



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

*Roger Duncan*

*UC Cooperative Extension, Stanislaus County*

*Nathaniel Battig, Stanislaus County*



**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 Various Pruning Strategies on Cumulative Nonpareil Yields

Spacing = 7' x 22'. John Edstrom, et. al., Nickels Soils Lab.

	Kernel pounds / acre through 16 <sup>th</sup> leaf
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



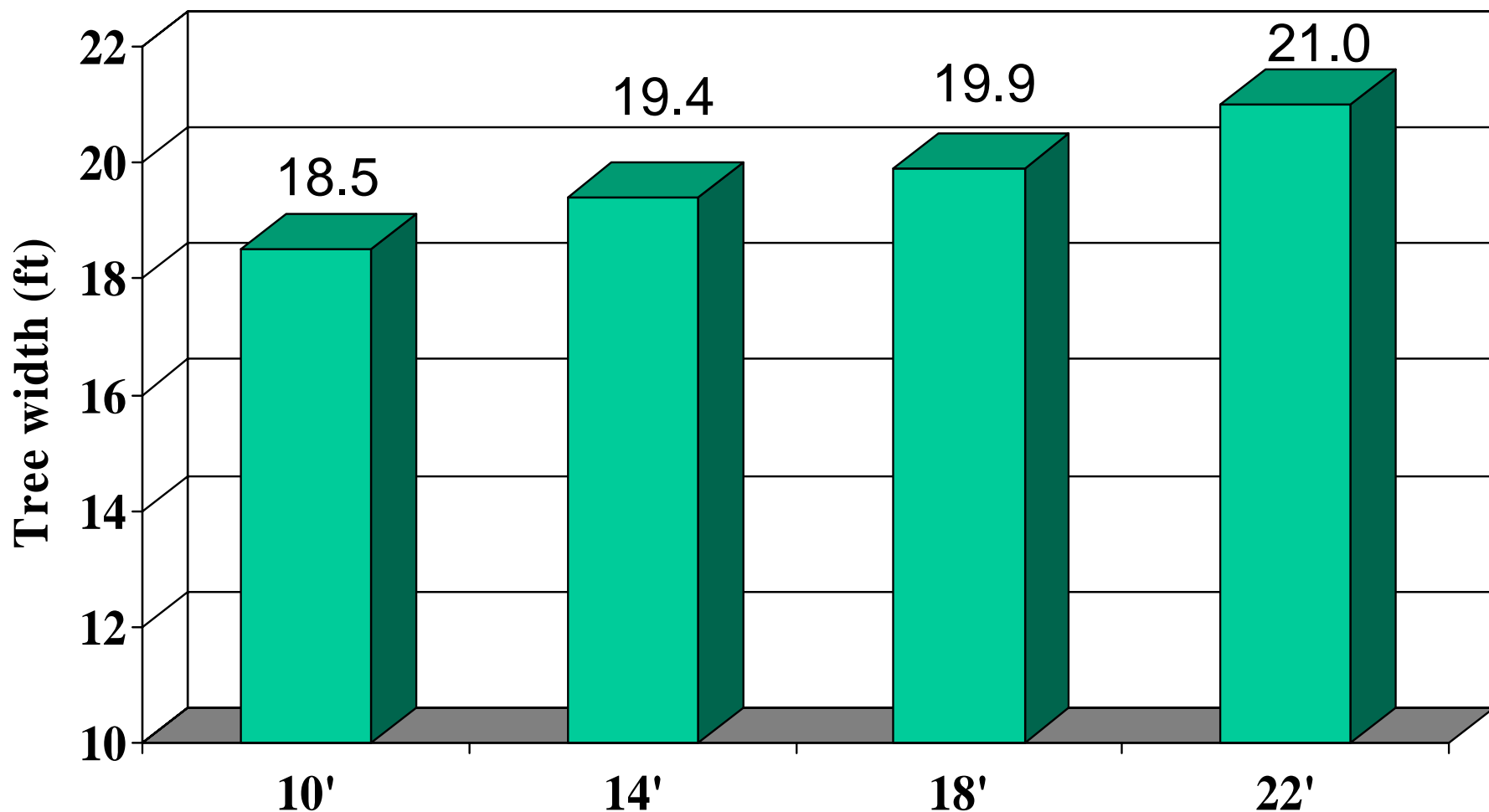
Untrained

# Tree Spacing:

Effect on tree size,  
architecture, yield, etc.

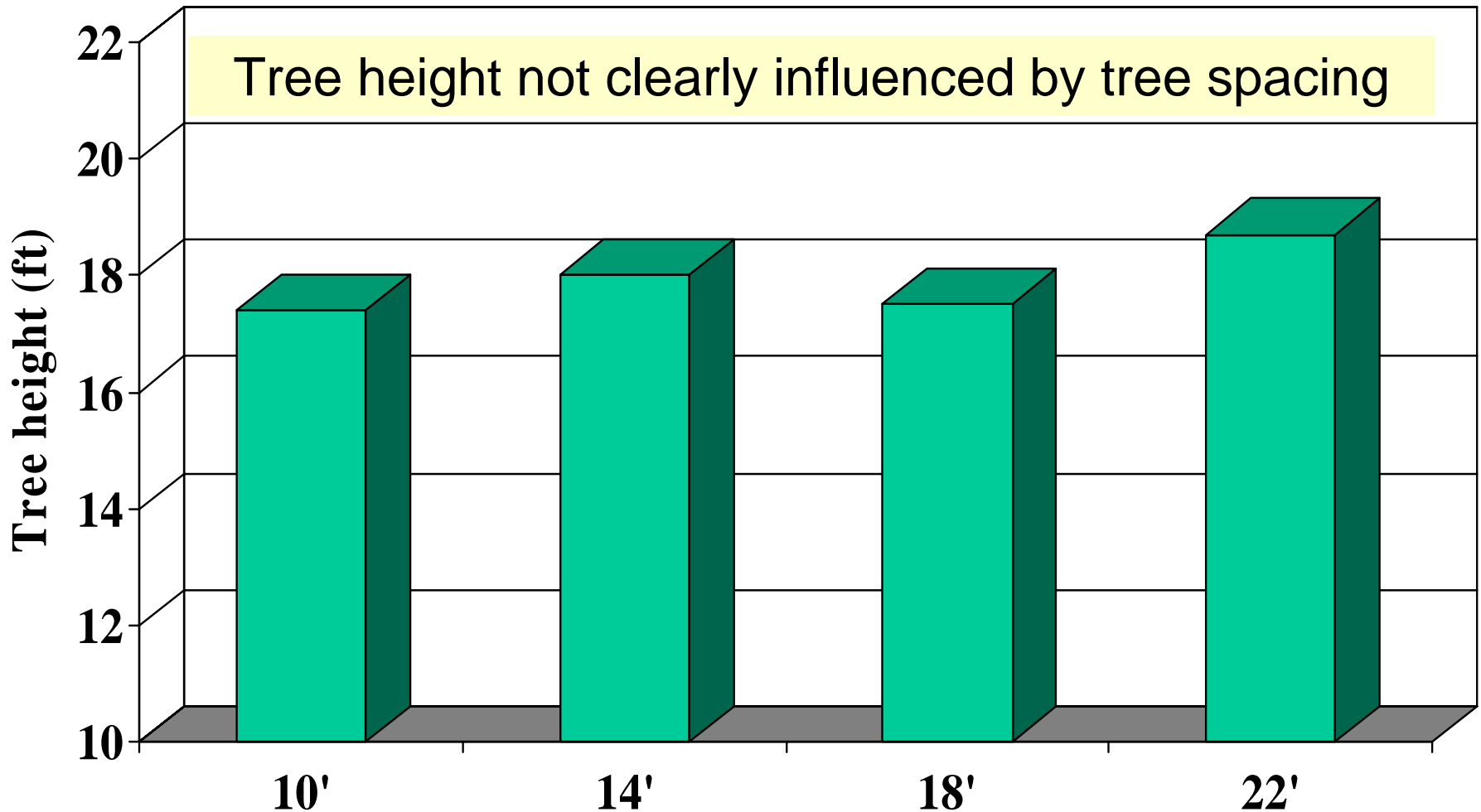
# The Influence of Tree Spacing on Canopy Width (into the drive row)

6<sup>th</sup>-leaf Nonpareil (June 2005)

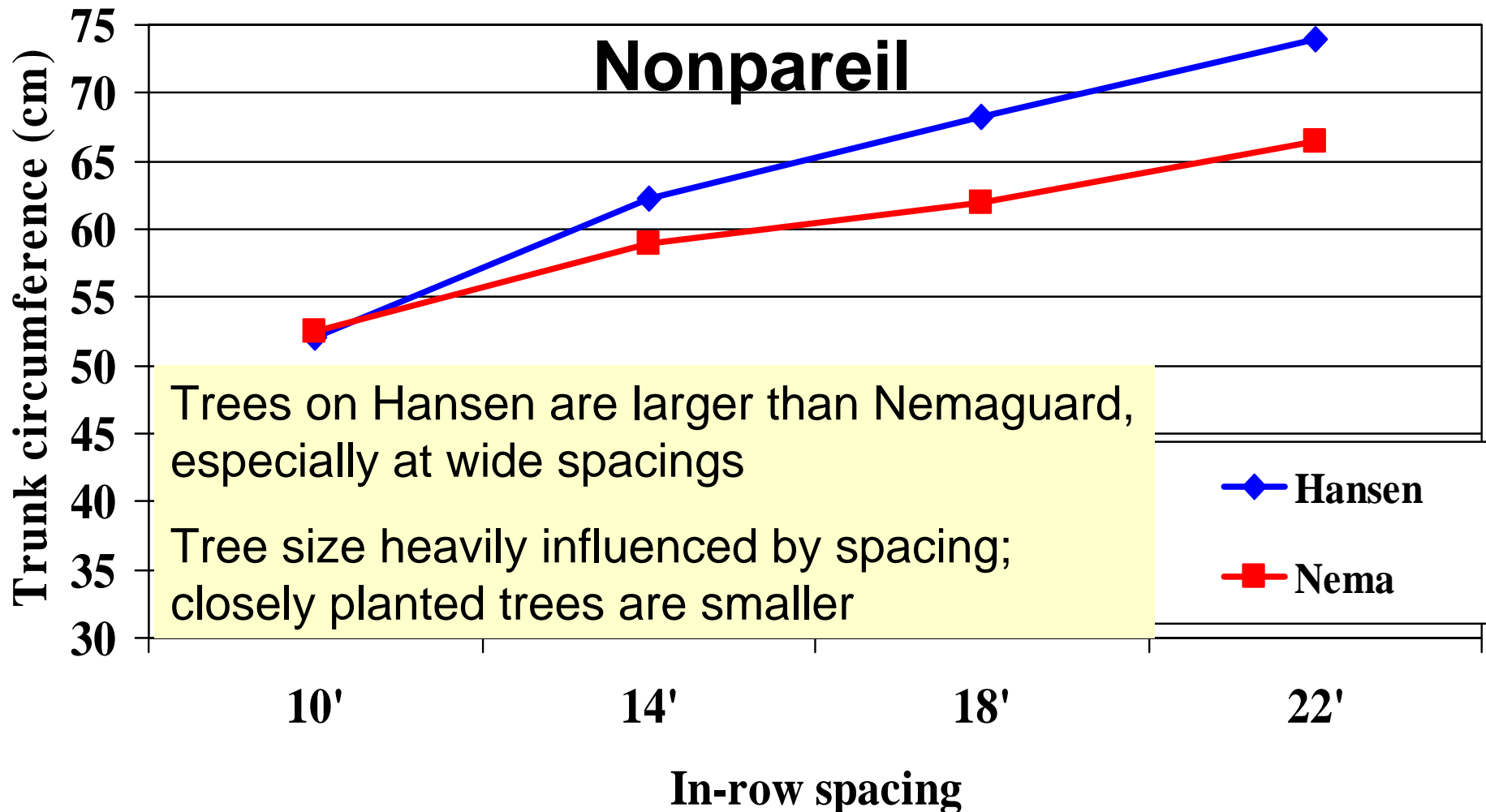


# The Influence of Tree Spacing on Tree Height

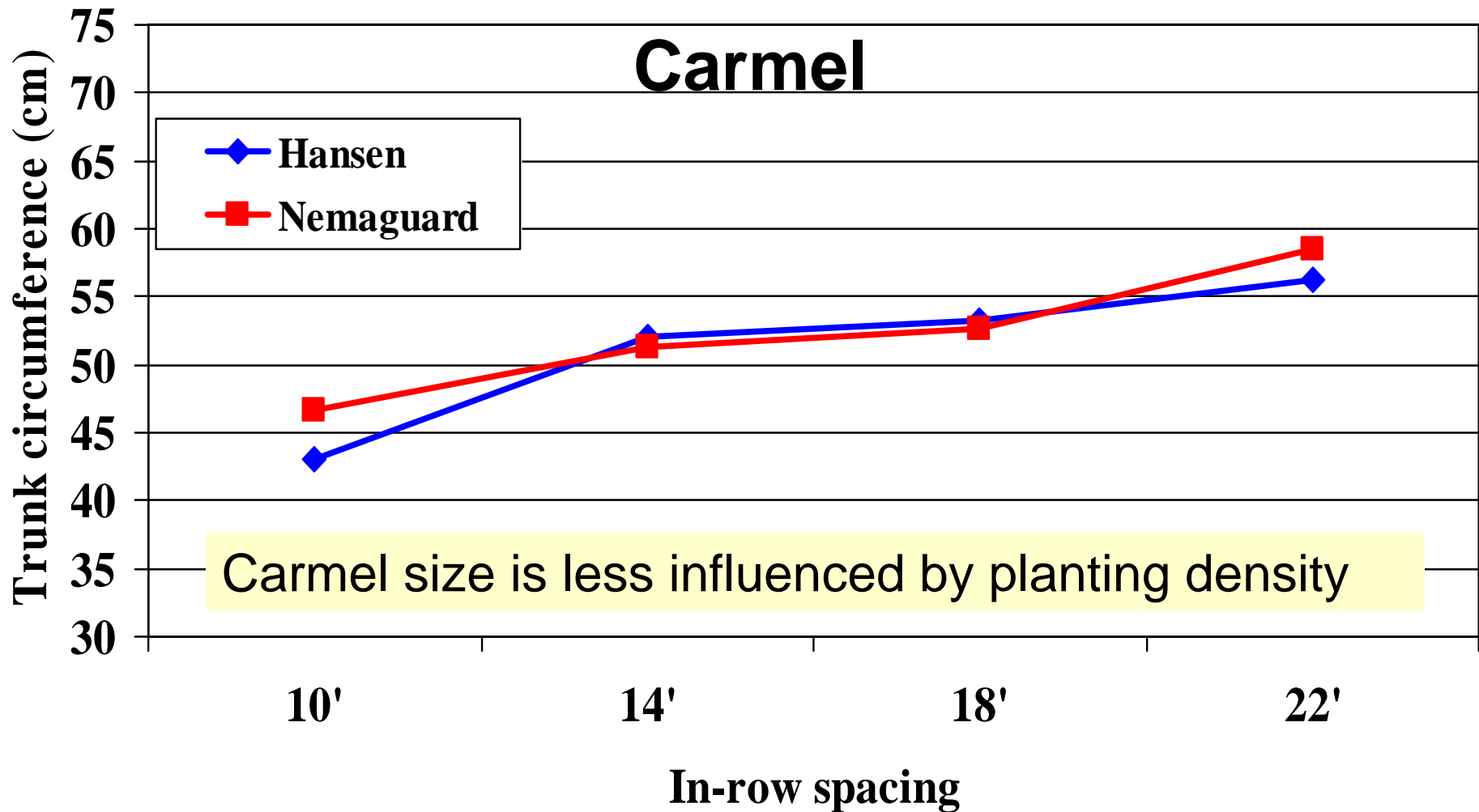
6<sup>th</sup>-leaf Nonpareil (June 2005)



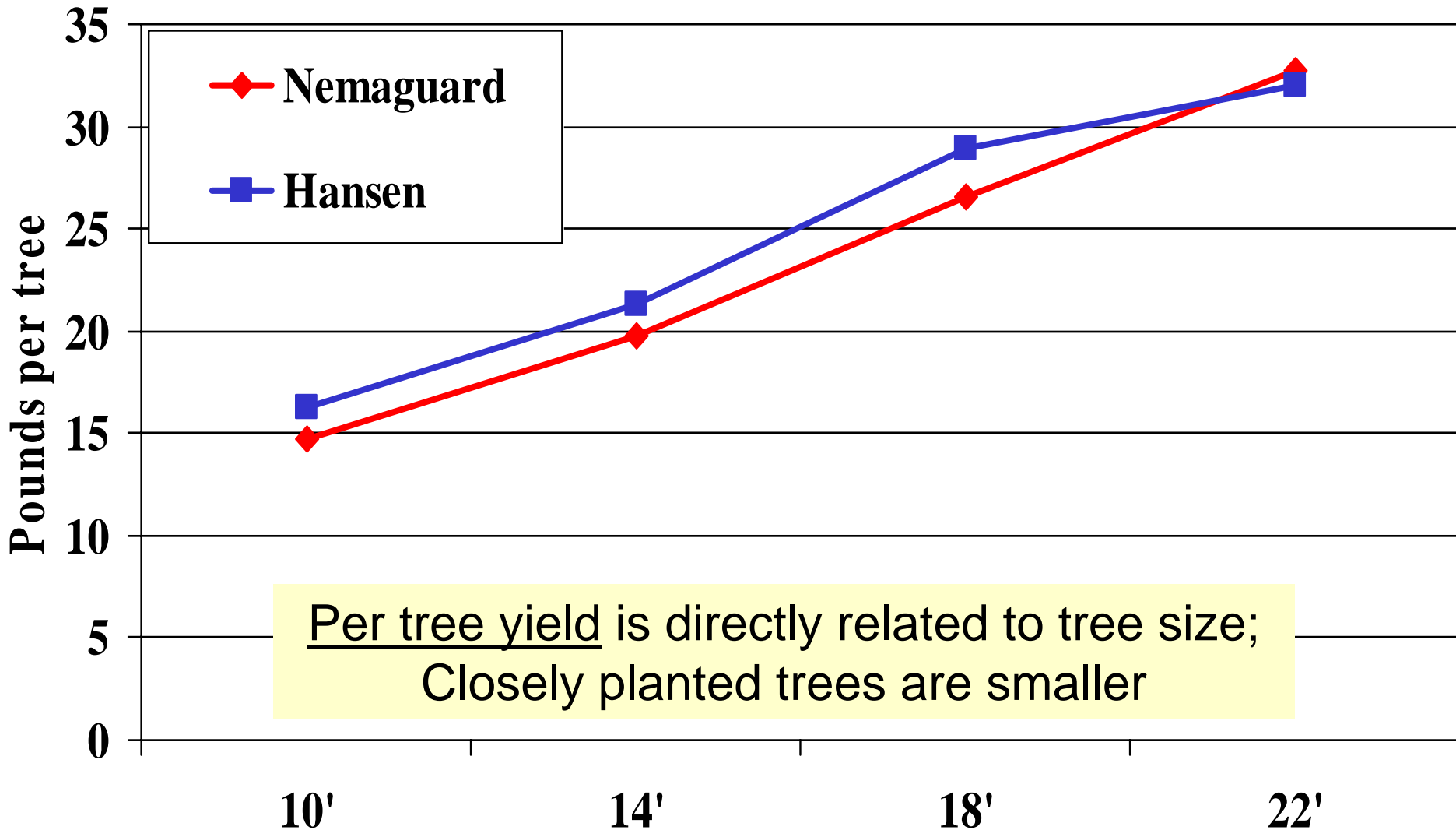
# Effect of Tree Spacing & Rootstock on Trunk Circumference. Feb. 2006



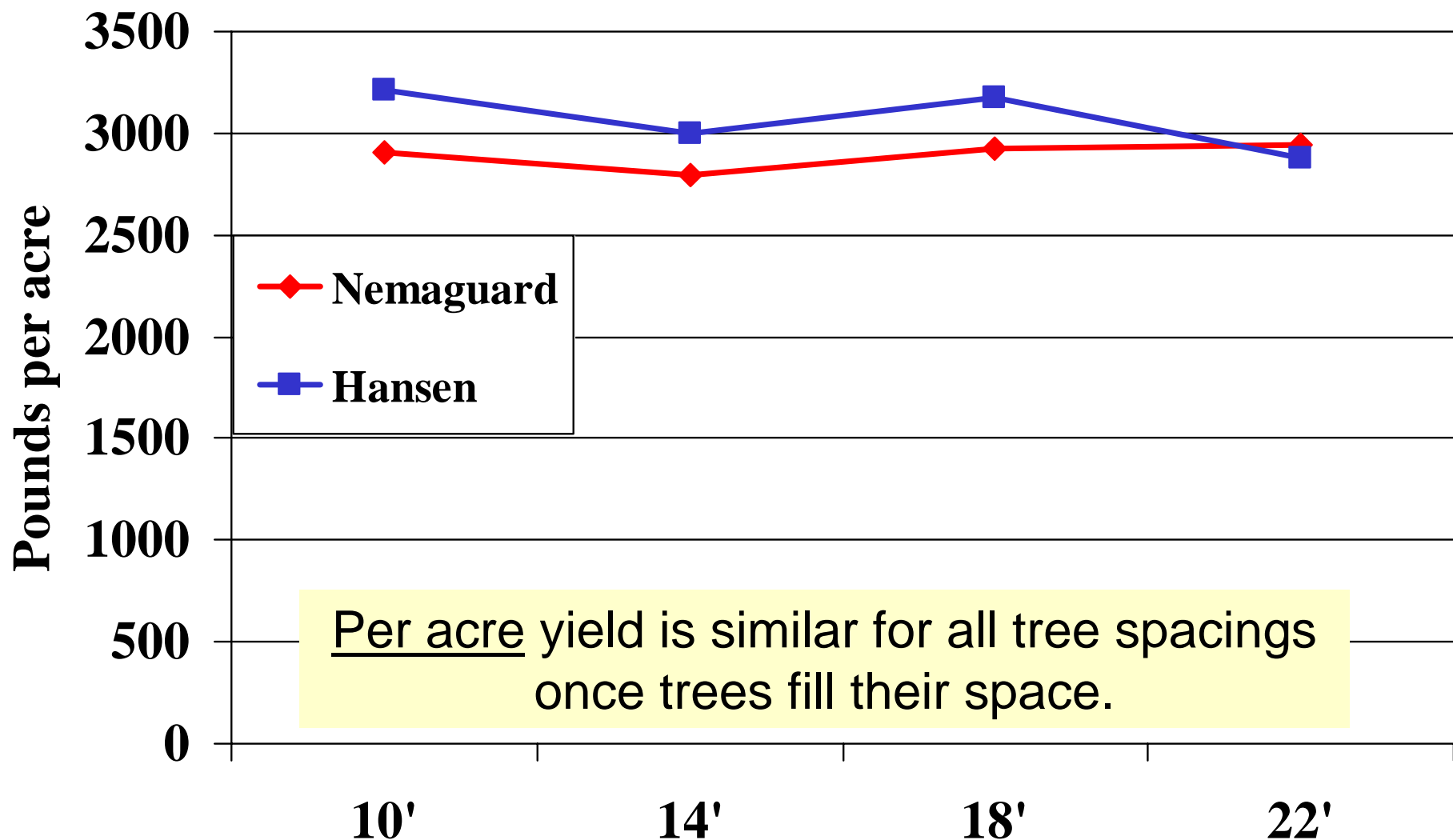
# Effect of Tree Spacing & Rootstock on Trunk Circumference. Feb. 2006



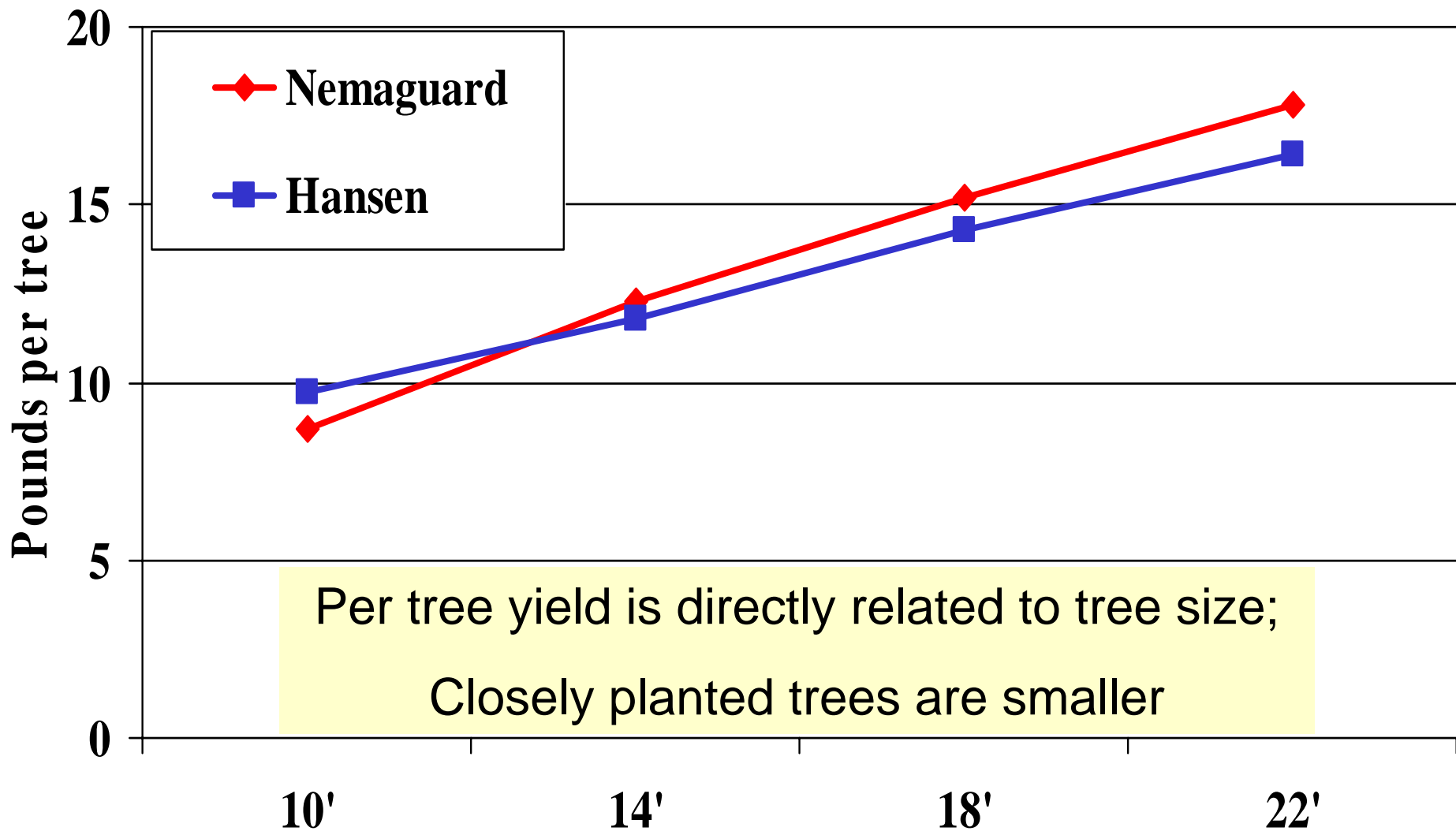
# Effect of Tree Spacing & Rootstock on per Tree Yield of Seventh-leaf Nonpareil. 2006



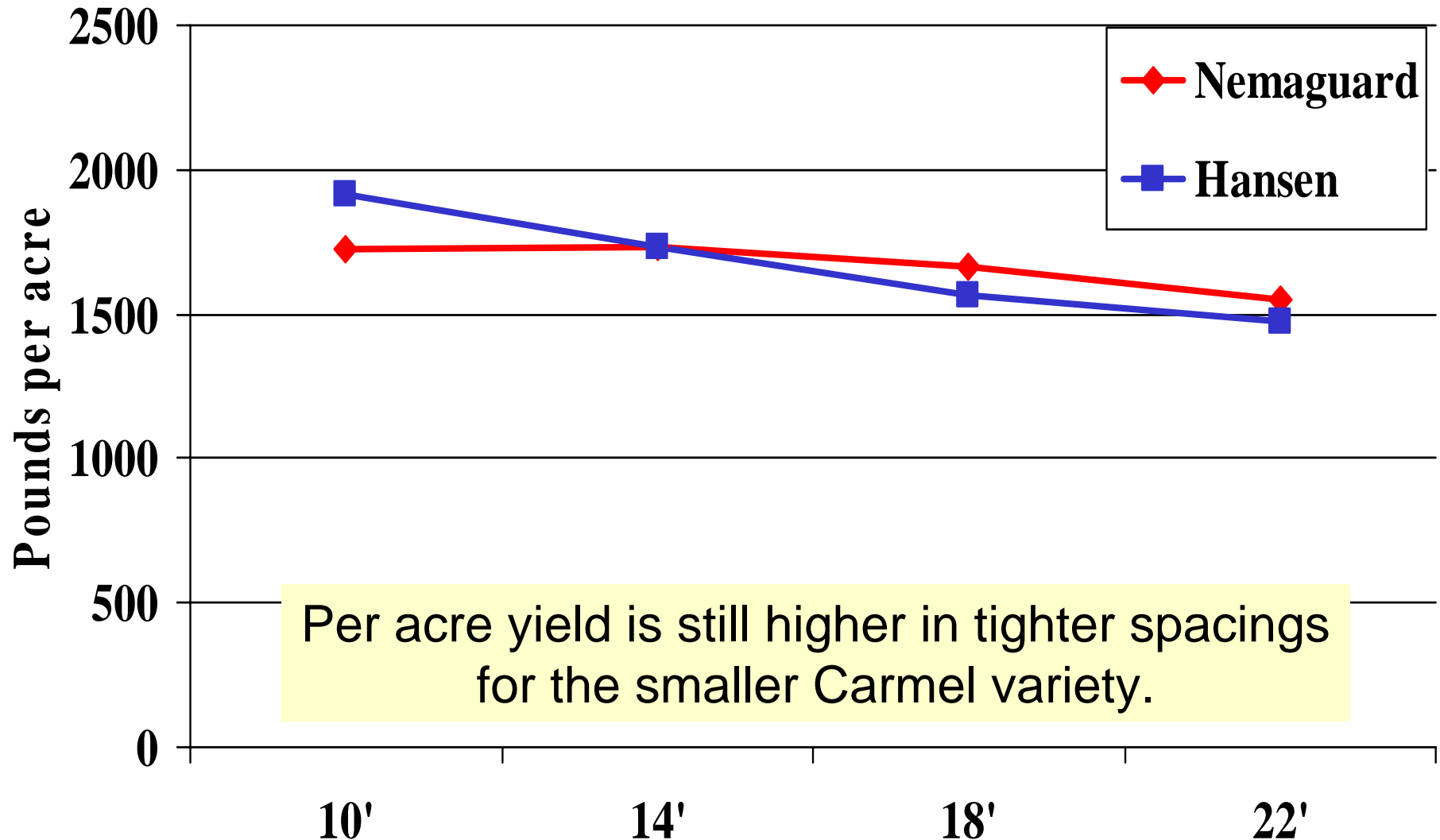
# Effect of Tree Spacing & Rootstock on per Acre Yield of Seventh-leaf Nonpareil. 2006



# 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



# Tree training & pruning:

Effect on structural  
failure, disease, yield,  
etc.

# First “dormant” pruning February 2001



Trained to 3  
scaffolds



Minimally  
trained

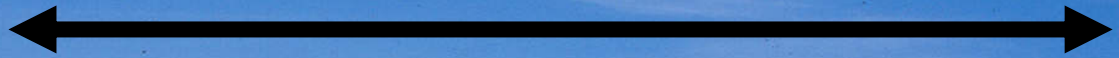
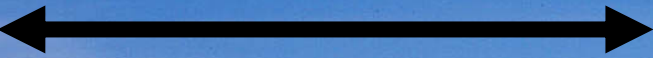


Untrained

2nd-leaf. May, 2001

Standard trained  
& pruned

Untrained &  
unpruned



10' x 22'

# 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



14' x 22'



**Standard Trained, Annually Pruned Nonpareil. 7<sup>th</sup> Leaf**



**Standard Trained, Unpruned five years**

# Untrained / unpruned Nonpareil. 7<sup>th</sup> Leaf.





Difference in shaded  
ground area

Spacing = 22' x 22'

↑ Trained,  
annually pruned

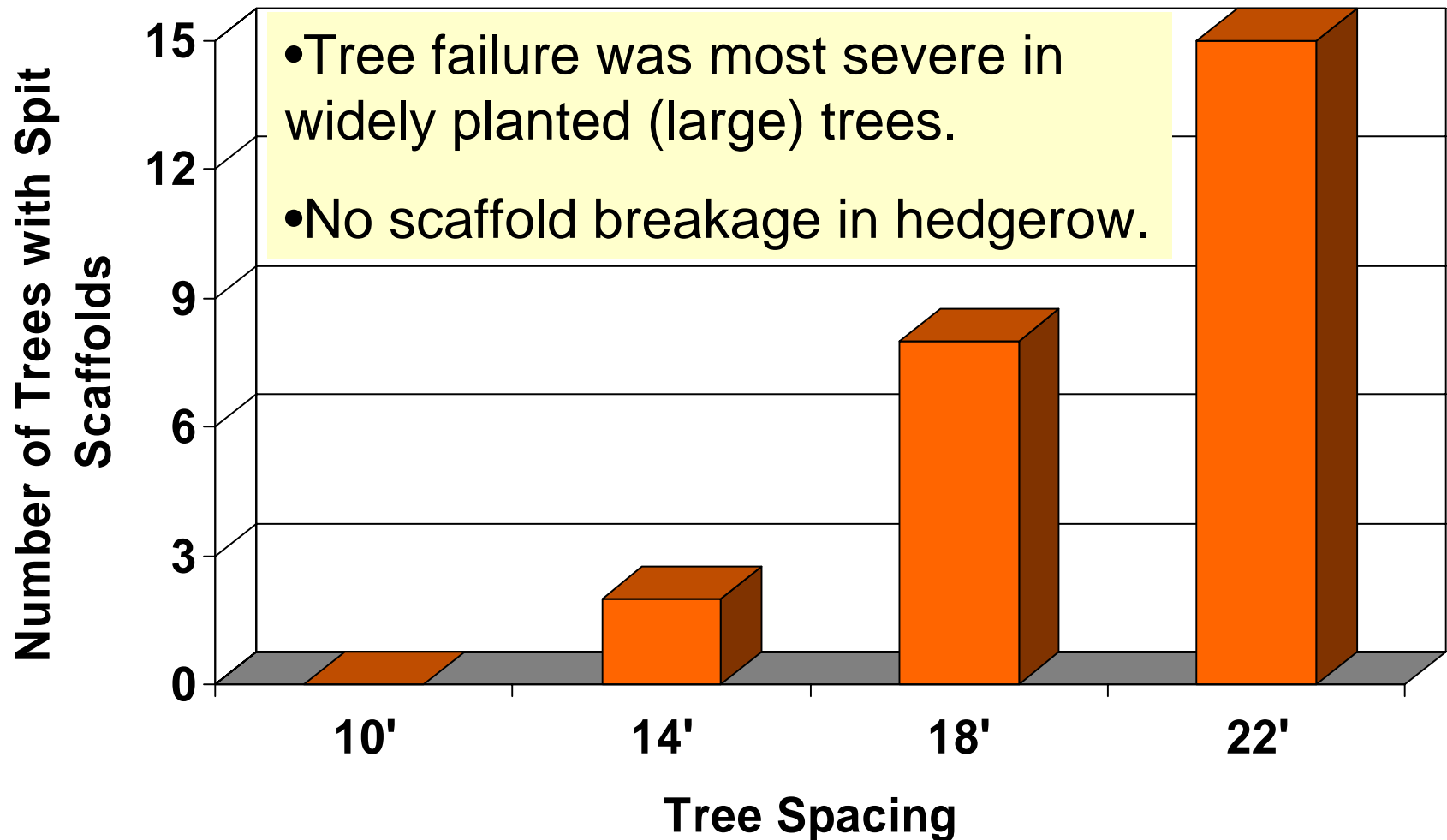
→ Untrained,  
unpruned



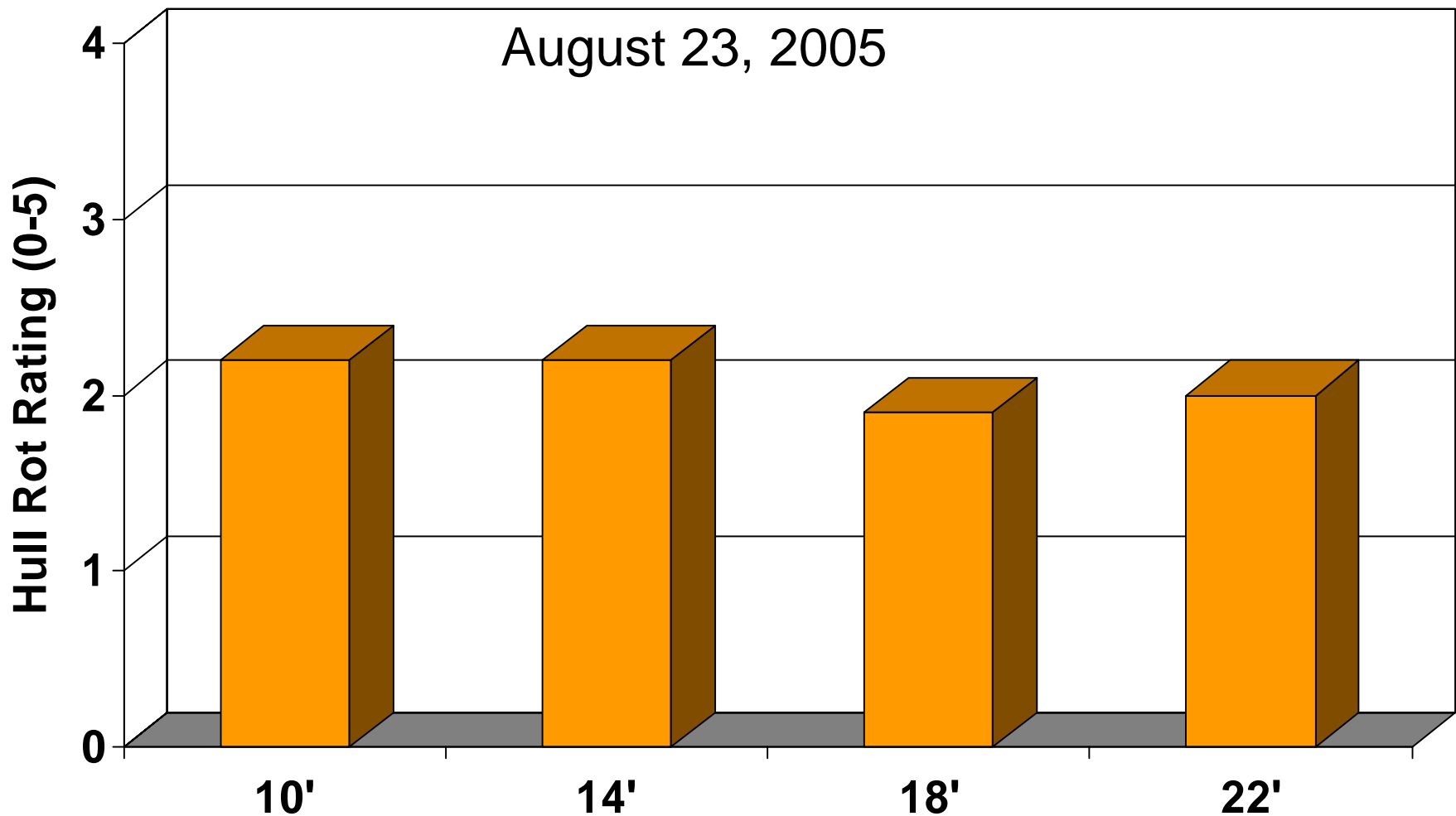
# The Effect of Pruning on Scaffold Splitting 2005



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



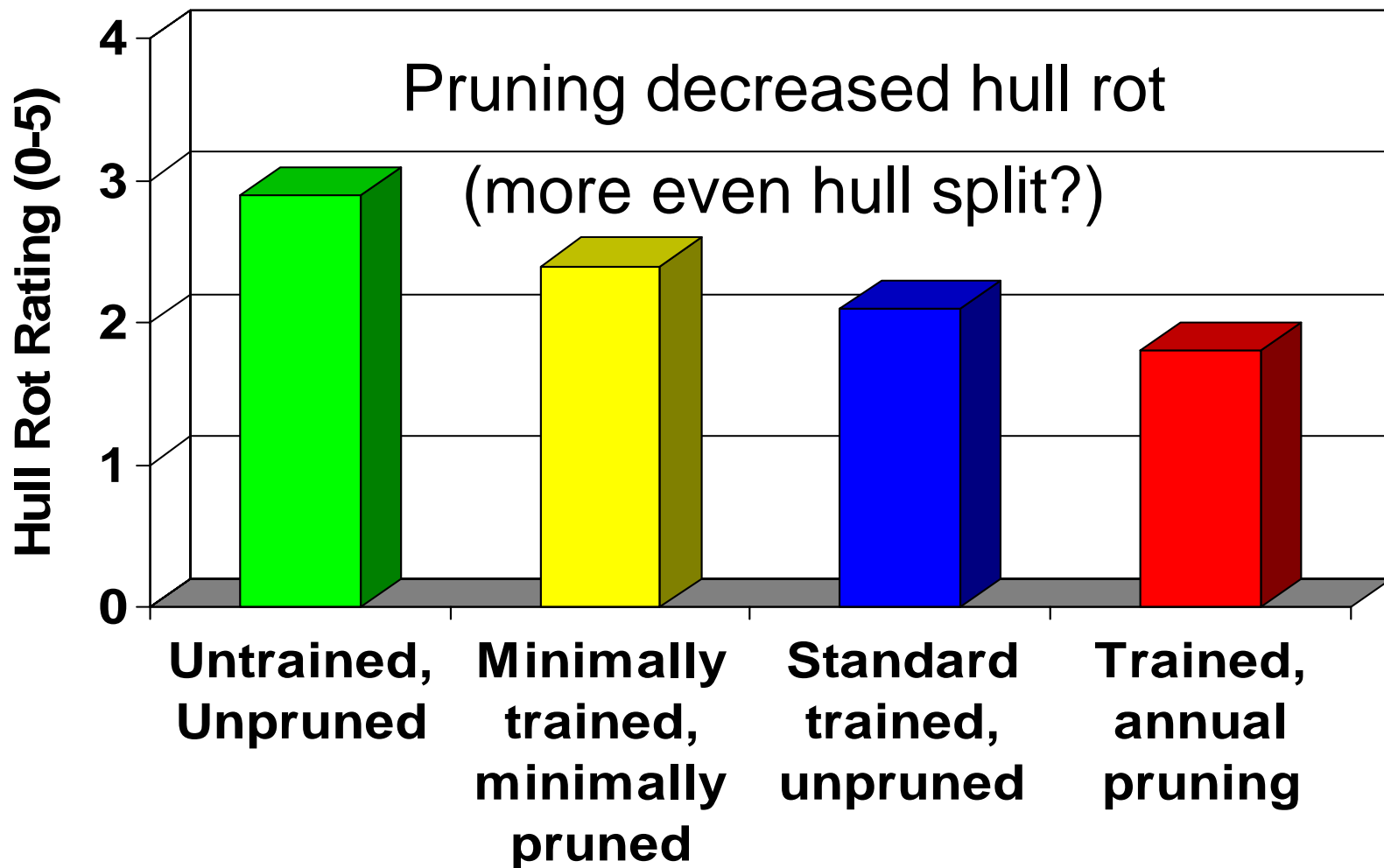
# The Effect of Tree Spacing on Hull Rot of Nonpareil Almond



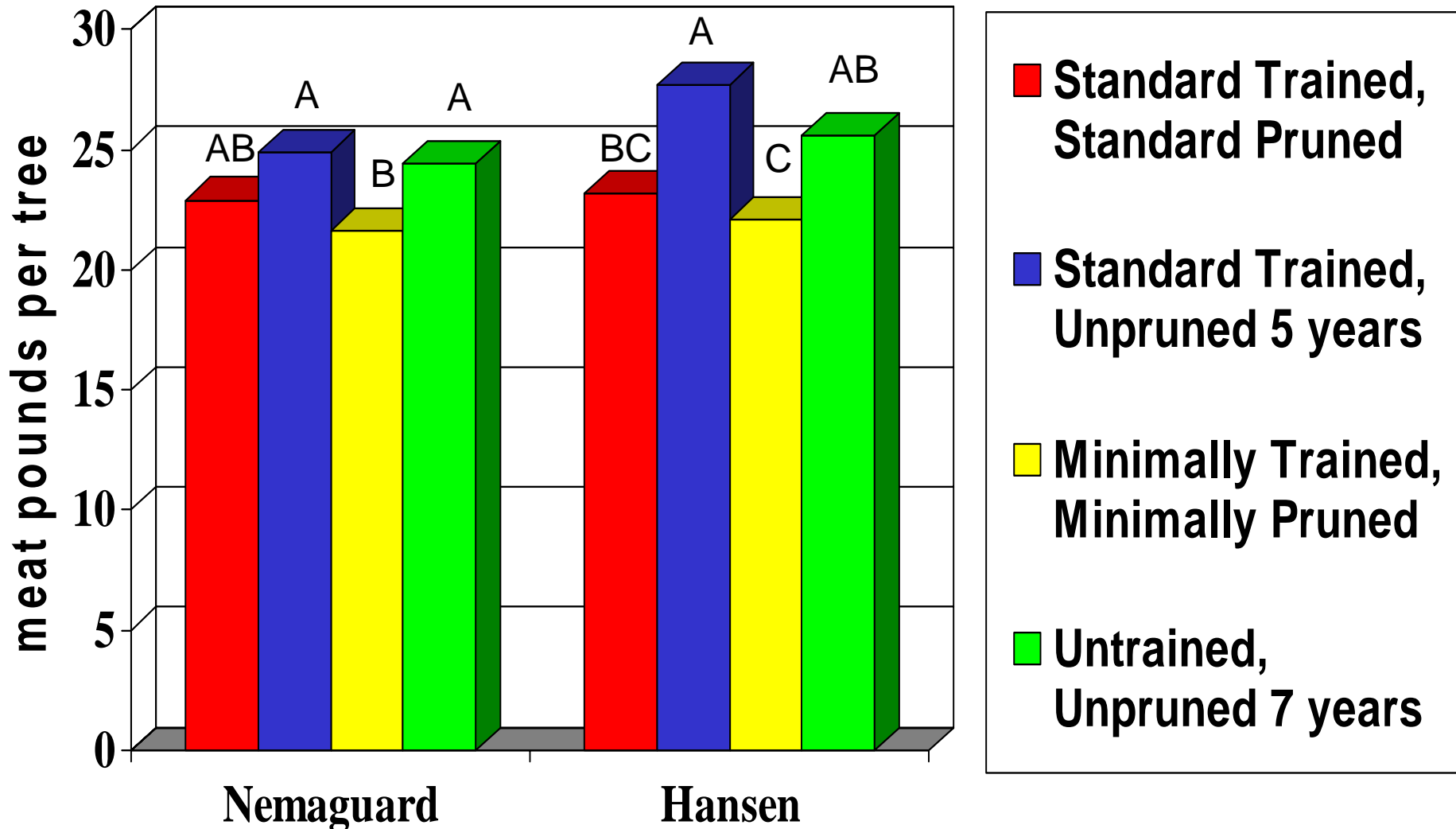
# Planting density had a minimal effect on hull rot



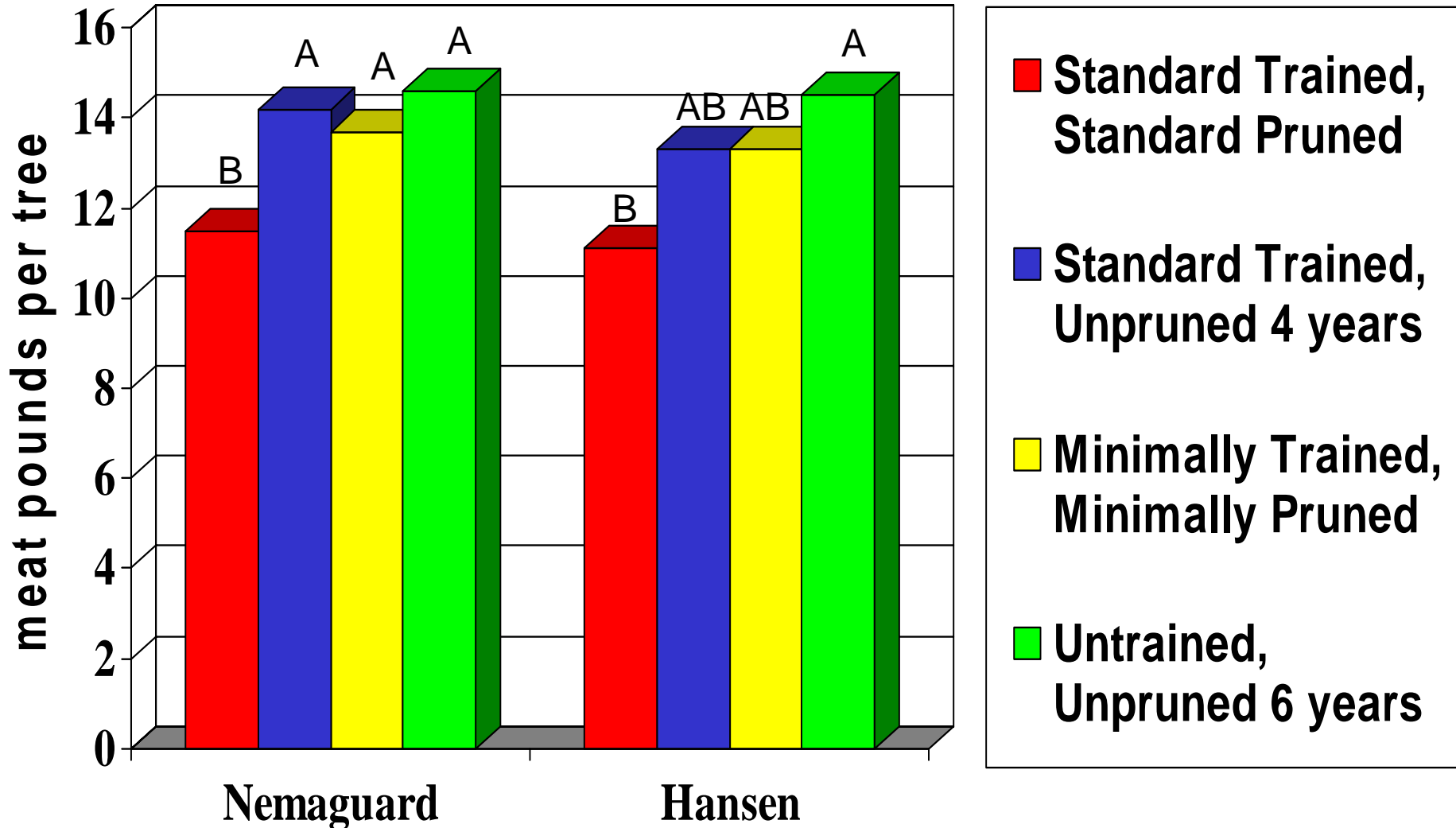
# The Effect of Pruning on Hull Rot of Nonpareil Almond



# 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	<u>23</u>
Lovell	8	6	13	<u>27</u>
Hansen	5	16	21	<u>42</u>

# Early Conclusions:

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- 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.:

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- Pruning has not increased yield through the 7<sup>th</sup> 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.:

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- 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