

The Continuing Quest for Optimal Harvest Management & Storage of Apples

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Outline

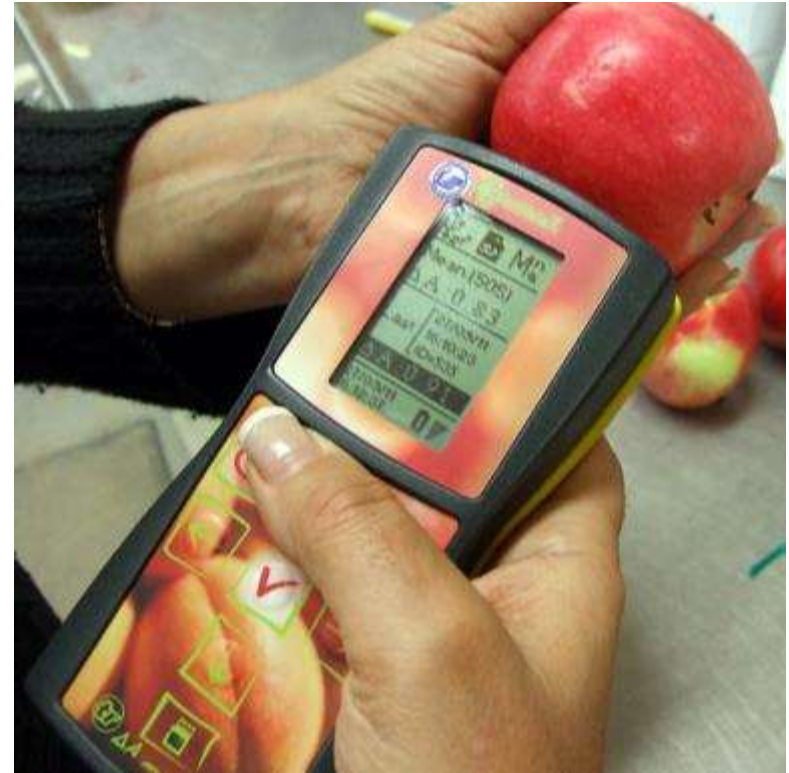
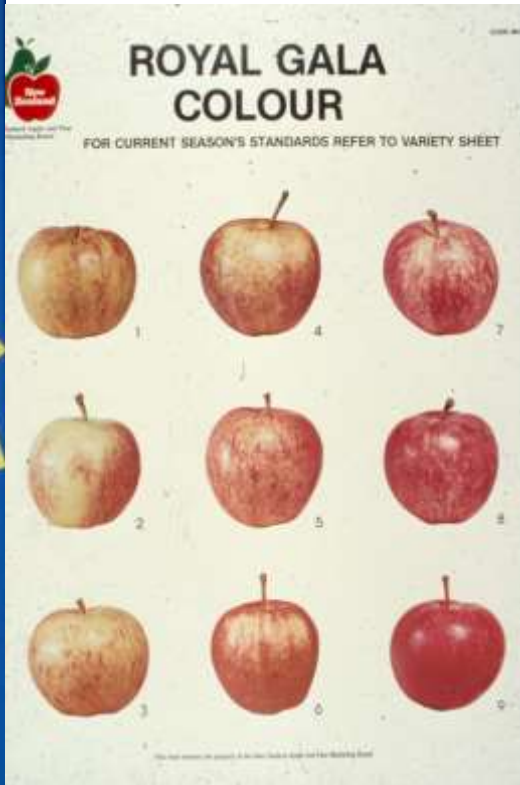
- 1. New harvest technologies – DA meter**
- 2. Dynamic Controlled Atmosphere (DCA) storage**
- 3. Gala stem end browning**

1. DA Meter

- ▶ Delta Absorbance (DA) meter
 - ▶ Hand held non-destructive measurement
 - ▶ Developed from vis/NIR spectroscopy
 - ▶ In theory can be used in the field



Essentially an electronic color chart that provides an index representing Chlorophyll a concentrations



But DA meter is not limited by red coloration of fruit

Current tools to assess “Maturity” (Harvest indices)

Maturity indices

- ▶ **Internal ethylene concentration (IEC)**
- ▶ Starch pattern index (SPI)

Where does the DA meter fit in?

Quality indices

- ▶ Firmness
- ▶ Soluble solids concentration
- ▶ Acidity
- ▶ Red coloration
- ▶ (background color/ground color)

Honeycrisp separation by DA reading



Honeycrisp separation by DA reading

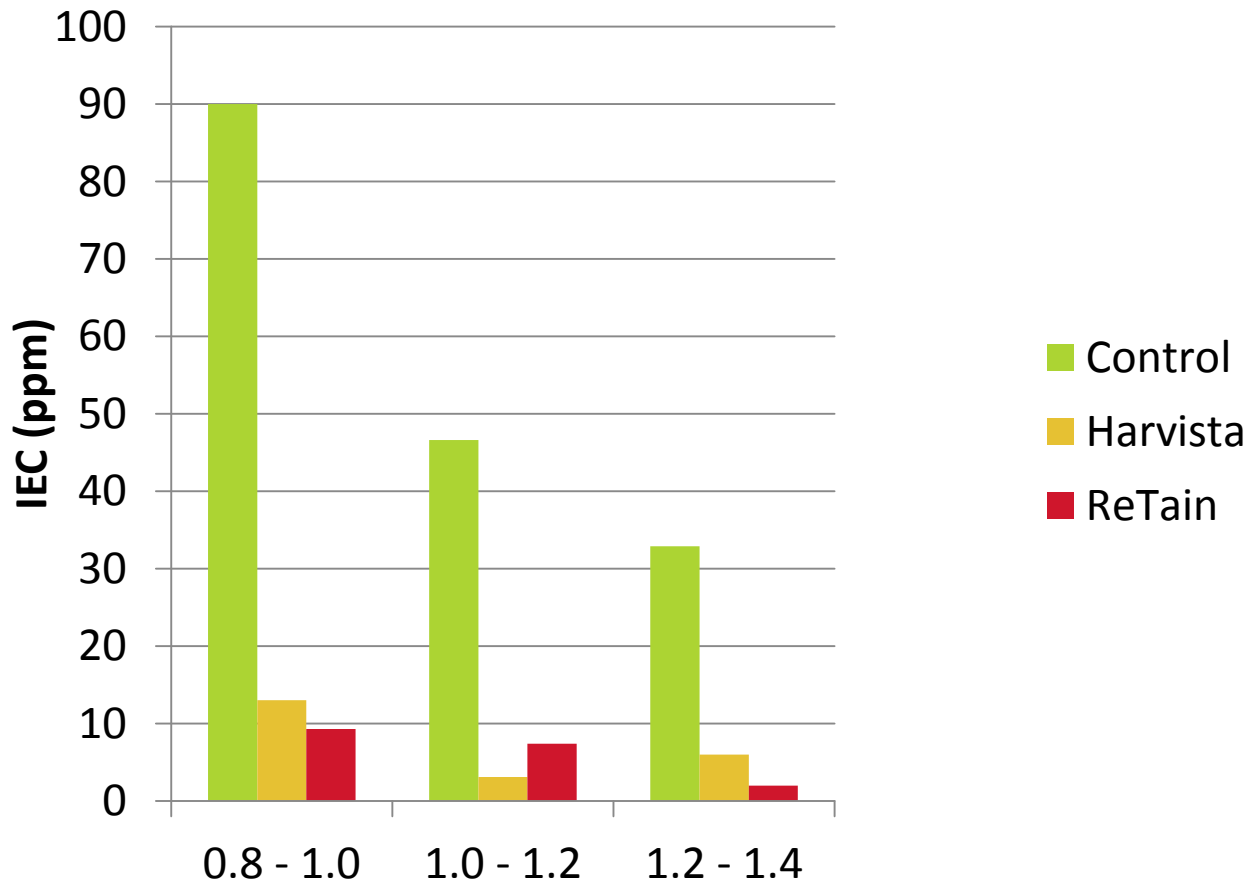


Summary: (data not shown)

- ▶ We have generally found good correlations between I_{AD} values and chlorophyll concentrations.
- ▶ Depending on cultivar, relationships between I_{AD} values and IEC and/or starch indices are good.

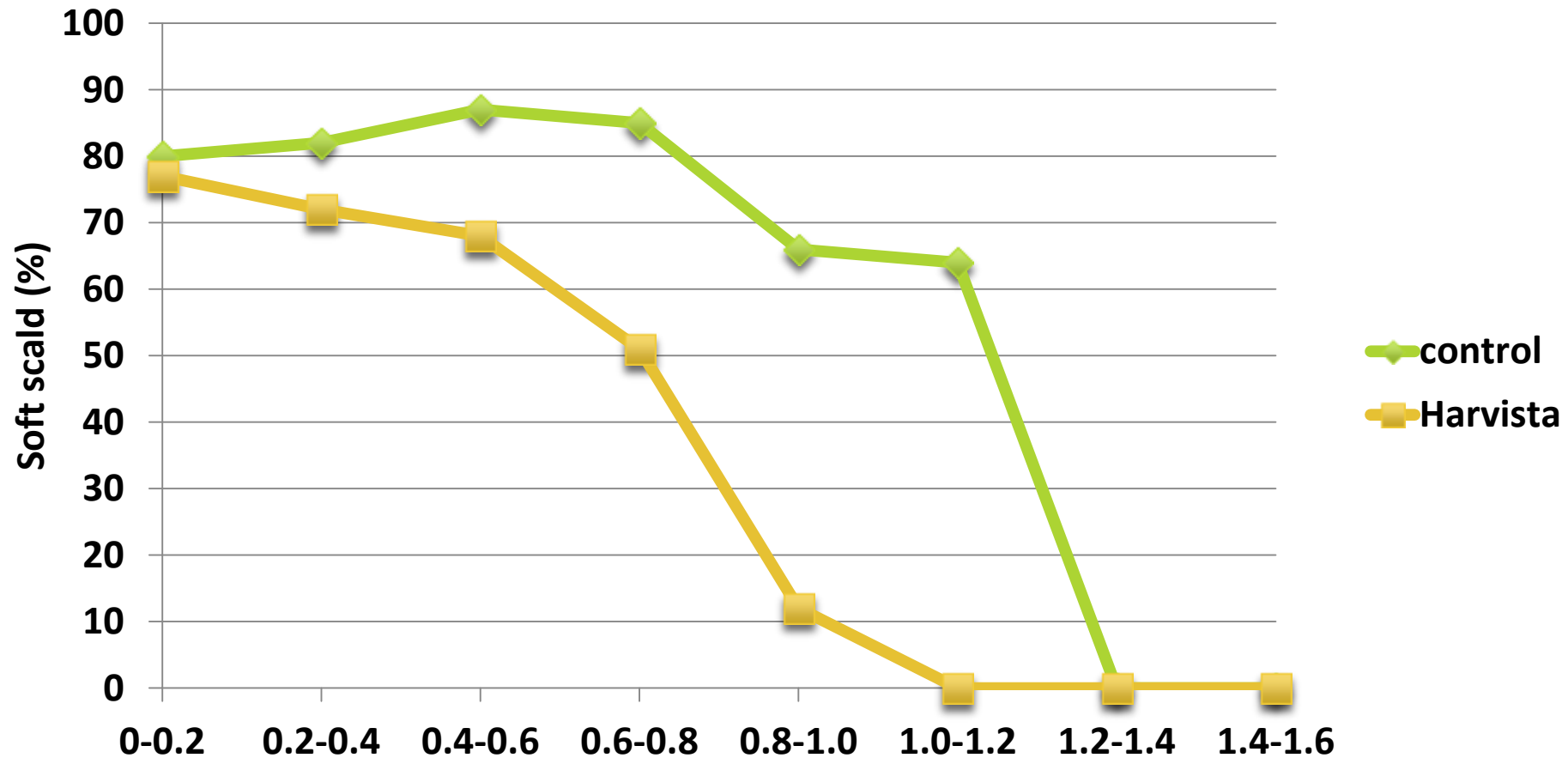
But the greatest concern is that preharvest factors such as PGRs interfere with interpretation of DA meter readings

I_{AD} values and internal ethylene concentrations (ppm) - Delicious



- ▶ Relationships between I_{AD} values and IEC good for untreated fruit
 - lower I_{AD} values = riper fruit and higher IEC.
- ▶ Harvista and ReTain trts result in loss of relationship within a given I_{AD} value.

Soft scald (%) in Honeycrisp apples at different I_{AD} value categories: Harvest 2

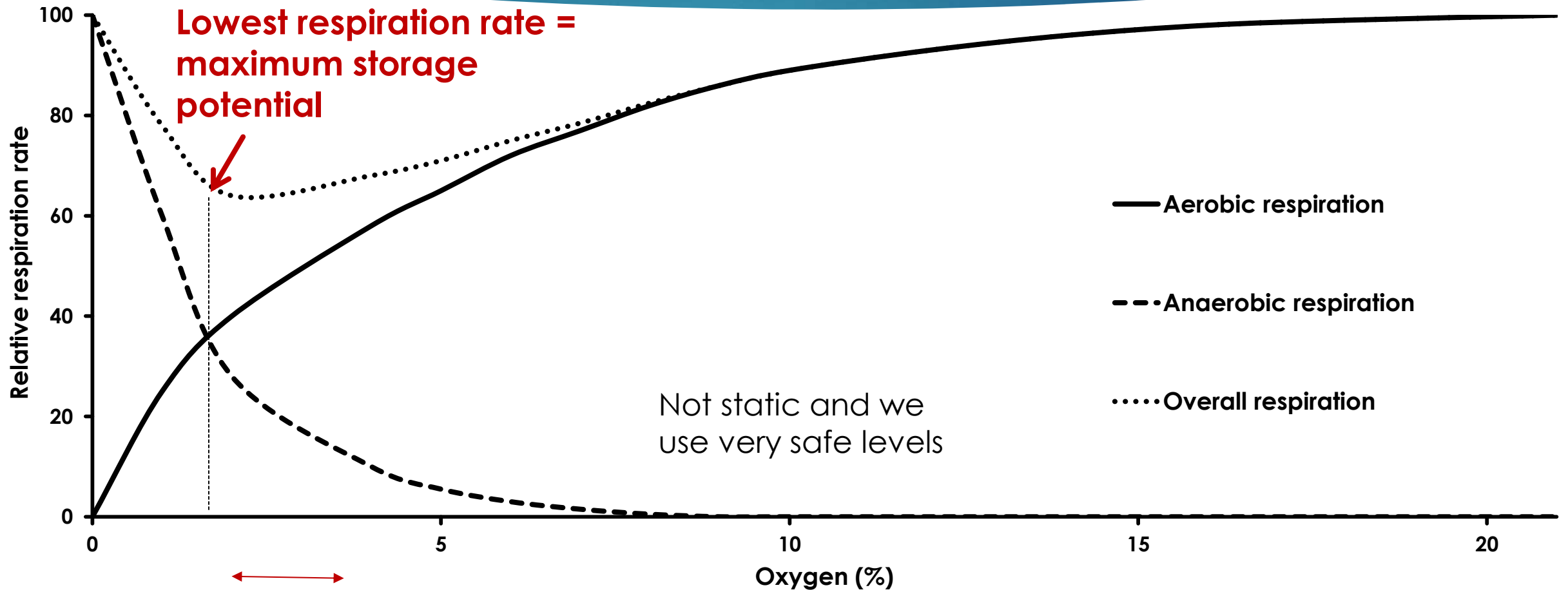


2. Dynamic Controlled Atmosphere (DCA) storage

New technology widely used in Europe

- ▶ **Scald control is a driver for DCA, and the technology represents a non-chemical means of disorder control if don't want to use 1-MCP**

The principle underpinning DCA



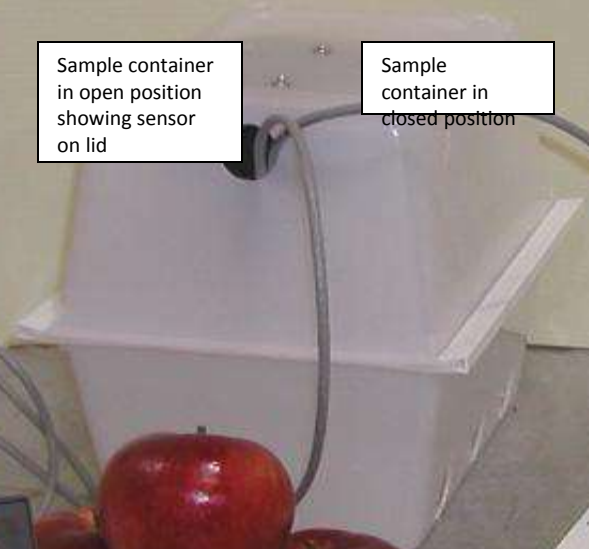
Three methods available

1. - **Fluorescence**
2. - **Ethanol**
3. - **Respiratory quotient (CO₂/O₂ ratio)**

HarvestWatch – based on Fluorescence



Sample container in open position showing sensor on lid



Sample container in closed position

Hub for multiple sample containers



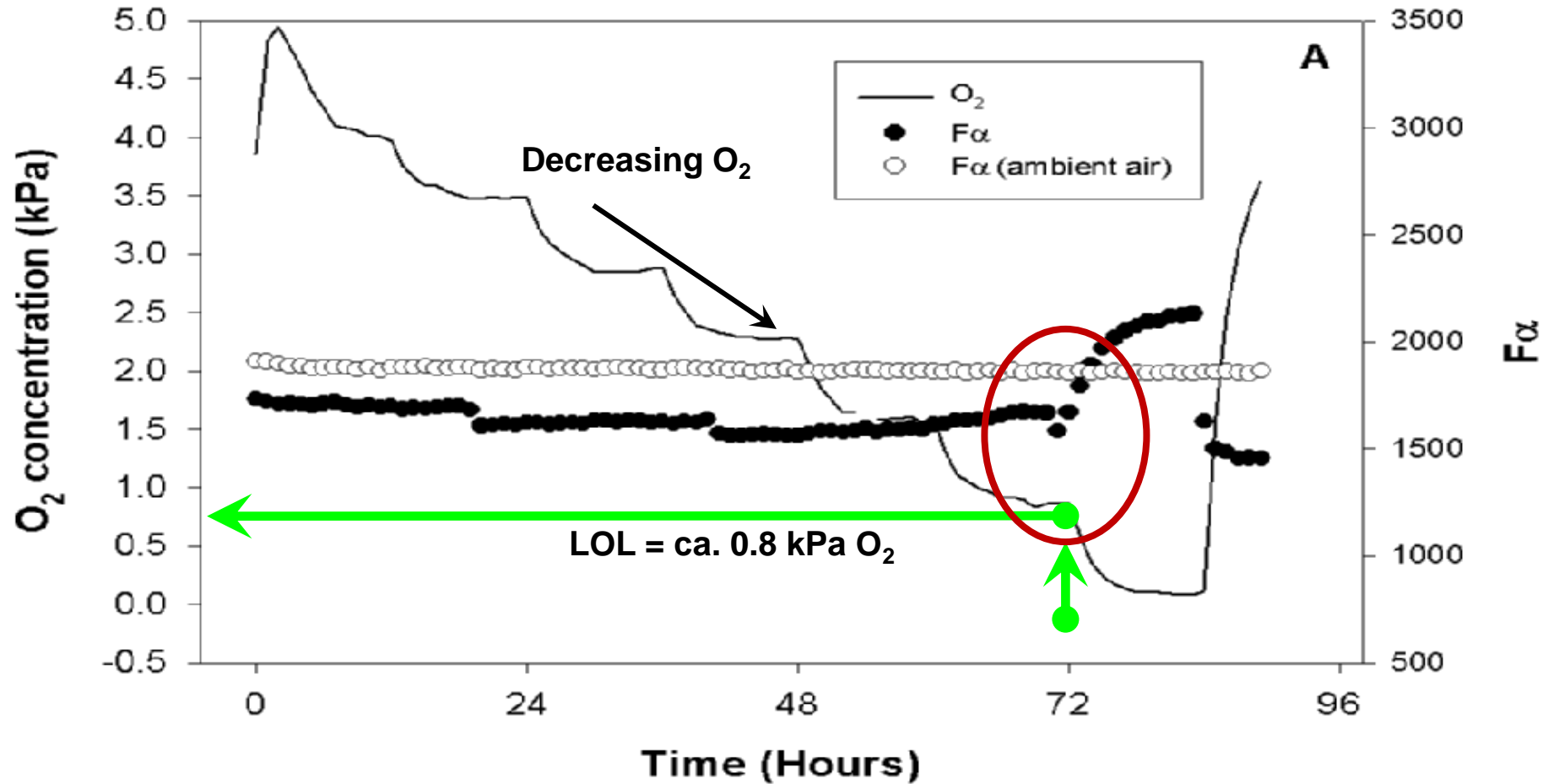
Compute



HarvestWatch containers in storage bins



Using HarvestWatch to determine LOL in apple



Varieties

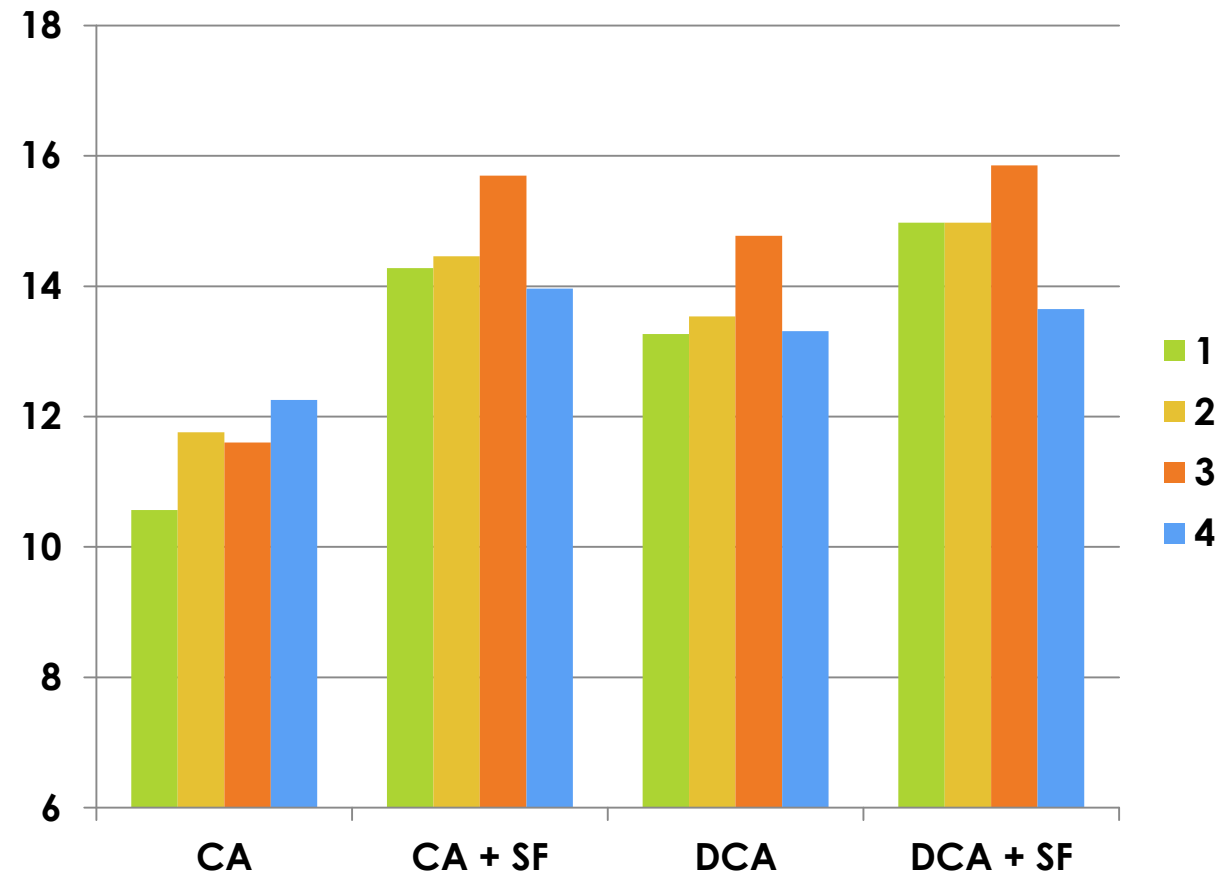
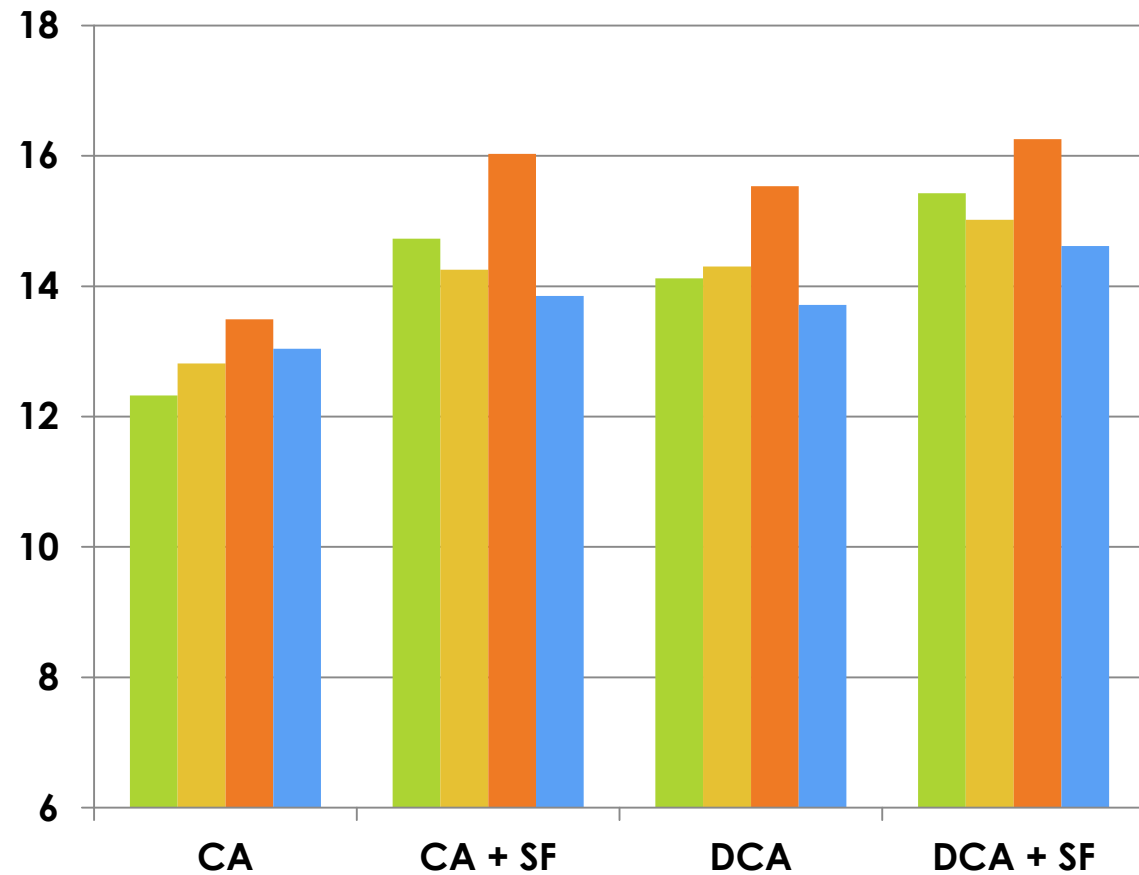
- ▶ McIntosh – WNY (2014), Champlain (2013, 2014)
- ▶ Delicious – WNY (2013, 2014)
- ▶ Empire – WNY (2013, 2014)
- ▶ Cortland – WNY (2014)
- ▶ Rome – WNY (2014)
- ▶ Gala (2015)
- ▶ Honeycrisp (2015)
- ▶ Gala (2015)

McIntosh (2013) - Flesh firmness (lb-f) day 1

Note
Champlain

4 months

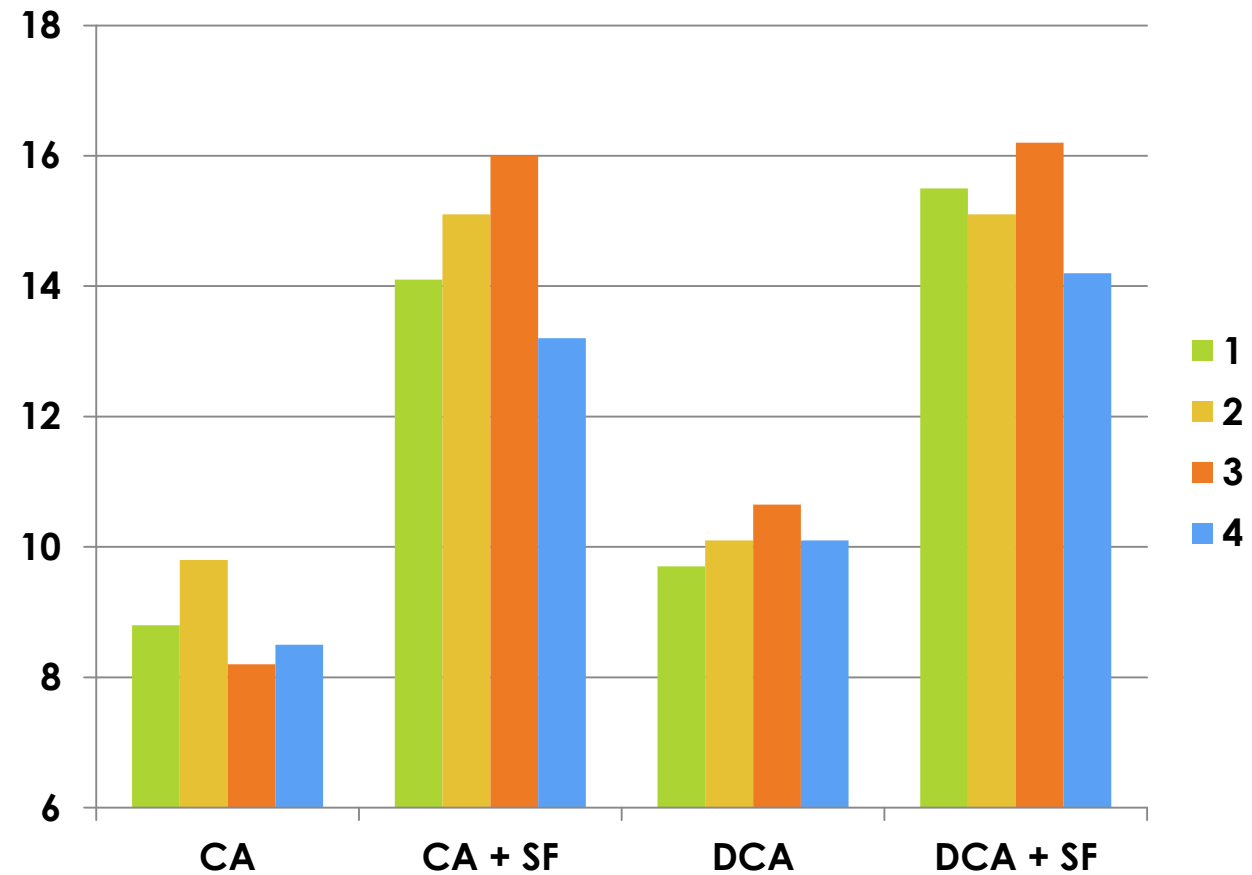
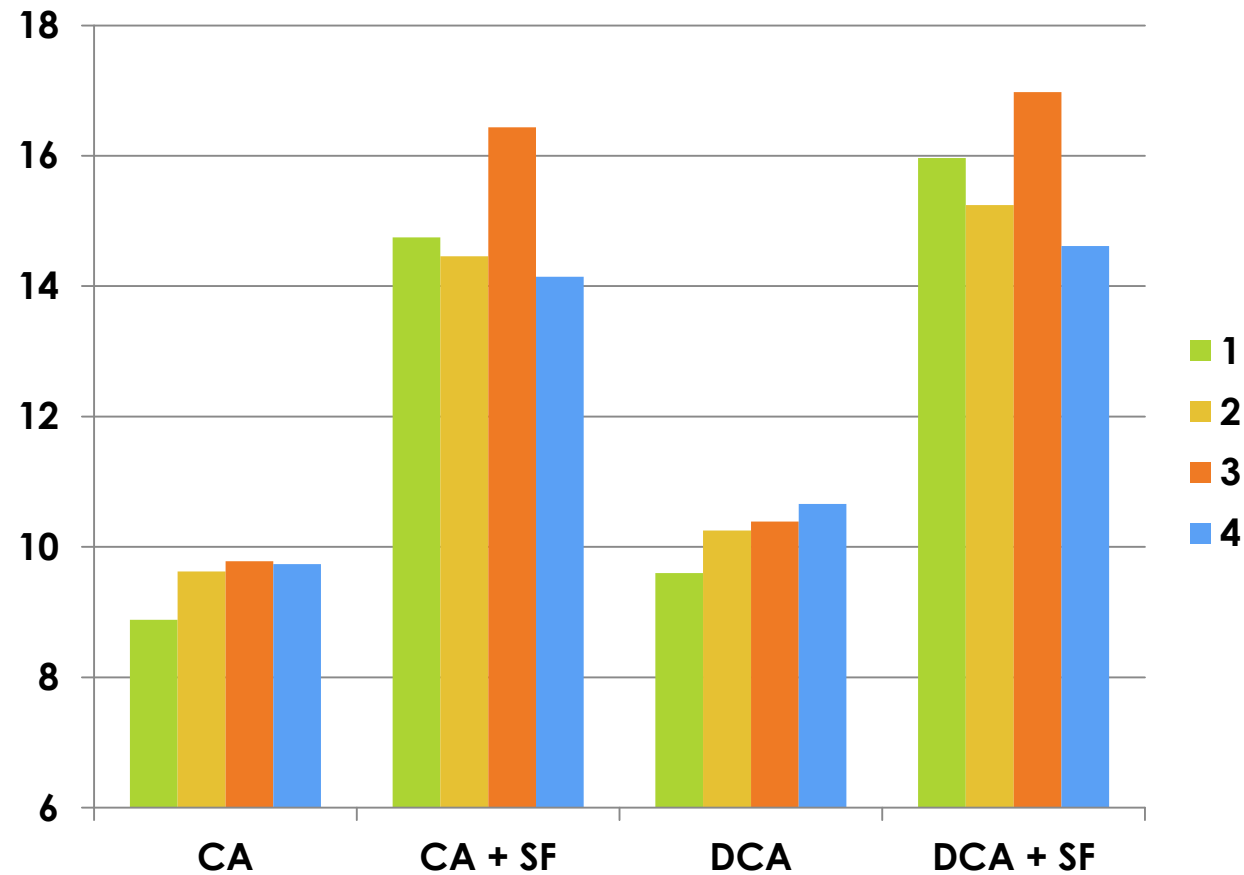
8 months



McIntosh (2013) Flesh firmness (lb-f) day 7

4 months

8 months



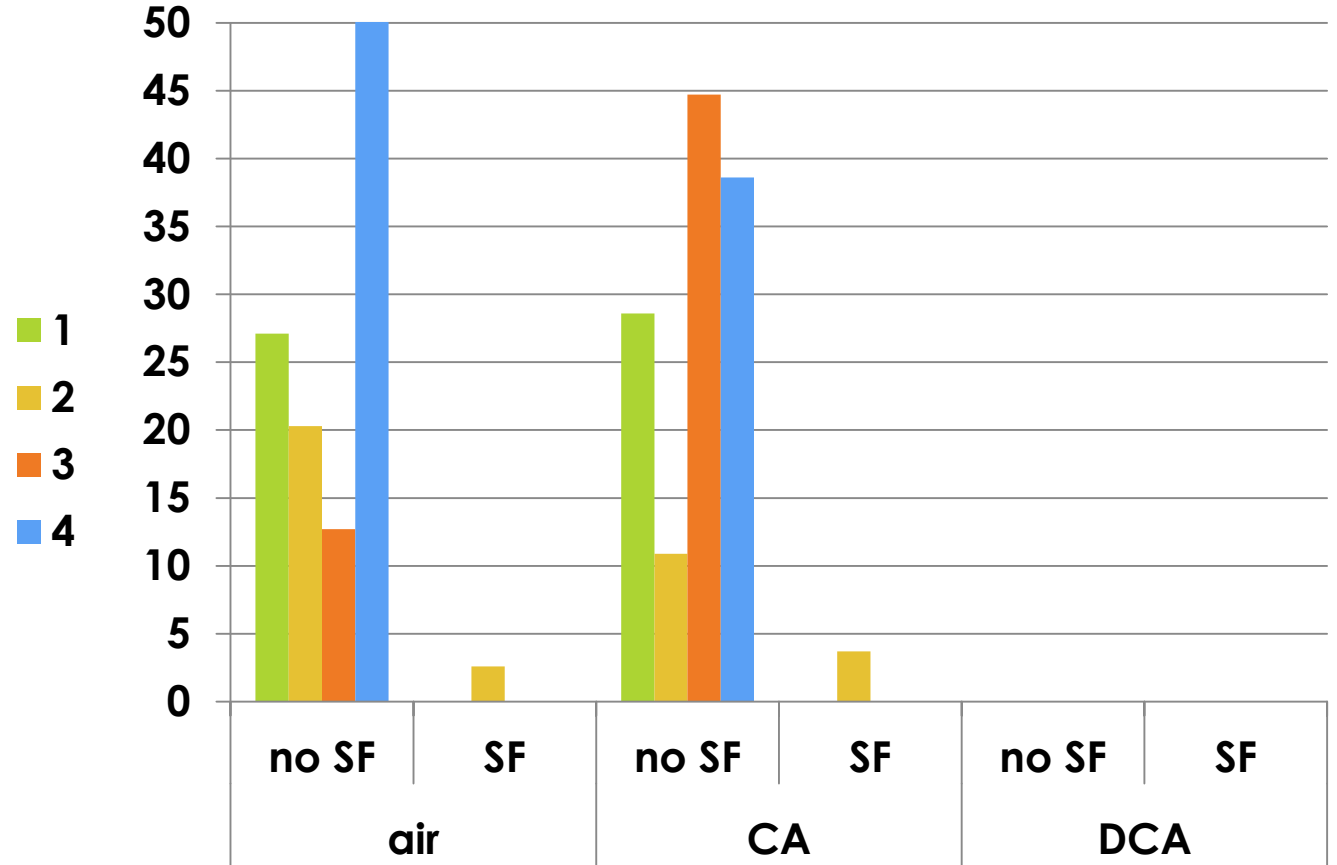
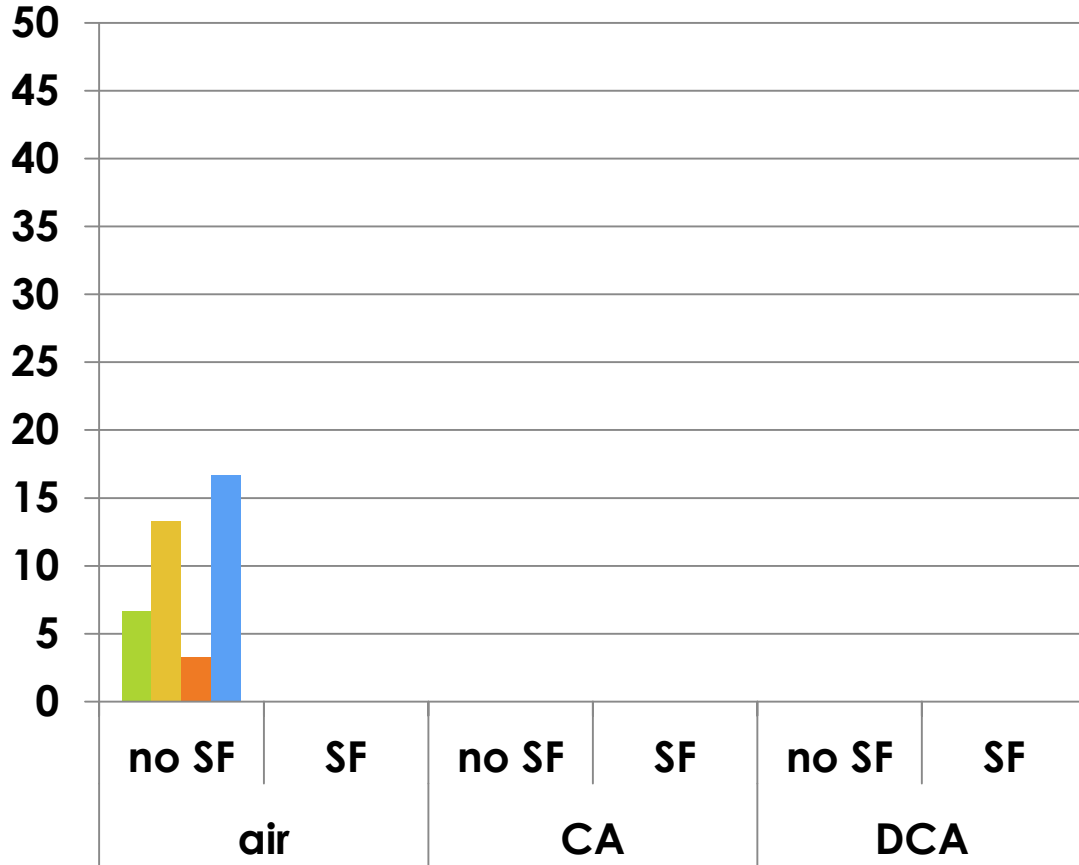
WNY – Delicious firmness (lb-f) after CA and DCA-CF storage

Treatment	5 months plus 7 d	8 months + 7 d
CA	13.6	10.5
CA + SF	15.8	14.8
DCA-CF	14.0	11.4
DCA-CF + SF	16.3	15.4

Delicious Superficial scald (%)

5 months plus 7 d

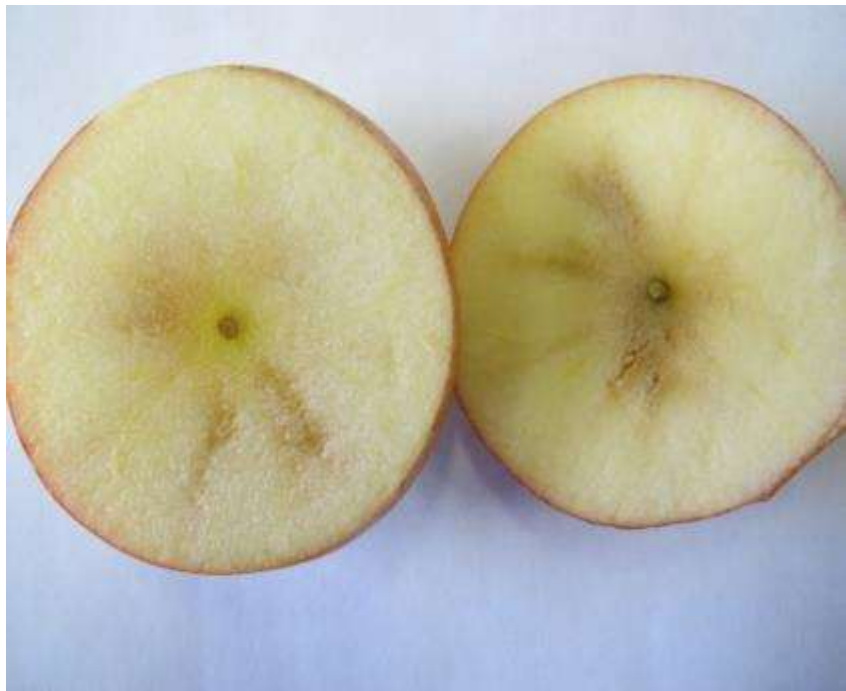
8 months plus 7 d



DCA conclusion

- ▶ DCA represents a non-chemical means of disorder control if don't want to use 1-MCP and/or DPA
- ▶ Condition, especially firmness, is lost during shelf life without 1-MCP treatment

3. Gala Stem end browning



Courtesy of Matheis

Stem end flesh browning

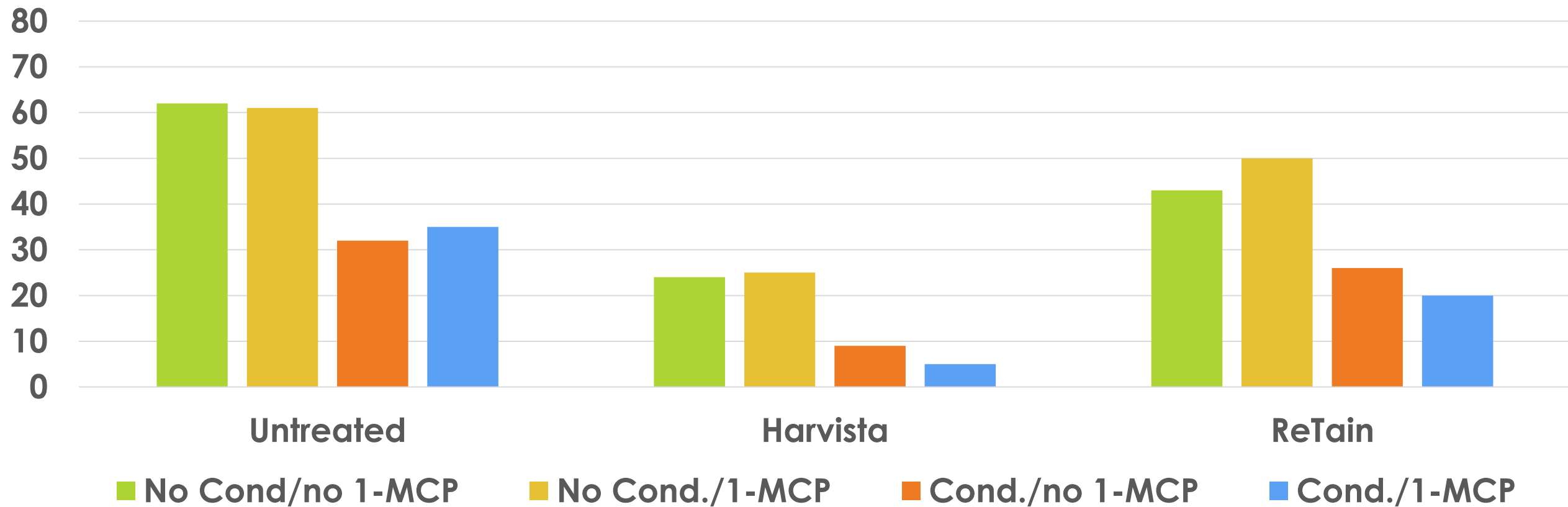
- ▶ **Appears to becoming more of a problem, perhaps increasing with higher fruit volumes = longer storage periods**
- ▶ **Orchard block factors are large. (Appears analogous to 'Empire' browning)**
- ▶ **Problem also in some Washington Orchards**

2013 Harvest date, PGRs, and conditioning

- ▶ **Commercial block of 'Gala' (Fulford strain)**
- ▶ **Untreated, Harvista (1 week before H1), ReTain (half rate 3 weeks before H1)**
- ▶ **Fruit harvest**
 1. H1 spot pick
 2. H2 spot pick – week 2 harvest all remaining fruit from 1.
 3. H2 strip pick (week 2 harvest, no harvest in week 1)
- ▶ **On each harvest date, fruit either untreated or treated with 1 ppm SmartFresh, and then stored at 33°F or 7 days at 50°F before storage at 33°F.**
- ▶ **4 months CA**

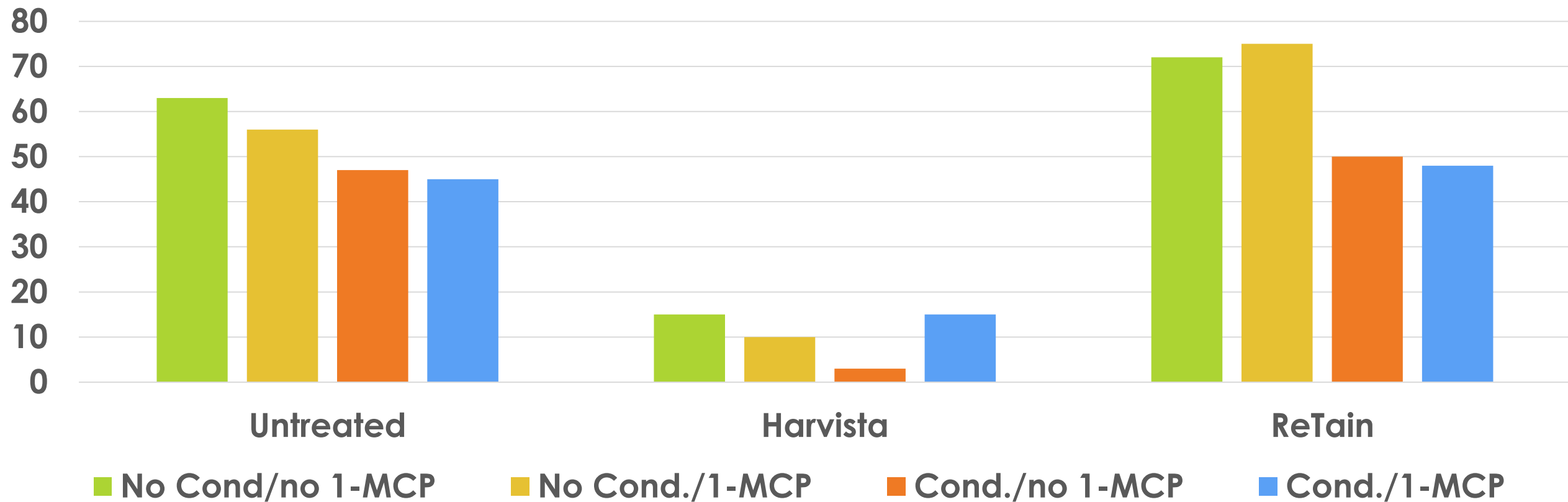
Harvest 1 – week 1: spot pick

Stem end browning (%)



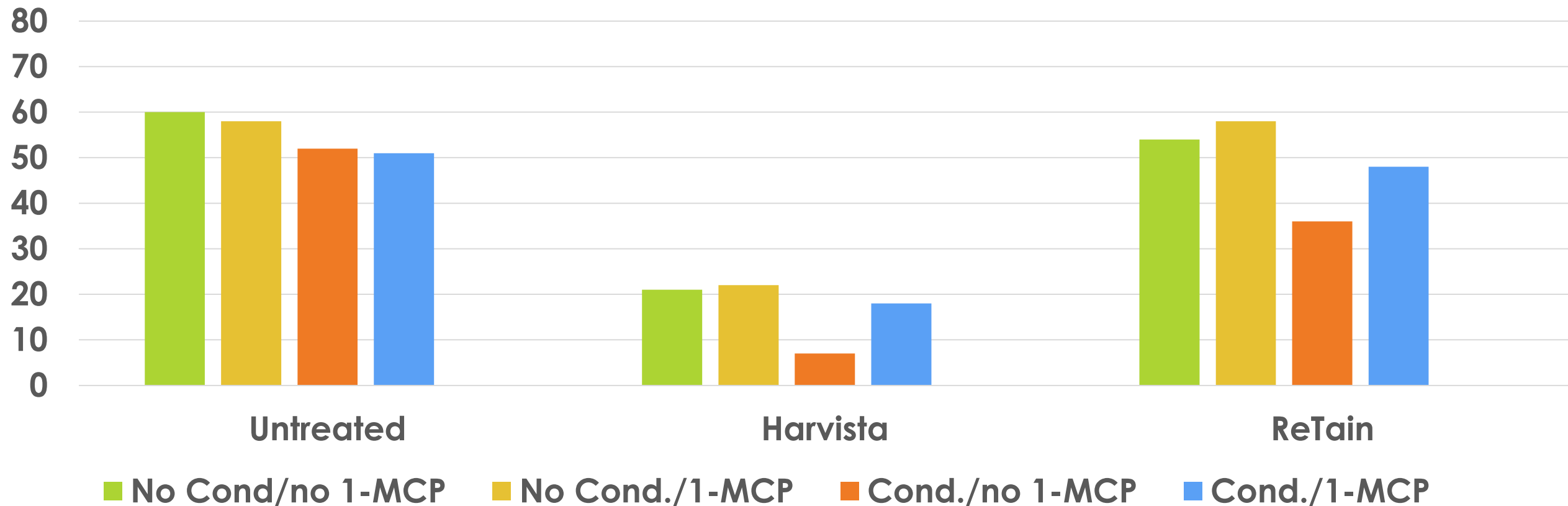
Harvest 2 – week 2: second spot pick

Stem end browning (%)

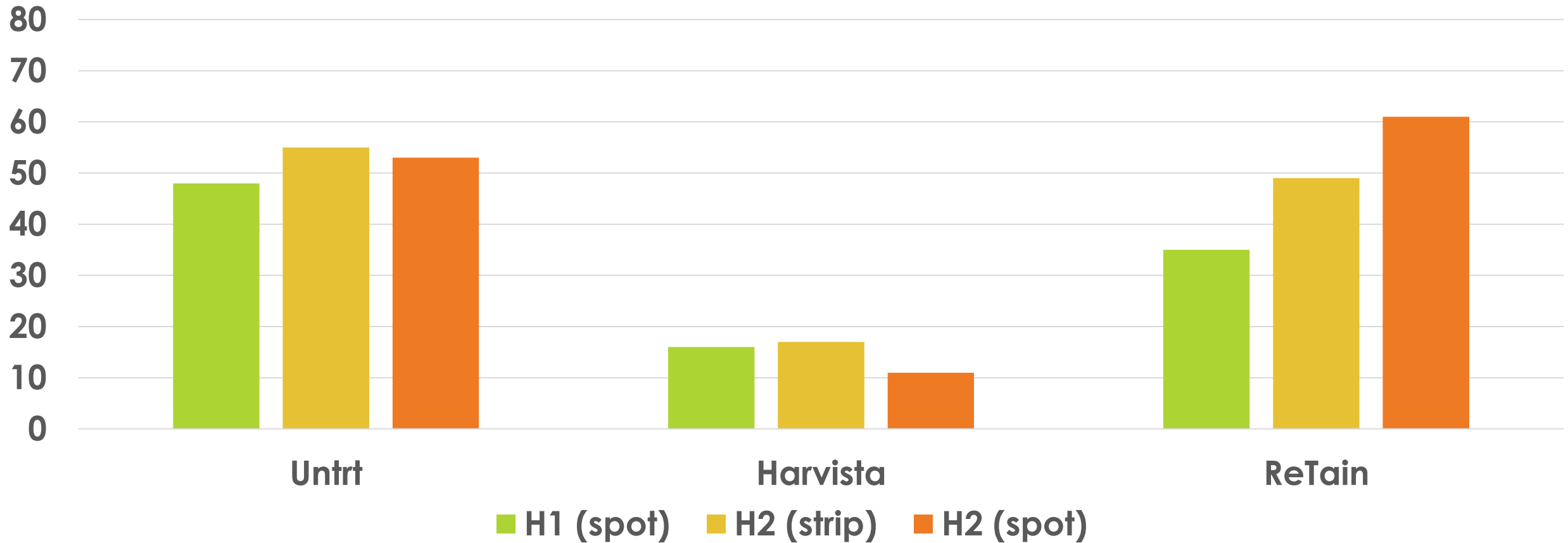


Harvest 2 – week 2: strip pick (all fruit)

Stem end browning (%)



Harvest x Field treatment***



2014 experiments

- ▶ Two harvests – spot picks
- ▶ Untreated and Harvista only
- ▶ Plus/minus Conditioning
- ▶ 6 months CA

Untrt = 71%;
Harvista = 30% ***

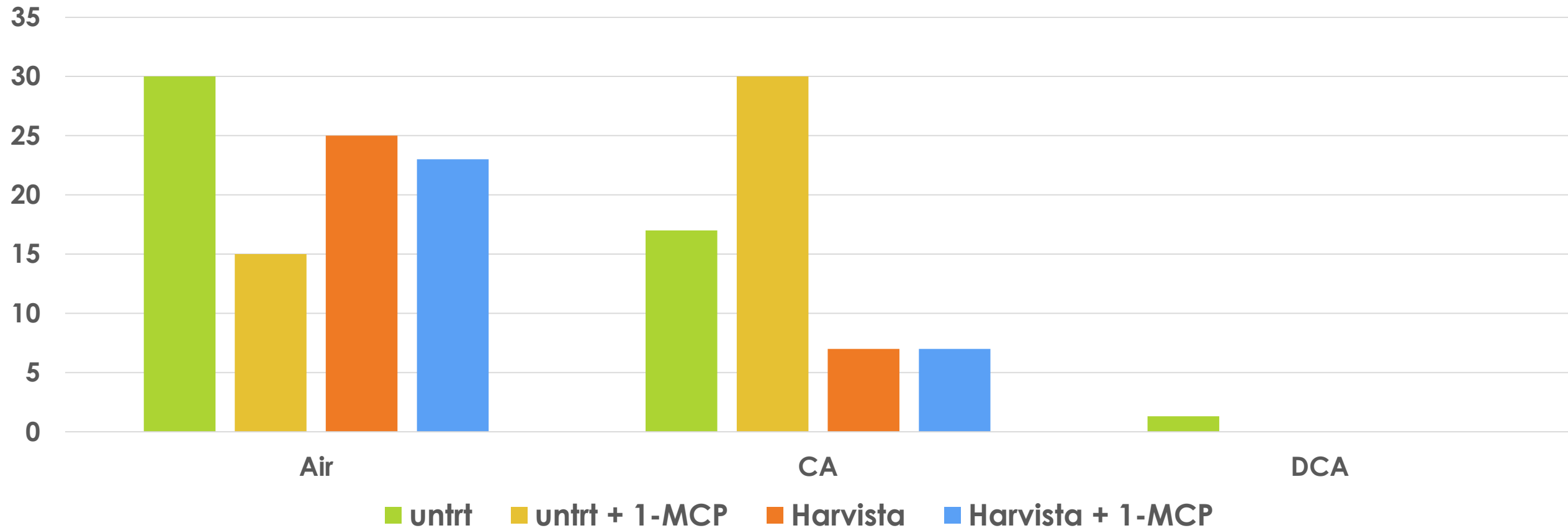
Non cond. = 64%;
Cond. = 37%***

Take home messages

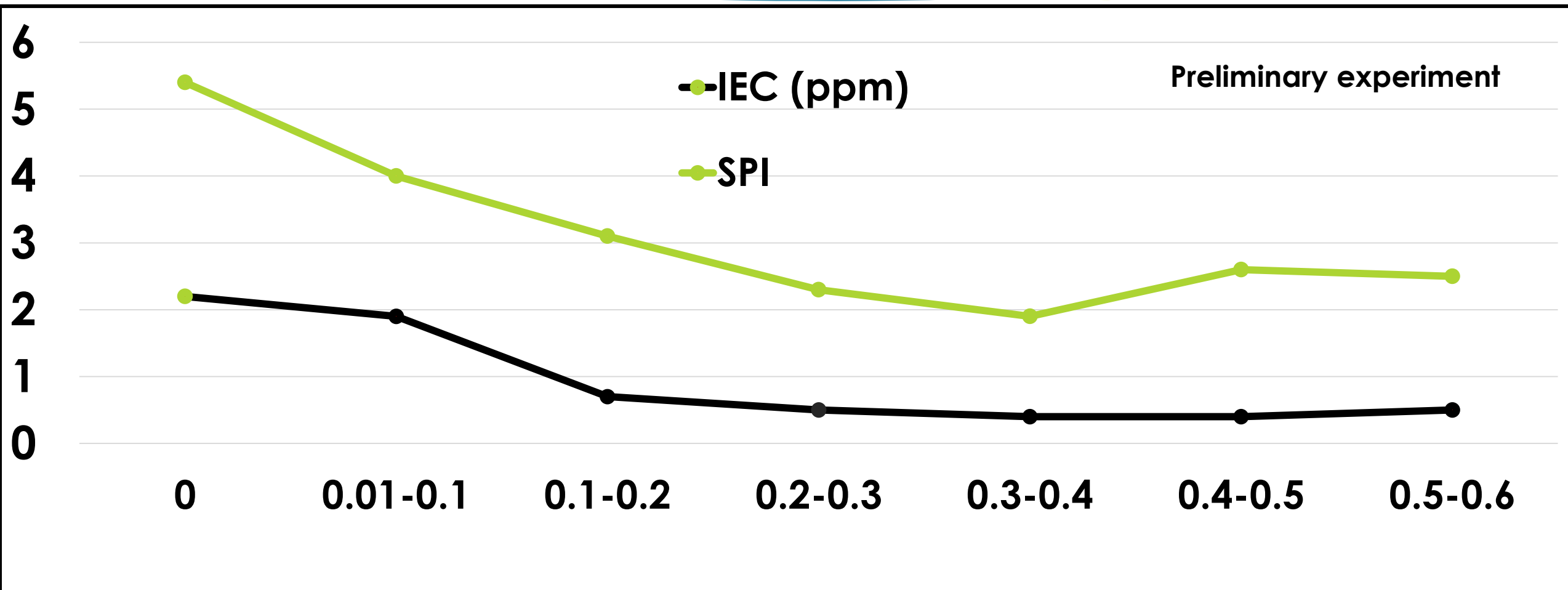
- ▶ **ReTain and Harvista can reduce stem end browning, but harvest date effects influence extent of reduction.**
- ▶ **Conditioning can reduce browning but also affected by harvest date.**
- ▶ **Harvista overall strongest effect, both on flesh browning and other quality attributes.**
- ▶ **Conditioning did not result in loss of quality.**

2015 harvest – effect of DCA storage

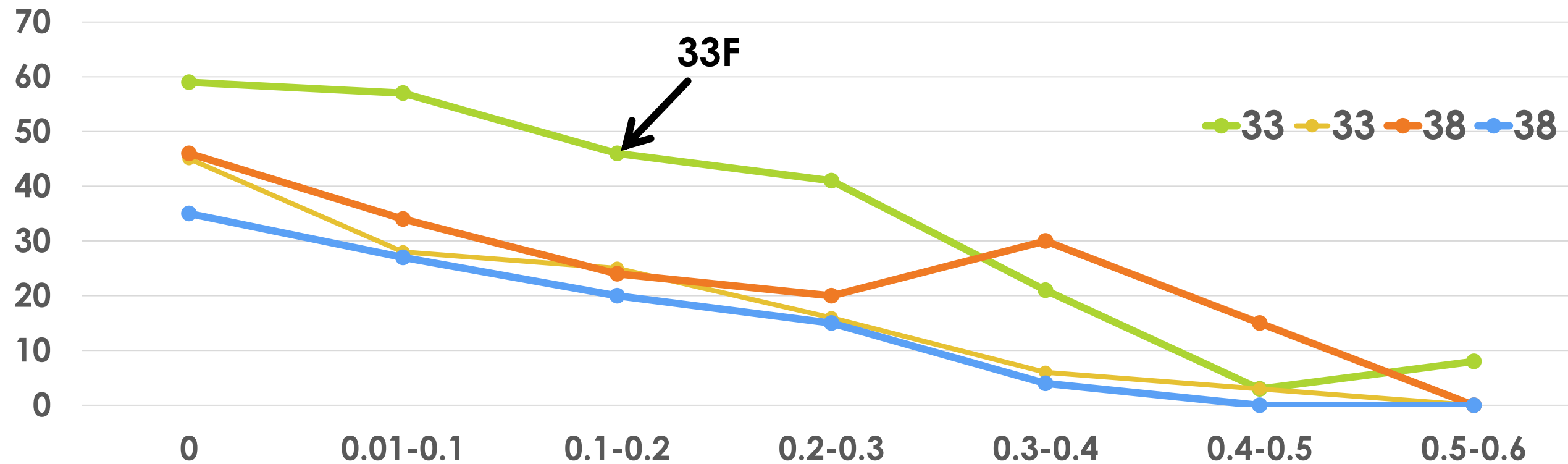
Flesh browning (%) **12 weeks**



Internal ethylene and starch pattern indices by color class



Flesh browning (%) in CA stored fruit - 2 temperatures plus/minus conditioning



FB incidence greater in more mature fruit, and effect of conditioning more marked in fruit stored at 33F

Summary

Flesh browning incidence is:

1. Decreased by Harvista treatment, and by ReTain at early harvest, indicating a maturity effect on the disorder.
2. Increased in more mature fruit as indicated by DA meter categories.
3. Decreased by conditioning but effects are inconsistent (and may be affected by harvest maturity). Conditioning probably has little commercial usefulness.
4. Greater at 33 °F than at 38 °F. Maybe Gala is not the 32/33F apple that we have assumed it is!

Acknowledgements

The people

- ▶ Yosef Al-Shoffe
- ▶ Jackie Nock
- ▶ The many NY cooperating growers and storage operators

The funding

- ▶ NY Apple R&D Program
- ▶ NYFVI
- ▶ AgroFresh
- ▶ Federal Hatch funding (Multistate)

Thank you

QUESTIONS?