Effects of calcium sprays and AVG on fruit quality at harvest and after storage

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Making a Difference for California

Background
Calcium

- Many physiological disorders in fruits are associated with Ca deficiency
- Ca foliar sprays have been shown to reduce fruit diseases and physiological disorders in apples
- Fruits with a high level of Ca have lower respiration rate and longer potential storage life than fruits containing low Ca

Ca Problem in Delta Orchards

- OK by UC guidelines (decades old, unknown criteria), but longer storage sometimes needed
- 2009 – $1M fruit bad (Argentina dumping)
- Growers use 200 lbs. $CaNO_3$ May & June in part to add Ca, thought to improve quality
- Many growers include Ca in blight sprays
- There appears to be a rate effect

Background
ReTain

- Ethylene biosynthesis inhibitor
- May enhance fruit color and size by allowing fruit to remain on the trees longer, extending harvest
- More consistent effects on apple than pear
- May extend pear storage life

Ca and ReTain Cost

- Vigor-Cal = $22/gal., Agro-K 9-24-3 = $16 gal.
- 2 qts./acre each → $19/application
- 4 tank-mixed applications = $76 total, no application cost

- ReTain applied at 11.7 oz./acre (1 bag) = $265
- Could be tank mixed with NAA, but timing might not be ideal

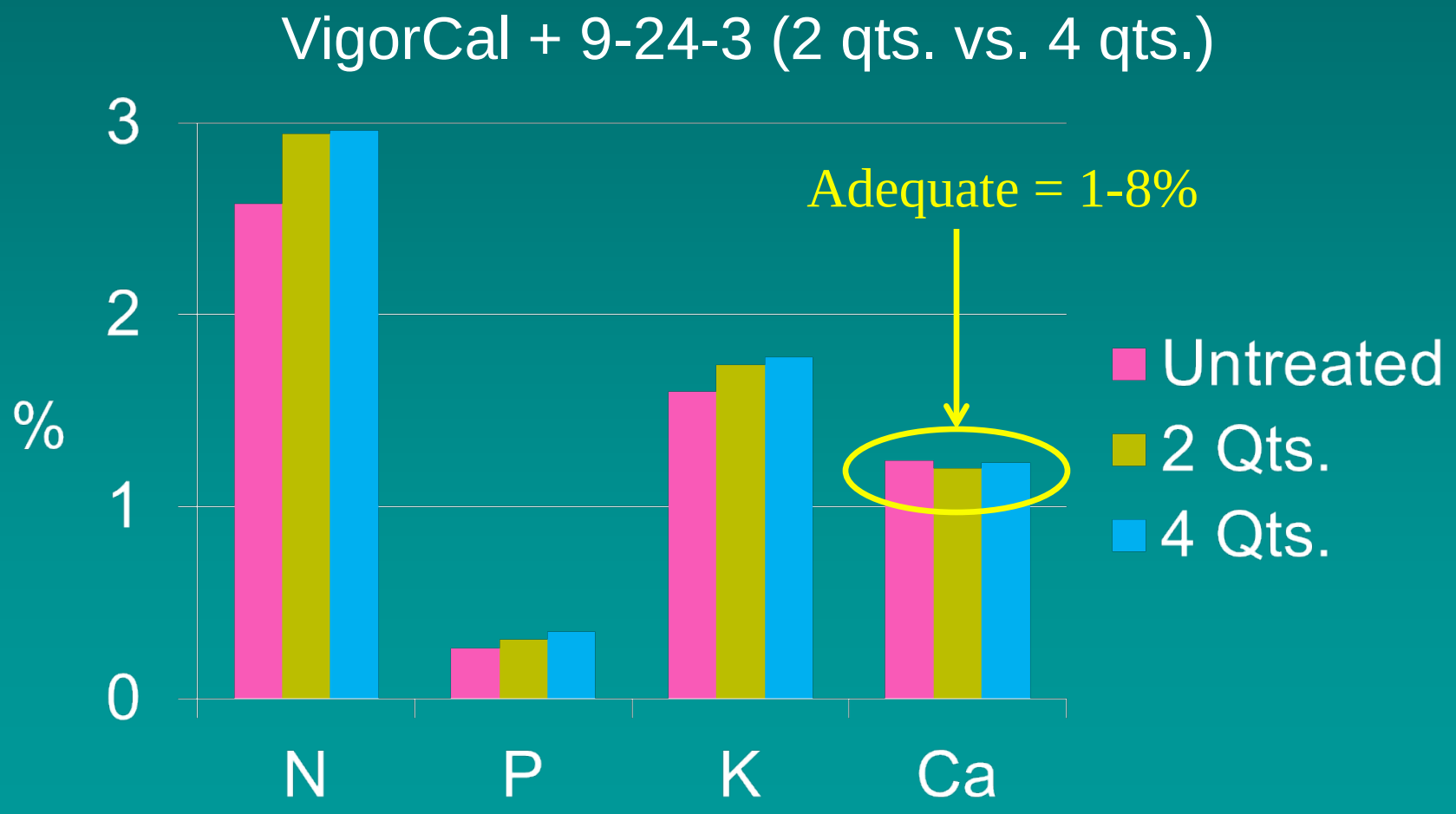
Objectives

1. Evaluate effects of foliar Ca sprays and ReTain on Bartlett fruit size and quality

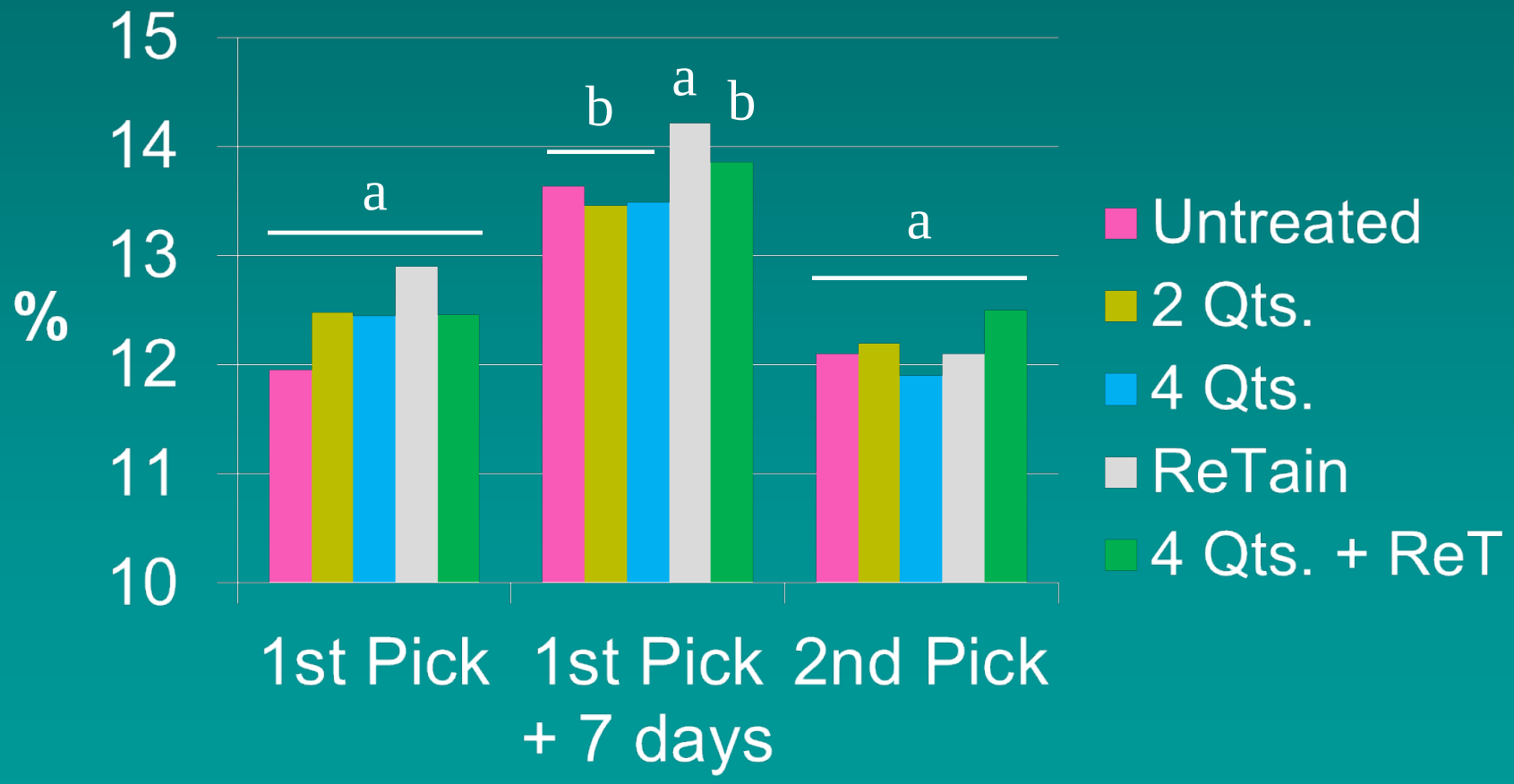
2. Compare effects on postharvest fruit quality after storage and ripening

Leaf Nutrient Content

Apr. 22, 2013



Total Soluble Solids
2013



Experimental Protocol
2014

- Bartlett orchard on Merritt Island
- Some black end present
- Randomized complete block design
- 6 treatments, 9 single-tree replicates
- Trees separated by guard tree and full row
- 100 gal./acre, mist blower backpack sprayer

Treatments
2014

	Treatment	Rate/Acre	Application Dates
1	Vigor-Cal + 9-24-3	4 qts. each	3/19, 3/24, 4/2, 4/8, 4/15, 4/22, 5/13, 6/3
2	ReTain + NuFilm 17	11.7 oz.	6/26
3	# 1 and #2		
4	Ca chloride ($CaCl_2$)	1.8 lbs.	4/29, 5/13, 5/20
5	Soluble gypsum	8 lbs.	4/2, 4/8, 4/15, 4/22, 4/29, 5/13, 6/3
6	Untreated	--	--

Vigorous Black End Tree

Nutrients in Leaves

July 2014

Treatment	% N	% P	% K	% Ca
Vigor-Cal + 9-24-3	1.77	0.24	1.51	1.23
ReTain	1.88	0.25	1.62	1.32
#1 + #2	1.85	0.24	1.66	1.27
$CaCl_2$	1.93	0.24	1.66	1.54
Gypsum	1.94	0.24	1.52	1.30
Untreated	1.88	0.29	1.76	1.30
Black end trees	2.05	0.19	1.46	1.30

Nutrients in Fruit (Wedges)

July 2014

Treatment	% N	% P	% K	% Ca	% Mg
Vigor-Cal + 9-24-3	0.20	0.068	0.69	0.031	0.040
ReTain	0.23	0.073	0.75	0.033	0.041
#1 + #2	0.23	0.074	0.77	0.032	0.043
$CaCl_2$	0.22	0.072	0.76	0.033	0.042
Gypsum	0.22	0.073	0.73	0.028	0.039
Untreated	0.25	0.080	0.79	0.035	0.044
Black end trees	0.37	0.090	0.90	0.042	0.053

Evaluation of 1st Pick Fruit
At Harvest

- Fruit quality evaluations at 1st or 2nd pick (both picked to 2¾”)
  - » Few or no differences in fruit weight, firmness, soluble solids, or color

Storage Disorders

Superficial scald

Senescent scald

Internal breakdown

Evaluation of 2nd Pick Fruit

3.5 months, no ripening

Treatment	Firmness (psi)		Color Rating (a*[C])		% of Fruit with Scald	
Vigor-Cal + 9-24-3	13.5	a	-8.46	ab	0.0	b
ReTain	13.8	a	-9.32	a	0.0	b
#1 + #2	13.7	a	-8.91	a	0.0	b
$CaCl_2$	14.3	a	-7.28	bc	0.0	b
Gypsum	11.6	b	-6.56	c	35.8	a
Untreated	9.7	c	-5.20	d	28.6	a

Evaluation of 2nd Pick Fruit

3.5 months + ripening

Treatment	Firmness (psi)		% of Fruit w/ Scald		IB Score	
Vigor-Cal + 9-24-3	2.19	b	10.8	b	0.0	b
ReTain	2.32	b	7.8	b	0.0	b
#1 + #2	2.07	b	10.1	b	0.0	b
$CaCl_2$	2.13	b	4.8	b	0.0	b
Gypsum	3.29	a	61.0	a	0.60	a
Untreated	3.70	a	47.0	a	0.98	a

Selected Replicates

3.5 months, no ripening

CaCl2, rep 1

Gypsum, rep 6

Gypsum, rep 1

Untreated, rep 6

Black End Spray Trial
VLS Home Orchard, Twin Cities Rd.

- Rosired trees with black end (B.E.)
  - » 9 trees sprayed with $CaCl_2$
  - » 9 trees untreated
- 2 lbs./acre in 100 gal./acre water
  - » Backpack mist sprayer
- 5 sprays applied 4/29, 5/7, 5/13, 5/20, 6/3
- Preharvest evaluation:
  - » Sprayed trees: Avg.15 B.E./50 fruit (30%)
  - » Unsprayed trees: Avg. 17 B.E./50 fruit (34%)

Black End Sampling
VLS Home Orchard, Twin Cities Rd.

- 2 trees each of Rosired and Red Sensation with and without black end
  - » Good fruit from one side of orchard (near levee)
  - » Bad fruit from other side (away from levee)
- Sampled 50 leaves & 10 fruit each analyzed for nutrient content
- Soil samples taken from under each tree

Soil Nutrients (0-12″)

Good trees and black end (B.E.) trees

	NO3-N	Olsen-P	X[1]-K	X-Ca	X-Mg	CEC	OM
Variety	(ppm)		(meq/100g)				
Rosired (good)	10.7	27.3	0.56	16.5	9.2	26.6	3.4
Rosired (B.E.)	6.2	44.5	0.69	21.0	13.9	36.2	4.8
R. Sens. (good)	5.2	22.3	0.64	13.5	8.5	22.9	3.1
R. Sens. (B.E.)	7.5	38.1	0.70	22.2	12.6	35.9	4.6

Nutrient Analyses of Good and Black End (B.E.)

Leaves and Fruit

	N	P	K	Ca	Mg
Variety	(%)				
	Leaves				
Rosired (good)	2.40	0.146	0.79	1.12	0.358
Rosired (B.E.)	2.32	0.179	1.12	1.51	0.363
R. Sens. (good)	2.25	0.140	1.15	1.57	0.372
R. Sens. (B.E.)	2.26	0.158	0.95	1.59	0.323
	Fruit				
Rosired (good)	0.36	0.058	0.59	0.028	0.035
Rosired (B.E.)	0.54	0.094	0.83	0.045	0.050
R. Sens. (good)	0.41	0.065	0.71	0.031	0.038
R. Sens. (B.E.)	0.52	0.088	0.81	0.042	0.047

Conclusions

- Little effect of sprays on fruit quality at harvest
- Little effect of sprays on leaf or fruit nutrients
  - » $CaCl_2$ increased leaf Ca but not fruit Ca
- Most Ca sprays improved long-term storage
  - » Gypsum did not
- Black end trees at Merritt Island more vigorous
  - » Trees at both sites had higher leaf nutrient values
- $CaCl_2$ did not reduce black end

Thanks to Matt Hemly and

Topper Van Loben Sels

for participating in these studies

Evaluation of Pear Tissue Sampling Protocols for Improving Nutrient Management

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Current Leaf Sampling Recommendations in Calif.

- Non-bearing spur leaves in mid-summer
  - Leaves 3 months old, not strong nutrient sink
  - Static in nutrient mobilization
- Shoot or bearing spur leaves are a better indicator of nutrient status
  - Real-time status of nutrient mobilization
- Shoot leaves used throughout world
  - Also in Calif. before 1983

Spring Sampling

- With spring sampling, can make in-season fert. adjustments based on crop load
  - Reduce vigor potential
  - Anticipate fruit quality problems from nutrient imbalances

Leaf Sampling

- No benefit has ever been documented from N application when July leaf N > 2.2%
- Leaves not always indicative of fruit nutrient status, especially Ca
  - Fruit sampling may be more indicative

Objectives

- Compare nutrient levels & ratios from different tissues and timings
- Determine if a better sampling protocol can improve nutrient management
- Lead-in to possible FREP project
- Possibly revise UC recommendations for sampling & nutrient management

Sampling

(in 4 alternating drive rows)

- Late April (after early fruit drop)
  - Fruits and leaves
- July
  - Mid-shoot and non-bearing spur leaves
  - Fruit just before first pick
  - Soil

Three Bartlett Blocks

- Block A – Very productive, loam soil
- Block F – Struggled for years, low production, drainage problems, loam soil
- Block O – Organic transition, younger, highly uniform, higher density but one with lower production, clay soil
- No foliar nutrients applied

Soil Sampling Results

	NO_3-N	Olsen-P	X-K	X-Ca	X-Mg	CEC	OM	pH
Block	ppm		meq/100g				%	
A	5.3	54.3	1.5	7.4	3.5	12.5	2.0	6.1
F	10.7	40.9	1.8	17.6	6.2	26.7	3.5	6.9
O	19.8	46.5	1.3	21.7	9.5	33.0	4.9	6.6

- Yields highest in A, intermed. in F, lowest in O
- Fruit size: A & F = 0.41 lb., block O = 0.47 lb.

Leaf Sampling Results N & K

	Block	N (%)		K (%)	
April Mid-Shoot	A	2.86	b	1.44	a
	F	3.14	a	1.33	b
	O	2.95	b	1.47	a
July Mid-Shoot	A	2.43	ab	1.01	b
	F	2.52	a	0.98	b
	O	2.40	b	1.26	a
July N-B Spur	A	1.98	ns	1.65	b
	F	1.95	ns	1.73	b
	O	2.03	ns	2.16	a

Fruit Sampling

- No relation:
  - Leaf vs. fruit analyses
  - Fruit analyses in April vs. July

July Leaf Prediction Model

Nonpareil Almond

- Sample all leaves of 5-8 non-fruiting spurs/tree 6 weeks after full bloom when reach full size (mid-April)
- Collect leaves from 18–28 trees /orchard, place in a single bag
  - EACH SAMPLED TREE AT LEAST 30 YARDS APART
  - 100 leaves/sample bag
- Send to lab, ask for a FULL NUTRIENT ANALYSIS
  - N, P, K, B, Ca, Zn, Cu, Fe, Mg, Mn, S

July Leaf Prediction Model – Almond

Pear Leaf Samples 2014 (mid-shoot leaves)

Enter the tissue nutrient values for leaves collected **in spring**										
N (%)	P (%)	K (%)	S (ppm)	B (ppm)	Ca (%)	Mg (%)	Zn (ppm)	Mn (ppm)	Fe (ppm)	Cu (ppm)

Block	July % N **Predicted** (N-F Spur)	Predicted % of Trees above C.V.	July % N **Actual** (Mid-Shoot)	July % N **Actual** (N-F Spur)
A	2.41	94.7%	2.43	1.98
F	2.45	97.1%	2.52	1.95
O	2.44	96.6%	2.40	2.03

Conclusions

- Little to no relationship in nutrient values of leaves or fruit between April and July sampling dates
- Mid-shoot leaves higher in N, lower in K
- Little relationship between soil, leaf nutrients
- Strong fit of April leaf levels with predicted July leaf levels
- Would knowledge of July N levels in April affect pre-harvest N fertilization?

Thanks to Chris Frieders

for participating in this study

Pear Variety Evaluation in the Sacramento River District

Pear Research Meeting

Feb. 4, 2015

Chuck Ingels
UC Cooperative Extension, Sacramento County

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Blake's Pride

- Created through breeding 1965
- Blight resistant, consistent yield
- Fruit shaped like Bartlett, skin golden, light tan russetting; very russetted in North Coast
- Requires pollination
- Ripens 2 weeks after Bartlett in the Pacific Northwest but closer to Bartlett in California

Blake's Pride

Mod. size, sweet, and ugly

Sunrise

- USDA-ARS variety
- Blight resistant
- Early season, ripens before Bartlett, close to Starkrimson
- Yellow skin, slight pink blush, little russetting
- Sweet pleasant flavor
- Excellent overall consumer acceptance

Sunrise

Good yields/size, red blush

Cinnamon

- Discovered as limb mutation in a Bartlett tree near Hood River in 1979, but is a winter pear
- Late-harvested variety that fully russetted in North Coast trial and in Sacramento Delta
- Ranked high in taste tests, scoring as well as Bartlett

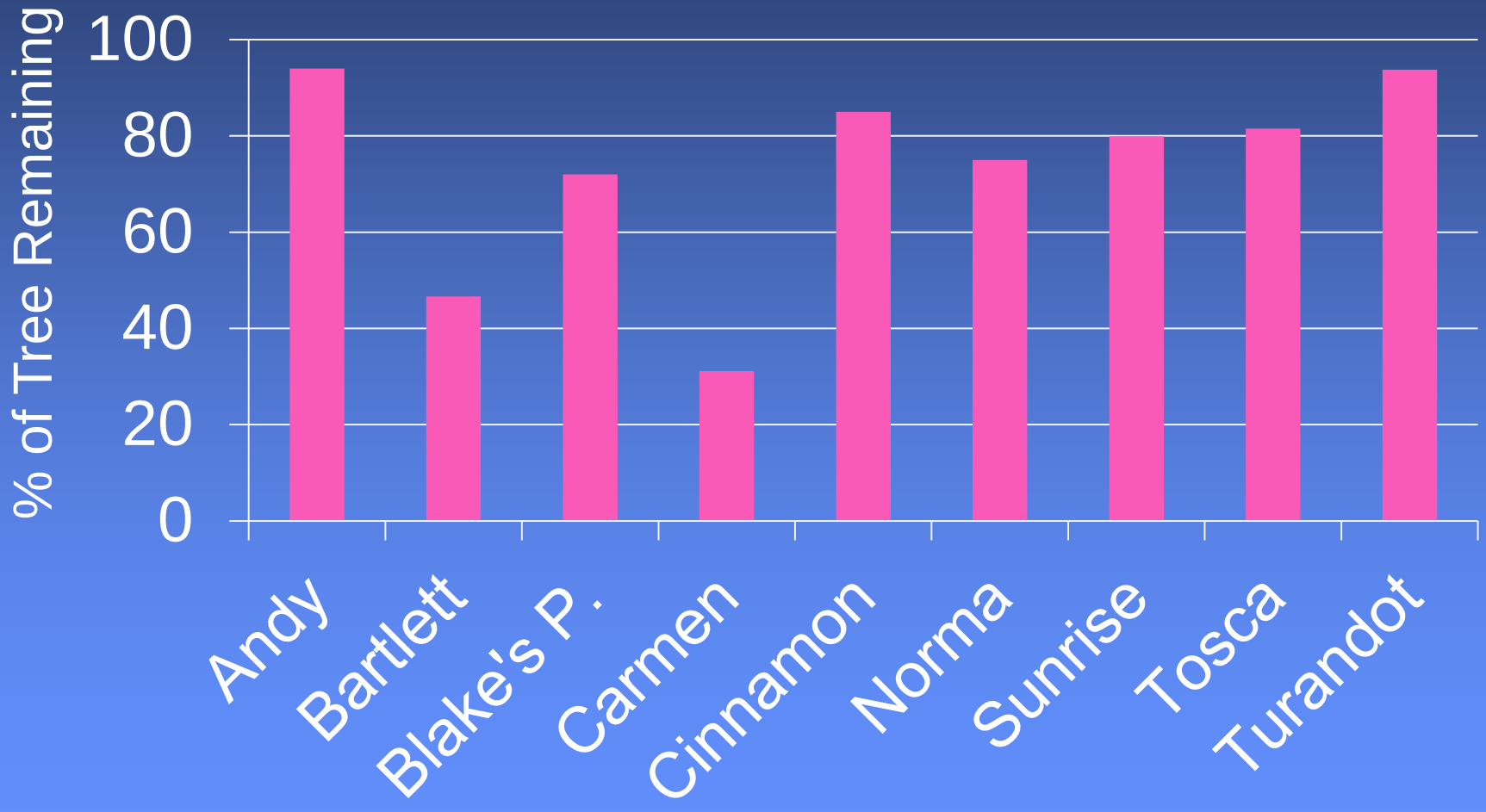
Carmen

- The most widely sold new variety in Italy
- Consistent bearer, flowers with Bartlett but ripens much earlier
- Attractive yellow & red color that is accentuated during refrigeration
- Long shelf life, very tolerant of handling
- Rattails and blight

Carmen Rattail Blooms!

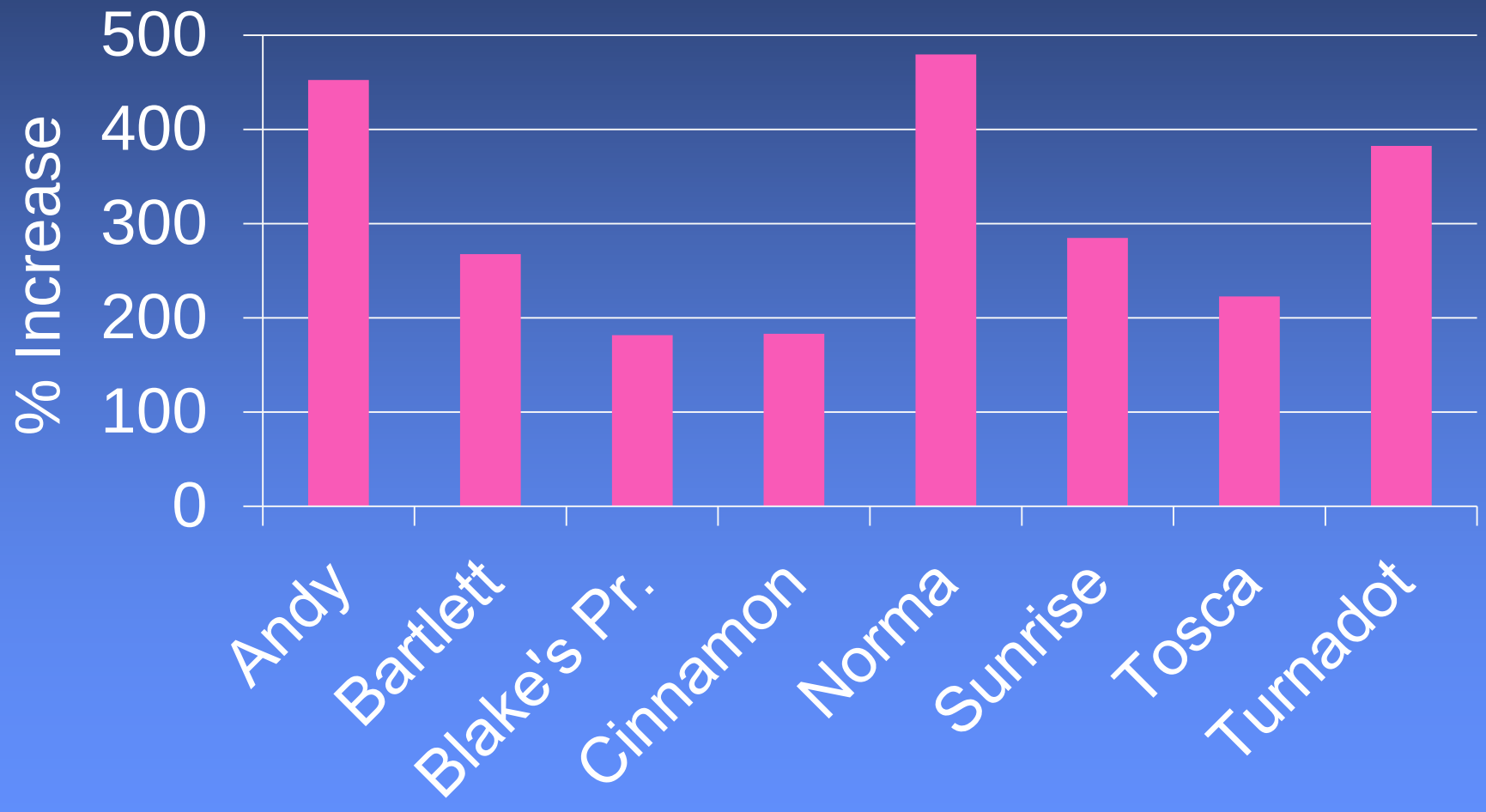
Avg. % of Tree Remaining

2014 Fire Blight Damage



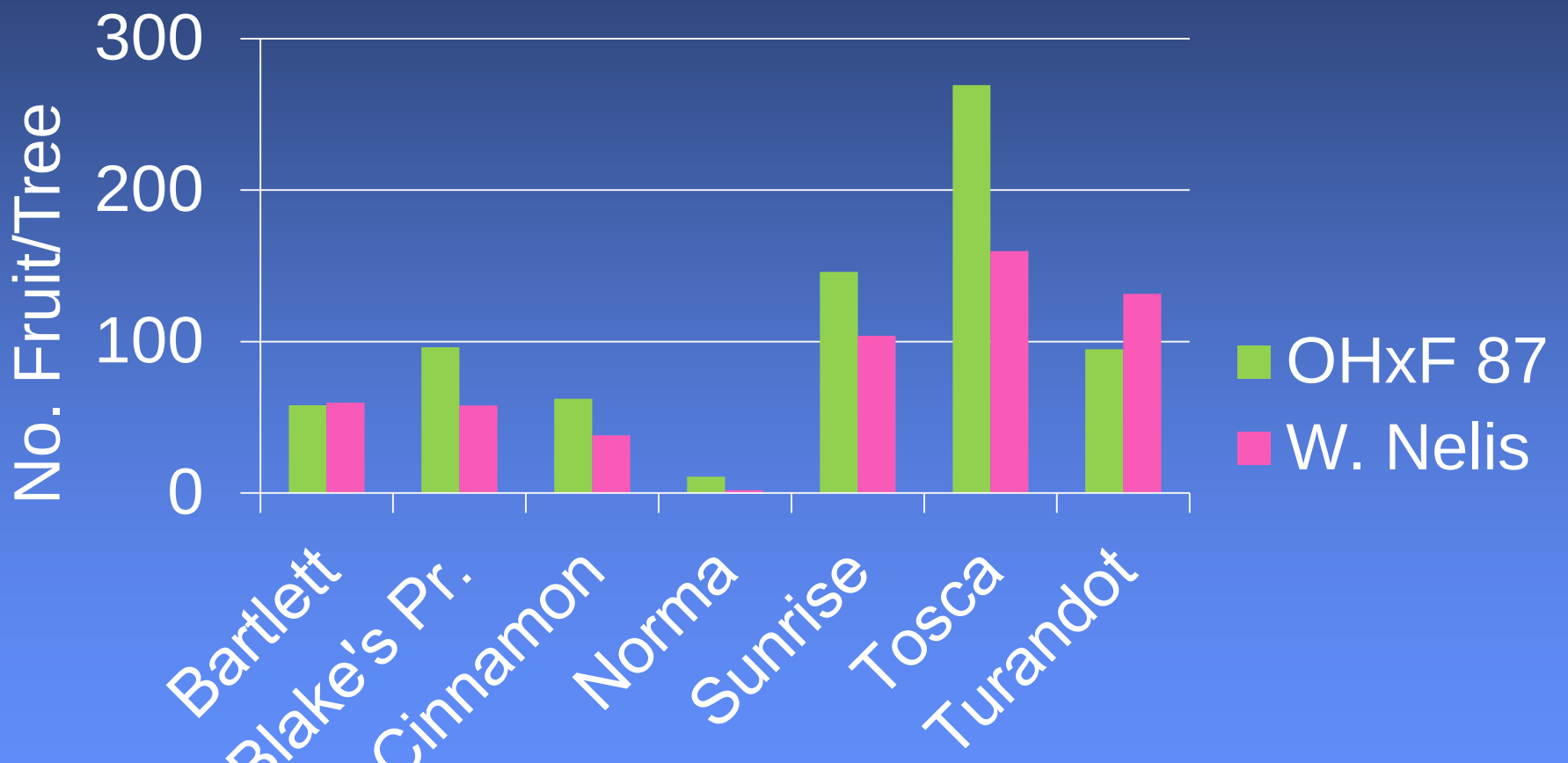
Trunk Growth Increase

2011-14



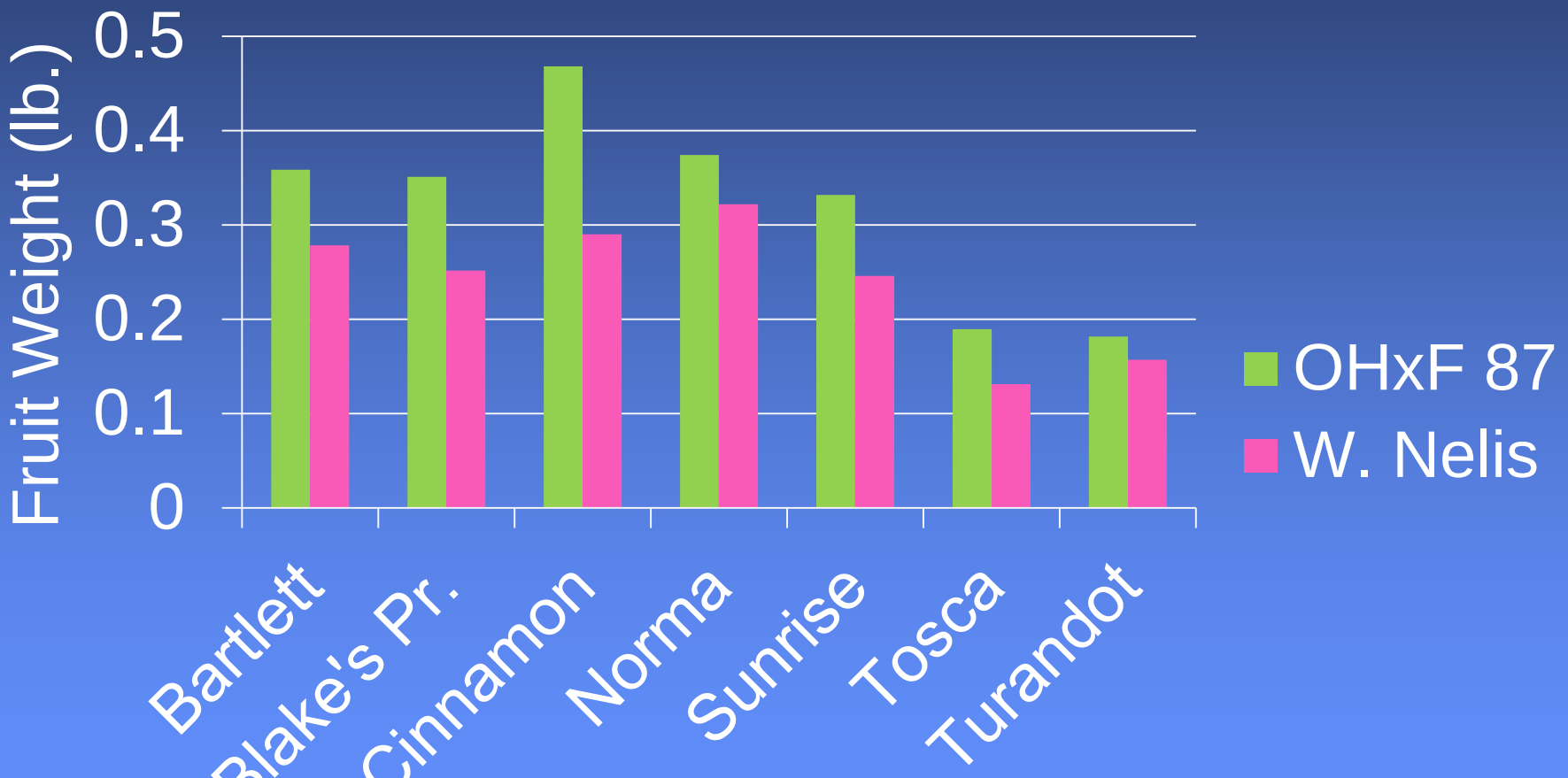
No. of Fruit per Tree

2014

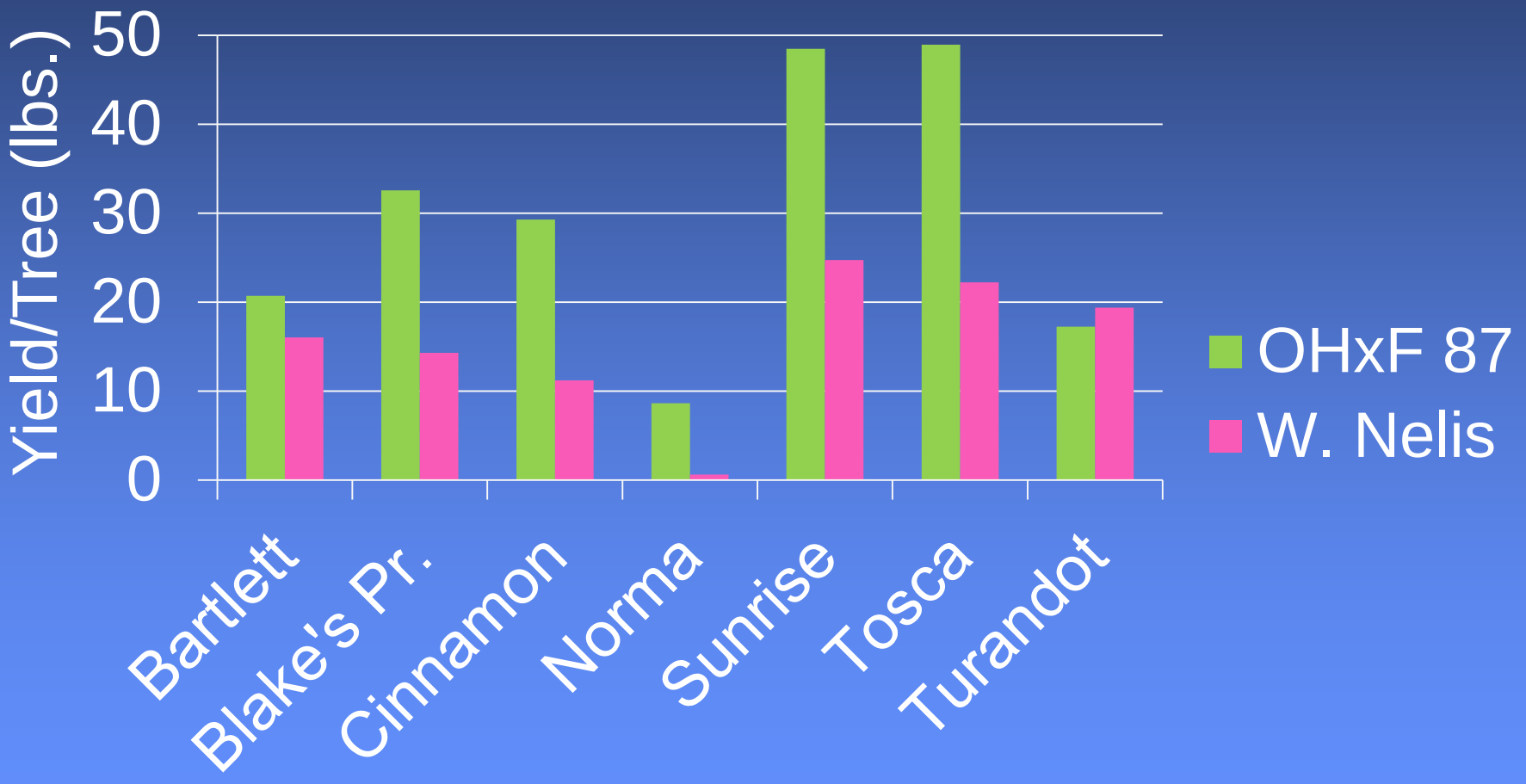


Weight per Fruit

2014

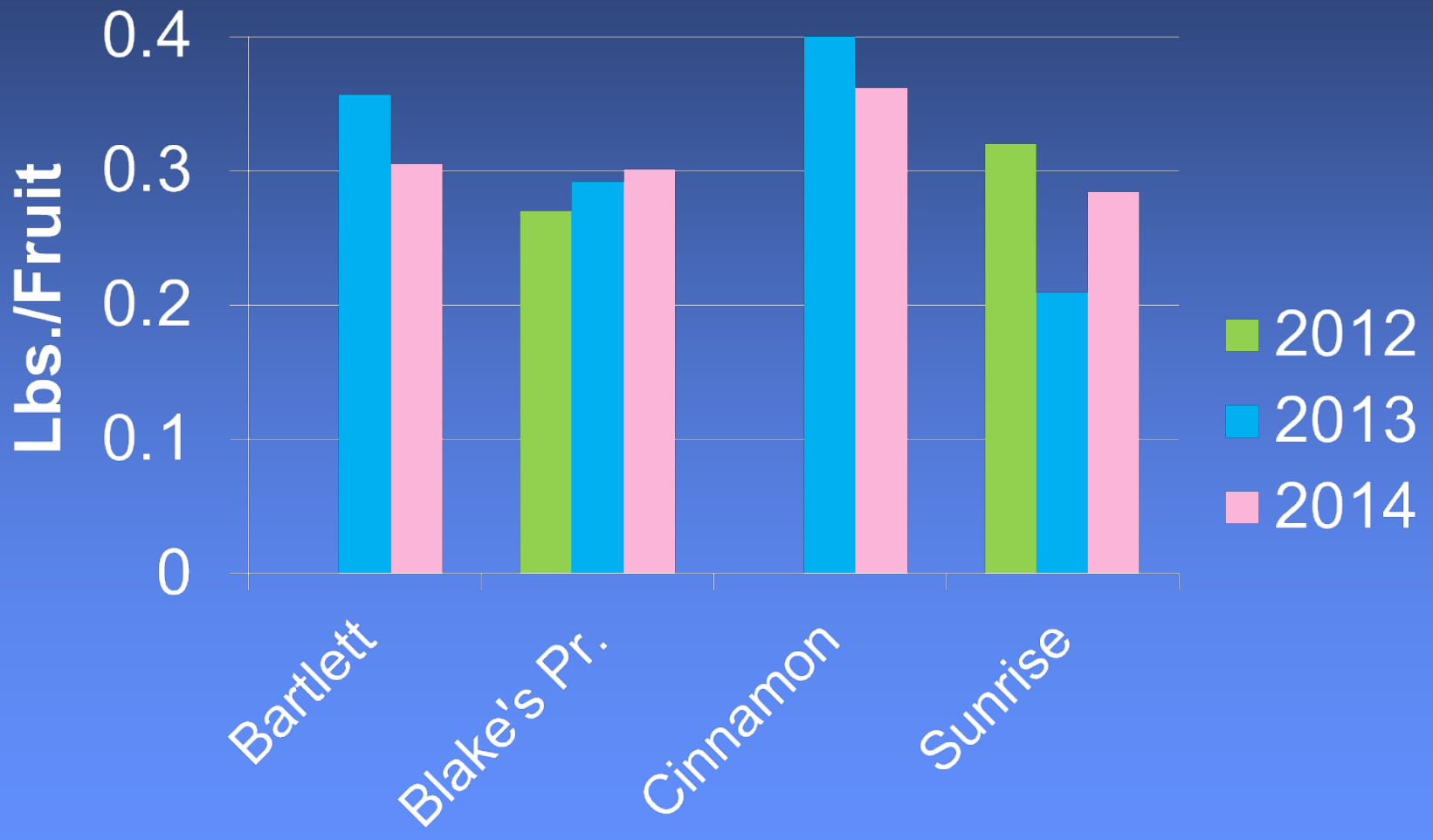


Yield per Tree
2014



Weight per Fruit (Single Pick)

2012-14



New Blight-Resistant Varieties (R. Bell)

Growth Increase, 2013-14

Varieties and Prospects
Likely not acceptable

Promising except for blight:

- Santa Maria – removed 2012 due to blight
- Carmen – Big trees, big fruit, early, bad blight
- Bartlett – Promising new variety but major blight

Poor performers:

- Tosca – Large number of fruits but very small
- Norma – Excess vigor, low yields
- Andy – Large trees, little blight, low yields
- Turandot – Large trees, little blight, low yields

Varieties and Prospects
Delicious with little blight, but some flaws

- Blake's Pride – Mod. vigor, good fruit size, delicious, but russetted and ugly
- Cinnamon – Low-mod. vigor, low-mod. fruit numbers early, but consistently large fruit, very late
- Sunrise – Mod. vigor, good yields, good size, partial red blush

Thanks to Daniel Wilson

for participating in this study

Questions?