

MILLENNIUM BLOCK: A LARGE-SCALE GRAPEFRUIT SCION AND ROOTSTOCK VARIETY TRIAL AT THE INDIAN RIVER



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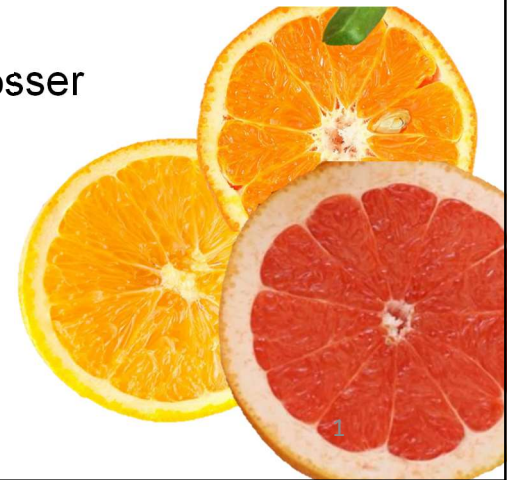
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UF/IFAS CREC

Dr. Ed Stover

USDA-ARS



MB, a new beginning for the River



Citrus Industry News

Millennium Block Resurrected for HLB Research

November 20, 2017 / Grapefruit, HLB Management

<https://citrusindustry.net/2017/11/20/millennium-block-resurrected-for-hlb-research>



UF/IFAS Millennium Block citrus grove drive through event

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<https://blogs.ifas.ufl.edu/irrec/2020/09/28/uf-ifas-millennium-block-citrus-grove-drive-through-event>



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Citrus Industry News

Massive Research Project in Millennium Block

July 10, 2020 / Research



<https://citrusindustry.net/2020/07/10/massive-research-project-in-millennium-block>



Study rationale

There is an **urgent need** to test **newly released varieties and rootstocks** in the IR.



**DATA => PLANTING
DECISIONS**

***Scion and rootstock variety performance trials** are cost-effective tools to:*

- ✓ Evaluate **disease tolerance** of the scion
- ✓ Test **rootstock horticultural attributes** in a specific site
- ✓ Evaluate **plant growth and yield** to **base planting decisions**

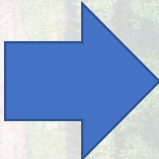


OBJECTIVES

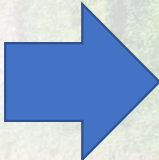
1. **Assess the early performance of new grapefruit scion cultivars** on three commercial rootstocks in the IR

2. **Compare grapefruit, navel, and mandarin** growth and yield **on** University of Florida **rootstocks**, other recently released, and standard rootstocks in the IR

HYPOTHESES



1. **New grapefruit hybrids have better horticultural attributes and HLB-tolerance** than the standard cultivars used in the IR



2. **The rootstock provides higher tolerance** to tree decline due to **HLB** while maintaining high yield and fruit quality.

Study site

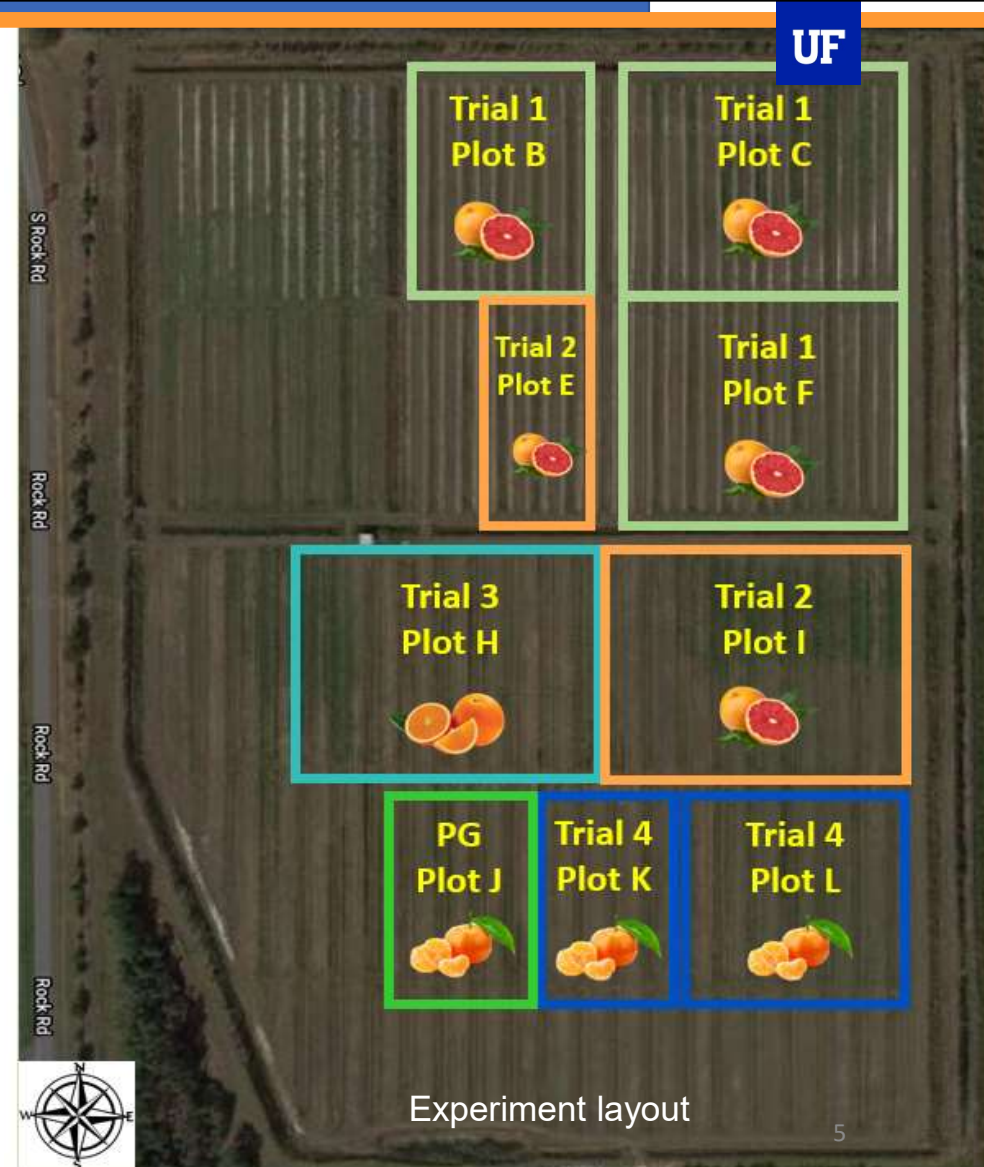
UF/IRREC Millennium Block at Fort
Pierce, FL (**27°25'49.7"N**
80°24'19.5"W)

~20 acres planted (~**4,500 trees**)
trees spaced 8' × 25' at 218 trees/acre

Pineda **sandy soil** / Flatwoods →
Raised beds

Planting date: **Sep 2019** and Aug
2020

All trials are independent



Materials and methods: TRIAL 1

Grapefruit scions and rootstocks

SCIONS (18)

'US 6-16-172'	'US 6-17-48'	'US HoneyCoat'	'US Seedless Surprise'	'US 1-83-179'	'US 6-17-16'
'US 4-4-1'	'UF N40-16-11-11'	'Summer Gold'	'UF N40-16-11-7'	'UF N11-29'	'UF 914'
'UF N40-16-11-3'	'UF 5-1-99-2'	'UF N40-16-11-15'	'Jackson'	'Star Ruby'	'Ray Ruby'

University
of Florida

Commercial
standard

Planted on
2020

ROOTSTOCKS (3)

Sour orange	US-942	X-639
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Materials and methods: TRIALS 2, 3, and 4 (independent)

Grapefruit, navel orange, and mandarin scions on a wide range of rootstocks

SCIONS

'Ray Ruby'

'Glenn F-56-11'

'UF 950'

ROOTSTOCKS (30-36)

2247x2075-
02-26

2247x6070-
02-2

46x20-04-42

46x20-04-6

A+VolkxOrange
19-11-8

C-22

C-54

Cunningham

Kuharske
citrange

Sour orange

Willits

X-639

US-802

US-812

US-897

US-942

Orange 14

Orange 16

WGFT+50-7

UFR-1

UFR-2

UFR-4

UFR-5

UFR-15

UFR-16

UFR-17

Rootstocks planted on 2020: **C-57, Cleopatra, Sun Chu Sha, US-1283**

Rootstocks to plant in 2021: **C-146, UFR 7 to 14**

EXPERIMENTAL DESIGN

- ✓ Arranged in a RCBD
- ✓ Treatment: scion/rootstock combination
- ✓ 5-tree replicated plots & 6 replications/treatment → 30 trees/treatment

Grove caretaking based on standard horticultural practices according to UF/IFAS recommendations

Data is collected from the 3-central trees/rep
Statistical analysis through ANOVA (Proc GLM), and
Tukey mean comparison test using SAS v. 9.4

DATA COLLECTION



Tree phenological stage monitoring



Pest and disease incidence



Tree size



Fruit yield* and quality*

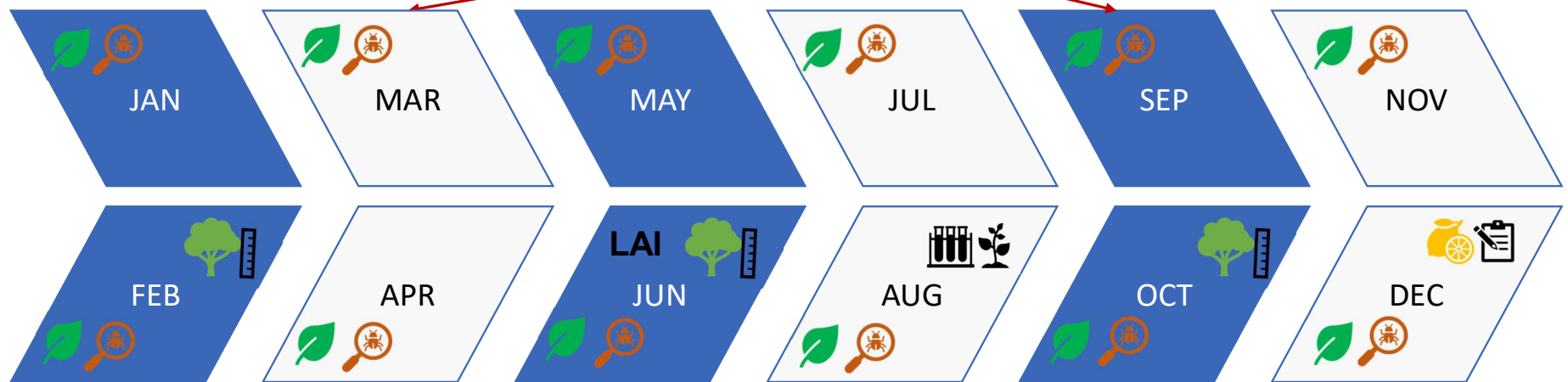


Leaf and soil nutrient concentrations

LAI

Leaf Area Index – Canopy thickness

HLB incidence + Canopy color + Leaf sampling for CLas titer

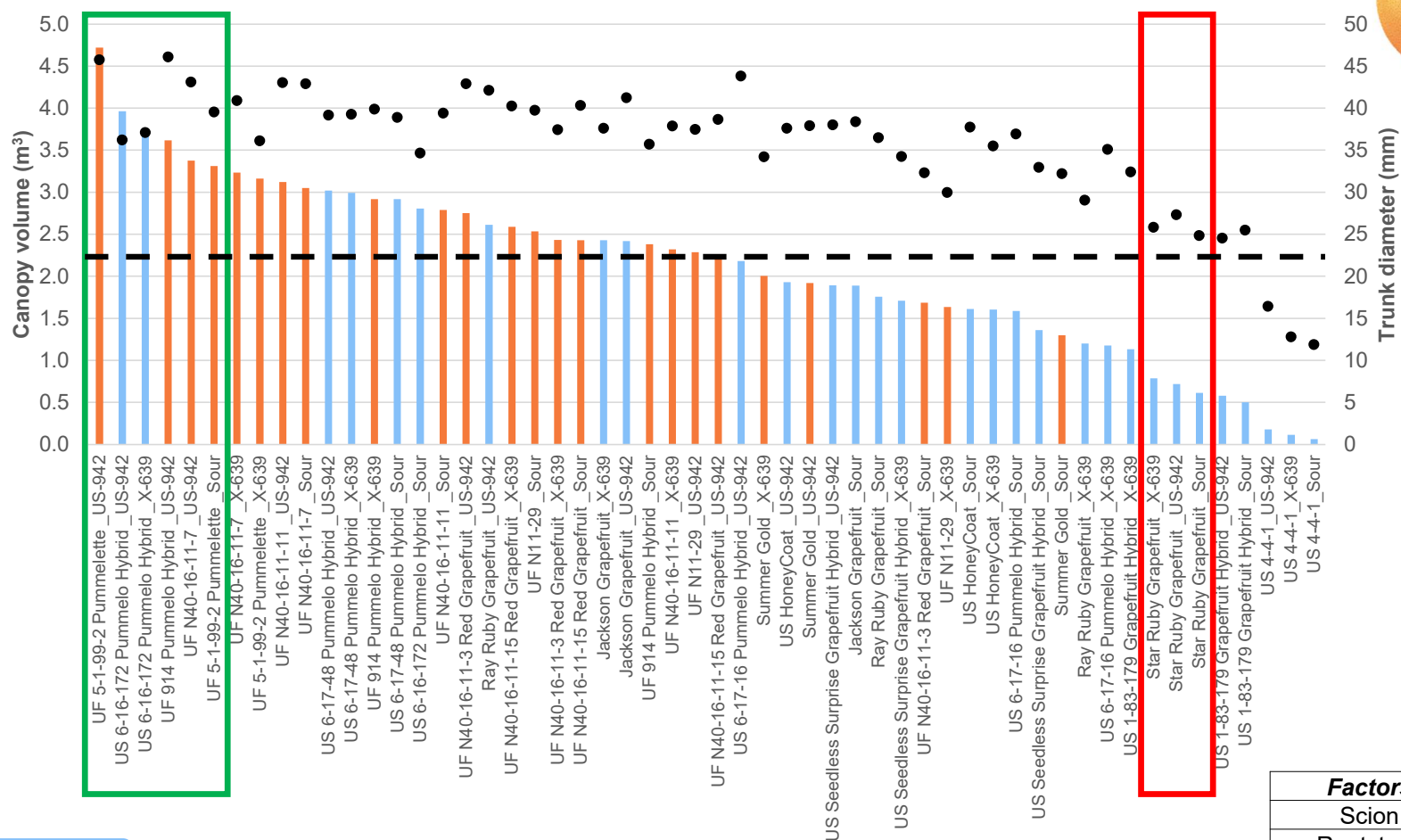


*As of 2nd year of growth



Preliminary results (2019-2021): Trial 1

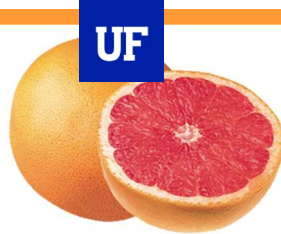
Grapefruit scions and rootstocks



Factors	p-value
Scion	≤0.0001
Rootstock	≤0.0001
Scion x Rootstock	¹⁰ 0.0002

Preliminary results (2019-2021): Trial 1

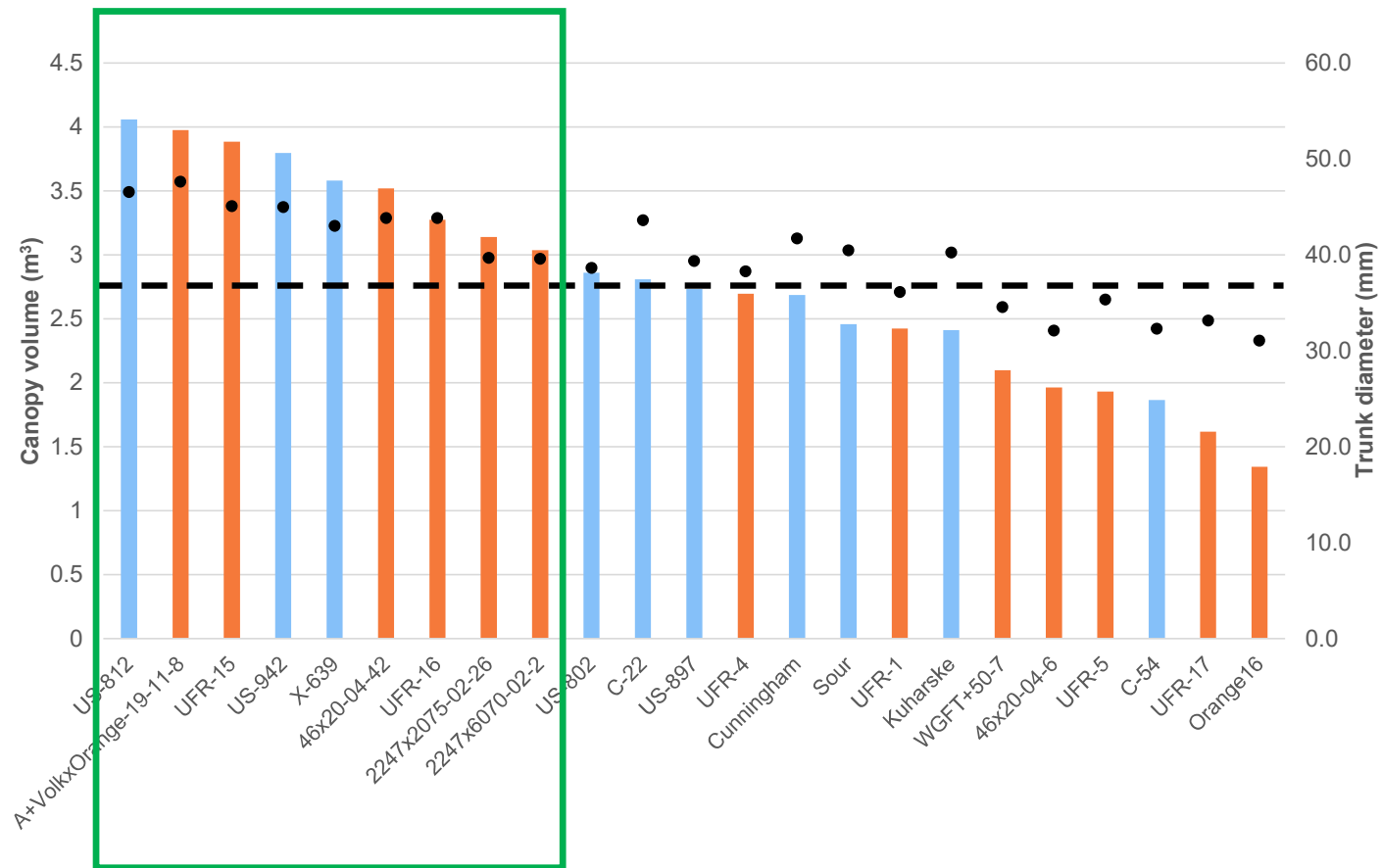
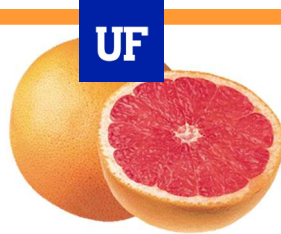
Grapefruit scions and rootstocks



‘UF-5-1-99-2’ Pummelette grapefruit on US-942 (**A**), Sour (**B**) and X-639 (**C**), and
‘Star Ruby’ on US-942 (**D**).

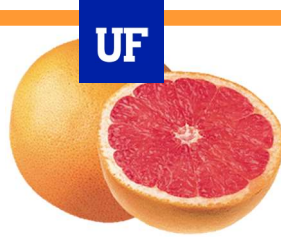
Preliminary results (2019-2021): Trial 2

'Ray Ruby' grapefruit and rootstocks



Preliminary results (2019-2021): Trial 2

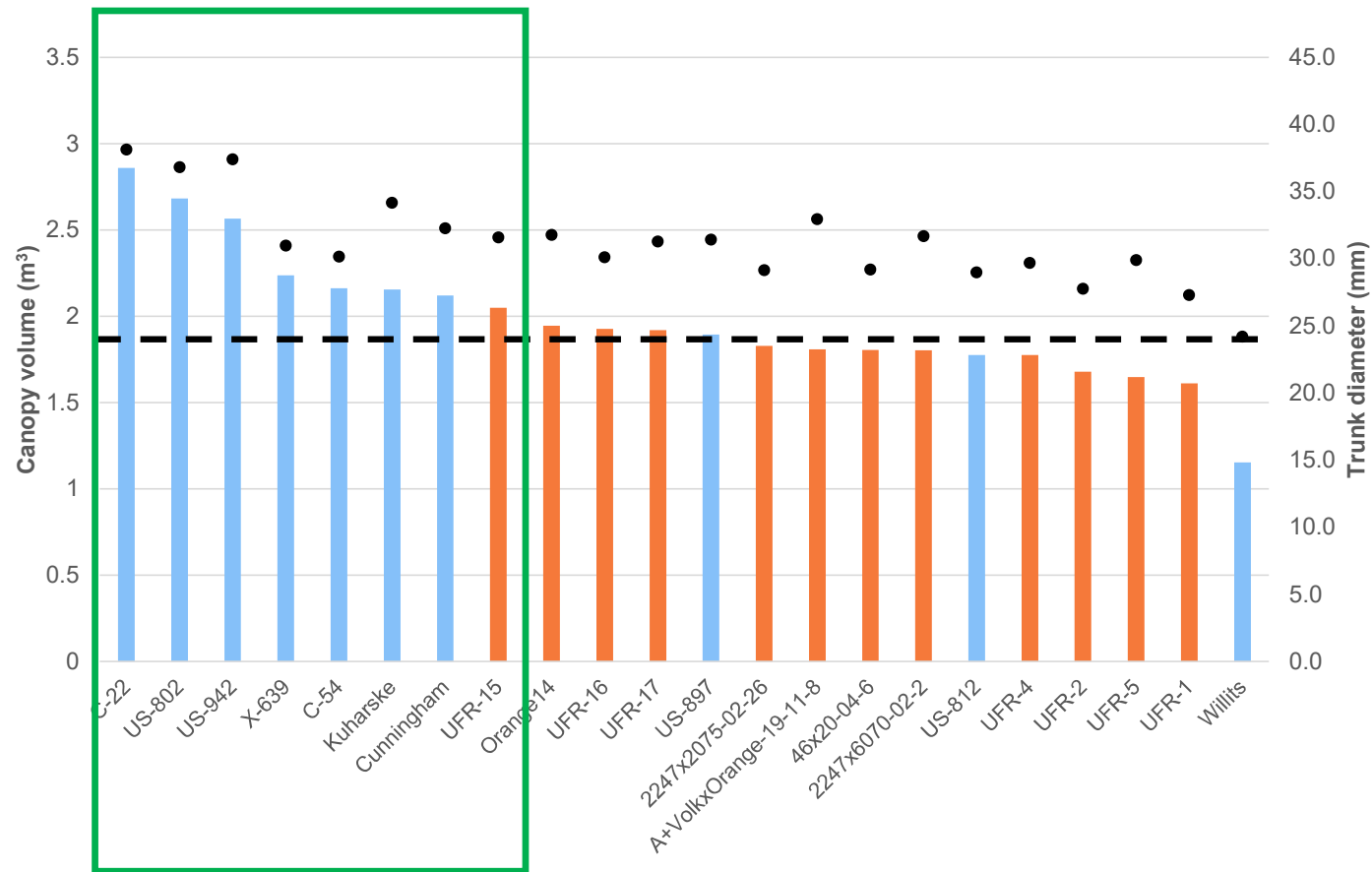
‘Ray Ruby’ grapefruit and rootstocks



‘Ray Ruby’ grapefruit on A+VolkxOrange-19-11-8 (**A**) and Orange 16 (**B**).

Preliminary results (2019-2021): Trial 3

'Glen F-56-11' navel orange and rootstocks



Preliminary results (2019-2021): Trial 3

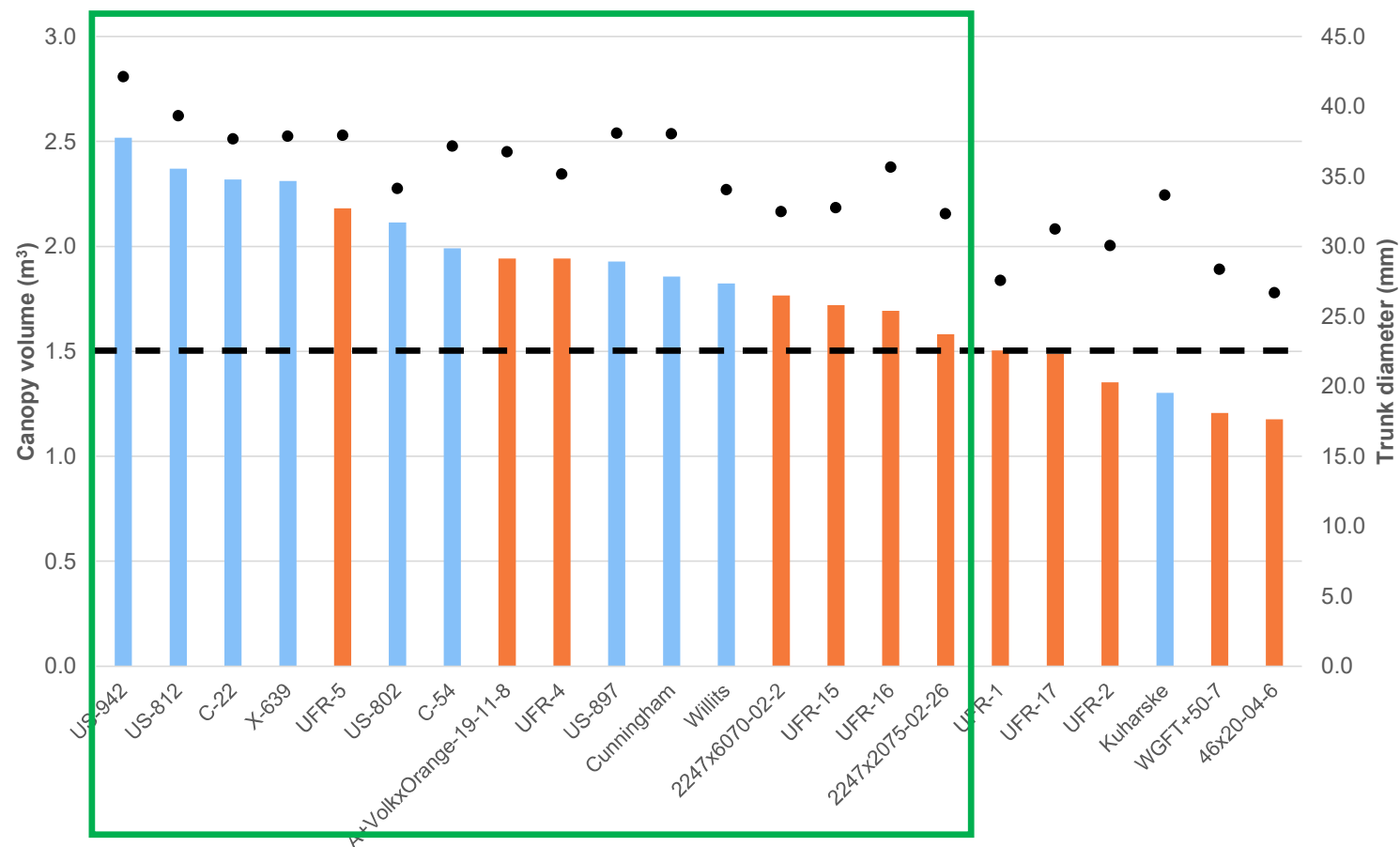
'Glen F-56-11' navel orange and rootstocks



'Glen F-56-11' navel orange on C-22 (**A**) and Willits (**B**).

Preliminary results (2019-2021): Trial 4

'UF 950' mandarin and rootstocks

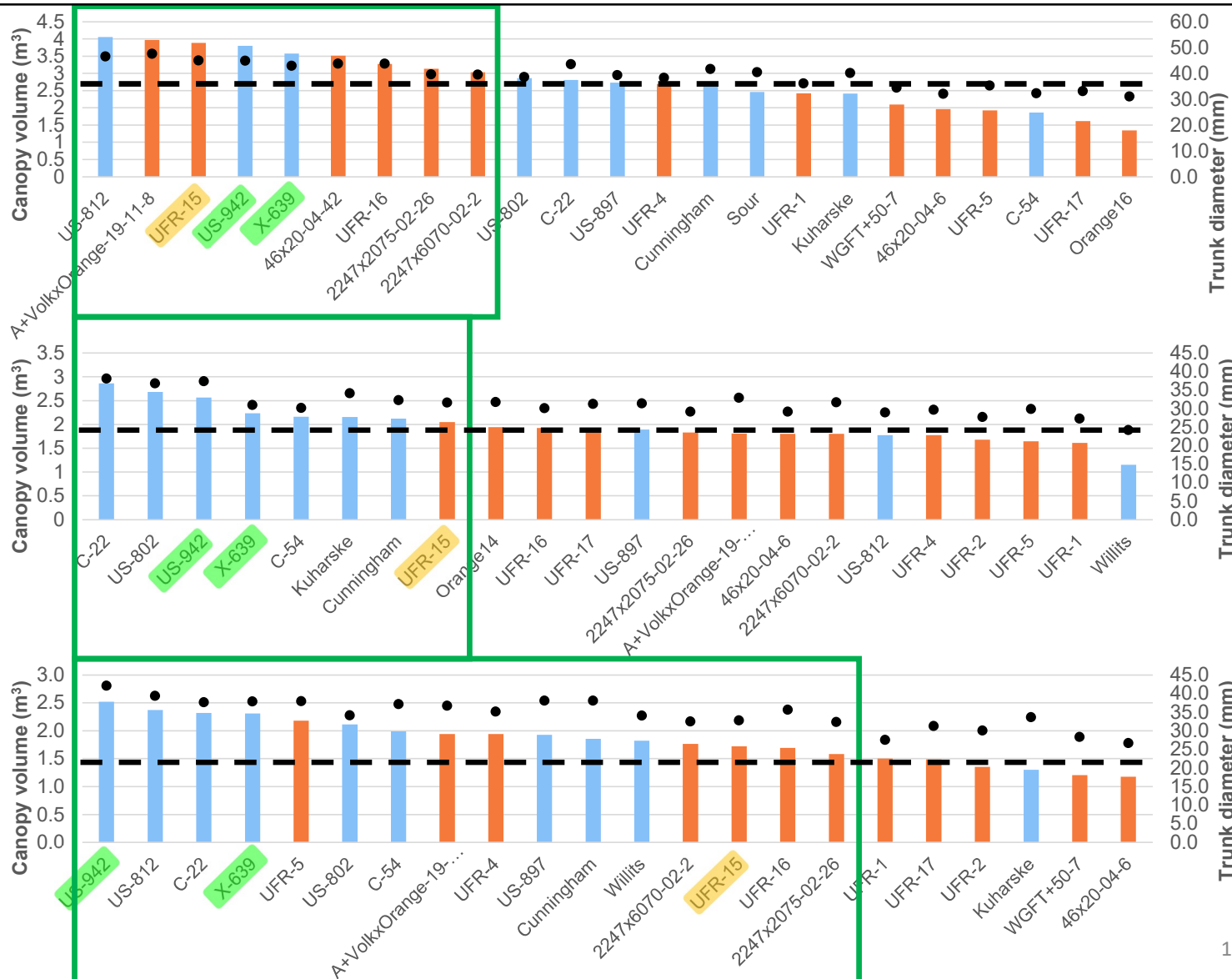


Preliminary results (2019-2021): Trial 4

'UF 950' mandarin and rootstocks



'UF 950' mandarin on US-942 (**A**) and WGFT+50-7 (**B**).



UF

Is HLB around?



Summary

❖ Trial 1

'UF-5-1-99-2' Pummelette had the highest canopy volume, and US-942 induced large-size trees

❖ Trial 2

US-812 along with other rootstocks → largest 'Ray Ruby' grapefruit trees

❖ Trial 3

C-22 along with other rootstocks → greatest 'F-56-11 Glenn' navel orange trees

❖ Trial 4

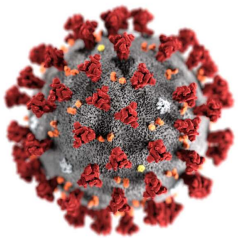
US-942 along with other rootstocks → best 'UF 950' mandarin trees

❖ Overall T2-T4

The cultivar performance is directly influenced by the rootstock used, with US-942, X-639 and UFR-15 producing the largest trees

INNOVATION: 2020 UF/IFAS IRREC “Millennium Block Drive-thru Field Day”

<https://www.youtube.com/watch?v=ytnUNFy0PeM>



Acknowledgments



We thank the Ferrarezi Lab Awesome Team, Randy Burton, Wayne Brunk, the Indian River Citrus League, Tom Stopyra, Anna Jameson and Nate Jameson (Brite Leaf Nursery), Dr. Brian Scully and Dr. Kim Bowman (USDA ARS USHRL) for their contributions to this project.

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Projects at the Ferrarezi Lab

- **Host**

- Precision irrigation
- Soil/Foliar enhanced fertilization and high planting density
- **Variety performance trial**

- **Vector**

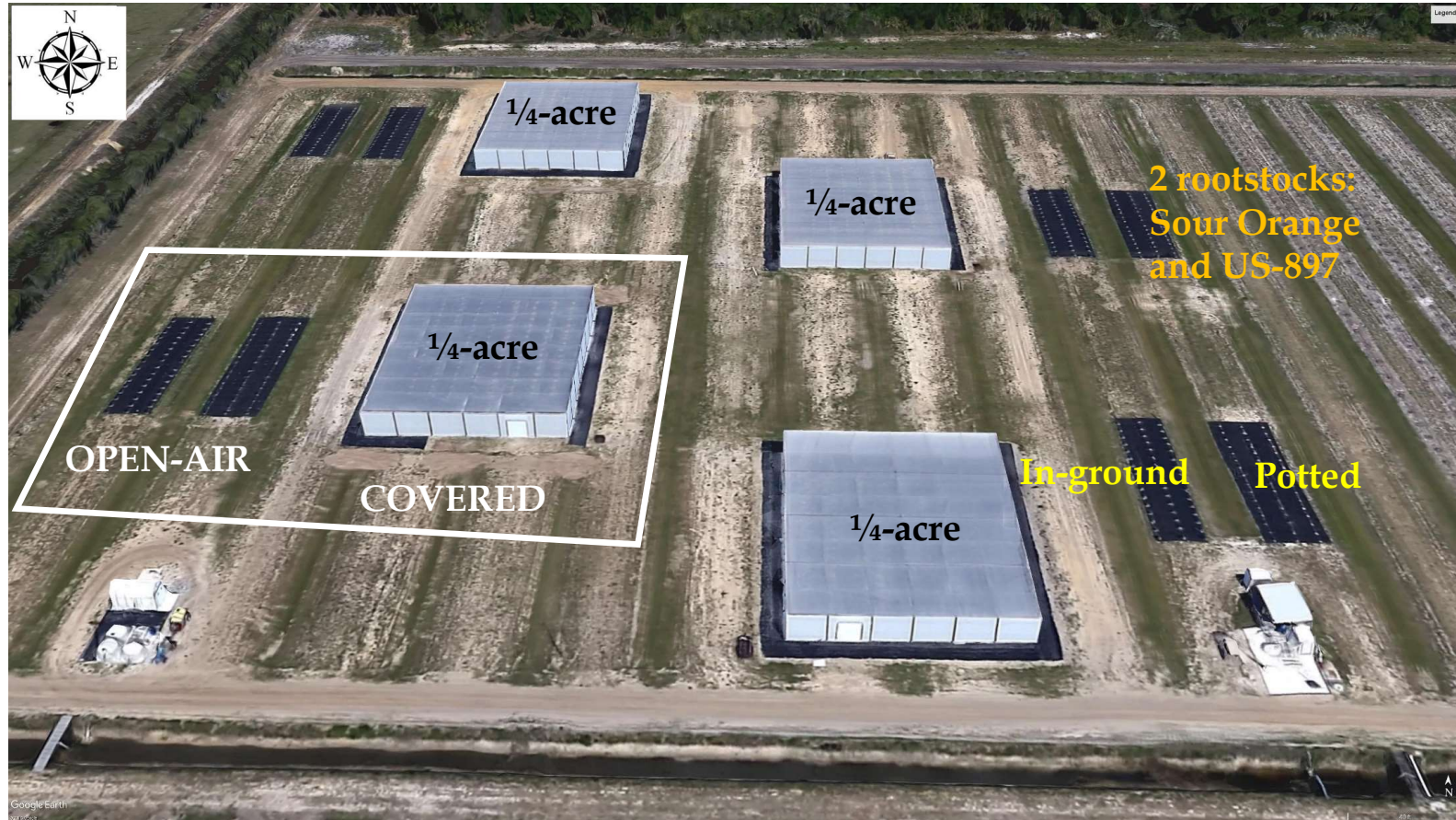
- **Citrus Under Protective Screen (CUPS)**
- Mini-CUPS or IPC

- **Bacteria**

- Antibiotics (Chemotherapy)
- HLB-free nursery plant production



Citrus Under Protective Screen (CUPS)



This work is supported by the USDA National Institute of Food and Agriculture, USDA-NIFA-CDRE project 2018-70016-27387.

Irrigation management

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Objectives

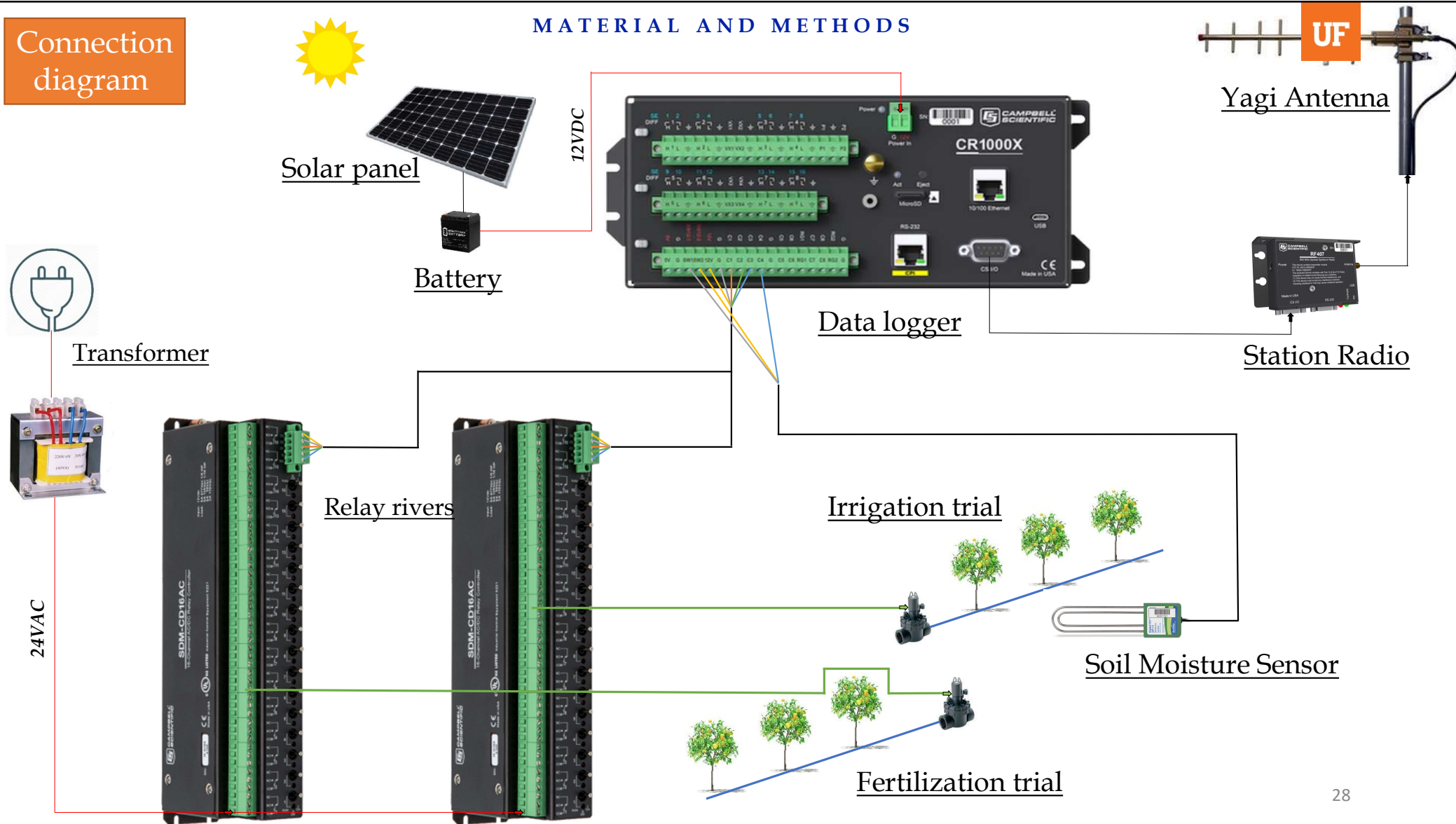
- Plant material: '**Ray Ruby**' grapefruit on **US-897** rootstock planted Sept/2013
- Treatments:
 - Two production systems (¼-acre each):
 - ❑ Enclosure (100-ft wide × 120-ft long × 14-ft tall screen house)
 - ❑ Open-air
 - Two planting systems:
 - ❑ In-ground with typical Riviera sandy soil
 - ❑ Potted in 10-gal plastic containers (#10 Accelerator AP-10; Nursery Supplies, Chambersburg, PA) with substrate [50% Canadian sphagnum peat moss, 39% coarse expanded perlite & 11% medium expanded vermiculite (Fafard Citrus Mix Rsi; Sun Gro Horticulture, Agawam, MA)]
 - Three irrigation managements:
 - ❑ Weather-based
 - ❑ Soil-based with irrigation triggered when soil moisture drops below 33% Maximum Allowable Depletion (MAD)
 - ❑ Soil-based with irrigation triggered when soil moisture drops below 50% MAD
- Replications: 3
- Experimental design: Split-split plot

Experimental details

- Plant material: 'Ray Ruby' grapefruit on US-897 rootstock planted Sept/2013
- Treatments:
 - Two production systems (¼-acre each):
 - ❑ Enclosure (100-ft wide × 120-ft long × 14-ft tall screen house)
 - ❑ Open-air
 - Two planting systems:
 - ❑ In-ground with typical Riviera sandy soil
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 - Three irrigation managements:
 - ❑ Weather-based
 - ❑ Soil-based with irrigation triggered when soil moisture drops below 33% Maximum Allowable Depletion (MAD)
 - ❑ Soil-based with irrigation triggered when soil moisture drops below 50% MAD
- Replications: 3
- Experimental design: Split-split plot

Connection diagram

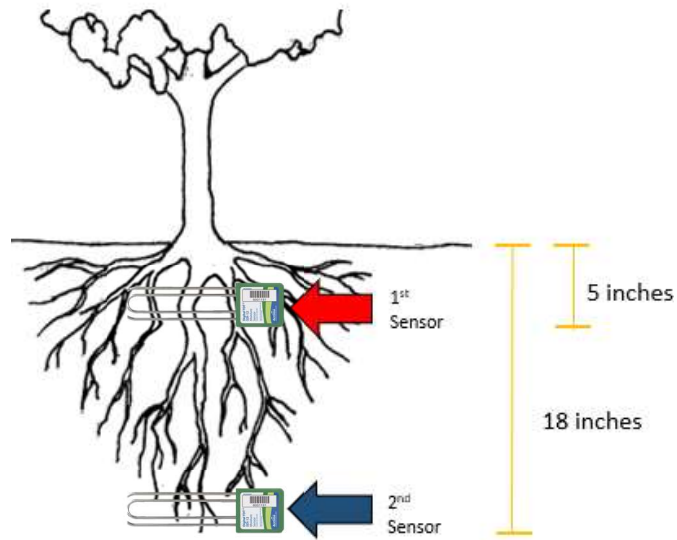
MATERIAL AND METHODS



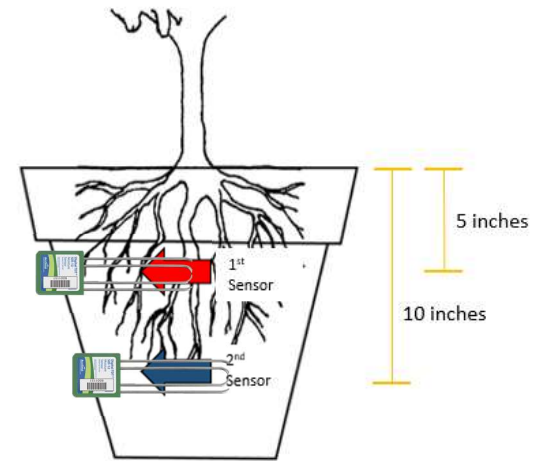
Sensor Installation

MATERIAL AND METHODS

UF

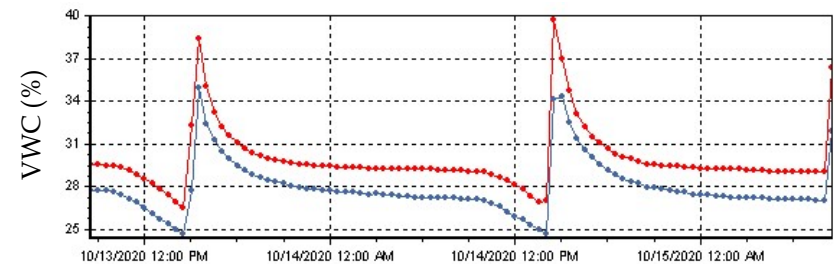
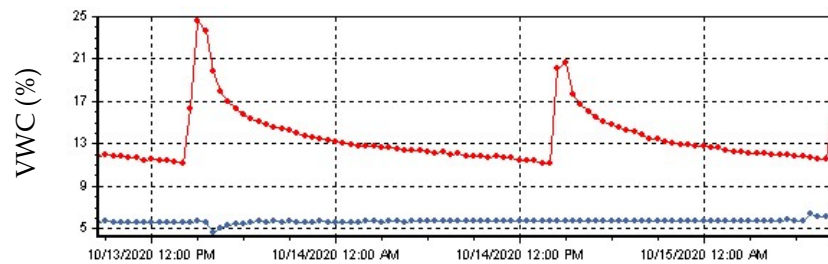


In-ground



Potted

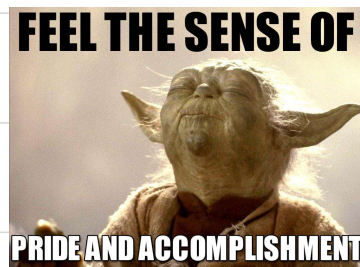
Sensor data



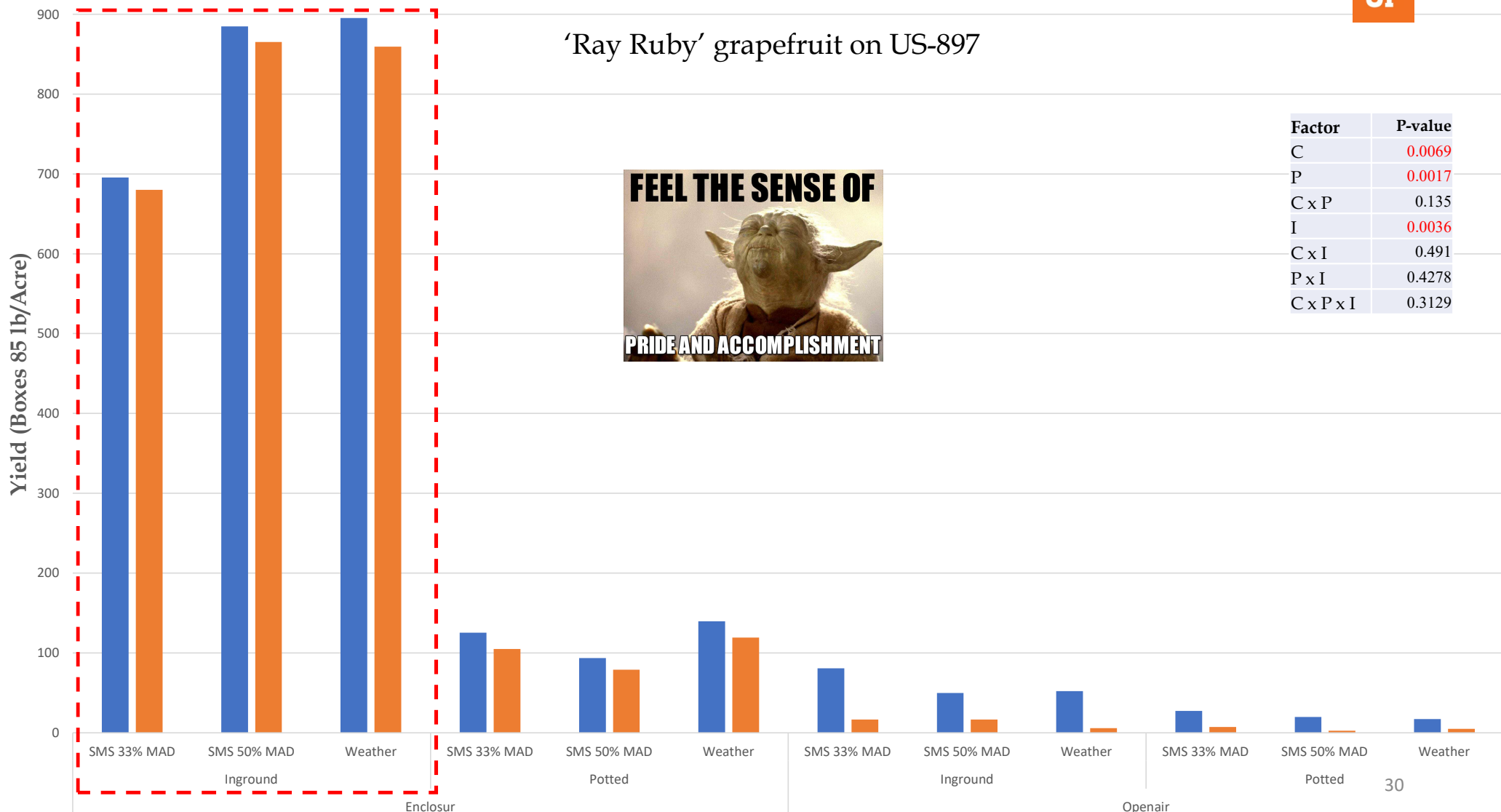
- Volumetric Water Content (VWC) is recorded every 30 minutes.
- The graphs show how the soil moisture responds to irrigation and rain events.

■ Average of Total yield (Boxes 85 lb/Acre) ■ Average of Salable yield (Boxes 85 lb/Acre)

'Ray Ruby' grapefruit on US-897



Factor	P-value
C	0.0069
P	0.0017
C x P	0.135
I	0.0036
C x I	0.491
P x I	0.4278
C x P x I	0.3129



Fertilization management

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Objectives

To identify the best fertilization strategy for grapefruit cultivated under protective screen using **granular** and **liquid fertilizer** application.



Experimental details

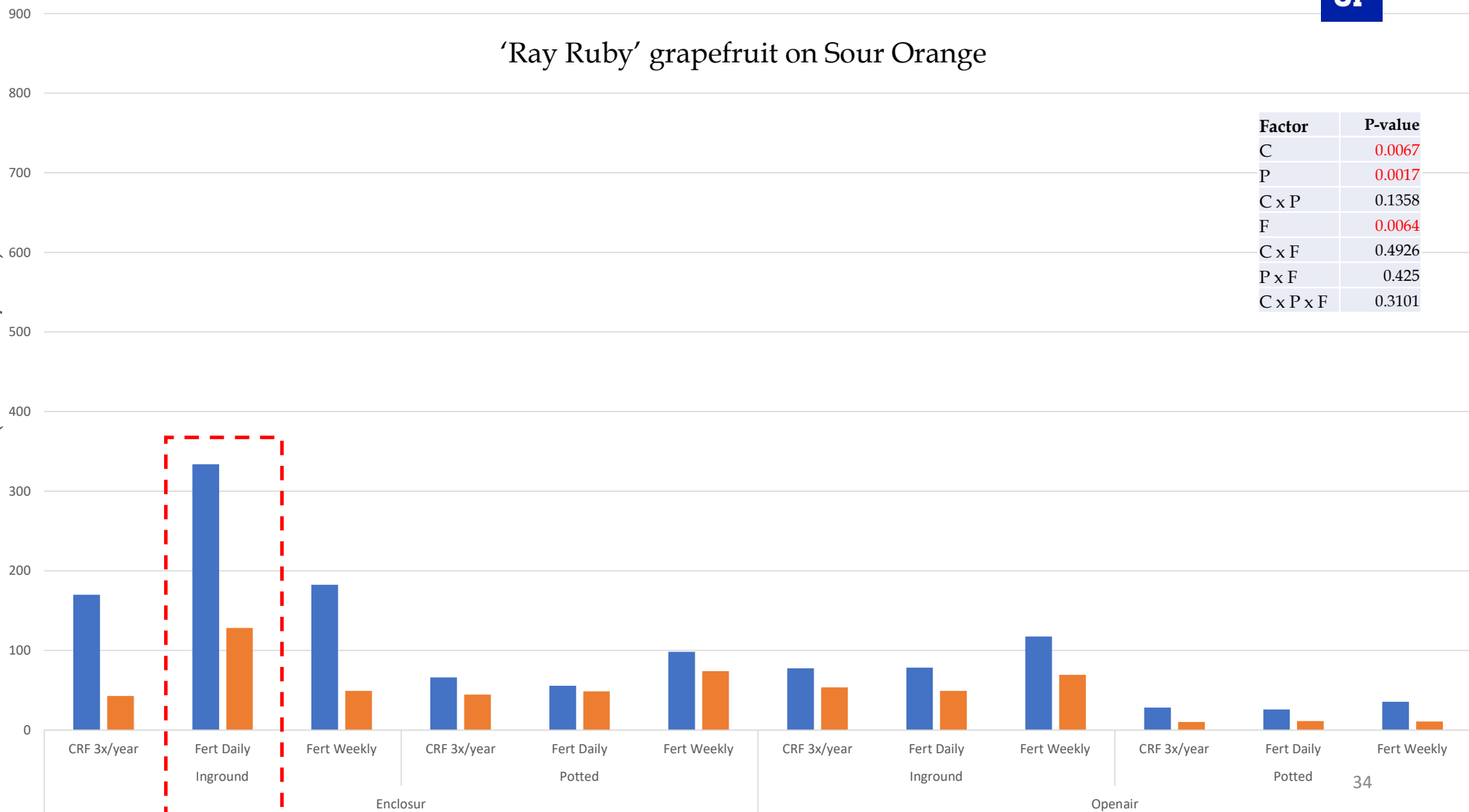
- Plant material: **'Ray Ruby'** grapefruit on **Sour Orange** rootstock planted Sept/2013
- Treatments:
 - Two production systems (¼-acre each)
 - ❑ Enclosure (100-ft wide × 120-ft long × 14-ft tall screen houses)
 - ❑ Open-air
 - Two planting systems
 - ❑ In-ground with typical Riviera sandy soil
 - ❑ Potted in 10-gal plastic containers (#10 Accelerator AP-10; Nursery Supplies, Chambersburg, PA) with substrate [50% Canadian sphagnum peat moss, 39% coarse expanded perlite & 11% medium expanded vermiculite (Fafard Citrus Mix Rsi; Sun Gro Horticulture, Agawam, MA)]
 - Fertilization methods
 - ❑ Fertigation (daily)
 - ❑ Fertigation (weekly)
 - ❑ Controlled-release fertilizer applied by soil 3x/year
- Replications: 3
- Experimental design: Split-split plot

■ Average of Fruit Wt (Boxes 85 lb/Acre) ■ Average of Salable yield (Boxes 85 lb/Acre)

'Ray Ruby' grapefruit on Sour Orange

Factor	P-value
C	0.0067
P	0.0017
C x P	0.1358
F	0.0064
C x F	0.4926
P x F	0.425
C x P x F	0.3101

Yield (Boxes 85 lb/Acre)



QUESTIONS???

