CITRUS UNDER PROTECTIVE SCREEN (CUPS) – YEAR 4 UPDATE

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Citrus Under Protective Screen

INTRODUCTION

- The CUPS idea was developed in ~2011/12 (with Tim Spann, Chris Oswalt + Barrett Gruber) after two productive visits to Fruit World in California (Craig Kaprielian)

High yielding, high quality production under cover

Murcotts: >1,000 boxes/acre

Tomatoes: 30x higher yield than outdoors

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INTRODUCTION & OBJECTIVES

- Grow Citrus Under Protective Screen (CUPS) to exclude the Asian Citrus Psyllid and therefore Huaglongbing (HLB) disease
- Produce asymptomatic, low-seeded, premium grade fresh fruit in HLB-endemic Florida by using CUPS
- CUPS is a complex integrated system– not simply a screen cover- but a completely reworked modern production system
- The protective screen house is the single most costly item required for CUPS (up to one dollar per square foot): much less/ sq.ft than a greenhouse, and the price can be reduced 50% or more by using overseas suppliers, careful design, and economies of scale
- The higher cost of CUPS must be offset by high fruit revenue

CUPS facility at the CREC
1.3 acres (58,000 sq. feet)

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MAIN CREC CUPS RESEARCH HYPOTHESIS:

Container hydroponics can accelerate and boost fresh citrus production in a CUPS environment to maximize early return on investment

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February 2017:
‘Honey Murcott’ @ 2.5 years, 7-gal pots, 1,361 trees /acre:
680 boxes/acre, 99% pack-out

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‘Ray Ruby’ grapefruit @ 2.5 years, 10-gal pots, 871 trees /acre: 346 boxes/acre (total 496 boxes/acre in 2 years)

‘Honey Murcott’ commercial harvest @ 2.5 years

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‘Honey Murcott’ commercial harvest @ 2.5 years

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‘Honey Murcott’ after post-harvest hedging

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June 2017: ‘Honey’ murcott @ 2.75 years

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‘Early Pride’ early variety @ 2.0 years, 10-gal pots, 1,361 trees /acre

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January 2018: ‘Ruby Red’ grapefruit @ 3.5 years

‘Ray Ruby’ grapefruit @ 3.5 years, 10-gal pots, 871 trees /acre

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‘Honey’ murcott @ 3.5 years, 7-gal pots, 1,361 trees /acre
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January 2018: Outdoor ‘Ray Ruby’ @ 3.5 years

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Outdoor ‘Ray Ruby’ @ 3.5 years

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Outdoor ‘Honey’ murcott @ 3.5 years

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Feb 2018: ‘Ray Ruby’ grapefruit hedging, 871 trees /acre

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Mar 2018: ‘Honey’ murcott topping, 7-gal pots, 1,361 trees /acre

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SEEDLESS vs SEEDY FRUIT – CREC CUPS

November 2017: ‘Early Pride’ = seedless

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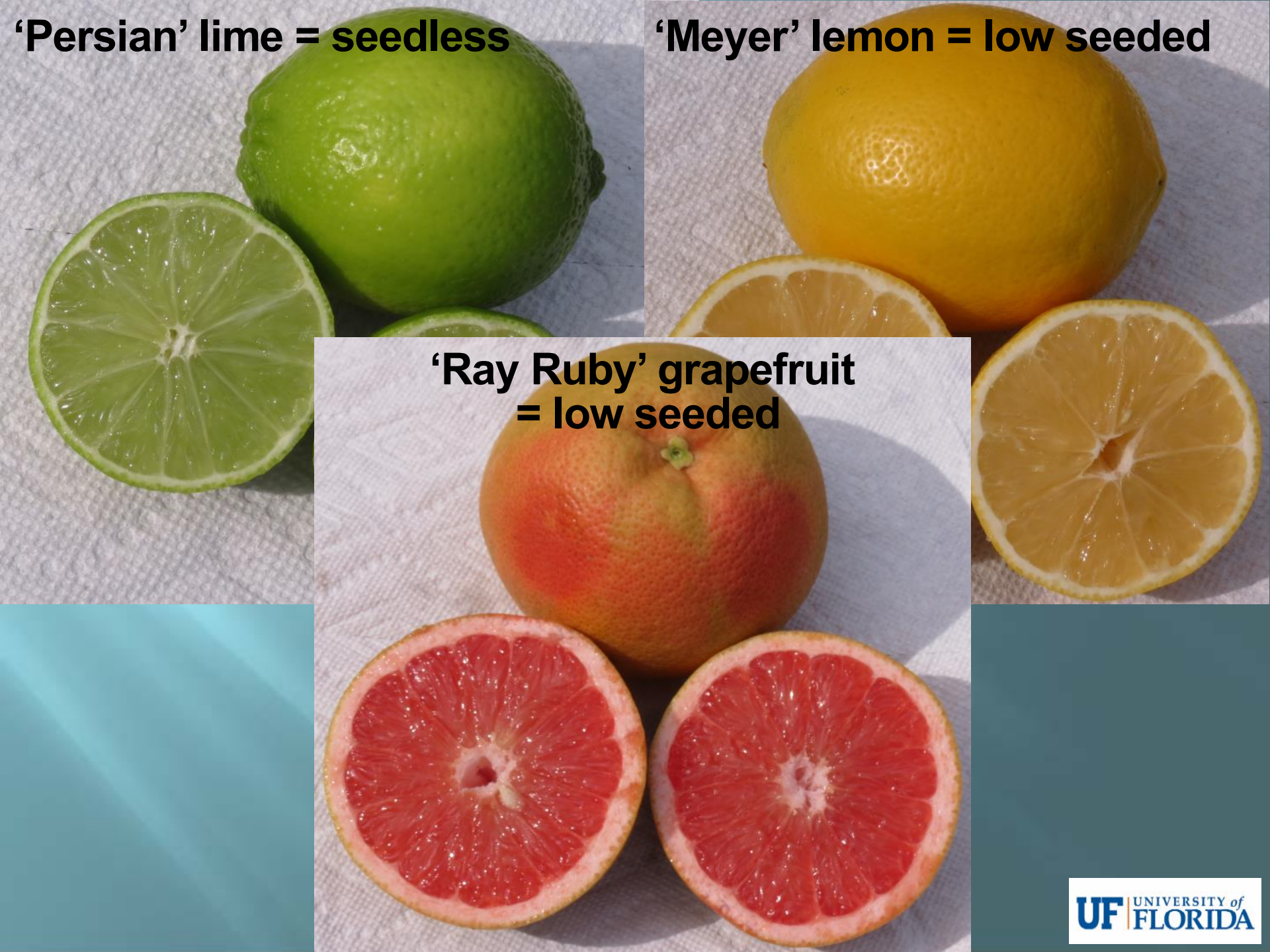

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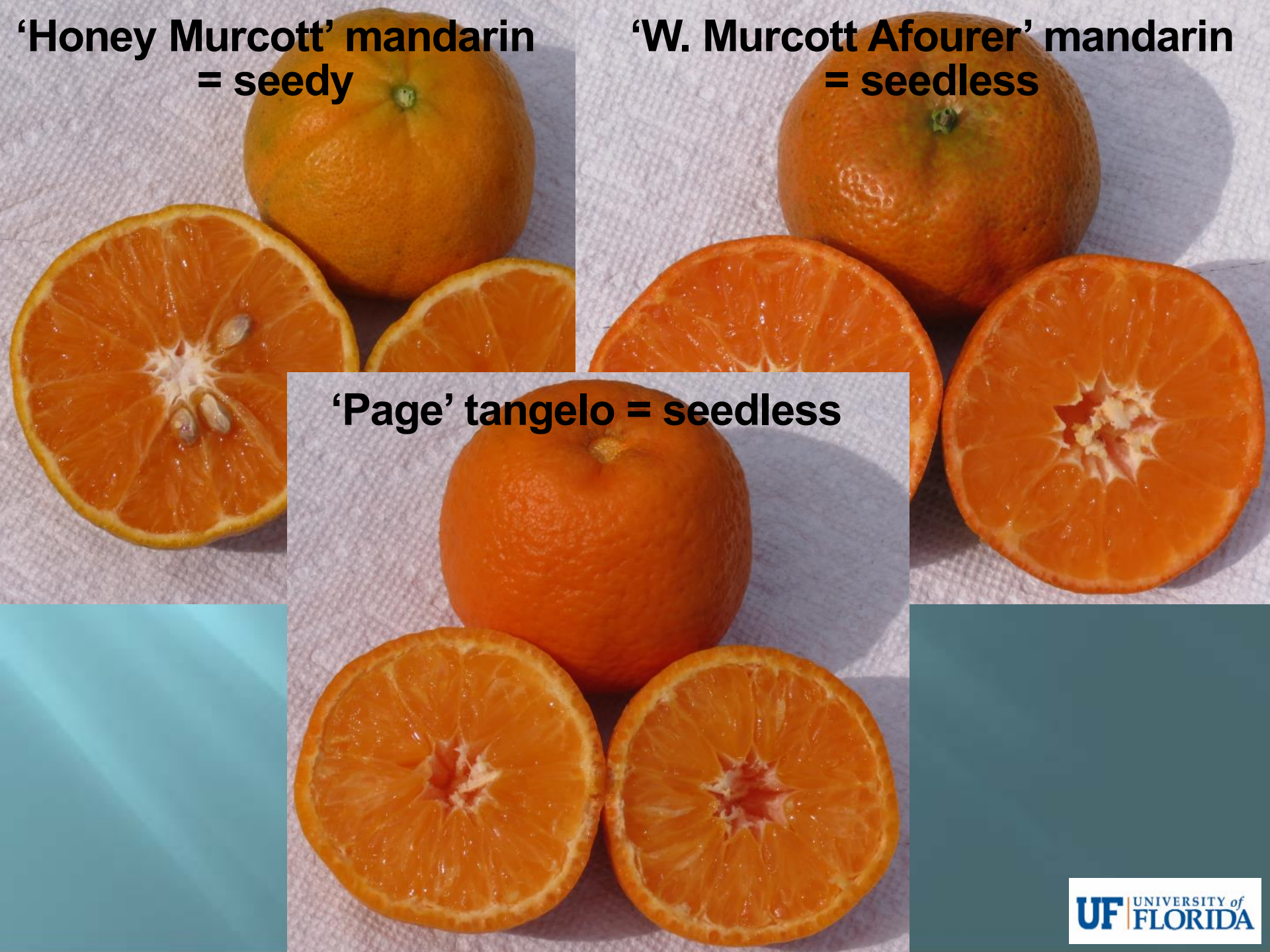

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July 2018 immature fruit samples – CREC CUPS
‘Bingo’ = seedless

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‘Dancy’ = seedy

‘Kinnow’ mandarin = low seeded

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‘Nules’ clementine = seedless

‘Sugar belle’ = seedless

‘Temple’ = low seeded

CUPS yield results at 3.5 years

- ‘Ray Ruby’ grapefruit trees grown in CUPS or Outdoors:

‘Ray Ruby’ grapefruit	Fruit yield boxes/ ac	Fruit diameter (cm)	Acid (%)	Brix	Ratio	SS lb/box
CUPS	731	10.11	0.763	7.80	10.23	3.52
Outdoors	80	8.42	0.929	7.08	7.69	3.07
F-prob	*<0.001* ***	*<0.001* ***	*<0.001* ***	*<0.001* ***	*<0.001* ***	*<0.001* ***

juice yield: NS

All significant effects were due to HLB disease affecting the outdoor trees

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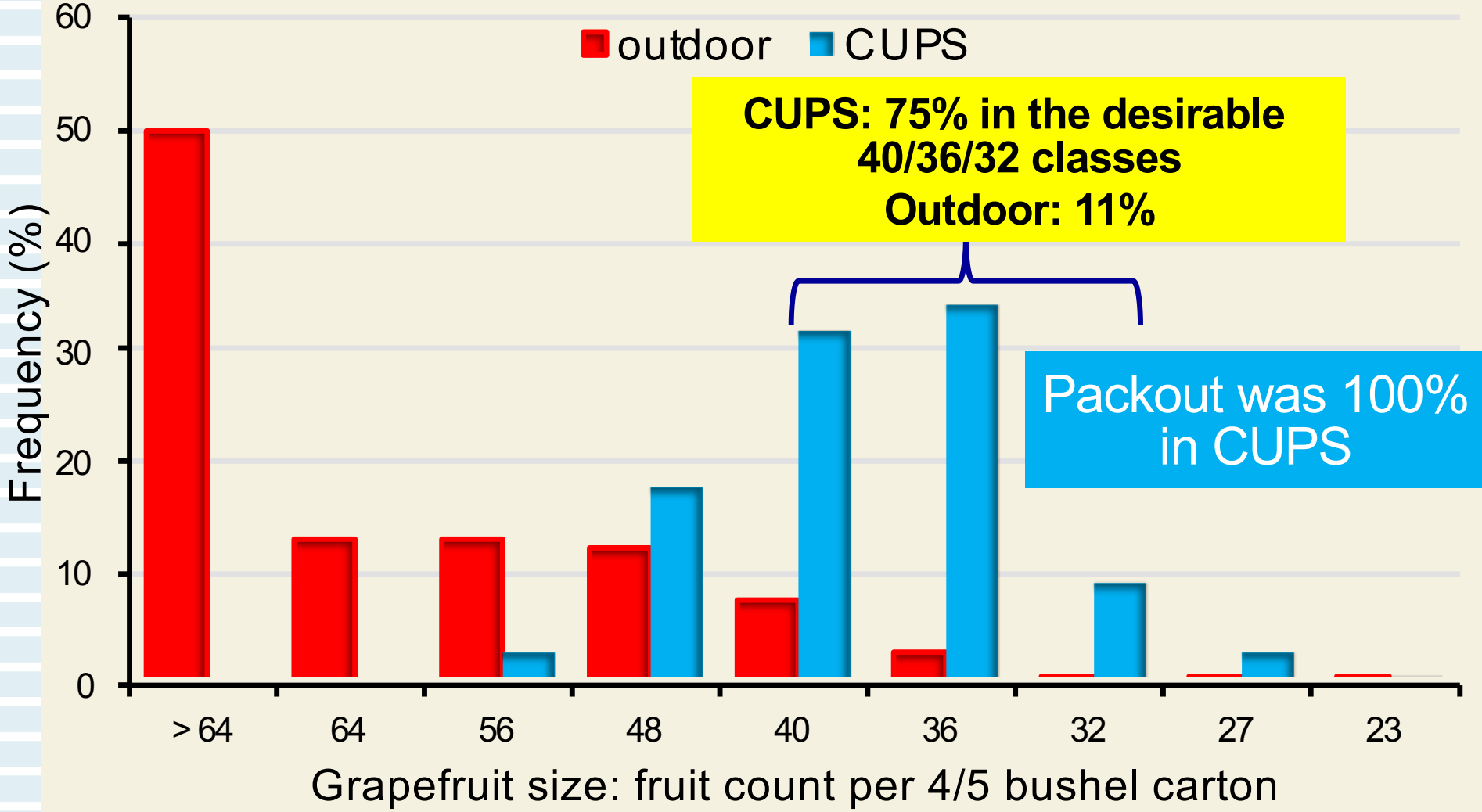
CREC 'Ray Ruby' fruit size: 2018 plot harvest



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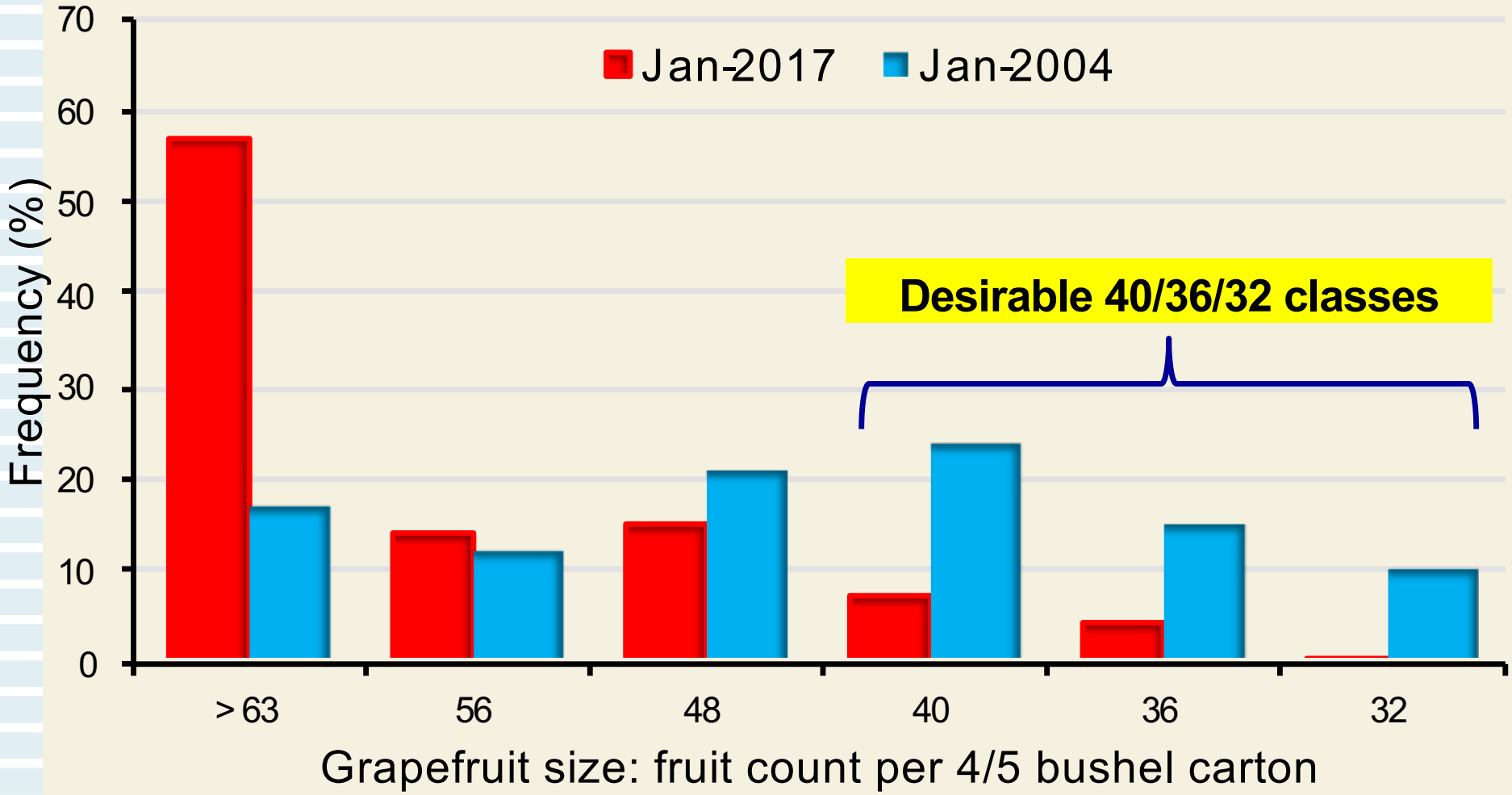
Red grapefruit size: Florida 2004 versus 2017

(Florida Agricultural Statistics Service)



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Economic indicators for CUPS

Price structure, 'Ray Ruby', excluding pick and haul:

SIZE	Field boxes	Sales	Container charge	Other charge	Net	Net/box
32	27	$1,266.43	$260.82	$13.50	$992.11	$36.74
40/36	64	$3,343.12	$950.40	$32.00	$2,360.72	$36.89
48	3.5	$135.34	$43.09	$1.75	$90.50	$25.86
Bulk (lower grade)	63	$902.01	$63.00	$31.50	$807.51	$12.82
TOTALS	**157.5**	**$5,646.89**	**$1,317,31**	**$78.75**	**$4,250.83**	**$26.99**

202 trees harvested: 157.5 boxes, 0.78 boxes/tree

871 trees/acre: 679 boxes/acre

@ $23.86/box incl. pick & haul: **$16,204/acre net**

(=average across all experiment treatments)

Highest = 824 boxes/acre: **$19,661/acre net**

***60% of fruit was premium grade**

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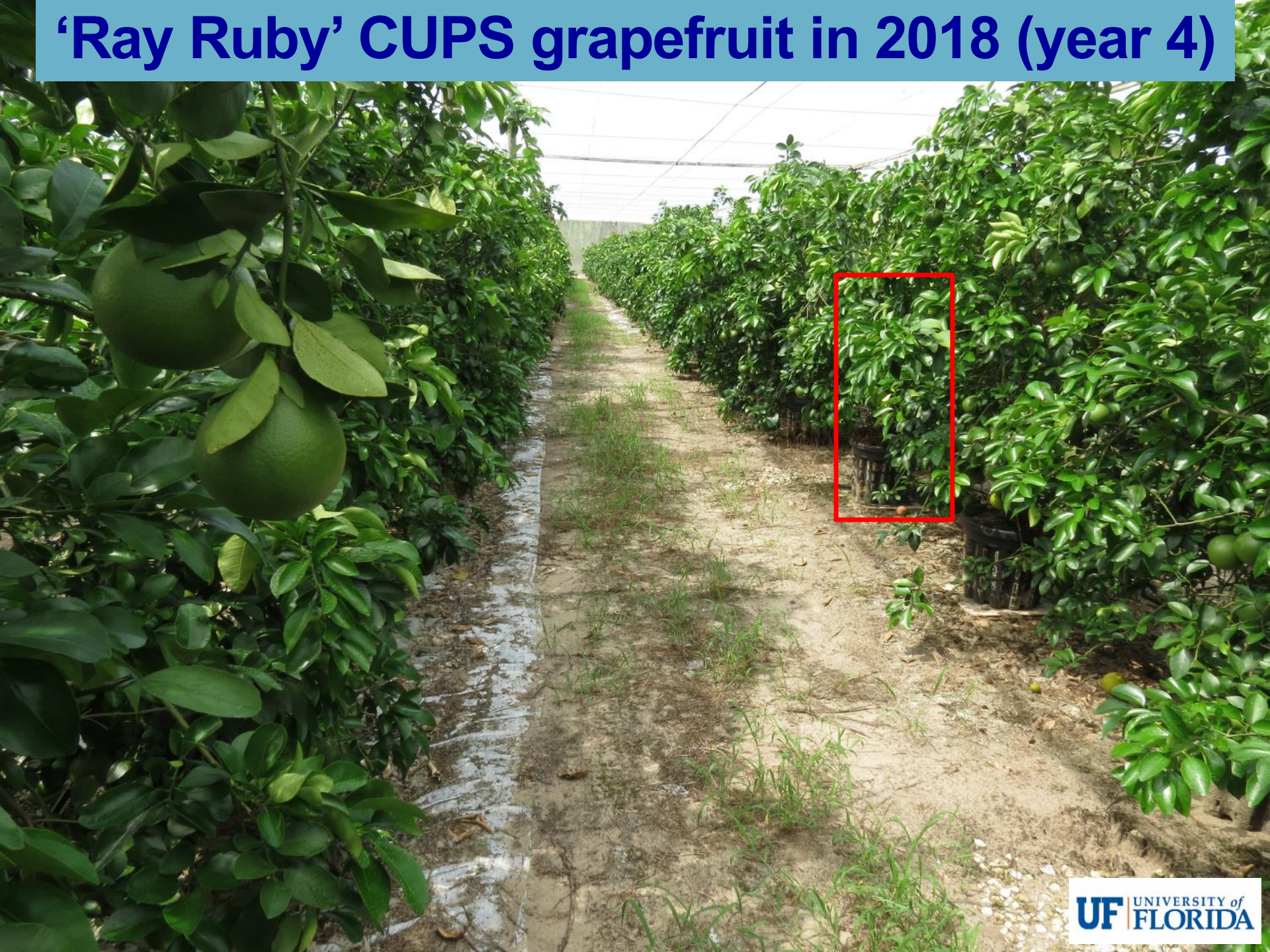
‘Ray Ruby’ CUPS grapefruit in 2018 (year 4)



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‘Ray Ruby’ CUPS grapefruit in 2018 (year 4)

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‘Ray Ruby’ CUPS grapefruit in 2018 (year 4)

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‘Ray Ruby’ CUPS grapefruit in 2018 (year 4)

Estimated yield by fruit count= 860 boxes/acre
4-year cumulative= 2,135 boxes/acre

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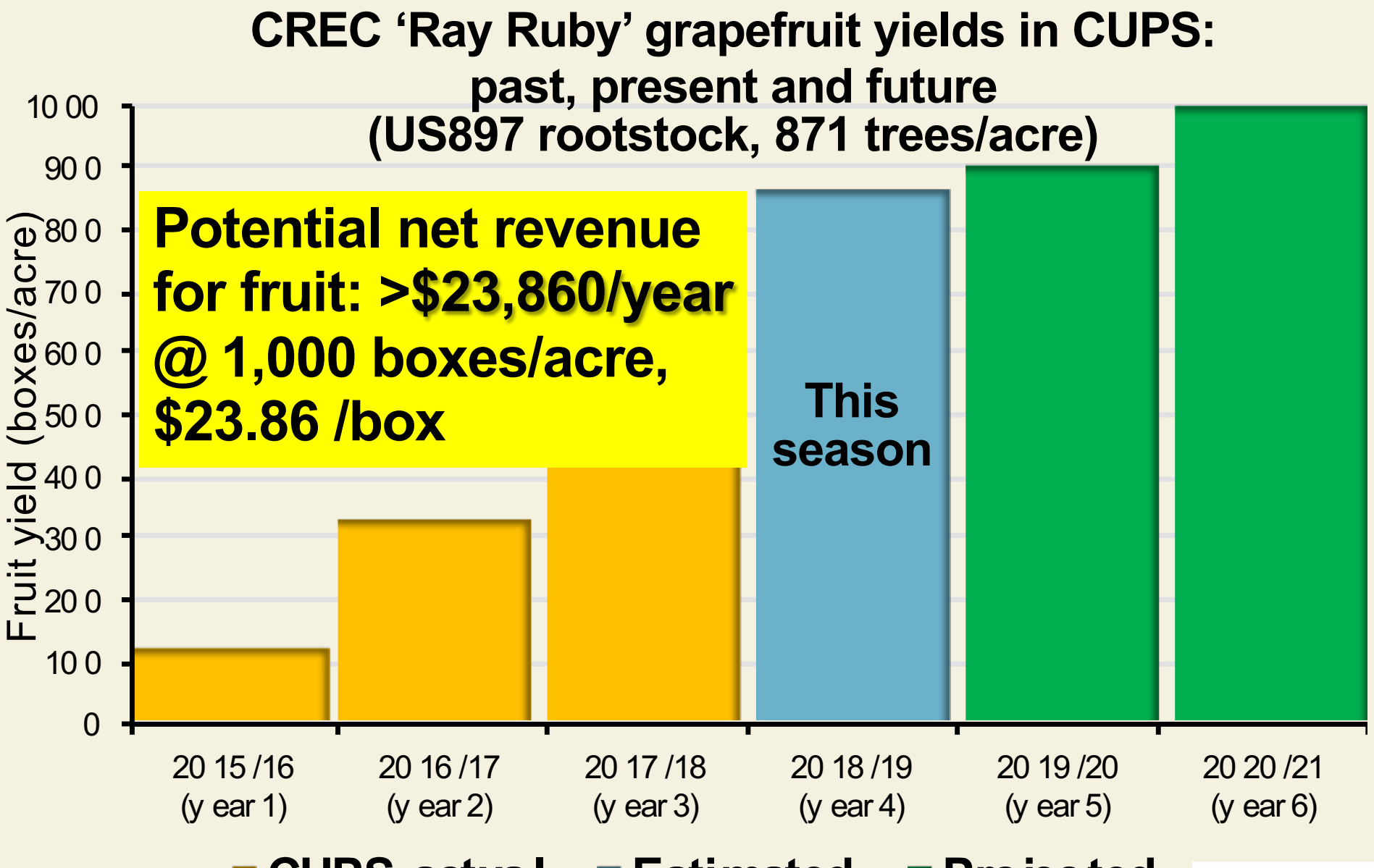
‘Ray Ruby’ CUPS grapefruit long-term prospects



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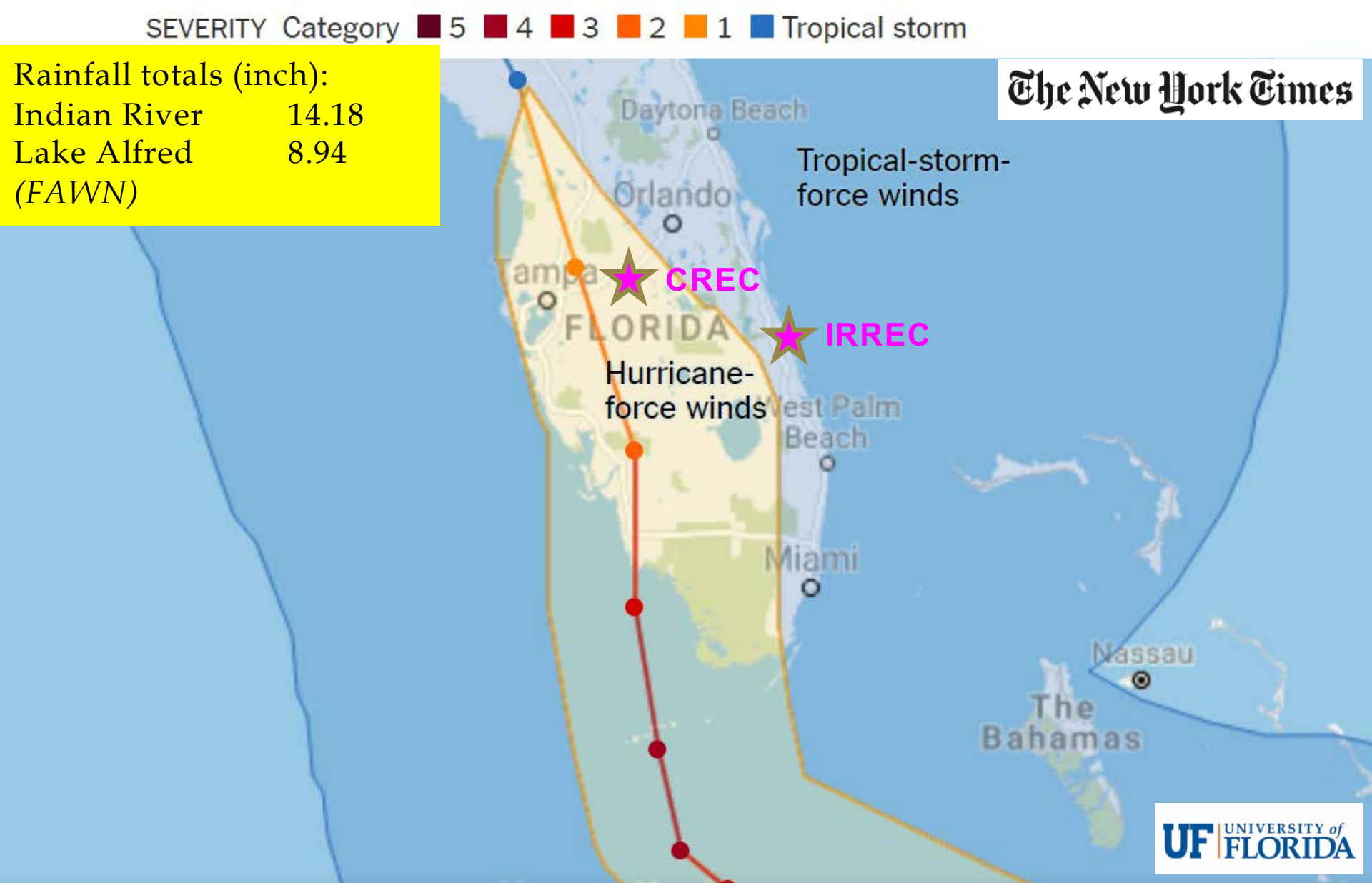
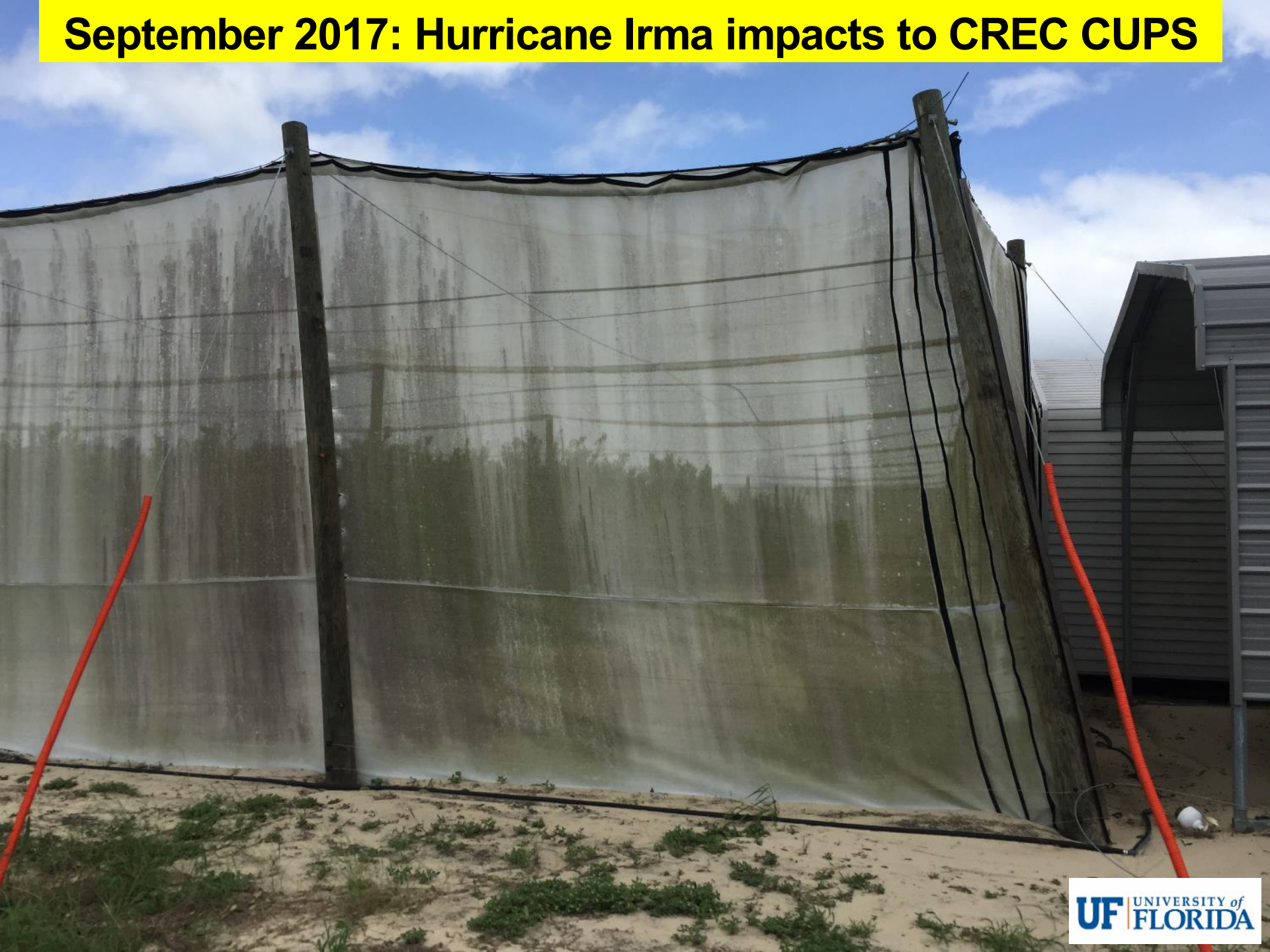
Hurricane Irma in Florida: 10-11 September 2017



September 2017: Hurricane Irma impacts to CREC CUPS



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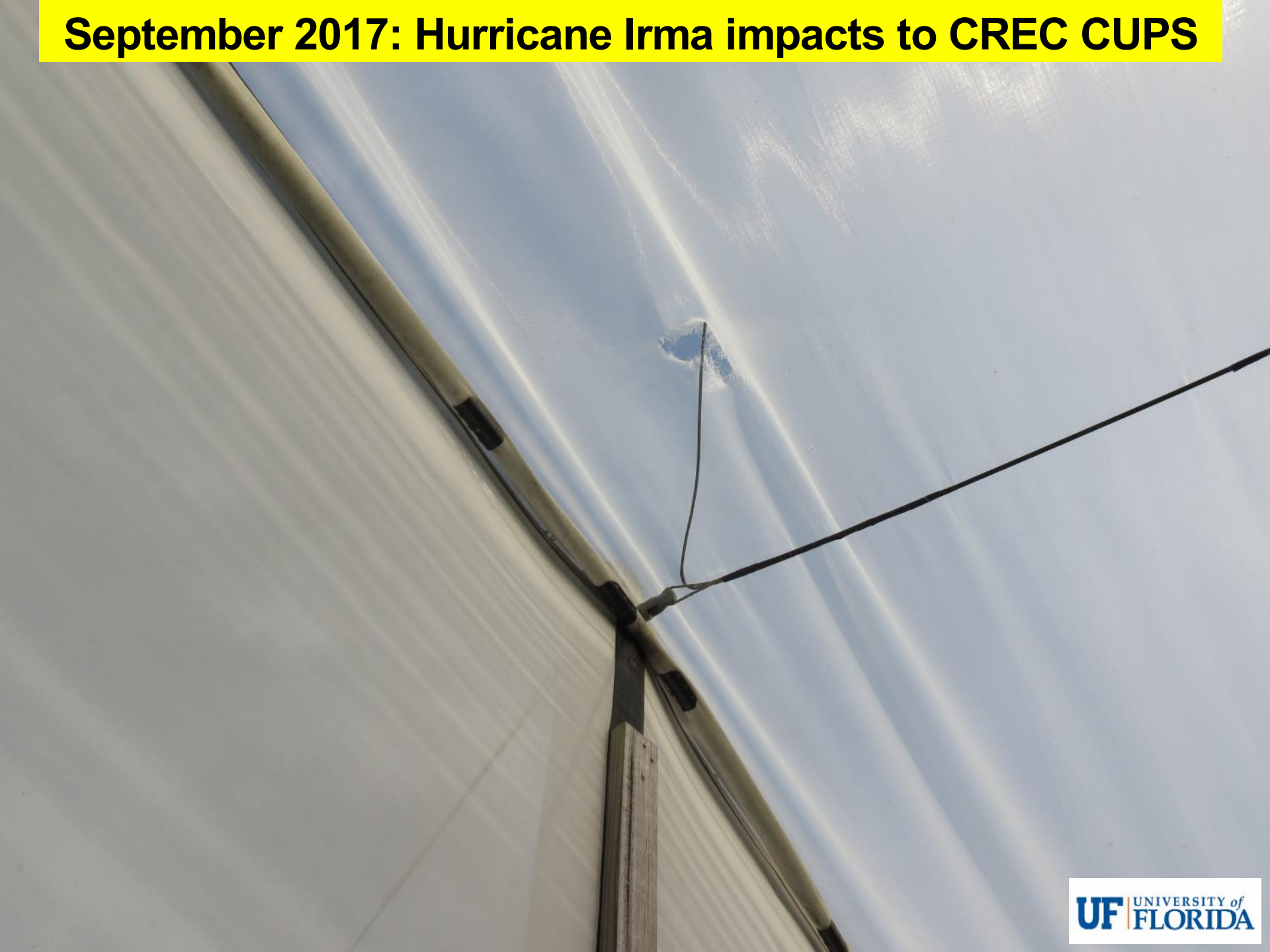

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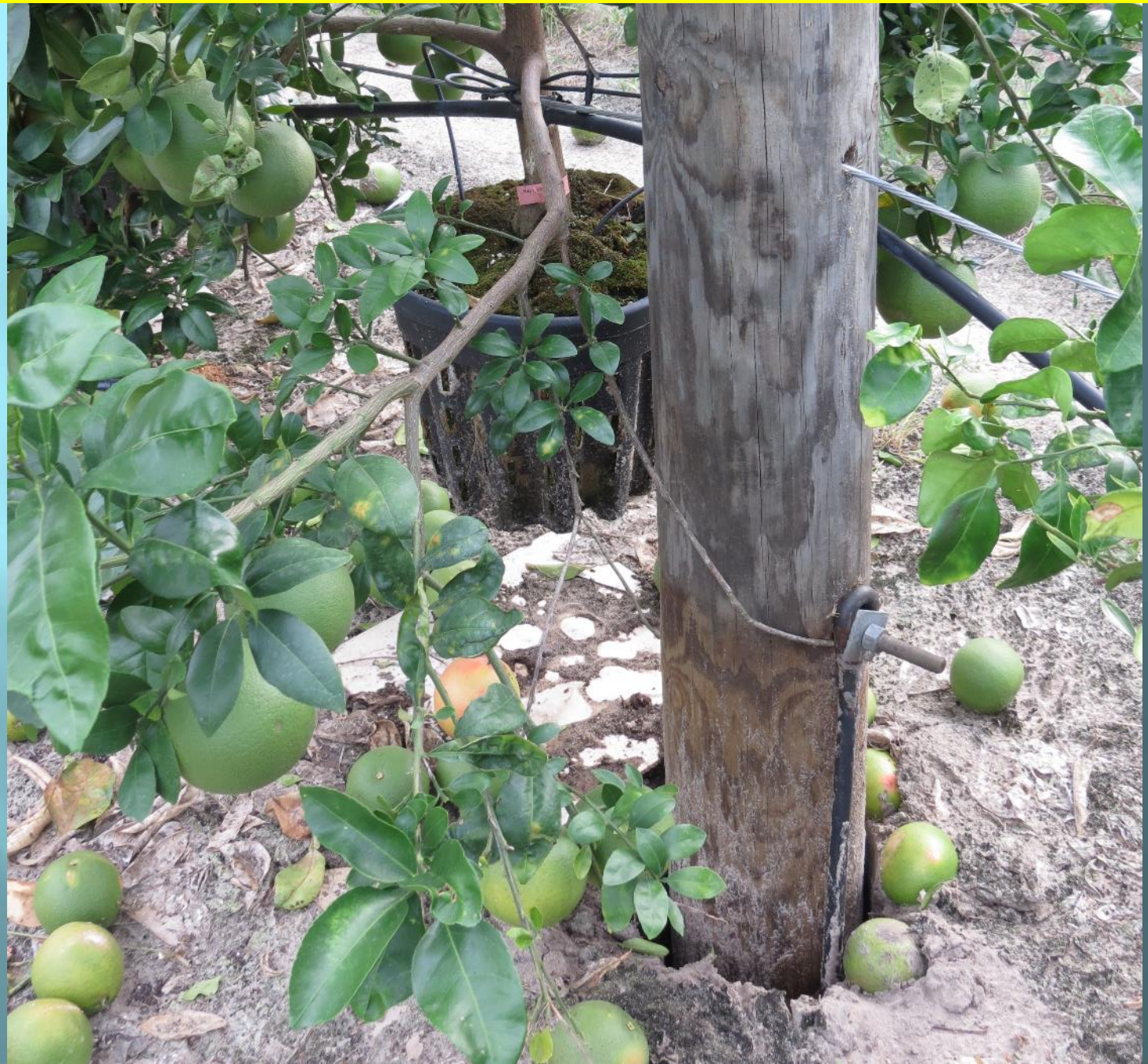

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September 2017: repairs to CREC CUPS

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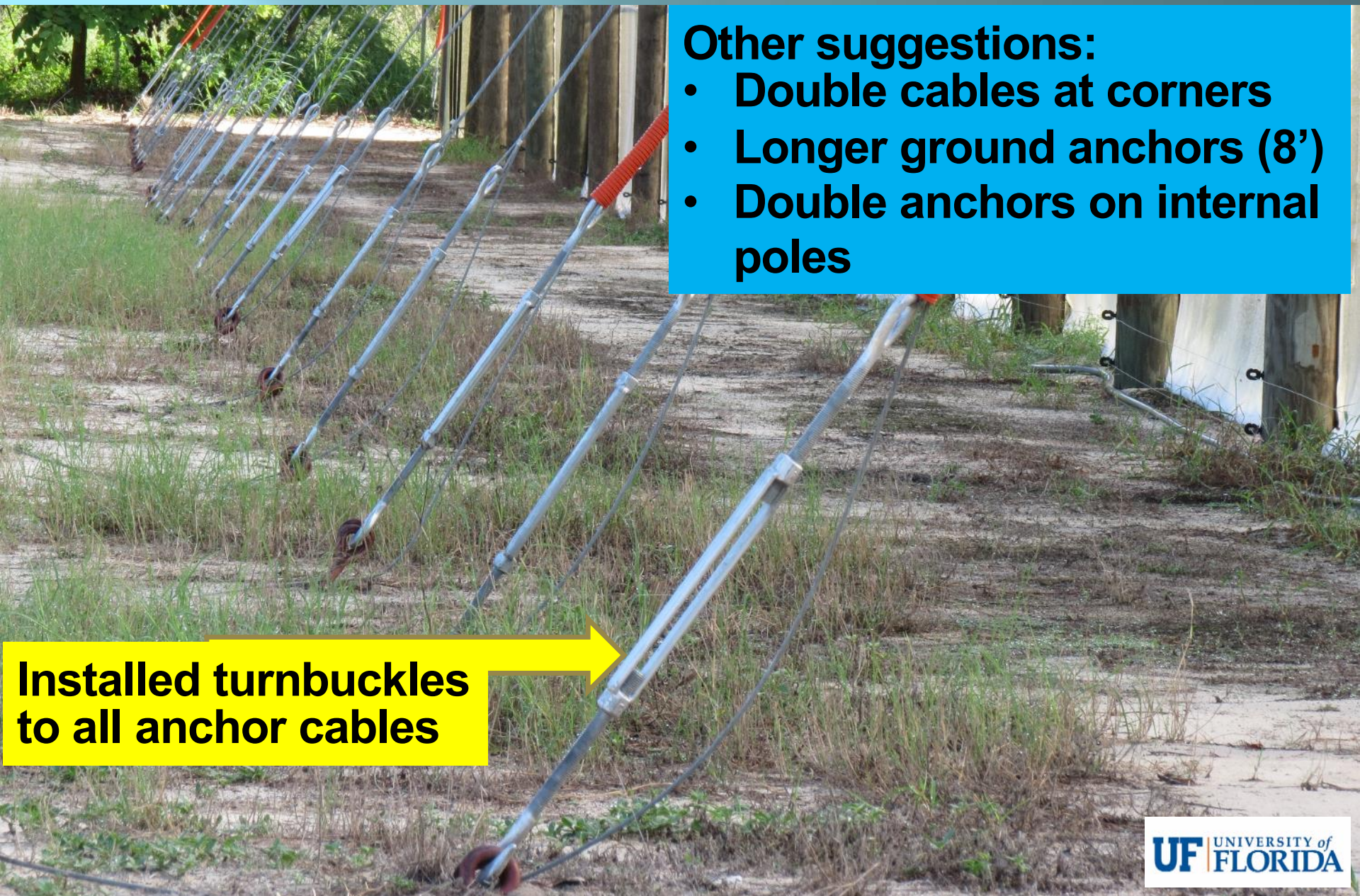

Other suggestions:

- Double cables at corners
- Longer ground anchors (8’)
- Double anchors on internal poles

Installed turnbuckles to all anchor cables

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Future plans and outlook

UF/IFAS is working with commercial CUPS growers in Florida

Commercial CUPS @ 1 year

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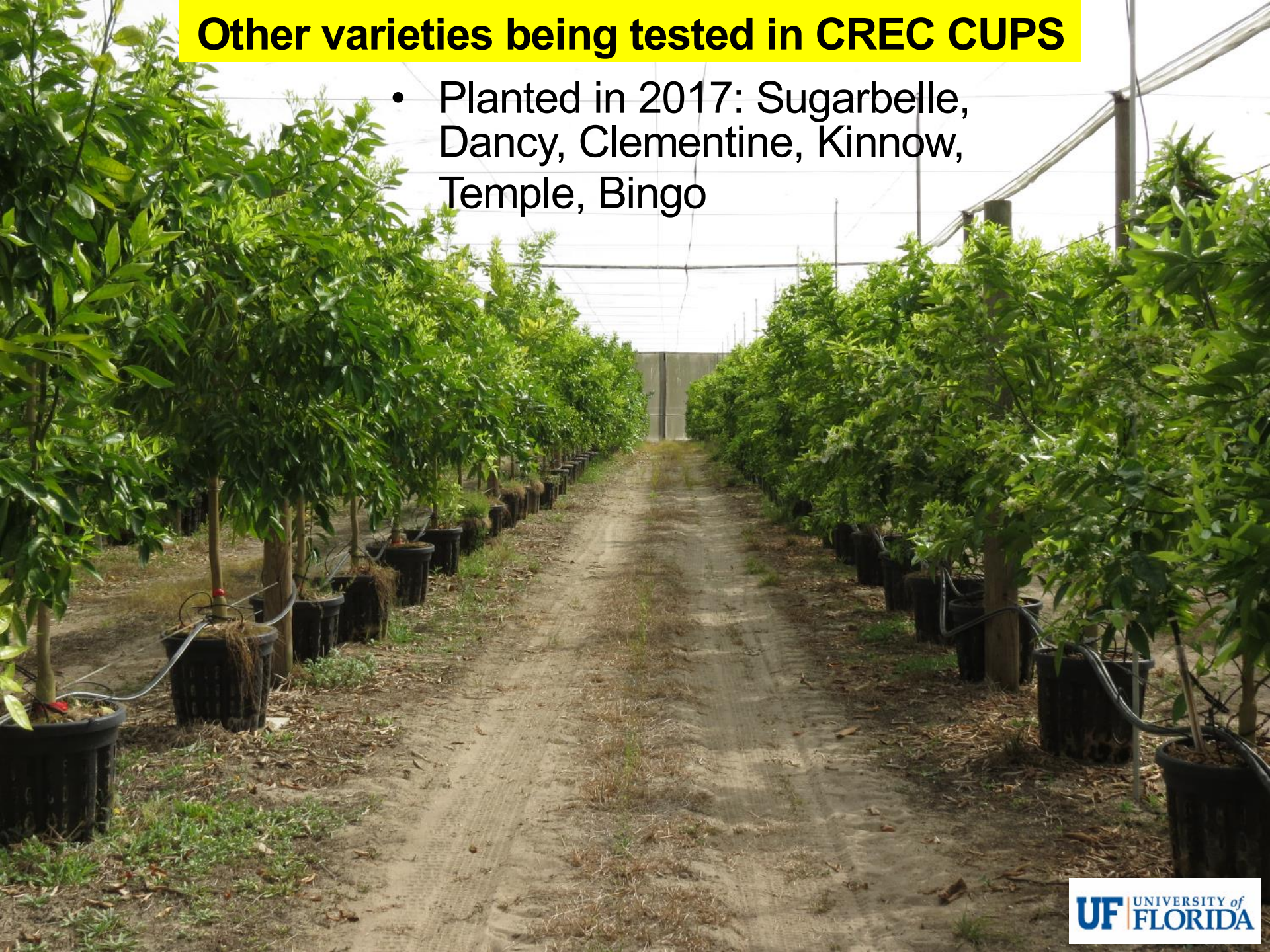
Other varieties being tested in CREC CUPS

- Planted in 2017: Sugarbelle, Dancy, Clementine, Kinnow, Temple, Bingo



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New varieties testing in CREC CUPS
'Bingo', @ 1.5 years
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New varieties testing in CREC CUPS: Red grapefruit-like UF914, @ 4 years

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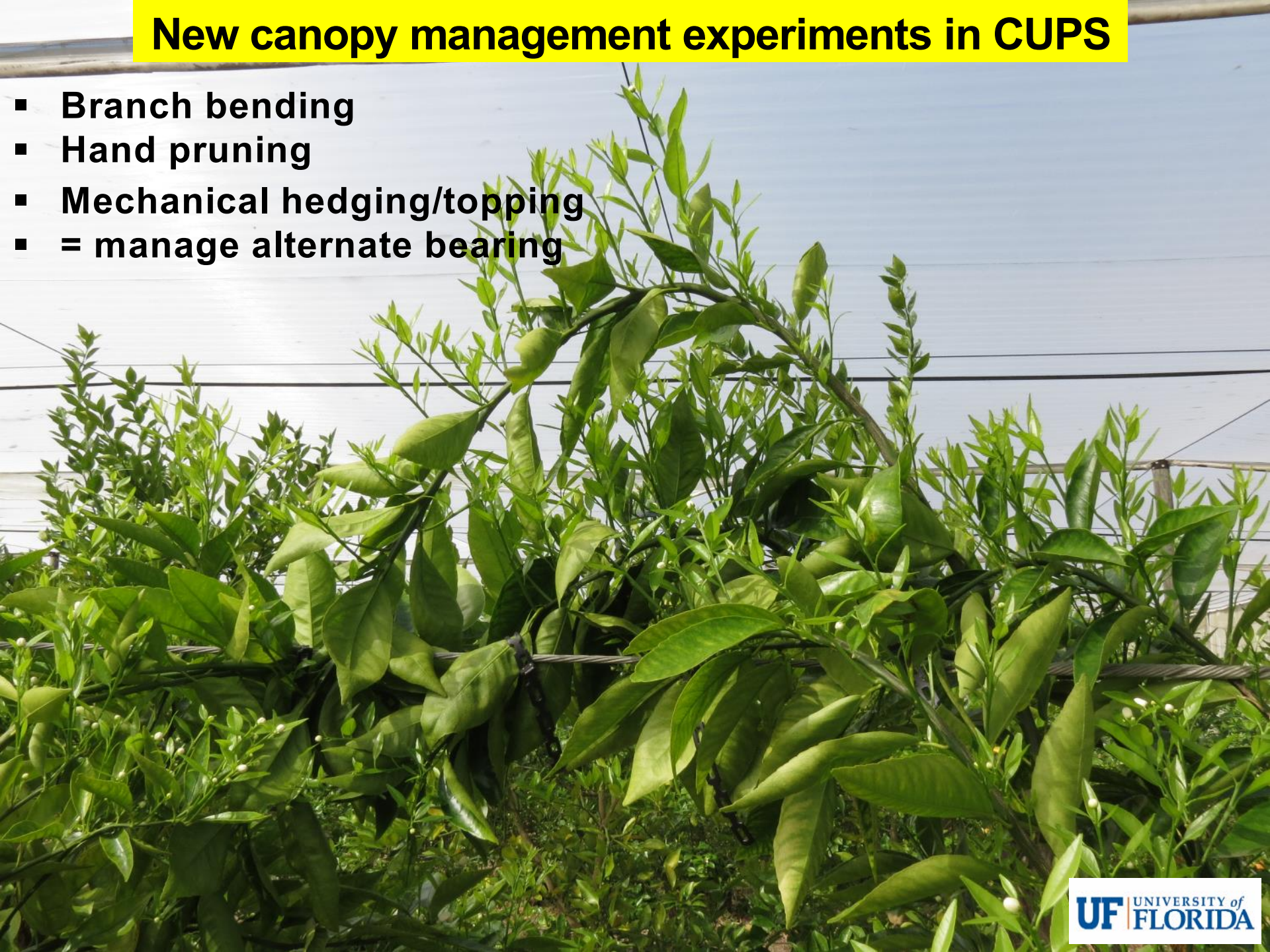
New canopy management experiments in CUPS

- Branch bending
- Hand pruning
- Mechanical hedging/topping
- = manage alternate bearing



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CONCLUSIONS

- CUPS is an attractive non-GMO fresh fruit solution to HLB
- Economic viability of CUPS technology can be maximized by early high yields of premium grade fruit & high pack-out,100%
- Hydroponic cultivation of citrus in containers is an attractive option for boosting planting densities, early yields and quality of fresh fruit in CUPS, but is more complicated
- Questions remain, such as alternate bearing, longevity of the hydroponic citrus, and ultimate profitability, to be investigated with ongoing research and economic assessments
- Notable disadvantages of hydroponic citrus include higher establishment costs, more management, trellises required for support, and more difficult weed control. However robotic fruit harvesting is more feasible with trellised trees

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SUMMARY – CREC CUPS

- The CREC screen house survived a category 2 hurricane in 2017
- Trees & fruit in the CUPS were protected from the hurricane
- After four years, there is no HLB in the CREC CUPS
- During four years of scouting, one psyllid adult found on a trap
- Two commercial harvests of ‘Ray Ruby’ grapefruit, and ‘Murcott’ sold fruit with 100% pack-out and up to 824 boxes/acre/year
- Estimated third harvest (fruit count) is on track >850 boxes /acre
- Other grapefruit- and tangerine- like varieties are being tested: seedless, early-season, attractive additions for CUPS

Thank you for your support

Grower stakeholders & cooperators
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UF/IFAS Extension Agents
Laboratory and Support Staff

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IFAS Research
Florida Agricultural Experiment Station

(Mark McLellan, previous Dean for Research)

CREF
Citrus Research and Education Foundation, Inc.

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