An Overview of Selected Almond Field Trials in Stanislaus County

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Nonpareil	
Capitola	Burchell
Supareil	Burchell
P15.044*	Burchell
P10.001*	Burchell
Booth	Burchell
Sterling	Burchell
Folsom	Wilson
Durango	Fowler
Jenette	Fowler
Winters	UCD
Eddie	Bright's
Bennett	Duarte
Sweetheart	UCD
Marcona	Spain
Y121-42-99*	USDA
Y117-86-03*	USDA
Y116-161-99*	USDA
Y117-91-03*	USDA
2-19E (Kester)	UCD
Aldrich	
UCD3-40	UCD
UCD18-20	UCD
UCD1-16	UCD
UCD8-160	UCD
UCD8-27	UCD
UCD1-271	UCD
UCD1-232	UCD
UCD2-19Hyb	UCD
UCD7-159	UCD
UCD8-201	UCD

Varieties Planted in Regional Trials

- Chico State on Krymsk 86
- Salida on Nemaguard
- Madera on Hansen

Planted winter 2014

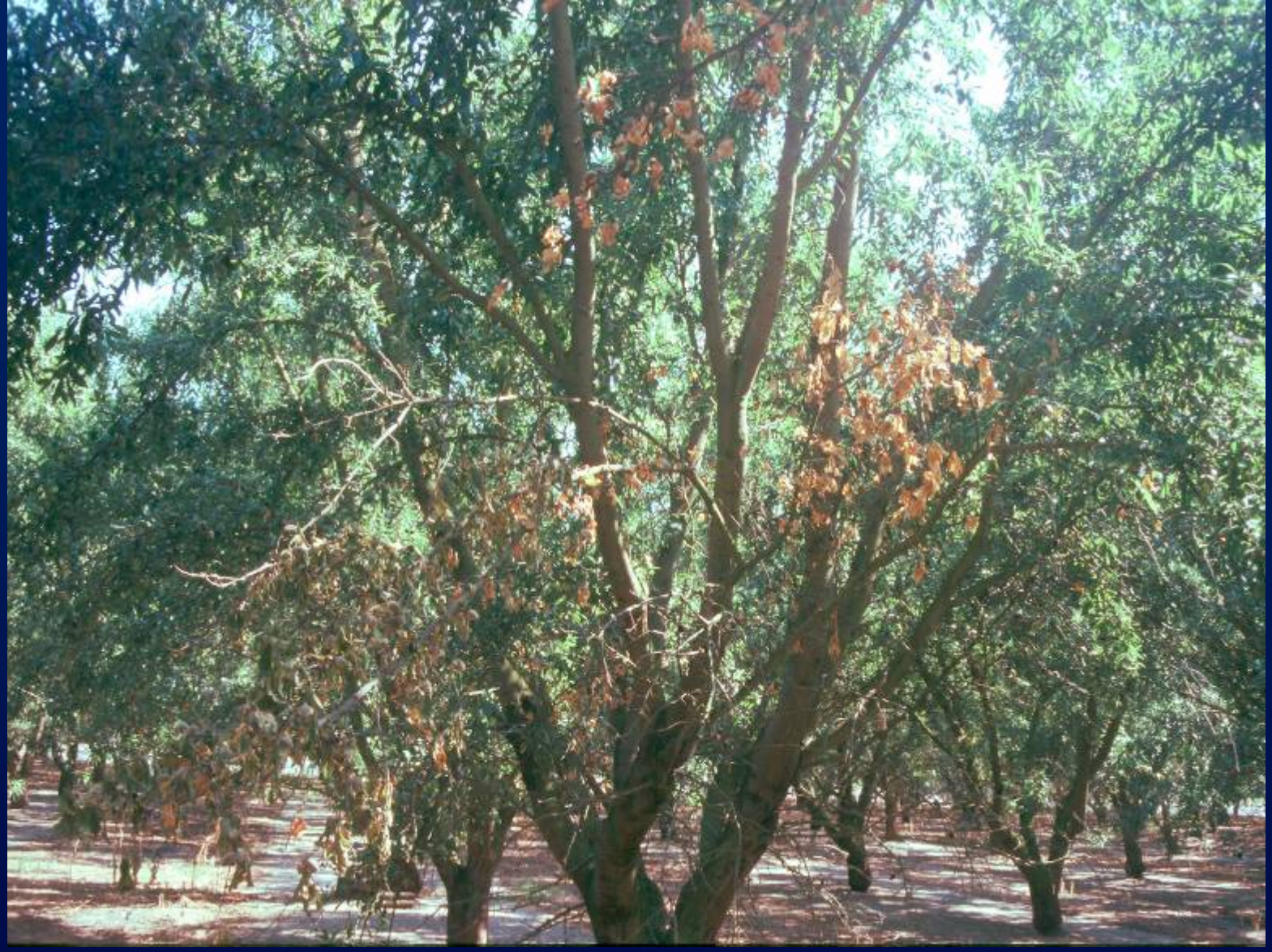
32 varieties

Includes 11 self-fruitful varieties

Do Dormant Copper Sprays Reduce Lower Limb Dieback?

Usually beginning in late April or early May, leaves on lower limbs begin to yellow

Leaves turn brown as limb collapses.



Eventually, limbs collapse.

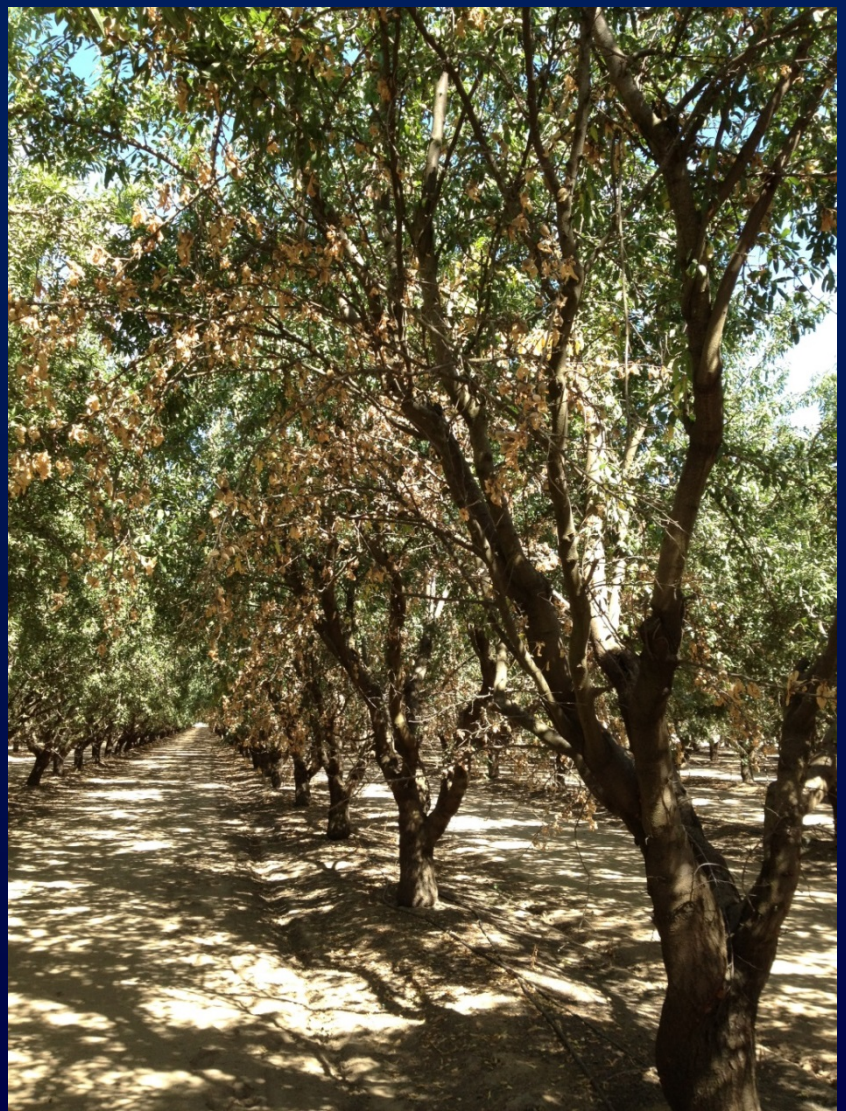
Symptoms progress all summer long.

No Dormant Spray	**Dormant Spray**	**No Dormant Spray**	**Dormant Spray**
Dormant Spray 8 rows	**No Dormant Spray** 8 rows	**Dormant Spray** 8 rows	**No Dormant Spray** 8 rows

7th leaf Butte & Padre in 2014
Dormant Sprays: 12 pounds of Kocide 2000 + oil
January 2013 & 2014

After Two Years…

- Minor LLDB symptoms in 2013
- Substantial limb dieback in 2014
- No difference in LLDB expression in dormant sprayed areas vs. unsprayed



Almond Rootstock Trials

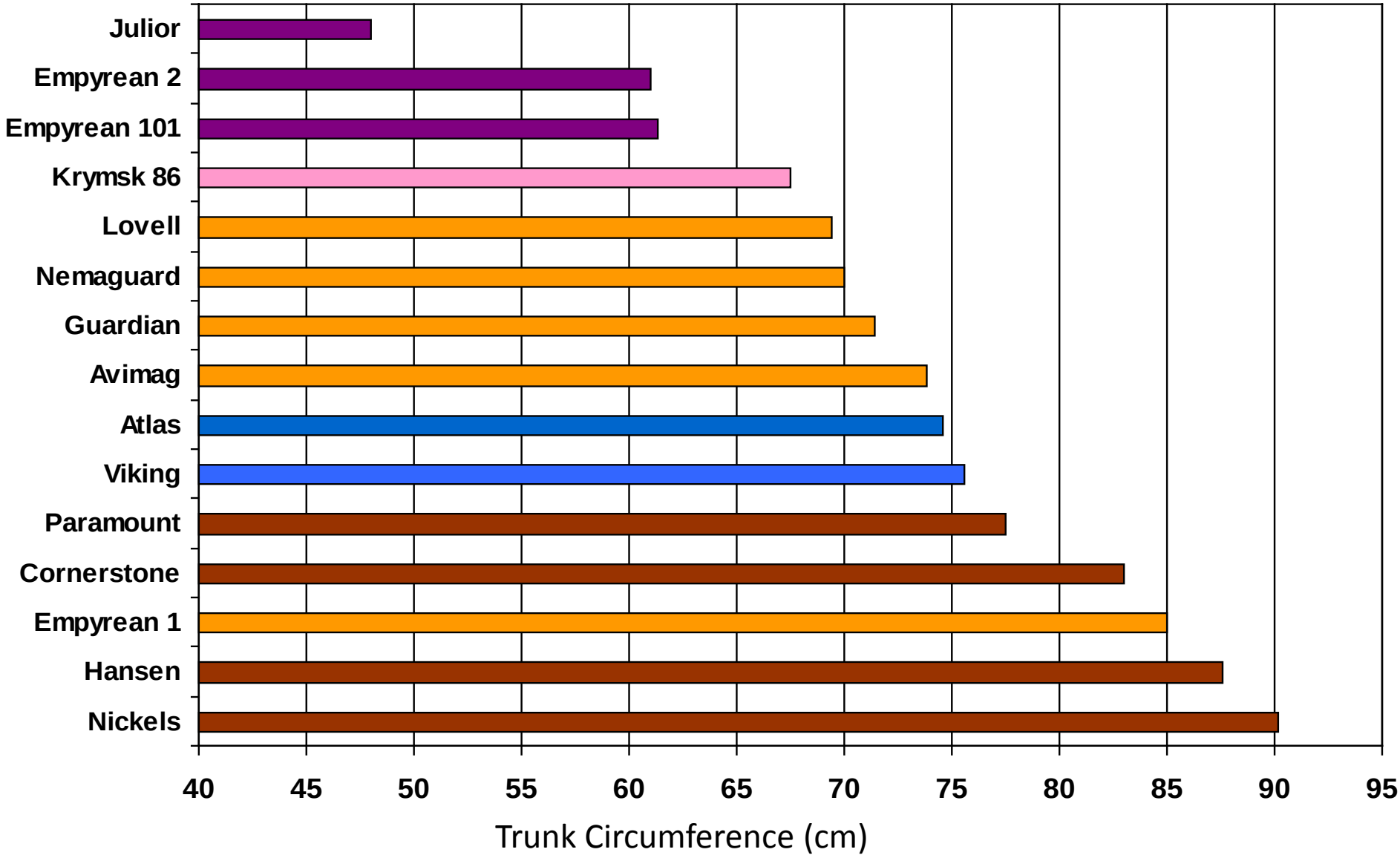
- Keyes: replant without fumigation, increasing salinity
- Westley: pH, salt, Verticillium
- Ceres: Oak Root Fungus

Keyes Trial

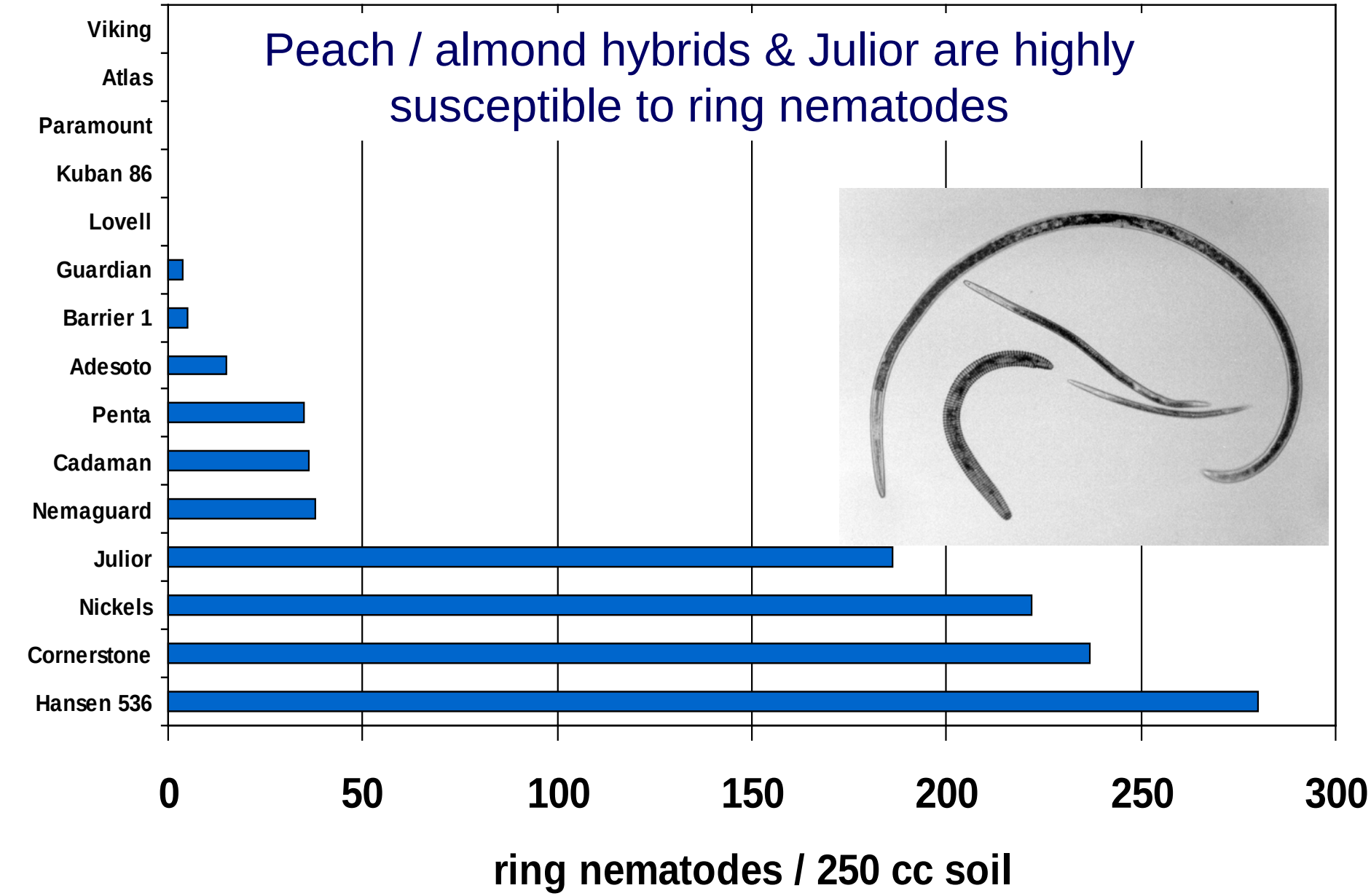
List of Rootstocks in Trial

Rootstock	Parentage
Nemaguard	Peach (*Prunus persica x P. davidiana)*
Lovell	Peach: chance seedling selected in 1882
Guardian SC-17	Peach
Avimag (a.k.a. Cadaman)	Peach
Empyrean #1 (a.k.a. Barrier 1)	Peach
Hansen 536	Peach x almond
Nickels	Peach x almond
Cornerstone	Peach x almond
Paramount (a.k.a. GF 677)	Peach x almond
Empyrean #2 (a.k.a. Penta)	Plum - *P. Domestica* (European plum)
Empyrean 101 (a.k.a. Adesoto)	Plum - *P. Insititia (damson plum)*
Julior	Plum - *P. insititia* x *P. domestica*
Krymsk 86 (a.k.a. Kuban 86)	Peach x Myrobalan plum
Atlas	Peach x almond x plum x apricot
Viking	Peach x almond x plum x apricot

Rootstock Influence on Tree Size

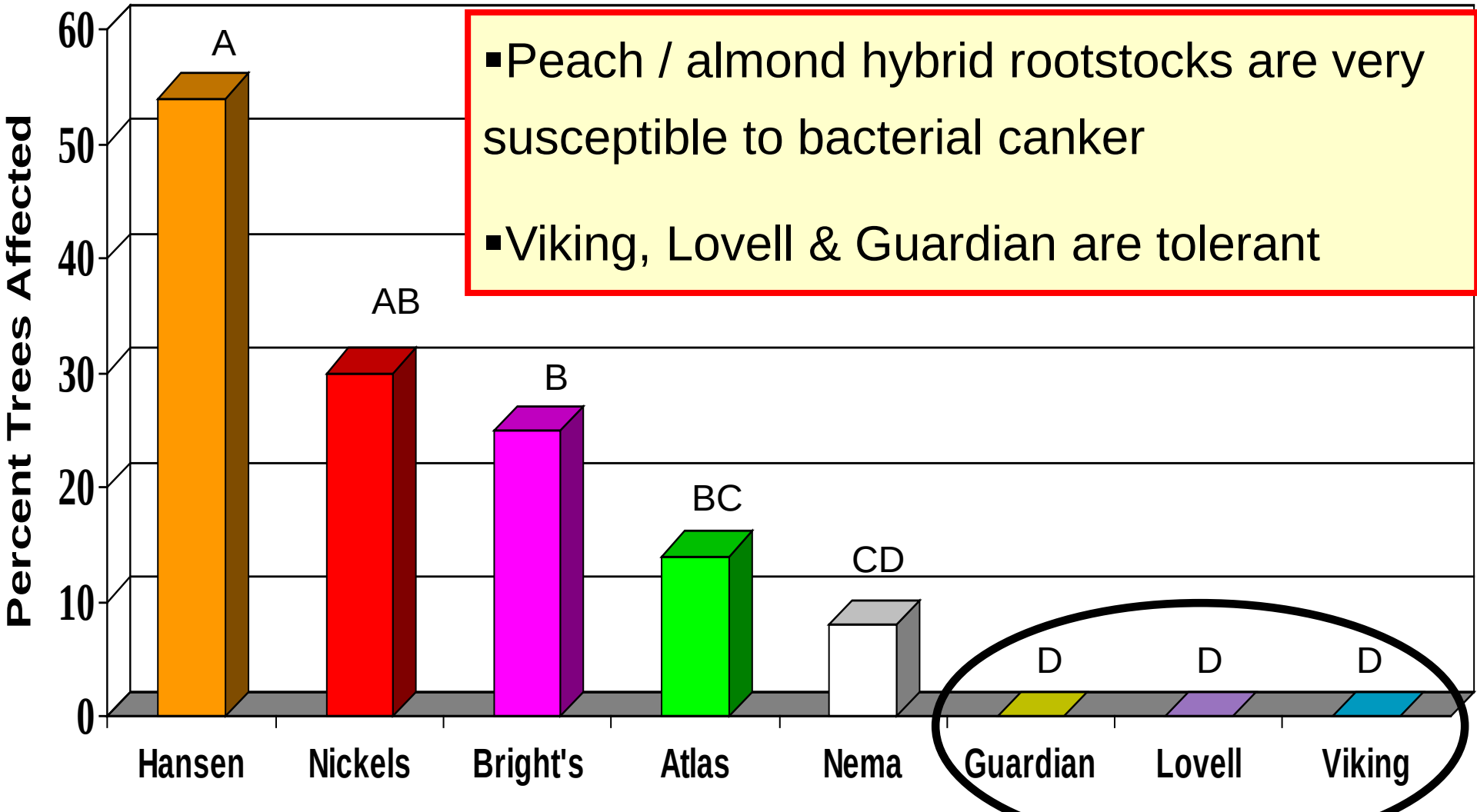


Ring Nematode



A Comparison of Almond Rootstocks for Incidence of Bacterial Canker

Escalon, CA 2005 (8th leaf)



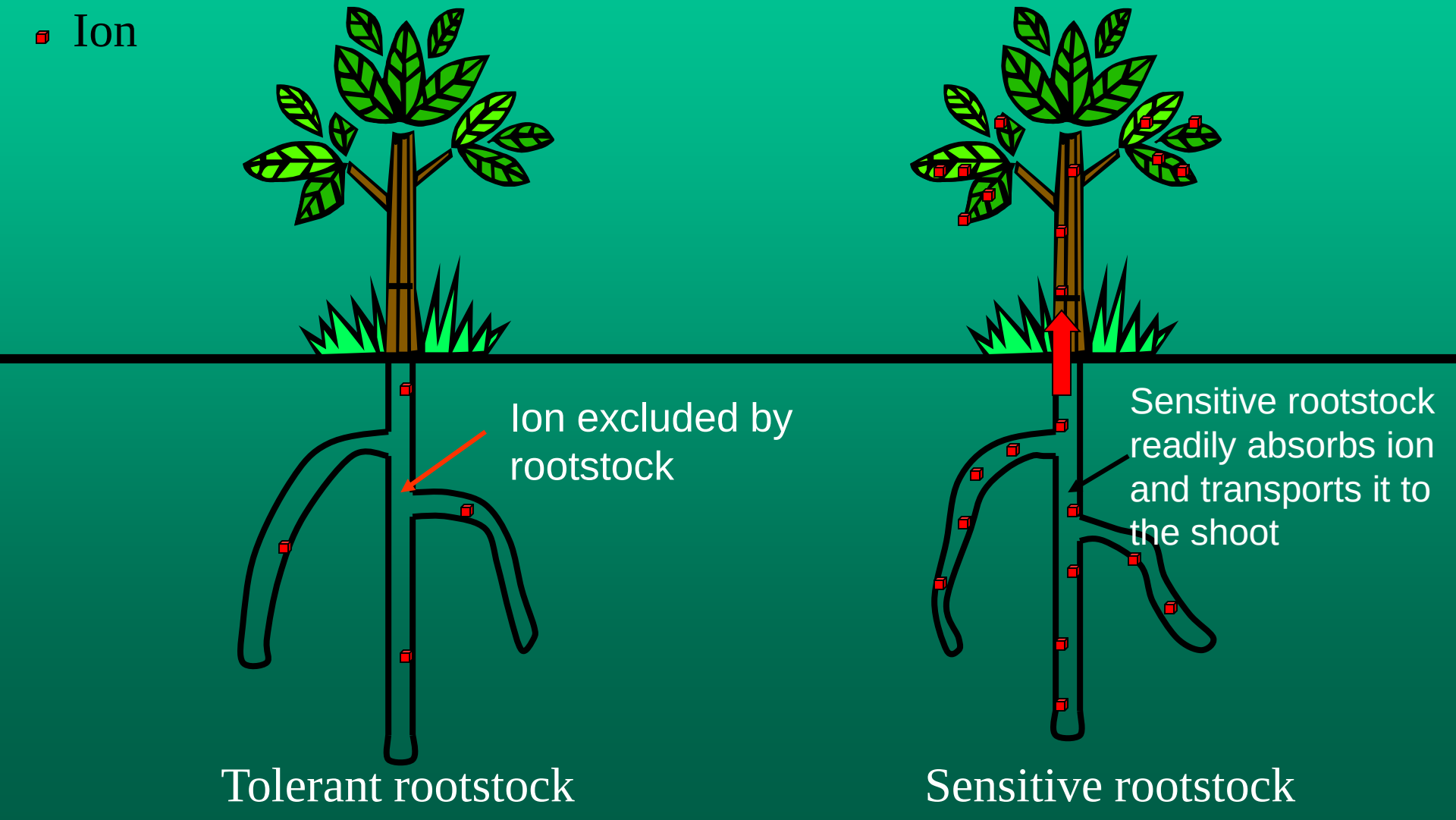
- Peach / almond hybrid rootstocks are very susceptible to bacterial canker
- Viking, Lovell & Guardian are tolerant

Almonds are Salt Sensitive

Growth rate decreases ~ 20% for each dS/m increase over 1.5

Rootstocks can Effectively Exclude Ions from Entering the Scion

- Ion



Almond Rootstock Sensitivity to Toxic Salt Ions.

Keyes, CA July, 2014

	Levels of Toxic Ions in July-Sampled Leaves			
	Nonpareil		Carmel	
	% Sodium	% Chloride	% Sodium	% Chloride
Nemaguard	**0.88** a	0.27 bc	**1.19** a	0.26 a
Guardian	**0.66** ab	0.21 cd	**0.69** bcd	0.27 a
Lovell	**0.58** bc	0.28 bc	**0.75** bc	0.25 a
Atlas	**0.57** bc	0.16 de	**0.86** b	0.22 ab
Krymsk 86	**0.55** bc	**0.32** b		
Cadaman	**0.31** cd	0.23 c	**0.47** cde	0.24 ab
Penta	0.24 d	**0.50** a		
Viking	0.21 d	0.12 ef	**0.43** de	0.18 bc
Nickels	0.18 d	0.12 ef	**0.35** ef	0.15 cd
Paramount	0.11 d	0.08 f	0.07 f	0.07 e
Empyrean 1	0.11 d	0.07 f		
Hansen	0.11 d	0.09 ef	0.10 f	0.10 de
Empyrean 101	0.10 d	0.12 ef		
Cornerstone	0.06 d	0.07 f		
Julior			**0.37** ef	0.11 de
Critical Level	**0.25**	**0.3**	**0.25**	**0.3**

Chlorophyll Status of Leaves from Nonpareil and Carmel Almond Trees Grown on Various Rootstocks[1]. May, 2014.		
	Nonpareil	Carmel
Hansen	38.4 a	39.8 a
Nickels	37.3 ab	39.6 ab
Paramount	37.2 abc	39.7 a
Empyrean 2	37.0 abc	38.0[2]
Cornerstone	36.8 bcd	
Empyrean 101	36.6 bcd	
Empyrean 1	36.4 bcd	37.6[2]
Atlas	36.1 bcd	36.1 c
Avimag	35.8 cd	38.3 b
Viking	35.4 d	36.4 c
Krymsk 86	34.0 e	
Guardian	33.3 e	35.0 cd
Nemaguard	33.2 e	34.4 d
Lovell	33.1 e	32.8 e

Lovell, Nemaguard, Guardian and Krymsk 86 were significantly yellower than trees on other rootstocks.

Westley Rootstock Trial. Planted 2012
Heavy soil, high pH, saline water quality

1. Lovell	*P. persica*
2. Nemaguard	*P. persica*
3. Empyrean 1	*P. persica x P. davidiana*
4. Avimag	*P. persica x P. davidiana*
5. HBOK 50	Harrow blood x Okinawa peach
6. Hansen	*P. dulcis x P. persica*
7. Brights #5	*P. dulcis x P. persica*
8. BB 106	*P. dulcis x P. persica*
9. Paramount	*P. dulcis x P. persica*
10. Flordaguard x Alnem	*P. persica* x Israeli bitter almond
11. PAC9908-02	(*P. dulcis x P. persica) x P. persica*
12. HM2 +	Hansen (*P. dulcis x P. persica)* x Monegro (*P. dulcis*×*P. persica*)
13. Viking	P. persica (Nemaguard) x (P. dulcis [Jordanolo] x [P. blireiana = P. cerasifera x P. armeniaca)
14. Atlas	*P. persica* (Nemaguard) x (*P. dulcis x P. blierianna)*
15. Krymsk 86	*P. cerasifera* x *P. persica*
16. Rootpac R	almond x plum

Almond Rootstock Sensitivity to Chloride.

Westley, CA July, 2014

Levels of Chloride in July-Sampled Leaves

	% Chloride
Krymsk 86	0.41 a
Lovell	0.41 a
Cadaman	0.28 b
PAC9908-02	0.28 bc
Nemaguard	0.27 bc
HBOK 50	0.26 bc
Paramount	0.24 bcd
Viking	0.22 bcde
Atlas	0.19 bcdef
Hansen	0.17 cdef
Empyrean 1	0.17 cdef
Rootpac R	0.16 def
Brights 5	0.15 def
HM 2	0.14 def
F x A	0.13 ef
BB 106	0.10 f

Westley Rootstock Trial. 3rd Leaf

Verticillium Wilt 3rd Leaf

Atlas
HM2
Krymsk 86
PAC 9908-02
Brights 5
BB 106
HBOK 50
Rootpac R
Viking
Nemaguard
Empyrean 1
Paramount
F x A
Hansen
Cadaman
Lovell

0 10 20 30 40 50

% Incidence

Poor Anchorage

HM2

Rootstock Tolerance to Oak Root Fungus

	% Dead Plants
Krymsk 86	27.3 a
Krymsk 1	35.8 ab
Marianna 26-24	63.1 bc
Lovell	71.8 cd
Empyrean 1	77.8 cd
Nemaguard	84.5 d
Brights 5	87.2 d
Hansen	89.1 d

*Baumgartner Lab Tests

Tree Planting Density & Pruning Trial – After 15 Years

Goal when designing an almond orchard – maximize yield:

- Capture as much sunlight as early and as long as possible
- Each 1% of intercepted sunlight = 50 pounds of yield potential.

Almond Spacing & Pruning Trial

- Planted 1999
- 37 acres
- Four tree densities
  - 10’ x 22’ (198 trees / acre)
  - 14’ x 22’ (141 trees / acre)
  - 18’ x 22’ (110 trees / acre)
  - 22’ x 22’ (90 trees per acre)

- Overlaid with four pruning strategies and 2 rootstocks (Nemaguard & Hansen)

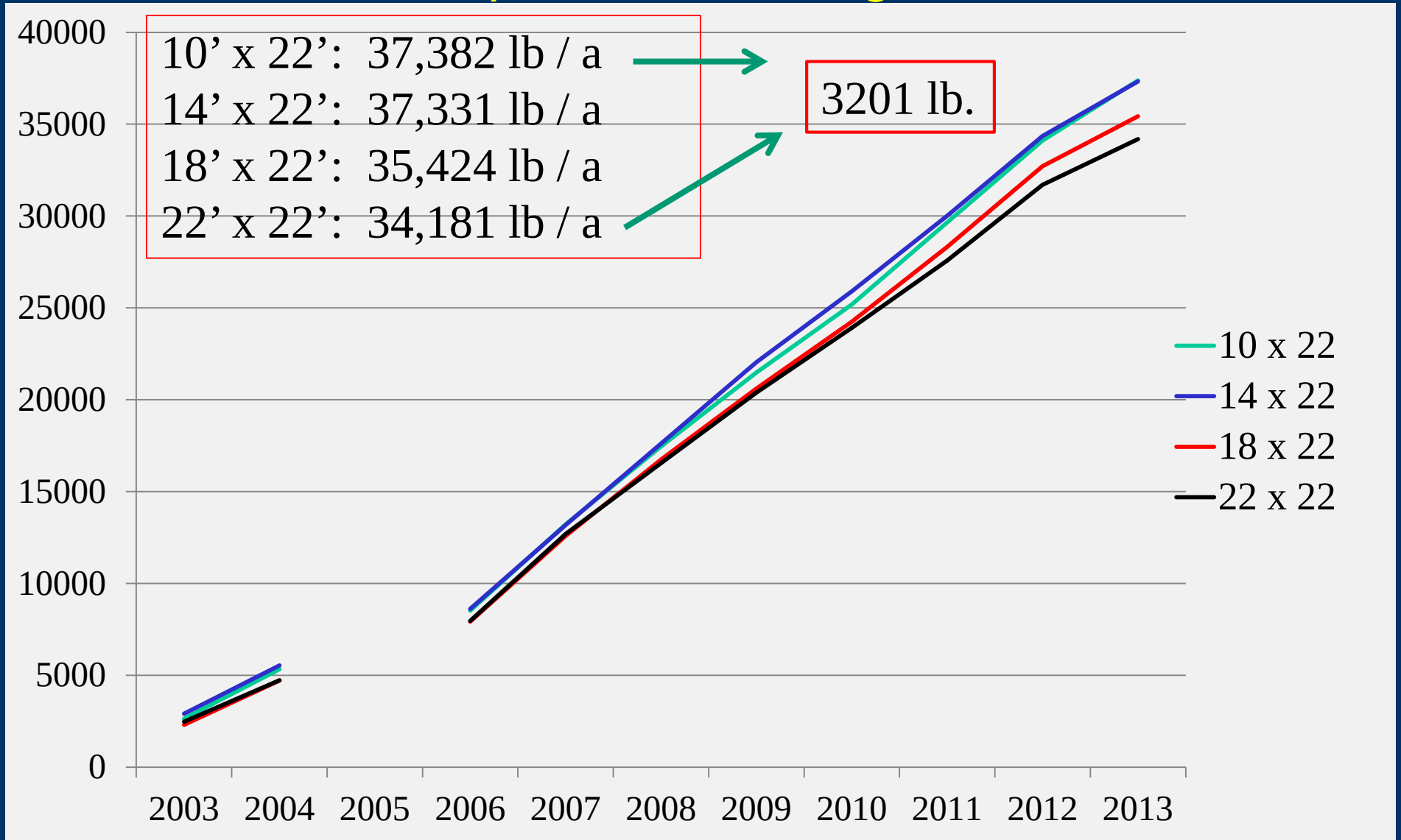

10’ x 22’
22’ x 22’

22’ x 22’ 6th season

10’ x 22’ 6th season

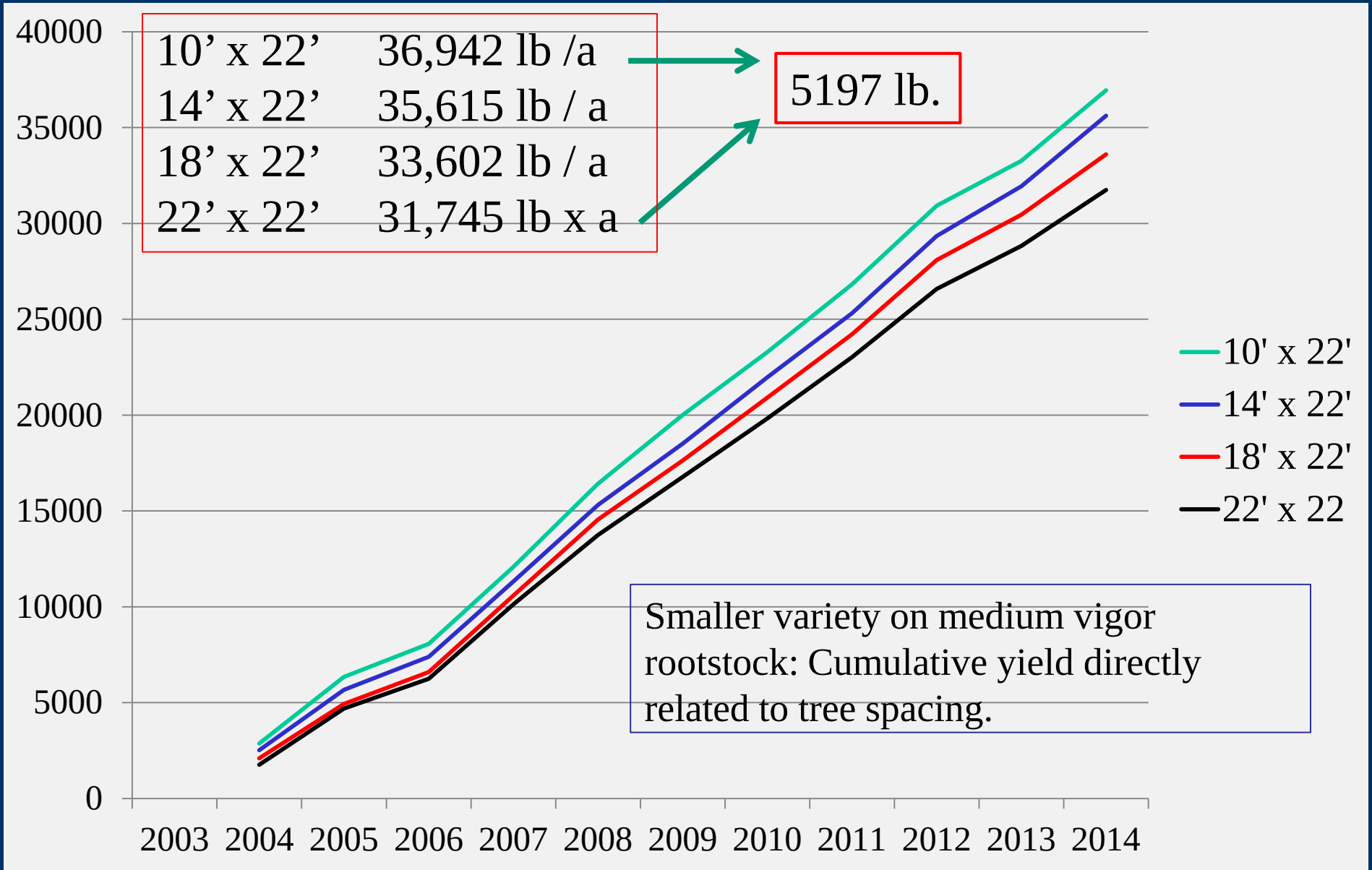
The Effect of Tree Spacing on Cumulative Yield Through 14th Season

Nonpareil on Nemaguard



The Effect of Tree Spacing on Cumulative Yield

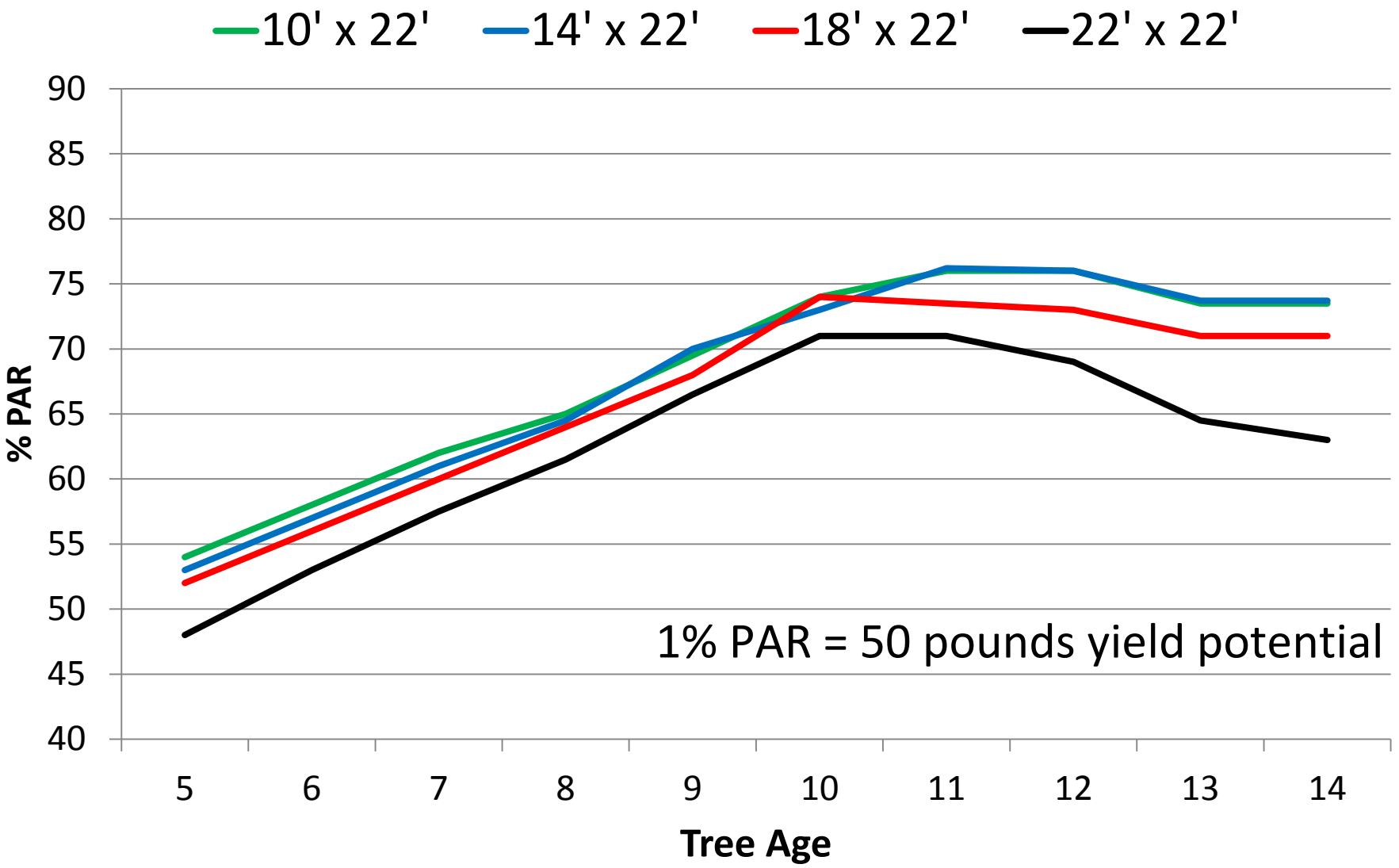
Carmel on Nemaguard



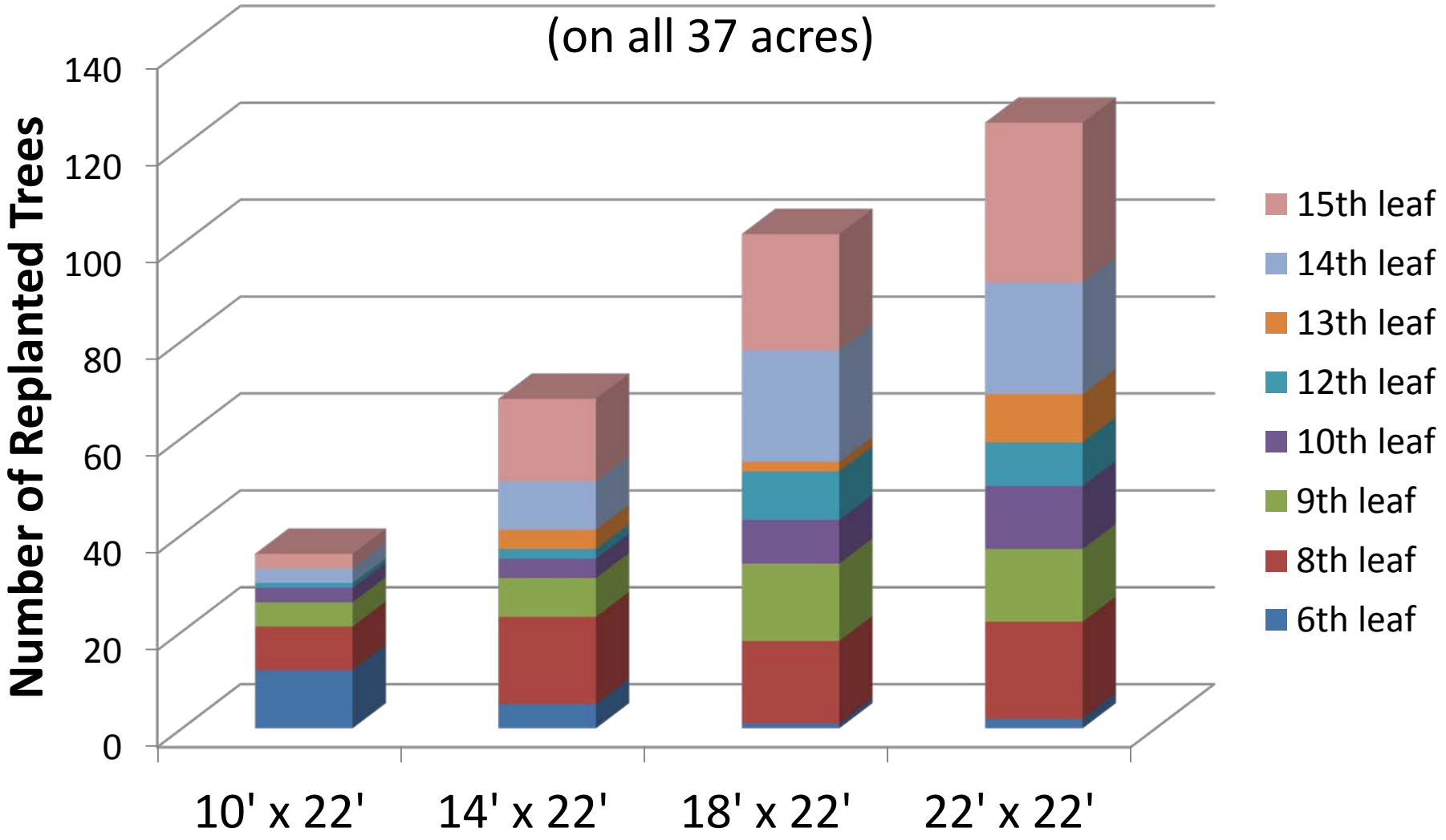
Effect of Tree Density on Yield to Date:

- Yield Advantage is highly dependent on tree vigor
  - Smaller trees will benefit most from tight spacing
  - Benefit may persist throughout orchard's life
  - Large, vigorous trees may not have substantially higher yields at higher density.
- No yield disadvantage to close spacing (yet)

Light Interception Dynamics of Differently Spaced Trees



The Influence of Tree Spacing on the Number of Replanted Trees



The Influence of Tree Spacing on Missing Canopy

	Cumulative Number of Replants	Square Footage of Missing Canopy
10 x 22	35	7,700
14 x 22	62	19,096
18 x 22	98	38,808
22 x 22	120	58,080

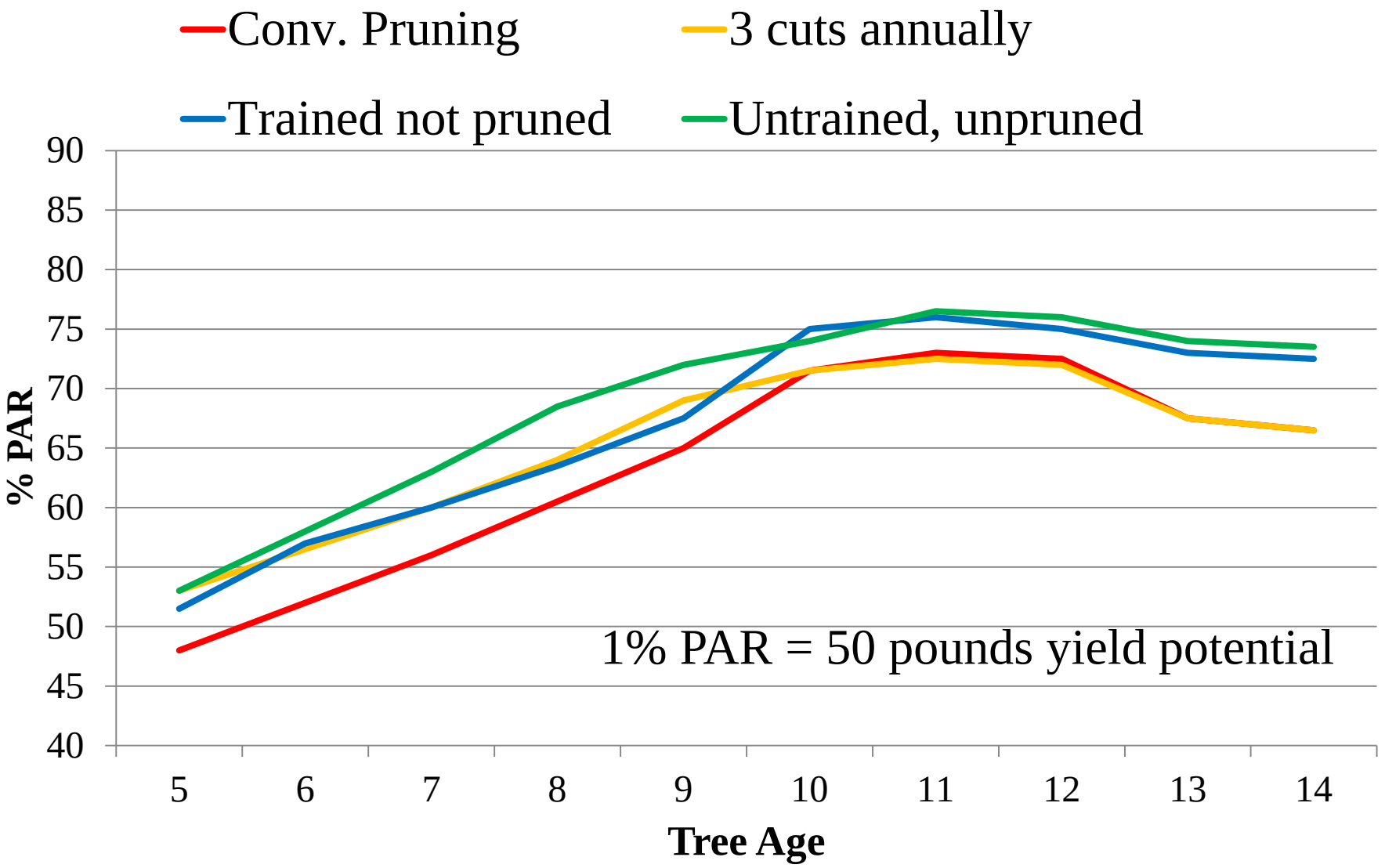
The Closer that Trees are Planted…

- The smaller & shorter the tree
- The fewer problems with scaffold breakage regardless of how they are trained.
- The less pruning they will need
- The easier they are to harvest
  - The less shaker injury they will have
  - The fewer mummies they have (less NOW)
  - Longer they will be productive
- The better the spray coverage

Pruning:

A business practice

Light Interception Dynamics of Different Pruning Methods



The Effects of Pruning on Current (15th Leaf) & Cumulative Yield

	Nonpareil		Carmel	
	2013 Yield (lb. / a)	Cumulative	2014 Yield (lb. / a)	Cumulative
Training & Pruning				
Trained to 3 scaffolds; Annual, moderate pruning	3199 a	32,537	2867 b	30,682
Trained to 3 scaffolds; unpruned after 2nd year	3092 a	33,762	3163 a	32,930
Trained to multiple scaffolds; Three annual pruning cuts	3093 a	31,862	3028 ab	32,448
No scaffold selection; no annual pruning	3236 a	33,625	3159 a	34,286

Early Conclusions, Stanislaus County Trial:

- Pruning has not increased or sustained yield. Conventional annual pruning has reduced yield in most years so far.
- 14 years x $150 pruning costs = $2100
- Decrease in yield by 1000 – 3000 pounds = loss of ~$2000 - $6000 / acre
  - Total loss from pruning $5,000 - $8,000 / acre

- Pruning reduces yield.
- The more you prune, the more you reduce yield.

- Sometimes you have to prune. You must accept the sacrifice in yield.

- Reason to prune needs to justify expense and yield loss

Tree Training: a discussion

Training: first dormant pruning is most critical.

- Space scaffolds vertically at least 3 inches if possible
- This requires topping newly planted trees at 36 – 40 inches
- Don’t choose top shoot – especially with Aldrich
- Don’t skim too many shoots down low during 1rst summer
- Avoid shoots too flat or too vertical
- Avoid occluded bark

Good

Better?

Bad Training

Scaffolds not spaced well vertically

Scaffolds too flat and not spaced well vertically

Bad Training

Better. Scaffolds staggered vertically and around

Gum in Crotch of Tree

Gum is a Result of Crack at Base of Limb


Avoid occluded bark

Excessively short pruning leads to many problems

- Short pruning will lead to excessive water sprouts and root suckers which will need to be removed.
- This leads to excessive pruning the next year
- Excessive pruning increases potential for canker diseases and crown gall
- Delay in yield is significant


Vigorous tree: PxA hybrid
• Short pruned first year
• Minimally pruned 2nd year
• Not roped

Multiple Problems

- Scaffolds originate from same plane
- Scaffolds too flat
- Pruned too short first year
- Mechanically topped

In Summary

- Initial tree training is important, especially in wider spacings
- Can certainly stop pruning at some point
- Trees that were initially trained to three, medium length scaffolds, pruned again second leaf and then left unpruned have been the lowest maintenance trees in trial.

Thank you for your attention.

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