Pre and Postharvest Handling of Honeycrisp for Maximum Storage Life and Quality

Chris Watkins

Department of Horticulture

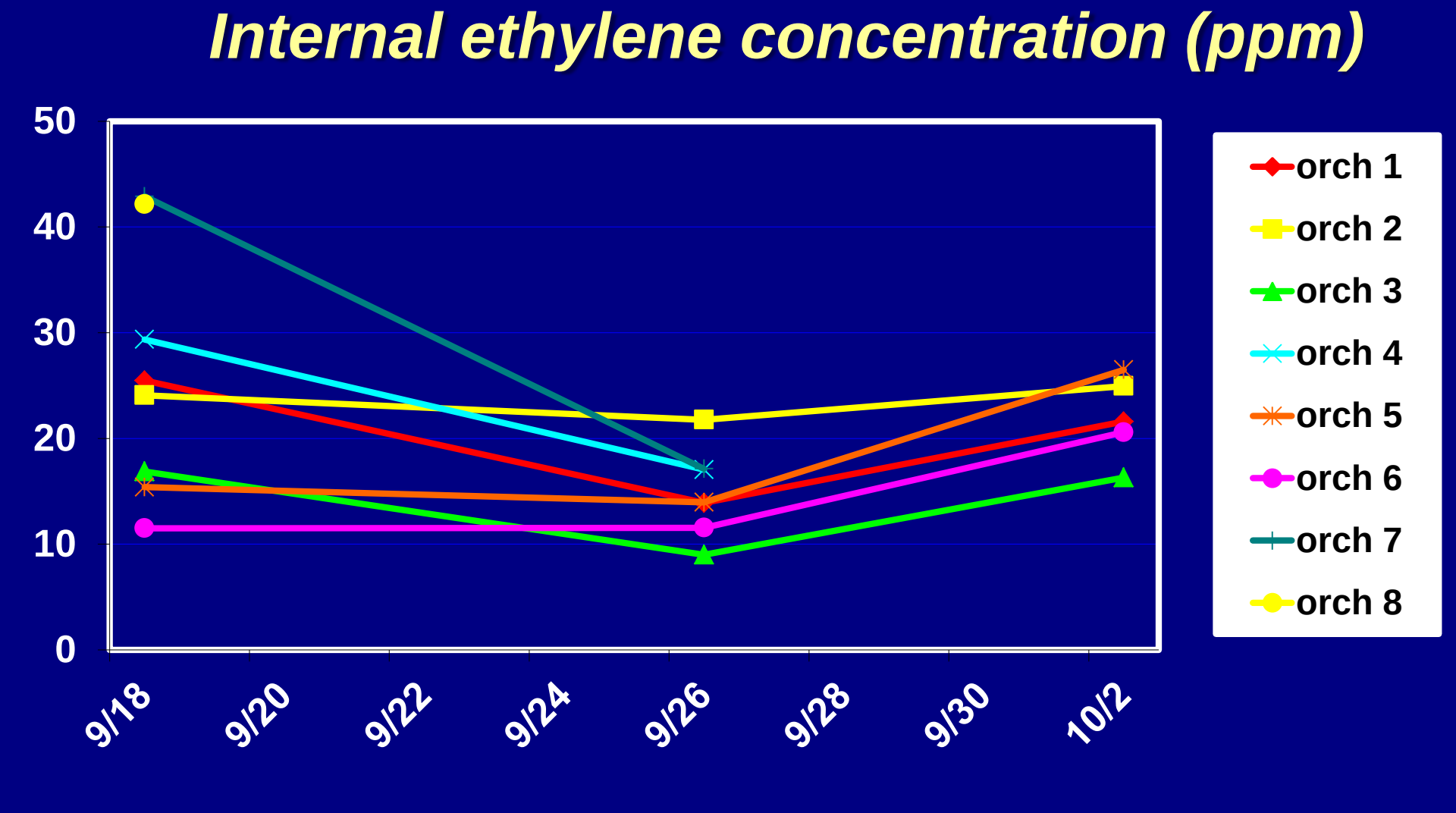
Cornell University

Ithaca

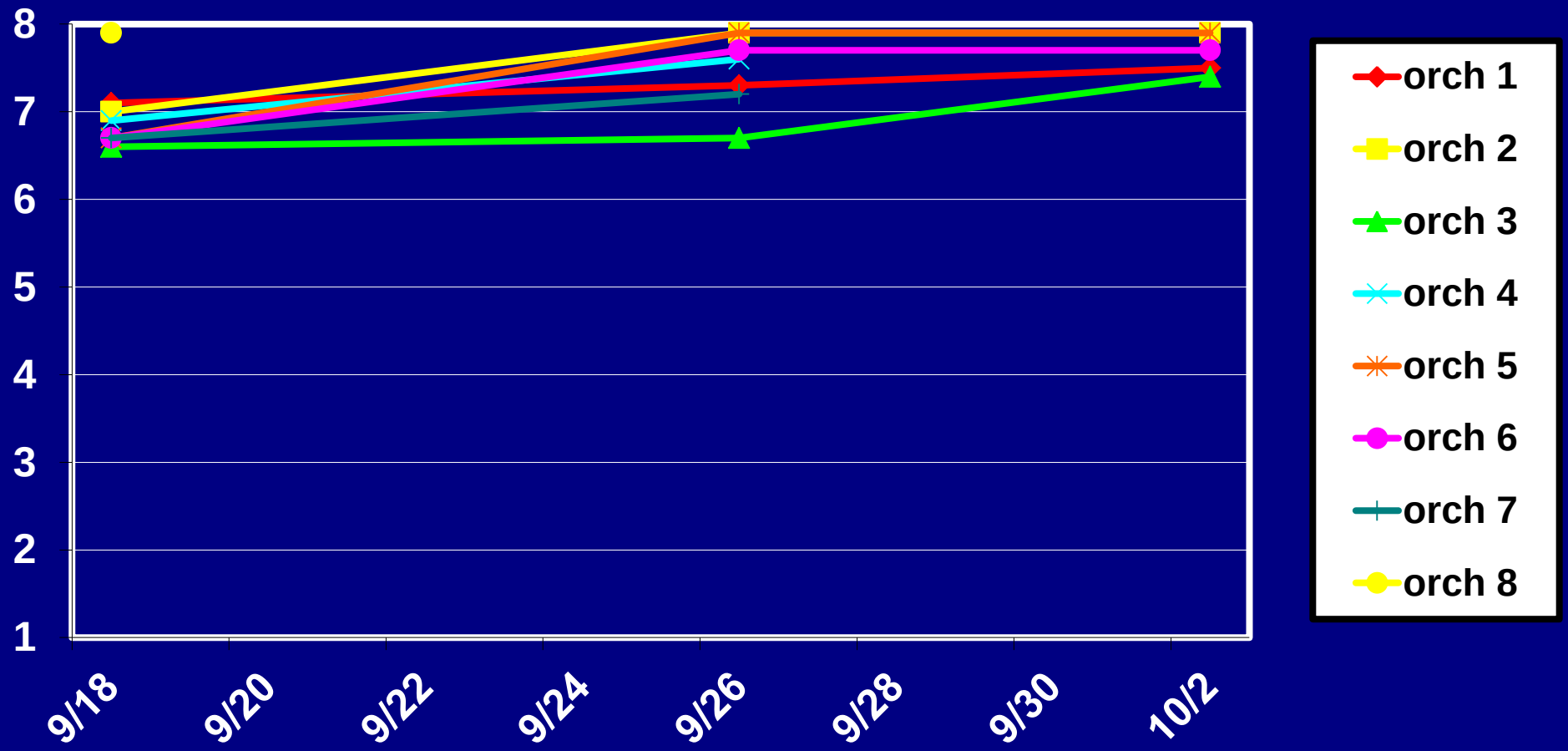
Today's presentation

1. Preharvest - Maturation and ripening
2. Postharvest - Storage quality including our experiences with CA

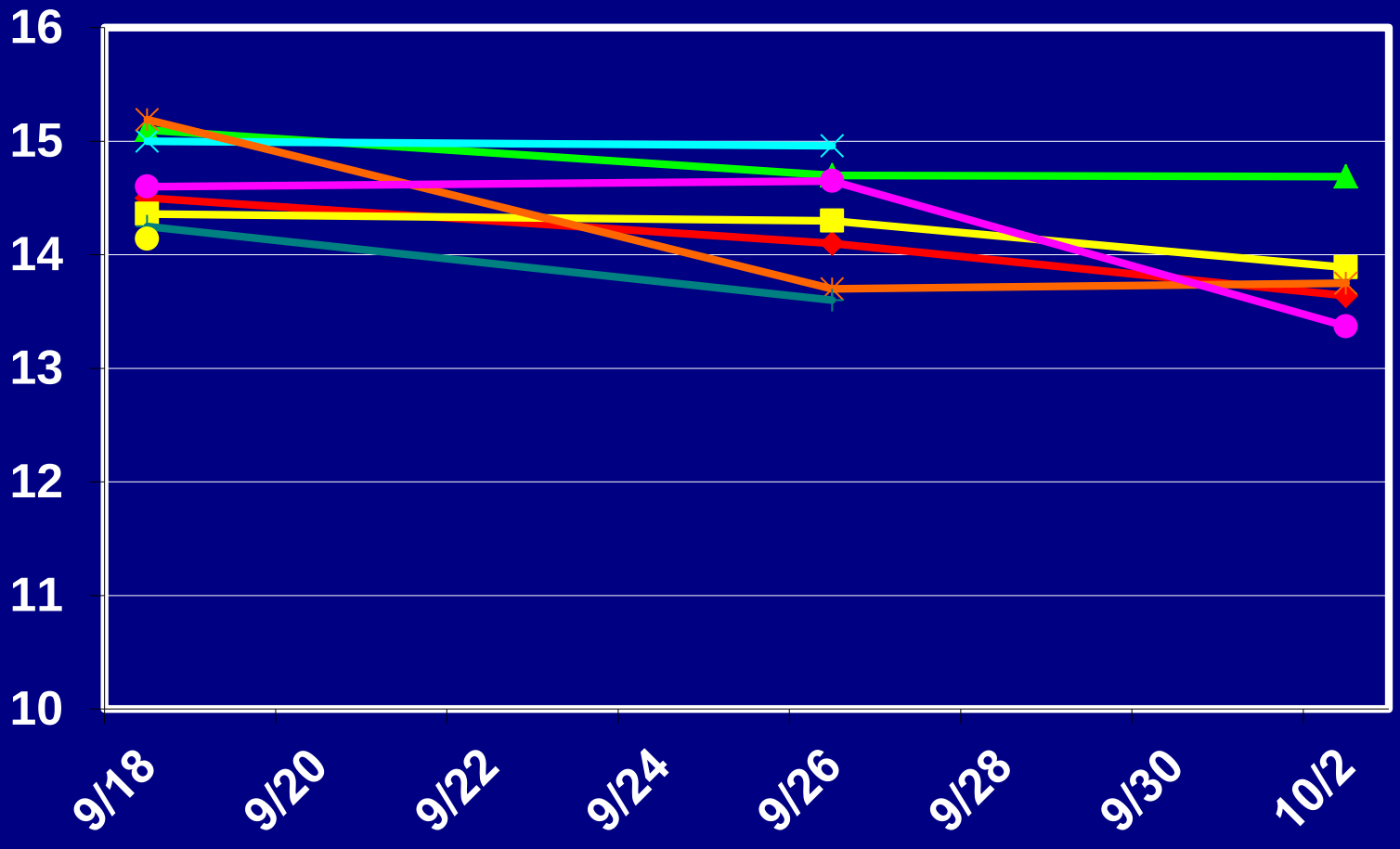
1. Preharvest - Maturation and ripening



Starch index



Firmness (lb-f)



Despite this apparent lack of harvest indices changes, the fruit is maturing!

- **Metabolically**
  - **Flavor**
  - **Volatiles**
  - **Susceptibility to disorders**

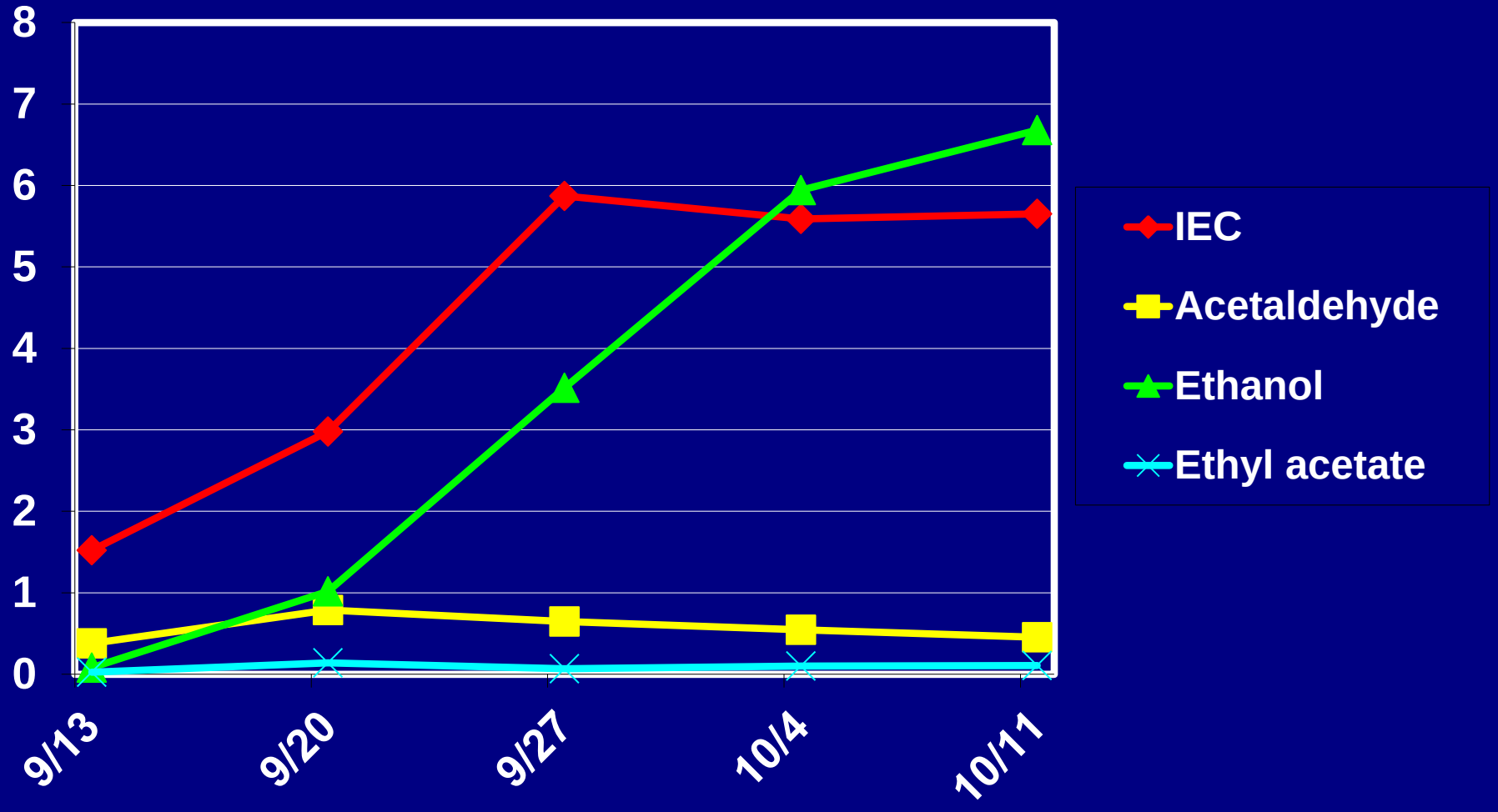
Highly susceptible to a number of serious physiological disorders, many related to maturity

- Bitter pit
- Soft scald
- Soggy breakdown
- Senescent breakdown
- Greasiness
- Skin wrinkling
- Blotch-like necrosis
- Internal CO_2 injury






IEC (ppm) and fermentation products (mg/kg) at 5 harvest dates



Meanwhile firmness is not changing greatly

HC PROBLEMS IN PART BECAUSE IT IS HARVESTED MORE MATURE THAN FOR A 'NORMAL' APPLE VARIETY

-As indicated by fermentation products during harvest

-Slow softening on and off tree allows later harvest

-Solution would be earlier harvest but not sufficient color, nor the Honeycrisp flavor that has made it so desirable in the marketplace

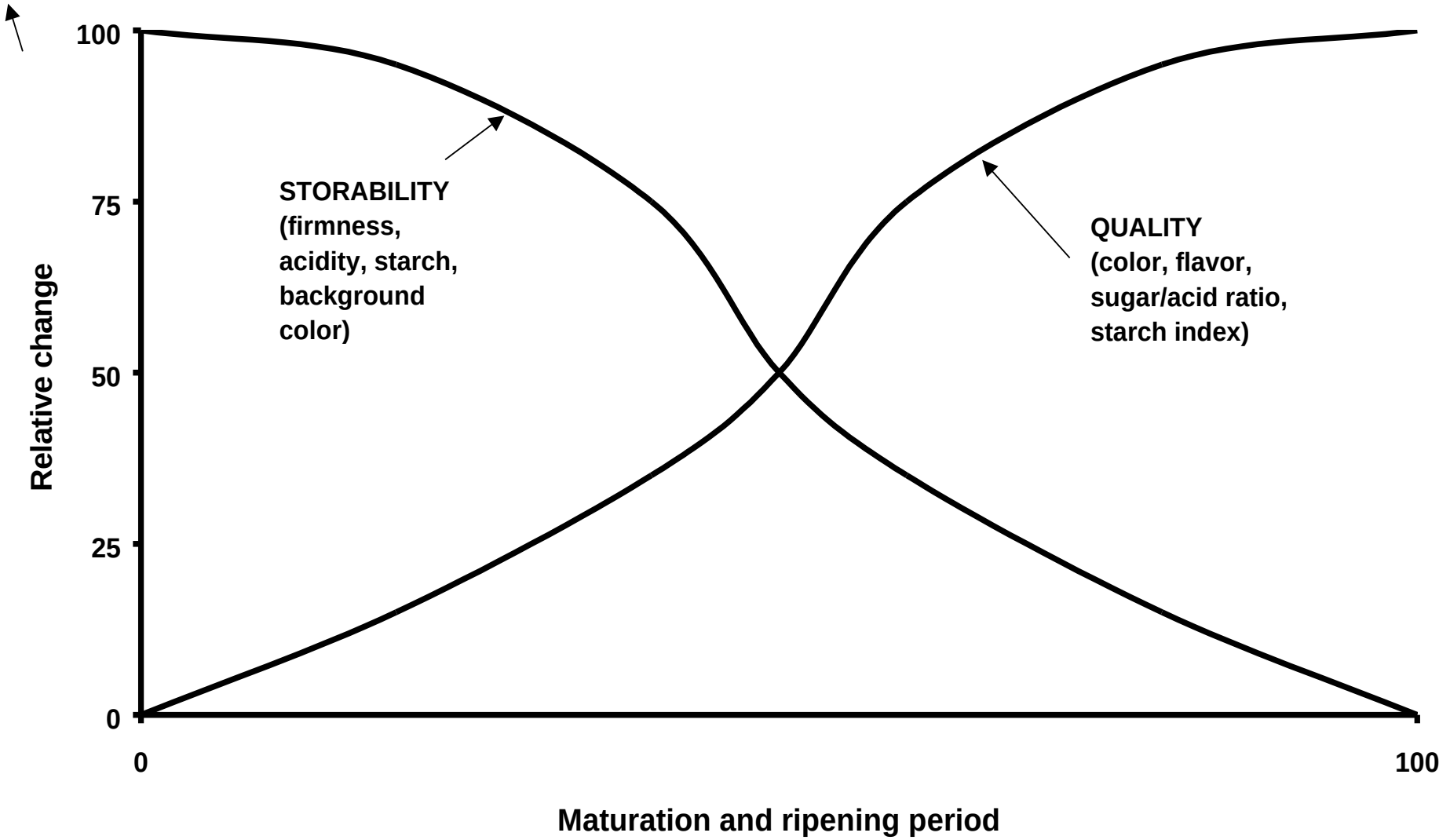
In summary

No major changes in usual harvest indices, but significant metabolic changes are obviously occurring

Harvest decisions should be based on:

- Bright color change (ground color change) as fruit “mature” is associated with full flavor development
- Spot/selective picking essential
- However, in practice harvested to red color, not necessarily ground color

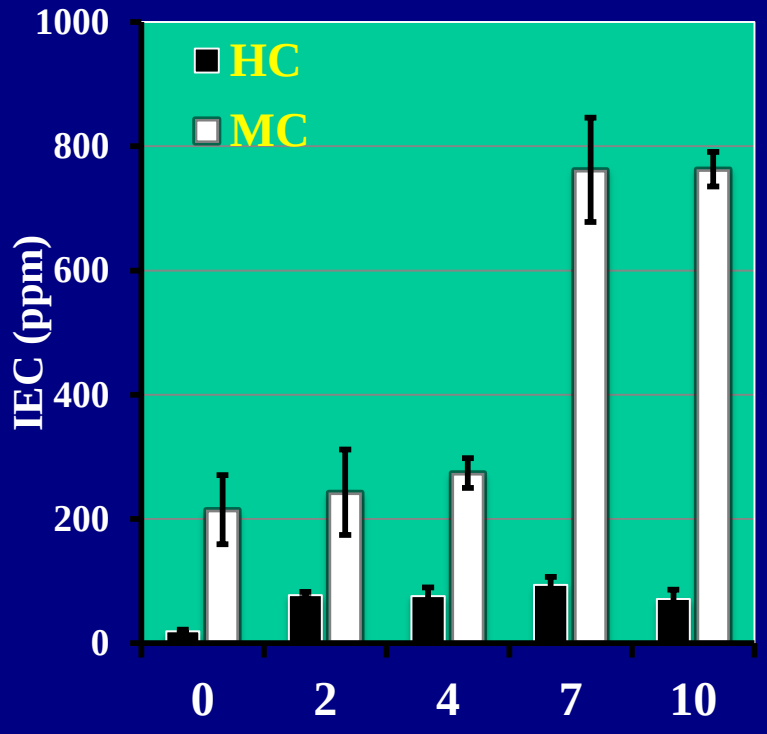
Correct maturity" is a *compromise* between quality and storage life required!



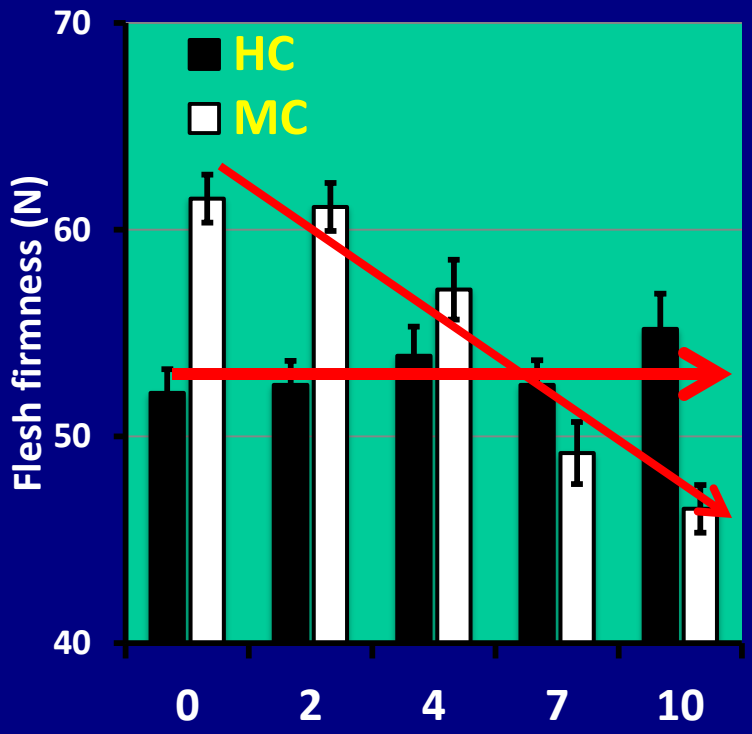
2. Storage quality including our experiences with CA

Postharvest uniqueness

IEC (ppm)

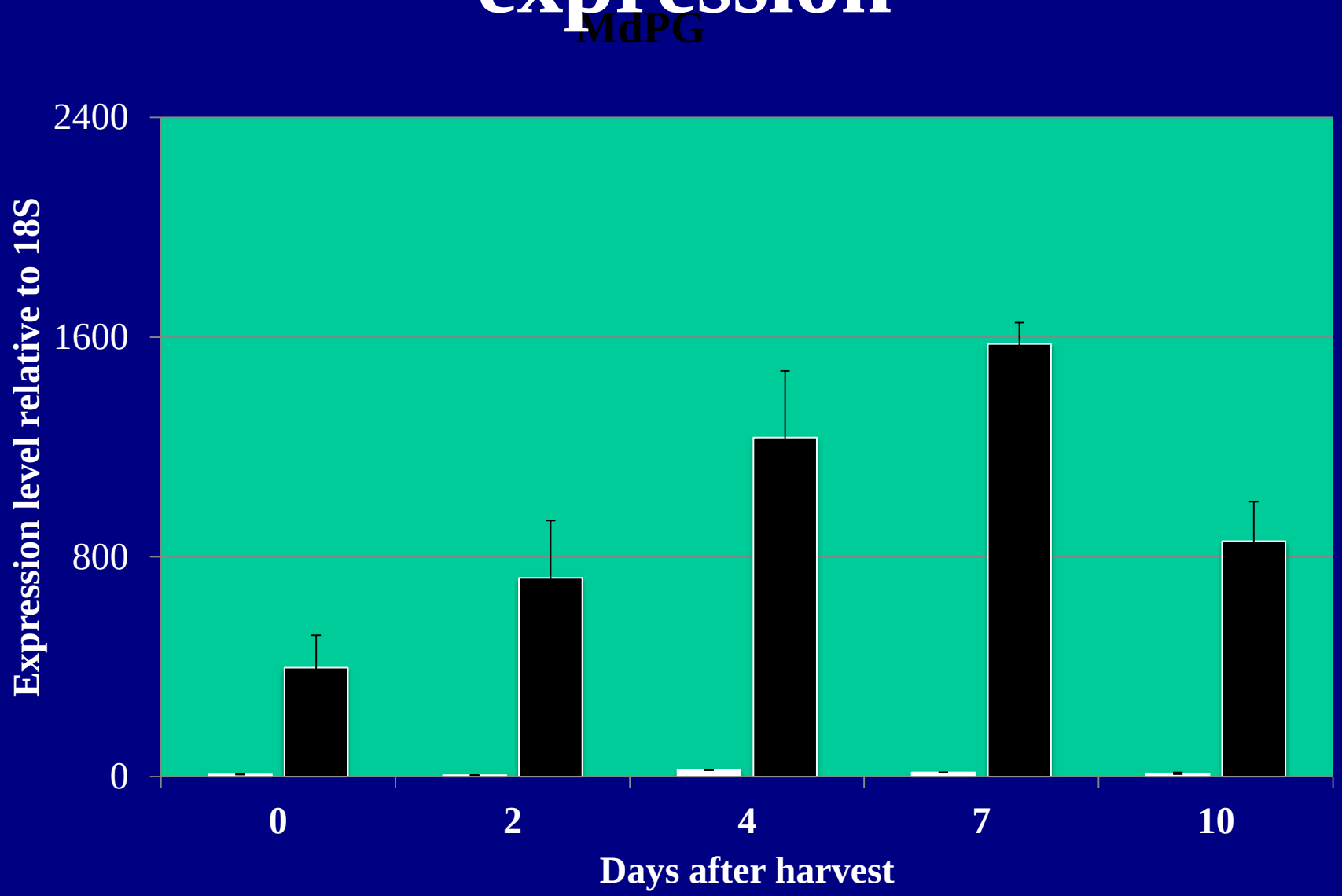


Firmness (N)



Days after harvest

Polygalacturonase gene expression



Limited softening after harvest allows unusual postharvest treatment

- Conditioning at
  - 50F for 7 days to reduce risk of soft scald development

Postharvest treatments
Delay at 50F for 7 days

Treatment	Soft scald (%)	Bitter pit (%)
33°F	62a	8b
38°F	9cd	13b
Delay, 33°F	14c	13b
Delay, 38°F	2d	40a

In general, high storage quality

- Firmness (crispness) maintained over extended periods of air storage
- Flavor maintained, but lost over time, resulting in bland taste

Increasing volumes mean that storage solutions must be found

Postharvest storage -Research emphases

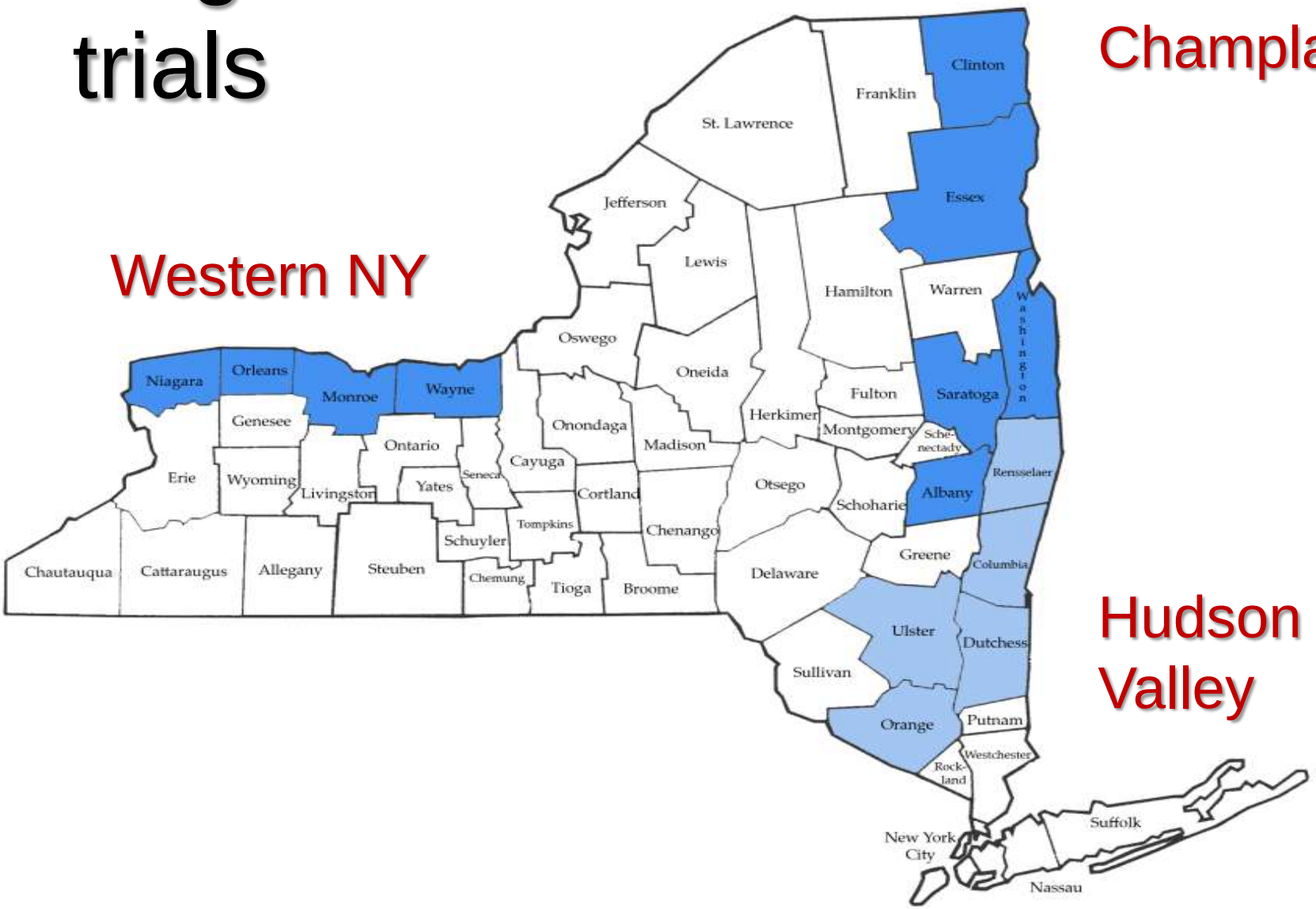
- Air storage – maintaining quality, focusing on 1-MCP
- CA storage – defining effects and developing safe atmosphere regimes

- [bitter pit – re-addressing including mineral prediction]

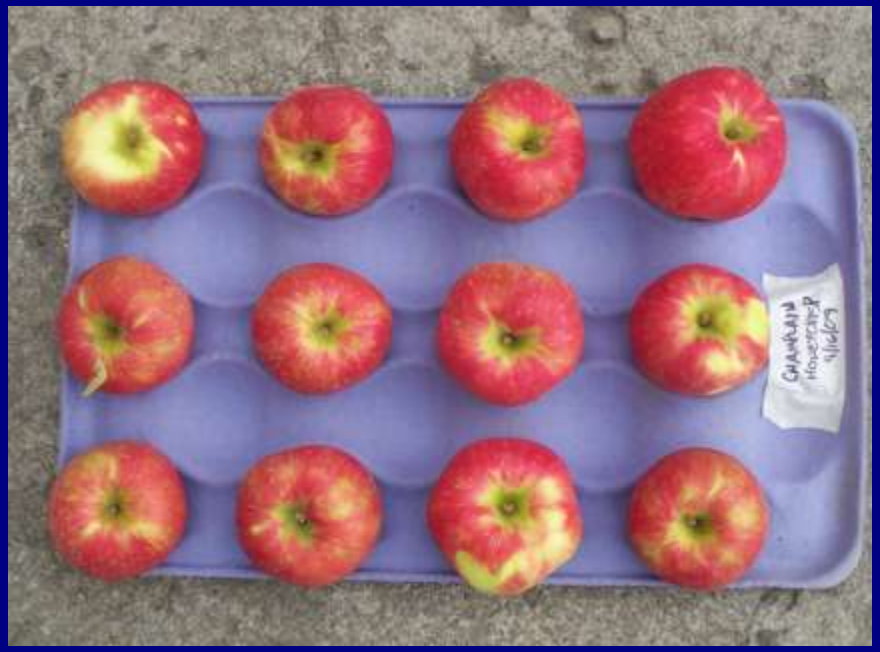
Regional trials

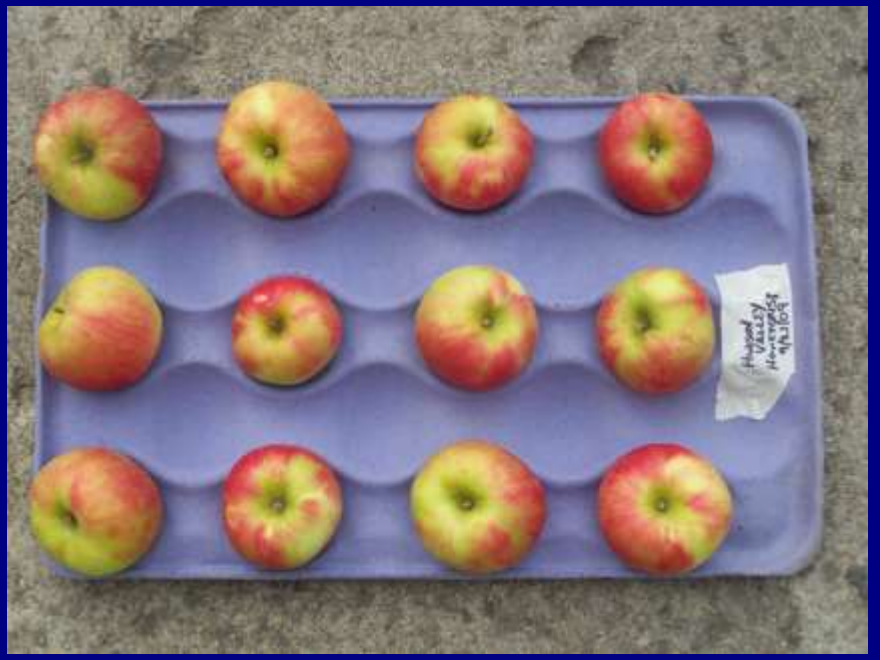
Champlain

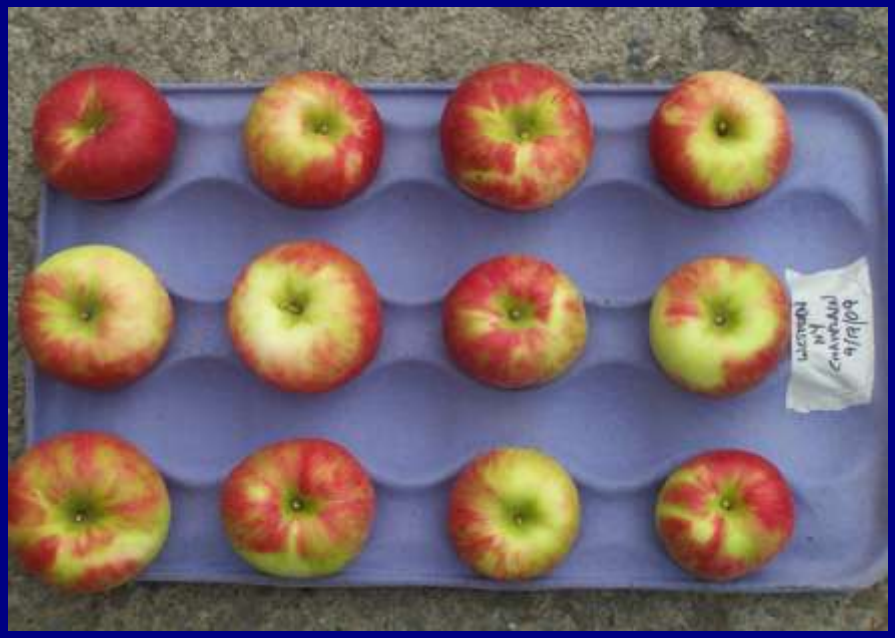
Western NY



Hudson Valley







Champlain

-higher acidity

-Higher soft scald

-Less bitter pit

Champlain summary: Untrt vs SF (air)

	3 months		6 months	
	UNTRT	**SF**	**UNTRT**	**SF**
Firmness (lb-f)	**16.0**	**15.9**	**15.5**	**15.5**
SSC (%)	**13.0**	**13.2**	**12.0**	**12.4***
TA (%)	**0.291**	**0.318**	**0.228**	**0.267*****

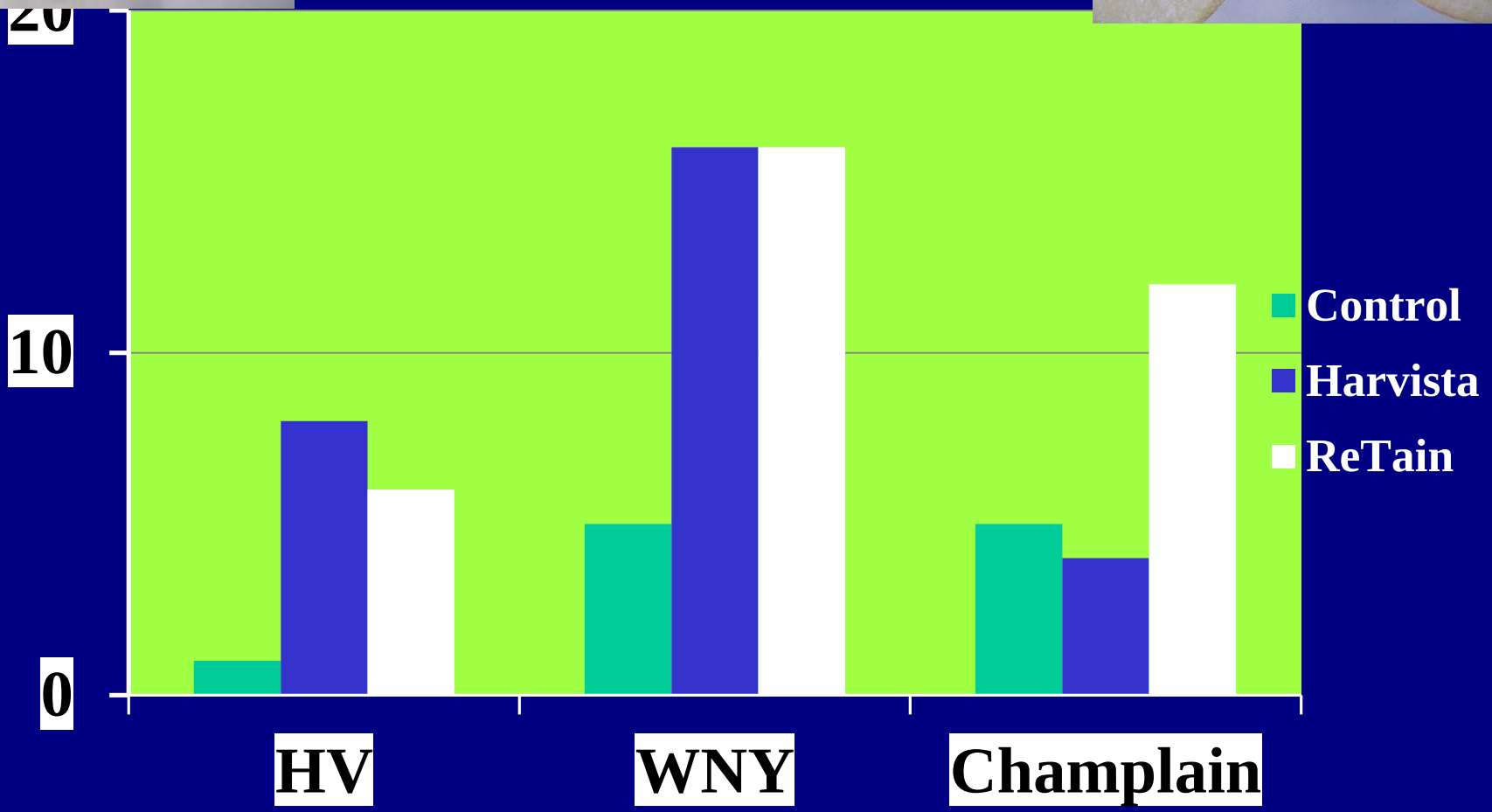
Champlain summary: Untrt vs SF (CA)

	3 months		6 months	
	UNTRT	**SF**	**UNTRT**	**SF**
Firmness (lb-f)	**16.0**	**16.0**	**15.6**	**15.5**
SSC (%)	**13.2**	**13.1**	**12.7**	**13.0**
TA (%)	**0.309**	**0.310**	**0.288**	**0.306**

Champlain summary: Air vs CA

	3 months		6 months	
	Air	**CA**	**Air**	**CA**
Firmness (lb-f)	**15.9**	**16.0**	**15.5**	**15.5**
SSC (%)	**13.1**	**13.1**	**12.2**	**12.8*** **
TA (%)	**0.305**	**0.310**	**0.248**	**0.297*** **

Internal CO_2 injury (CA only)



Summary

- **SmartFresh recommended for longer term air storage – can help maintain higher SSC and TA , and reduce greasiness for short term storage**
- **Little effect of SmartFresh in CA, but Air plus SmartFresh can be roughly equivalent to CA storage**
- **CA can maintain TA and reduce greasiness, but not recommended because of risk of carbon dioxide injury**
- **Effects of preharvest PGRs have to be taken into account**

Development of CA storage regimes

- Fruit from 6 orchard blocks in western NY (9/24-25)
- Preconditioning - 1 week at 50^{o}F
- 1.5, 3.0, 4.5% O_2 with either 1.5 or 3% CO_2 (38 ^{o}F)
- 6 months storage plus 4 days at 68 ^{o}F

Harvest indices (2009/2010)

Orchard #		Firmness (lb-f)	SSC (%)	TA (%)
1		14.1	11.1	0.216
2		15.2	11.4	0.304
3		13.7	11.5	0.280
4		14.9	10.8	0.364
5		15.1	12.6	0.386
6		13.1	10.8	0.275

Firmness, Acidity

CA (O_2/CO_2)	Firmness (lb)	SSC (%)	Acidity (%)
1.5/1.5	14.4	9.6	0.143
3.0/1.5	14.6	11.4	0.232
4.5/1.5	14.1	11.0	0.180
1.5/3.0	13.9	11.6	0.249
3.0/3.0	14.3	12.1	0.269
4.5/3.0	13.9	10.9	0.218
	NS	***	***

Greasiness, bitter pit, CO_2 injury

CA (O_2/CO_2)	Greasiness (%)	Bitter pit (%)	CO_2 injury (%)
1.5/1.5	11	2	**6**
3.0/1.5	26	3	**3**
4.5/1.5	22	2	**3**
1.5/3.0	**11**	2	8
3.0/3.0	**15**	4	8
4.5/3.0	**14**	3	10
	***	NS	***

CO_2 injury - Orchard variation

CA (O_2/CO_2)	#2	#4	#5	#6
1.5/1.5	**3**	**5**	18	**2**
3.0/1.5	**3**	**8**	**6**	**1**
4.5/1.5	**6**	**5**	**6**	**2**
1.5/3.0	5	11	26	1
3.0/3.0	9	9	19	4
4.5/3.0	16	8	25	6

See NY Fruit Quarterly

The latest complete CA results (2011)

- Fruit from WNY and Champlain
- Treated with DPA and/or SmartFresh at harvest
- Delayed CA (2, 7, 14 days after harvest)
- No conditioning
- CA (3% O_2/3% CO_2)
- Evaluated after 6 months of storage

Int. ethylene (ppm) after storage

Treatment	CA storage (days after harvest)		
	2	7	14
Untreated	101	116	132
DPA	99	123	122
SF	8	12	10
DPA/SF	4	6	4

Firmness (lb) after storage

Treatment	CA storage (days after harvest)		
	2	**7**	**14**
Untreated	13.6	13.8	14.0
DPA	13.5	13.8	14.1
1-MCP	13.6	13.7	14.3
DPA/1-MCP	14.1	14.5	14.6
	13.7	14.0	14.3

Int. CO_2 injury (%) after storage

Treatment	CA storage (days after harvest)		
	2	**7**	**14**
Untreated	27	13	12
DPA	0	0	0
1-MCP	34	25	25
DPA/1-MCP	2	0	0

Decr with incr. delay; higher with SF

Bitter pit (%) after storage

Treatment	CA storage (days after harvest)		
	2	**7**	**14**
Untreated	8	6	16
DPA	5	8	12
1-MCP	5	3	8
DPA/1-MCP	4	4	4
	6	5	10

CA storage Summary

- **DPA may permit storage in CA, *without conditioning* and associated bitter pit problems.**

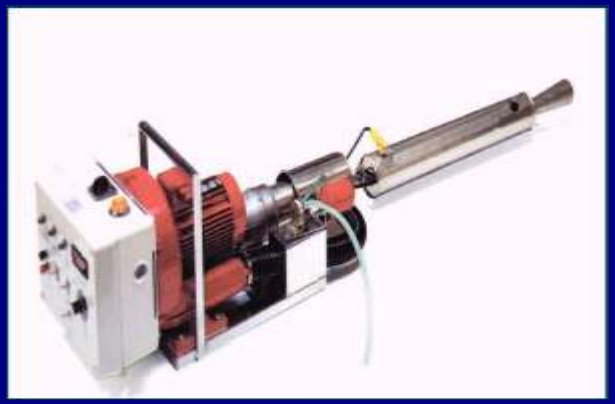
2012 harvest period

Fruit from 2 orchards from each of HV, WNY and Champlain (i.e. 6 orchard blocks):

- **Verifying effect of DPA**
- **Investigating effects of longer delay treatments prior to CA.**

DPA effectiveness with different application methods and decay potential?

- DPA drenching
- DPA thermofogging
- DPA aerosol
- DPA wand application



Take Home Messages

- Still no CA recommendations
- Strongly encourage testing small quantities of fruit with and without DPA in CA storage
- In meantime for storage of fruit in air beyond 4 months suggest using SmartFresh to maintain acidity and flavor

The people and the funding

The people

- Jackie Nock
- Jamil Harb
- Nigel Gapper
- Mike Fargione
- Jim Giovannoni

The growers and storage operators

- JD Fowler
- Jeff Crist
- Seth Forrence
- John Russell
- Jim Verbridge

The funding

NY Apple Research Development Program

AgroFresh Inc.

Valent BioSciences

NY Farm Viability Institute

Federal Funds Project NE1036