Management updates for Fusarium wilt and *Fusarium falciforme* vine decline

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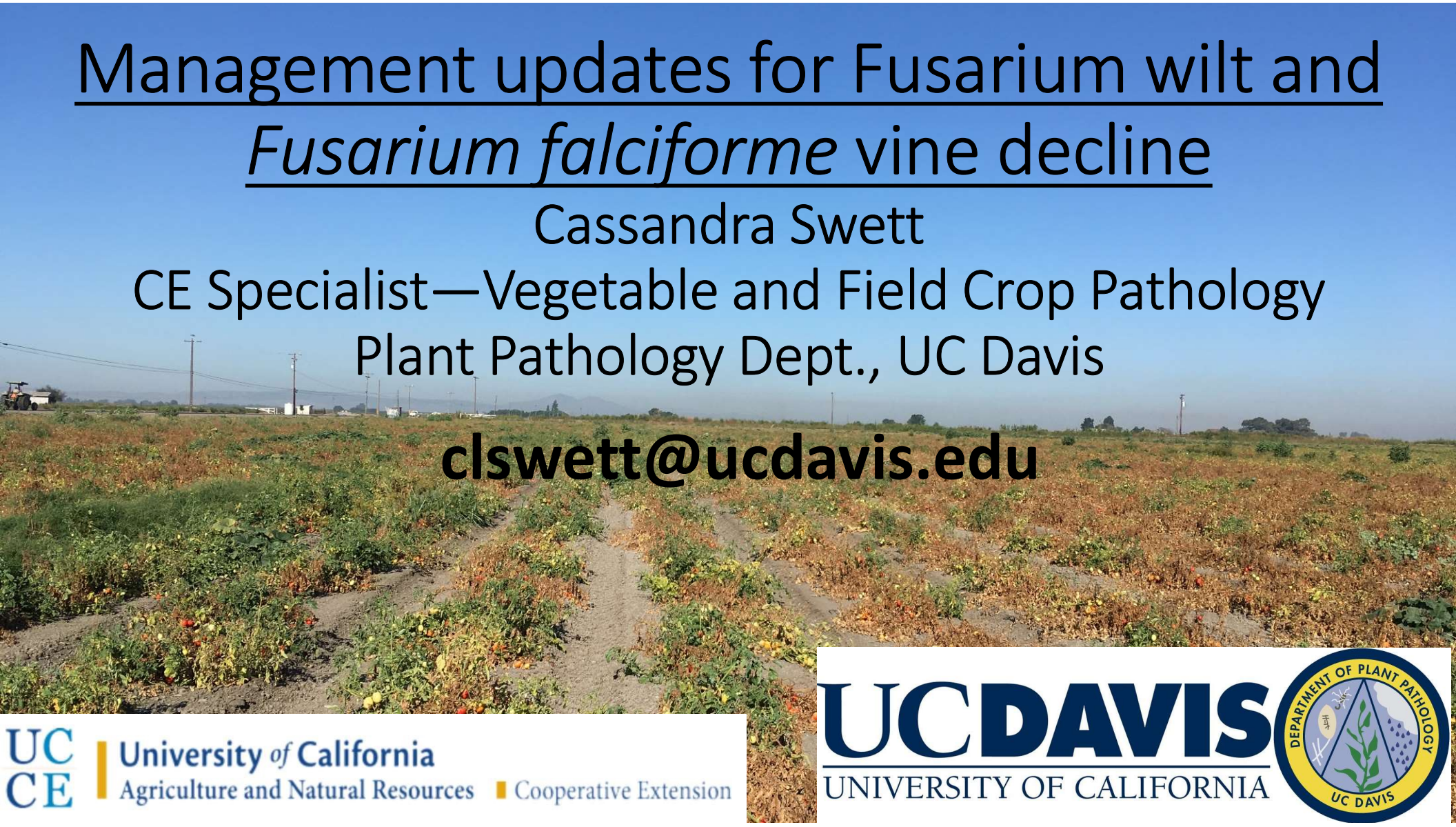

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Managing Fusarium wilt with informed crop rotation: assessing host status of rotation crops

Fusarium wilt: caused by Fusarium oxysporum f. sp lycopersici (Fol) race 3

This strain only causes wilt in tomato

The fungus survives in soil

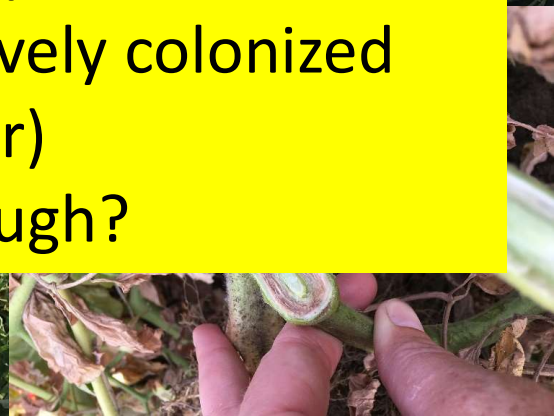
Crop rotations should reduce Fol R3 inoculum loads

Current recommendations:

Rotate with non-tomato crops—are some crops better?

Recent studies show that some crops are extensively colonized (eg. melons, cotton, onion, sunflower)

For at least 2-3 years?—is this long enough?

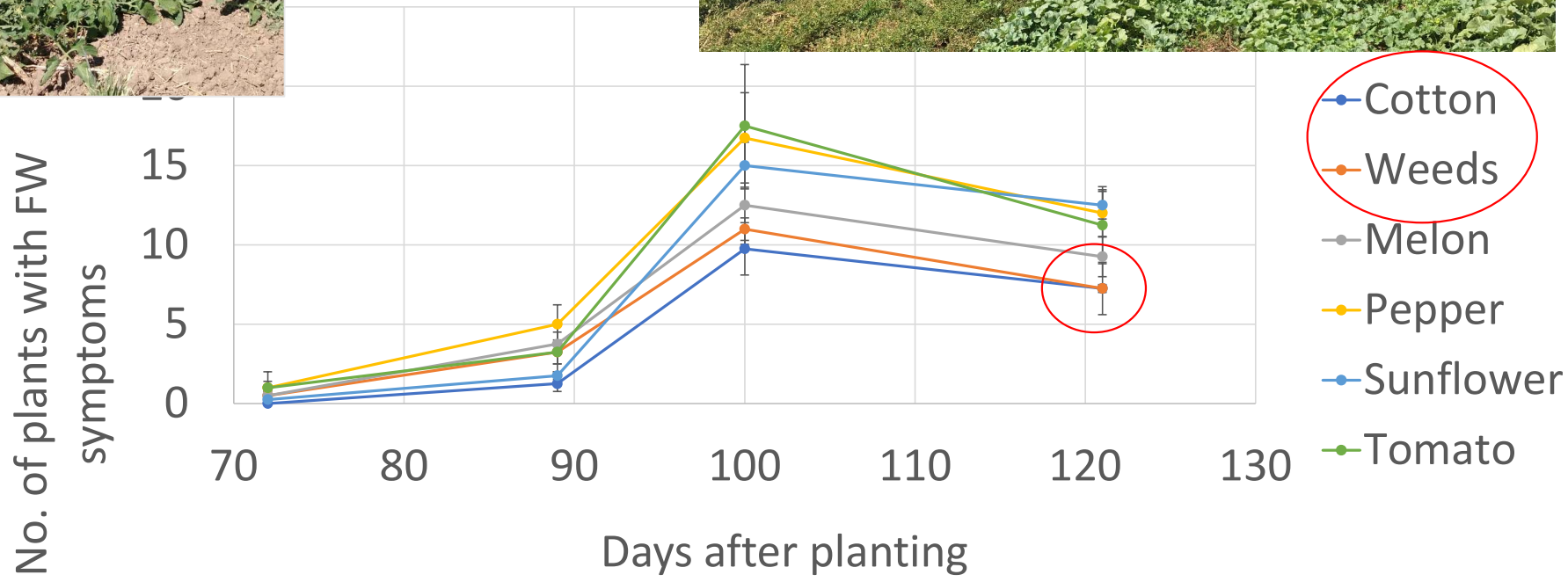


Managing Fusarium wilt with informed crop rotation: Effect of warm season rotation crops on Fusarium wilt

Dr. Kelley Paugh

Managing Fusarium wilt with informed crop rotation: Effect of summer rotation crops on Fusarium wilt

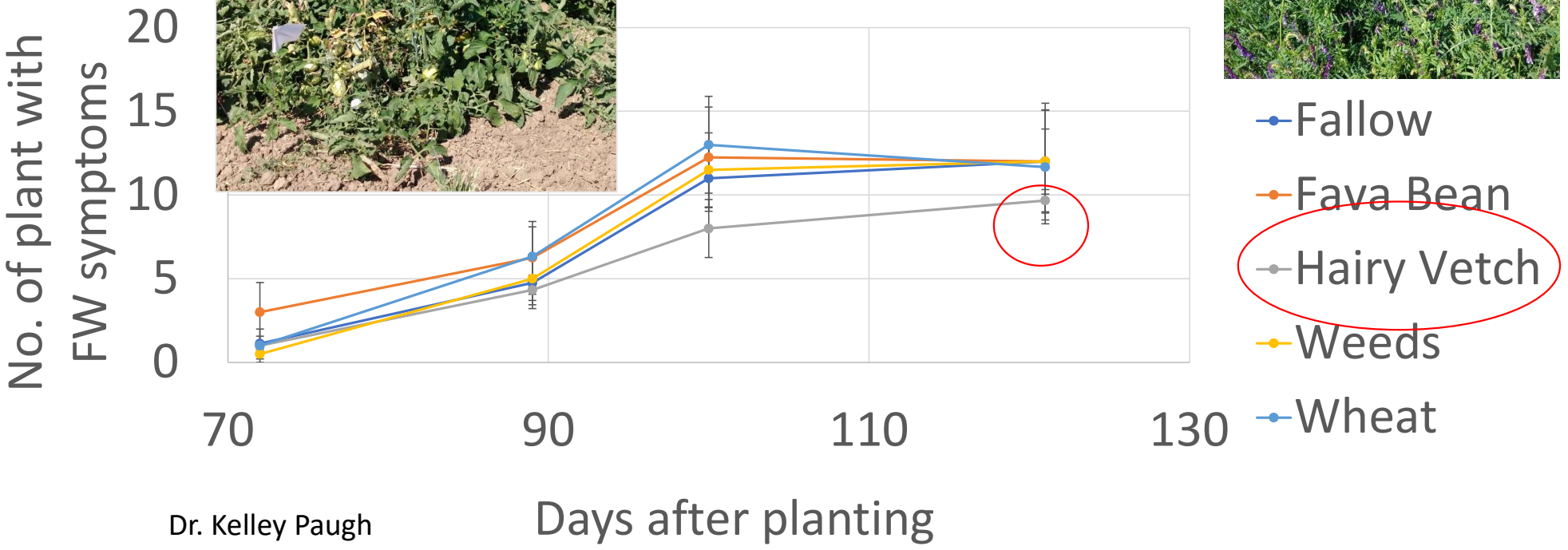
Dr. Kelley Paugh



Managing Fusarium wilt with informed crop rotation: Effect of cool season rotation crops on Fusarium wilt

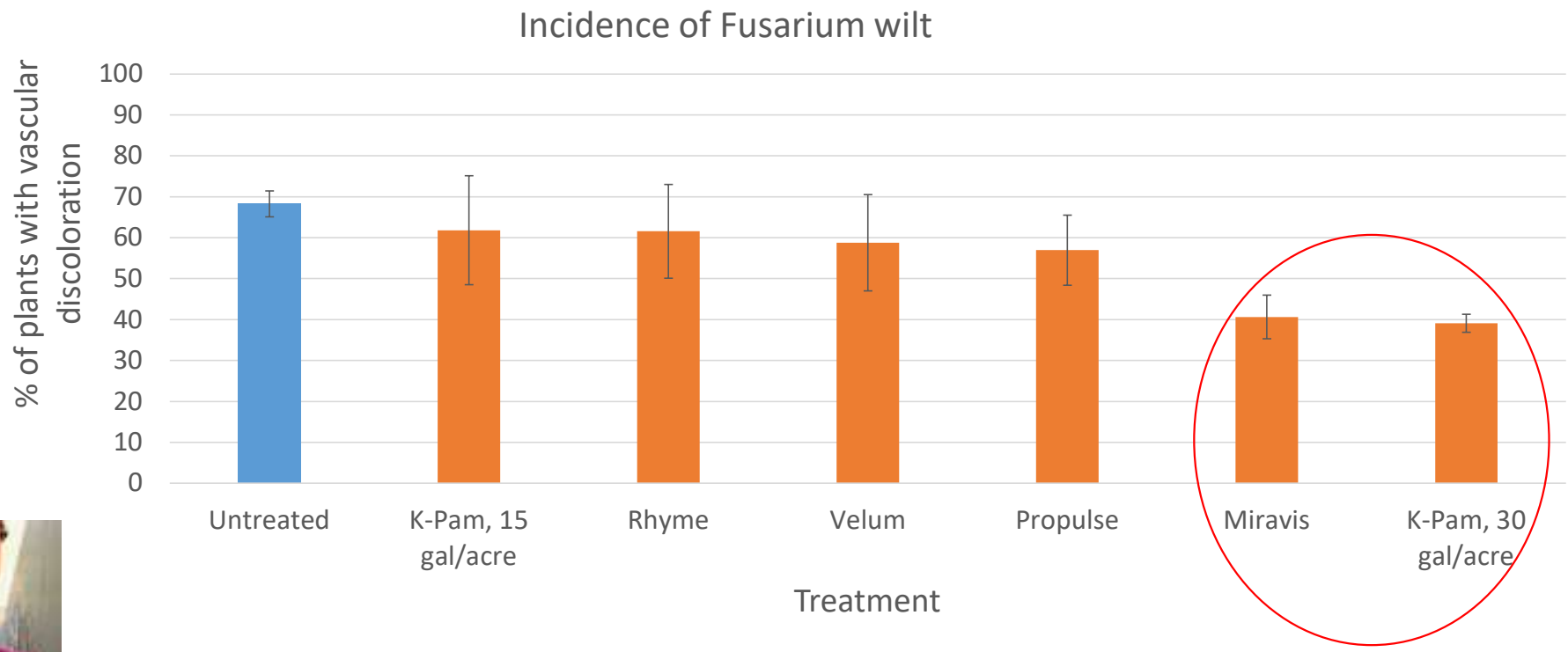
Dr. Kelley Paugh

Managing Fusarium wilt with informed crop rotation: Effect of summer rotation crops on Fusarium wilt



Dr. Kelley Paugh

Managing Fusarium with drip-applied fungicides and fumigation



Dr. Kelley Paugh

Managing Fusarium wilt

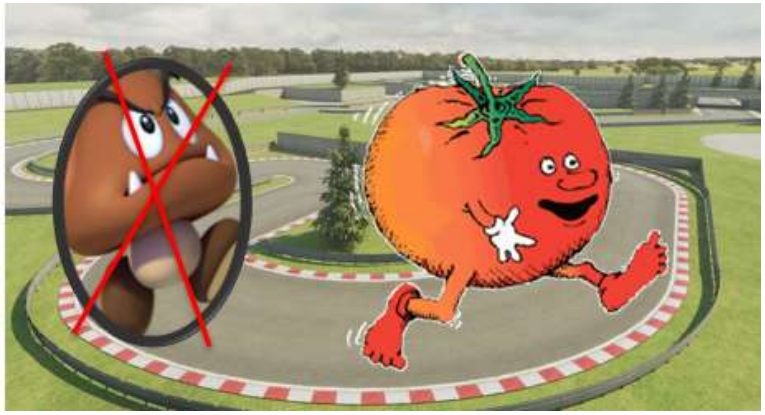
- Potentially low risk rotation cash crops:
  - Cotton?—was a good host…
  - Grasses (corn, rice, wheat)?—poor hosts
- Potential suppressive cover crops:
  - Hairy vetch
- Potentially high risk crops:
  - Warm: Pepper, cucurbits (melon, pumpkin), sunflower?
  - Cool: Fava bean and wheat were higher than vetch, but could still be suppressive
    - Beans and grasses were poor hosts
- Miravis and Kpam applied through the drip may work to reduce Fusarium losses

2019/20

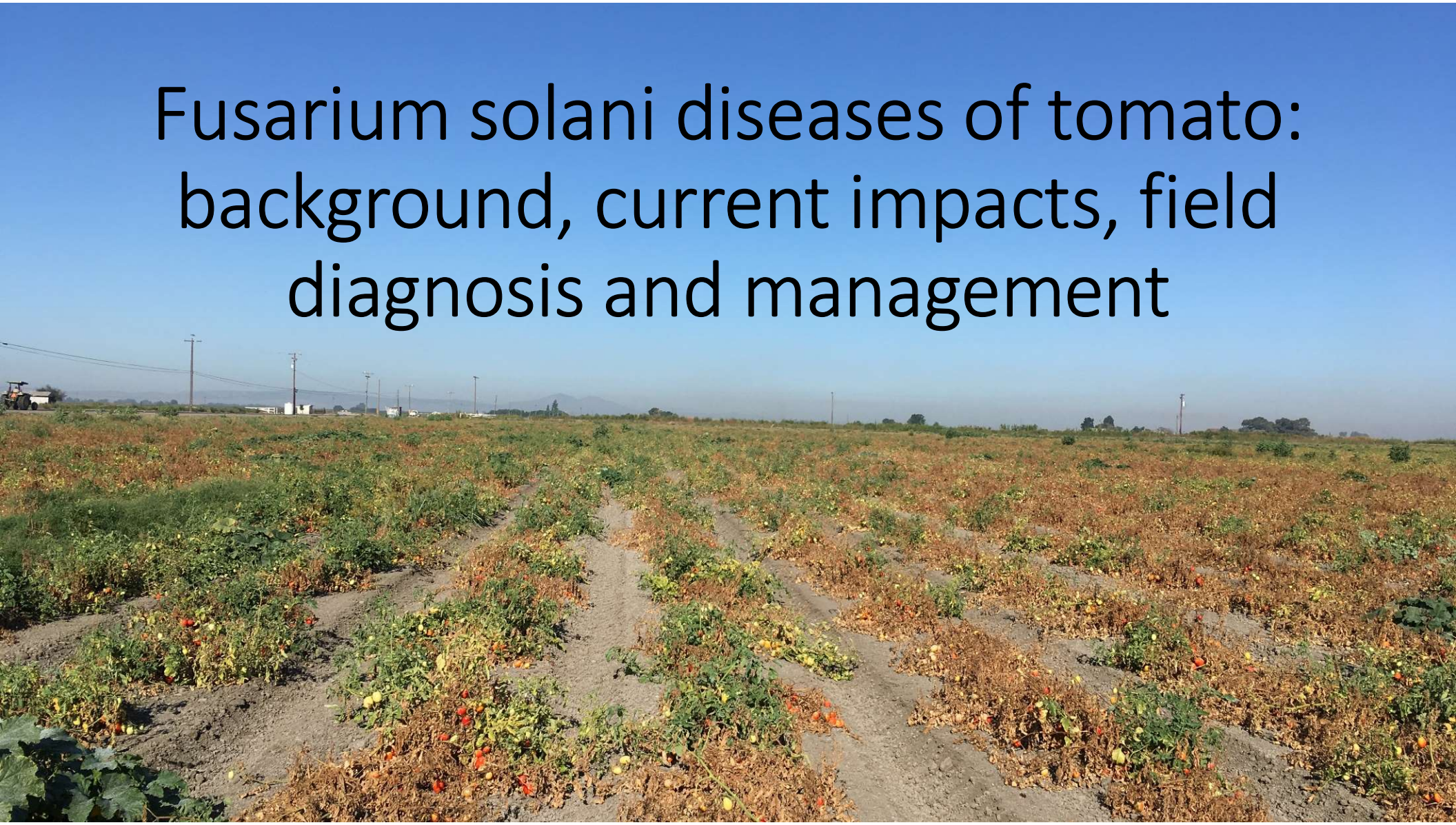
- Examine disease in repeat of above plus beans, onion, lettuce, broccoli and separate weed and chemical fallow plots
- Understanding crop effects on soil population
- Further chemical work

An update on Fusarium wilt race 4 monitoring

- **NO RACE 4 DETECTED**
- Race 4 not reported worldwide
- **2018:** Tested nine Fol recovered from F3 plants
  → All were Fol race 3
- **2019**: Recovered Fol from TWO F3 fields; plus three Fol isolates from F2 samples
  → All were Fol race 3



Fusarium solani diseases of tomato: background, current impacts, field diagnosis and management



Disease(s) caused by fungi in the *Fusarium solani* species complex in tomato

- First described in as a pathogen of fresh market tomatoes in Australia in 1975
  - Symptoms: girdled tap root, rotten crown, plants rarely killed, yield reduced
- Disease name: Fusarium foot rot
- Pathogen name:
  - 1975: Fusarium solani
  - 2007: *F. solani* f. sp. *eumartii*
  - 2019: *F. noneumartii*
- Observed in California on processing tomato in 1991
- Other hosts: potato, eggplant

Images: Mike Davis

Reported Fusarium foot rot symptoms

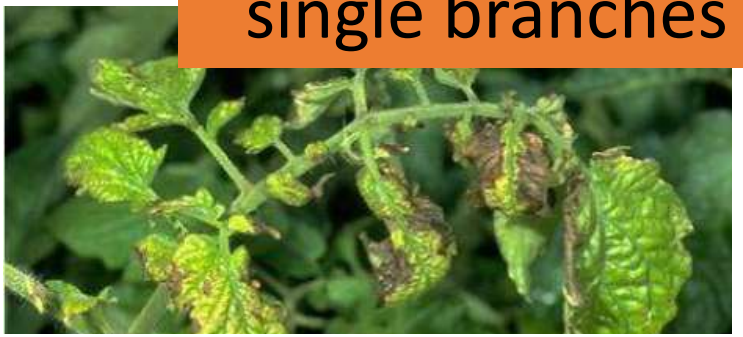
Images: Mike Davis

Foot rot

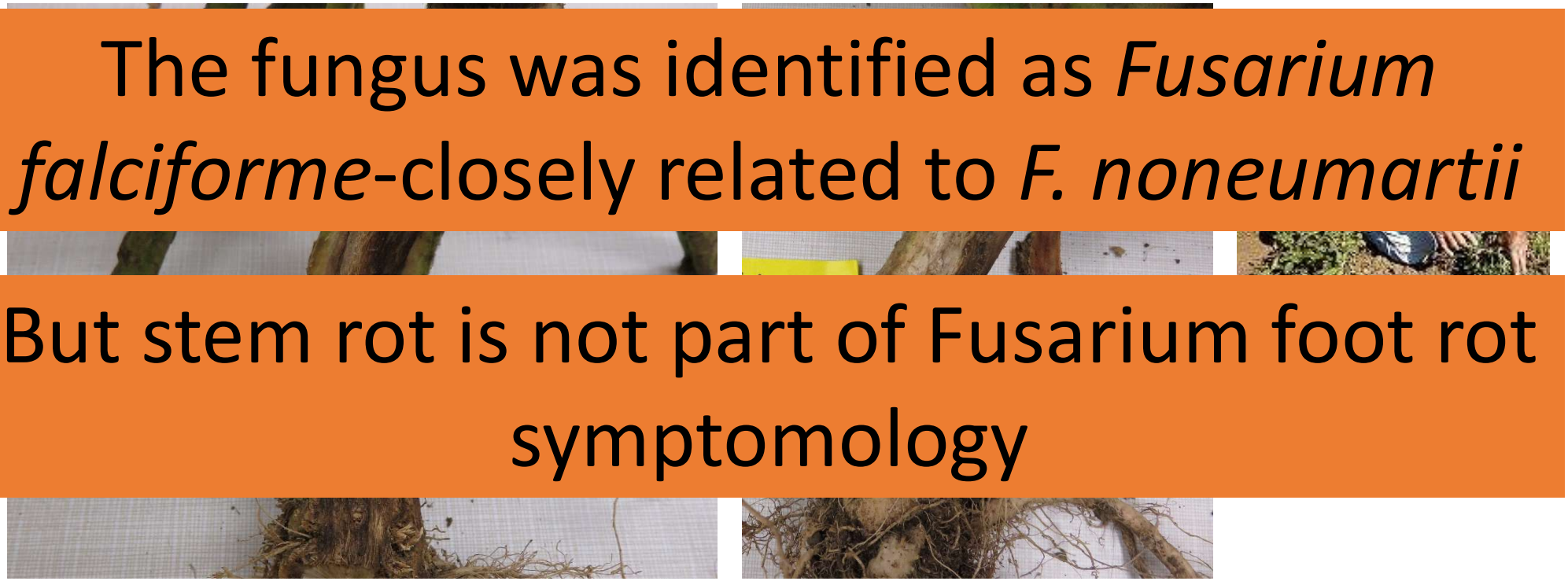
Root banding

Bleaching of single branches

Leaf necrosis of single branches



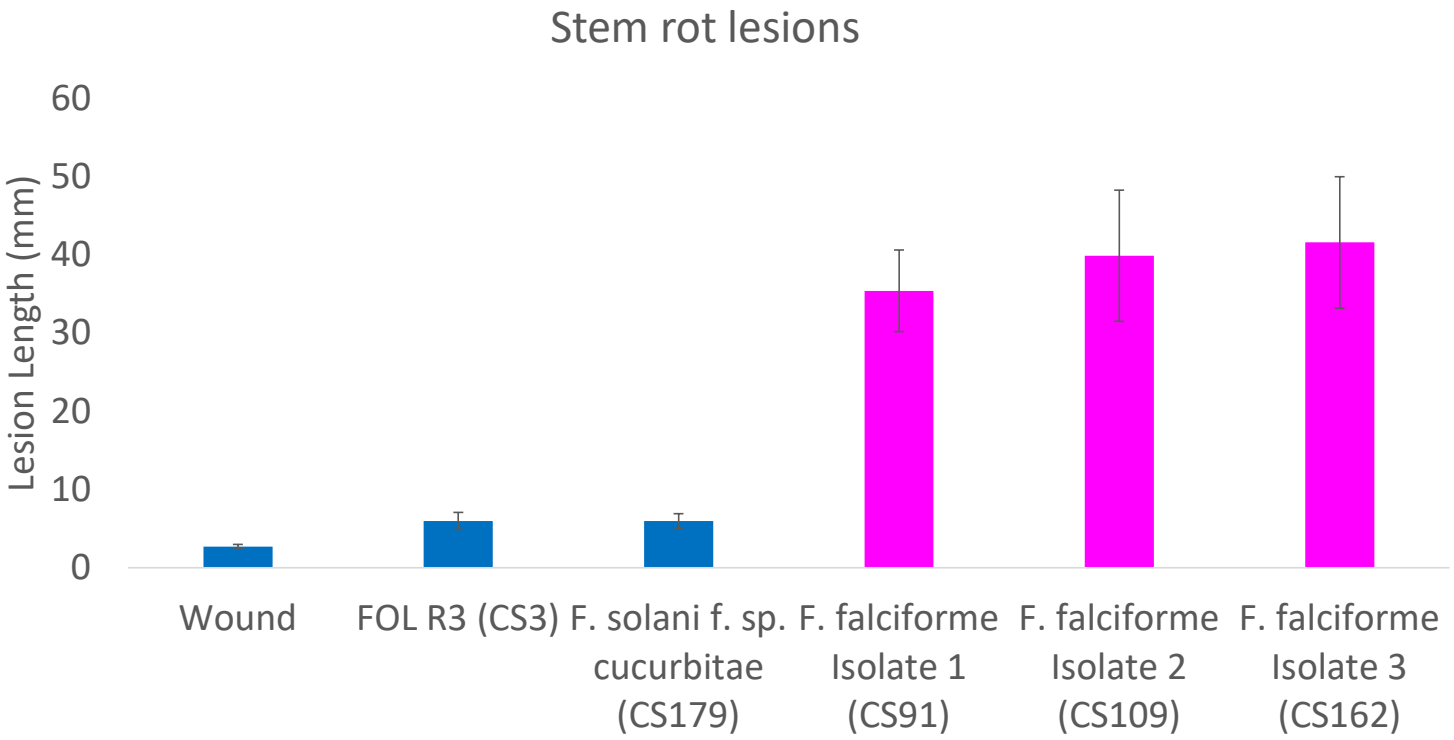
Fast forward: Severe stem rot samples collected and brought to our lab by Gene Miyao in 2017



The fungus was identified as *Fusarium falciforme*-closely related to *F. noneumartii*

But stem rot is not part of Fusarium foot rot symptomology

Confirmed stem rot abilities of *F. falciforme*

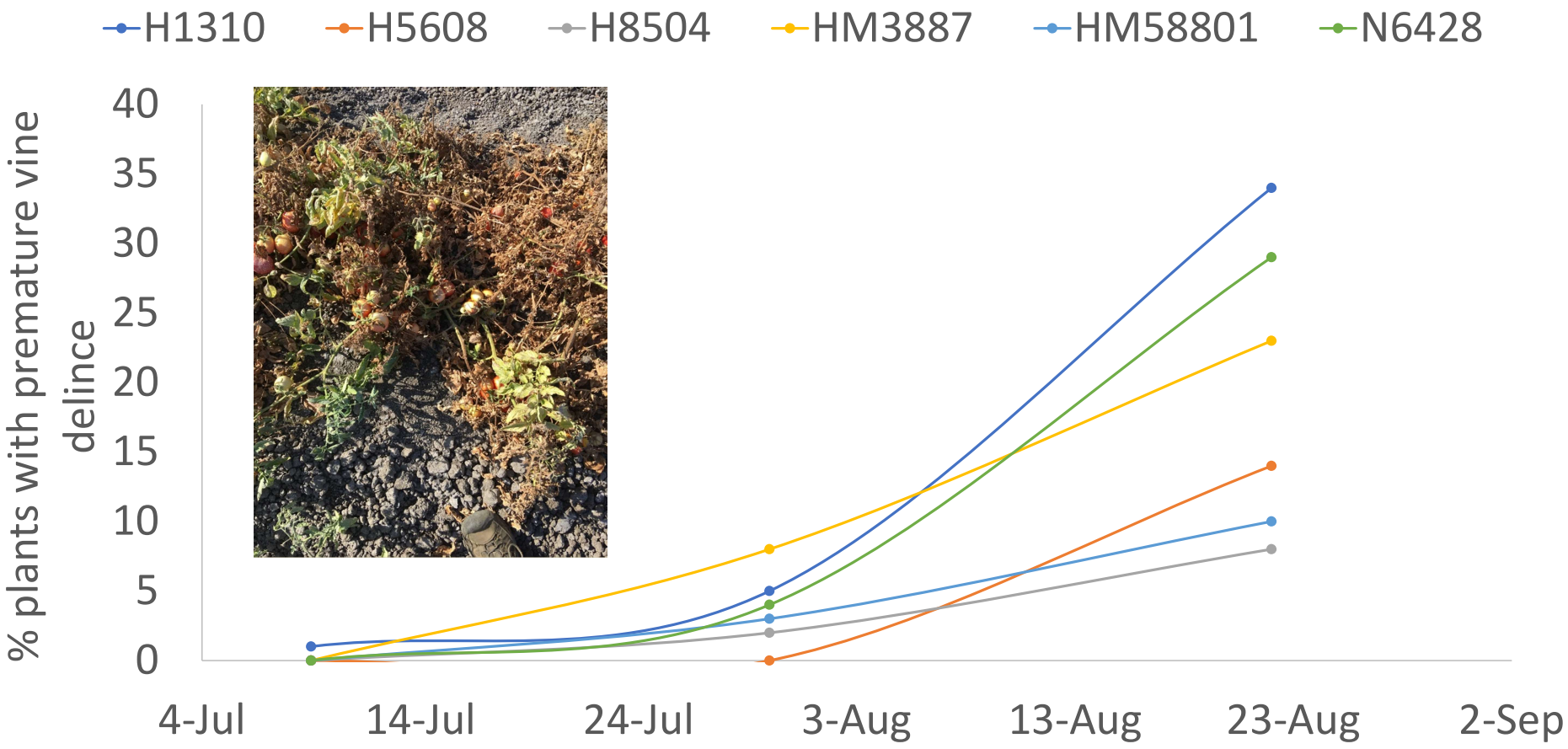


Erin Helpio

Concern was elevated in 2019 with multiple *F. falciforme* fields exhibiting severe losses

High incidence of plants dying early in the season

Confirmed premature vine decline abilities of *F. falciforme*
Starts ~40-50 days pre-harvest



Fusarium foot rot is reported to be a MINOR disease

NOT reported to cause PLANT DEATH or SEVERE yield loss
Confirmed by Mike Davis, Gene, Brenna, Tom and others

We are working to determine whether this is a NEW manifestation of Fusarium foot rot or a NEW disease altogether

Some are saying it's a new disease…

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DISEASE NOTES

OPEN

Foot Rot and Wilt in Tomato Caused by *Fusarium falciforme* (FSSC 3 + 4) in Mexico

T. A. Vega-Gutiérrez, C. A. López-Orona, G. A. López-Urquídez, S. Velarde-Félix, L. A. Amarillas-Bueno, A. R. Martínez-Campos, and R. Allende-Molar

Affiliations

Published Online: 29 Oct 2018 | https://doi.org/10.1094/PDIS-06-18-1001-PDN

Vol. 103, No. 1
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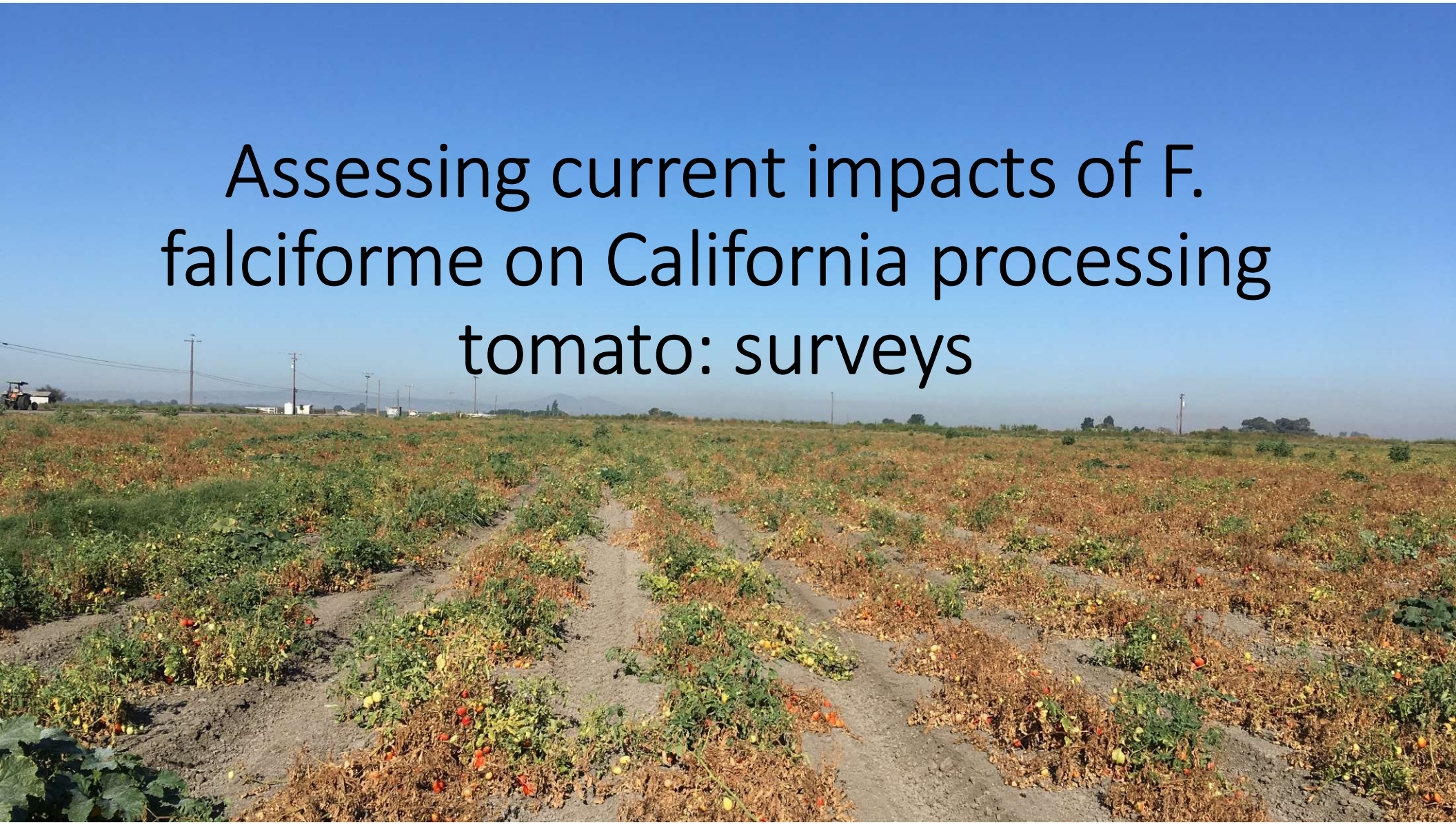
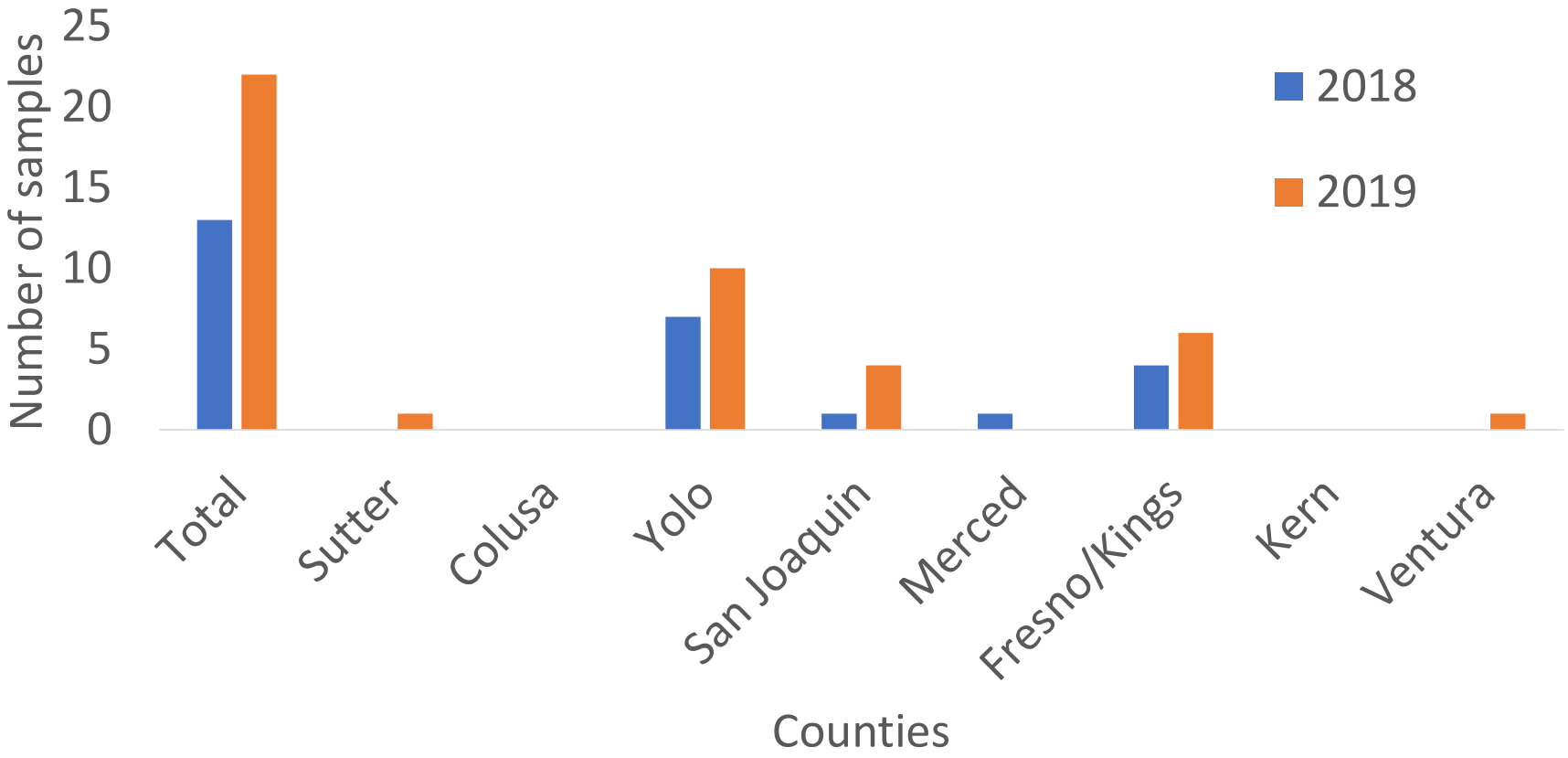
tomato crops in the state of Sinaloa (Mexico). The symptoms included wilting, leaf yellowing, defoliation vascular tissue darkening, and drying and death of branches and the entire plant. Plant crowns exhibited necrosis (visible in the interior) that advanced through the main root, along with slight root

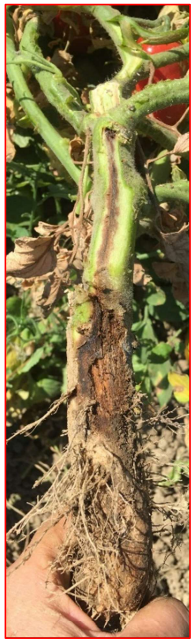
Assessing current impacts of F. falciforme on California processing tomato: surveys

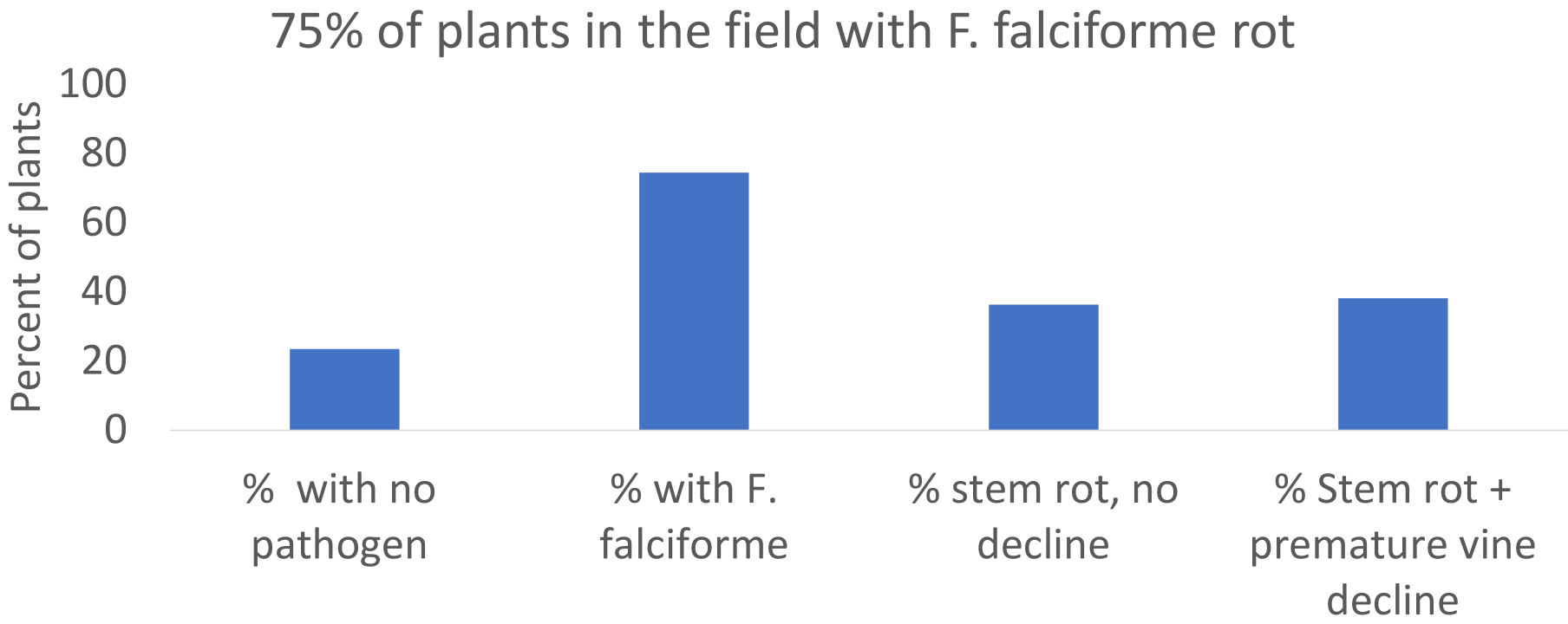


County-level distribution of *F. falciforme* in California 2018 and 2019 (based on submissions from advisors)

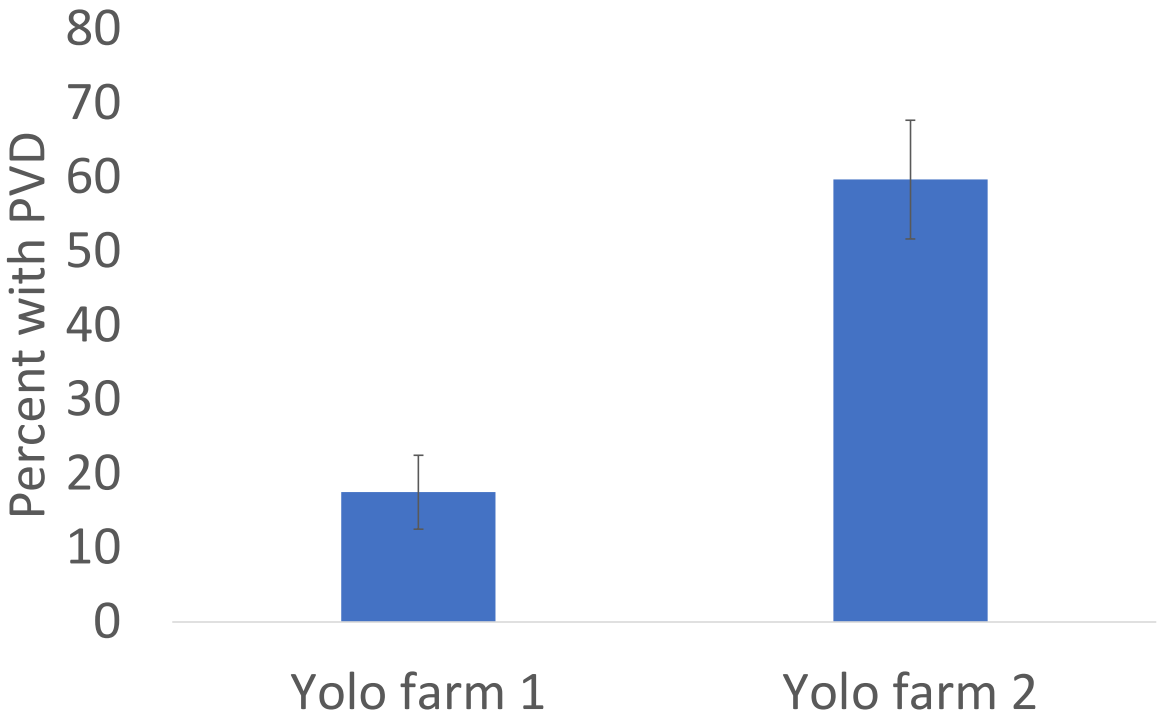


Impacts of *F. falciforme* on production



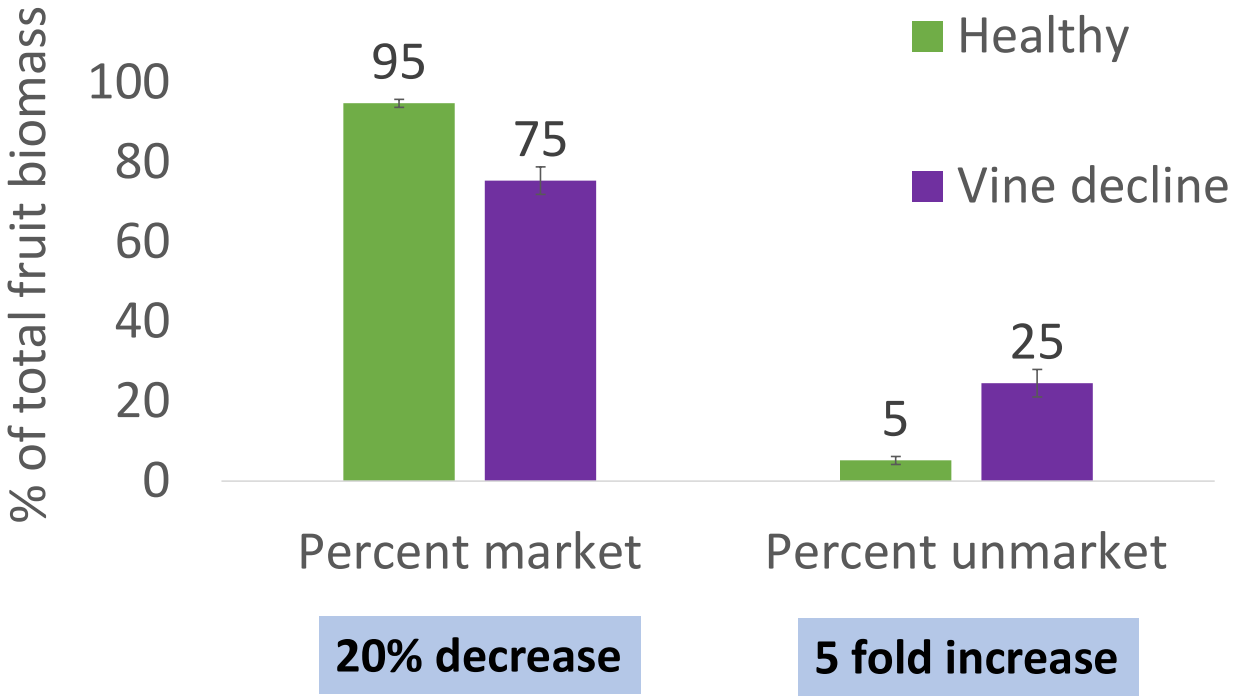


Incidence of FF premature vine decline in commercial processing tomato fields (F3)



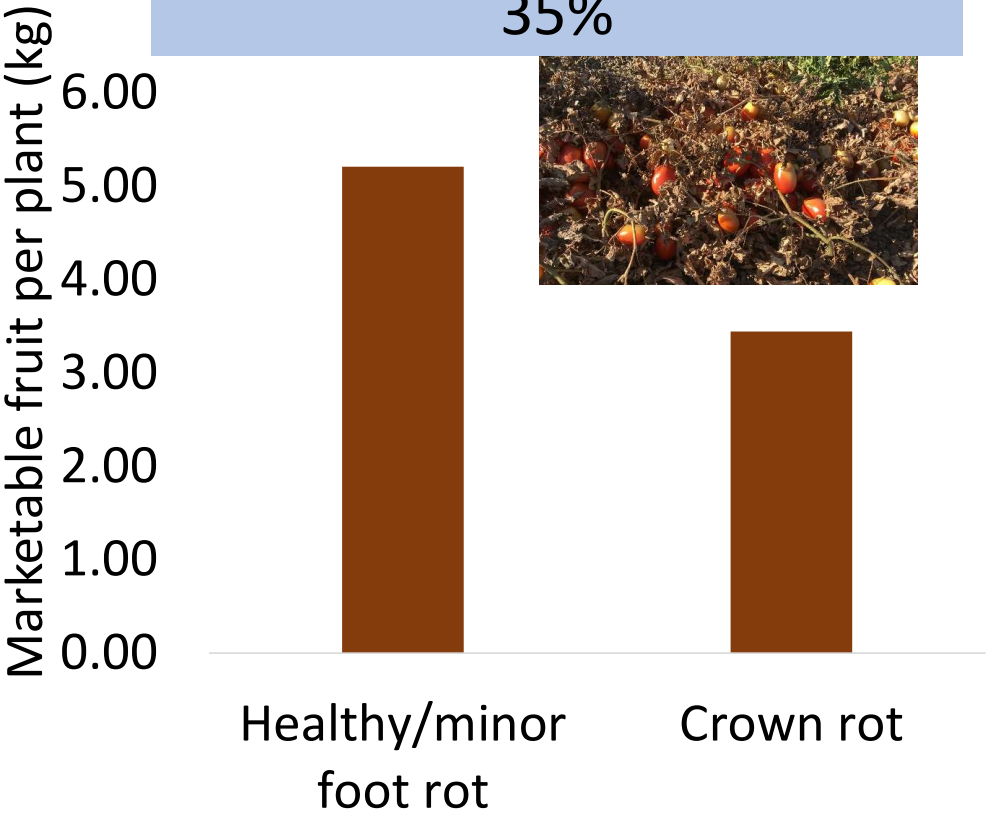
Premature vine decline causes sunburn and fruit rot

Effects of *F. falciforme* on yield-Field 1

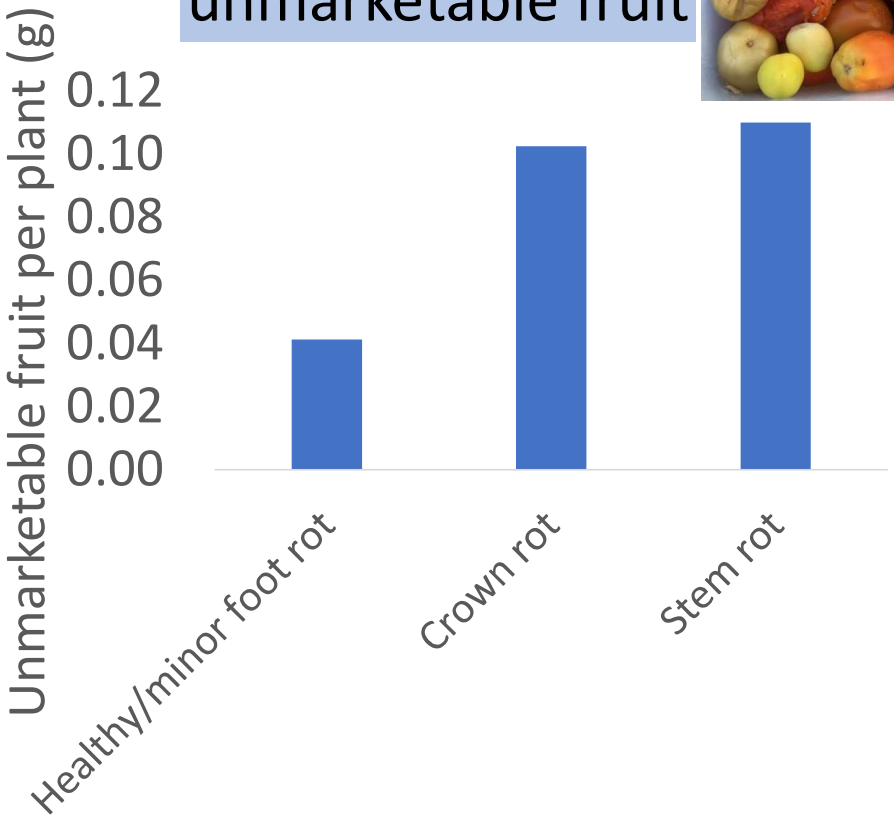


Impacts of *F. falciforme* on yield: Field 2

Reduced marketable yields by 35%

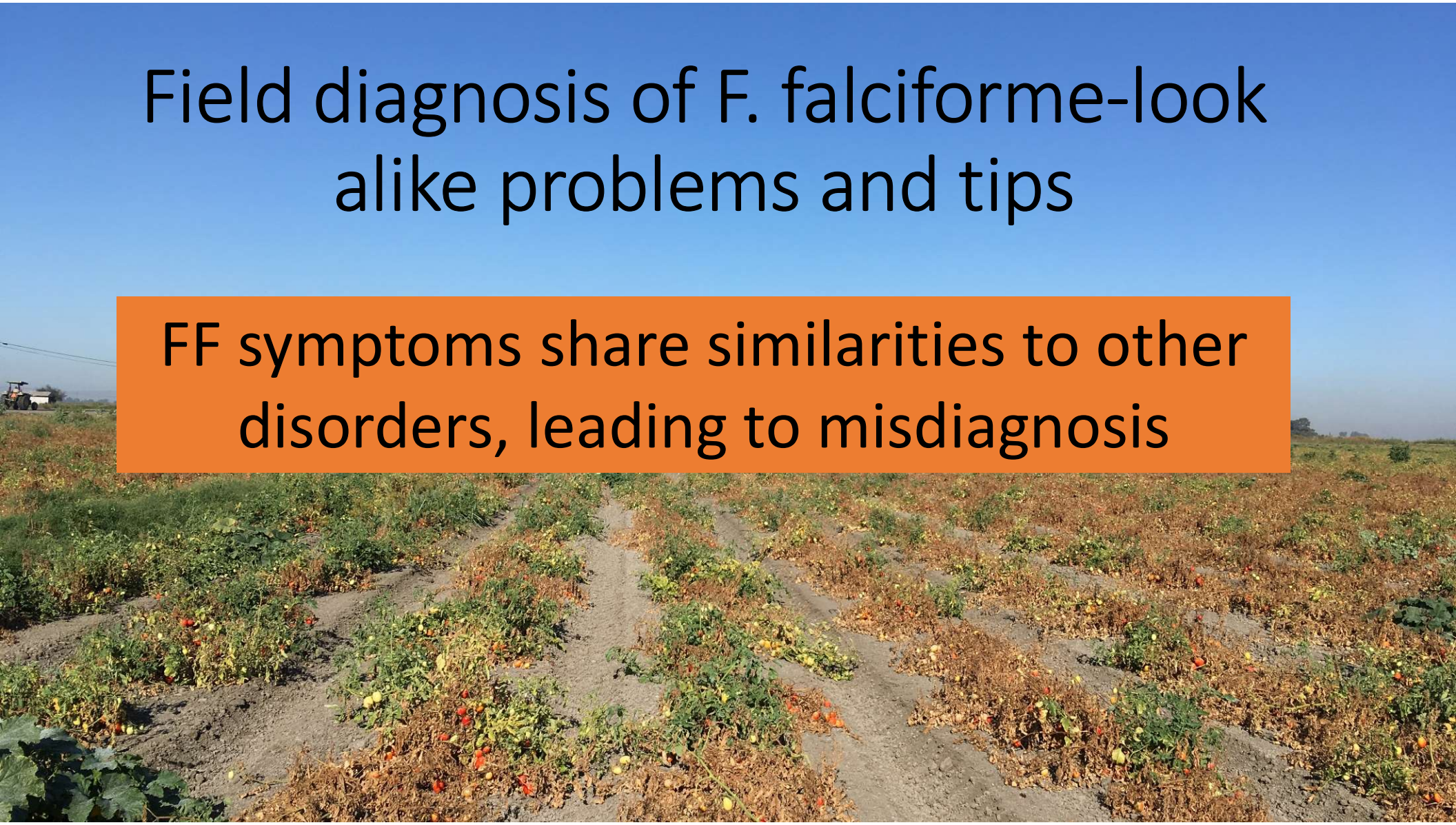


3 fold increase in unmarketable fruit



Field diagnosis of F. falciforme-look alike problems and tips

FF symptoms share similarities to other disorders, leading to misdiagnosis



Foliar yellowing / bleaching symptoms

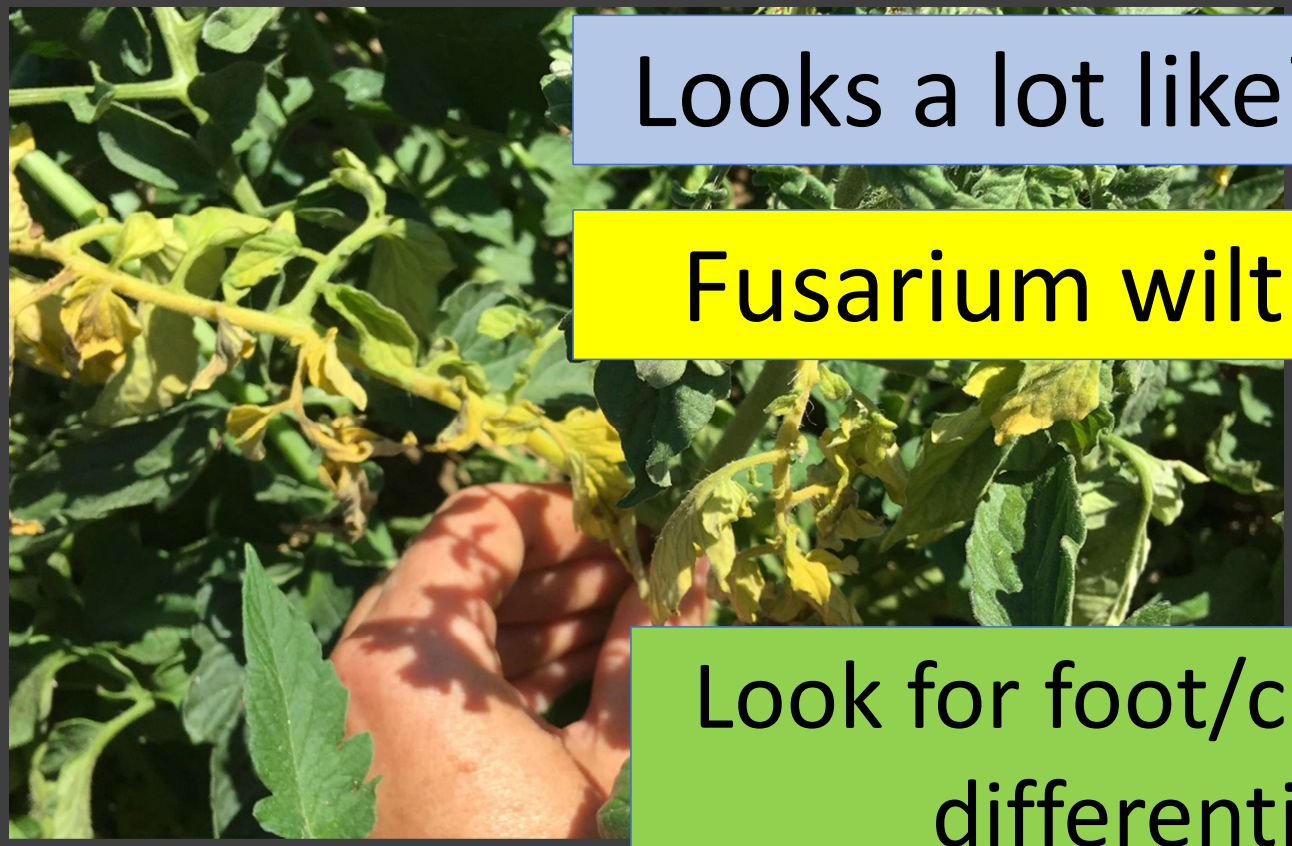
Branch chlorosis

Whole plant chlorosis

Looks a lot like?

Fusarium wilt

Foliar symptoms
Share similarity to other disorders, leading to misdiagnosis

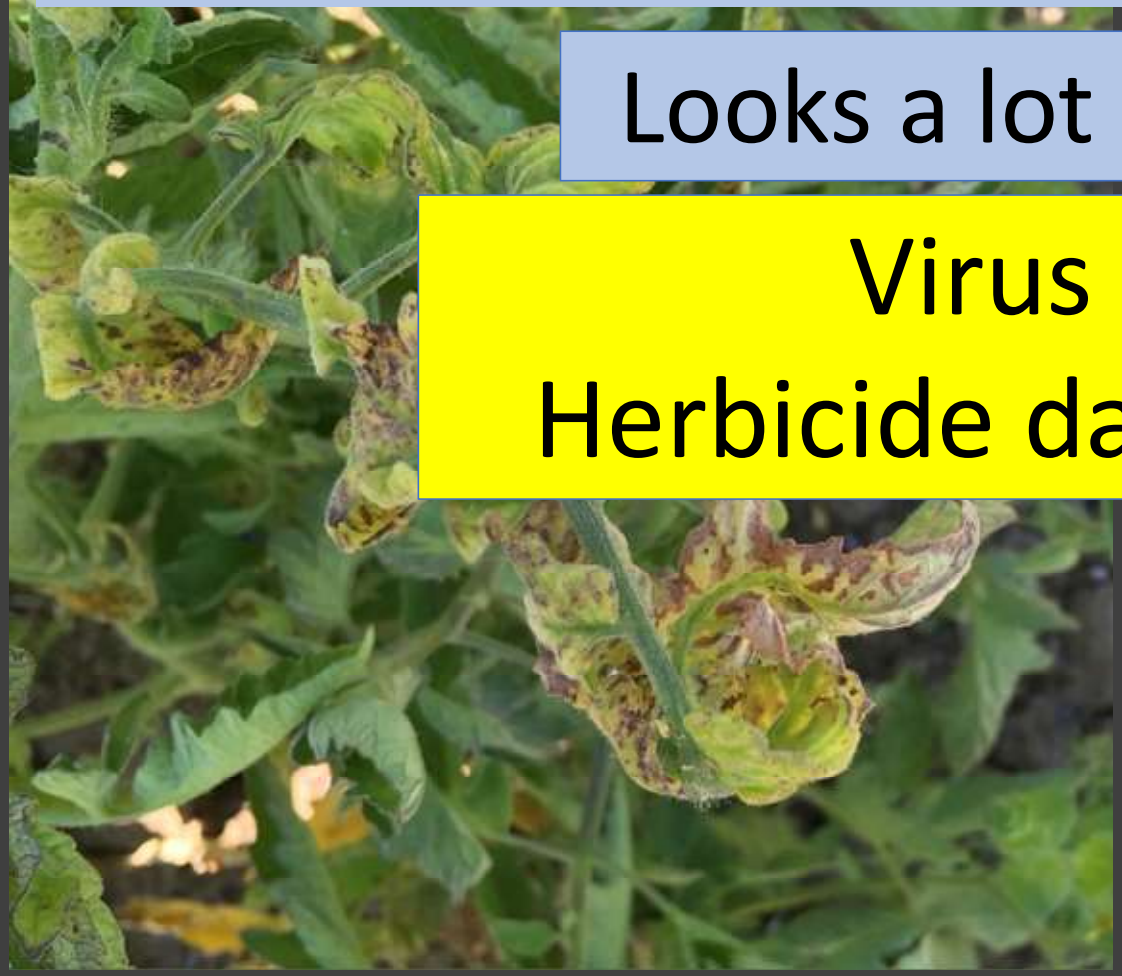


Looks a lot like?

Fusarium wilt

Look for foot/crown/stem rot to differentiate? EARLY

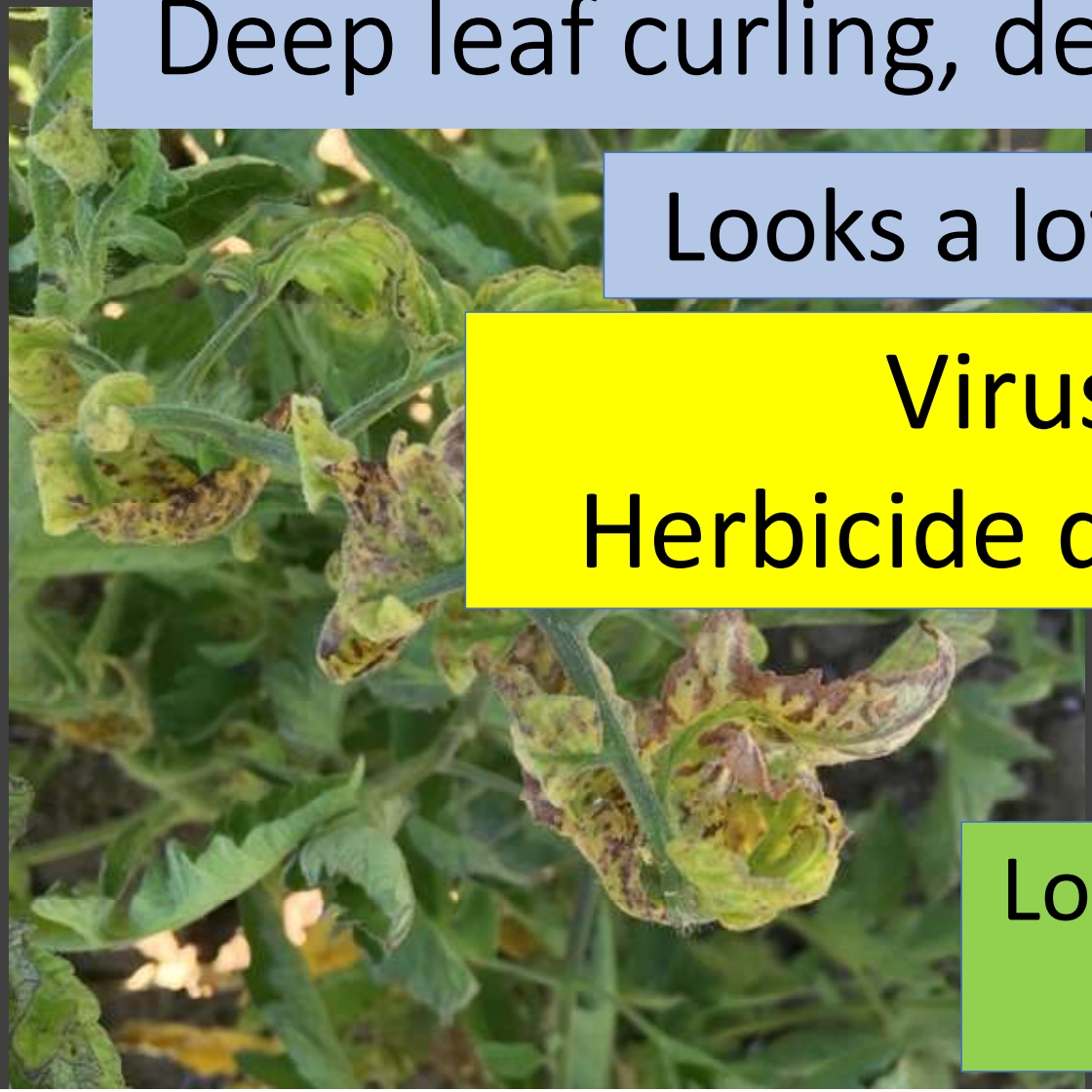
Deep leaf curling, deformity, little leaf



Looks a lot like?

Virus
Herbicide damage

Deep leaf curling, deformity, little leaf



Looks a lot like?

Virus
Herbicide damage

Look for foot/crown/stem rot to differentiate

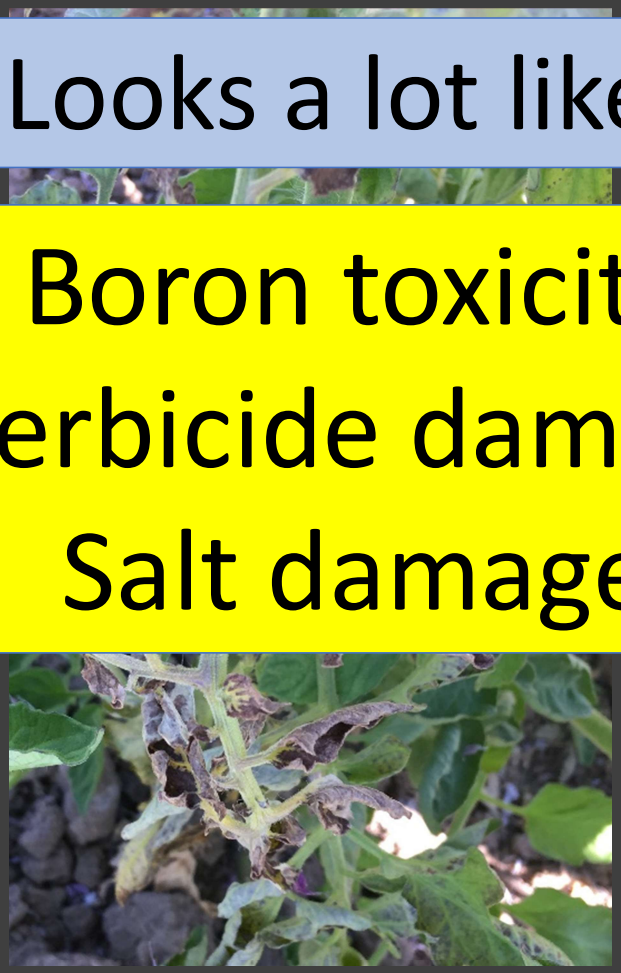
Leaf speckles → leaflet blight → leaf death

Leaf death→ whole plant death

Leaf speckles → leaflet blight → leaf death

Looks a lot like?

Boron toxicity
Herbicide damage
Salt damage



Leaf speckles → leaflet blight → leaf death

Looks a lot like?

Boron toxicity
Herbicide damage
Salt damage

Look for foot/crown/stem rot to differentiate

Foot and crown rot

Looks a lot like?

Fusarium foot rot
Fusarium crown and root rot
Southern blight

Foot and crown rot

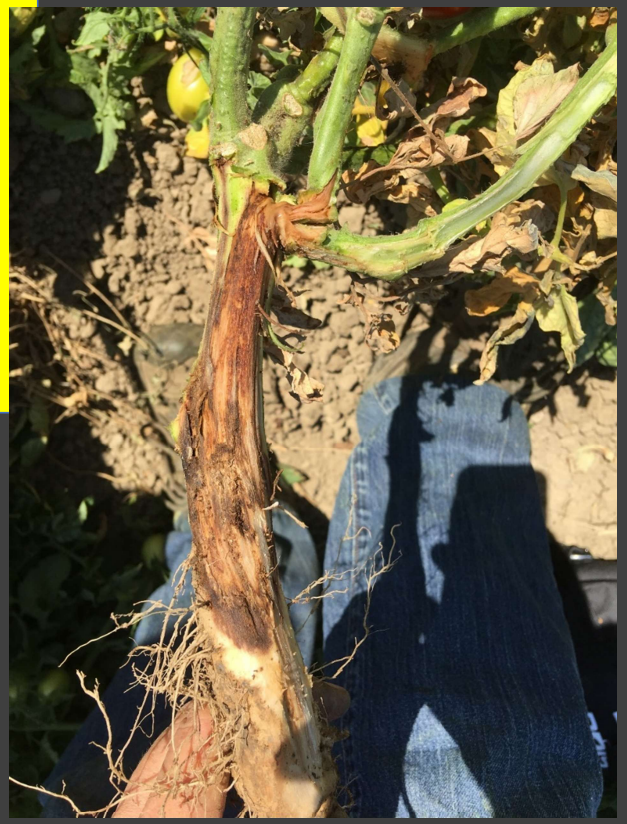
Looks a lot like?

Fusarium foot rot

Fusarium crown and root rot

Southern blight

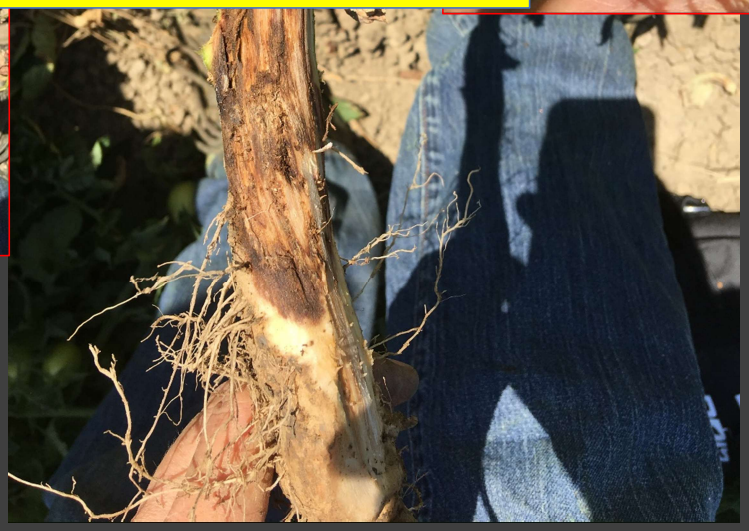
Look for severe stem rot? HARD



Stem rot

Looks a lot like?

Fusarium wilt or Verticillium wilt…



Foliar speckles/necrosis

Stem rot

Looks a lot like?

Fusarium wilt or Verticillium wilt…

Discrete lesions

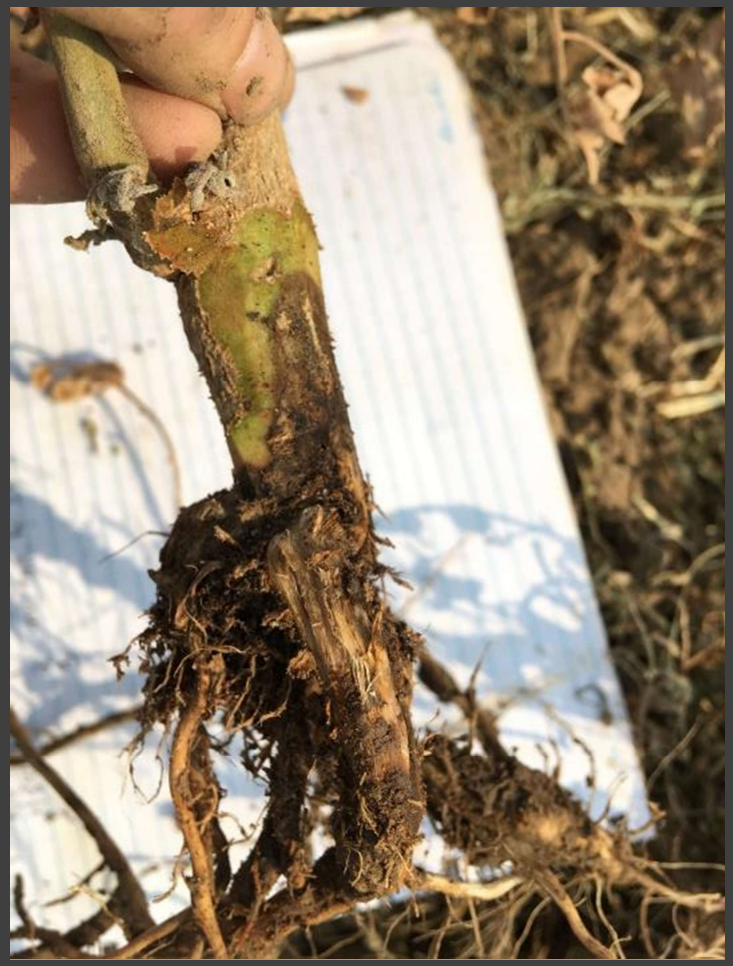
Not all foliar symptoms develop in all cultivars

Rare

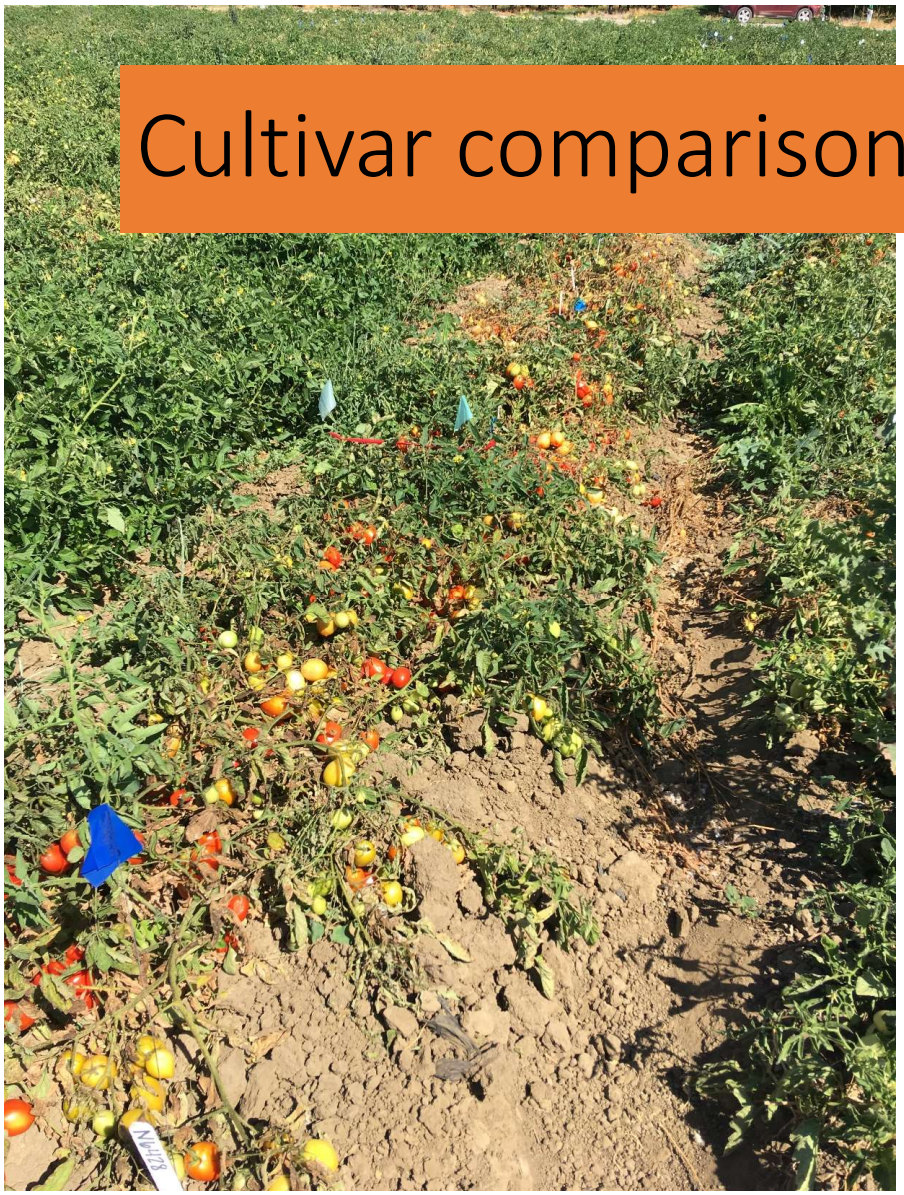
Less rare

Most common

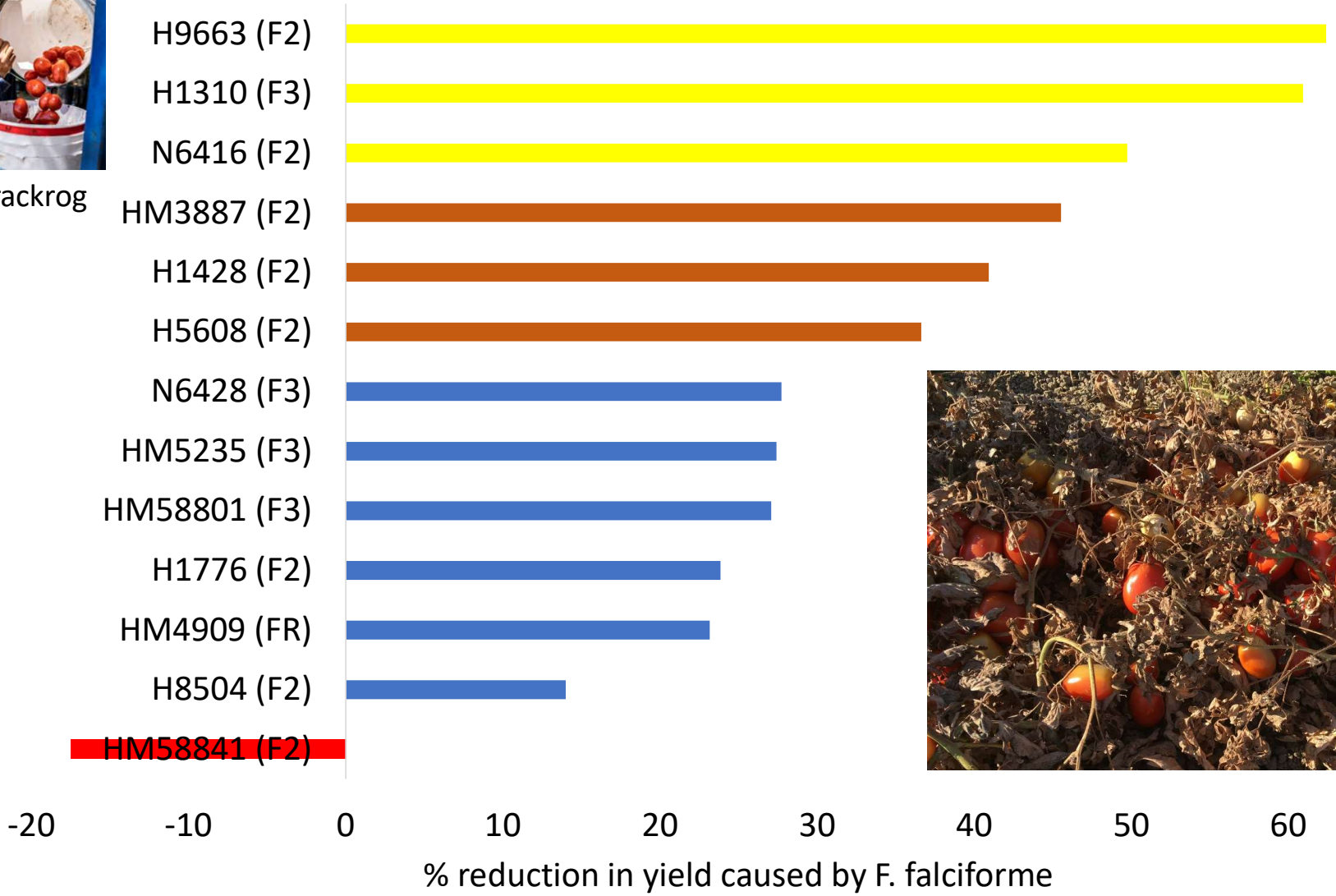
Foot/crown/stem rot are the ONLY consistent symptoms



Cultivar comparisons: 16 commercial varieties

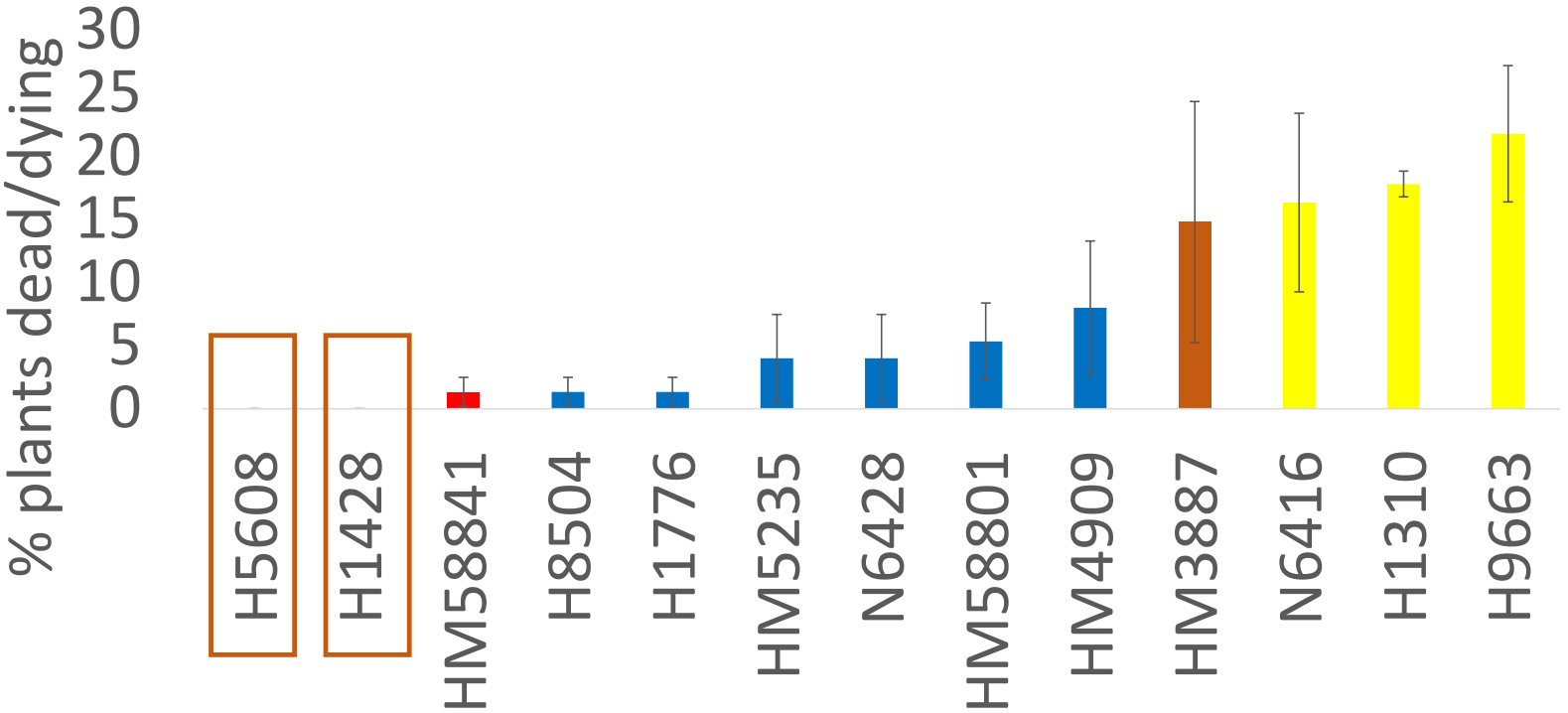


Alyssa Brackrog



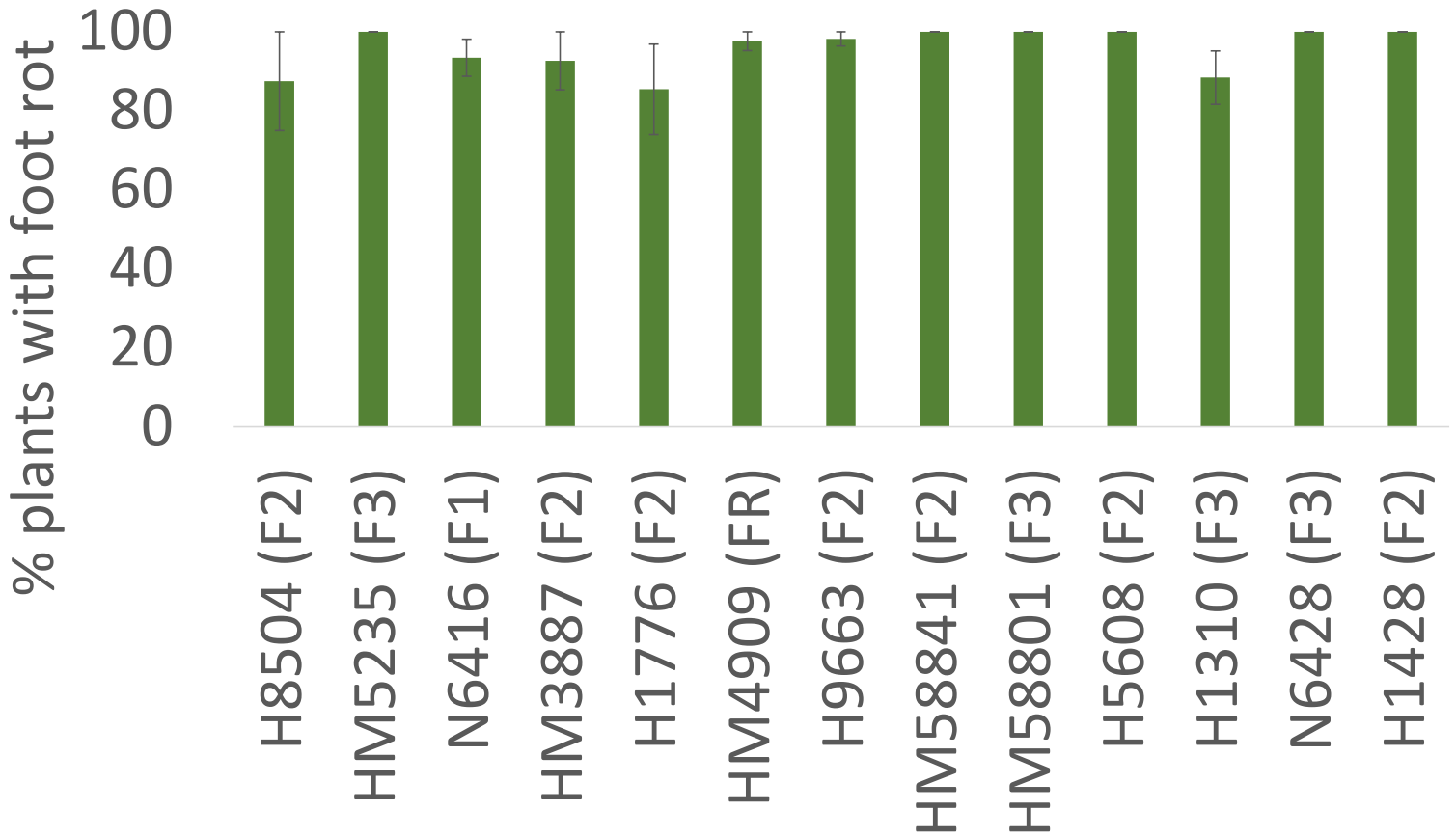
Alyssa Brackrog

Better yield performance associated with lower premature vine decline incidence

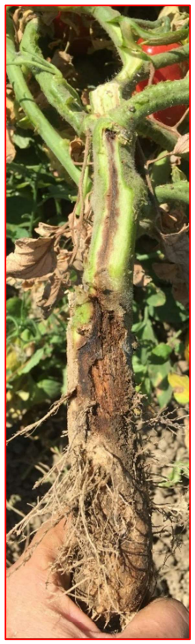


Alyssa Brackrog

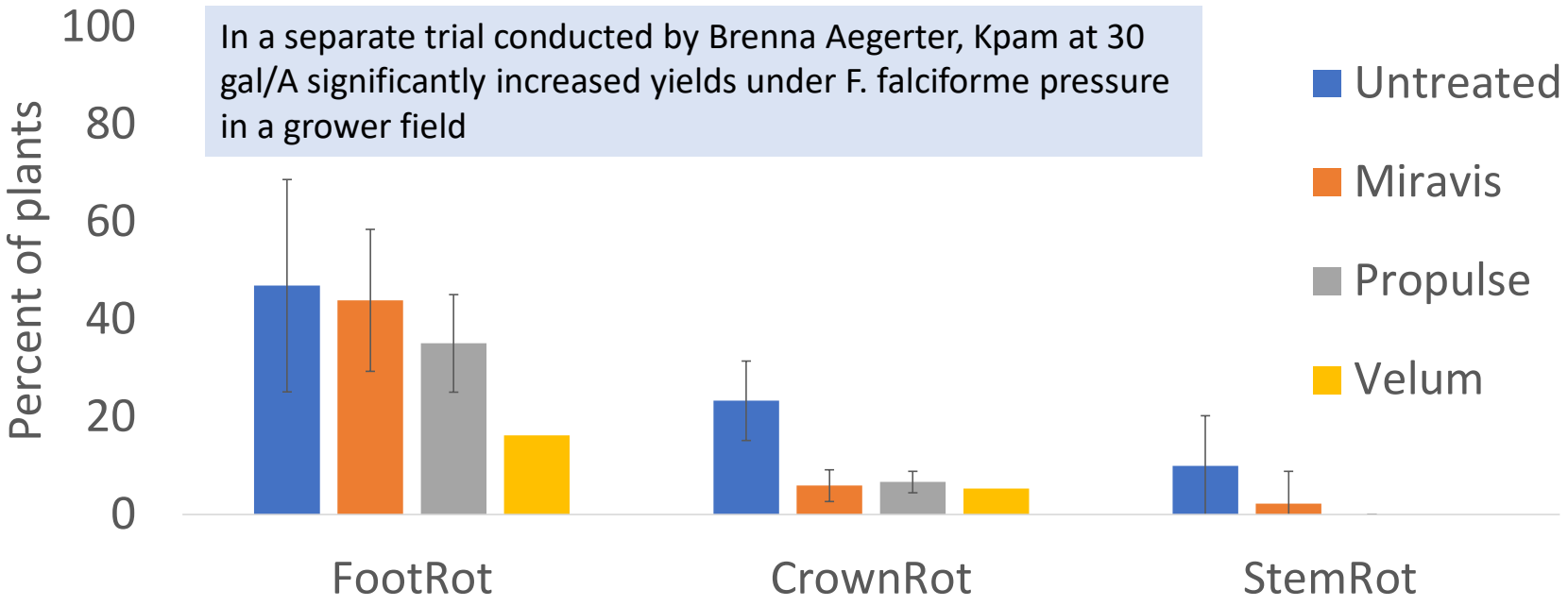
All cultivars: 85-100% of all plants developed rot



On-farm management options-Effect of drip applied fungicides on *F. falciforme*



In a separate trial conducted by Brenna Aegerter, Kpam at 30 gal/A significantly increased yields under F. falciforme pressure in a grower field



Progress on *F. falciforme* IPM

- **Commercial cultivars have field tolerance to *Fusarium falciforme***
  - HM58841
  - H1776, HM 4909, H8504? (poor in 2018), HM58801, HM5235, N6428 (strong in 2018)
- **Some cultivars are highly susceptible to F. falciforme--avoid if possible in heavily infested fields**
  - H9663, H1310, N6416 and HM3887
- **Fungicide and fumigants may fit into IPM programming for F. falciforme**
  - Velum and Kpam show the most promise
- **Crop rotations / alternate hosts?**
  - TBD—funded project (CTRI)

To see this in action:
Biennial Tomato Disease Field Day-UC Davis

Next field day: 2021
1:1 available by appointment

The amazing Swettonians!

- **People who conducted/assisted with these projects**: **Alyssa Brackrog, Kelley Paugh, Johanna Del Castillo, Erin Helpio,** Beth Hellman, Justine Beaulieu, Megan Kozel, Andrea Paulk, Karla Espino, Mirialini Narayan,Harrison Powell, Greg Sugwara, Elver Raymundo, Emma Centeno
- **Field support**: Bryan Pellissier, Lexi, Armstrong field assistants
- **Collaborating farm advisors:** Brenna Aegerter, Gene Miyao, Amber Vinchesi, Tom Turini, Joe Nunez, Scott Stoddard, Margaret Lloyd, Joe Nunez
- **Research advisors:** Zach Bagley, industry breeders and pathologists, **many tomato growers**

- **People who conducted/assisted with these projects**: **Alyssa Brackrog, Kelley Paugh, Johanna Del Castillo, Erin Helpio,** Beth Hellman, Justine Beaulieu, Megan Kozel, Andrea Paulk, Karla Espino, Mirialini Narayan,Harrison Powell, Greg Sugwara, Elver Raymundo, Emma Centeno
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