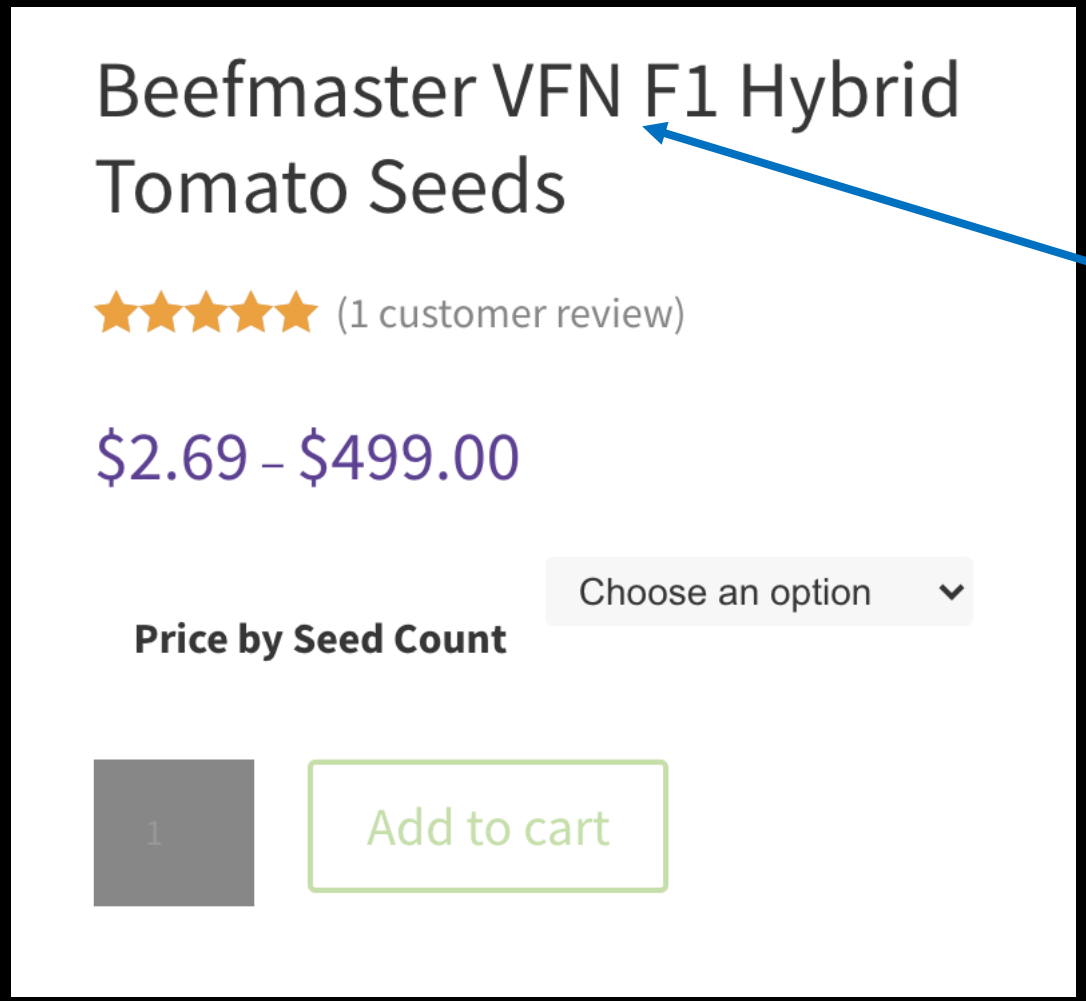


Thomas Gordon

Resistance – the silver bullet

- In many crops, complete resistance is available
- There is also usually a spectrum of “less susceptible” cultivars
- In many crops, different “races” are present that affect cultivars differently

Where to find resistant varieties?

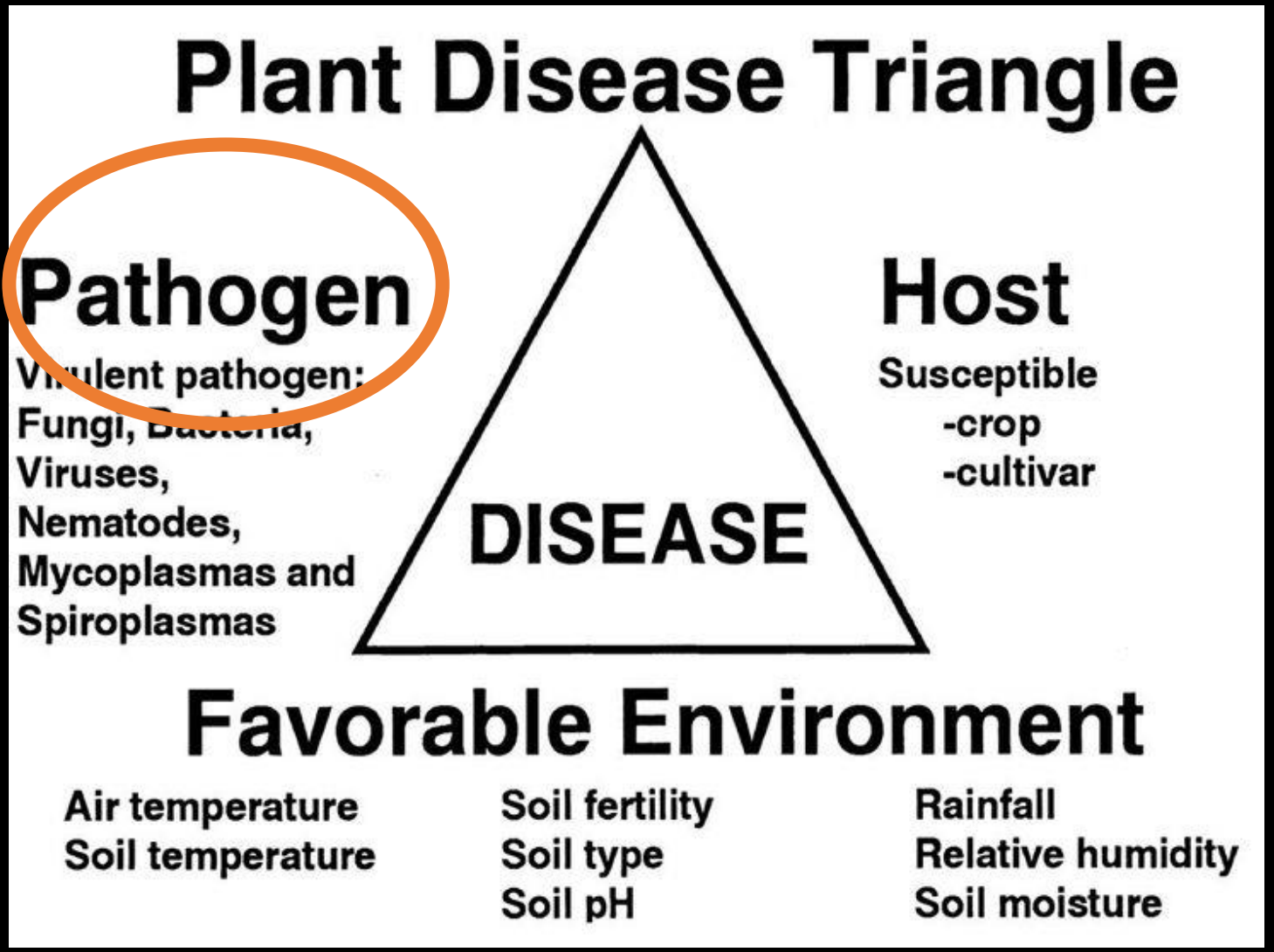


VFN = Verticillium, Fusarium, Nematode resistant…

Race specificity not mentioned.

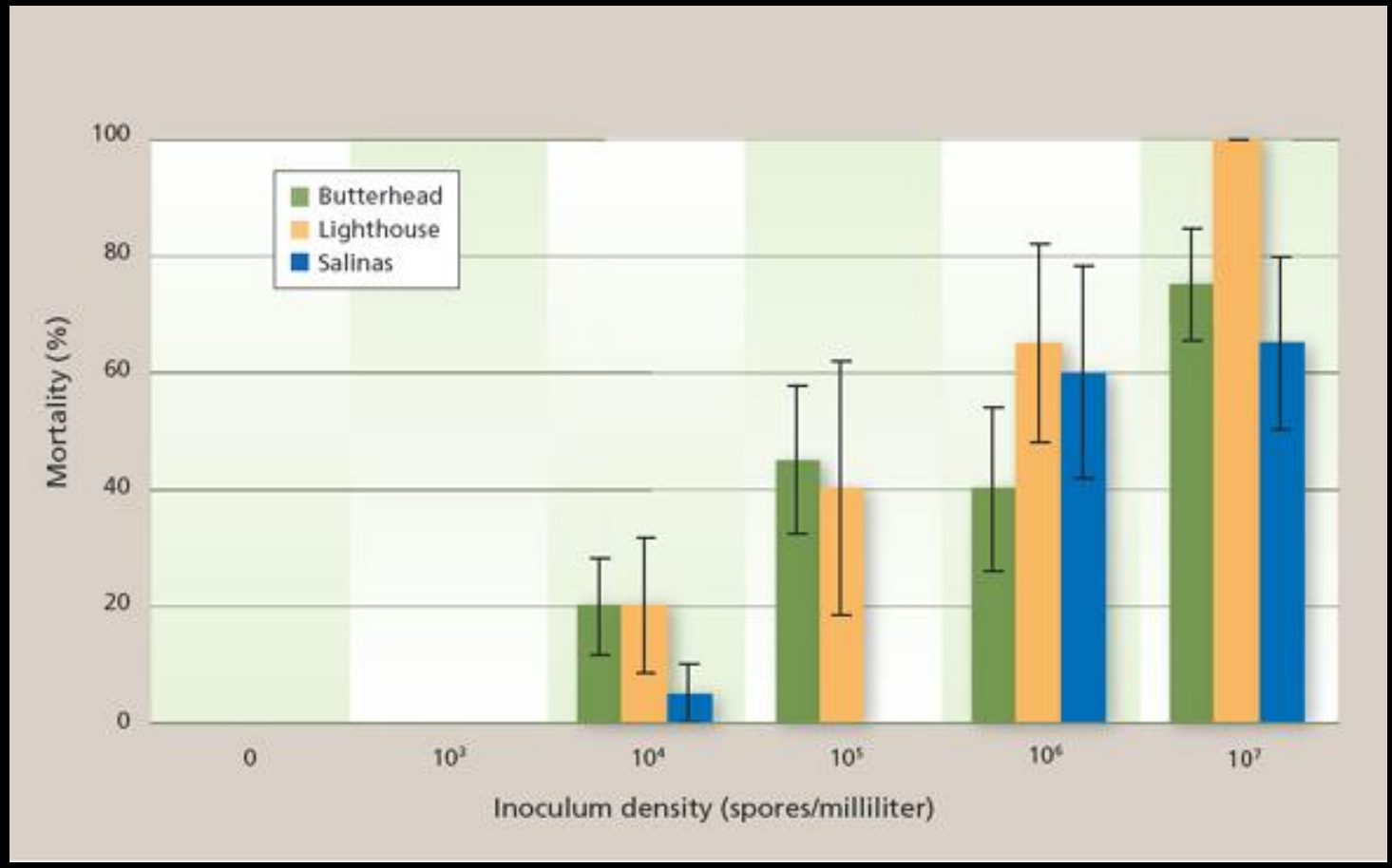
Slide curtesy P. Henry

Disrupt the disease triangle!



More fungus = more disease!

- Use management tactics to reduce the pathogen load

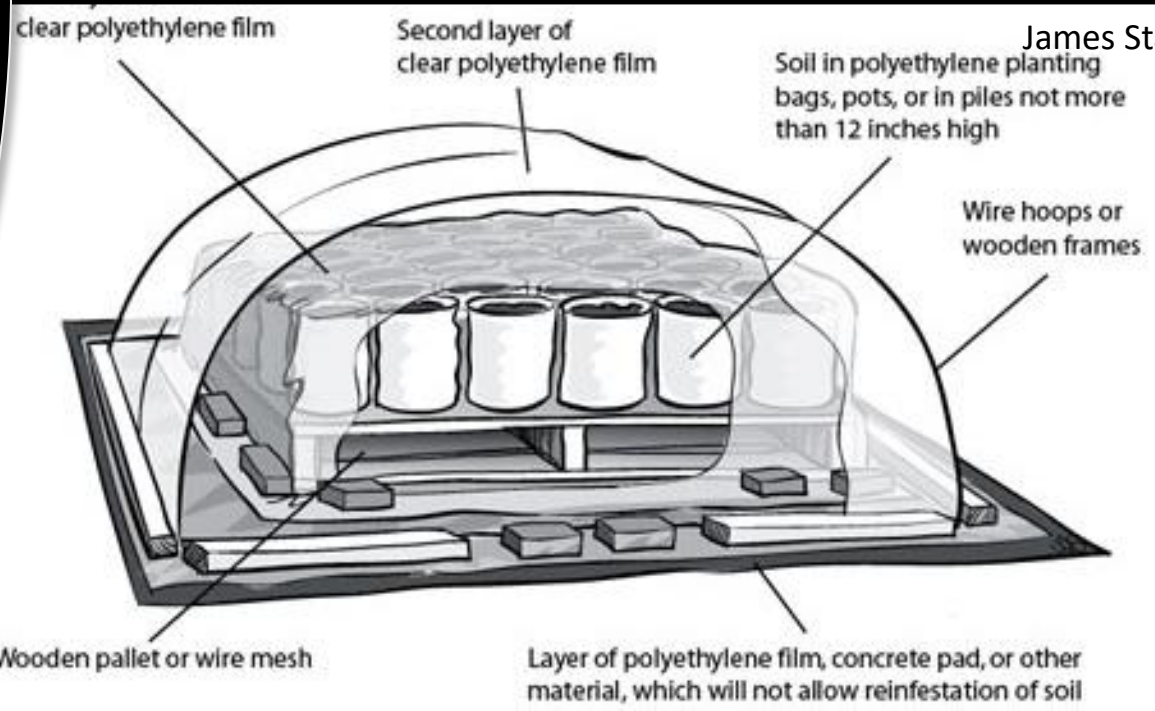


Scott et al., 2012

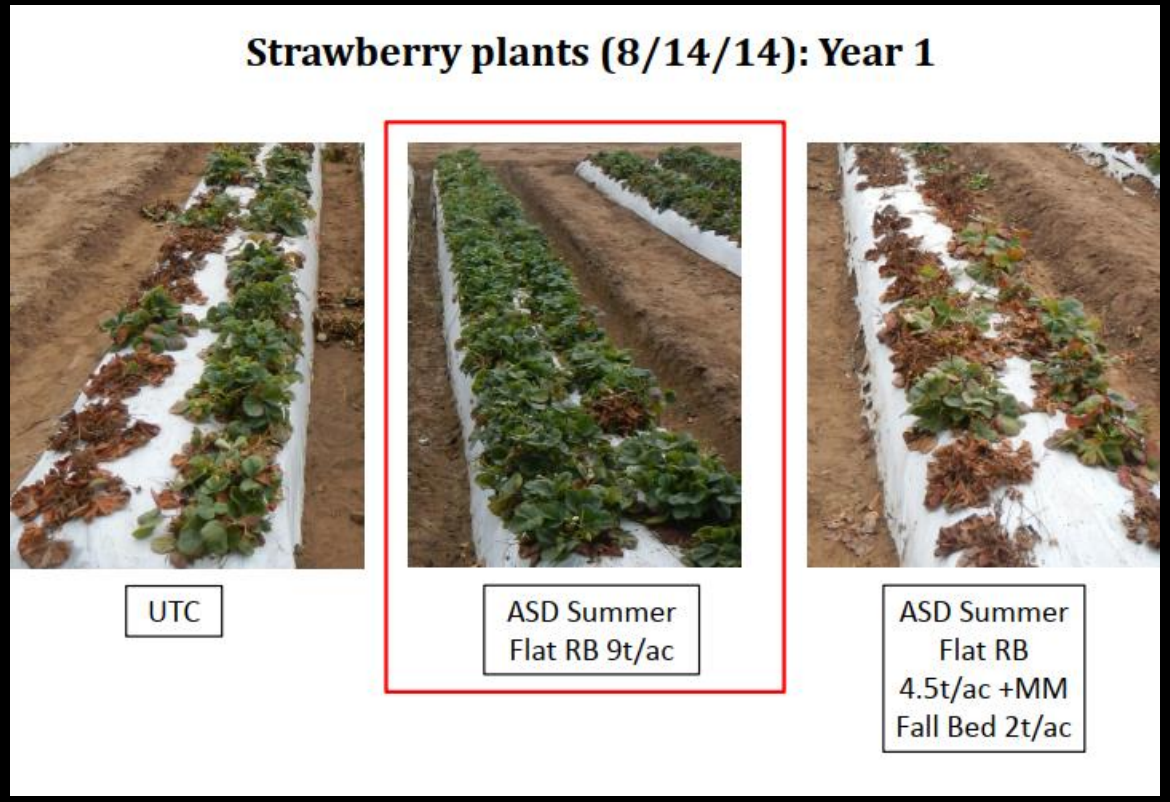
Soil solarization

- Kill it with heat!
- Need lots of sun and time
  - Your beds are out of production
- Top 6 inches of soil at or above 110 to 125°F for 4-8 weeks

James Stapleton



Shennan et al., 2014



Anerobic soil disinfestation

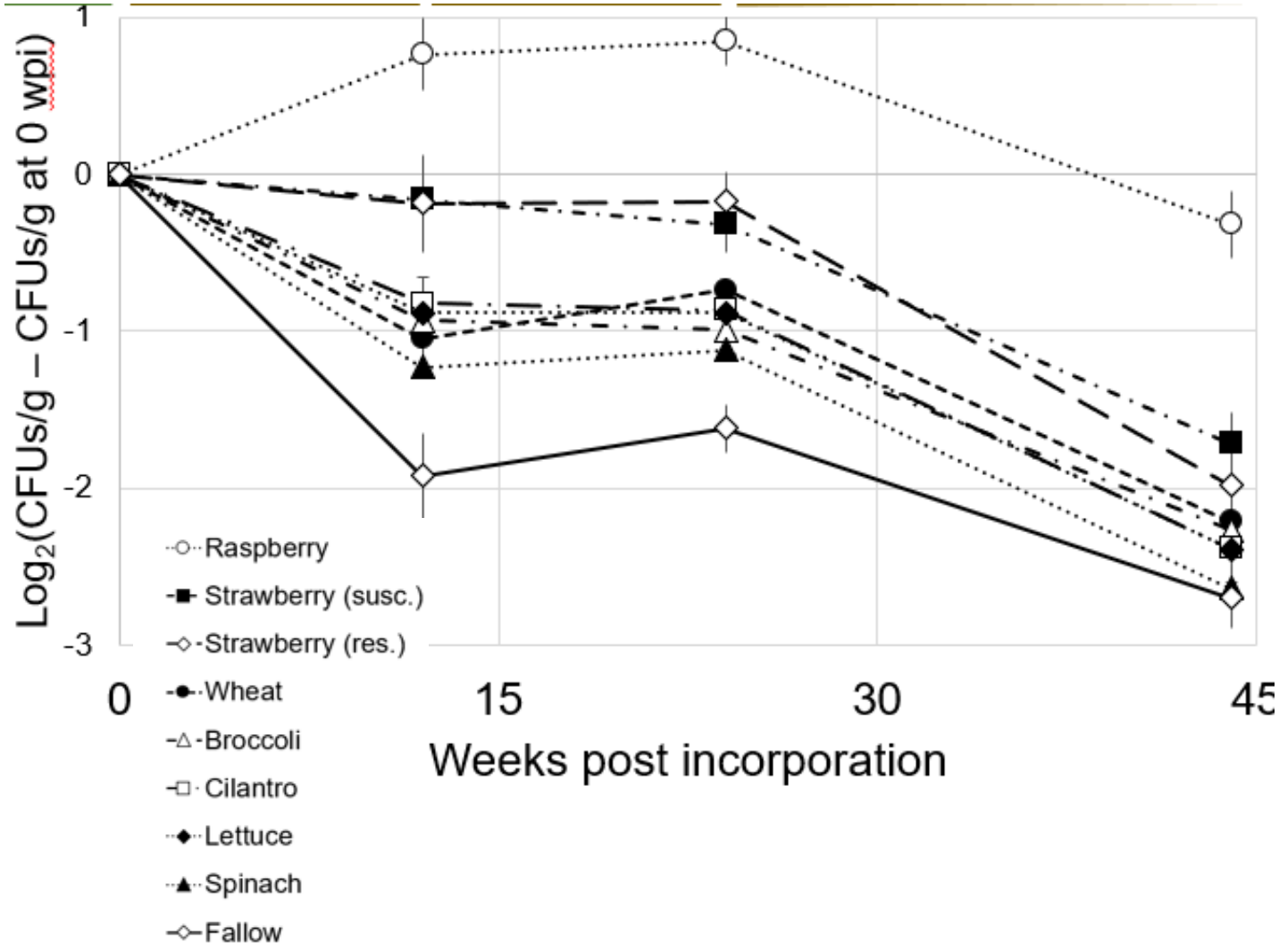
- 300h over 86F at 8” soil depth
- Hard to achieve, requires a fallow bed during production season
- Can backfire and make fusarium wilt worse

Steaming

- Expensive but quick
- Used more frequently in greenhouses
- Potential short-term benefits
- Often recolonized by fusarium – more on this later

Wikipedia

Recommendations for crop rotation - Strawberry

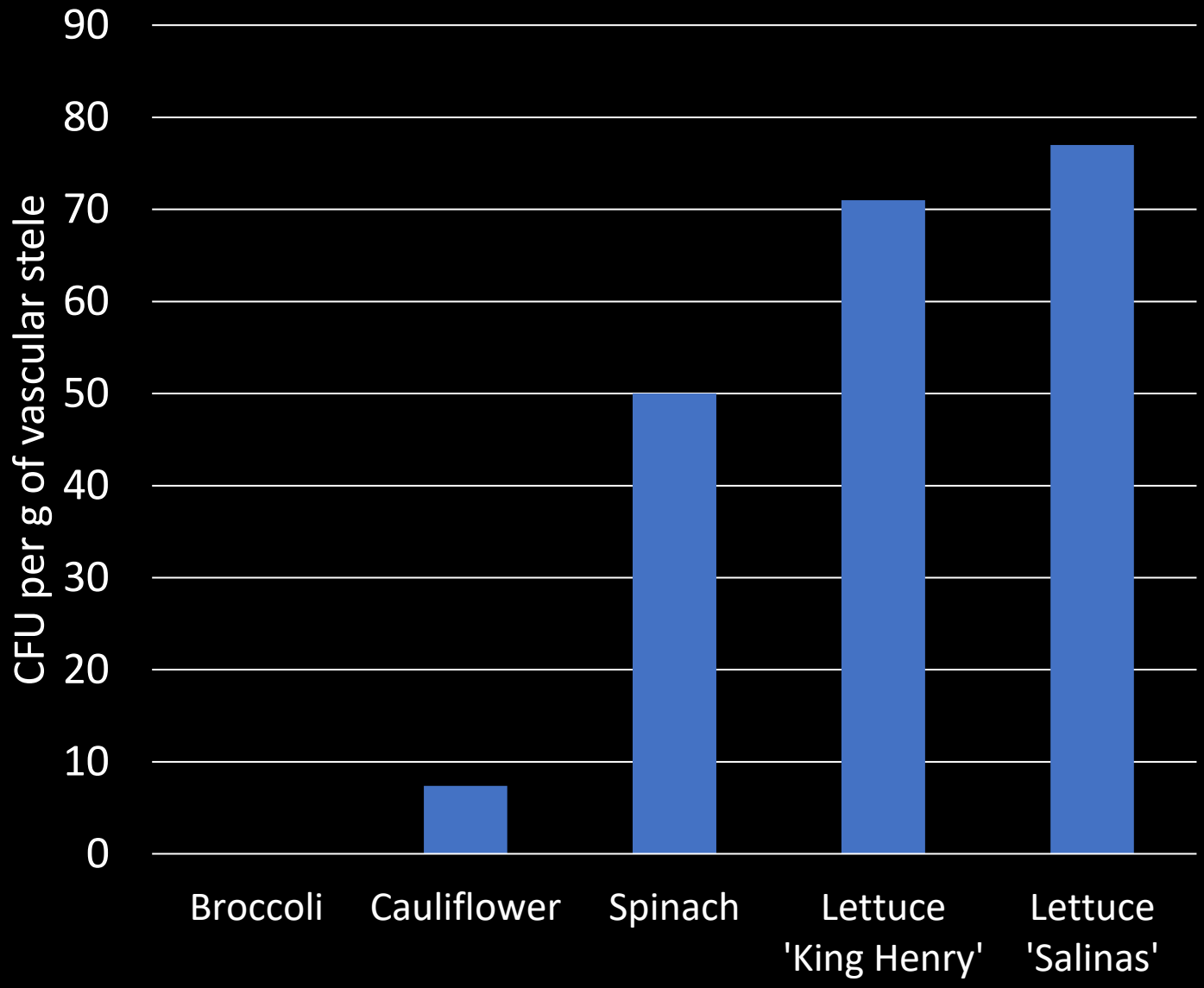


Crop:	Host type:
Spinach	Weak
Broccoli	Weak
Cilantro	Weak
Lettuce	Weak
Wheat	Weak
Raspberry	Reservoir
F.o. fragariae-**resistant** strawberry cultivars	Reservoir
F.o. fragariae-**susceptible** strawberry cultivars	Symptomatic

Henry et al. 2019, Phytopathology

Colonization of crops by fusarium - lettuce

- Recommendations can differ by crop
- Duration:
  - One year no-host rotation is good
  - Three years is better
- Don’t wait for an outbreak!



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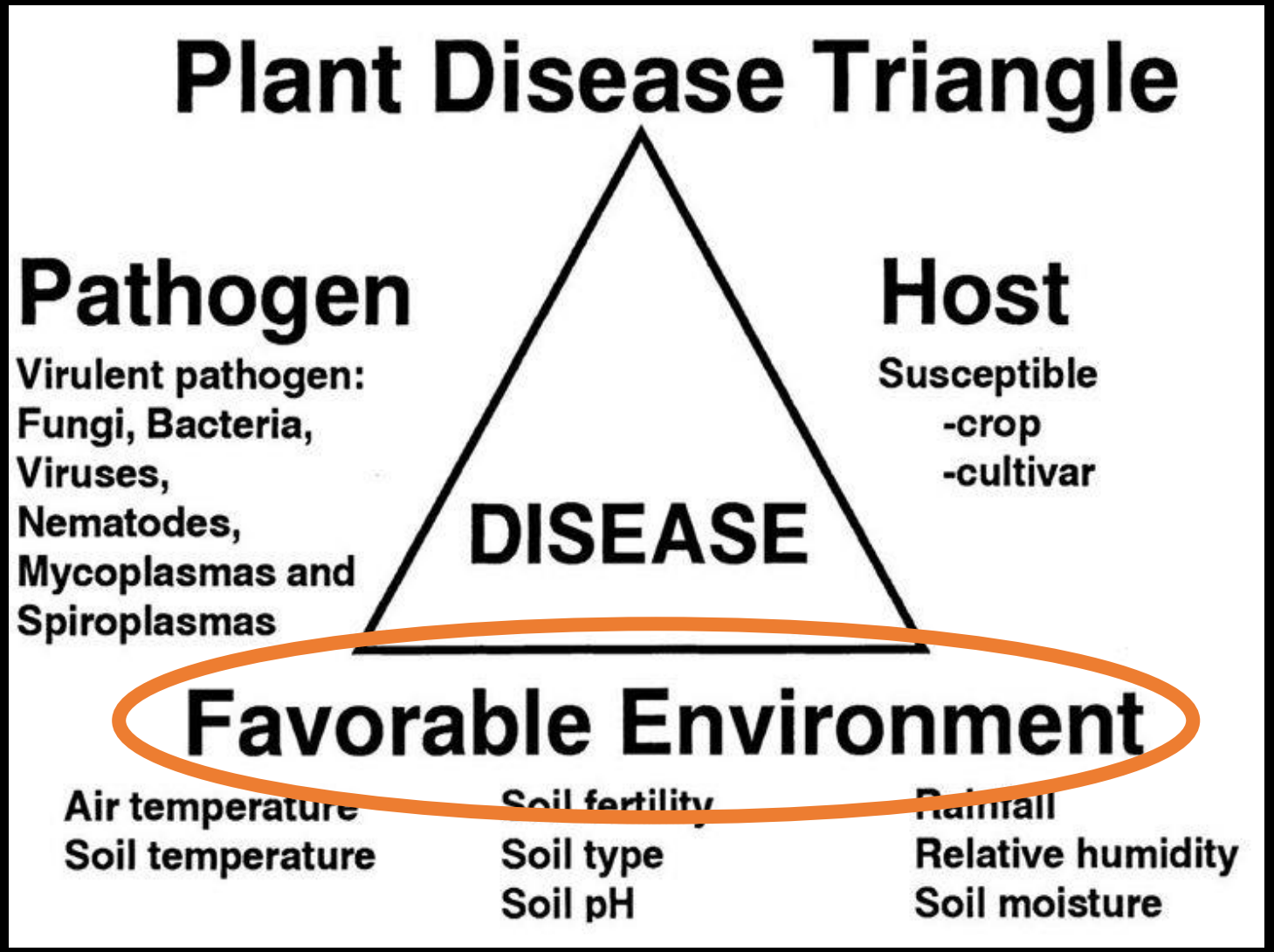
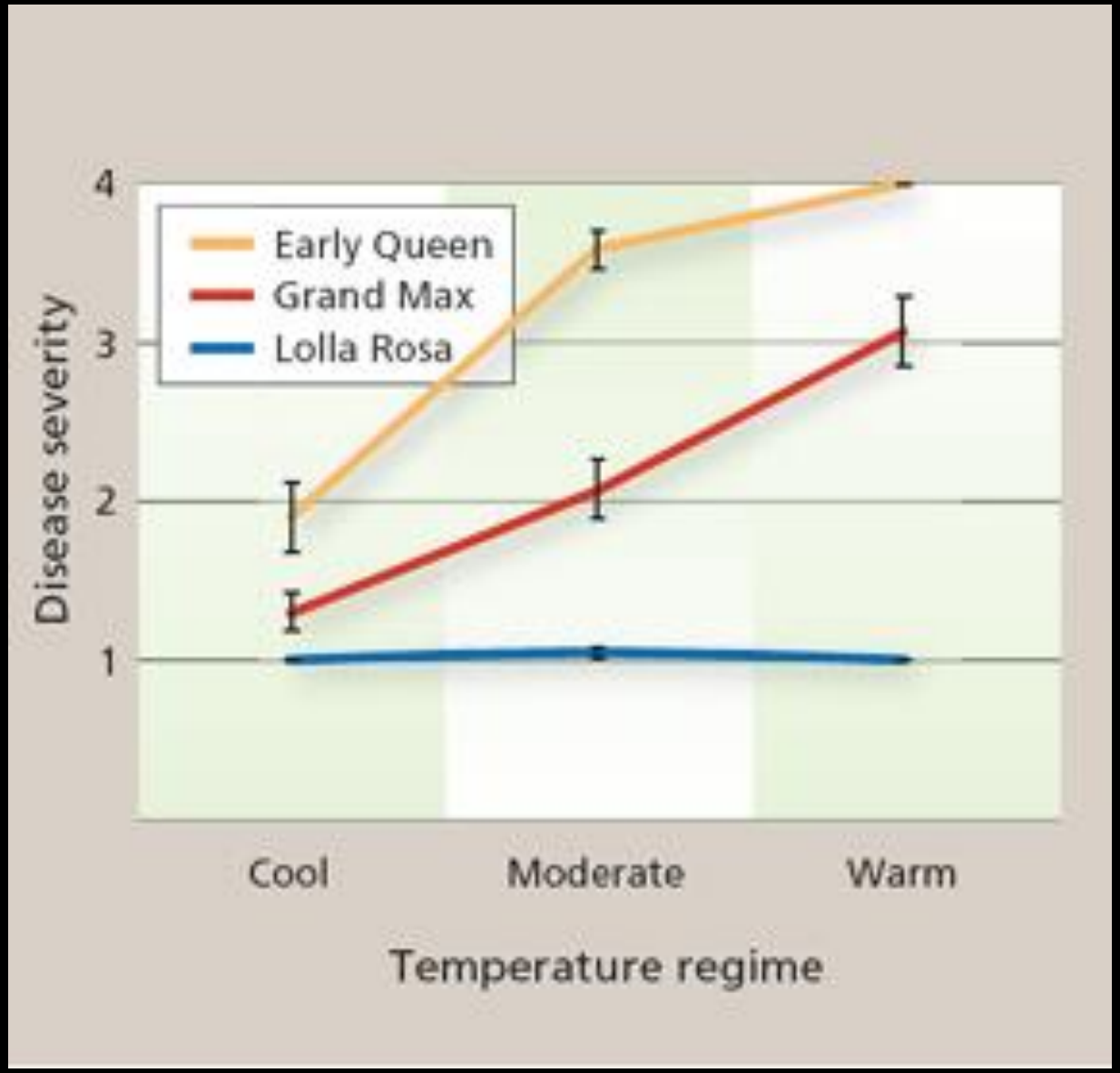


Temperature

- Temperature is a primary factor
- Warm temperature >82f
- Management tactics are always interacting (i.e. with cultivar)



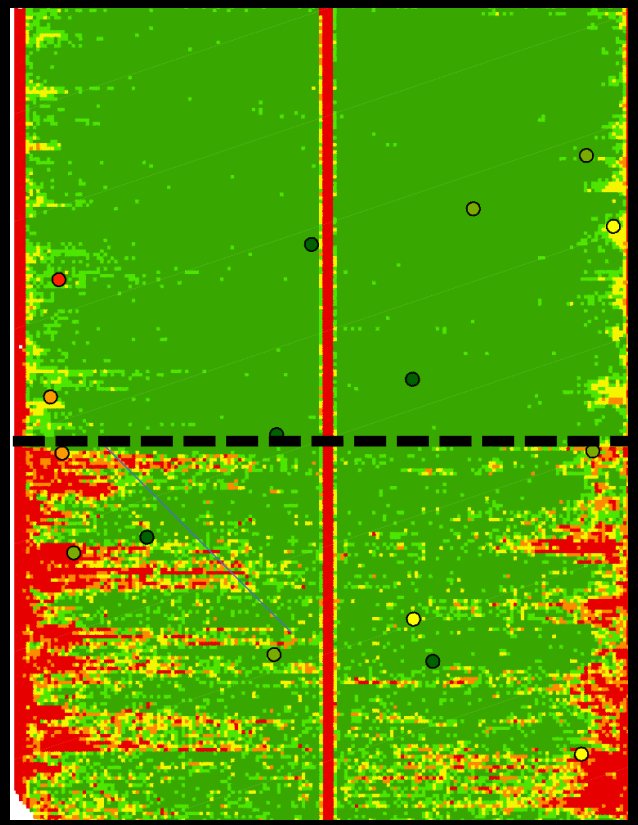
Scott et al., 2012

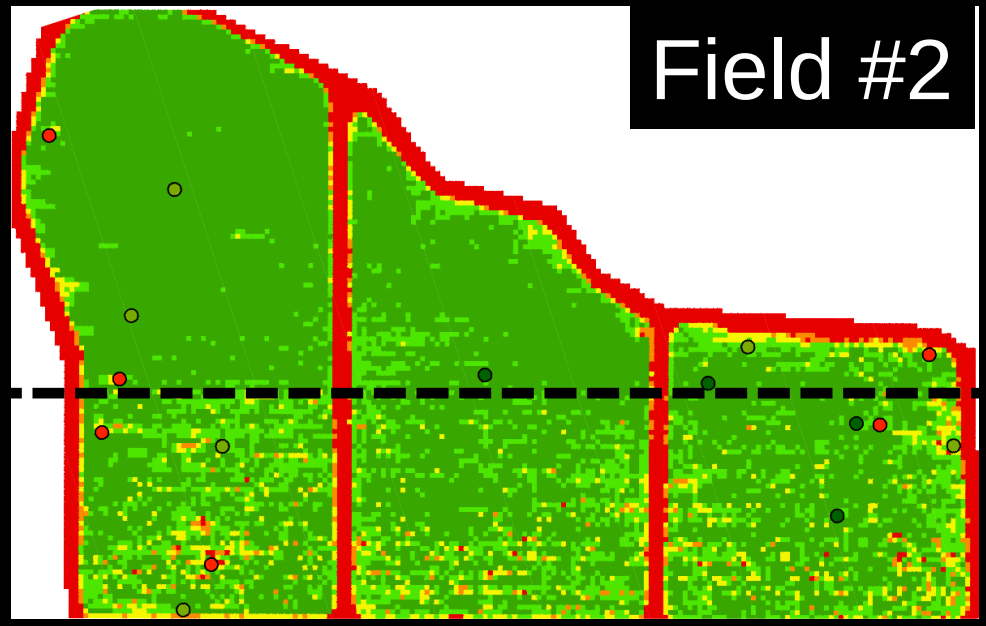
Warmer soil leads to more disease

What can you do to decrease temp – straw mulch?
Can have other crop consequences

Field #1

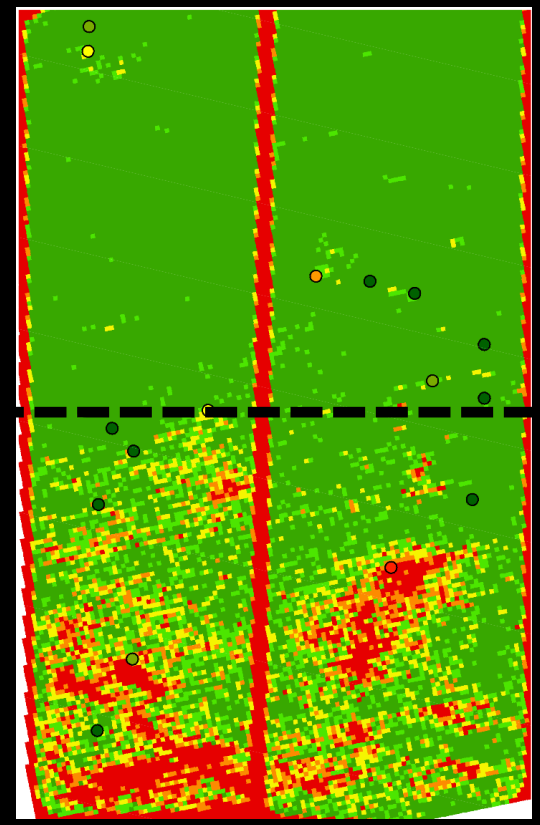
Dark green plastic





Clear plastic

Field #3



Drone images provided by Michael Hang (CSUMB), Forrest Melton (CSUMB), Michael Matson (USDA-ARS), Frank Martin (USDA-ARS)

Many factors contribute to disease

- Much of this boils down to proper management
- Keep plant stress low
- Nothing here is a panacea, but it can add up

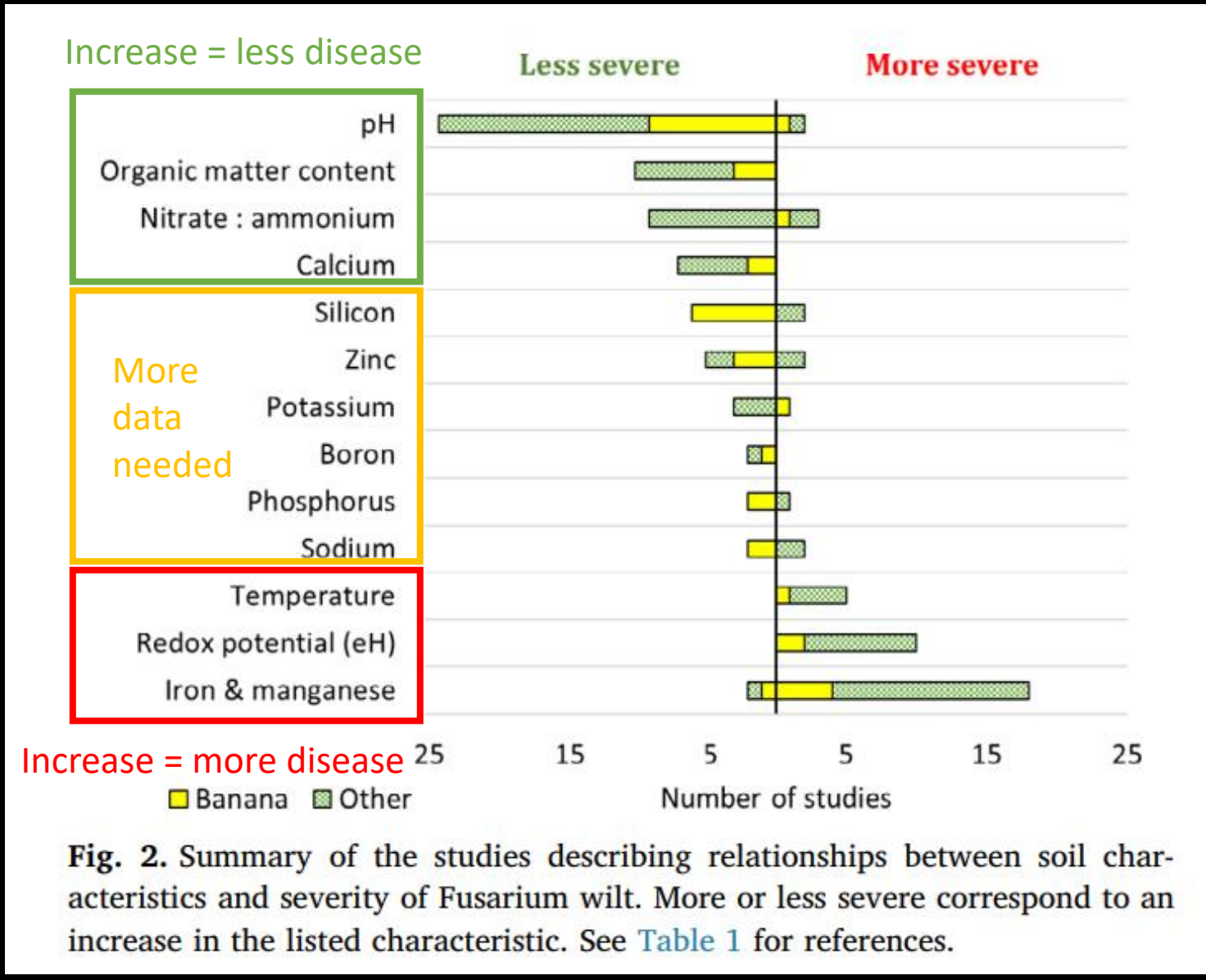


Fig. 2. Summary of the studies describing relationships between soil characteristics and severity of Fusarium wilt. More or less severe correspond to an increase in the listed characteristic. See Table 1 for references.

Orr and Nelson 2018

Fertilizer

- More ammonium = more severe disease
- Careful about soluble fertilizer applications!
- Consider raising soil pH
  - Ag lime, not dolomitic lime (usually)
- So much more to say on the topic
  - Test, don't guess!!

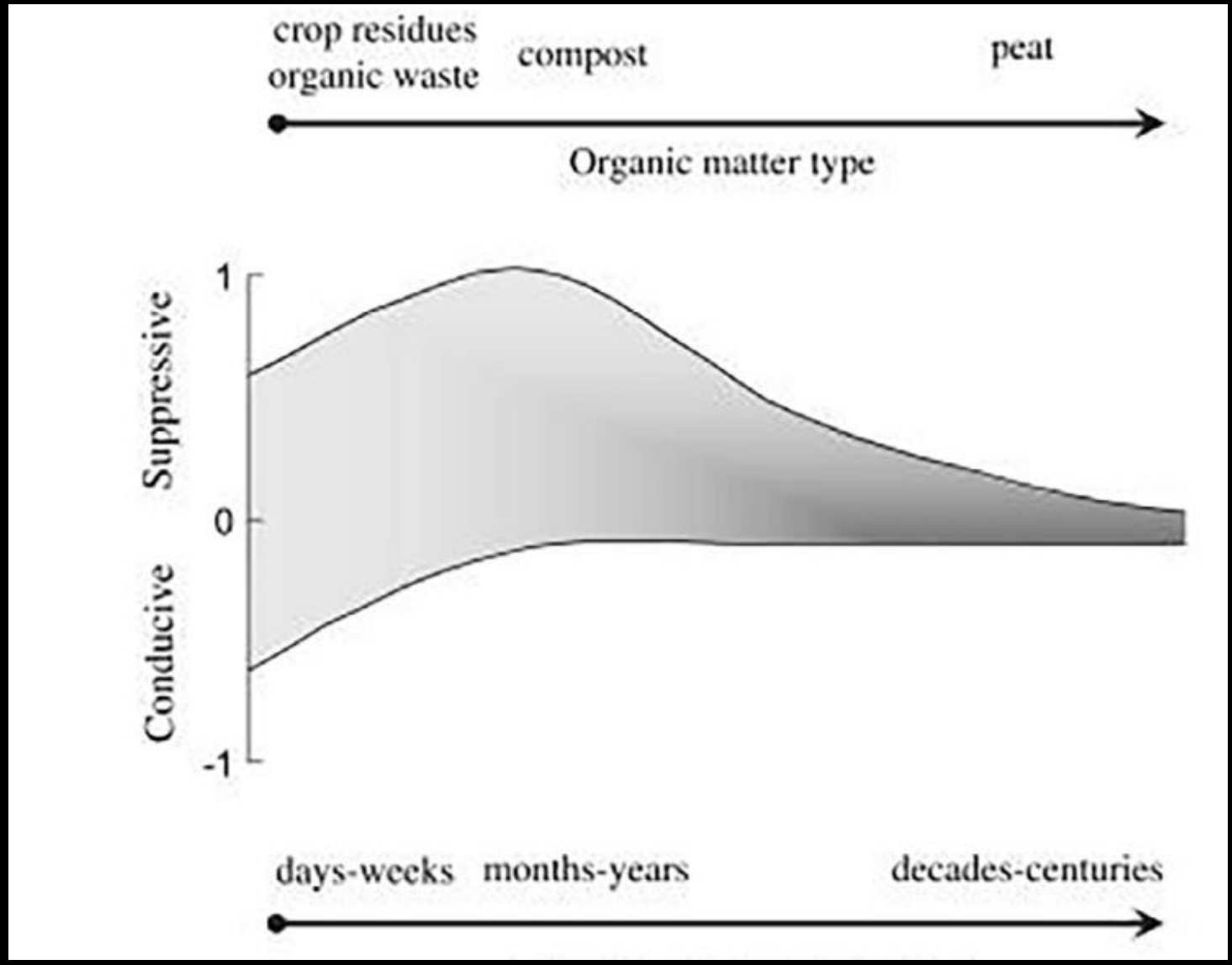
Zhou et al., 2017

"I" = inoculated with fusarium wilt

Organic amendment

- Too fresh – fusarium can grow as a decomposer
- Too old – no microbial community to suppress fusarium

Orr and Nelson 2018

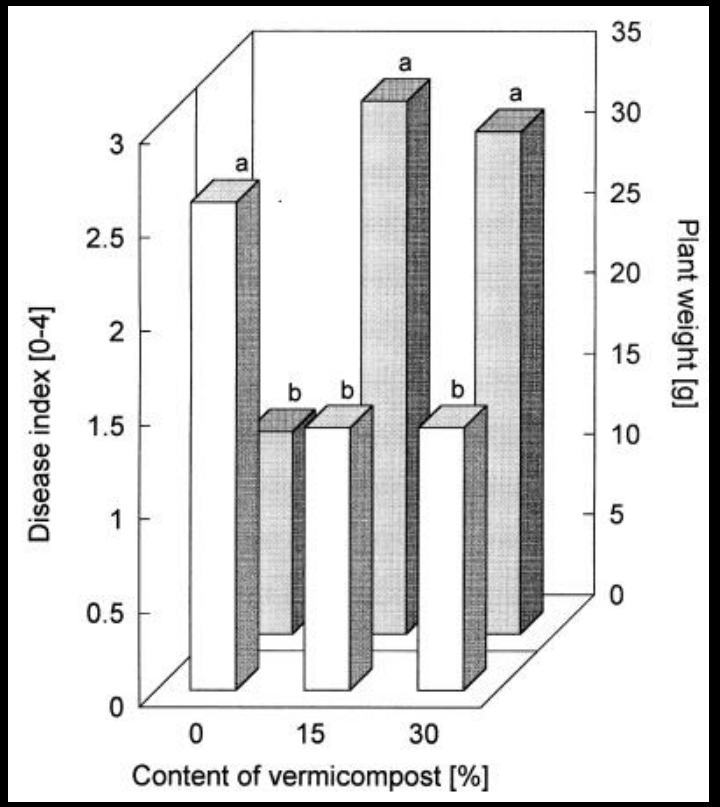


Vermicompost

- Positive effects of earthworms
- Positive effects of vermicompost
- Limited studies

Wade Elmer

Szczech 1999

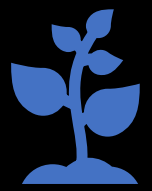


Other amendments

Brassica seed products
Chitin

- Both seem mildly effective
- Both used in ASD
  - (limited data, chitin seems promising?)
- Applied at least 3 weeks before planting

Some final thoughts

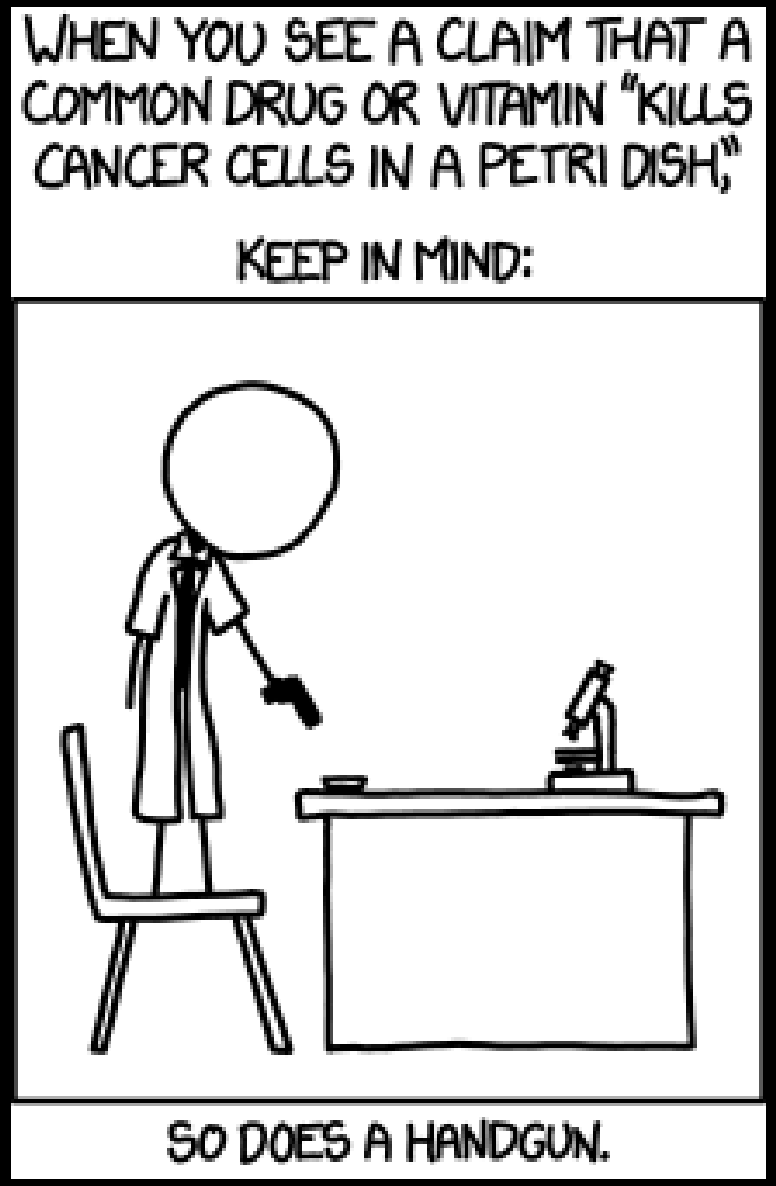


Plant stress!

- Follow good management guidelines for your crops
  - Properly fertilized following lab tests
  - Properly prepared soils – i.e. not compacted
  - Good irrigation – not drowning roots, not drying out. This is measurable and there are guidelines.
  - Healthy transplants/strong seed

Biocontrol/fungicides/defense inducers

- Little evidence that commercially available products work in field production to provide economical returns – especially for organics
- Don’t rely on these in a make-or-break situation
- Great opportunities for on-farm trials
- Still an area of active research



On farm research

- Many questions not sufficiently answered
- I encourage you to conduct experiments on your farm
- Keep it simple and replicated + control!
- UC advisors are usually happy to help design a trial

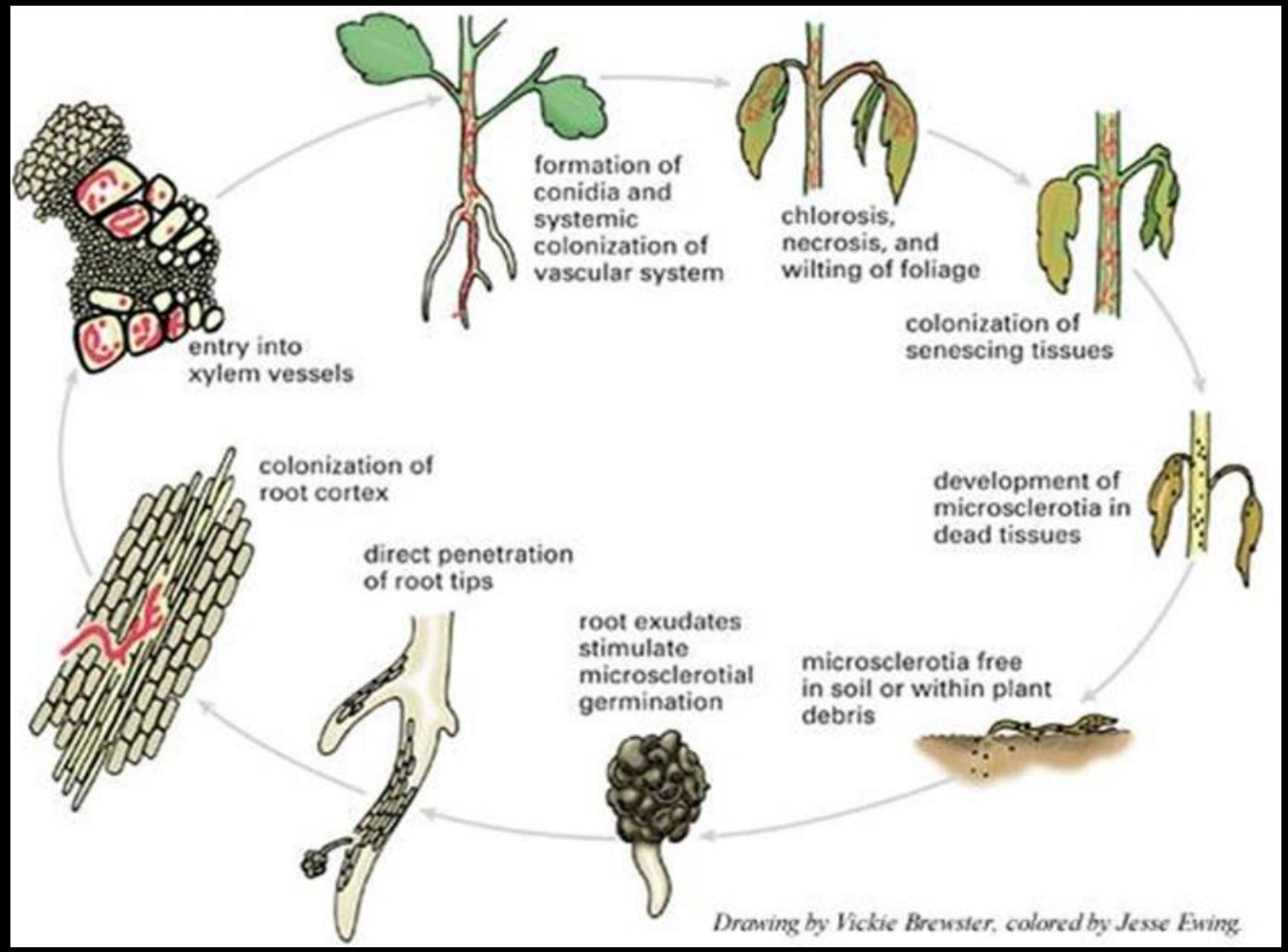
- If you are suffering from fusarium wilt, I am interested in on farm trials, please reach out!

- gabesacher@psu.edu

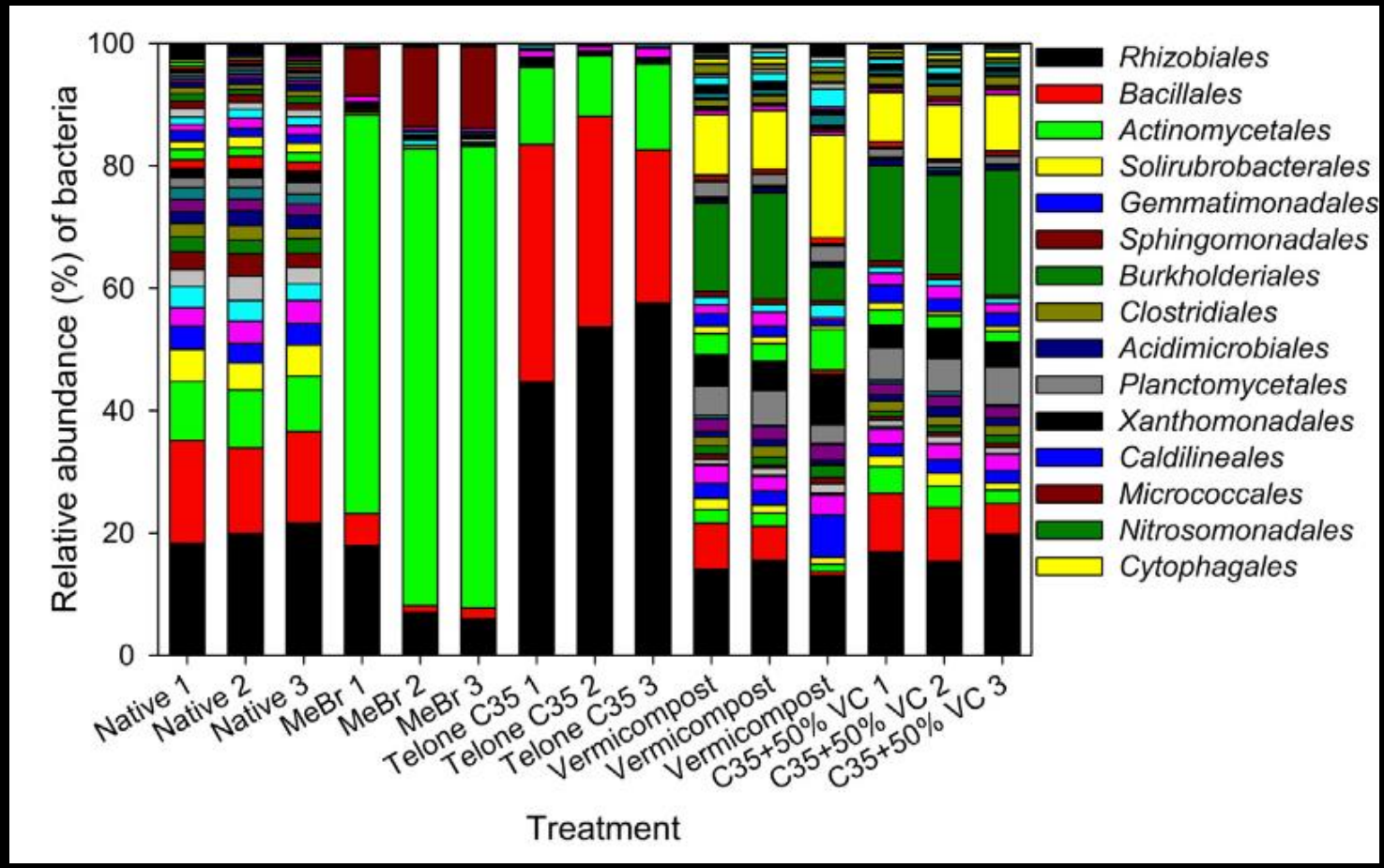
Additional slides/graphs below

Life cycle

- Long latent period
- Difficult to detect the disease before it is a large problem



Vermicompost effect on microbiome following fumigation



Strauss et al., 2015

Solarization

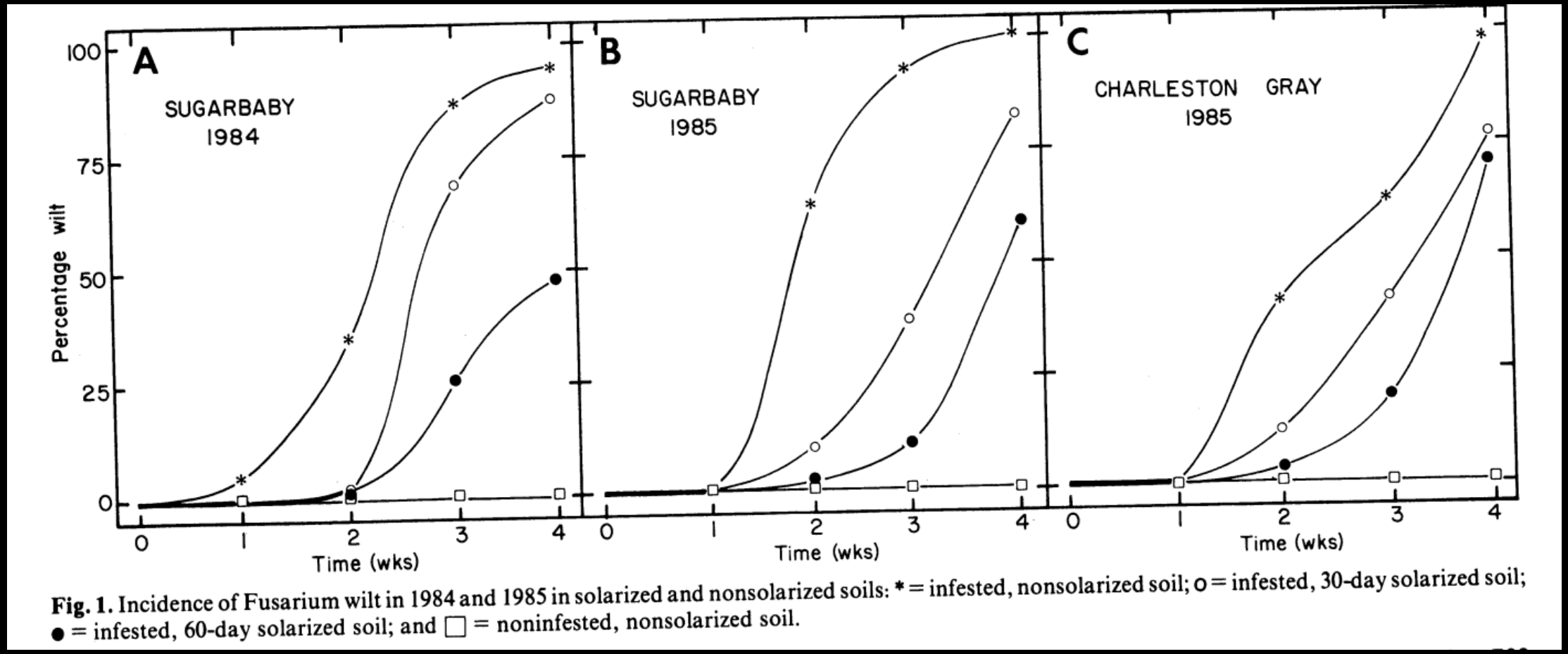
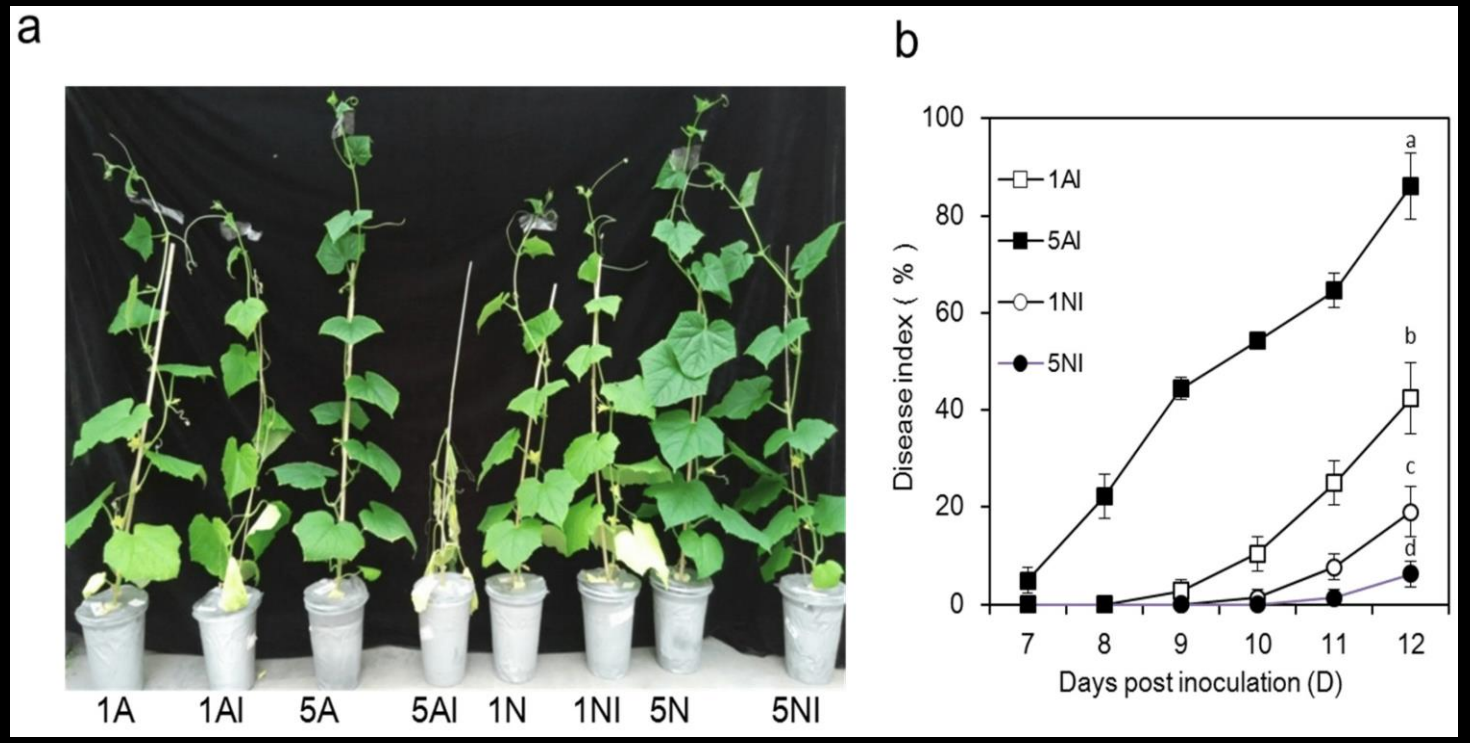


Fig. 1. Incidence of Fusarium wilt in 1984 and 1985 in solarized and nonsolarized soils: * = infested, nonsolarized soil; o = infested, 30-day solarized soil; ● = infested, 60-day solarized soil; and □ = noninfested, nonsolarized soil.

Martyn and Hartz 1986

Fertilizer



- More ammonium can lead to more severe disease
- Careful in your soluble fertilizer applications!
- So much more to say on the topic of fertilizers
  - Test, don’t guess!!

Chitin amendment

- Add weeks before planting plants
- Somewhat effective
- Used in ASD – seems effective
- More studies needed

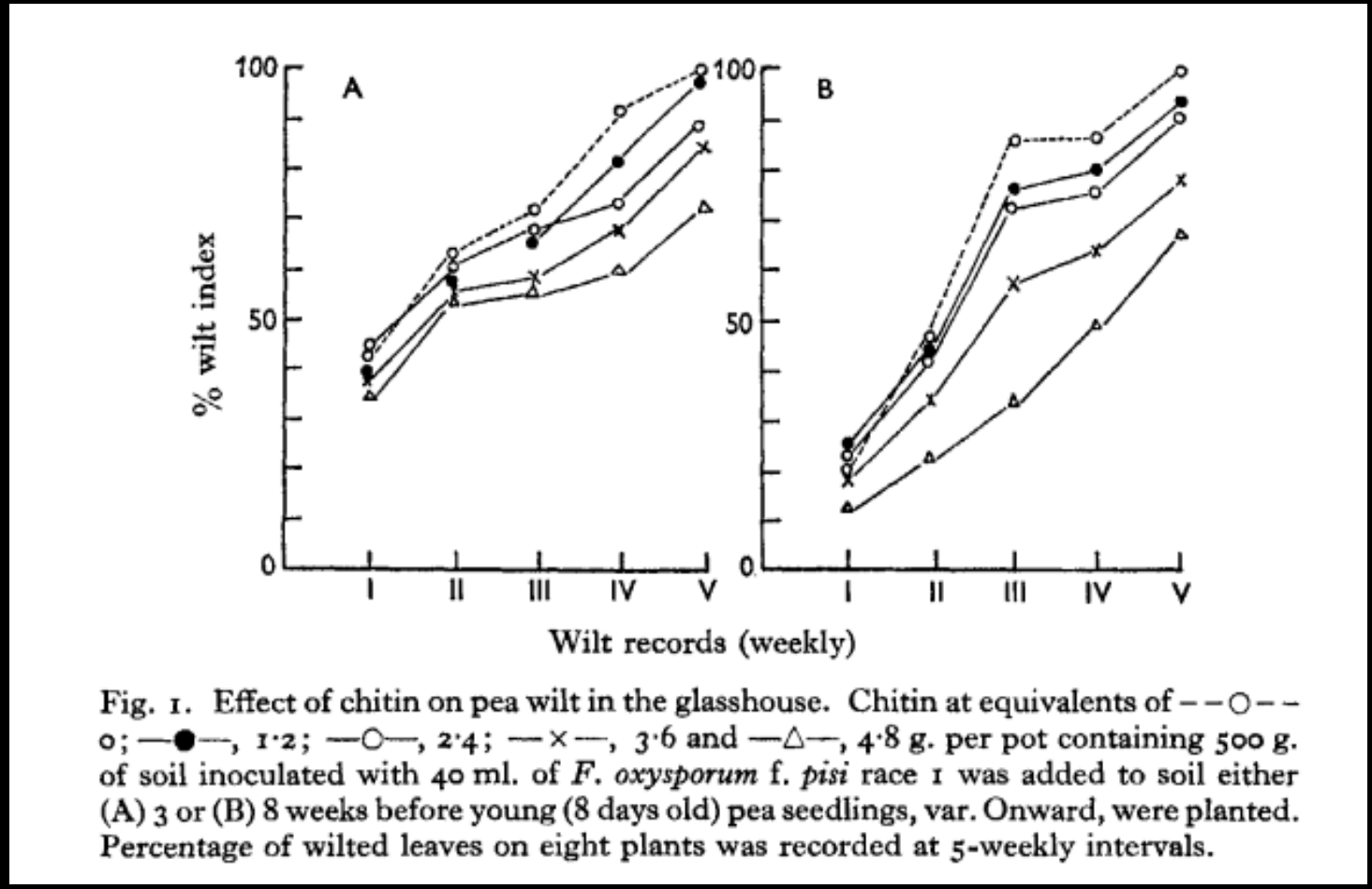


Fig. 1. Effect of chitin on pea wilt in the glasshouse. Chitin at equivalents of – – ○ – – o; —●—, 1·2; —○—, 2·4; —×—, 3·6 and —△—, 4·8 g. per pot containing 500 g. of soil inoculated with 40 ml. of *F. oxysporum* f. *pisi* race 1 was added to soil either (A) 3 or (B) 8 weeks before young (8 days old) pea seedlings, var. Onward, were planted. Percentage of wilted leaves on eight plants was recorded at 5-weekly intervals.

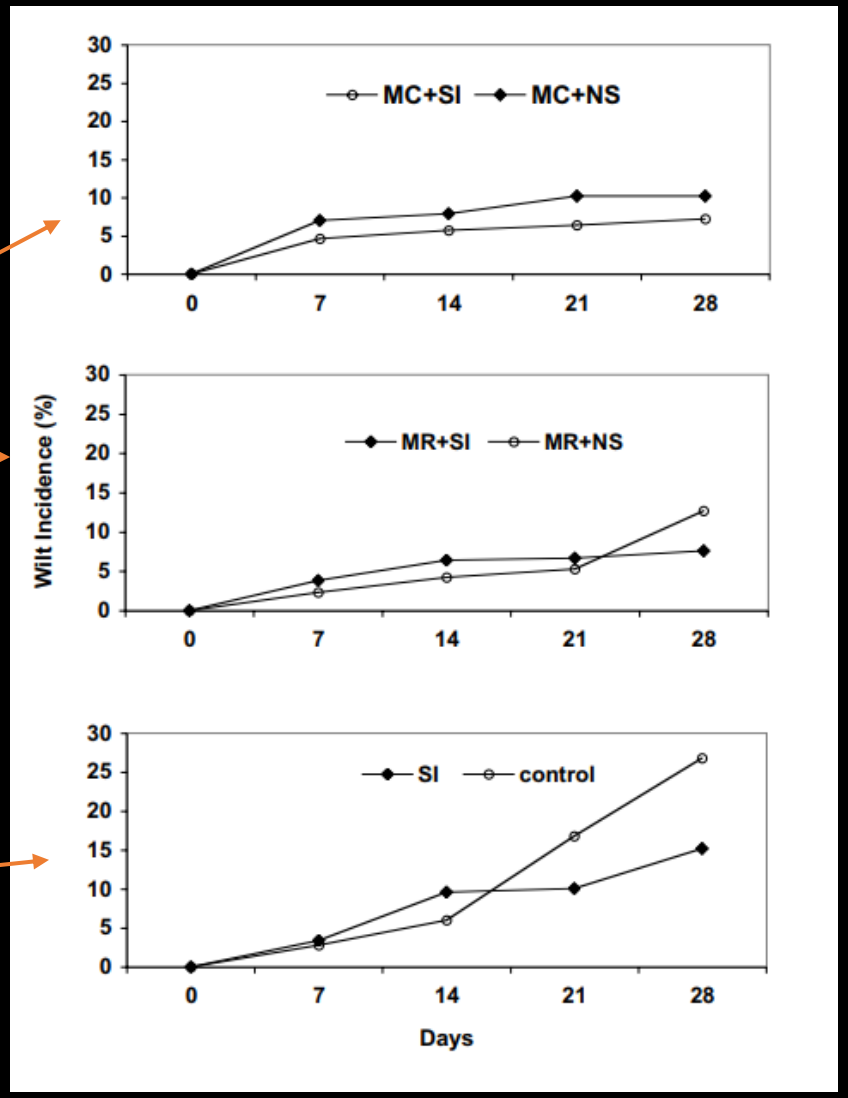
Khalifa 1965

Brassica amendments

- Used with ASD sometimes
- 3 week plant back
- Variable results
- Need further study

Two brassica amendment treatments

Control (most disease)



Mawar and Lodha 2002