Integration of Tree Spacing, Rootstock Selection & Pruning for Efficient Almond Production

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Premise: It is necessary to fill all available space in an orchard in order to obtain maximum yields

The sooner this is achieved, the sooner an orchard will obtain maximum yields

Questions:

- Can we fill orchard space more quickly with closer spacings and more vigorous rootstocks?

- If so, will early crowding increase early yields but sacrifice long-term profits?

- What effect does pruning have on short-term and long-term yield in low & high density orchards?

What is the best spacing?

How many limbs do we leave in a tree?

Effect of Pruning on Cumulative Nonpareil Yields (through 16th leaf)

Spacing = 7’ x 22’. Nickels Soils Lab.

	Kernel pounds
Annually pruned	23,117
Unpruned*	24,089
2 Scaffolds, annual pruning	24,522
Every other tree removed	19,206

Multifactorial Trial in Stanislaus County to Examine Interrelationships of Variety, Rootstock, Tree Spacing & Pruning

- 28 acres
- virgin soil
- soil deeply modified with slip plow
- planted September, 1999
- drip irrigated
- trees very vigorous (nitrogen = 3.0%)

Aerial View of Spacing / Pruning Trial 3rd-leaf. October, 2002

Multifactorial Trial

- 3 varieties
  - Nonpareil*, Carmel*, Sonora
- 3 rootstocks
  - Nemaguard*, Lovell, Hansen*
- 4 in-row spacings
  - 10’ x 22’, 14’ x 22’, 18’ x 22’ & 22’ x 22’
- 4 pruning strategies

4 training / pruning strategies

- Standard trained, standard pruned
  - 3 scaffolds, medium annual pruning to maintain open centers
- Standard trained, unpruned
  - 3 scaffolds, unpruned after second dormant season
- Minimal training & pruning
  - 4-6 scaffolds, maximum of 3 cuts each dormant pruning
- Untrained, unpruned
  - no scaffold selection, no annual pruning*

First “dormant” pruning
February 2001

Trained to 3 scaffolds

Minimally trained

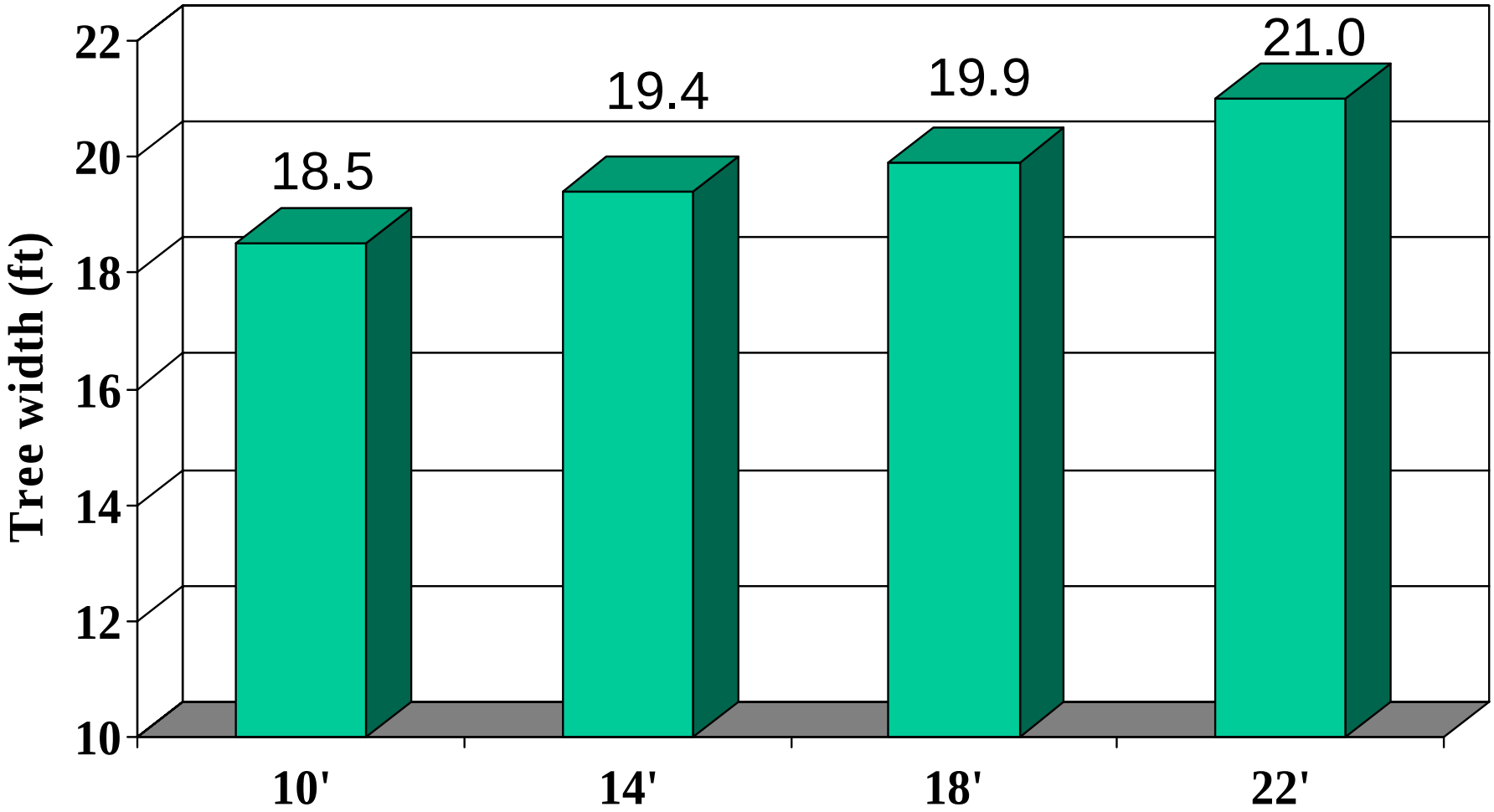
Untrained

Tree Spacing:

Effect on tree size, architecture, yield, etc.

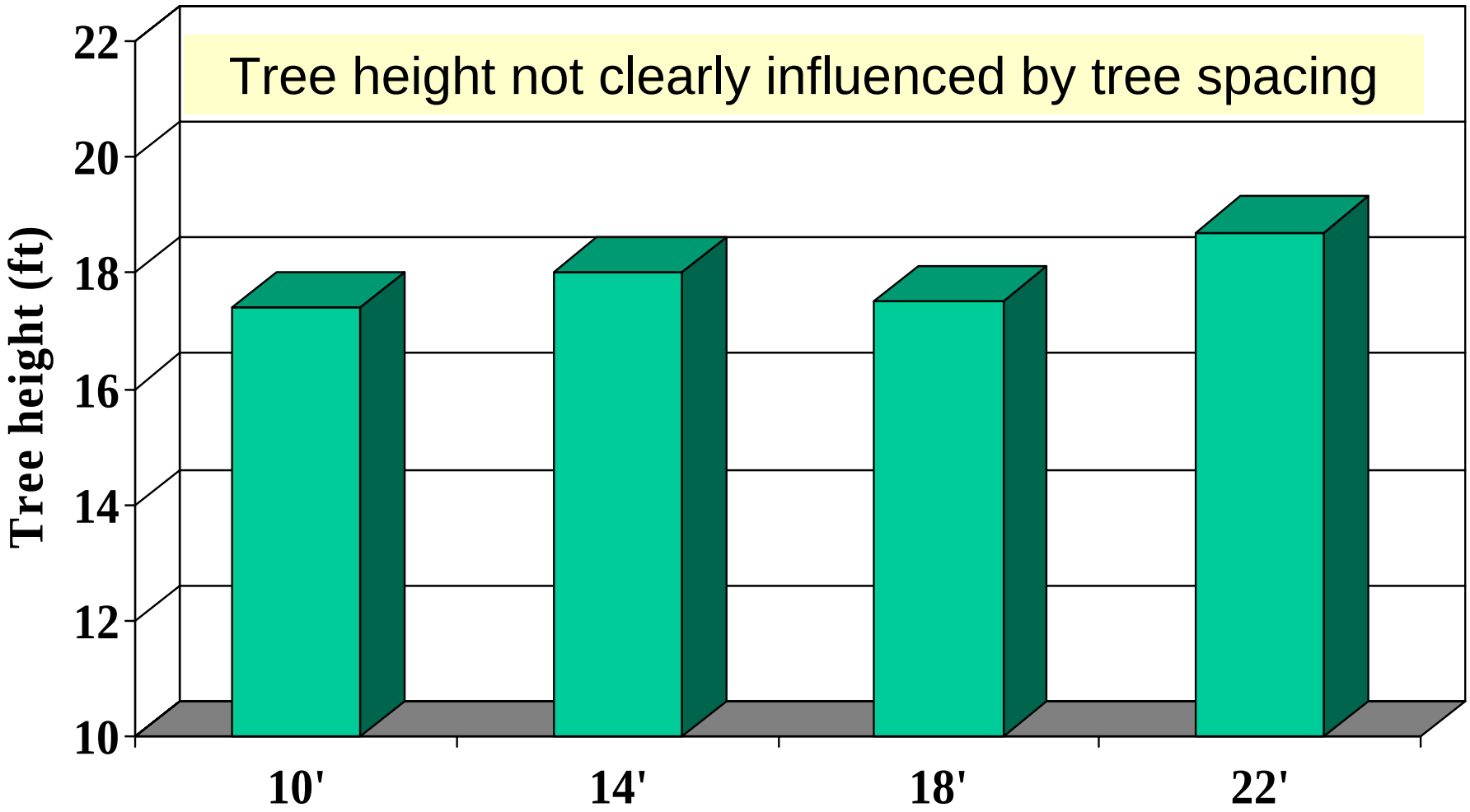
The Influence of Tree Spacing on Canopy Width (into the drive row)

6th-leaf Nonpareil (June 2005)

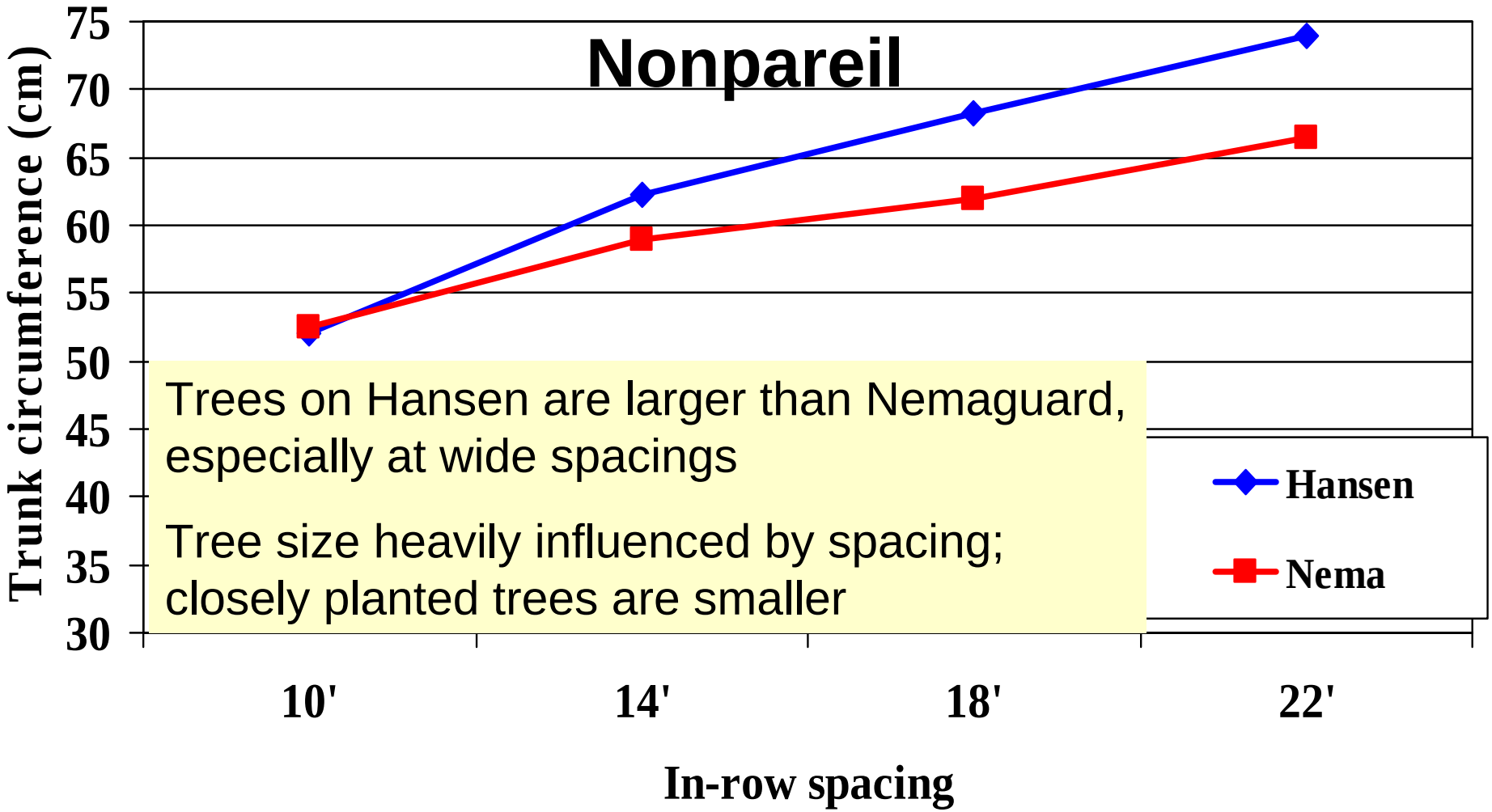


The Influence of Tree Spacing on Tree Height

6th-leaf Nonpareil (June 2005)



Effect of Tree Spacing & Rootstock on Trunk Circumference. Feb. 2006



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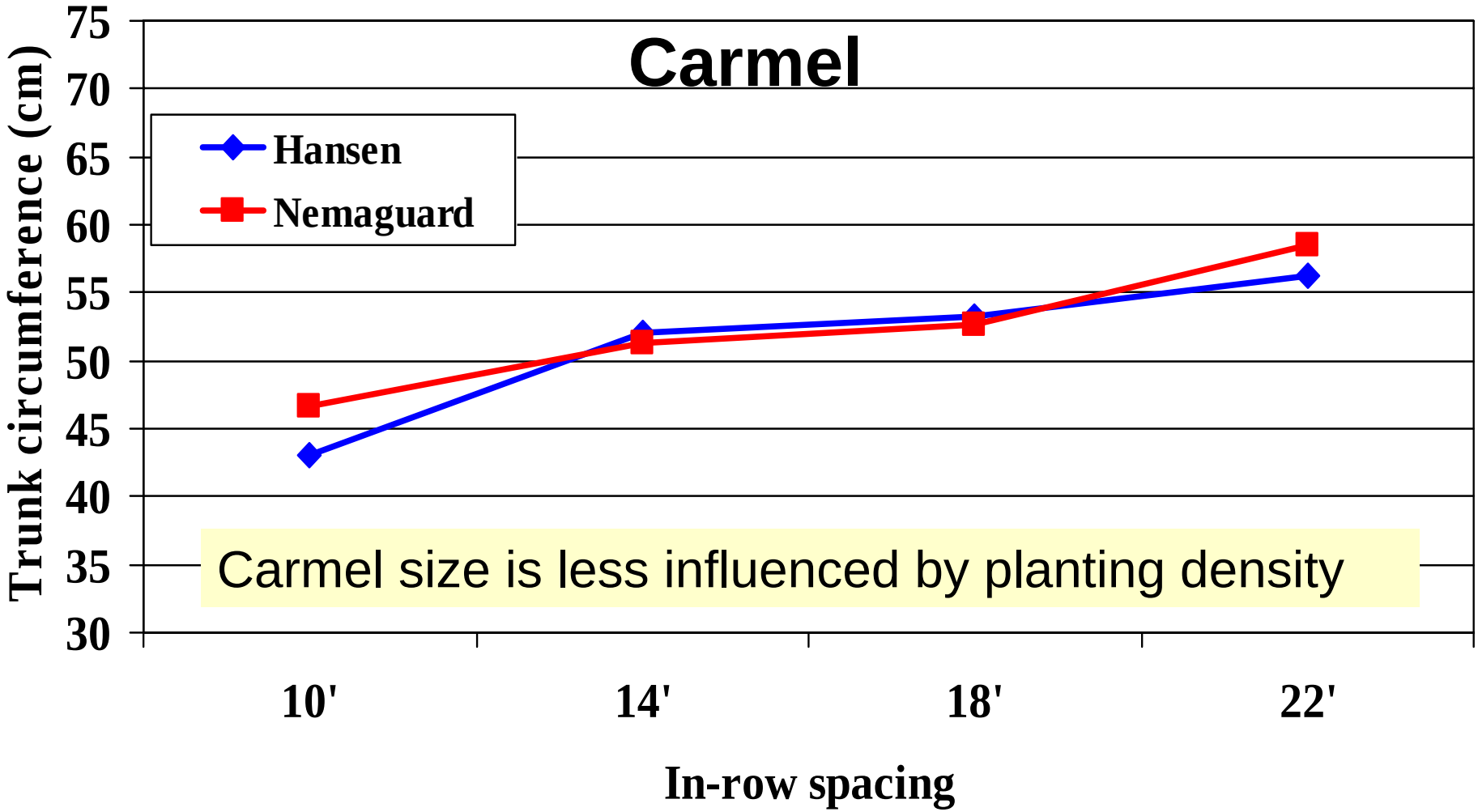
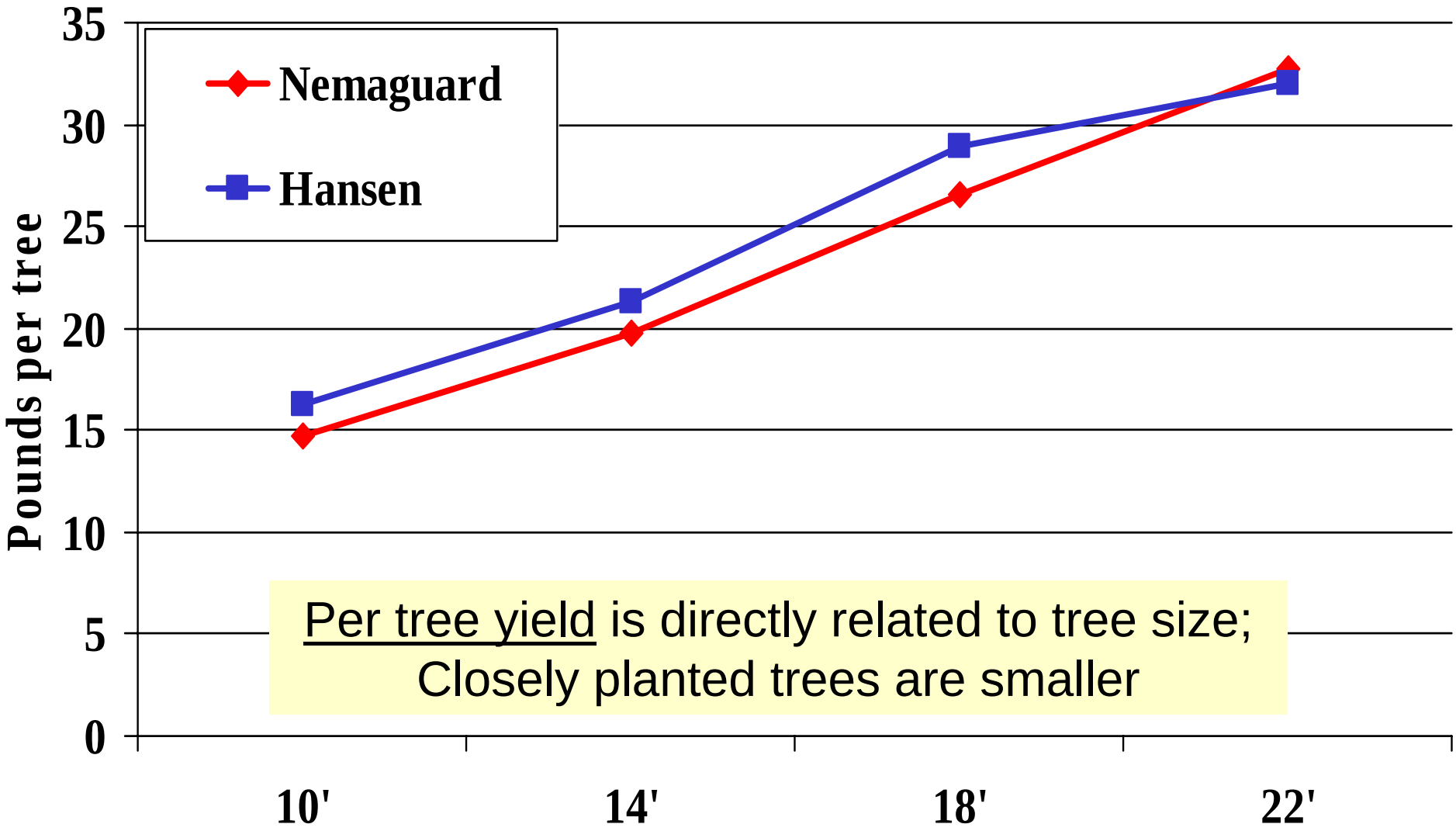
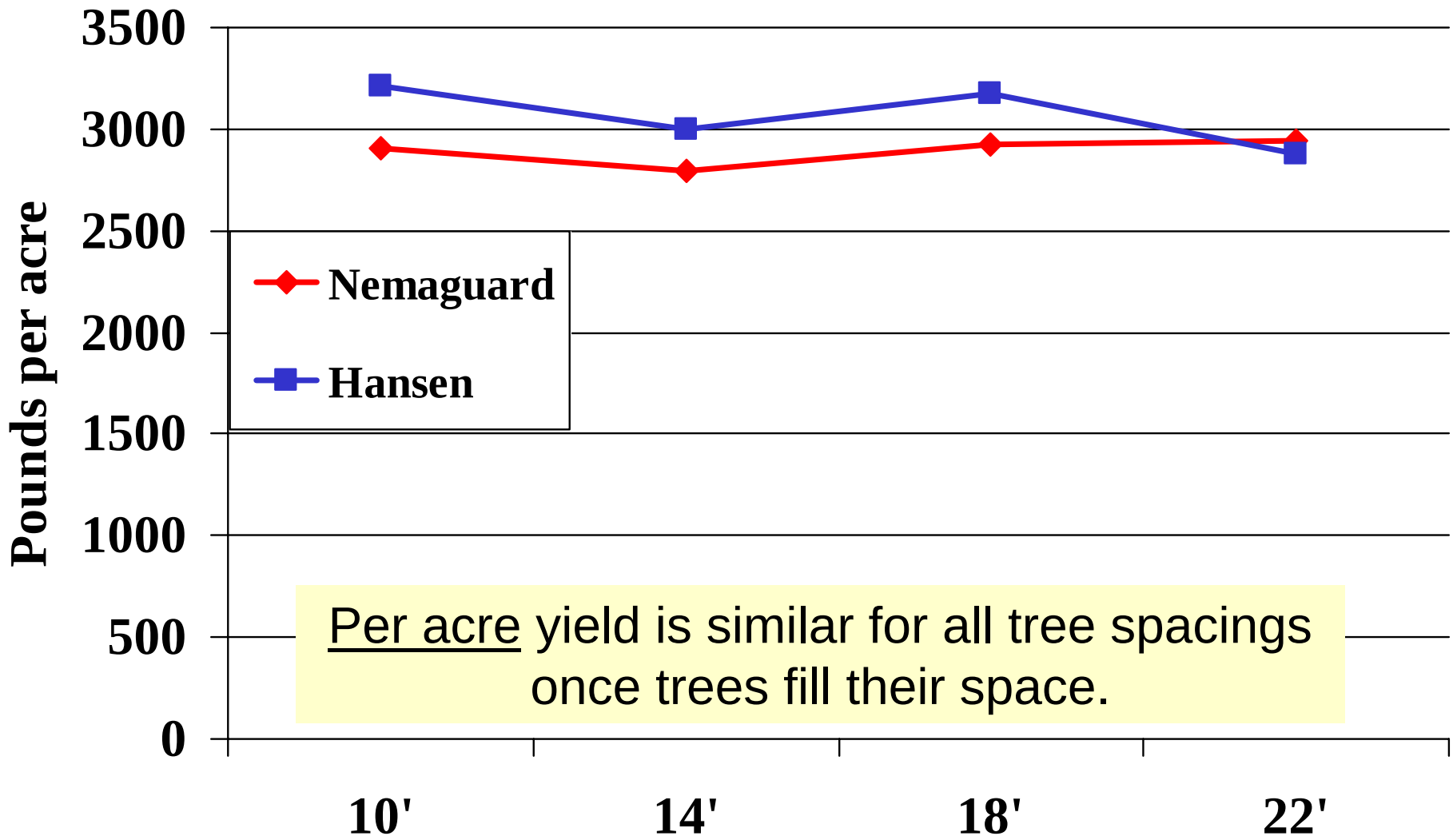


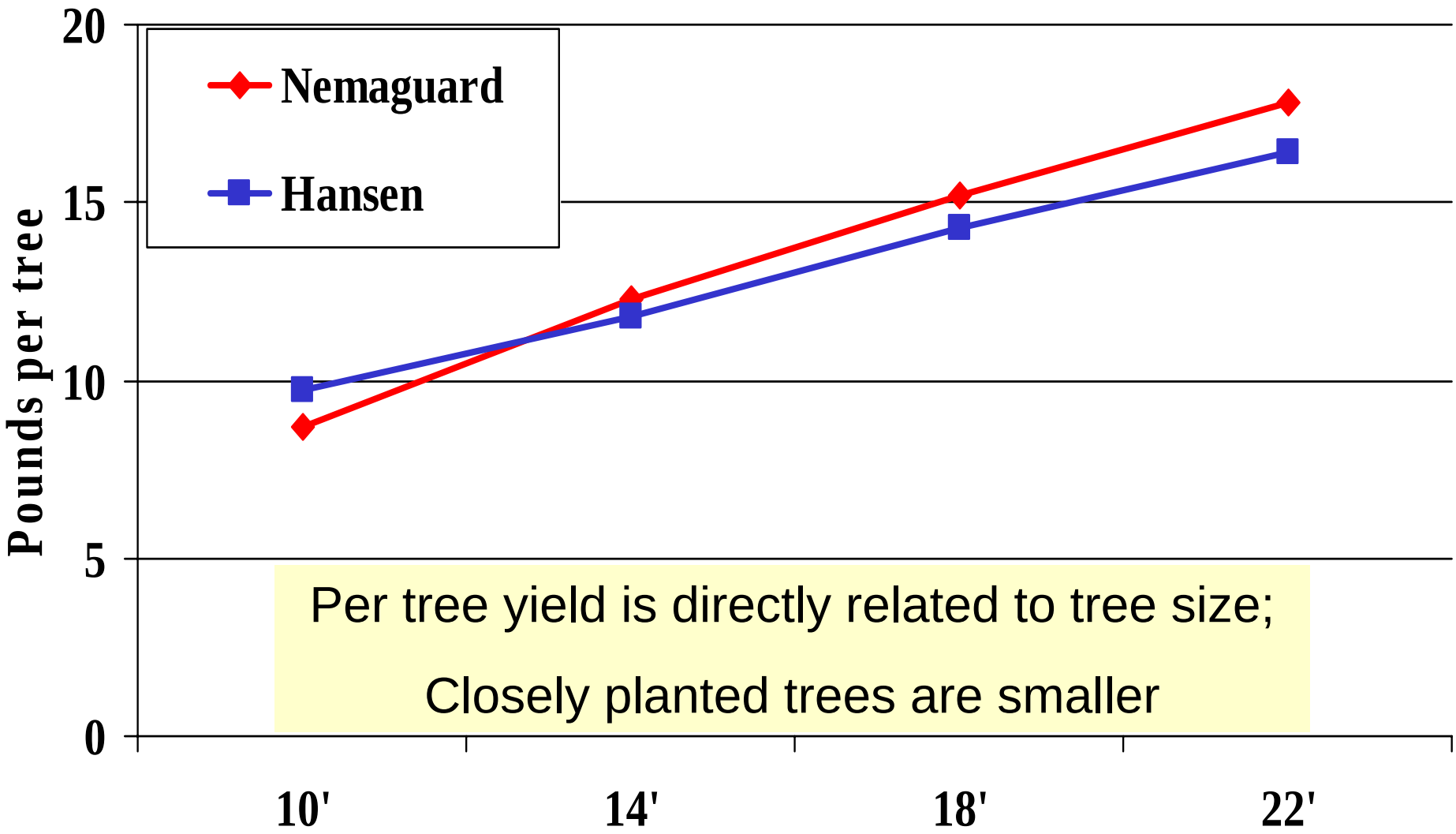
Effect of Tree Spacing & Rootstock on per Tree Yield of Seventh-leaf Nonpareil. 2006



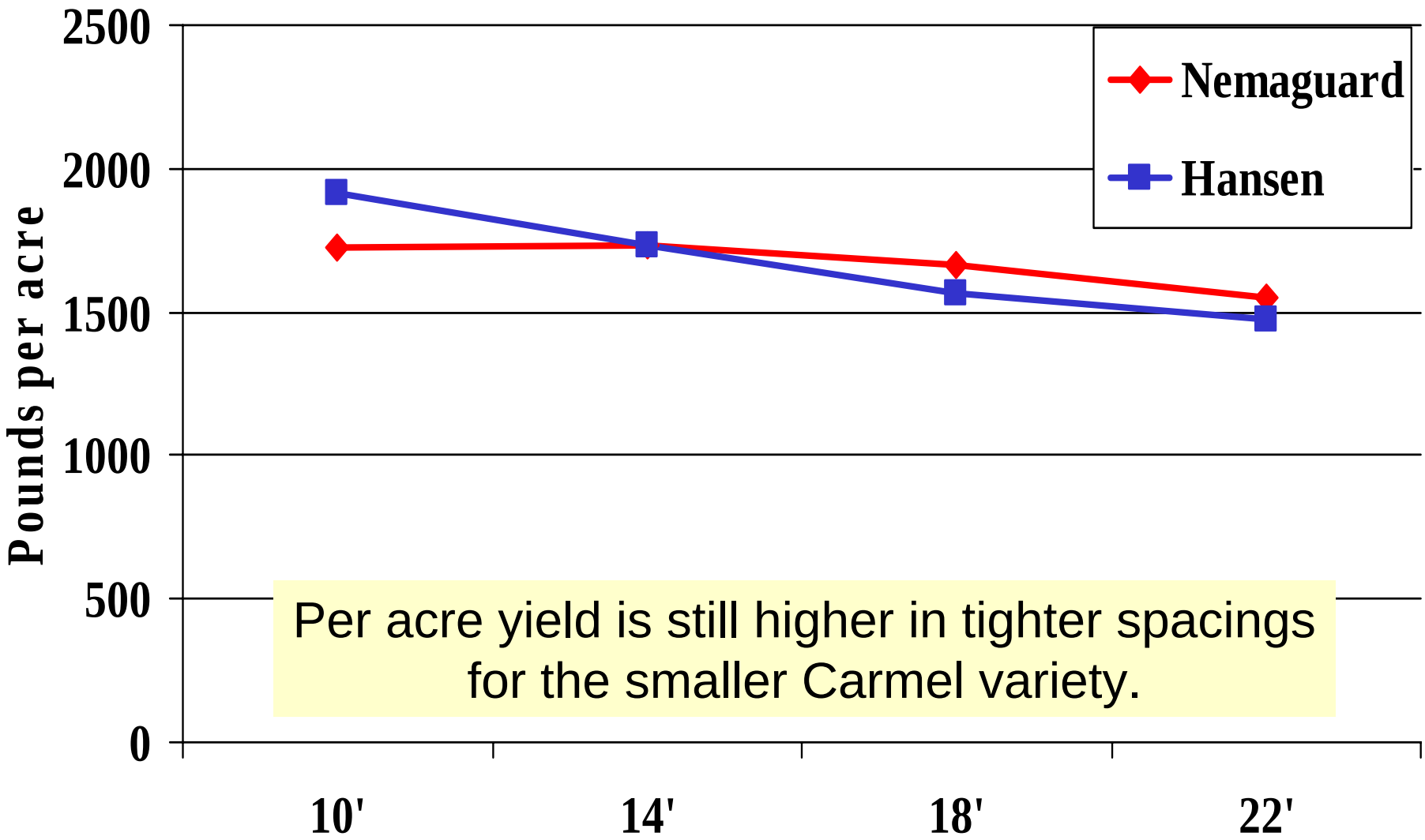
Effect of Tree Spacing & Rootstock on per Acre Yield of Seventh-leaf Nonpareil. 2006



Effect of Tree Spacing & Rootstock on per Tree Yield of Sixth-leaf Carmel. 2006



Effect of Tree Spacing & Rootstock on per Acre Yield of Sixth-leaf Carmel. 2006



Per acre yield is still higher in tighter spacings for the smaller Carmel variety.

Tree training & pruning:

Effect on structural failure, disease, yield, etc.

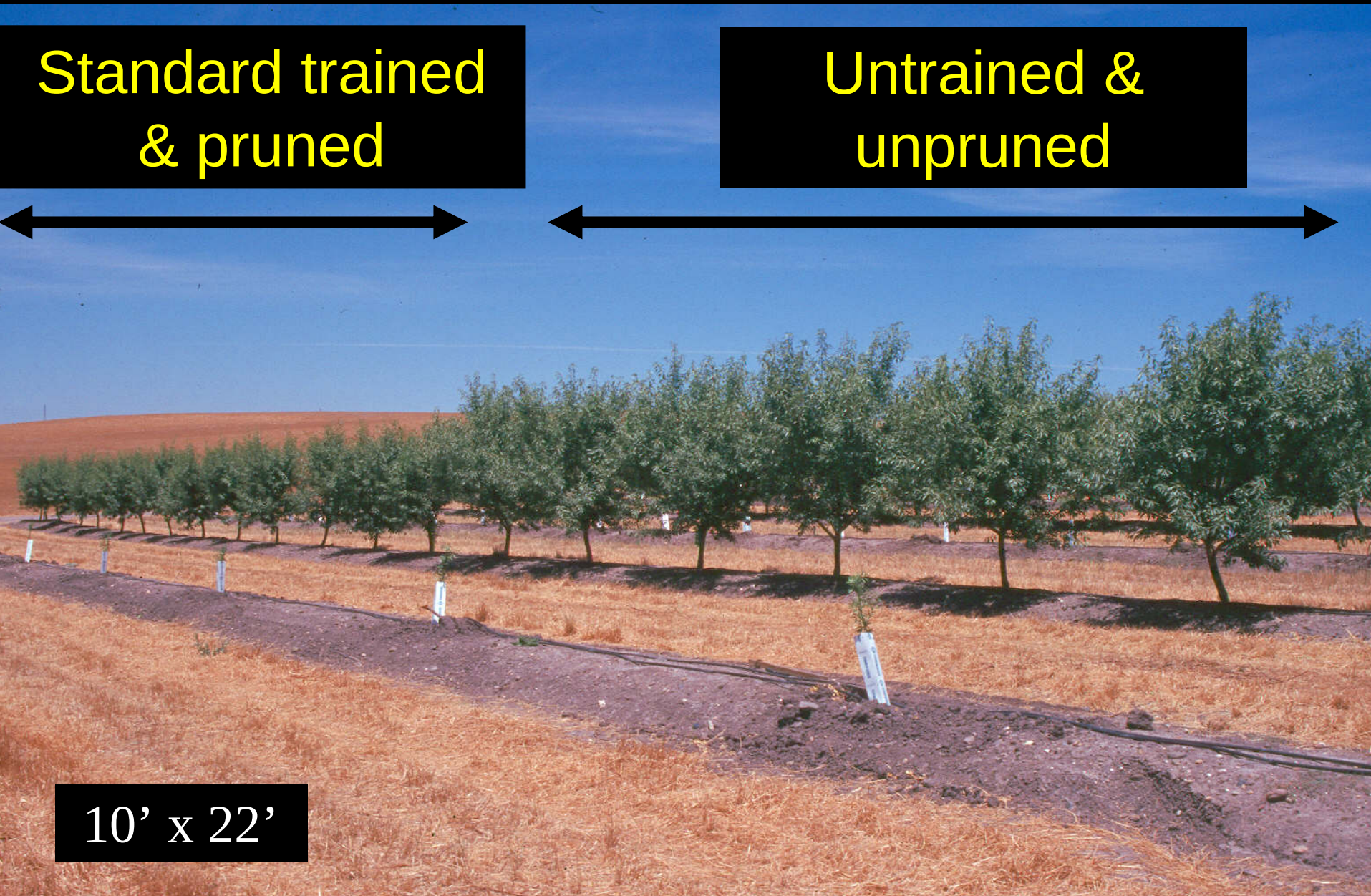
First “dormant” pruning
February 2001

Trained to 3 scaffolds

Minimally trained

Untrained

2nd-leaf. May, 2001



Second “dormant” pruning
March 2002

Standard trained,
pruned annually

Minimally trained,
minimally pruned

Untrained,
unpruned

Standard trained & pruned vs. Untrained & unpruned
3rd dormant. January, 2003

Standard Trained, Annually Pruned Nonpareil. 7th Leaf

Standard Trained, Unpruned five years

Untrained / unpruned Nonpareil. 7th Leaf.

Difference in shaded ground area

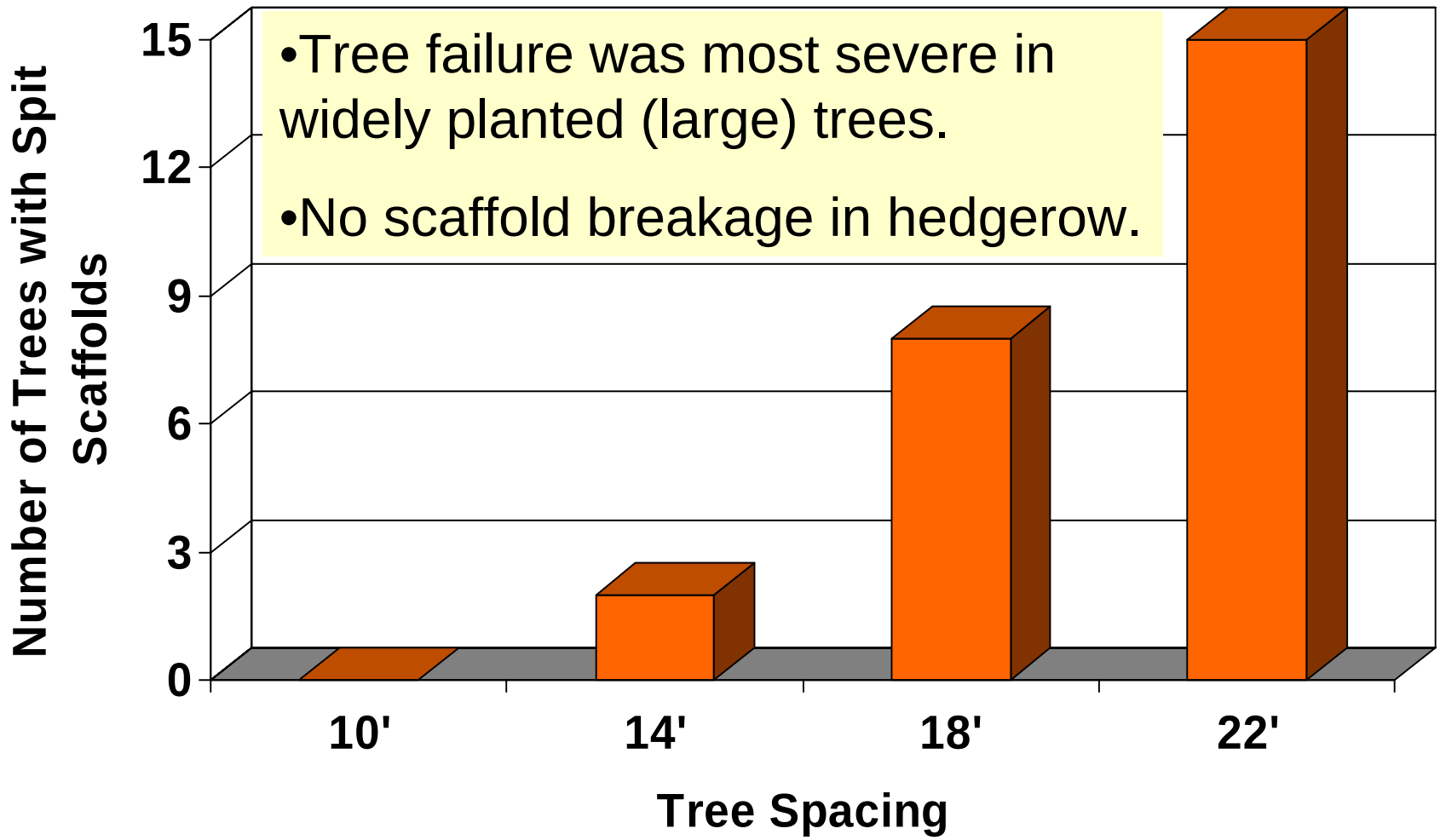
Spacing = 22’ x 22’

Trained, annually pruned

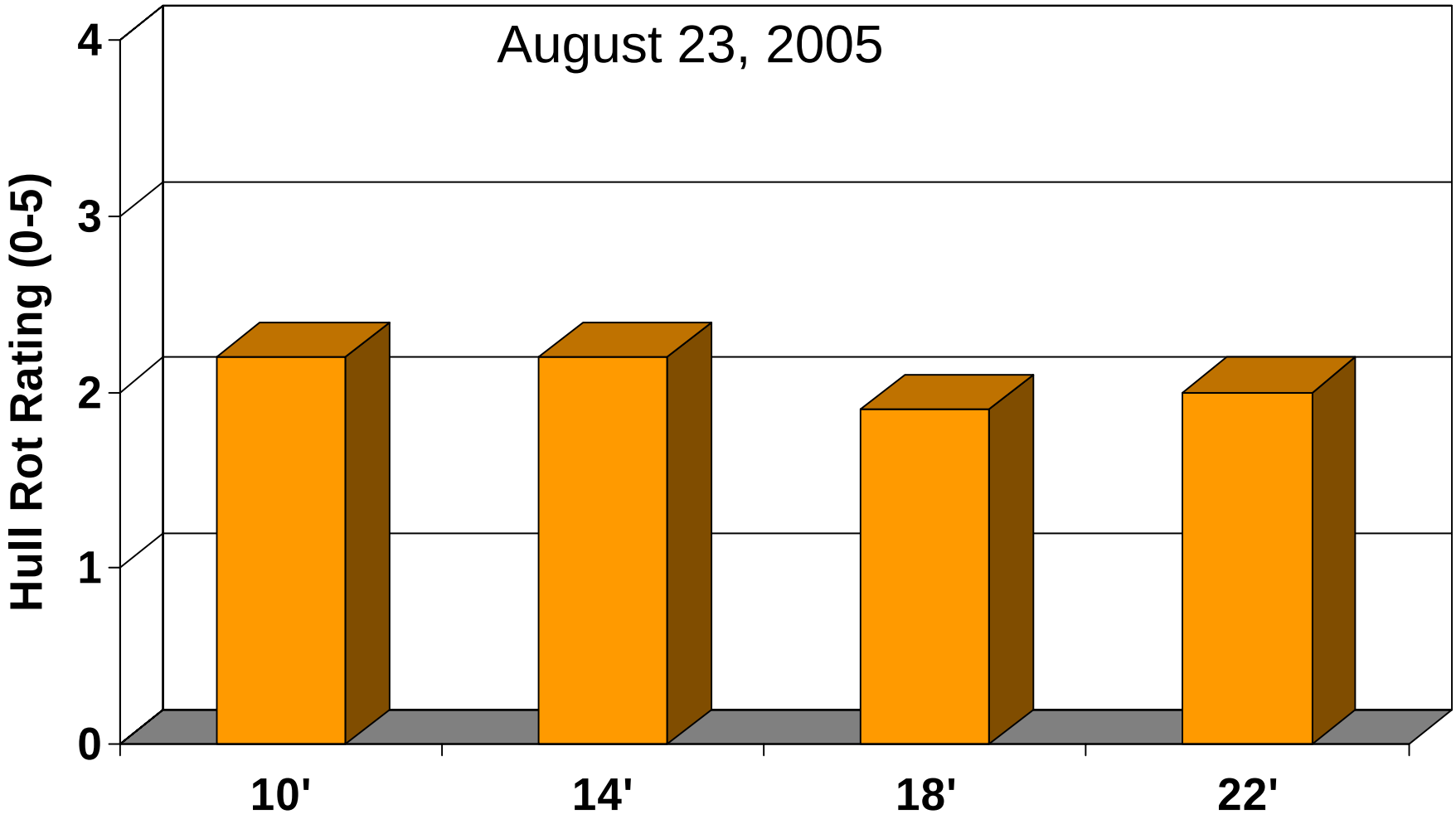
Untrained, unpruned

The Effect of Pruning on Scaffold Splitting 2005

The Effect of Tree Spacing on Scaffold Splitting of Almond Trees 2005

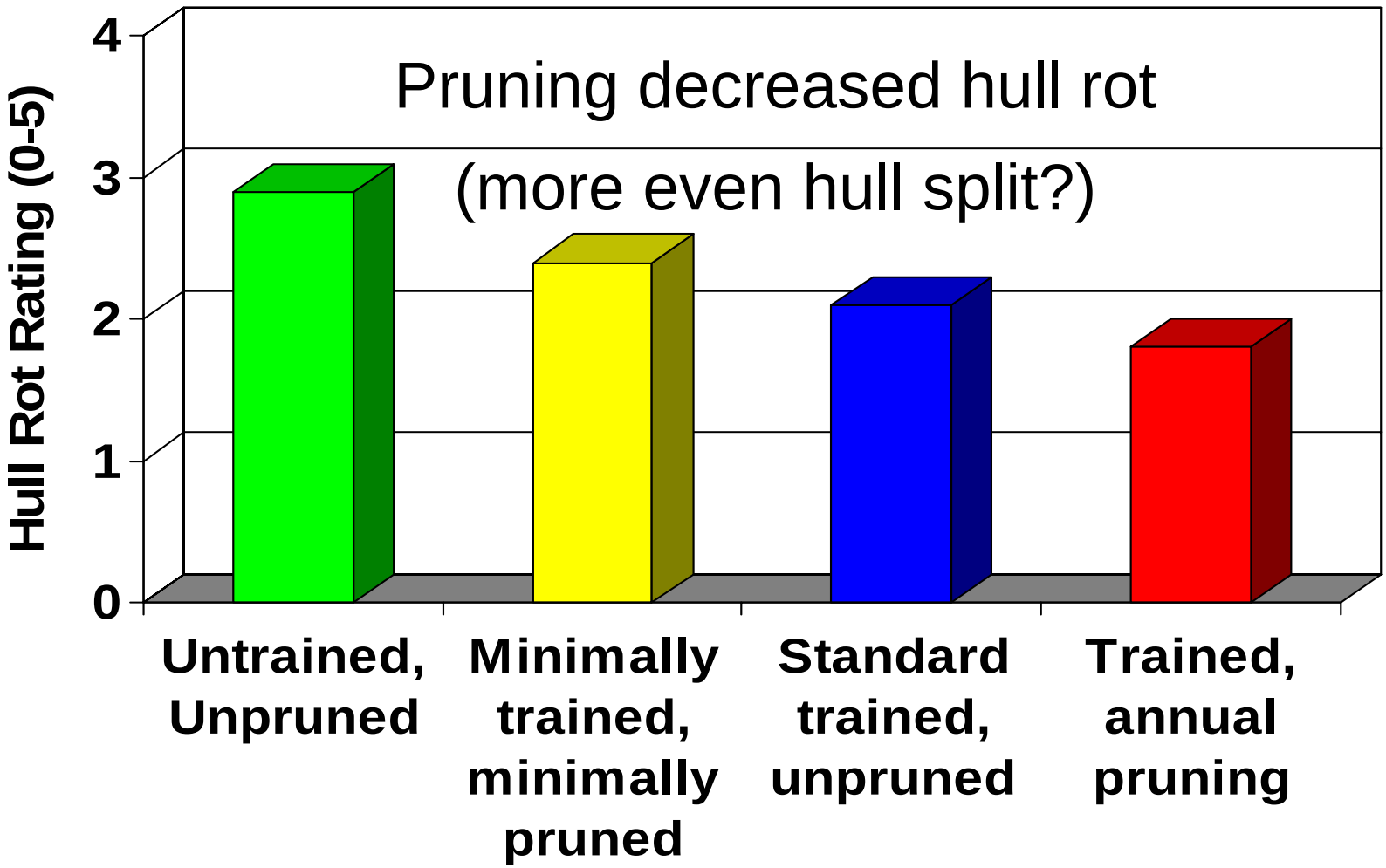


The Effect of Tree Spacing on Hull Rot of Nonpareil Almond

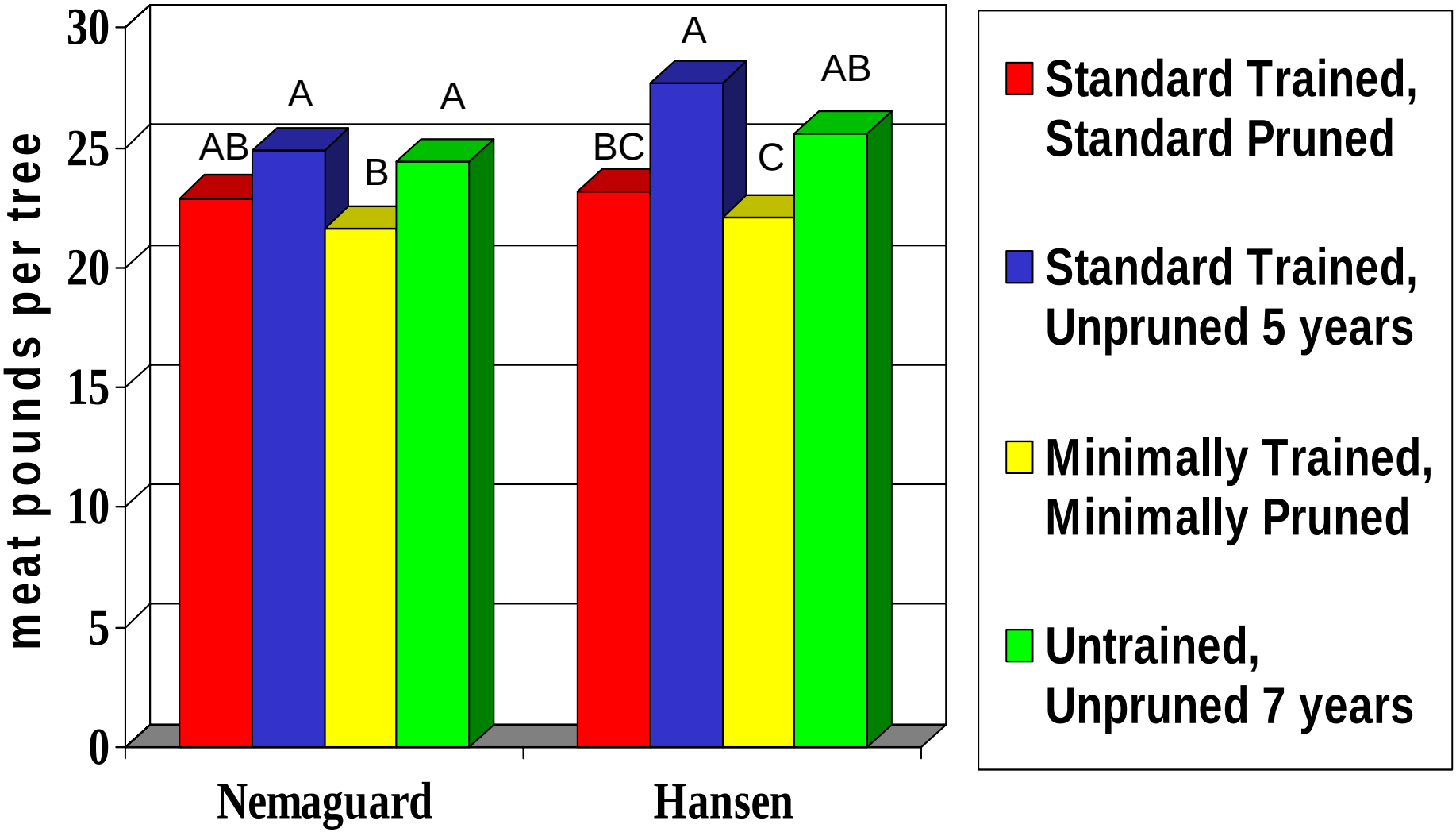


Planting density had a minimal effect on hull rot

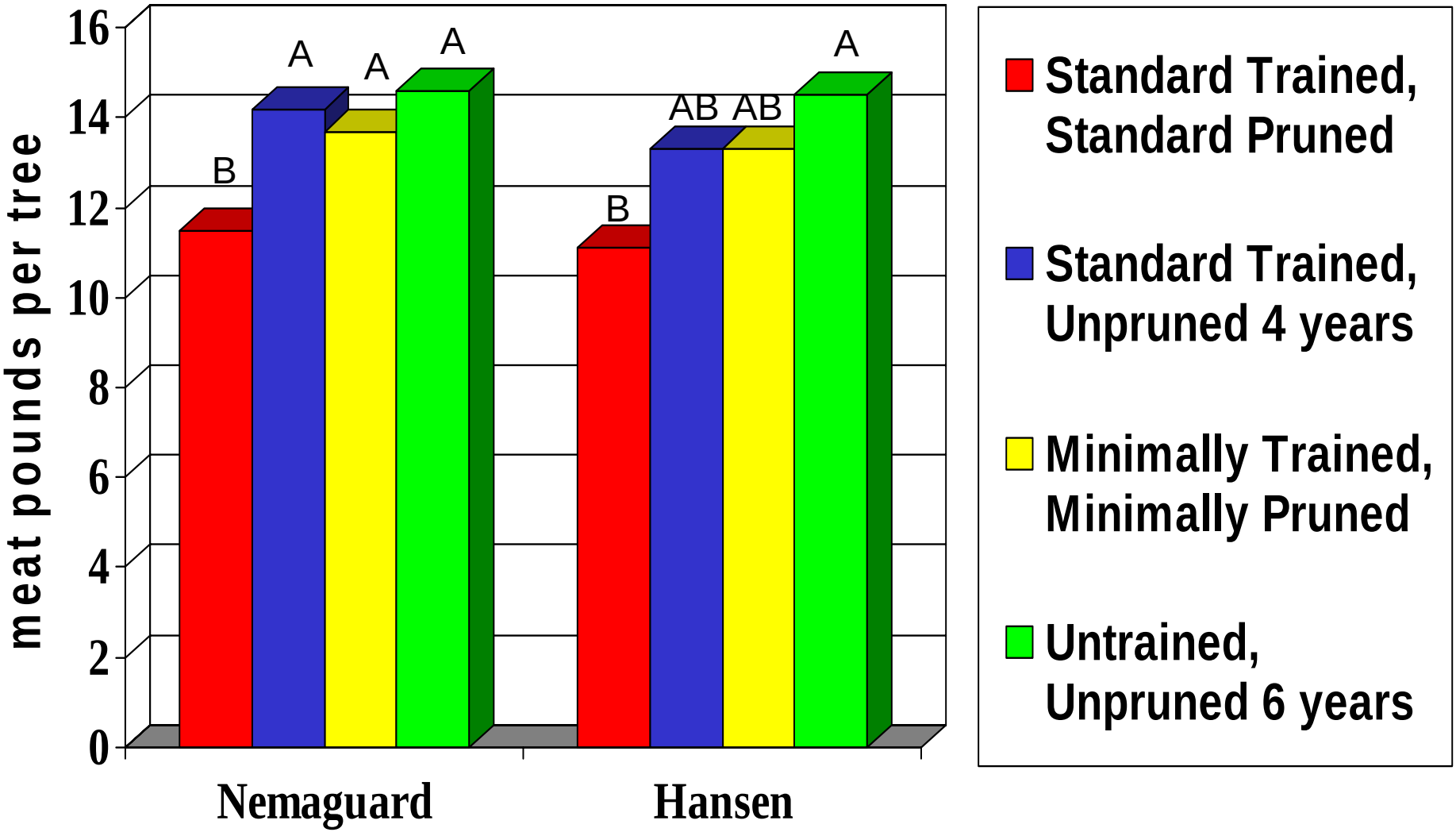
The Effect of Pruning on Hull Rot of Nonpareil Almond



The Influence of Training & Pruning on Yield of 7th-leaf Nonpareil Almond Trees. 2006



The Influence of Training & Pruning on Yield of 6th-leaf Carmel Almond Trees. 2006



We lost 63 trees due to wet 2006 spring, saturated soils.

Rootstock Tolerance to Saturated Soil Conditions. Spring 2006

	Dead	Severely Affected	Mildly Affected	Total
Nemaguard	6	3	14	***23***
Lovell	8	6	13	***27***
Hansen	5	16	21	***42***

Early Conclusions:

- High density planting may not lead to higher yields if trees are vigorous, even in the short term.
- Smaller varieties like Carmel may benefit more from higher density plantings.
- Closer spacing down the row may allow for narrower spacing between rows
- Scaffold selection is probably less critical in closely planted orchards.

Early Conclusions Cont.:

- Pruning has not increased yield through the 7th leaf. Conventional annual pruning has actually reduced yield in most years so far.
- Pruning may be more important for equipment access and tractor driver safety than for maintaining high yields.
- The effect of high density planting on disease is unclear so far.

Early Conclusions Cont.:

- Any yield advantage to pruning will be long term and must make up for short term losses (in yield and increased expenses).

- This trial must be monitored for many years to determine long-term effects on yield, disease, and overall profitability.

Thank you for your attention