Integration of Tree Density & Minimal Pruning for Efficient Almond Production

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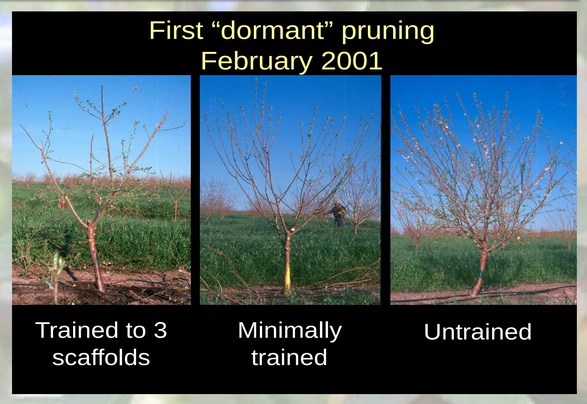
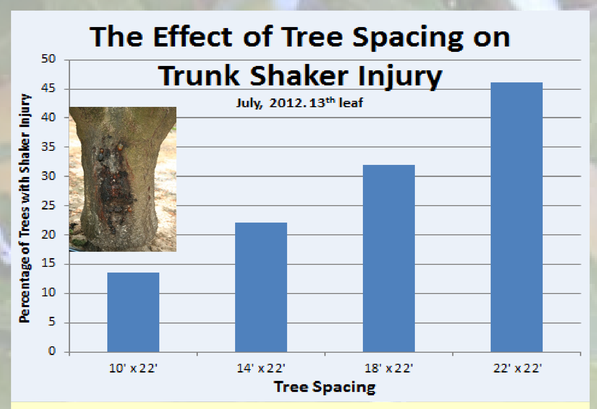
Objectives:

- 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.

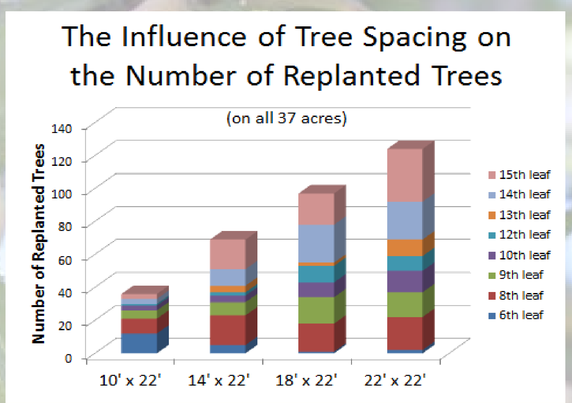
Multifactorial Trial:

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

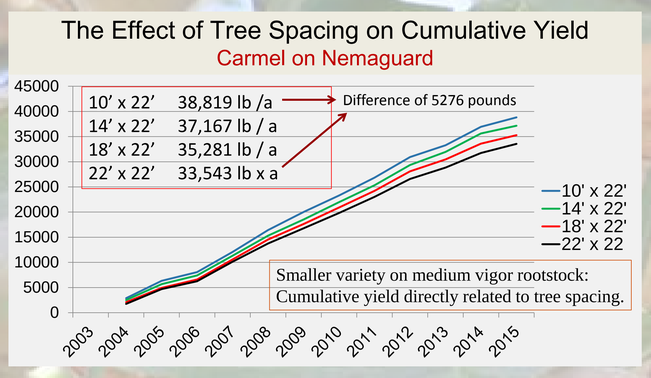


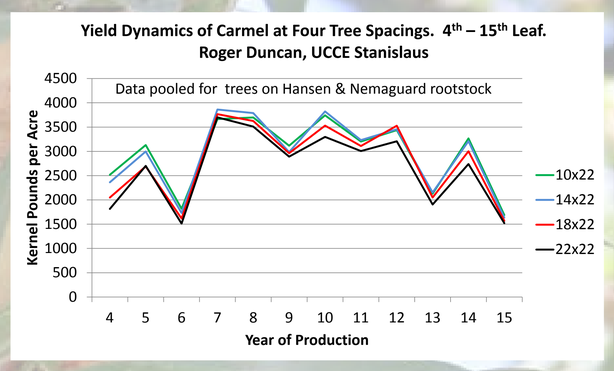


Widely spaced trees are larger, more difficult to shake and therefore more prone to shaker injury



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





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

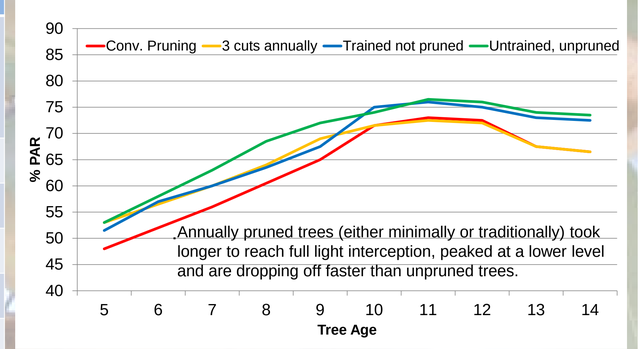
The Influence of Tree Spacing on the Time & Cost to Shake.

13th Leaf Nonpareil

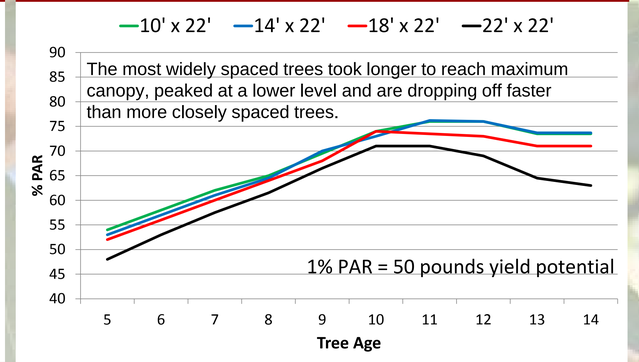
	Time (Minutes / Acre)	Cost ($ / Acre
10' x 22'	54.8	$91
14' x 22'	45.2	$75
18' x 22'	44.6	$74
22' x 22'	49.4	$82

*Shaker cost calculated at $100 / hour

Light Interception Dynamics of Different Pruning Methods



Light Interception Dynamics of Differently Spaced Trees



The Effects of Pruning, Tree Spacing & Rootstock on Current (16th Leaf) & Cumulative Yield[1]

	Nonpareil		Carmel	
	2015 Yield (lb/acre)	Cumulative	2015 Yield (lb / acre)	Cumulative
Training & Pruning				
Trained to 3 scaffolds; Annual, moderate pruning	1691 a	33,937	1548 a	32,030
Trained to 3 scaffolds; unpruned after 2nd year	1597 a	35,078	1646 a	34,373
Trained to multiple scaffolds; Three annual pruning cuts	1538 a	33,119	1536 a	33,771
No scaffold selection; no annual pruning	1542 a	35,166	1689 a	35,767
Tree Spacing				
10' x 22'	1513 a	34,306	1689 a	35,409
14' x 22'	1668 a	35,060	1636 a	35,232
18' x 22'	1676 a	34,680	1570 a	33,496
22' x 22'	1510 a	33,252	1520 a	31,800
Rootstock				
Hansen	1770 a	34,435	1502 a	31,327
Nemaguard	1413 b	34,213	1705 a	36,622

[1]Data followed by the same letters are statistically similar.

Conclusions after the first 16 years:

Tree Training & Pruning:

- In 2015, yield of Nonpareil and Carmel was substantially lower than the historical average of over 3000 lb / acre. Statistically, yield did not drop more in unpruned trees compared to annually pruned trees.
- Cumulatively, untrained & unpruned Carmel trees have accumulated 3,737 pounds more than conventional, annually pruned trees through the 16th leaf while unpruned Nonpareil has accumulated 1,229 more pounds.
- At $2.00 / pound, conventional training and pruning would have reduced gross income by about $6000 per acre so far in this trial, including pruning & shredding costs plus lower cumulative yield.
- Annual pruning has not maintained canopy light interception longer than unpruned trees
- 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:

- For the first time, yields were similar at all tree spacings (usually closely planted trees have yielded more).
- There has been no cumulative yield advantage to planting closer thane 14' apart down the row, except for the smaller Carmel on Nemaguard rootstock.
- 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, and have had the fewest replants.
- Sunlight interception per acre is decreasing faster in widely spaced trees which may lead to declining orchard yields earlier than closely spaced trees.