

Integration of Tree Density & Minimal Pruning for Efficient Almond Production

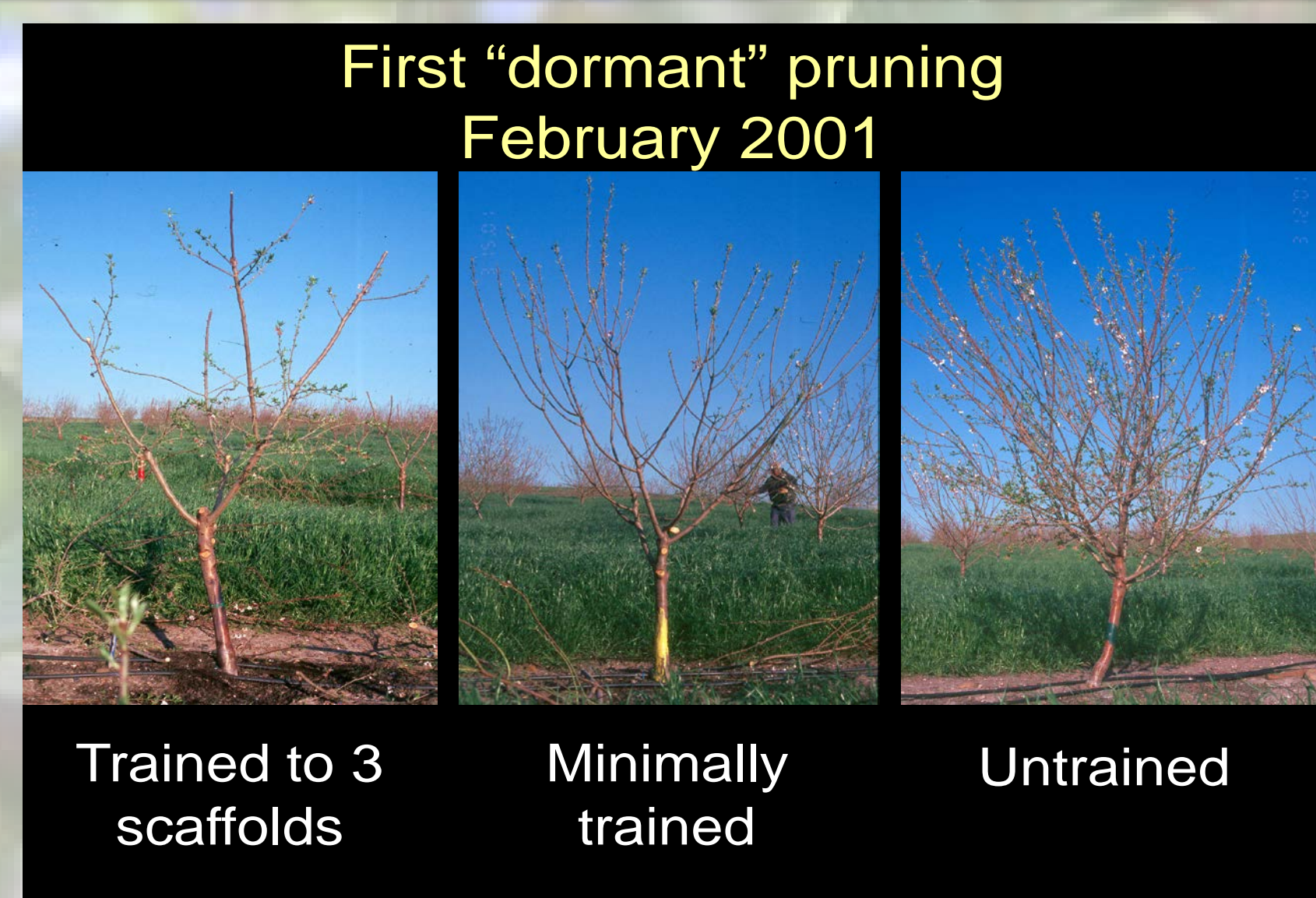
Roger Duncan, UC Cooperative Extension, Stanislaus County & Bruce Lampinen, UC Davis

Objectives:

- Test if almond trees need to be pruned annually to maintain light permeation throughout the canopy, sustain bud fruitfulness, renew fruitwood, control tree size (height) and maintain the productive lifespan of an orchard.
- Determine the optimal orchard spacing for large trees (Nonpareil variety on hybrid rootstock) vs. smaller trees (Carmel variety on nemaguard rootstock).
- Monitor long term effects on yield, orchard longevity and profitability.

Multifactorial Trial:

- 2 Varieties
 - Nonpareil & Carmel
- 2 Rootstocks
 - Nemaguard & Hansen
- 4 Tree spacings
 - 22'x22', 18'x22', 14'x22', 10'x22'
- 4 Pruning strategies



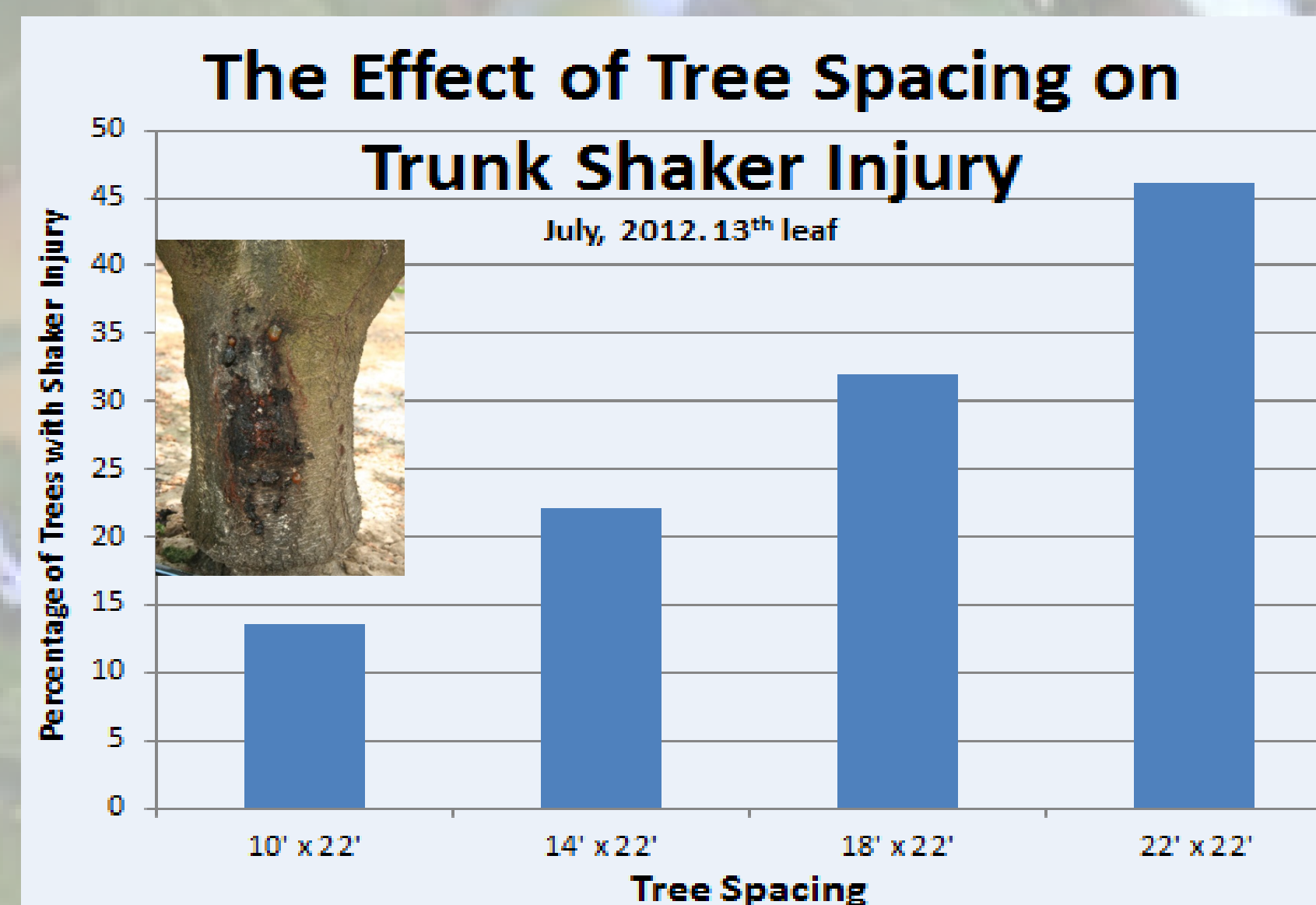
Pruning Strategies:

1. Standard trained, standard pruned
 - 3 scaffolds, annual moderate pruning
2. Standard trained, then unpruned
 - Trained with 3 scaffolds and open centers
 - Unpruned after 2nd dormant season
3. Minimal training & pruning
 - Trained with 4-6 scaffolds & open centers
 - Maximum of three pruning cuts annually
4. Untrained, unpruned
 - No scaffold selection, no annual pruning

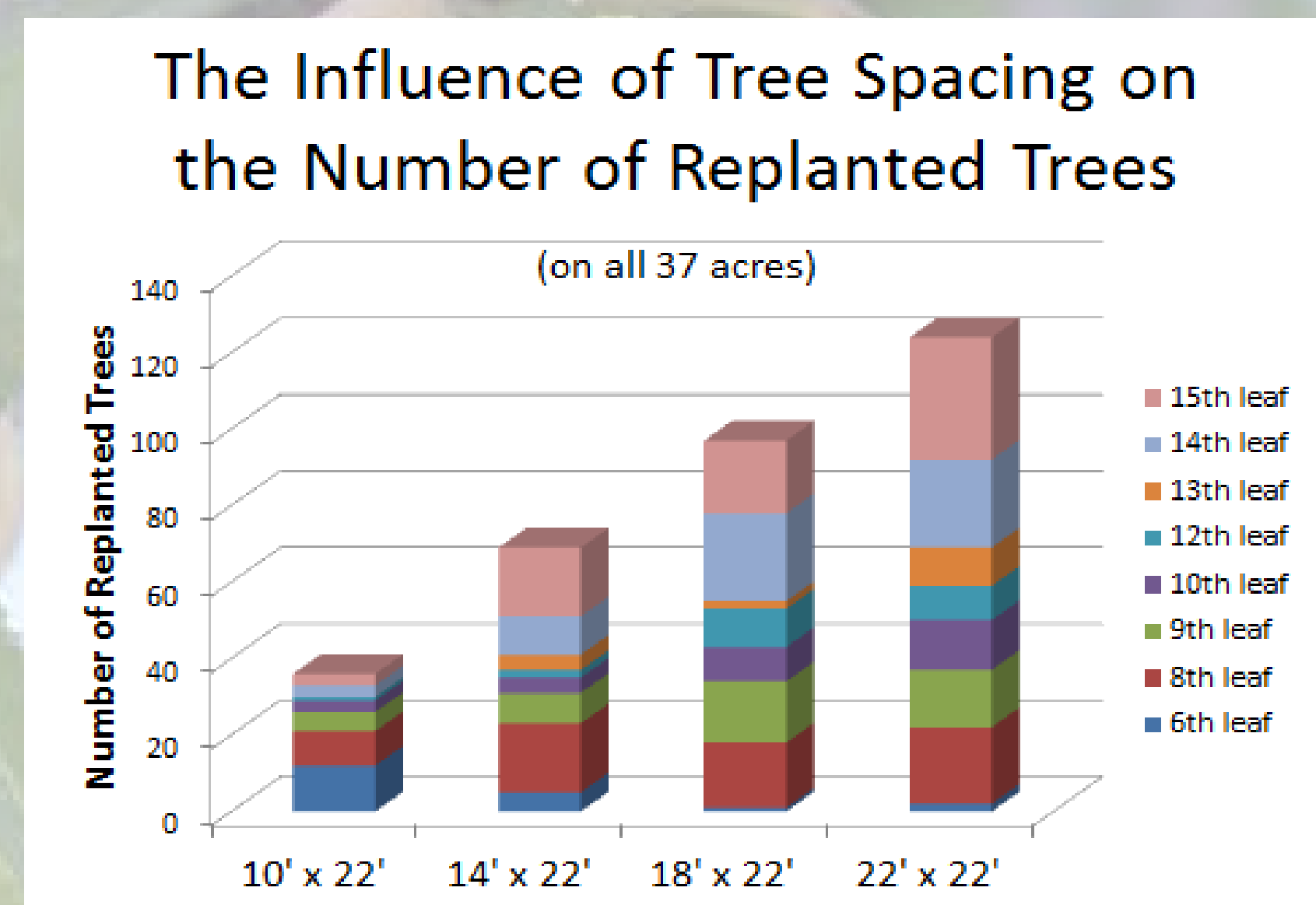
The Influence of Tree Spacing on the Time & Cost to Shake. 13th Leaf Nonpareil

Tree Spacing	Time (Minutes / Acre)	Cost (\$ / Acre)
10' x 22'	54.8	\$91
14' x 22'	45.2	\$75
18' x 22'	44.6	\$74
22' x 22'	49.4	\$82

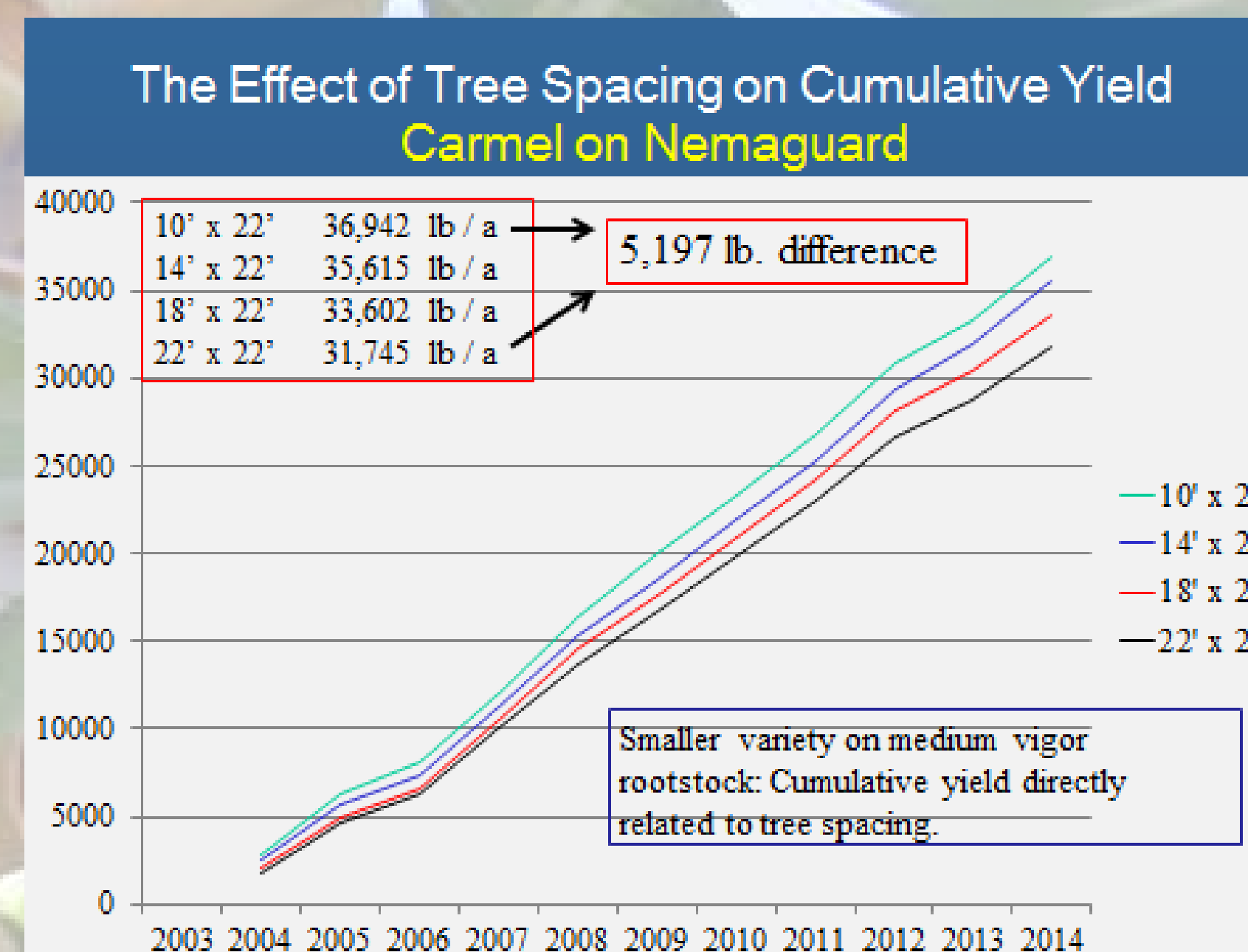
*Shaker cost calculated at \$100 / hour



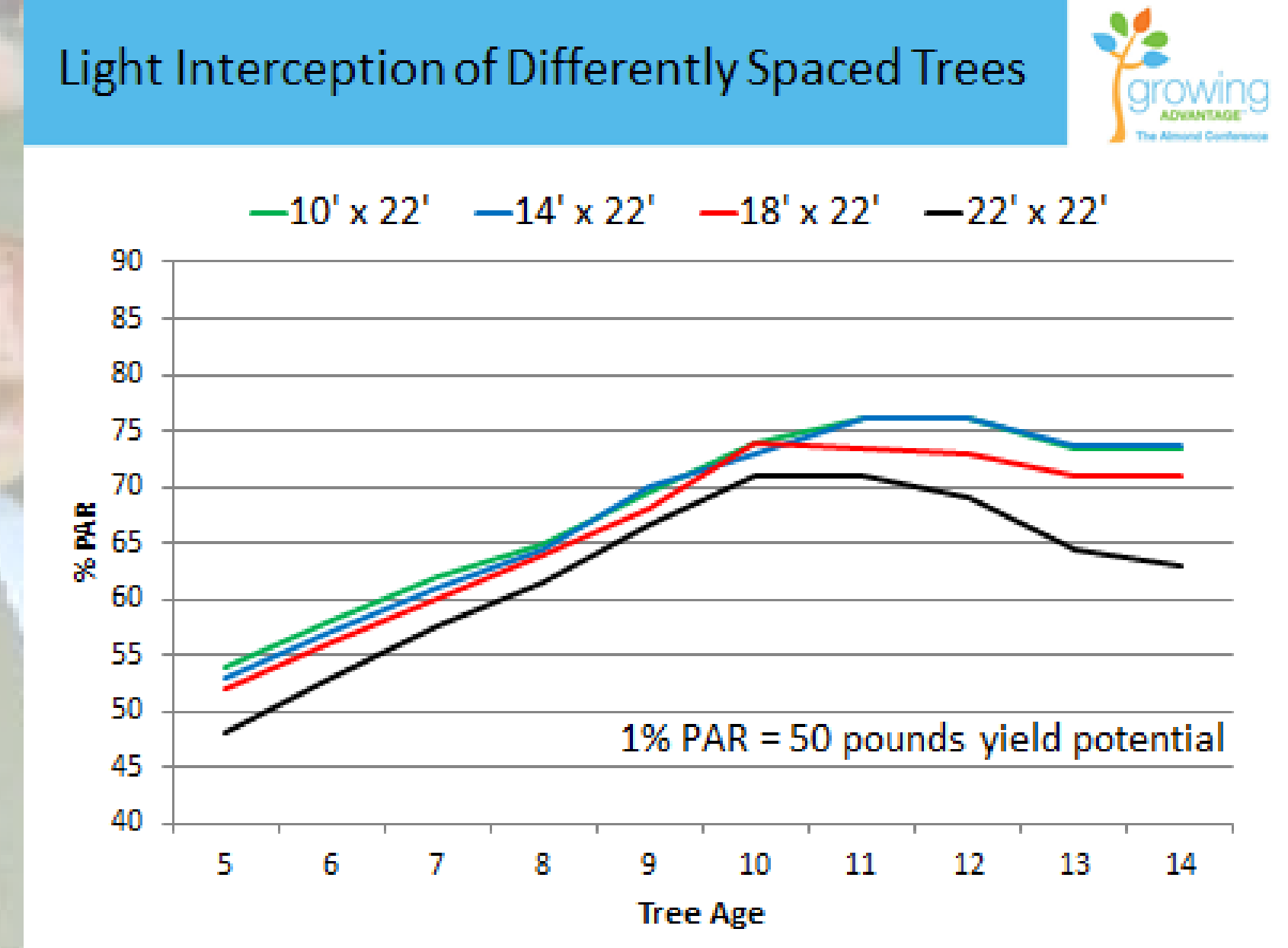
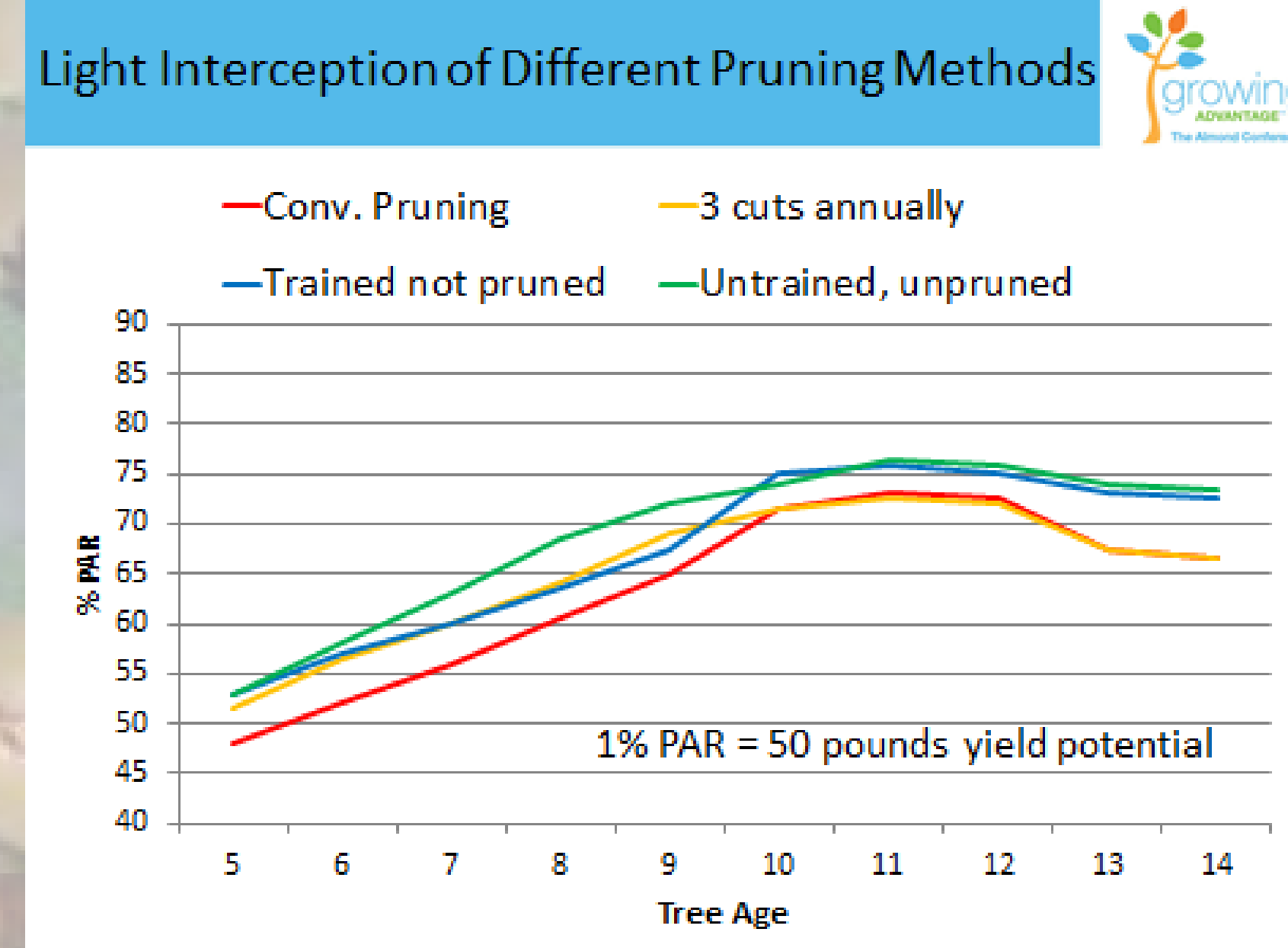
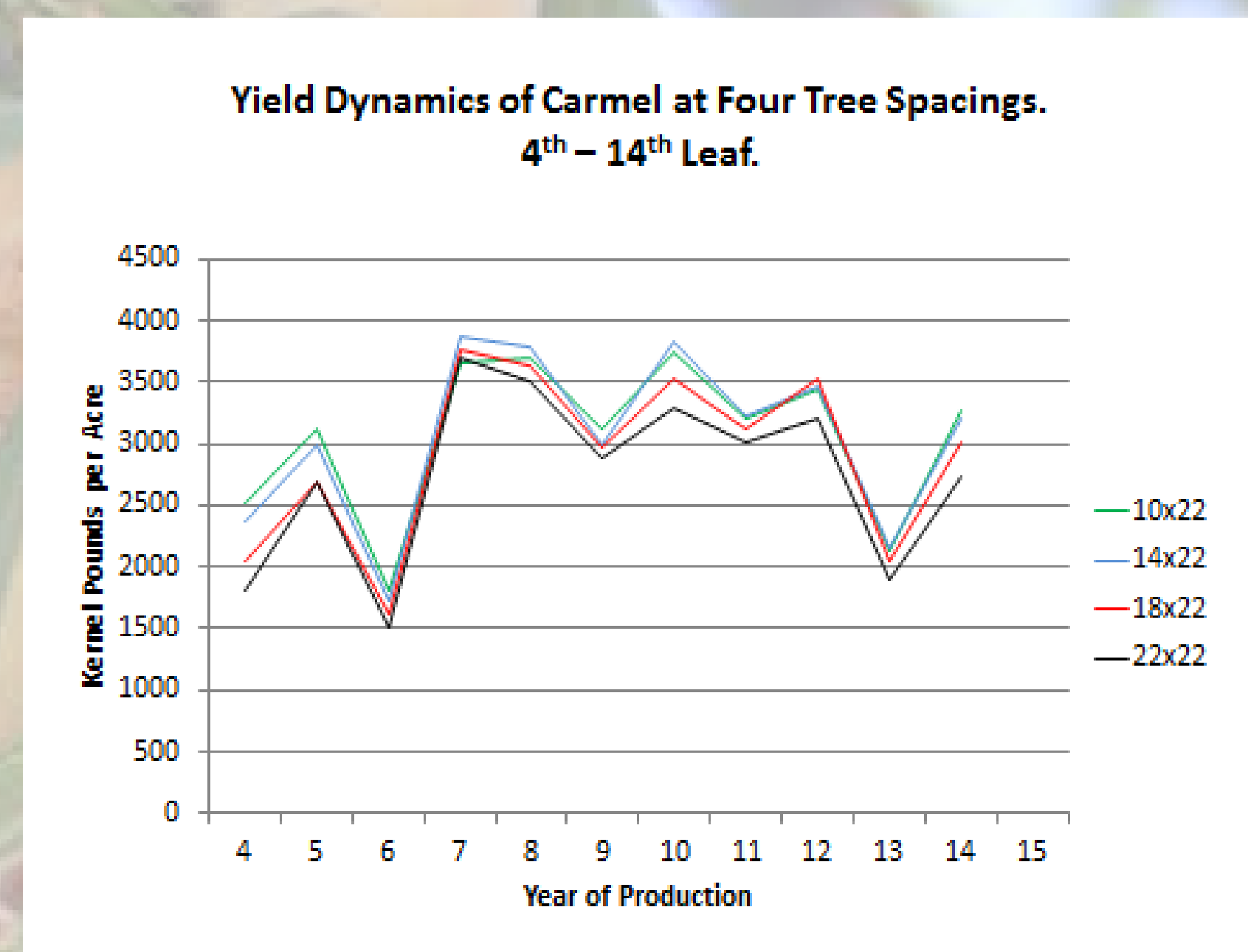
Widely spaced trees are larger, more difficult to shake and therefore more prone to shaker injury



The closer trees are planted, the less likely they will fail due to scaffold failure or shaker damage



Smaller variety on medium vigor rootstock: Cumulative yield directly related to tree spacing.



The Effects of Pruning, Tree Spacing & Rootstock on Current (15th Leaf) & Cumulative Yield

	Nonpareil		Carmel	
	2014 Yield ¹ (lb/acre)	Cumulative	2014 Yield ² (lb / acre)	Cumulative
Training & Pruning				
Trained to 3 scaffolds; Annual, moderate pruning	--	32,246	2867 a	30,482
Trained to 3 scaffolds; unpruned after 2 nd year	--	33,481	3163 a	32,727
Trained to multiple scaffolds; Three annual pruning cuts	--	31,581	3028 a	32,235
No scaffold selection; no annual pruning	--	33,625	3159 a	34,078
Tree Spacing				
10' x 22'	--	32,793	3267 a	33,720
14' x 22'	--	33,392	3209 a	33,596
18' x 22'	--	33,003	3002 ab	31,926
22' x 22'	--	31,742	2738 b	30,280
Rootstock				
Hansen	--	32,665	2757 b	29,825
Nemaguard	--	32,800	3351 a	34,917

¹Nonpareil yield was not recorded in 2014.

²Data followed by the same letters are statistically similar.

Conclusions after the first 15 years:

Tree Training & Pruning:

- Annual pruning has not maintained canopy light interception longer than unpruned trees
- In most years Nonpareil yields are statistically similar in conventionally pruned, minimally pruned and unpruned trees while Carmel yields are higher in unpruned trees.
- Cumulatively, untrained & unpruned Carmel trees have accumulated 3596 pounds more than conventionally pruned trees through the 15th leaf.
- At \$2.00 / pound, conventional training and pruning would have reduced gross income by about \$7775 per acre so far in this trial, including pruning & shredding costs plus lower cumulative yield.
- Trees trained to multiple scaffolds are more prone to scaffold failure and tree blow over (young trees), especially in widely spaced trees.
- Pruning has not affected kernel size.

Tree Spacing:

- There has been no clear yield advantage to high density planting of Nonpareil so far but cumulative Carmel yields are significantly higher on closely planted trees and the trend is continuing.
- More closely planted trees have significantly smaller trunk circumference and canopy width, and to a lesser extent, shorter tree height.
- Because closely planted trees are smaller, they have had fewer problems with scaffold breakage, are easier to shake, have fewer mummies, have suffered less trunk injury during harvest, have the fewest replants and may have a longer productive life.
- Sunlight interception per acre is decreasing faster in widely spaced trees which may lead to prematurely declining orchard yields earlier than closely spaced trees.
- Closely planted trees have not had more hull rot (bread mold) than widely spaced trees.