CITRUS UNDER PROTECTIVE SCREEN (CUPS) - UPDATE & POST HURRICANE OBSERVATIONS

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Citrus Research and Education Center

Citrus
Under
Protective
Screen

INTRODUCTION

- Growing Citrus Under Protective Screen (CUPS) excludes the Asian Citrus Psyllid and therefore Huaglongbing (HLB) disease
- Asymptomatic, low-seeded, premium grade fresh fruit can be grown 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 than a greenhouse, and the price can be reduced 50% or more by using overseas suppliers, careful design, and economies of scale
- The high cost of CUPS must be offset by high fruit revenue

Outline for today

- CREC CUPS – review 2017/18 season in pictures
- Hurricane Irma impacts, observations and recovery
- Fruit yields in year 3 (CREC), year 4 (IRREC)
- Economic Indicators – are we on track with CUPS?
- Future plans and outlook

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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SELECTED OBJECTIVES

- Evaluate hydroponic citrus growing system with containers and soilless media
- Compare container-grown citrus trees with trees in the ground
- Compare different size containers for growing citrus trees
- Compare two high planting densities (871 and 1,361 trees/acre)
- Evaluate potential fresh fruit varieties

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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 in 2 years)

‘Honey Murcott’ commercial harvest @ 2.5 years

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‘Honey Murcott’ commercial harvest @ 2.5 years

‘Honey Murcott’ after post-harvest hedging

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June 2017: ‘Honey’ murcott @ 2.75 years

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BB-4 early variety @ 3.0 years, 10-gal pots, 871 trees /acre

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November 2017: first ‘Early Pride’ fruit

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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

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

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

‘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

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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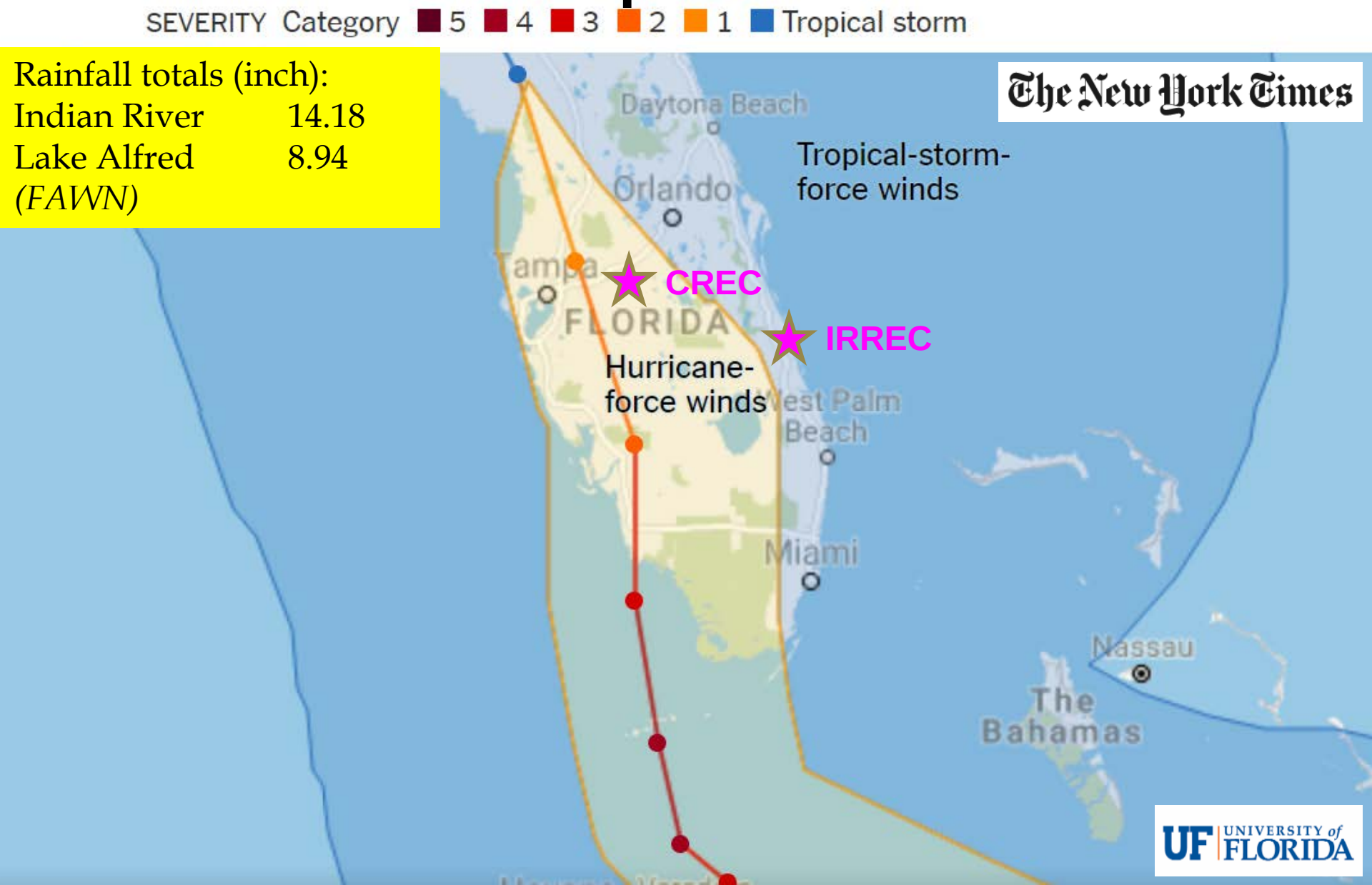
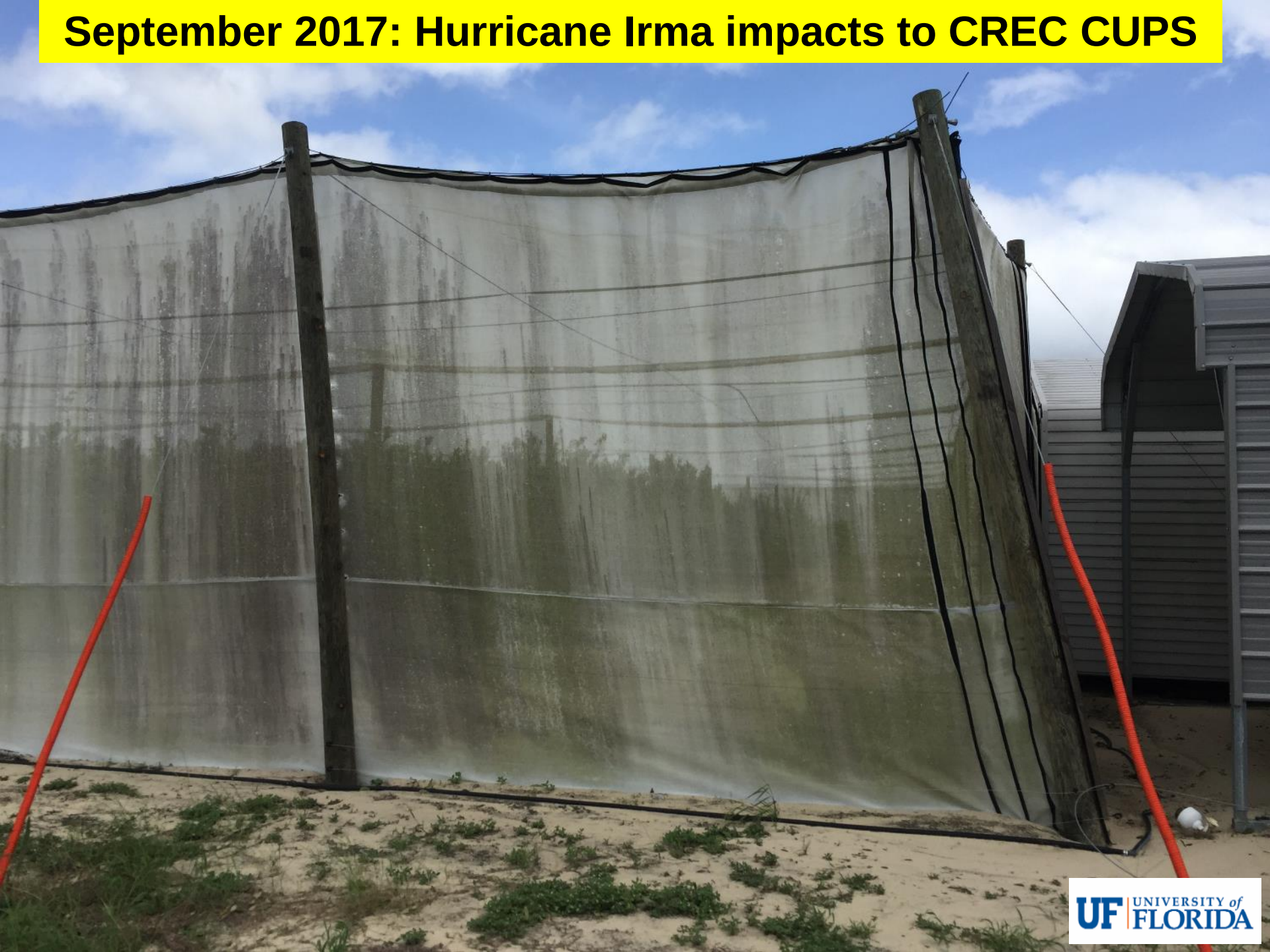
Hurricane Irma in Florida: 12-13 September 2017



September 2017: Hurricane Irma impacts to CREC CUPS



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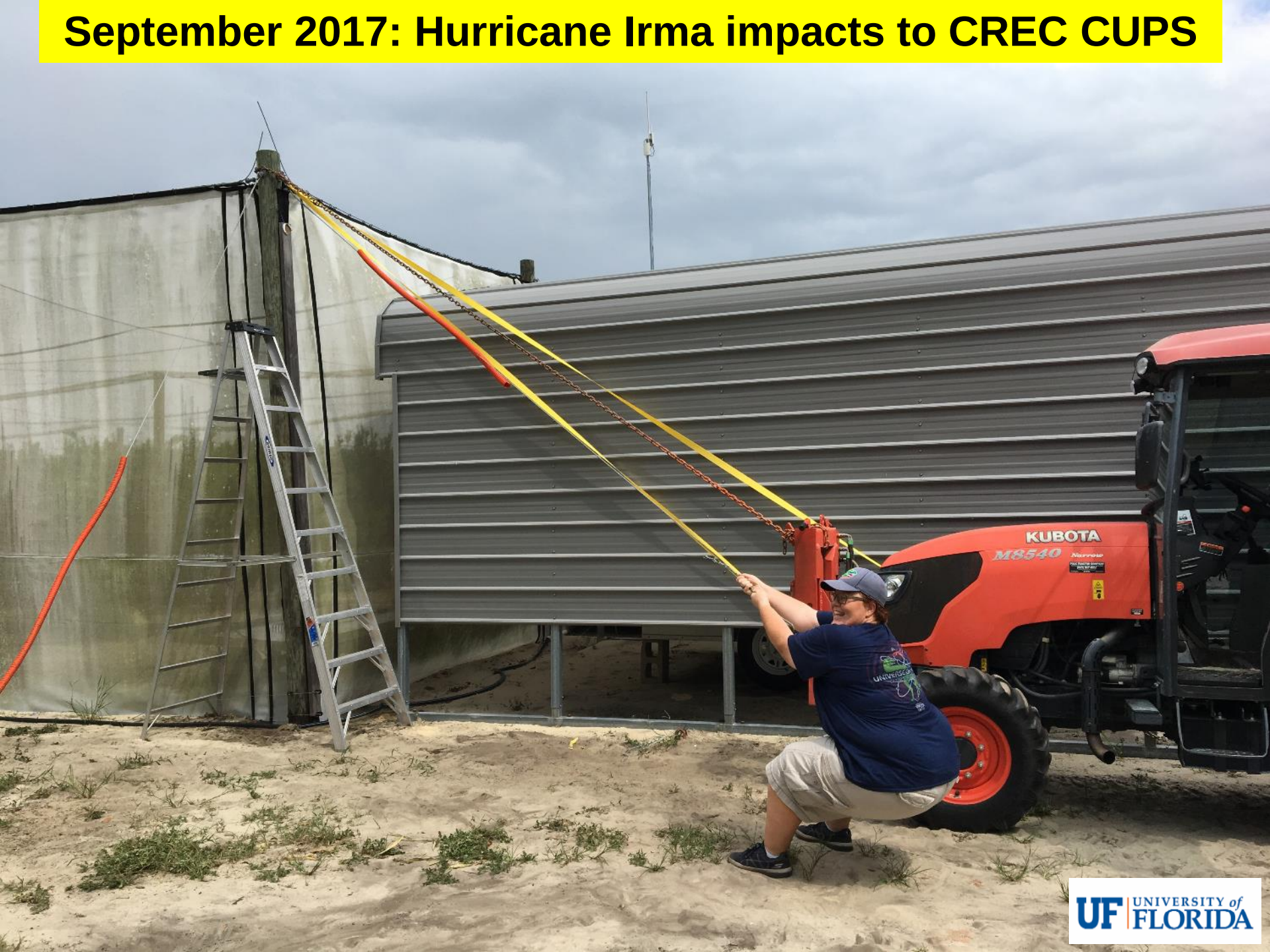

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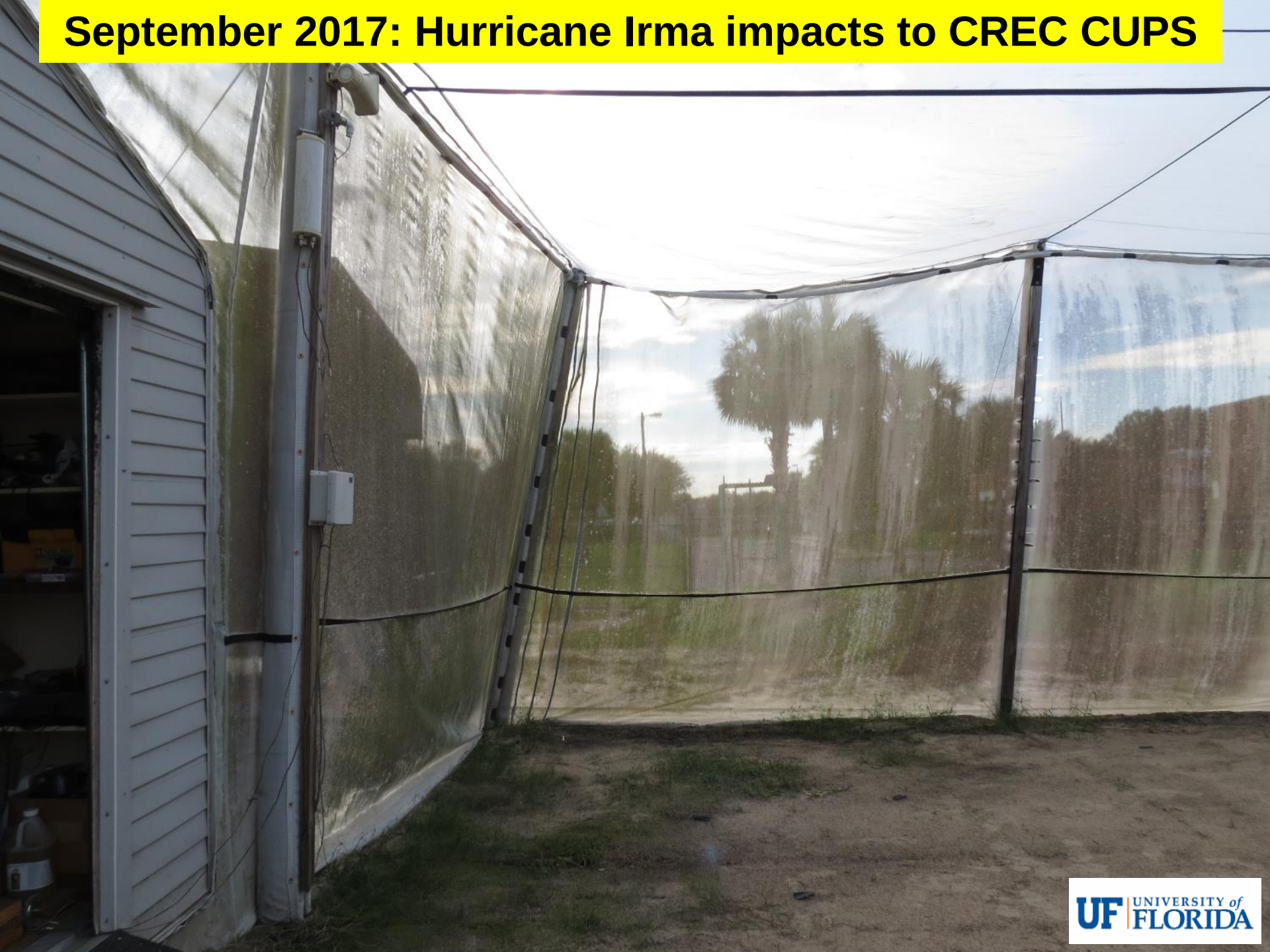

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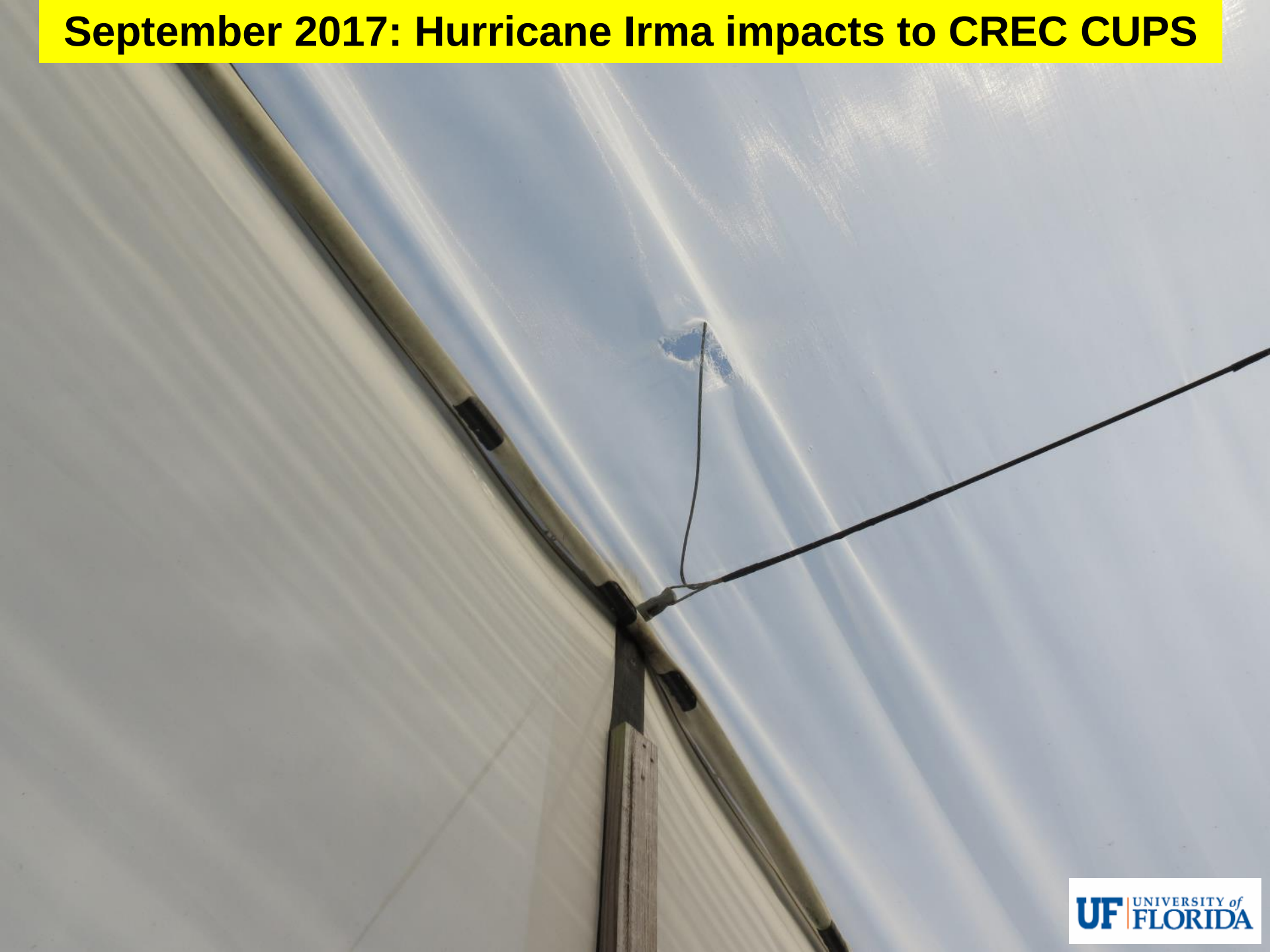

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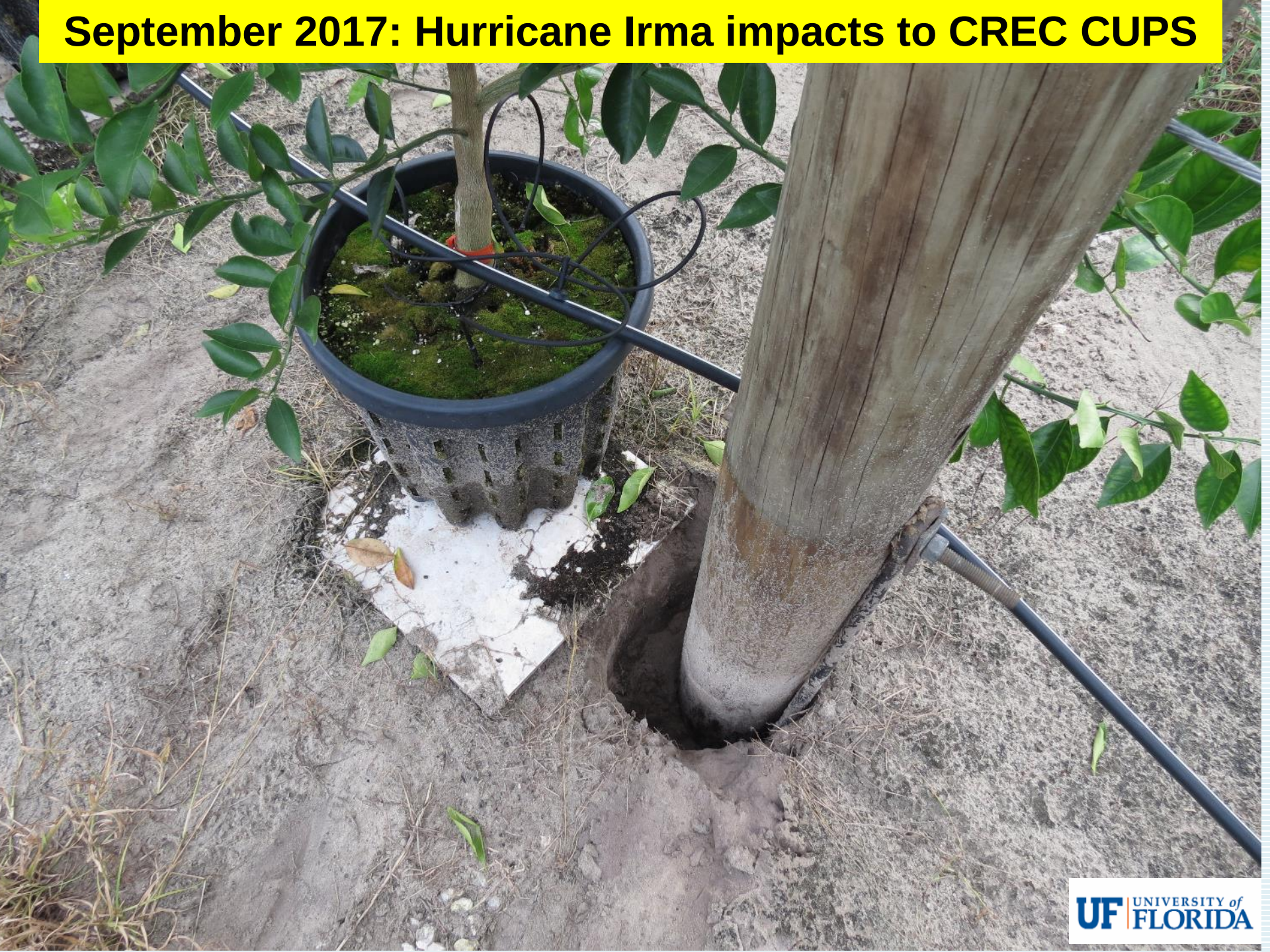

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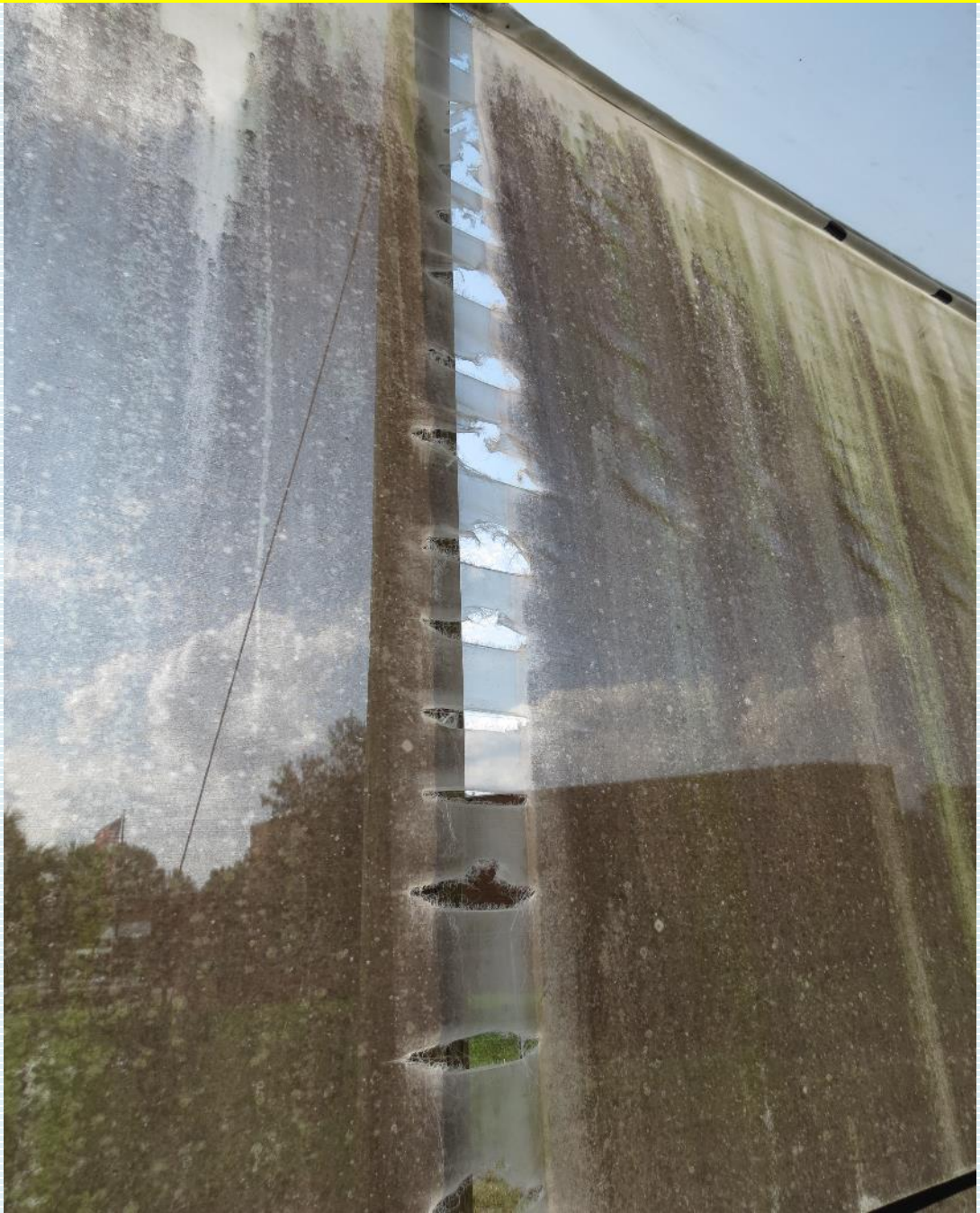

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September 2017: repairs to CREC CUPS

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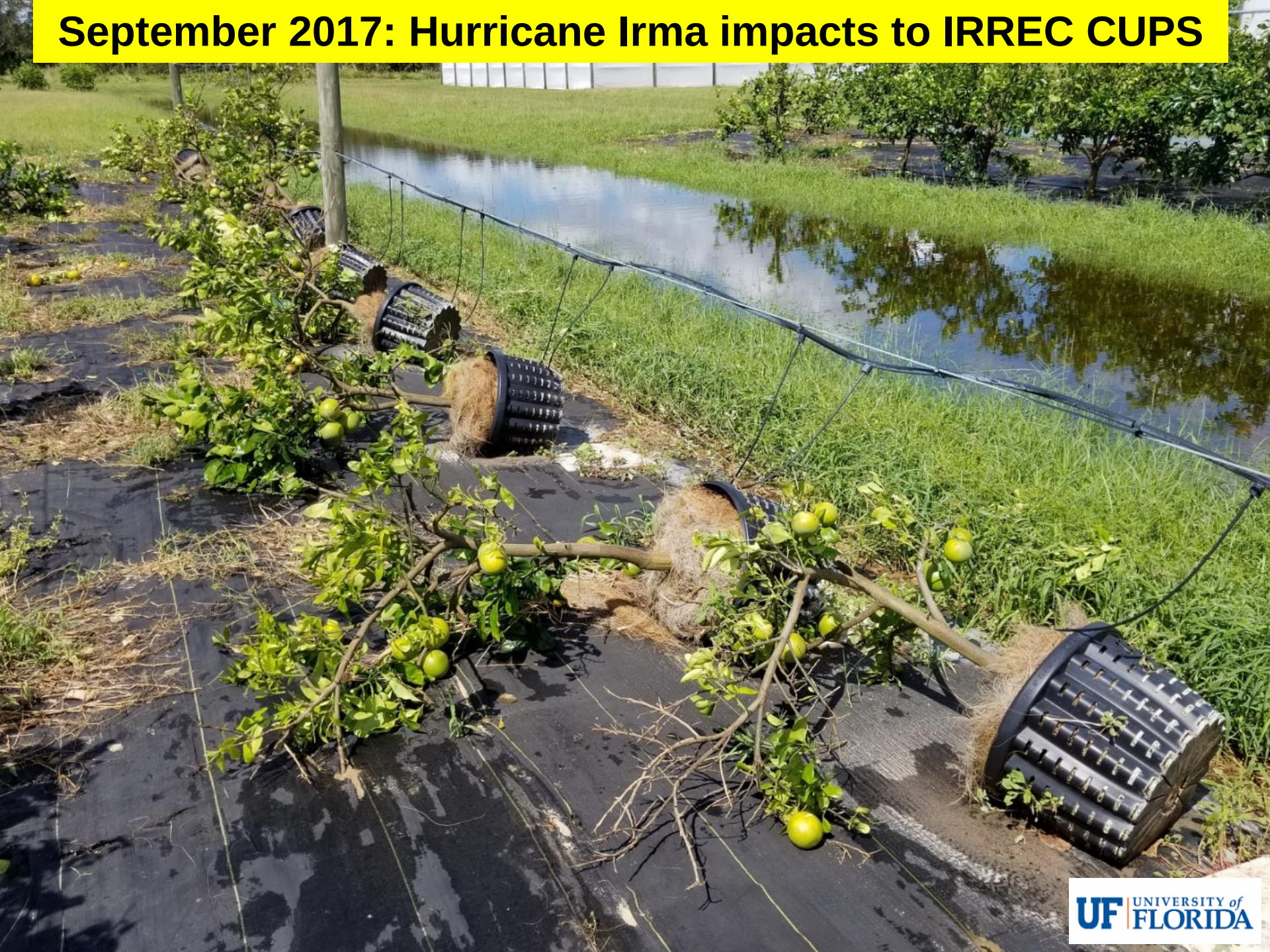
September 2017: Hurricane Irma impacts to IRREC CUPS



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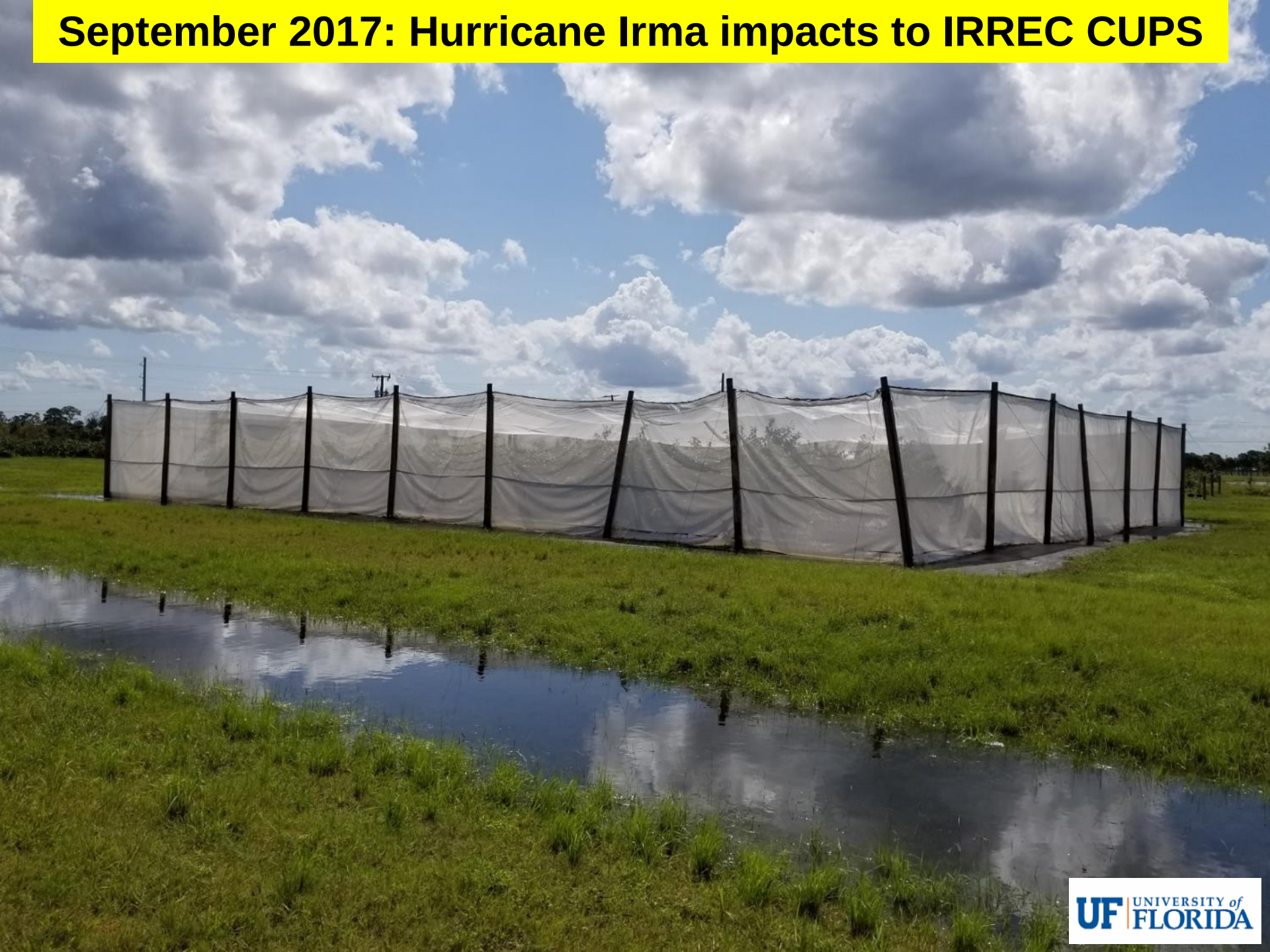
September 2017: Hurricane Irma impacts to IRREC CUPS



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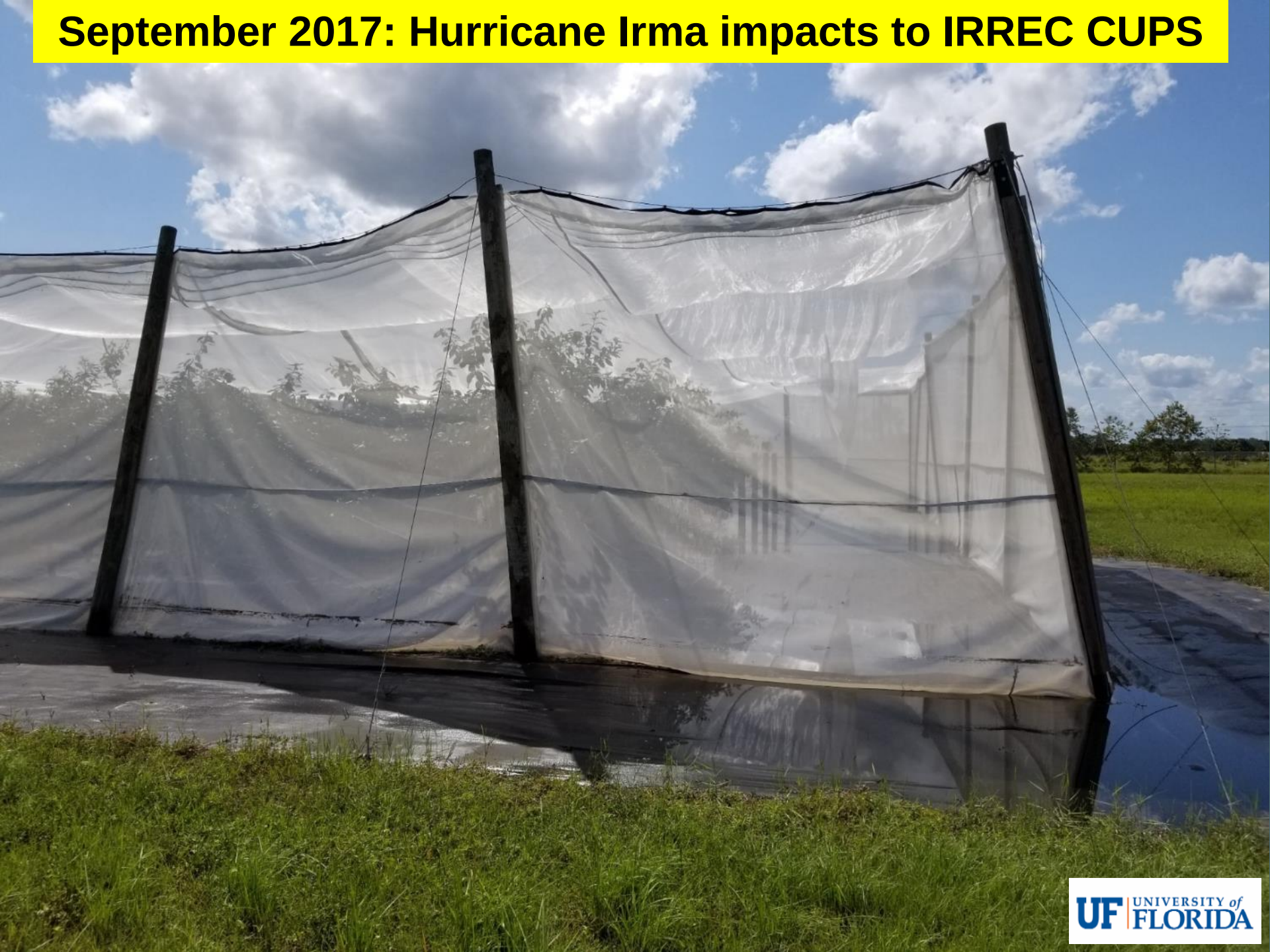

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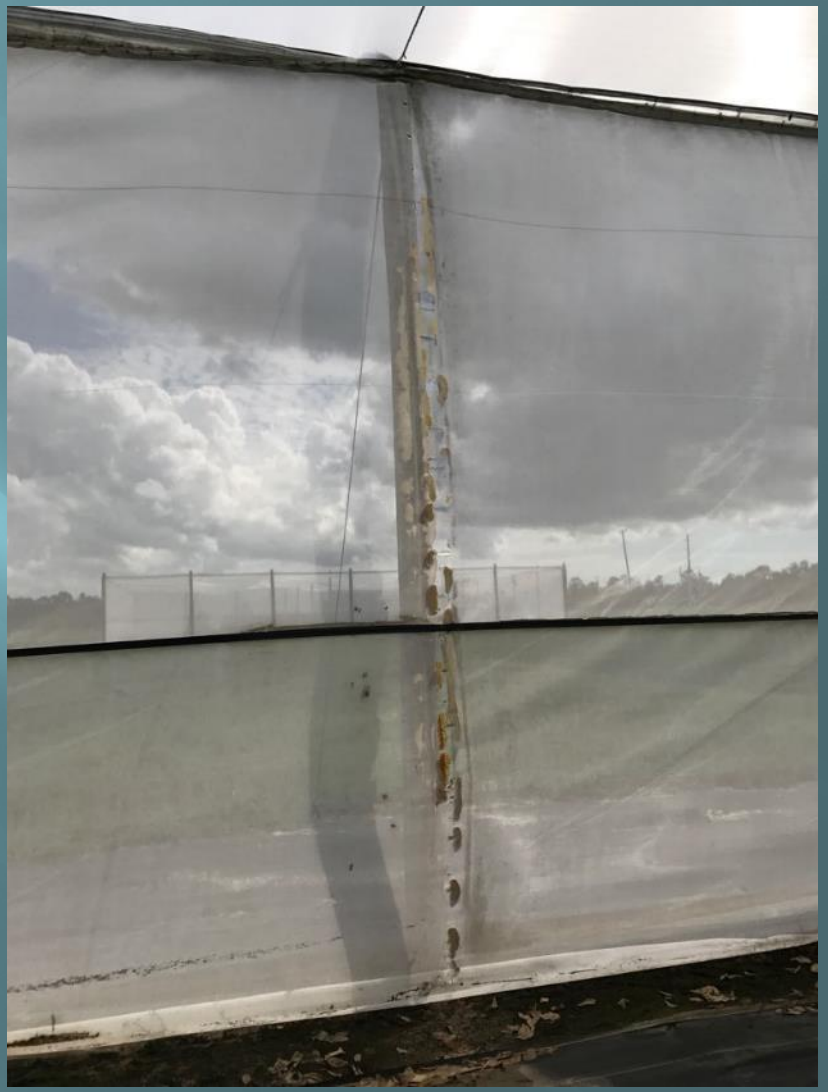
September 2017: Hurricane Irma impacts to IRREC CUPS



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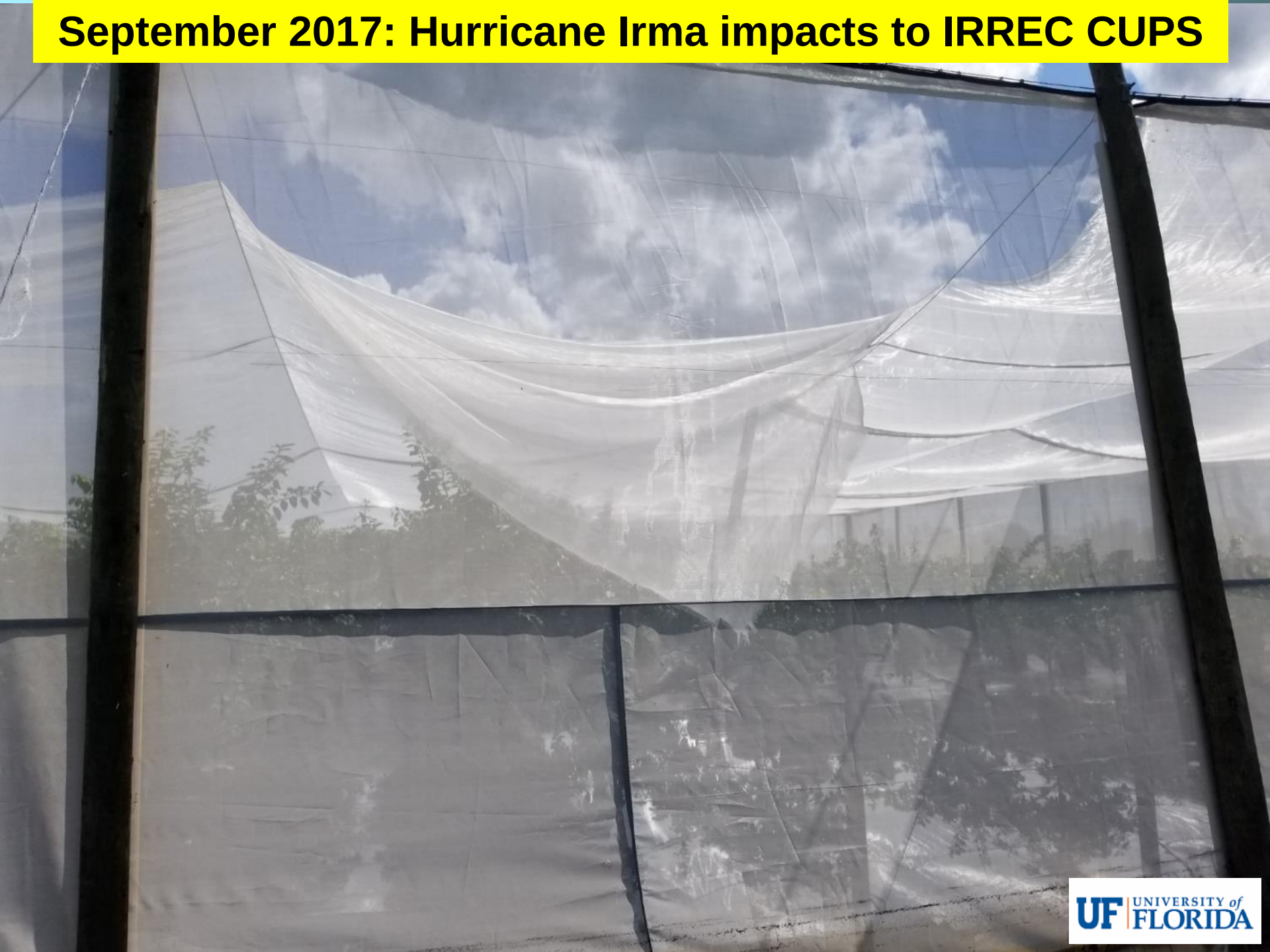
September 2017: Hurricane Irma impacts to IRREC CUPS



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IRREC CUPS storm damage situation:

- Loose guy wires, bent peripheral poles
- Lifting of ground cloth
- Center poles lifted out of ground 1’-2’
- Lifting of center poles likely caused rips in screens near peripheral poles and detachment of S hooks
- Pots overturned

CREC CUPS storm damage situation:

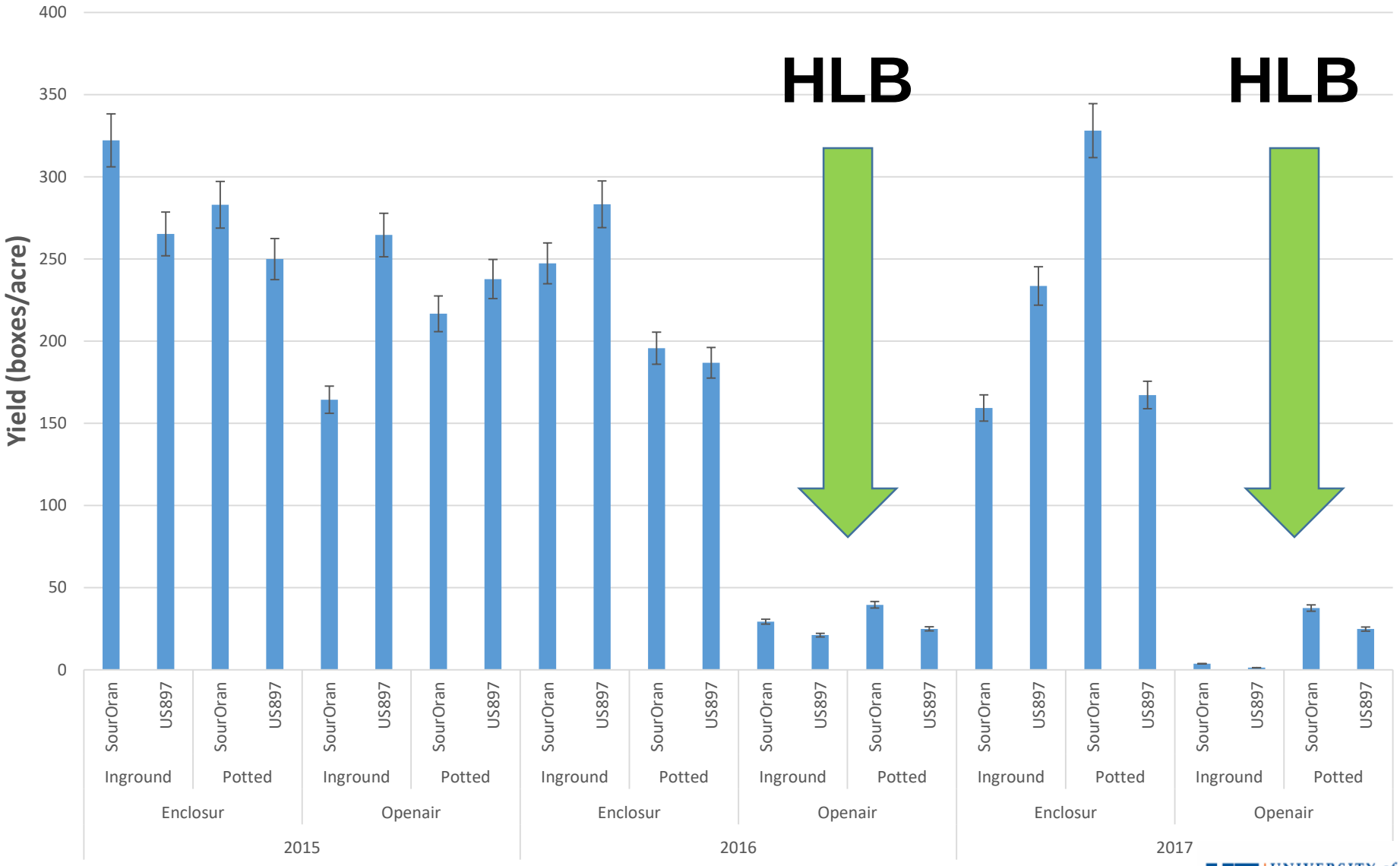
- One broken steel guy wire, leaning peripheral poles on west side
- Center poles lifted out of ground 1’-2’
- Small rips in screen at peripheral pole attachment
- Large rips in screen at roof panel attachments to wall poles
- Trellis wires loose

IRREC and CREC CUPS storm damage repairs:

- ✓ Glue patches over small tears at peripheral poles
- ✓ Re-sink internal poles and re-set anchors to original depth
- ✓ Replace broken cables
- ✓ Stitch and patch larger tears; replace largest damaged roof panels
- ✓ Straighten all poles – cable pullers
- ✓ Re-tighten all ground cables to balanced tension (installed turnbuckles at CREC)
- ✓ Re-tension all trellis wires

FLOODED soil problem at IRREC may need further attention

IRREC Yield results, years 2-4
‘Ray Ruby’ grapefruit



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CREC Yield results at 3.5 years

- ‘Honey’ murcott trees in deep alternate bearing cycle 2017/18
- Grapefruit trees were picked in research plots ahead of the commercial harvest
- Grapefruit trees in three pot sizes: 5, 7, 10 gal

‘Ray Ruby’ grapefruit	Fruit yield boxes/ac
5 gal	726
7 gal	824
10 gal	706
F-prob	*0.121 NS*

fruit yield, diameter, juice yield, acid, brix, ratio, solids /box: NS

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CREC Yield results at 3.5 years

- ‘Ray Ruby’ grapefruit trees on three rootstocks: US897, Sour Orange, X639

‘Ray Ruby’ grapefruit	Fruit yield boxes/ac	Brix	Ratio	SS lb/box
US897	713	7.5	9.8	3.4
Sour Orange	766	8.4	11.1	3.7
X639	699	6.9	8.9	3.2
F-prob	*0.162 NS*	*<0.001* ***	*<0.001* ***	*<0.001* ***

BEST TASTE!

fruit yield, diameter, juice yield, acid: NS

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CREC Yield results at 3.5 years

- ‘Ray Ruby’ grapefruit trees on white weed barrier cloth or none:

‘Ray Ruby’ grapefruit	Fruit yield boxes/ac	Fruit diameter (cm)
White cloth	719	10.18
None	706	9.96
F-prob	*0.762* *NS*	*0.028* *

fruit yield, juice yield, brix, acid, ratio, solids: NS

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CREC 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 trees outdoors

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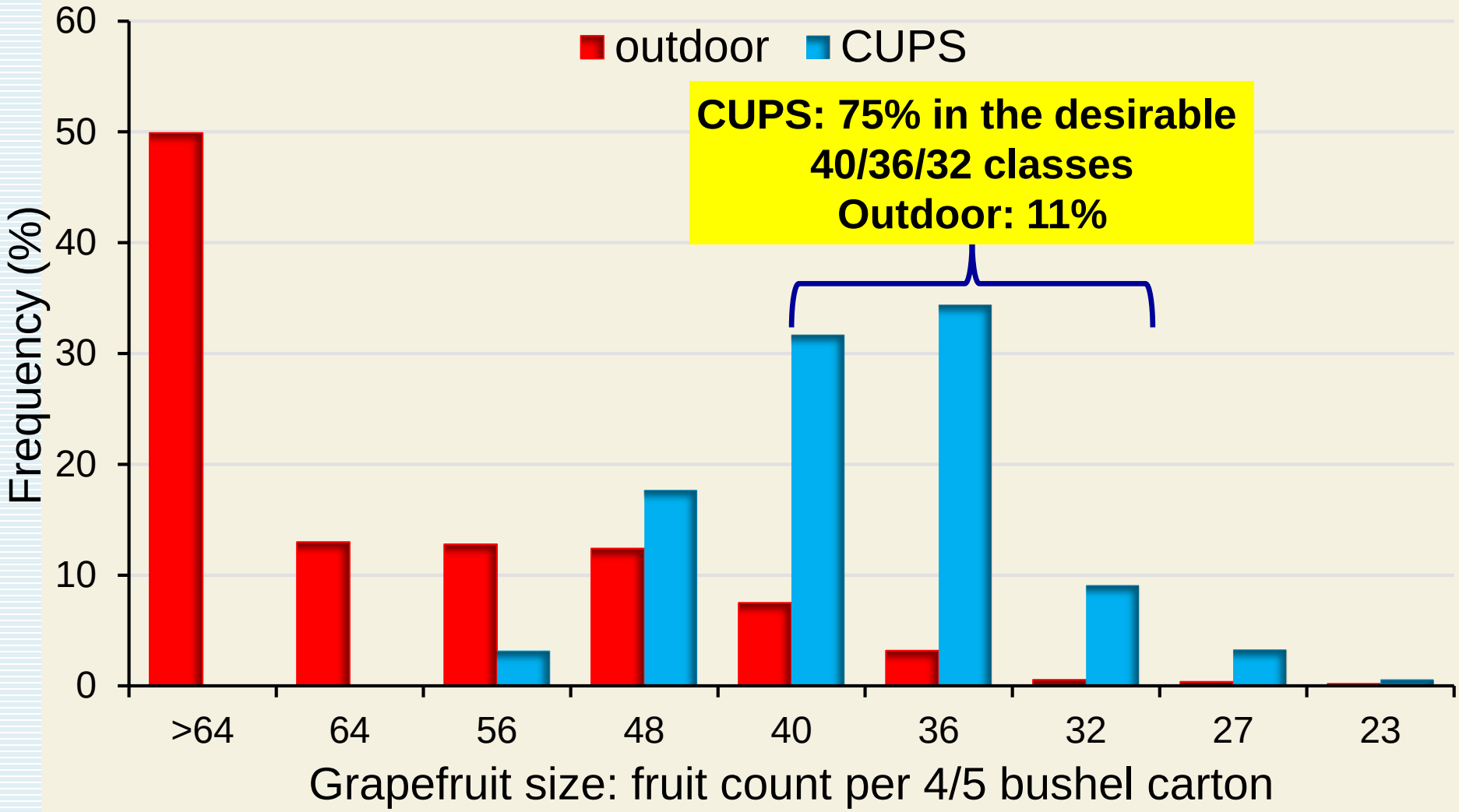
CREC ‘Ray Ruby’ fruit size: 2018 plot harvest



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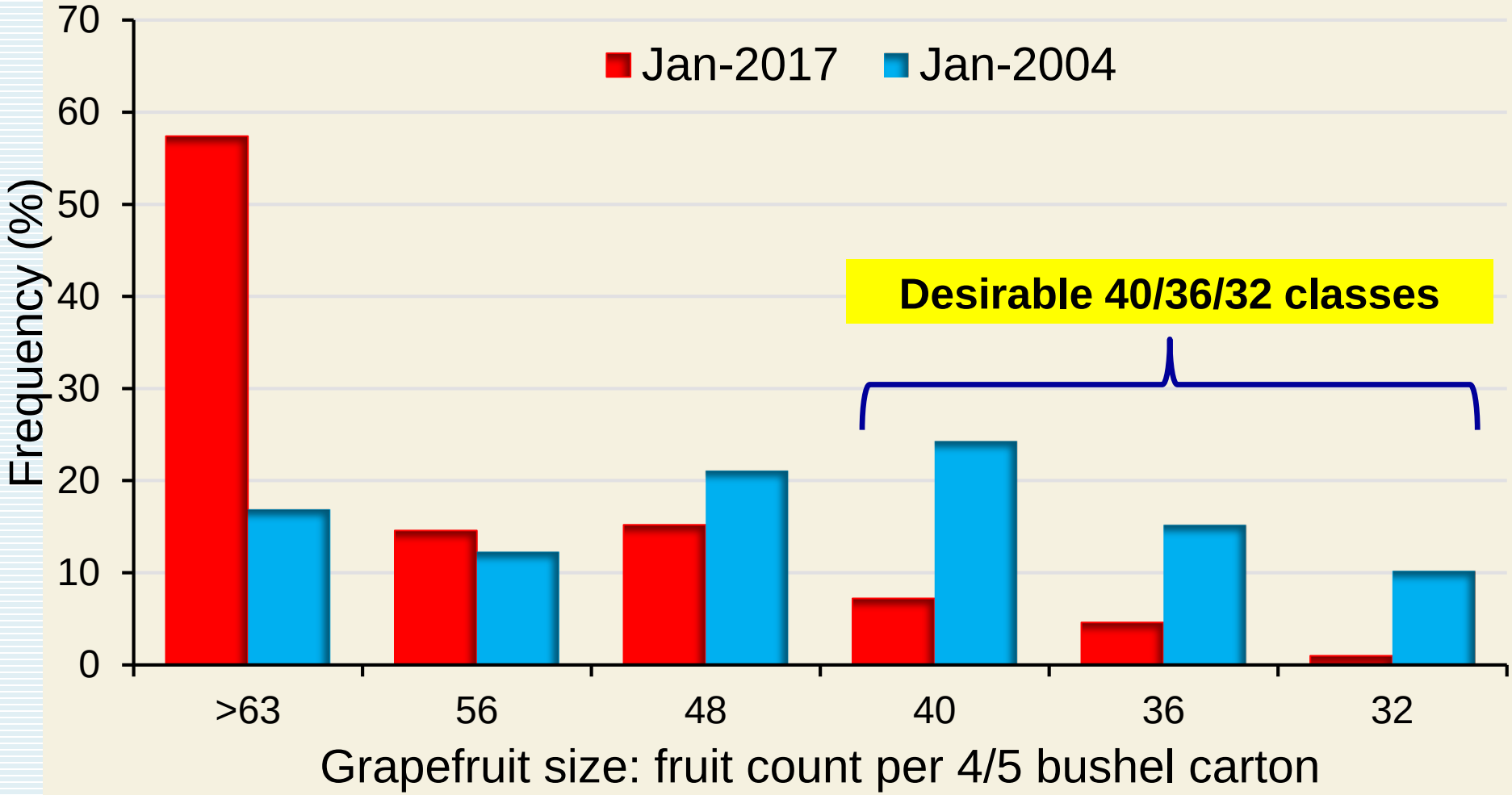
Red grapefruit size: Florida 2004 versus 2017

(Florida Agricultural Statistics Service)



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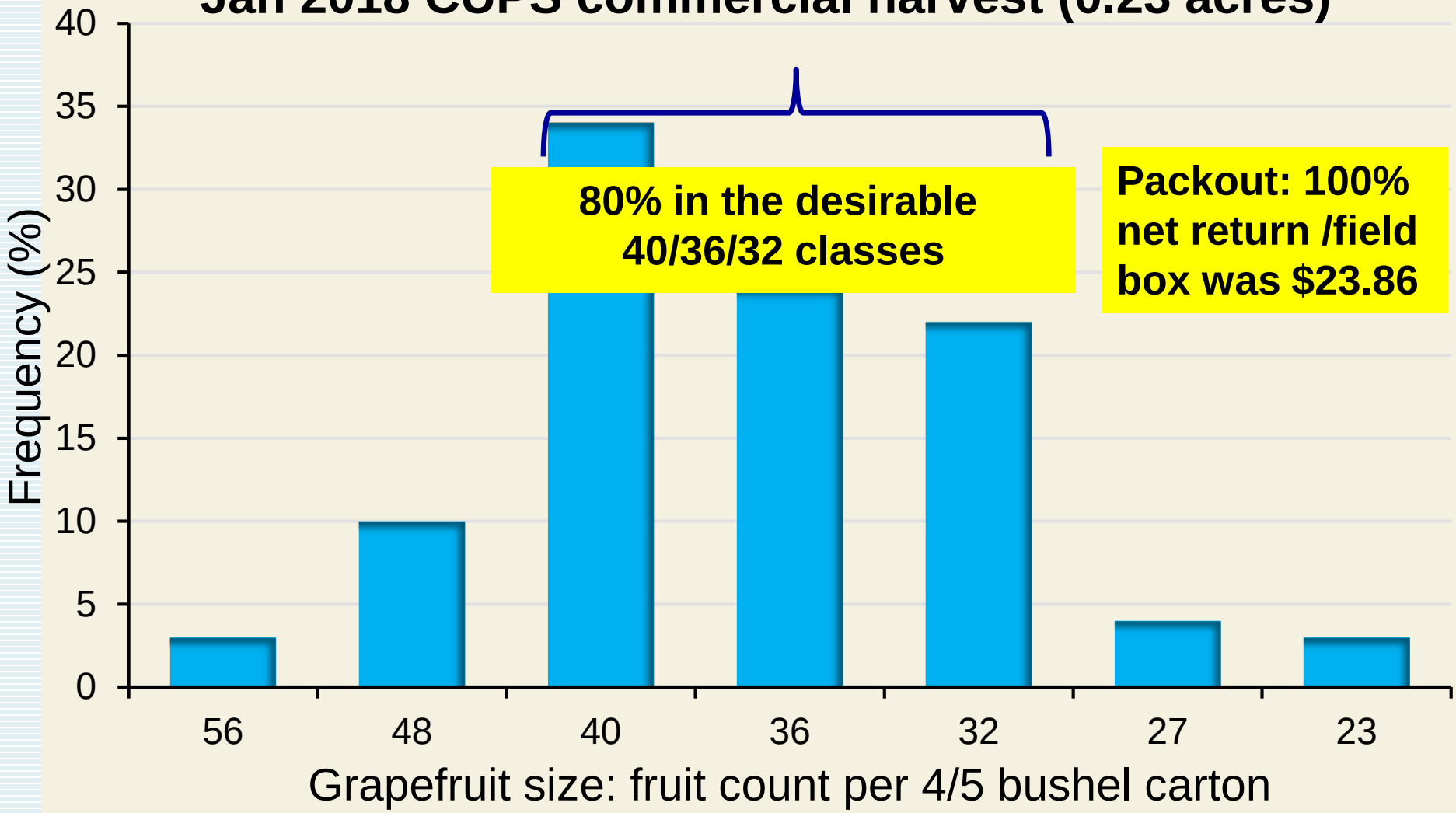
CREC 'Ray Ruby' fruit size: Jan 2018 CUPS commercial harvest (0.23 acres)



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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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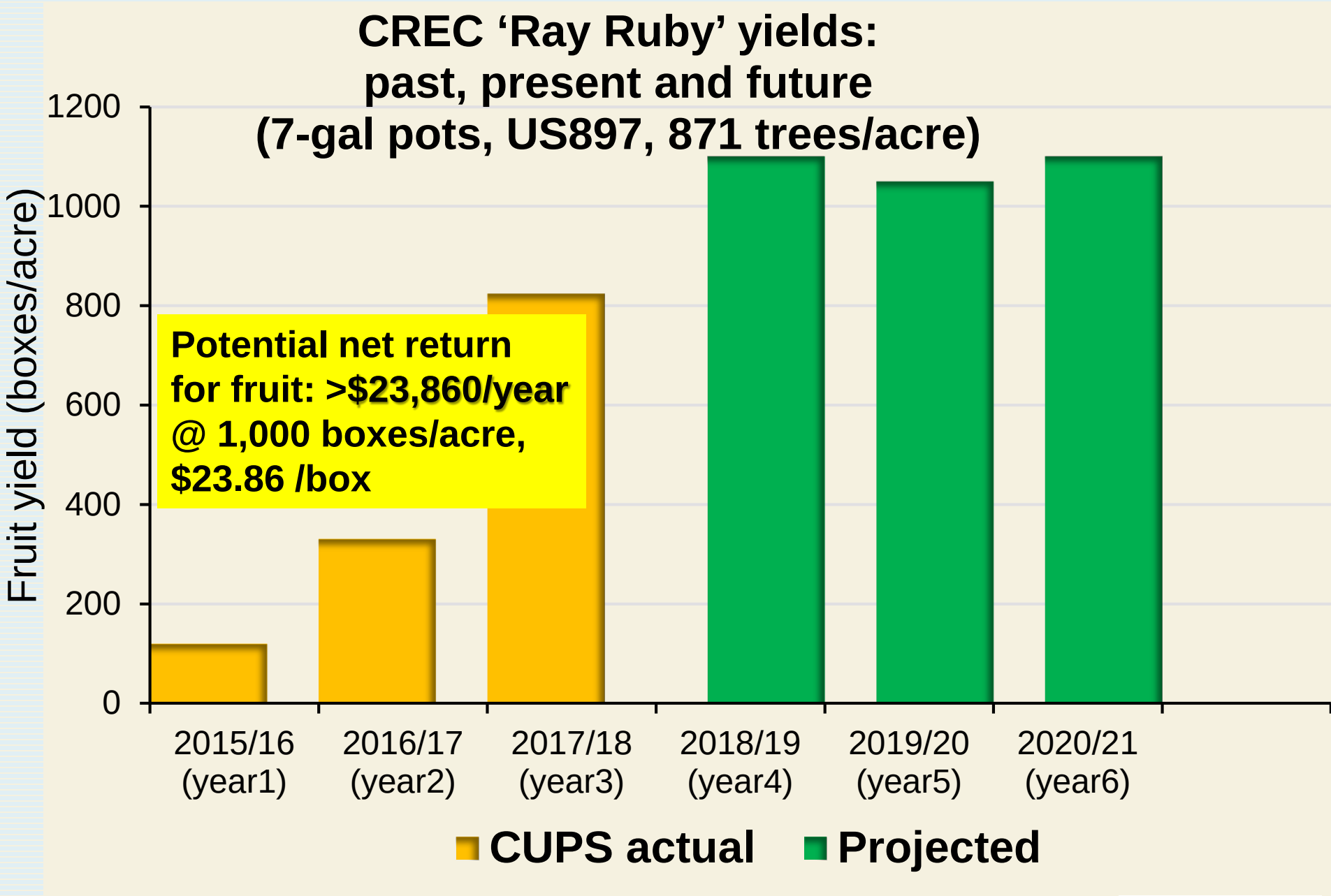

Future plans and outlook

UF/IFAS works with commercial CUPS growers

Commercial CUPS @ 1 year

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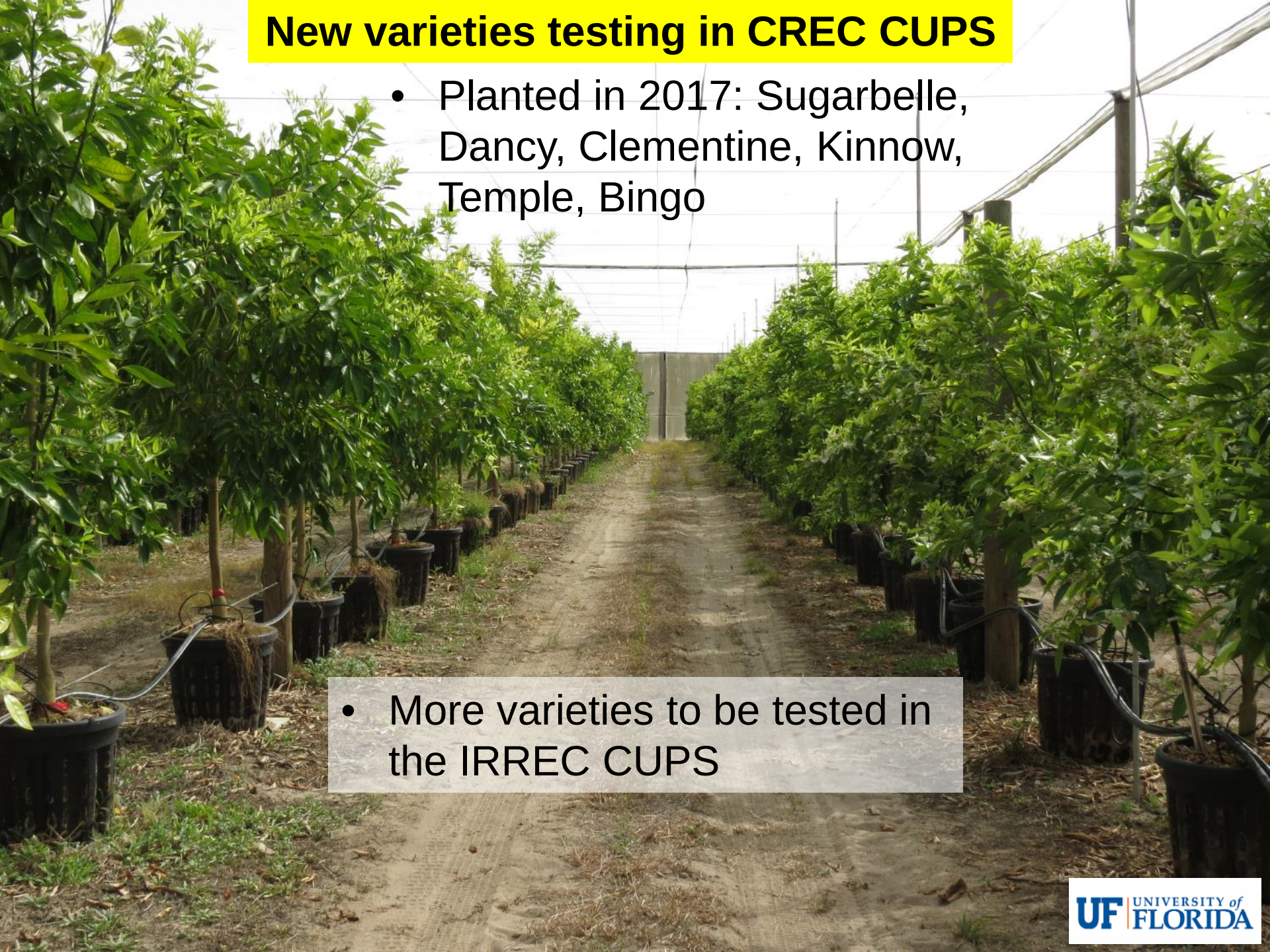
New varieties testing in CREC CUPS

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



- More varieties to be tested in the IRREC CUPS

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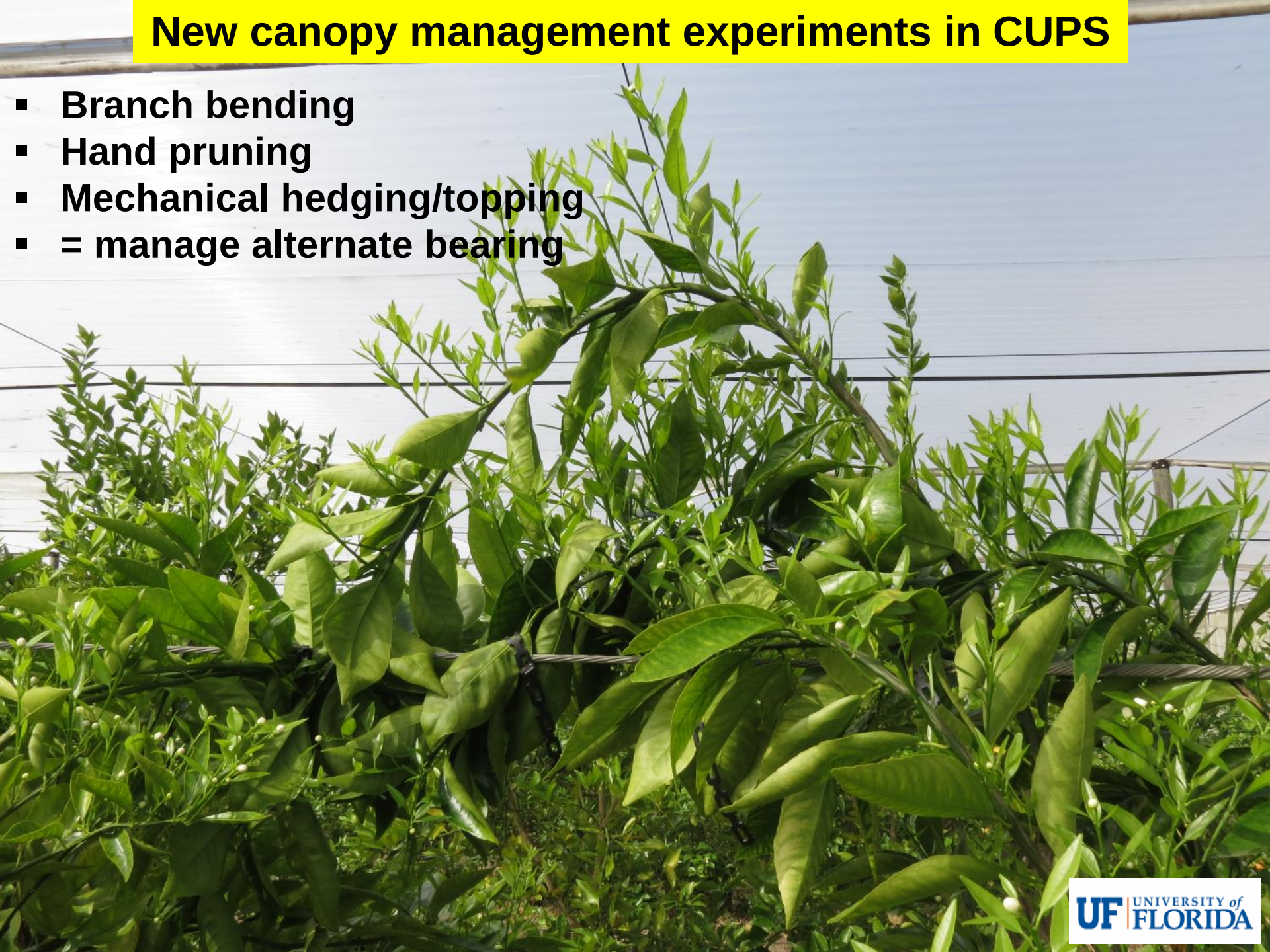
New canopy management experiments in CUPS

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



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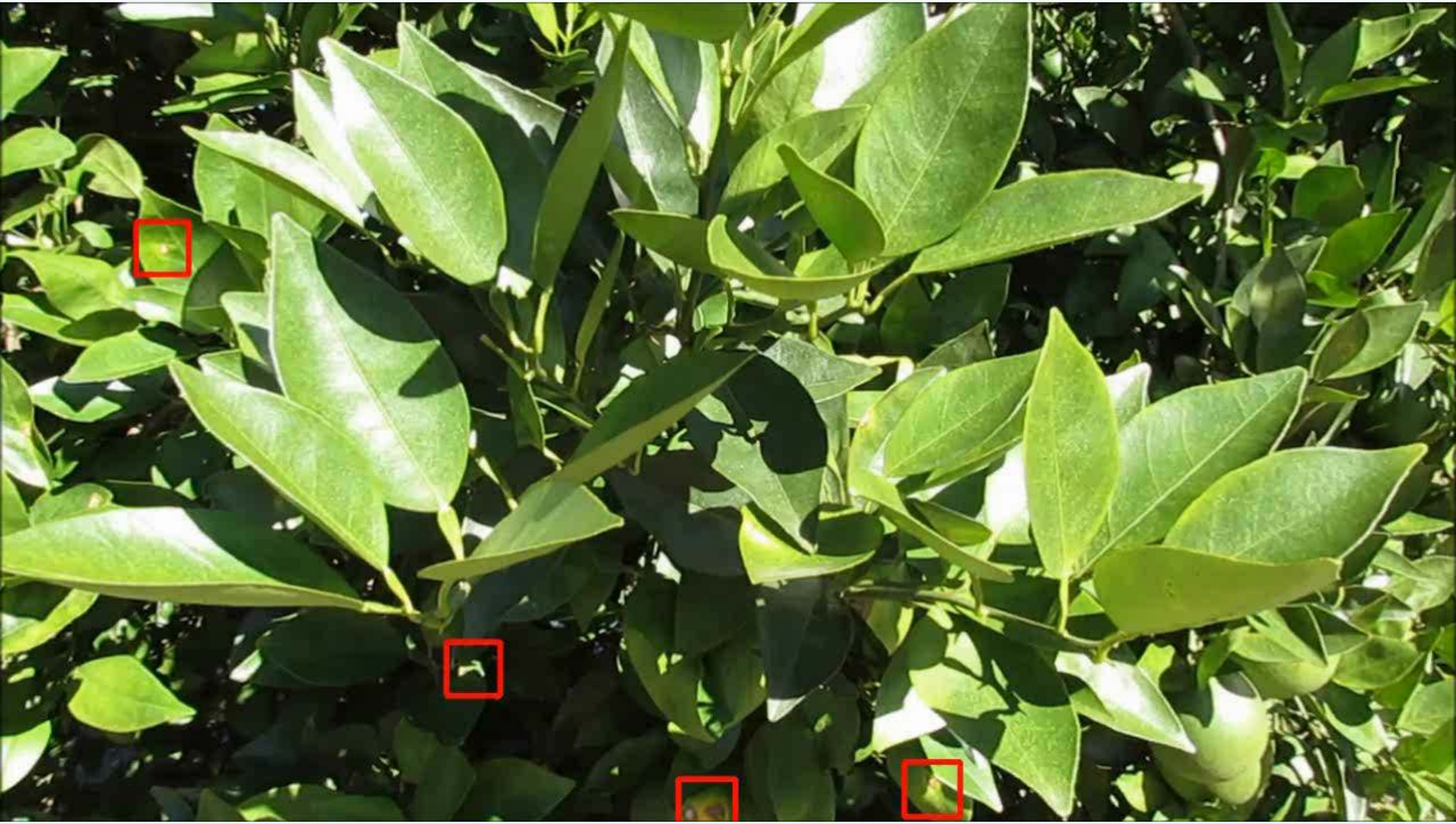
New robotic AI scouting methods for IPM in CUPS

EXAMPLE: Automated citrus canker detection



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EXAMPLE: Automated Asian citrus psyllid detection

NEW OBJECTIVES (SCRI grant)

Objective 1: Integrated pest and disease management
Objective 2: Robotic machine vision for pest and disease scouting
Objective 3: Scion and rootstock selection for CUPS
Objective 4: Horticultural improvements (canopy mgt., fertigation, photoselective screen)
Objective 5: Economics
Objective 6: Develop decision support guidelines for CUPS

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A. Krajewski (International Citrus Technologies Pty Ltd, Australia)

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CONCLUSIONS

- CUPS is an attractive non-GMO fresh fruit solution to HLB
- Economic viability of CUPS technology can be improved 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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CONCLUSIONS

- Fruit in the CUPS were protected from damage by hurricane Irma
- Moderate to high structural damage was sustained from hurricane Irma
- Hurricane damage was not catastrophic at CREC and IRREC
- Lessons learned from storm damage will be used to improve future CUPS
- Additional research on storm impacts, structural design and integrity is required to obtain the best solutions for future CUPS

Thank you for your support

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

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IFAS Research
Florida Agricultural Experiment Station

(Mark McLellan, previous Dean for Research)

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