Site-specific management of soil pests in California strawberry production

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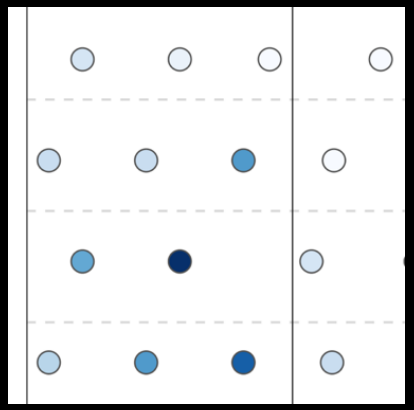
Fumigation

- Often applied uniformly at the high label rate when perceived risk is high
  - Broadcast/flat
  - Drip
- Soilborne diseases usually occur in clusters or hot spots

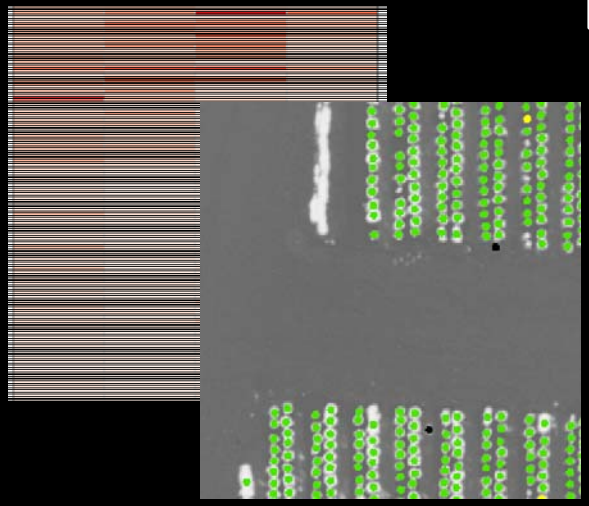
Determine spatial distribution



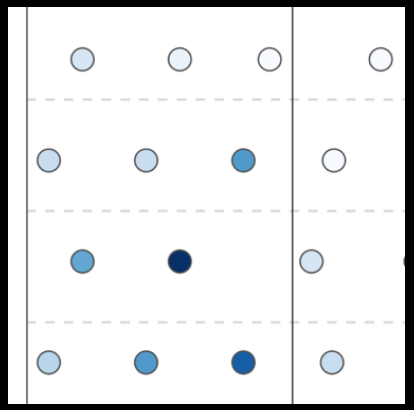
Pathogen counts in soil

Amount of pathogen in soil
is the biggest factor
affecting disease severity

Determine spatial distribution



Mortality and plant health



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Disease is likely to recur in the same area

Amount of pathogen in soil is the biggest factor affecting disease severity

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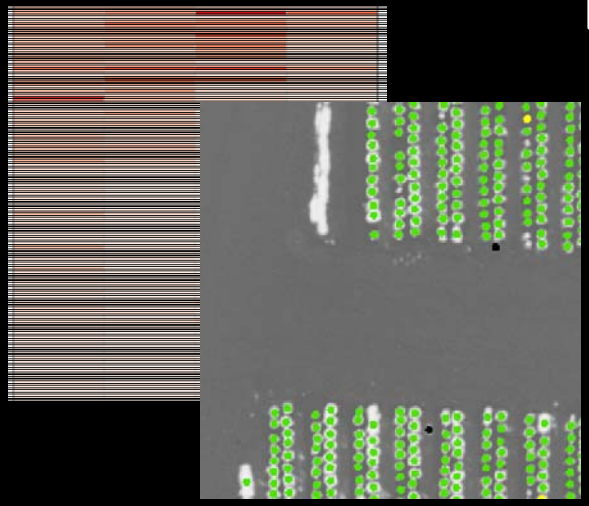

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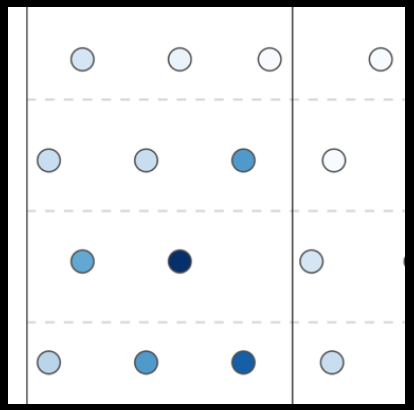

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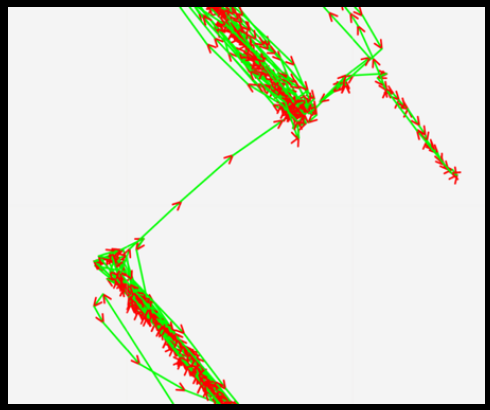
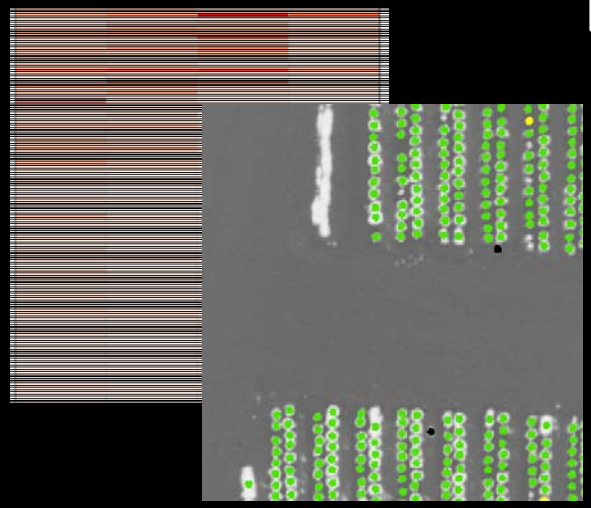


High-resolution yield

Determine how yield is influenced by plant health, pathogen

Determine spatial distribution



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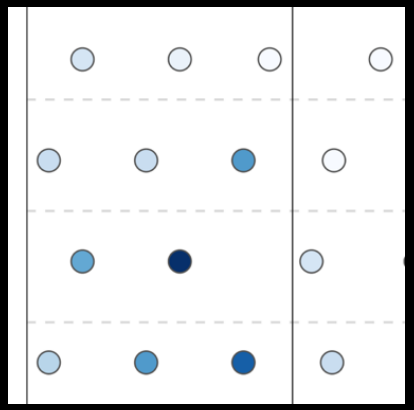

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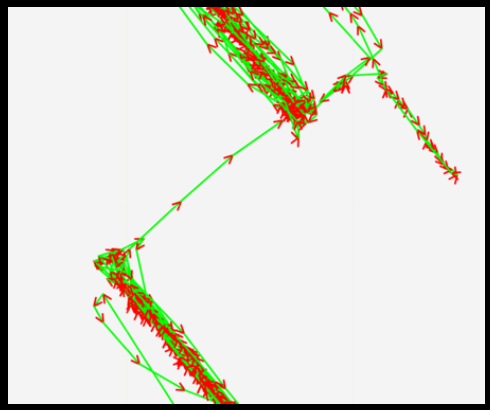

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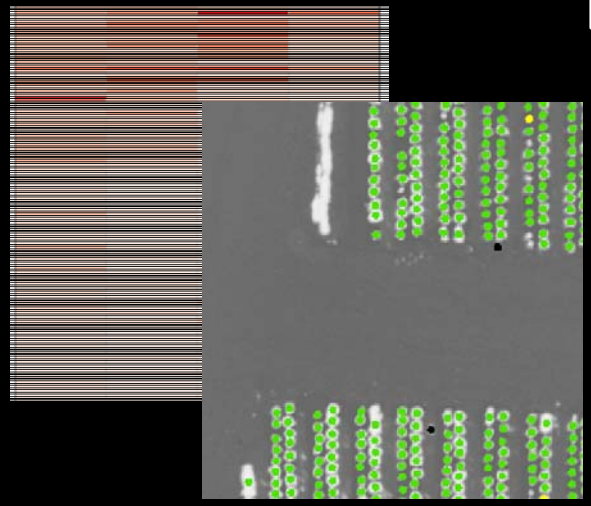

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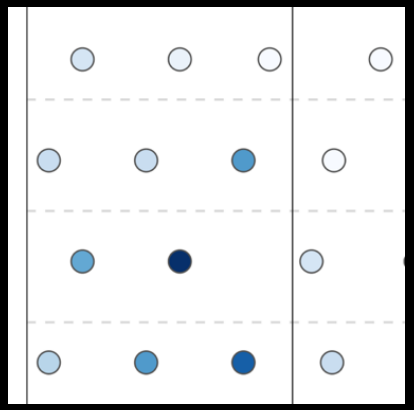

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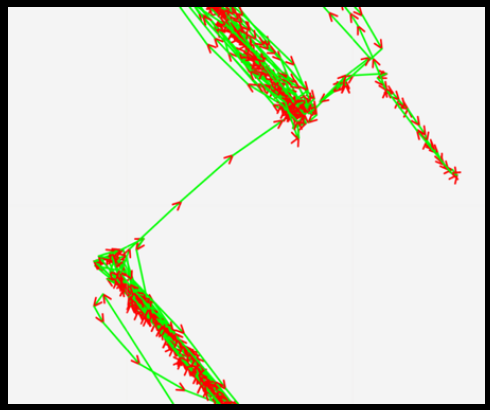


High-resolution yield

Can this information be used to reduce fumigation rate in low disease pressure areas without sacrificing yield?

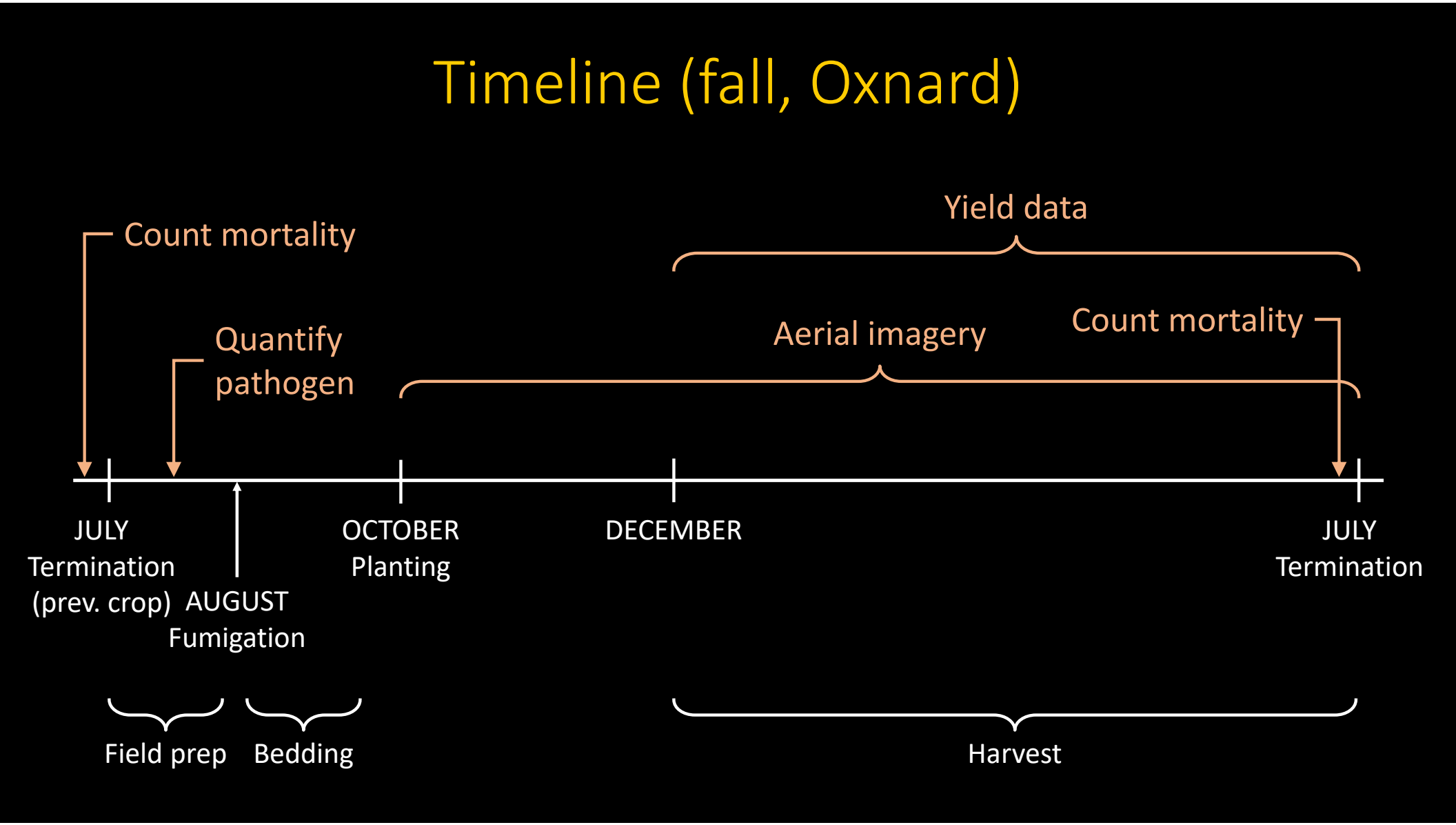
Methods

- Treatments
  - Standard: broadcast/flat fumigation
  - Precision: establish zones and apply fumigant at rate proportional to pressure
- Tri-Chlor (chloropicrin)
  - 250, 300, 350 lbs/acre
- Fields: ~10 acres
- Randomized complete block with 3 or 4 replications

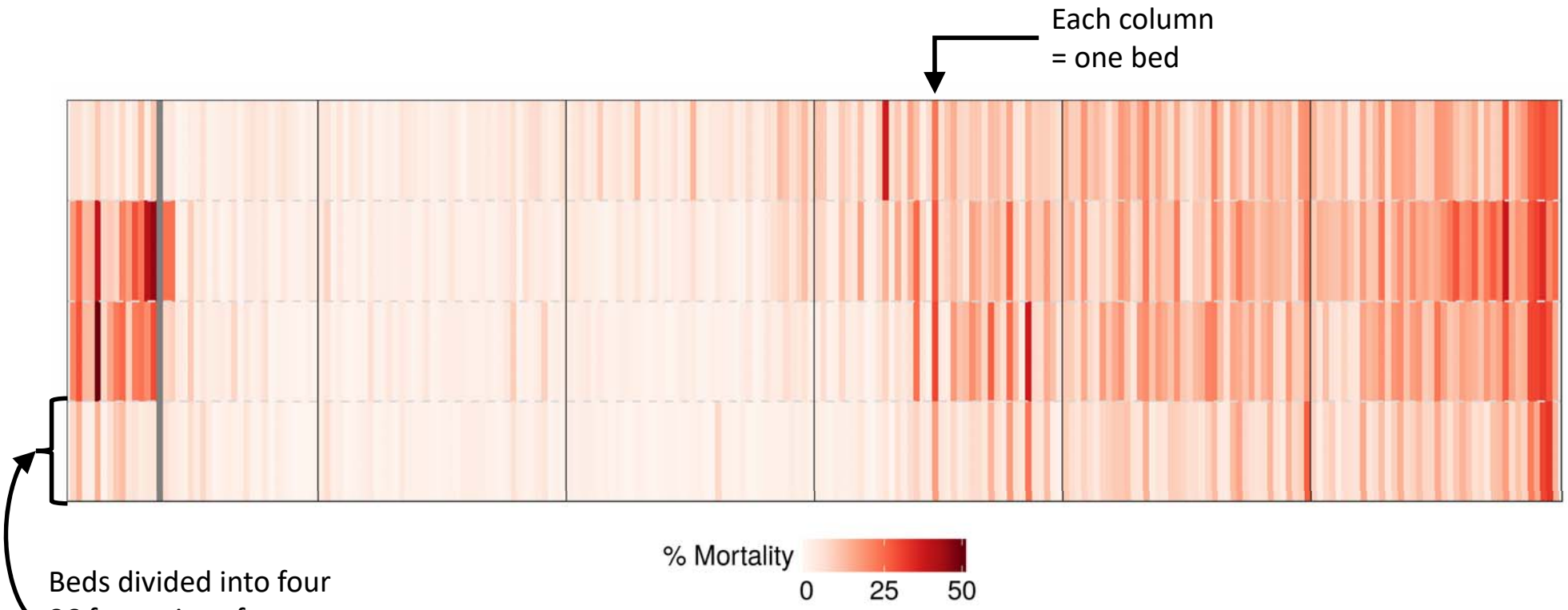
Study Locations

- Oxnard
  - Field A (2017-2018): Fall planting, history of Fusarium wilt and Macrophomina charcoal rot
  - Field B (2019-2020): Fall planting, history of Fusarium wilt
  - Field C (2019-2020): Summer planting, recent history of Macrophomina charcoal rot
- Salinas-Watsonville
  - 2018-2019: Fall planting, history of Verticillium wilt

Timeline (fall, Oxnard)



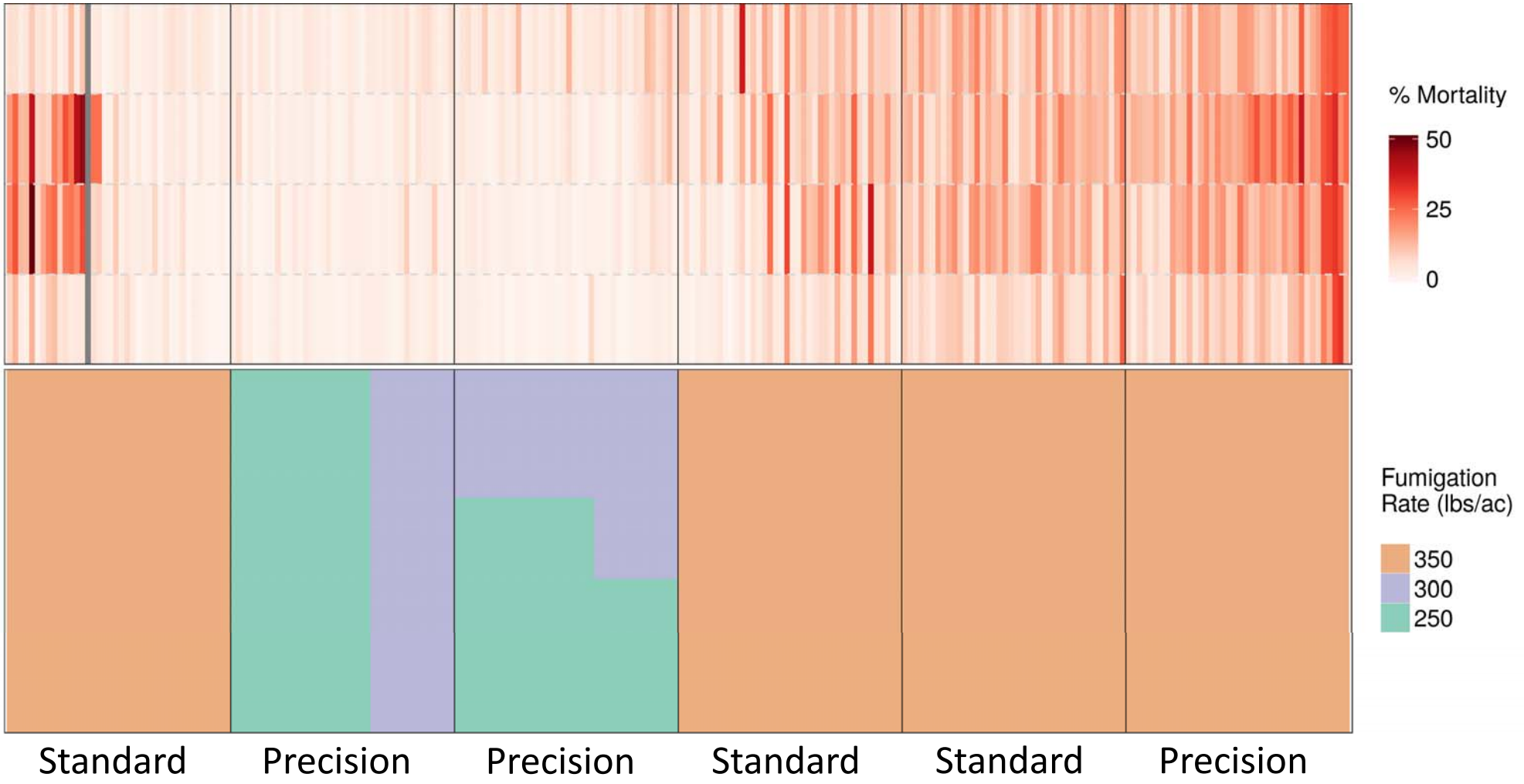
Mortality (previous crop)



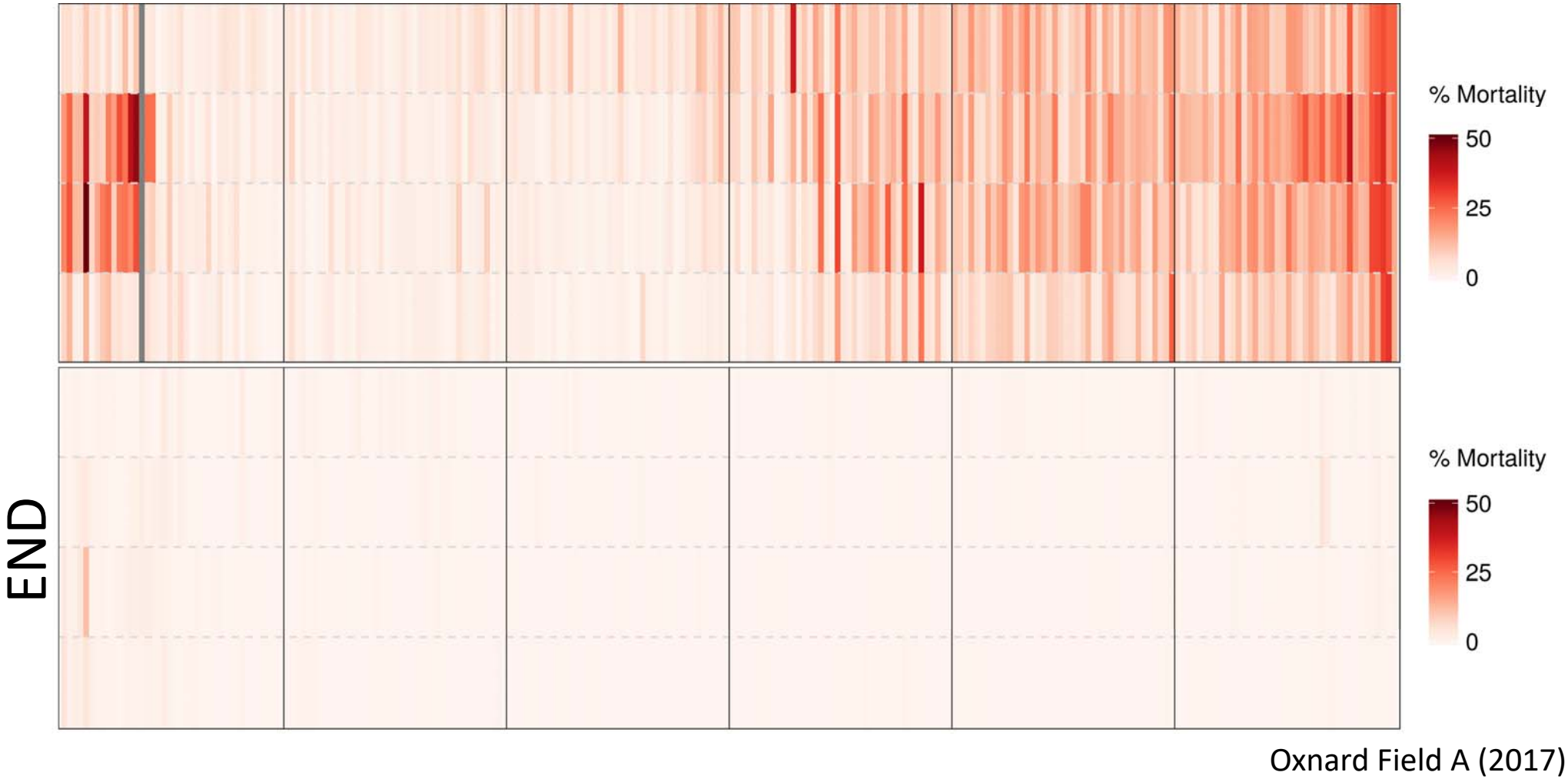
Oxnard Field A (2017)

Fumigant Rate Zones

Oxnard Field A (2017)

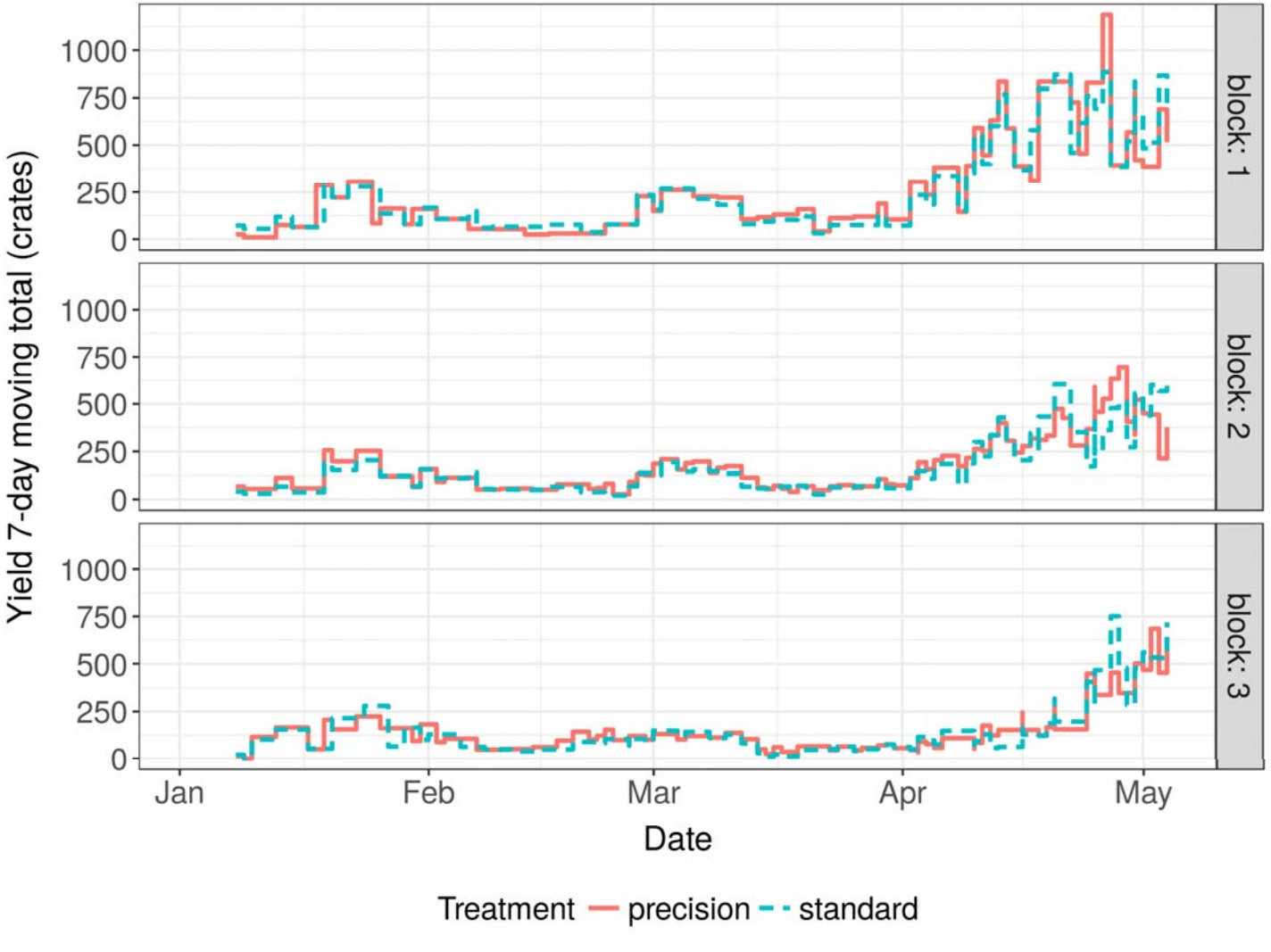


End of Season Mortality



Oxnard Field A (2017)

Yield



Oxnard Field A (2017)

Economic Performance (per plot)

Treatment	Plots	Yield	Gross revenues	Net returns
Precision	1,4,5	4,709	$53,751	$47,475
Standard	2,3,6	4,580	$51,750	$44,939

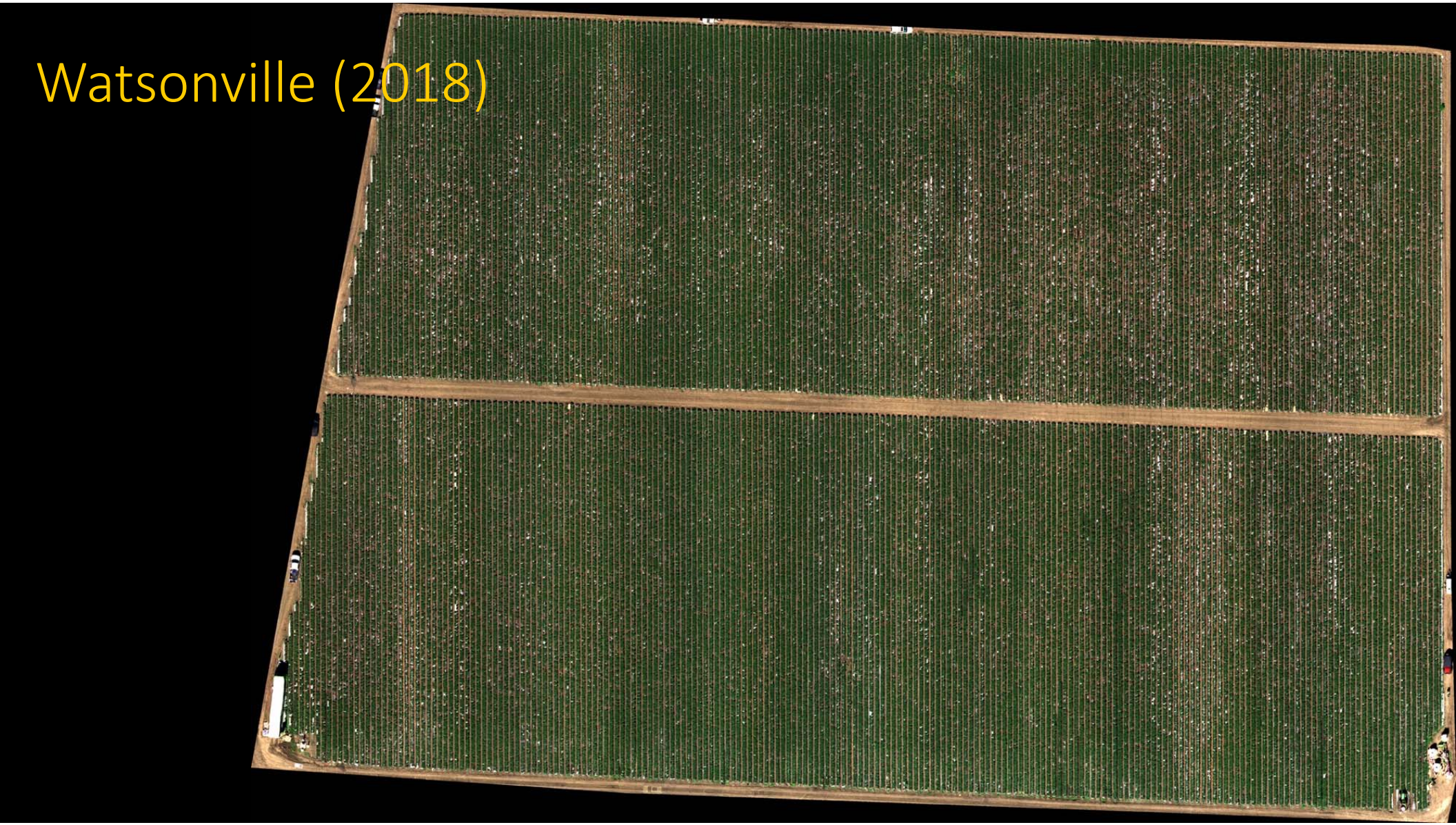
- Partial budgeting analysis: only treatment costs considered
  - Precision treatment includes pathogen sampling costs
- Daily prices from USDA Agricultural Marketing Service

Oxnard Field A (2017)

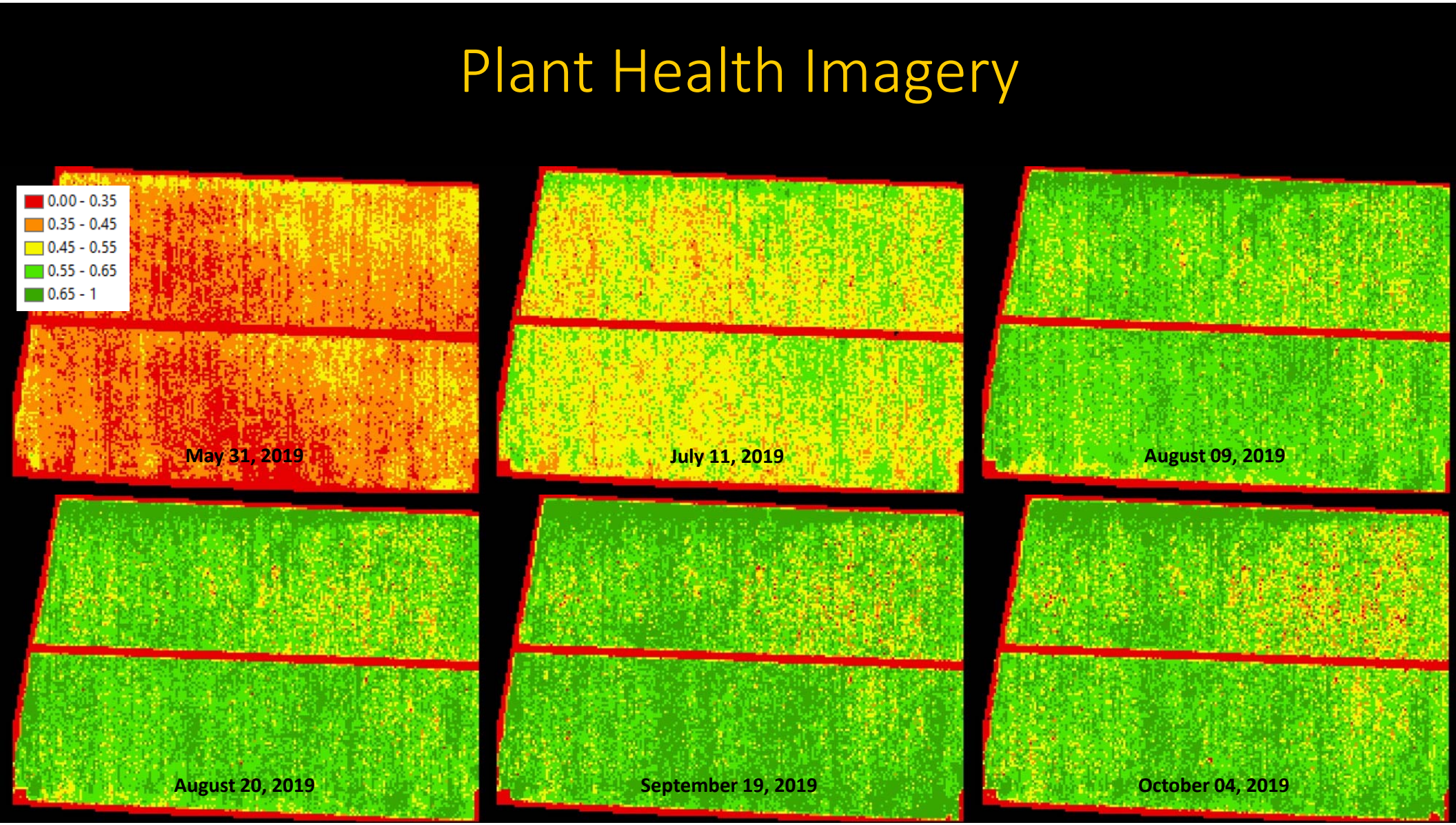
Summary – Oxnard Field A (2017)

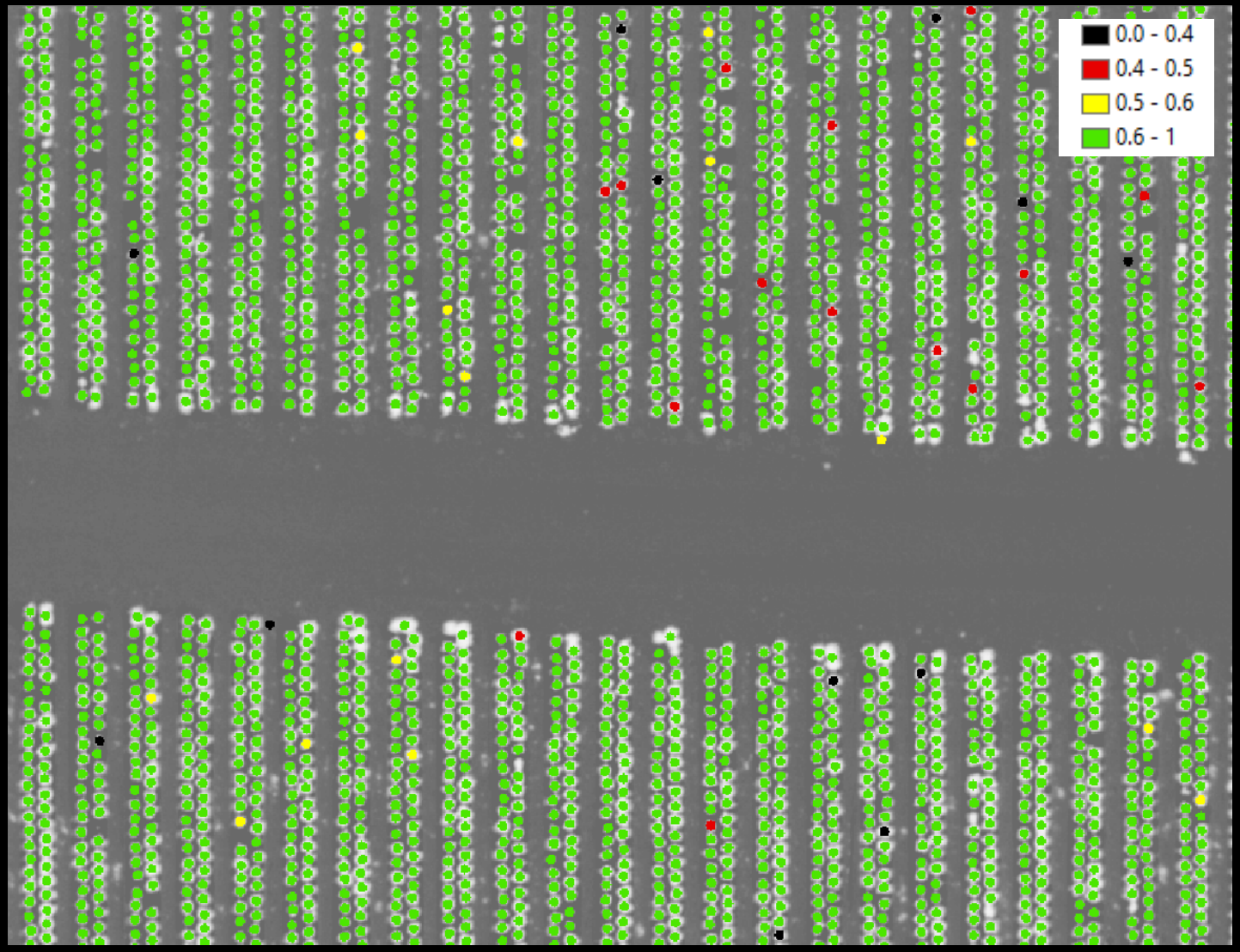
- Precision treatment: 6% higher net returns
  - First 4 months of yield
- Precision treatment used 15% less fumigant
- Low disease pressure
  - Mild weather
  - *Fusarium*-resistant cultivar planted during study season

Watsonville (2018)



Plant Health Imagery





Tracking Individual Plants

- Stand and mortality counts
- Plant health over time

Oxnard Field B: *F. oxysporum f. sp. fragariae* 2019-2020

Yields

No differences in fruit yields betwen precision plots (variable rate) and standard plots (350 lb /A flat fumigation)

The total amount of chloropicrin applied in precision plots was 11.7% lower compared to standard plots

Mortality

Previous season: 17.9% to 71.5%

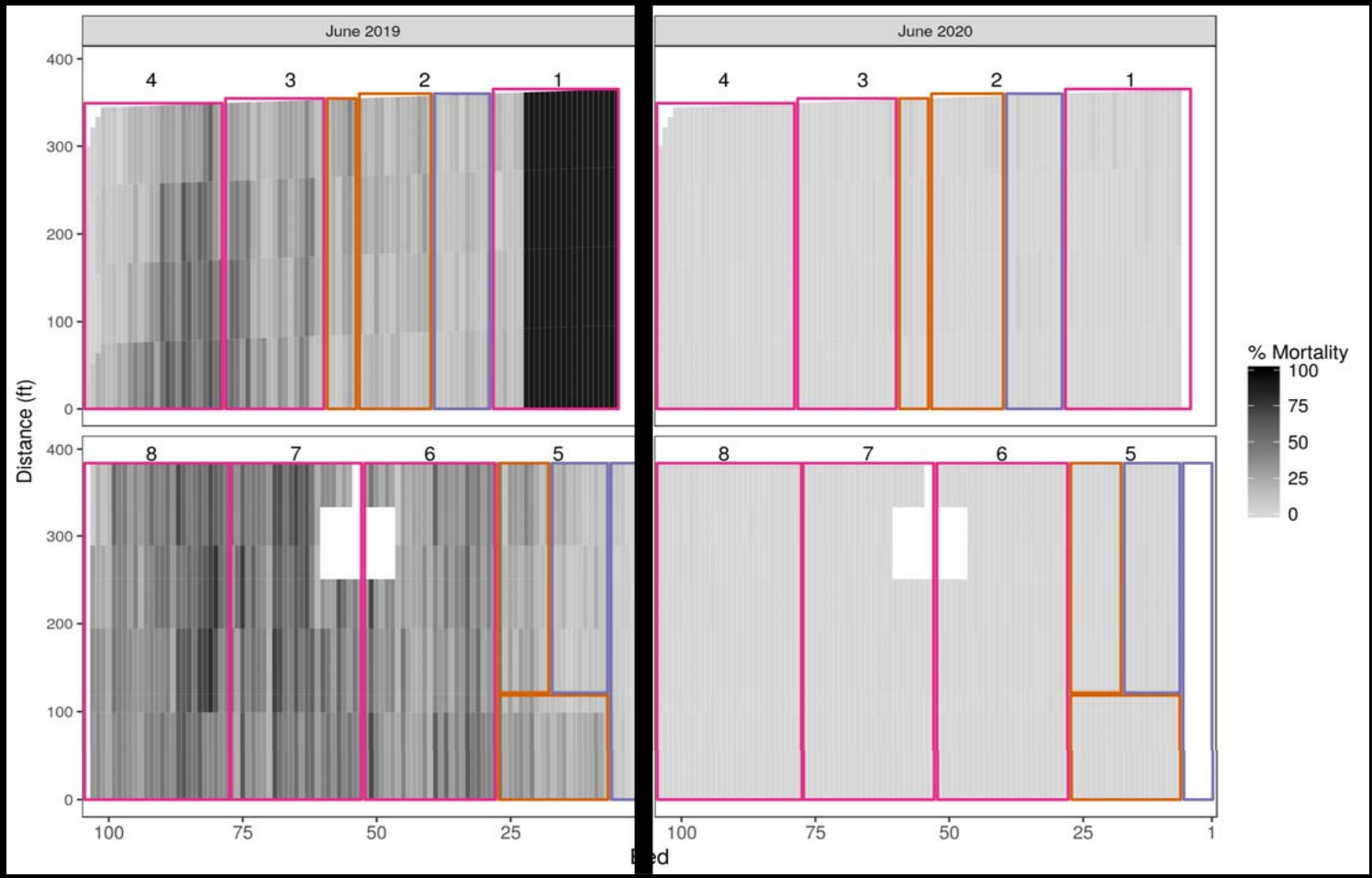
Current season 0.5% to 1.6%

Pathogen density in soil:

data pending

June 2019

June 2020



Acknowledgements

California Department of Pesticide Regulation

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Grower Cooperators

Matt Conroy and Dave Murray *Andrew and Williamson*

Henry Ito *Ito Bros.*

Jaime Lopez *Mixtekz Berries*

Ability to produce fruit in presence of pathogens

- Cultivar resistance
- Fumigation optimization
- Environmental considerations (cool soils slow disease development)
- Non-fumigant approaches (ASD, steam, solarization, biocides)
- Crop rotations
- Soilless culture/hydroponics

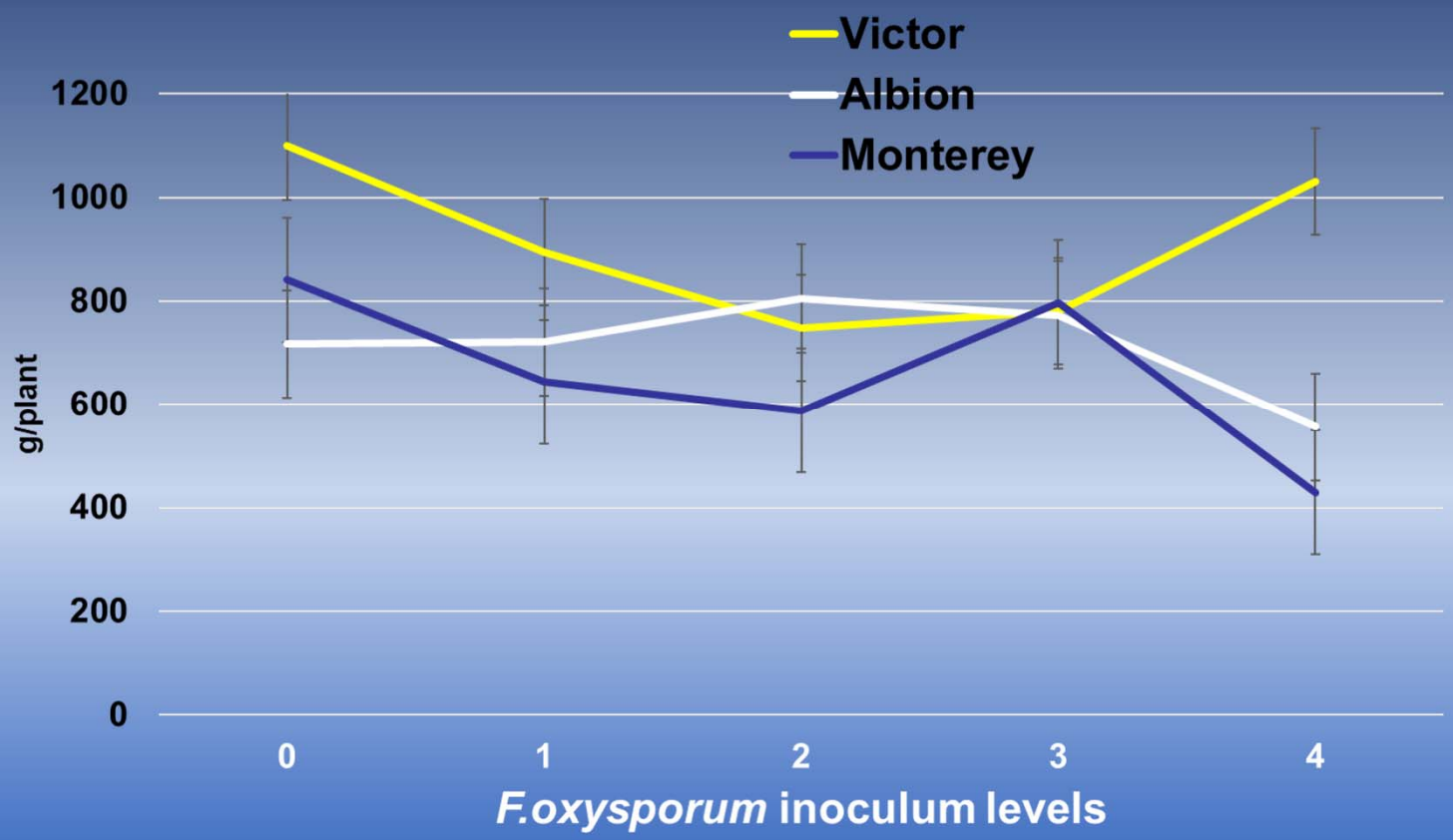
How much Fusarium in soil can strawberry handle?

Treatments

- **Soil flat fumigated with Chloropicrin at 300 lbs/A, beds made with black TIF , holes cut**
- **Soil excavated from planting holes (1L) is mixed with Fusarium-inoculated sand (0.1L) and returned to planting holes**
- **3 cultivars Planted in RCBD plots with 4 reps**

2000 CFUs per gram (4),
1000 CFUs per gram (3),
500 CFUs per gram (2),
100 CFUs per gram (1),
0 CFU (just sand) (0).

Fruit yield (total) in response to Fusarium



Albion without Fusarium - May

0

Albion in response to Fusarium - May

1

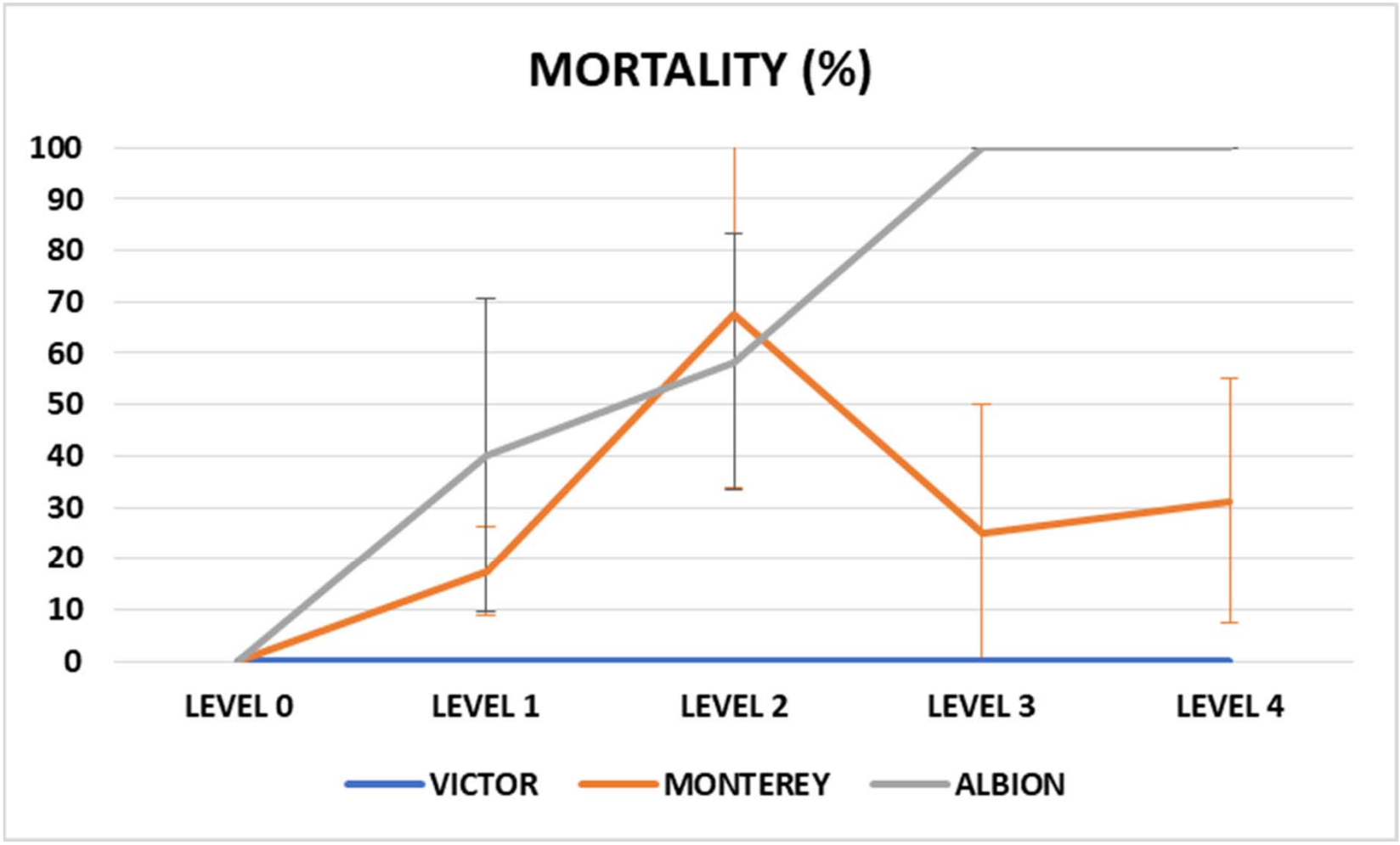
2

Albion in response to Fusarium - May

3

4

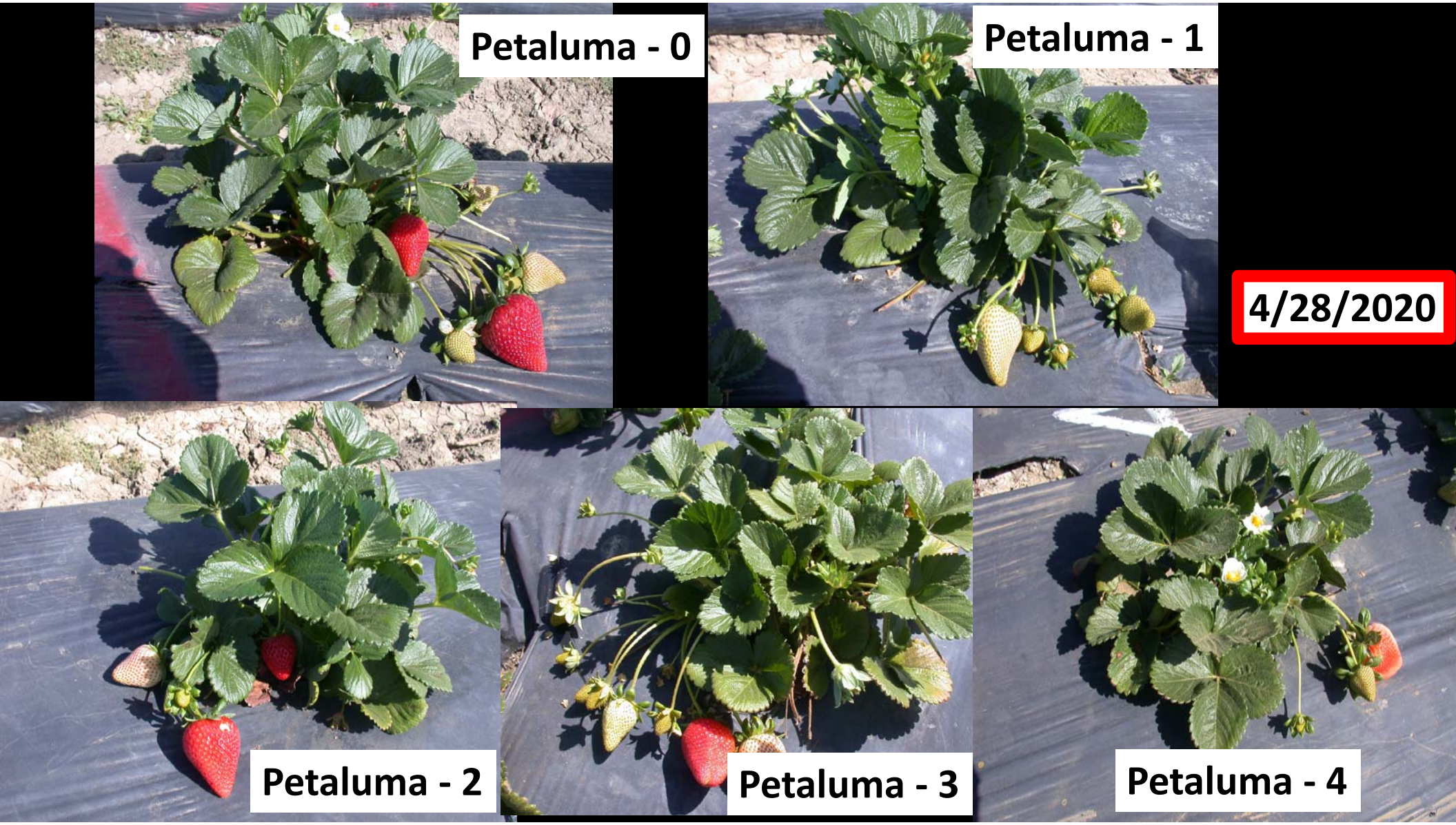
MORTALITY CAUSED BY F. OXYSPORUM F. SP. FRAGARIAE AT THE END OF THE EXPERIMENT



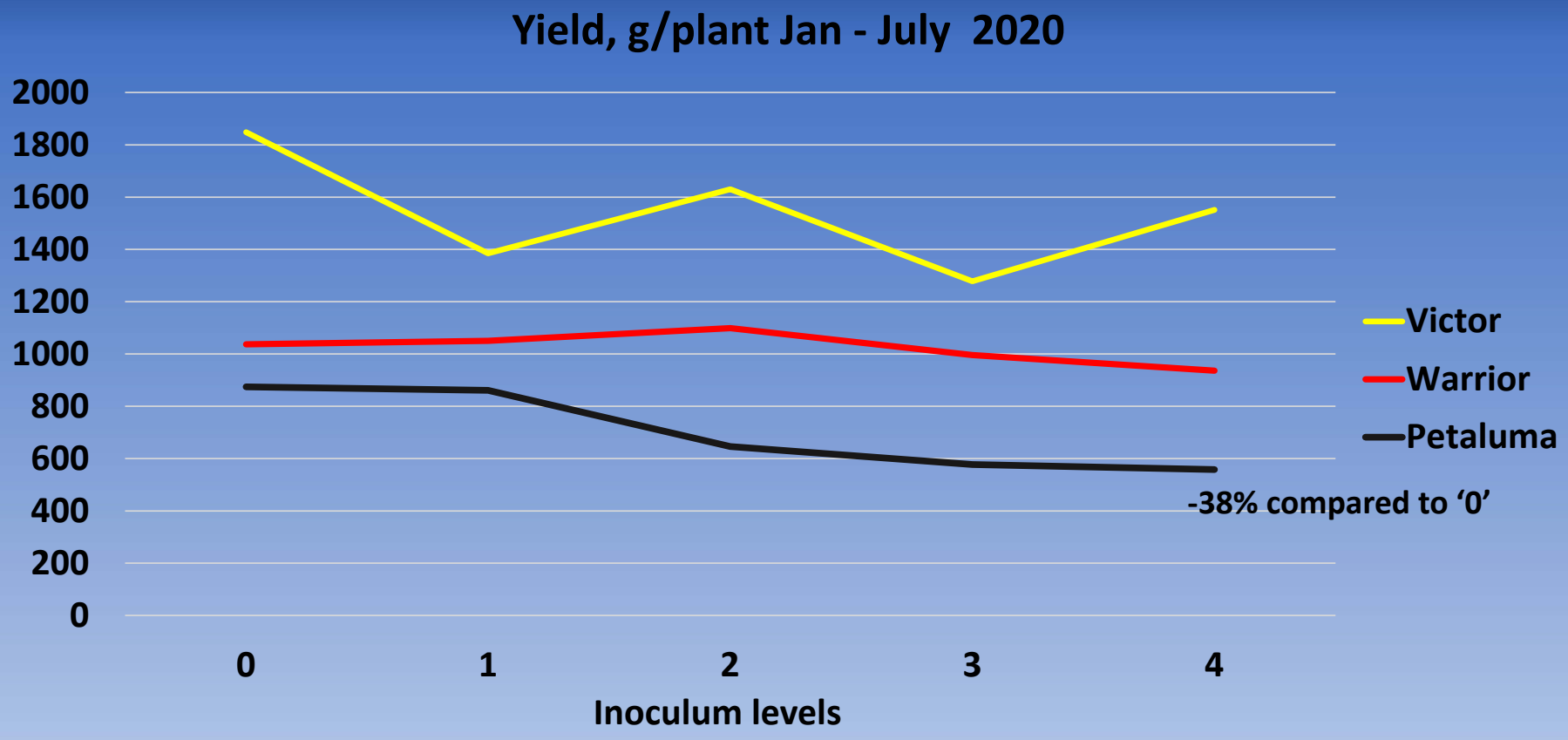
2019-2020 Season: short day cultivars

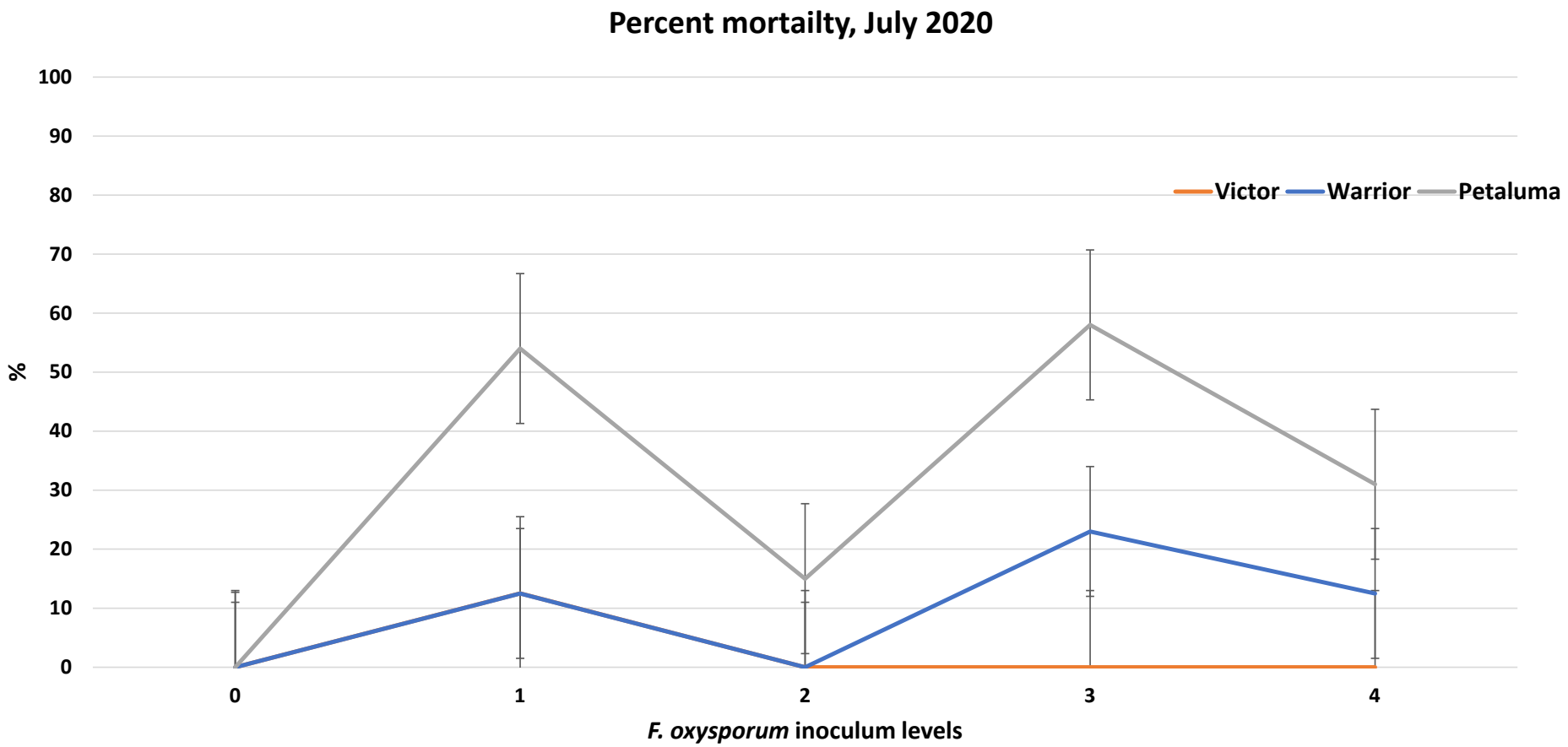
- **Petaluma (Fusarium susceptible)**
- **Victor (Fusarium resistant)**
- **Warrior (Fusarium resistant)**

PLANT SIZES, DEC 11	CM^2
• Petaluma	168 a
• Victor	113 b
• Warrior	138 b


Petaluma - 0
Petaluma - 1
4/28/2020
Petaluma - 2
Petaluma - 3
Petaluma - 4

Fruit yields Jan-April 2020




Percent mortailty, July 2020
100
90
80
70
60
50
40
30
20
10
0
%
Victor
Warrior
Petaluma
0
1
2
3
4
F. oxysporum inoculum levels

Acknowledgements

- UCD breeding Program
- Cedar Point Nursery and Lassen Canyon Nursery
- Hansen REC and UCCE staff
- NIFA grant funding

Questions

1. Did precision fumigation with reduced rates at reduced pathogen pressure areas caused yield losses? (answer = no, fruit yields were not affected)

2. Did mortality of all tested varieties increased with increased Fusarium densities in soil? (answer = no, for Victor it was the same ‘0 ‘ at all levels)