University of Vermont
Proctor Maple Research Center
Underhill, Vermont

Spout & Drop Sanitation for High Yield Production

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Major Factors Affecting Sap Yield

Tree Factors/Tapping Practices

Size and Health of Tree

Growth Rate / Sugar Content

Number of Taps/Tree

Depth of Taphole

Vacuum

System Design & Layout

System Installation

System Operation & Maintenance

Sanitation

Spout, Tubing Replacement

Tubing Cleaning

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Sanitation

Goal is to improve sap yield and quality and increase producer net profit

Replacement – "uncontaminated" material near tree
(new drop effect, new spout effect, CV effect)

Cleaning/Sanitation – reduce contamination
1) Removal of debris (cleaning effect) *and*
2) Reduction in microbe level (sanitizing effect)

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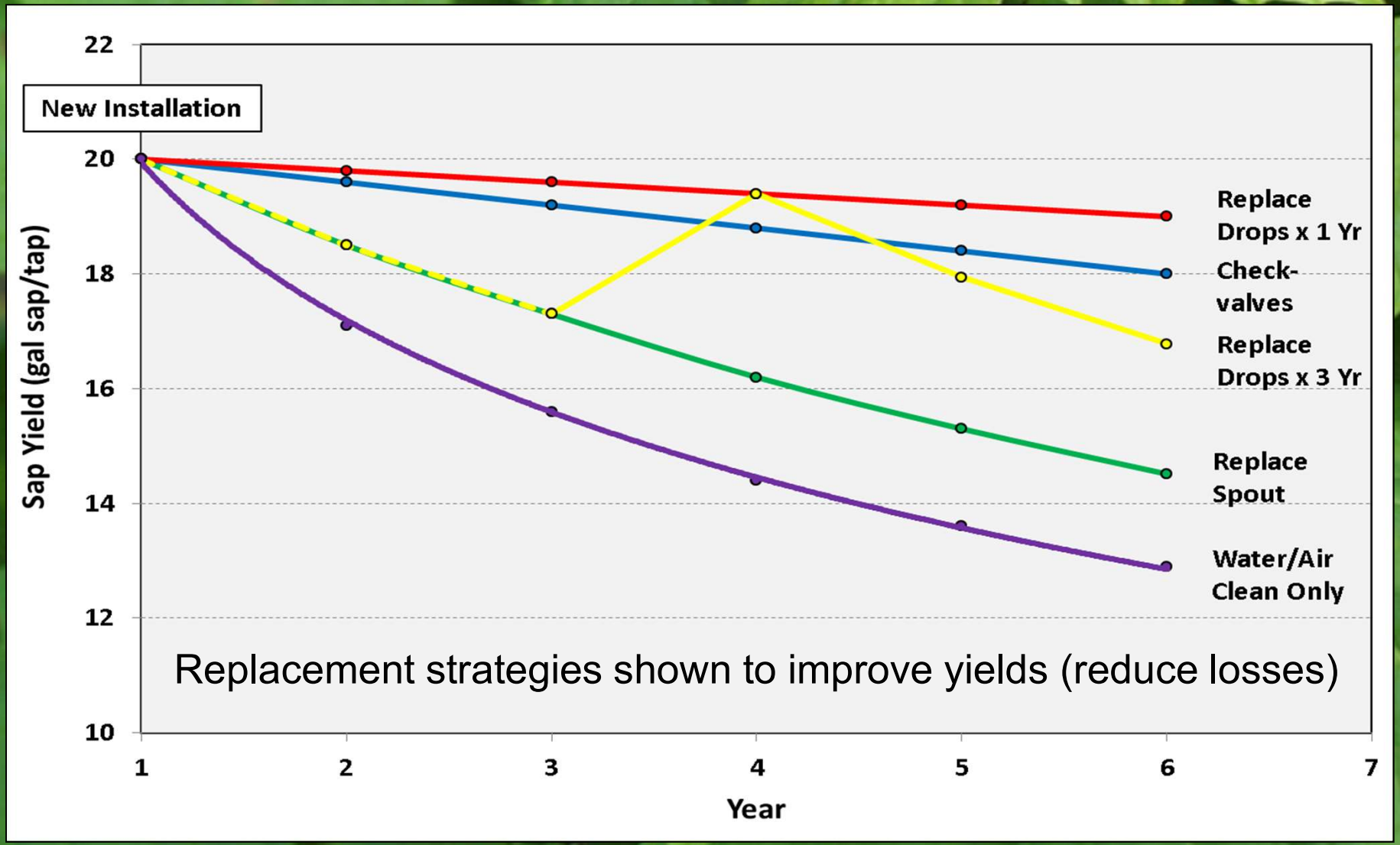
Sap yields decrease after tubing installation (microbial contamination)



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Tubing Cleaning Research

Study Objective:

Determine which tubing cleaning practice results in the greatest increase in yield and net value (versus control, no treatment)

Study at PMRC funded by the North American Maple Syrup Council (NAMSC) Research Fund
(van den Berg and Perkins)

Additional funding to expand study from
Northeastern Sustainable Agriculture Research and Education (NESARE) grant:
Compare cleaning and replacement treatments and combinations
Add additional year & replication site (Cornell Arnot Forest, Stephen Childs)
Research Phase, Education Phase

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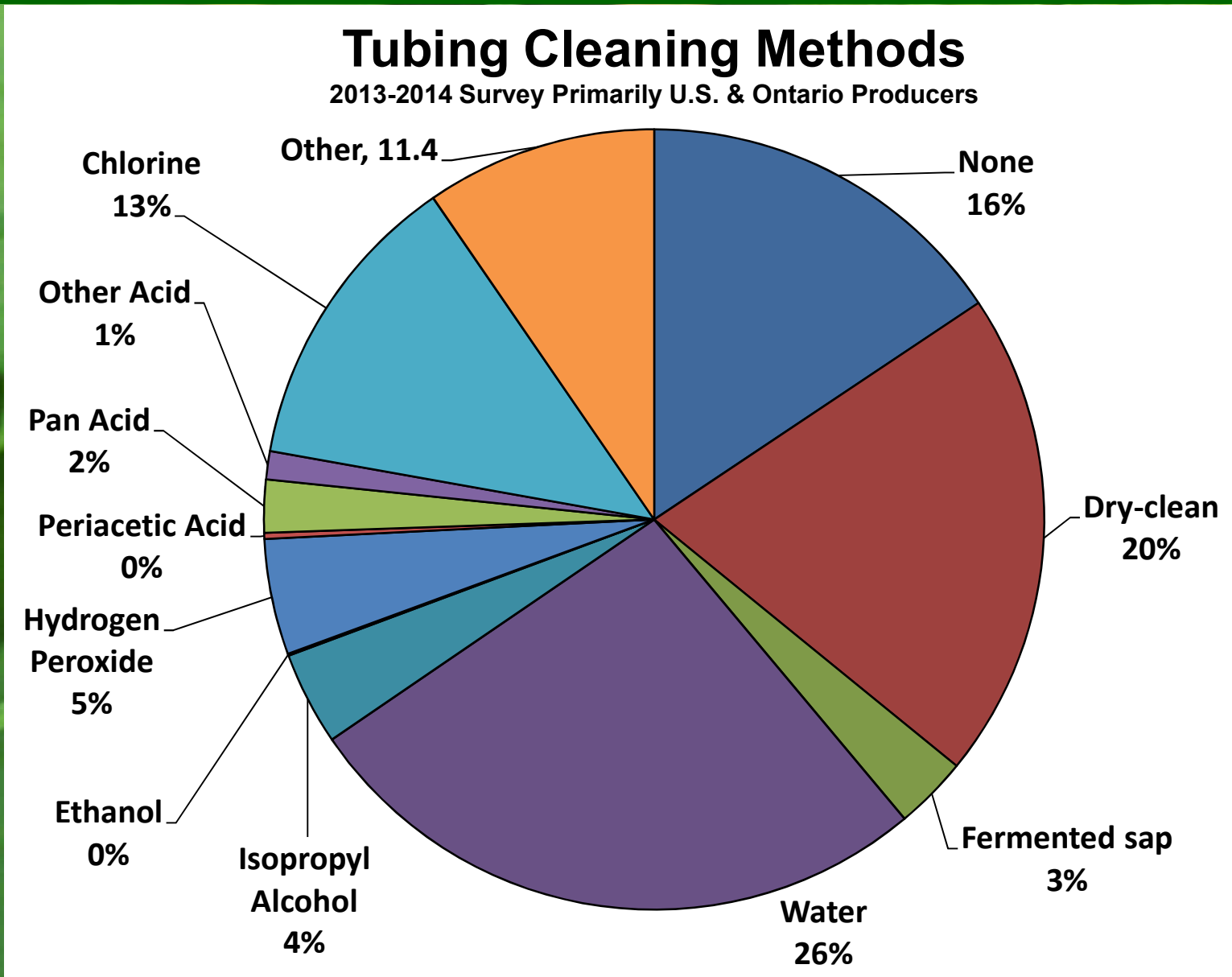

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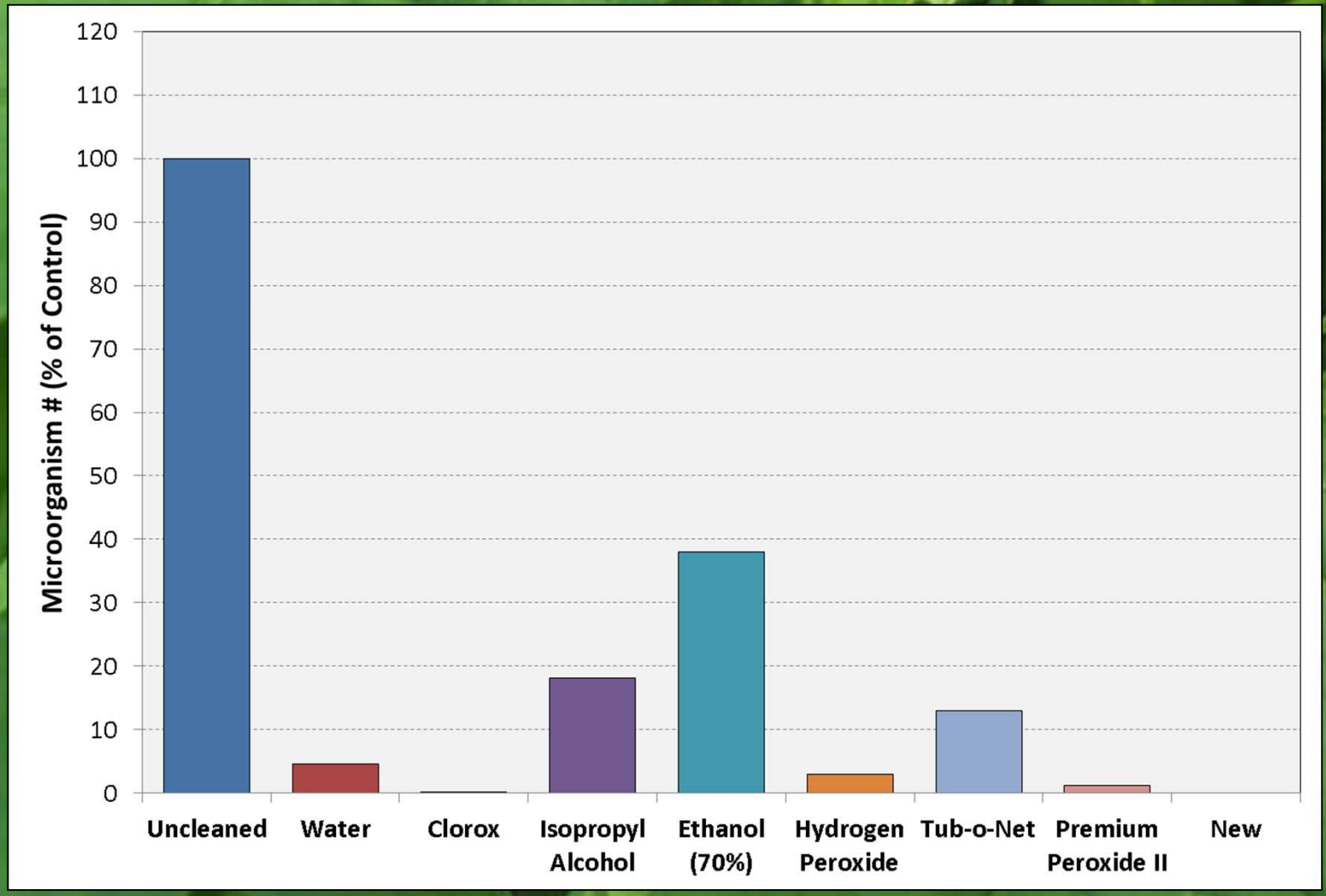
Preliminary studies:

Which cleaning treatments are most effective at reducing microbial counts?



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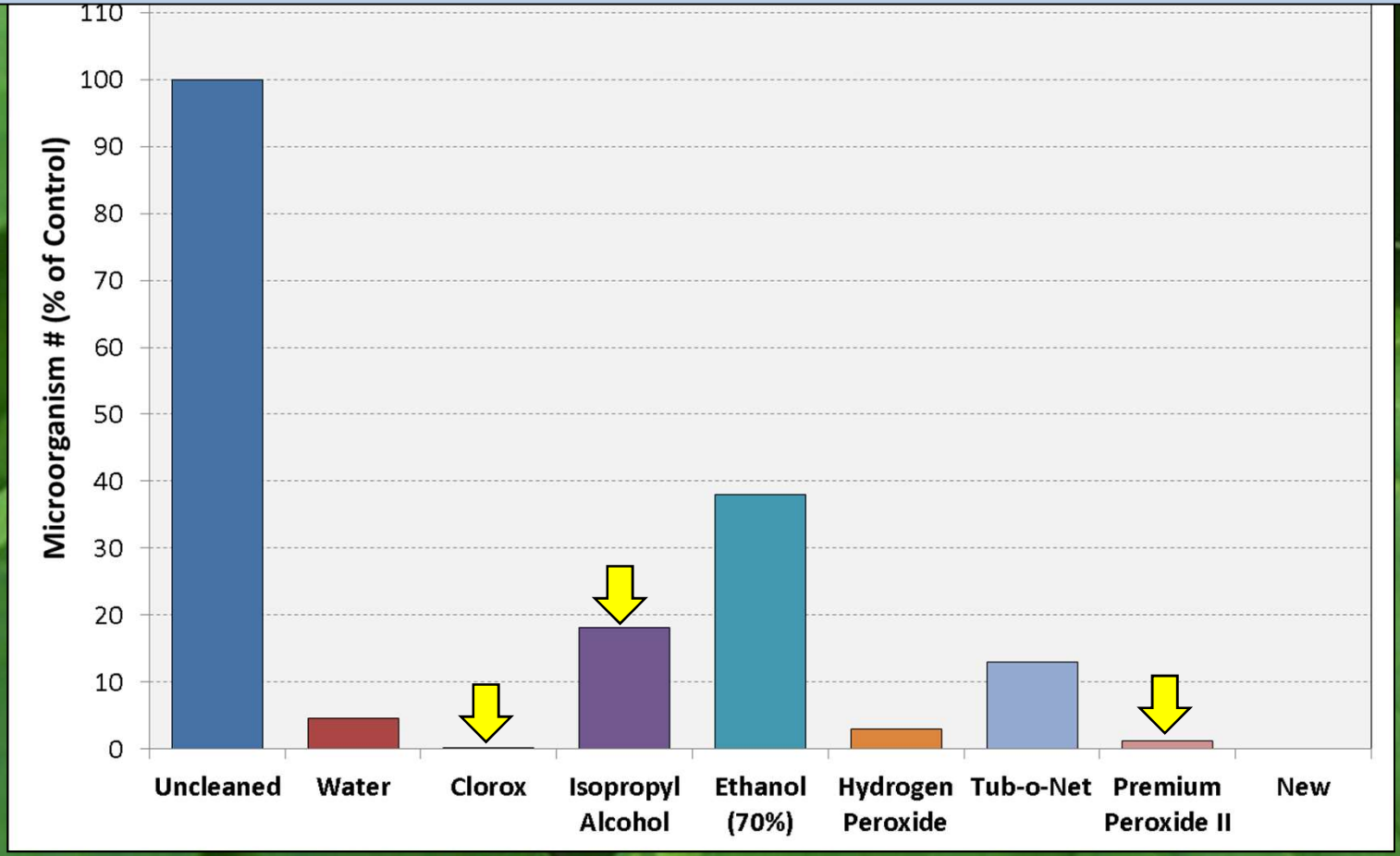
Cleaning Treatments Chosen:

Bleach (Calcium-based)

Premium Peroxide II (Hydrogen peroxide with periacetic acid)

Isopropyl Alcohol (70%) (Not permitted for use in U.S.A.)



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Cleaning, Replacement, Cleaning+Replacement:

11 treatments

Control (used dropline and spout)
Cleaning
Bleach (Calcium Hypochlorite)
Peroxide (Premium Peroxide II)
Isopropyl Alcohol (70%)
Replacement
Spout
Check-valve Spout
Dropline (includes dropline, tee, spout)
Cleaning & Replacment
Clean with Bleach & Replace Spout
Clean with Peroxide & Replace Spout
Clean with Isopropyl Alcohol & Replace Spout
Rinse with Water & Replace Spout

Treatments

PMRC

Used:

30P Droplines (6 Yrs)

Darveau/H_2O (6 Yrs)

New:

Lapierre ZML Clear

Check-valve = Leader Clear CV

Cleaning Treatments:

15 ml of solution sucked into tubing

Allowed to drain, plugged

(Some IPA residue allowed to remain in tubing until installed)

Cornell

Used:

30P Droplines (4 Yrs)

Leader Adapter (2 Yrs)

New:

Leader Tree Saver

CV = Leader CV Adapter

Cleaning Treatments:

Yr 1. Drops (tubing/spouts) immersed for 30 min then rinsed and installed

Yr 2. System flooded with solution

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44 plots - 3 trees per plot

(4 replications each of the 11 treatments)

UVM PMRC (Perkins & van den Berg)
Cornell Arnot Forest (Childs)

Common vacuum source
~25”Hg (PMRC), 19”Hg (Arnot)

Measured sap volume after each flow period throughout season

Total sap volume for each plot, average for each treatment

Repeated in 2014 and 2015 seasons

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VACUUM CHAMBER STUDIES

Only at PMRC

Total of 110 trees (10 trees per treatment)

Same 11 Treatments

Average 11.5” dbh

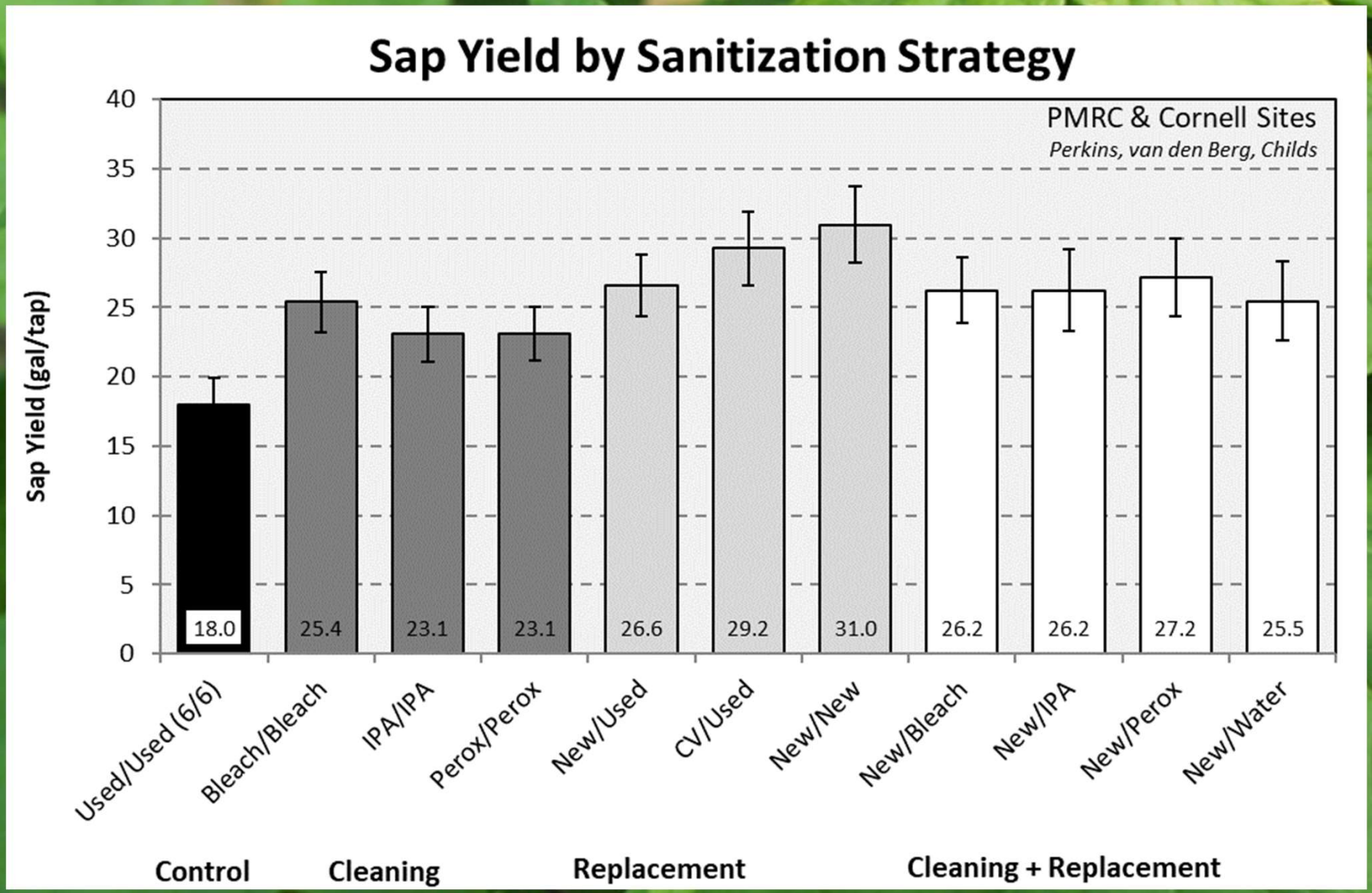
One chamber per tree

Common vacuum source (~25” Hg)

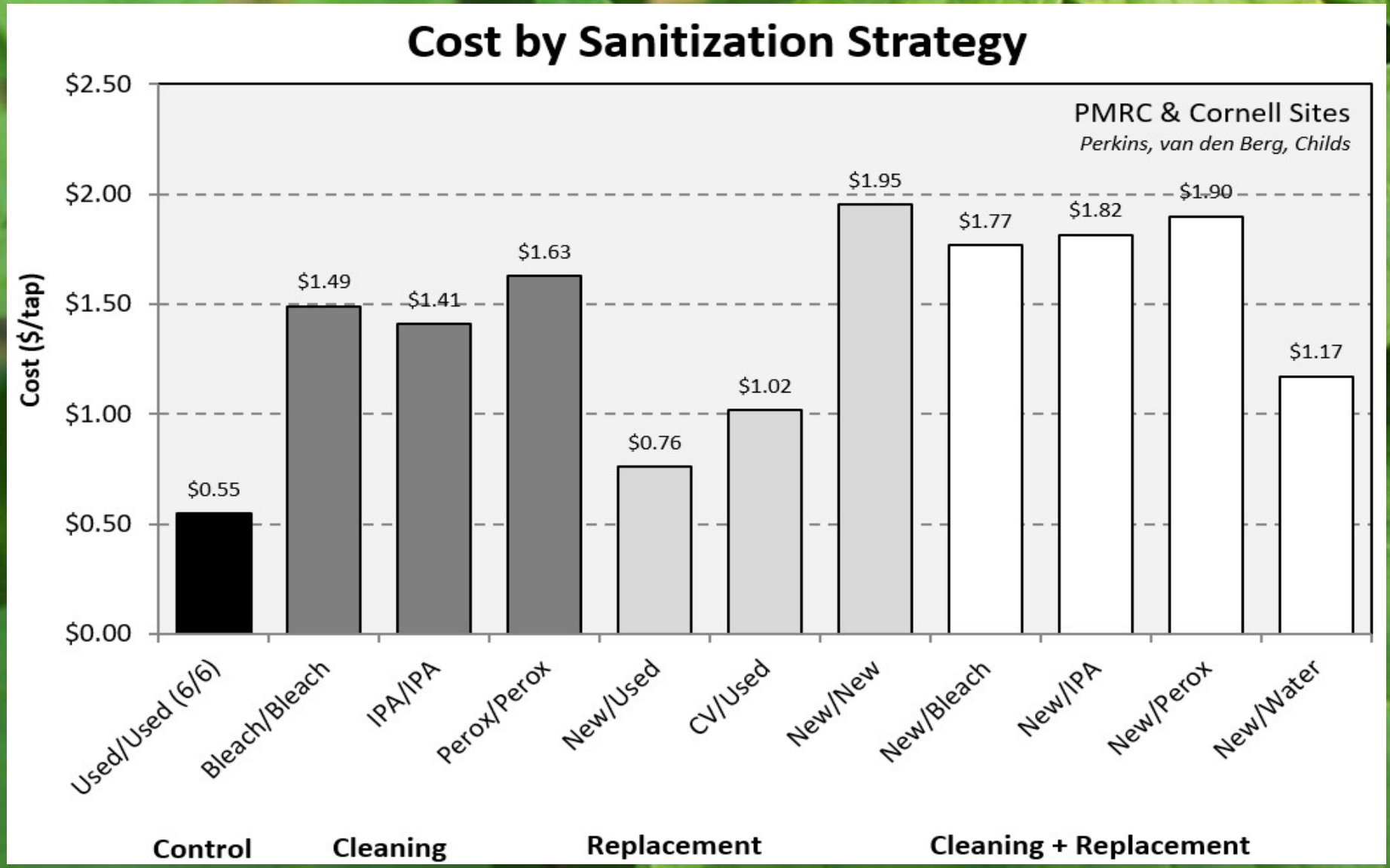
Measured sap volume after each flow period throughout the 2014 and 2015 seasons

Ancillary studies on labor/timing

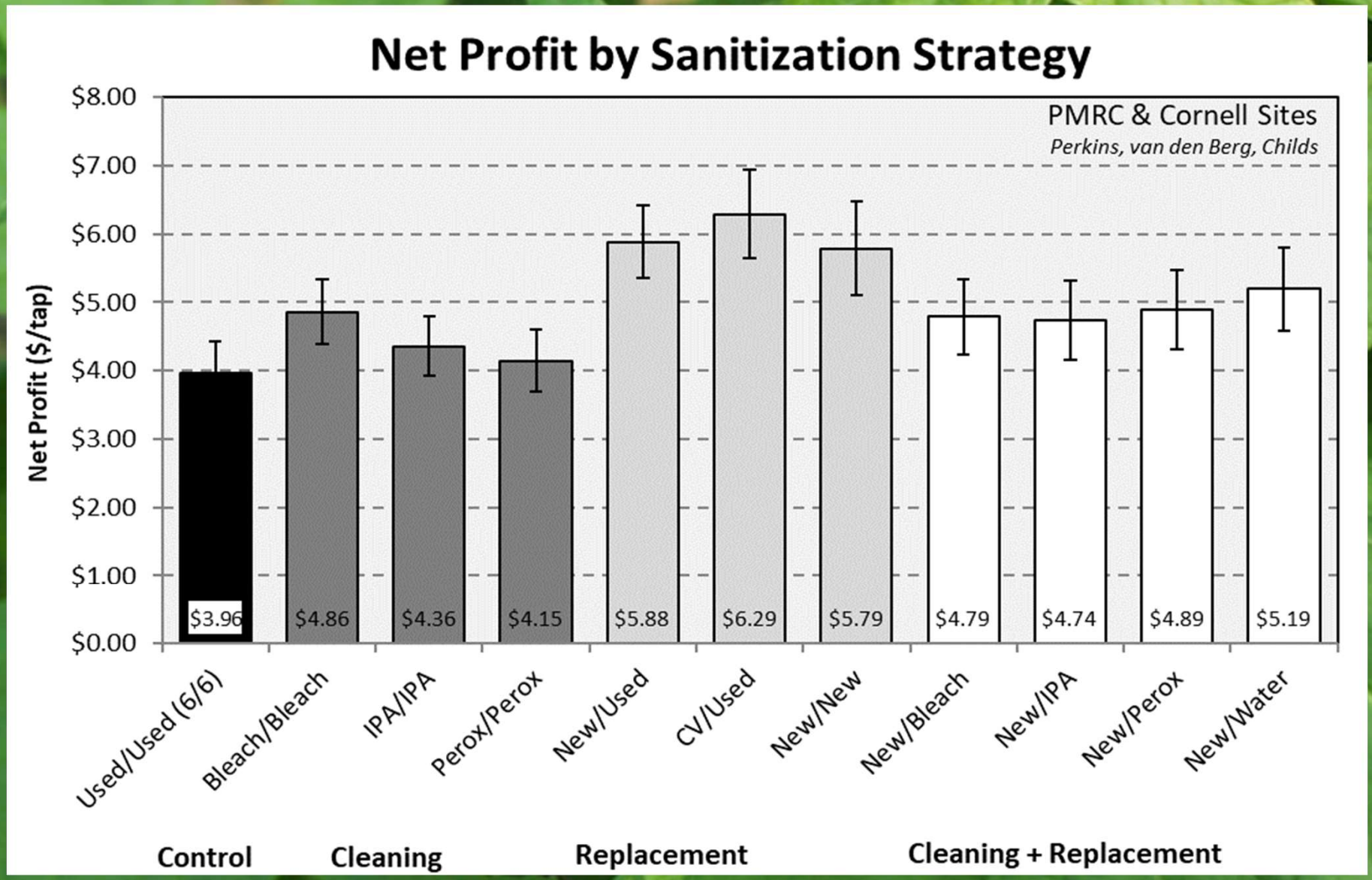
Results: 2014-2015



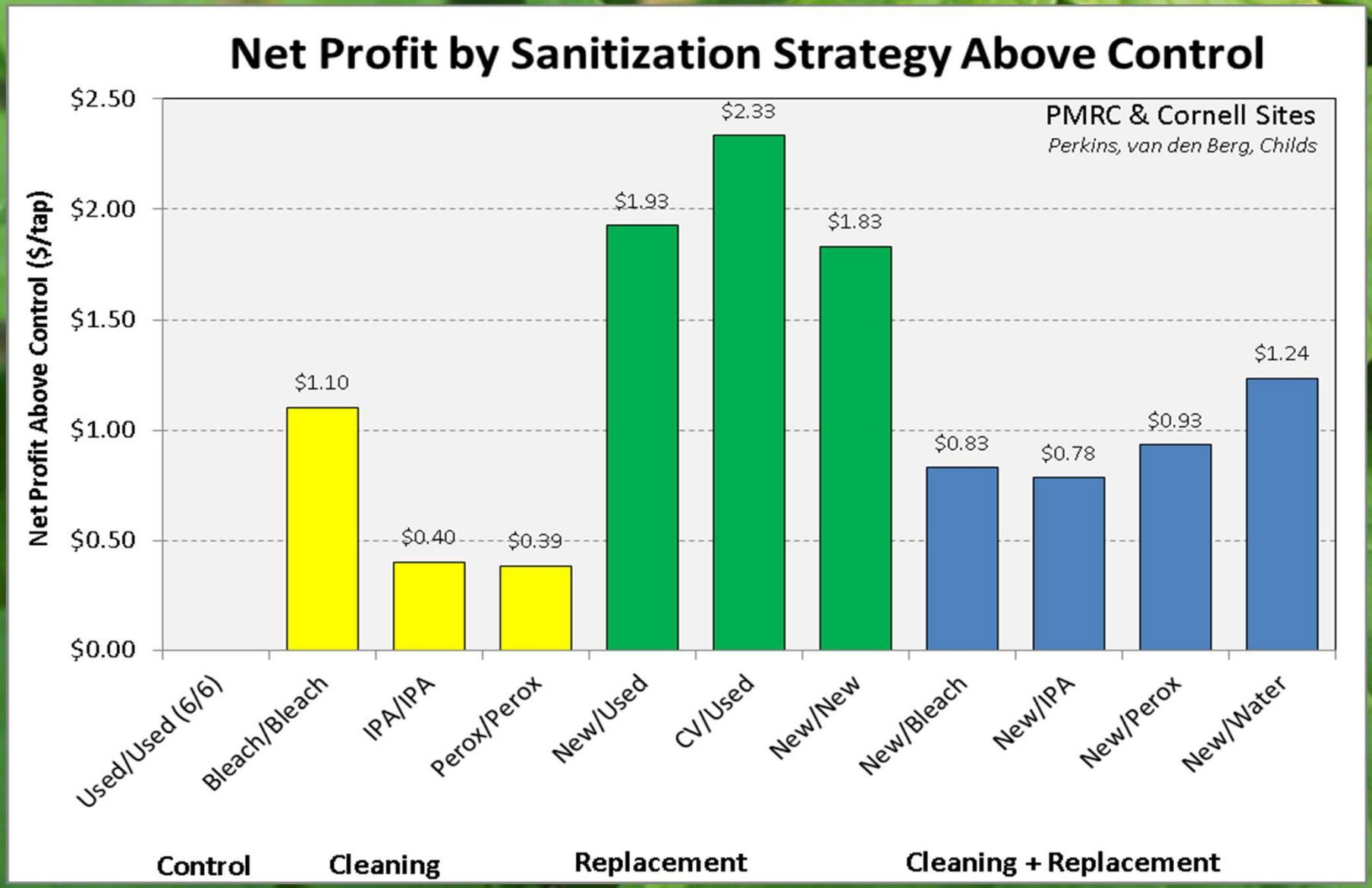
Results: 2014-2015



Results: 2014-2015



Results: 2014-2015



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Economic model of sap yield and replacement strategies

Input values – labor rate, baseline sap yields

Output net profit/loss for various strategies

http://www.uvm.edu/pmrc

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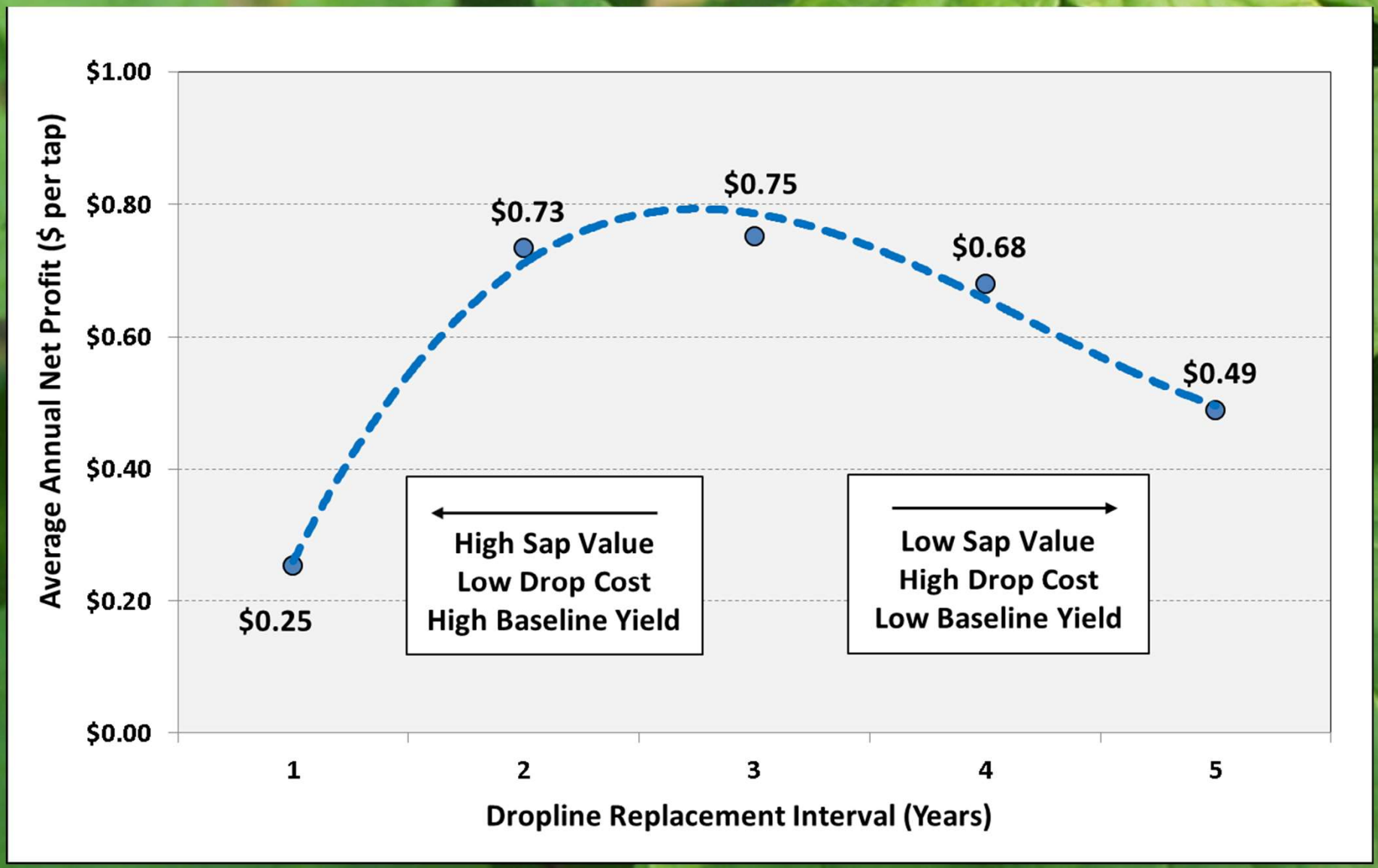
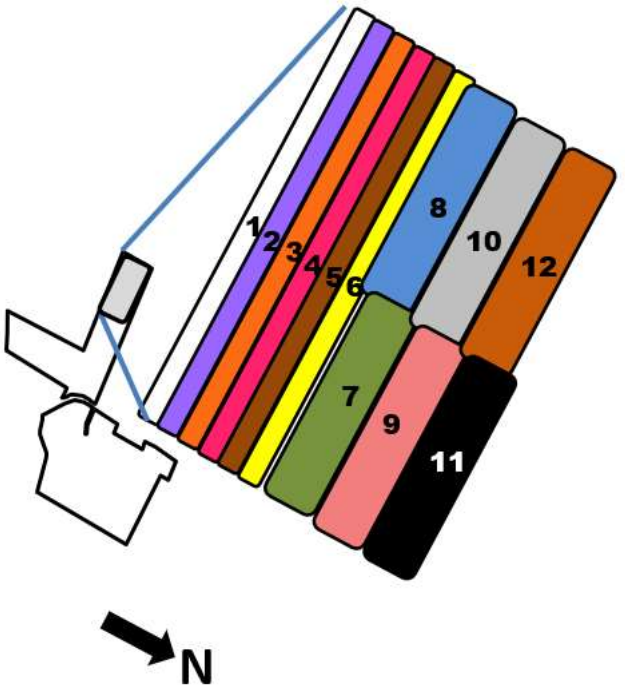


3/16” vs 5/16” Study

MARTIN BLOCK - 2015

Plot #	Treatment Description	# Trees	Vac Sensor
1	3/16”	113	K
2	5/16”	88	J
3	3/16”	75	F
4	3/16”	99	E
5	5/16”	92	I
6	5/16”	87	G
7	5/16”	78	A
8	3/16”	84	B
9	5/16”	96	H
10	3/16”	89	O
11	3/16”	91	L
12	5/16”	71	M



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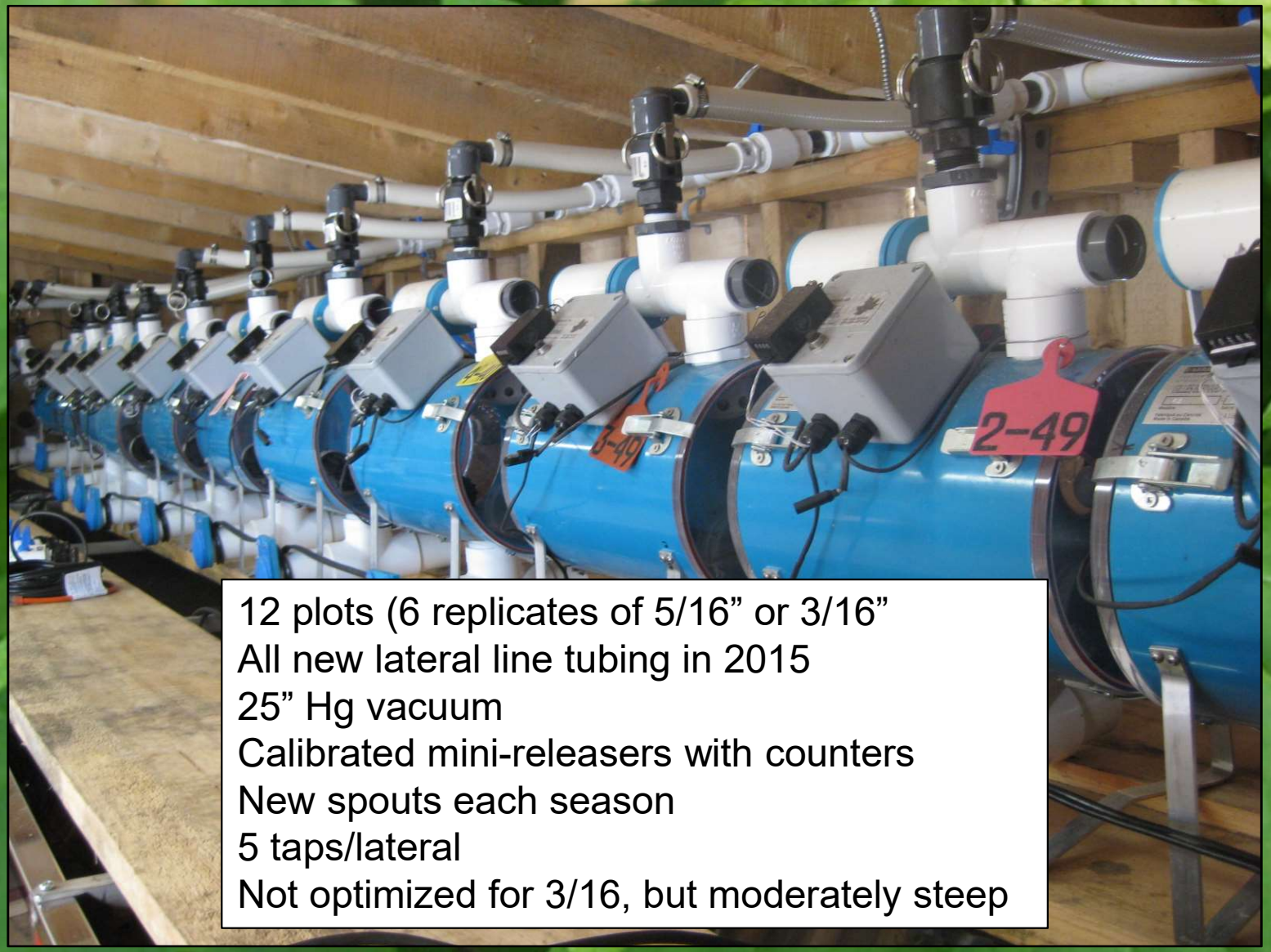
Version: April 8, 2015

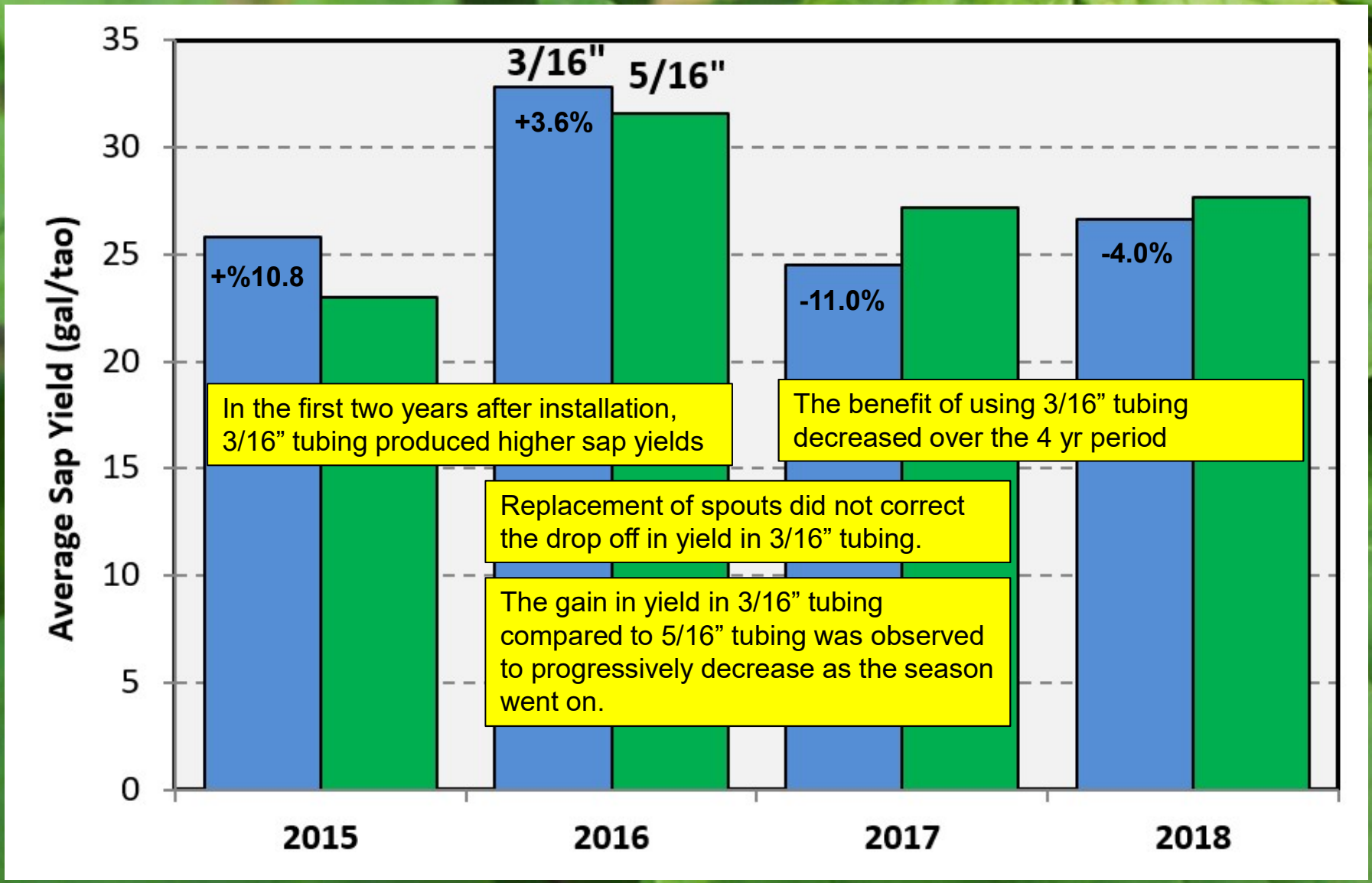
All experimental plots had lateral and droplines retubed in 2015

3/16” vs 5/16” Study

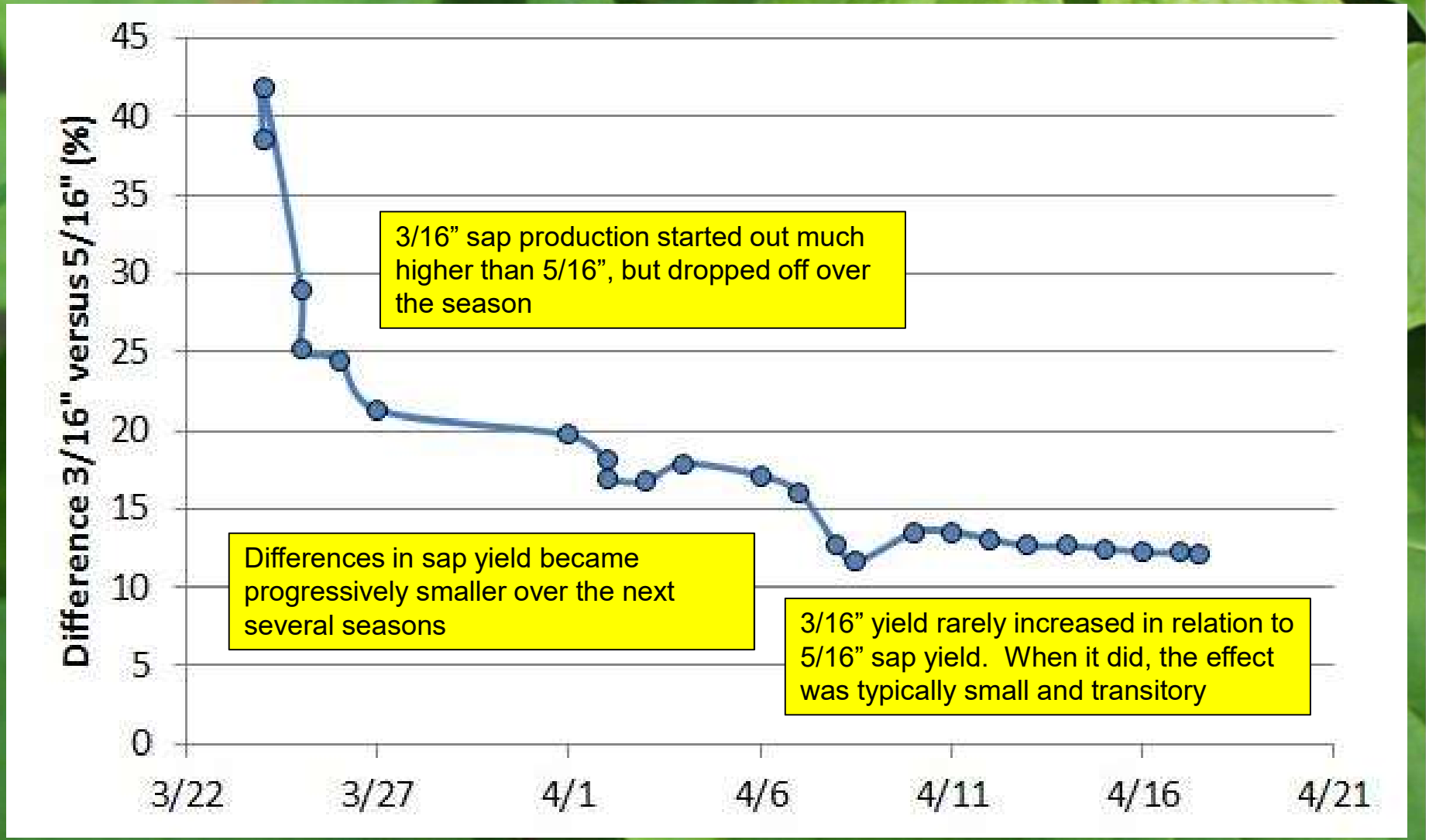


12 plots (6 replicates of 5/16” or 3/16”
All new lateral line tubing in 2015
25” Hg vacuum
Calibrated mini-releasers with counters
New spouts each season
5 taps/lateral
Not optimized for 3/16, but moderately steep

Results: 3/16” Tubing



Results: 2014-2015



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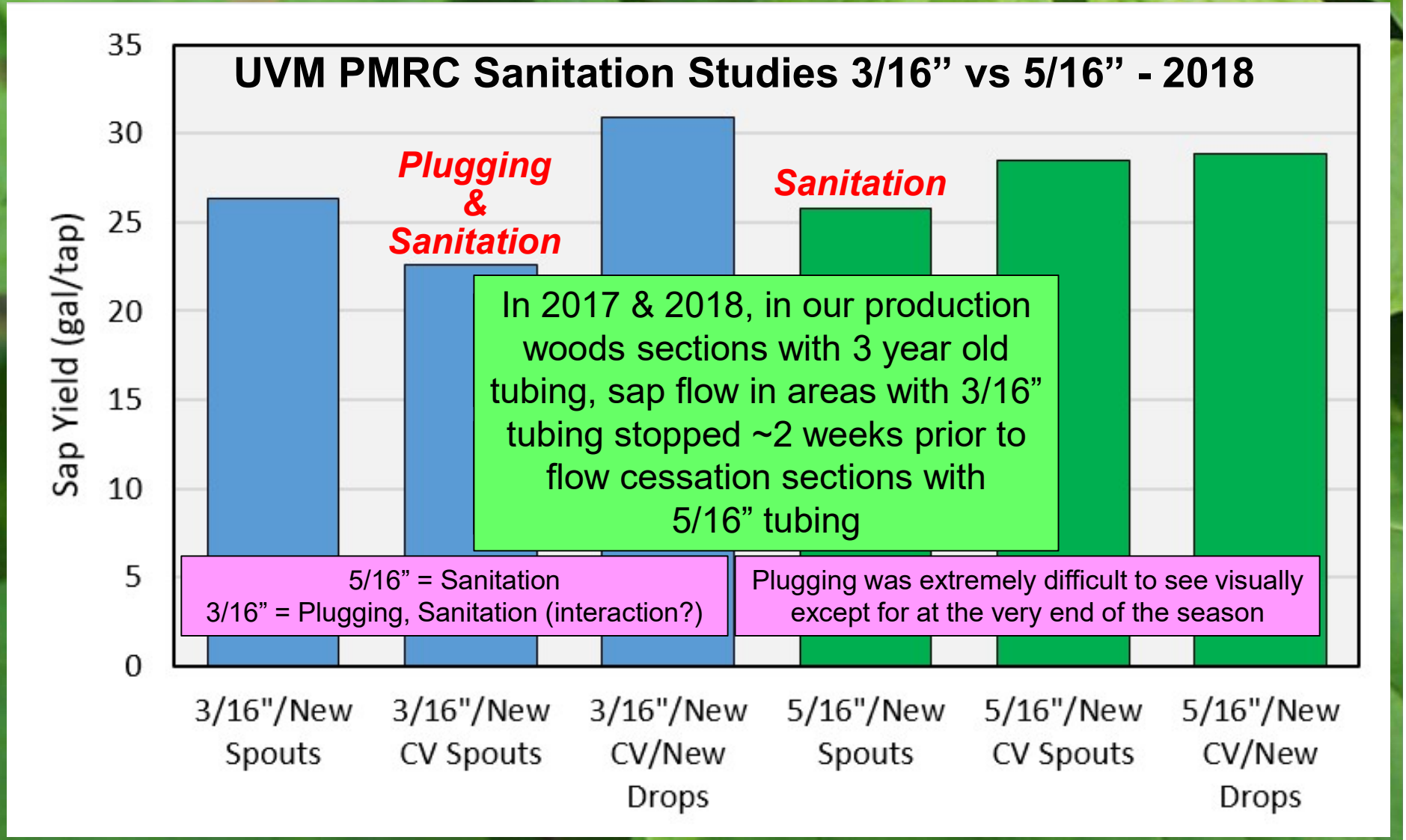
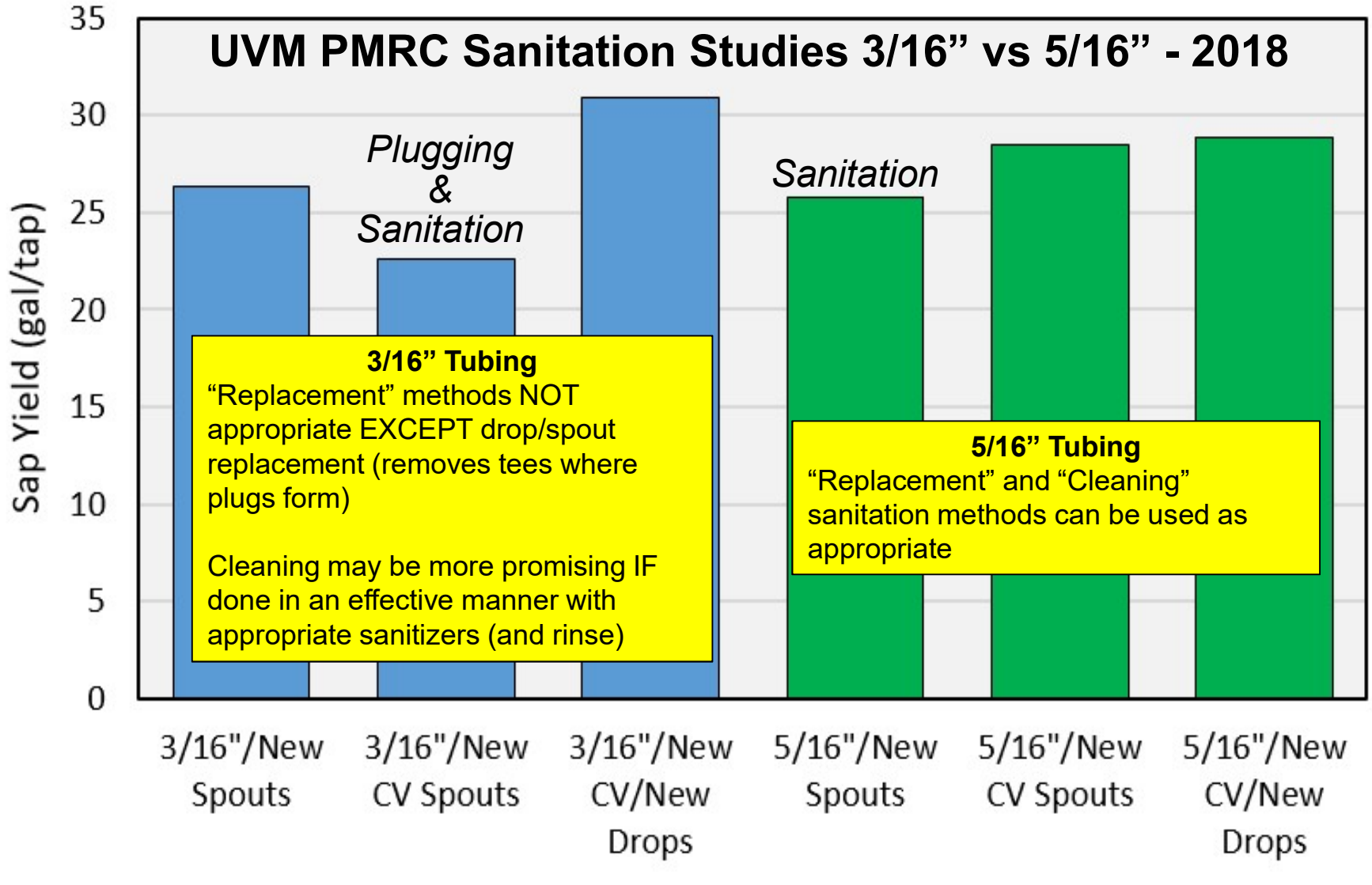


Results: 3/16” Tubing



Conclusions: 5/16”

Various replacement and cleaning strategies result in differing levels of improvement in sap yield and net profit.

(IPA not approved in U.S.)

Conclusions: 5/16”

(IPA not approved in U.S.)

Various replacement and cleaning strategies result in differing levels of improvement in sap yield and net profit.

Replacement strategies are typically more cost-effective (produce a higher net profit) than cleaning strategies.

Cleaning is more effective with increased contact times. Cleaning in place (CIP) by sucking sanitizer in under vacuum is far less effective than soaking or flooding.

Cleaning in low yield operations can often result in negative net profits.

The longer the season, the more “impact” any sanitation or replacement strategy has on sap yield.

Maple producers should select a strategy that fits their needs and results in the highest net profits for their operation.

Conclusions: 3/16”

(IPA not approved in U.S.)

Various replacement and cleaning strategies result in differing levels of improvement in sap yield and net profit.

Reductions in sap yield as 3/16” tubing systems age appears to result from both plugging and sanitation-related issues (and perhaps their interaction).

Traditional replacement strategies such as annual spout replacement and Check-valve spout use are NOT effective in 3/16” tubing systems due to the nature of the problem.

Replacement of drops (including tees) appears to restore sap yields to high levels (but perhaps not as high as in 5/16” systems), although it may not be cost-effective annually.

Research during the 2019 season will explore chemical based sanitation treatments for maintaining high yields in 3/16” tubing systems.

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