

The Tall Spindle: The System for NY



**Steve Hoying, Terence Robinson, Alison DeMaree, Mike Fargione and Kevin
Iungerman**

Dept. of Horticultural Sciences, Cornell University

Cornell, NY 14853

There has been a steady evolution in planting systems



40 trees/acre



1960's



200 trees/acre



1980's



Overgrown tops and shade

600 trees/
acre

Pedestrian
Orchards



There has been a steady evolution in planting systems

Pedestrian Orchards-1980's
M.9



Moderate yields and moderate light interception

High yields
and high light
interception



Triple Row Slender Spindle/



Higher yields but poor fruit quality in
the center row and poor weed control

Geneva Y-trellis/M.26

Late 1980's and early 1990's- Tall Orchards (again)



USA-Vertical Axis - 500 trees/acre

Mid 1990's - Super High Density (2,200 tree/acre)



Super Spindle/M.9



V- Super Spindle/M.9



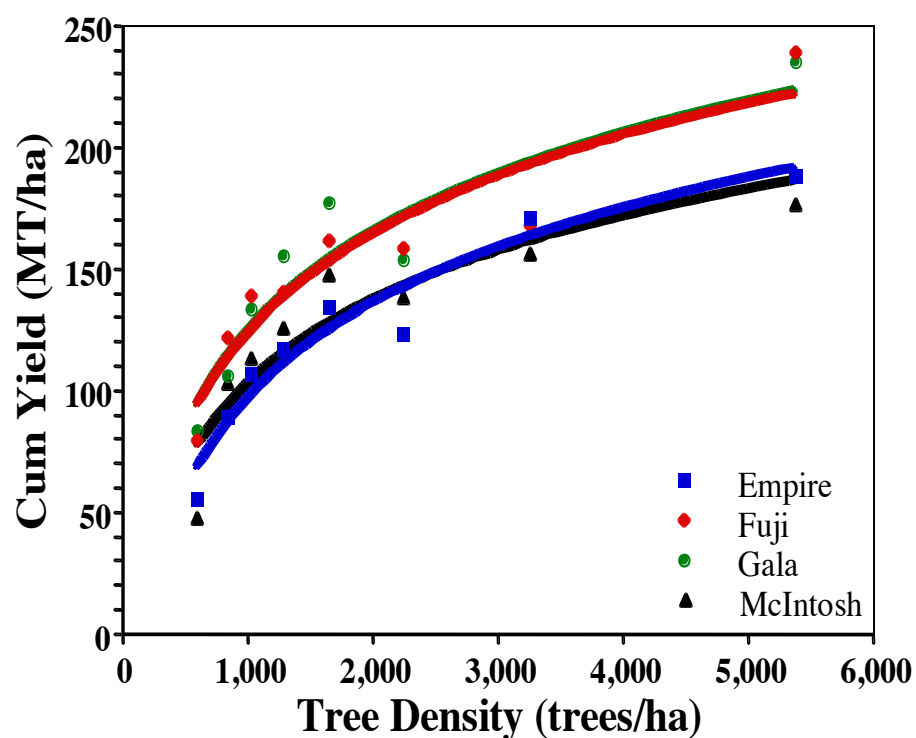
In search of more competitive orchard systems in NY:

We summarized our data over 20 years of orchard trials into 5 systems of merit and evaluated their economic potential

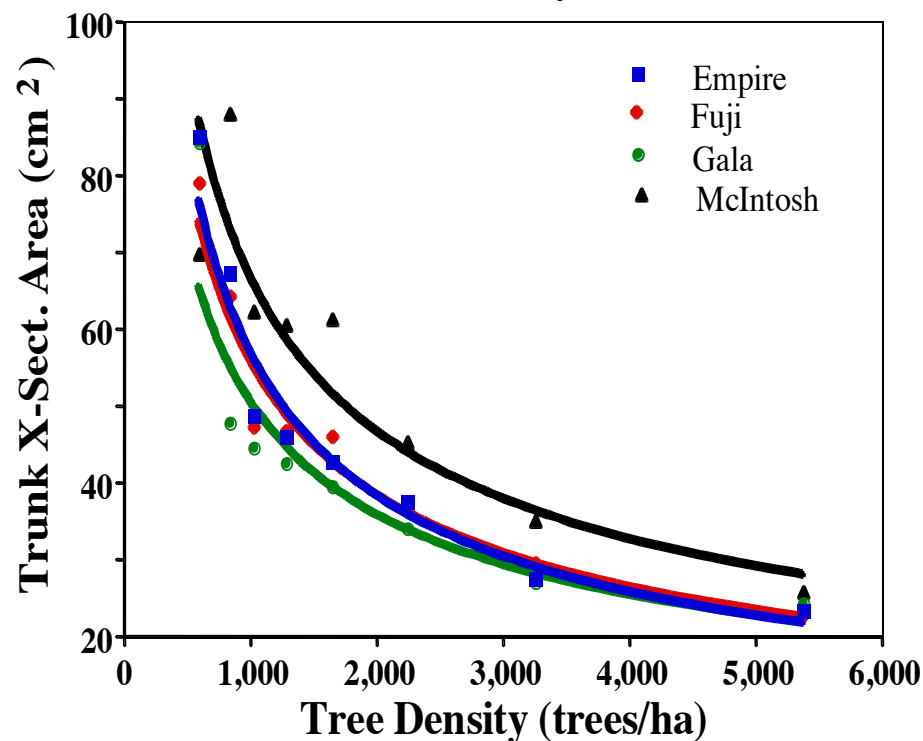
System	Tree Density (trees/acre)	Spacing		Rootstocks
		(m)	(ft)	
Slender Pyramid	340	2.4 x 4.9	8'x16'	M.26
Vertical Axis	518	1.5 x 4.25	6'x14'	M.9
Slender Vertical Axis	908	1.2 x 3.6	4'x12'	M.9
Tall Spindle	1320	0.9 x 3.3	3'x11'	M.9
Super Spindle	2178	0.6 x 3.0	2'x10'	M.9

Horticultural Results

Effect of Tree Density on 7 Yr. Cumulative Yield



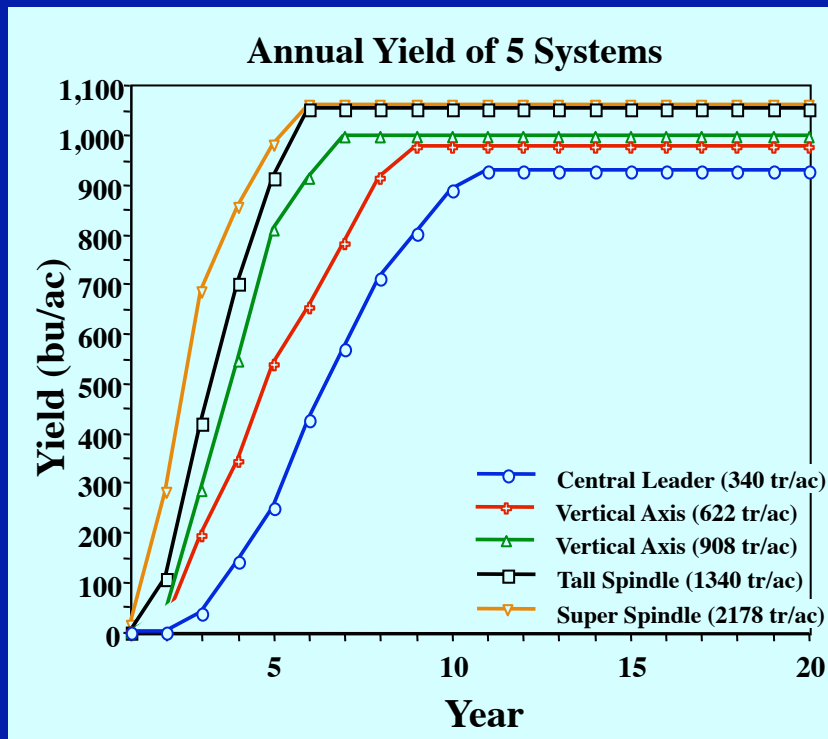
Effect of Tree Density on Tree Size



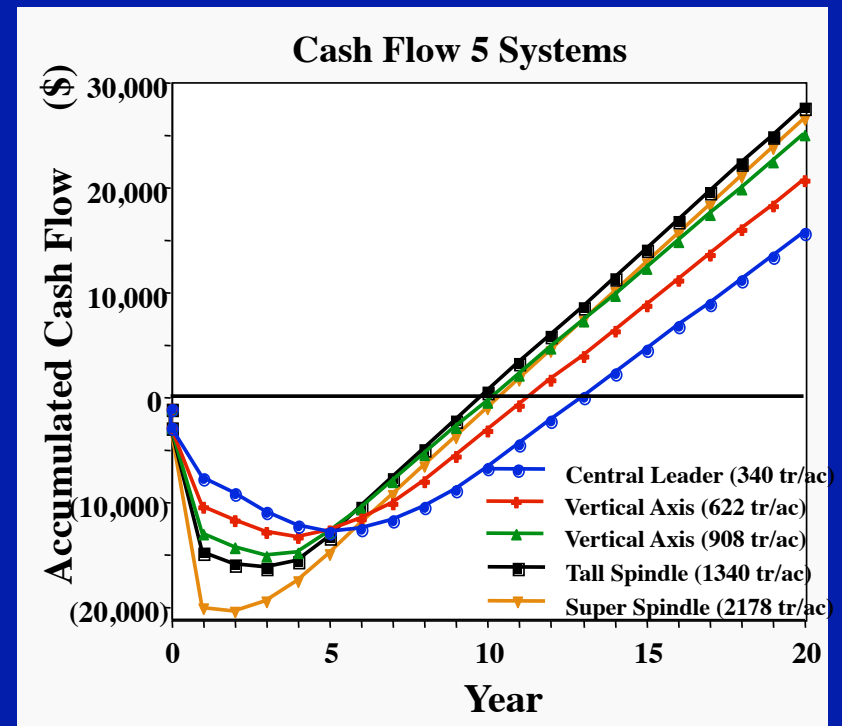
- Tree density had a highly significant positive effect on yield. The cumulative yield of the highest tree density was 3X greater than the lowest density.
- Tree density had a highly significant effect on final trunk cross-sectional area. The highest planting density produced trees about 1/3 the size of the lowest planting density.

Economic Study used average yields and estimated cash flows over 20 years

Yield Curves for 5 systems

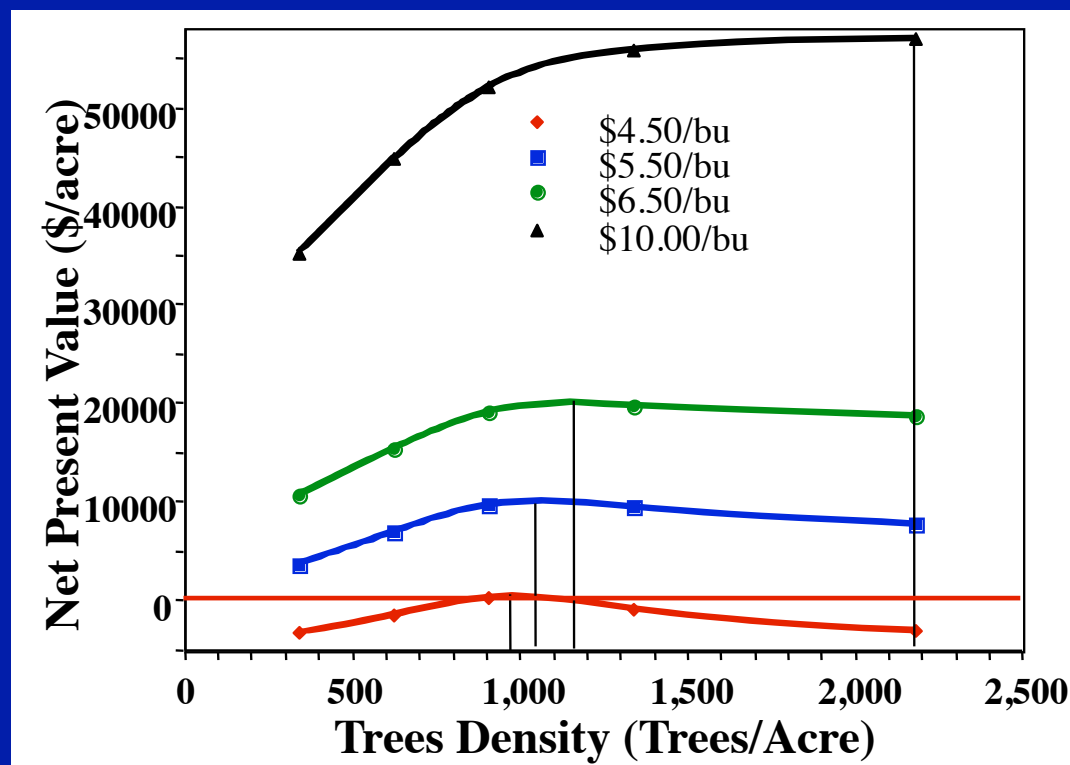


20 Year Cash Flows



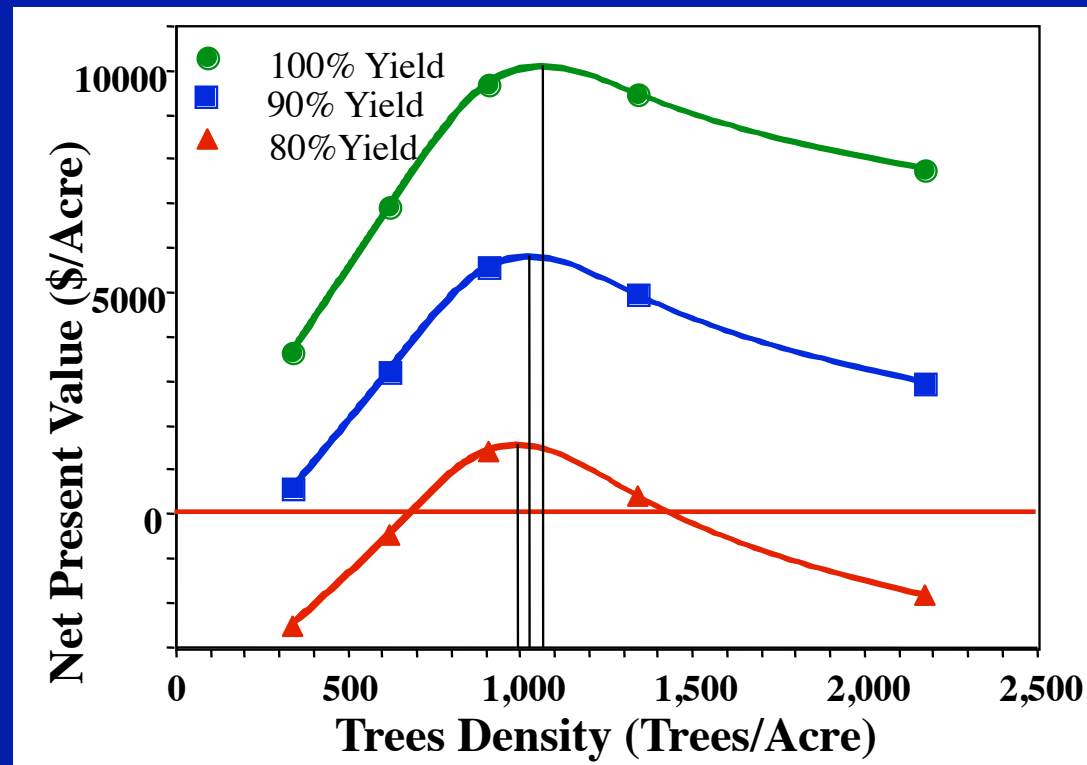
Effect of Fruit Price (Variety)

- Fruit price had the greatest effect on profitability.
- If fruit prices were low (\$4.50/bu) then all systems were not profitable except the Slender Vertical Axis.
- If fruit prices were very high (\$10.00/bu) such as with a new club variety then profitability was greatest at the highest tree density (2178 trees/acre- Super Spindle).
- At very high fruit prices profitability was extremely high for all systems.



The Necessity of Being an Efficient Producer

- Fruit yield had a large effect on profitability. If yields were reduced by 10% then the low density Slender Pyramid system was barely profitable. If yields were reduced 20% then only the Slender Vertical Axis system was profitable.
- Reducing yield level reduced the optimum density slightly from 1,100 to 1,000 trees/acre.



Our Results indicate NY growers should increase tree density from the current 500-600 trees/acre to 1,000-1,200 trees/acre.

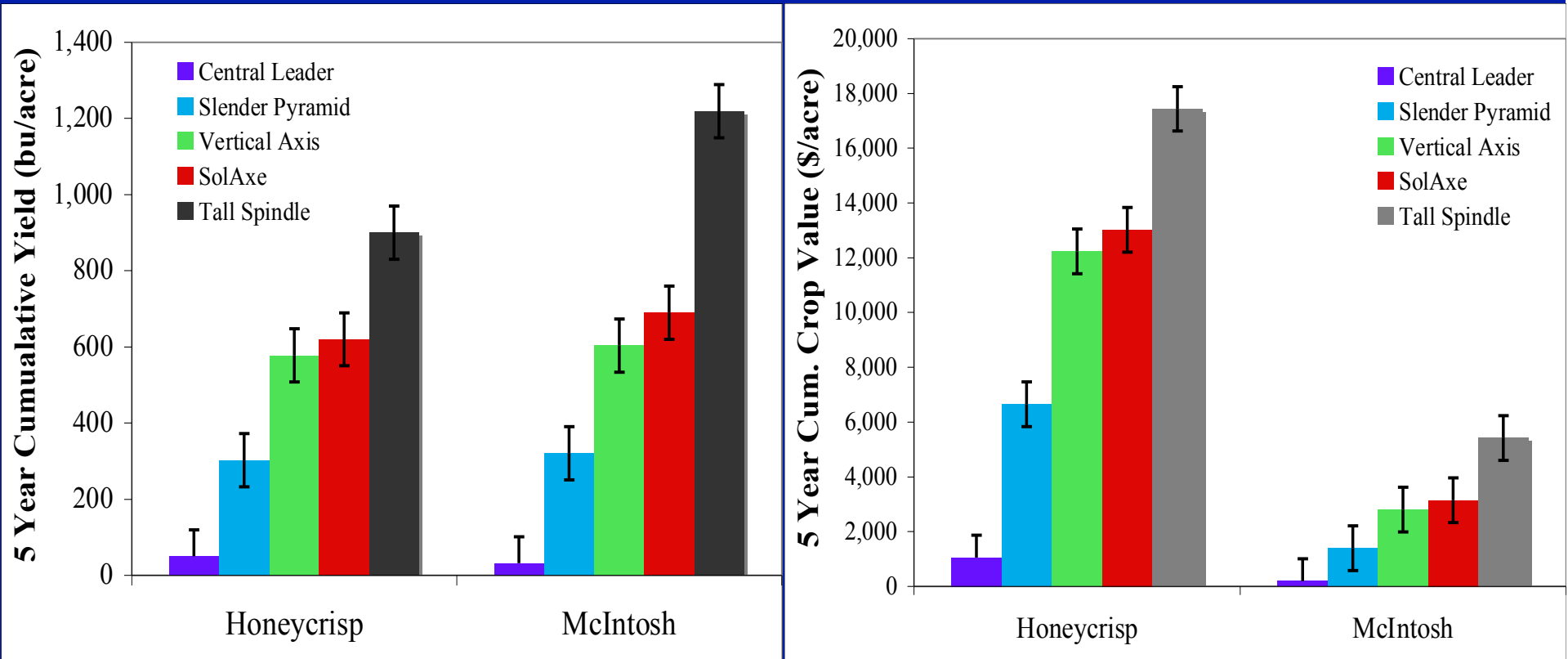
Tree Density System	Spacing			
	(tr/ha)	(tr/acre)	(m)	(ft)
Slender Pyramid	840	340	2.4 x 4.9	8'x16'
Vertical Axis	1538	518	1.5 x 4.25	6'x14'
Slender Vertical Axis	2244	908	1.2 x 3.6	4'x12'
Tall Spindle	3262	1320	0.9 x 3.3	3'x11'
Super Spindle	5382	2178	0.6 x 3.0	2'x10'

The Tall Spindle System

- 0.90-1.20 m in-row spacing (3-4')
- 3.0-3.5 m between rows (10-12')
- 3 m tall (10')
- **no permanent branches**
- highly feathered trees
- minimal pruning at planting
- feathers tied below horizontal at planting.

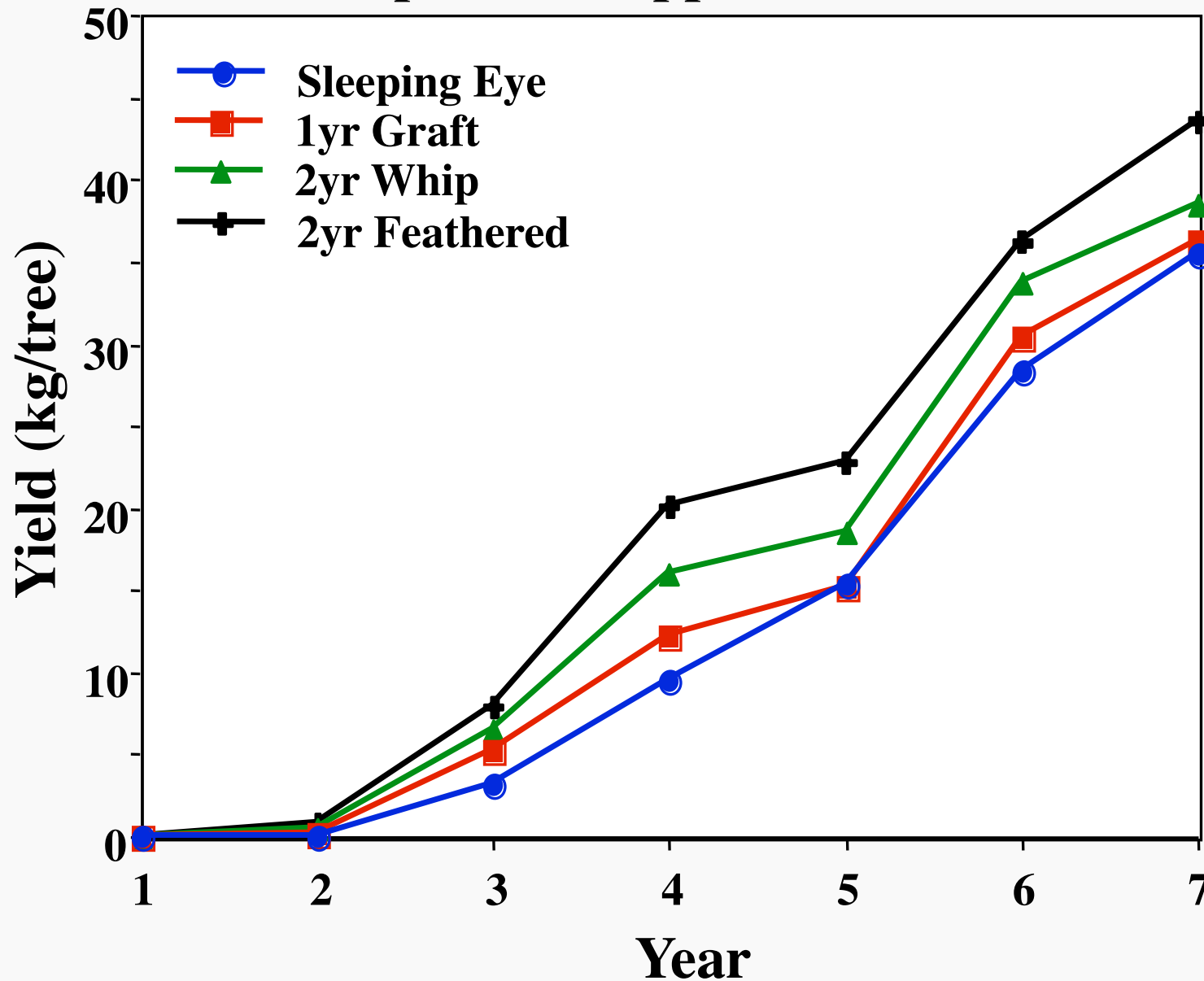


Orchard System Performance in Northern NY

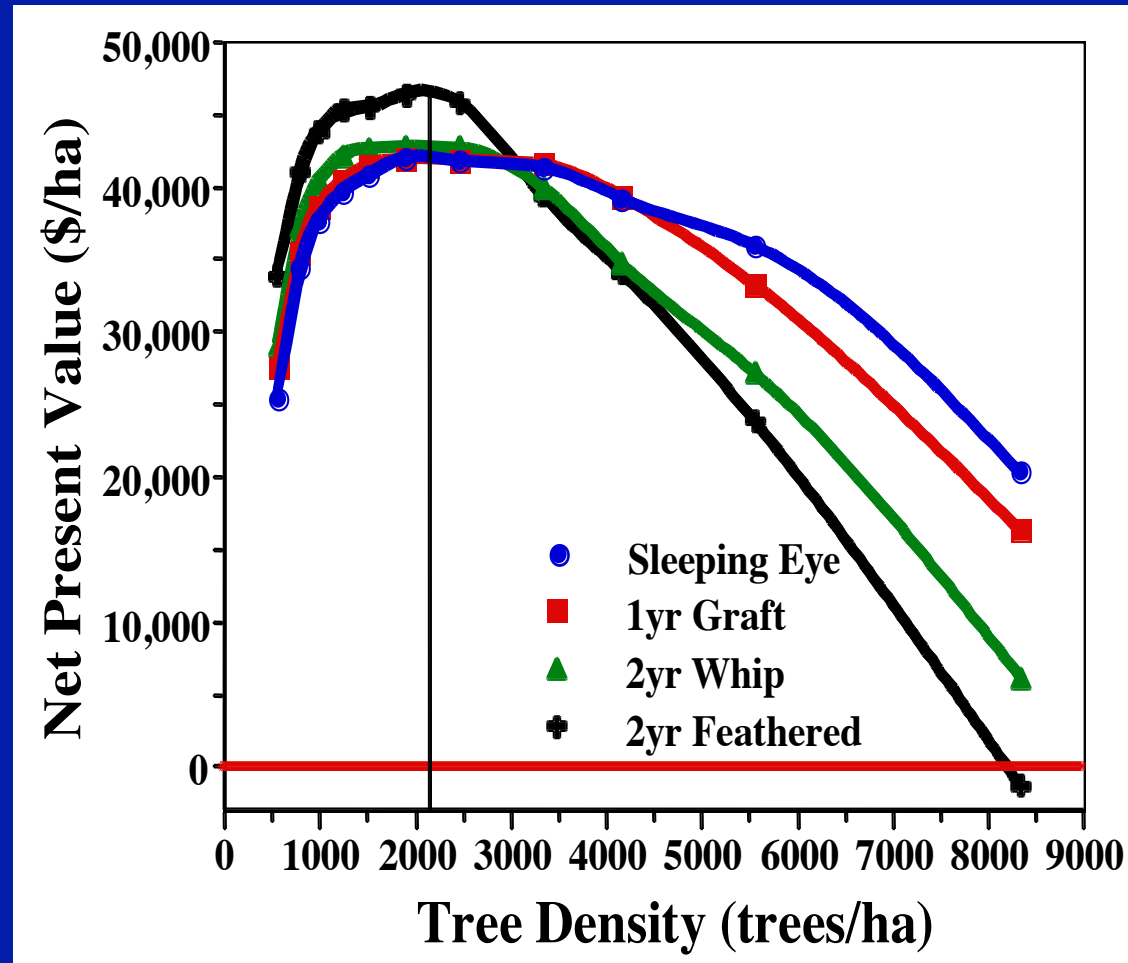


- The Tall Spindle was the only system to achieve 1000 bushels over 5 years. Although yield of McIntosh was greater than Honeycrisp the cumulative crop value of Honeycrisp was vastly greater than McIntosh.
- SolAxe yield and crop value was similar to the Vertical Axis.

Effect of Tree Quality on Yield of Empire/M.9 Apple Trees.



What is the best tree to use in the Tall Spindle system?



- Large caliper feathered trees have higher production than small caliper trees.
- Large caliper, feathered trees are the most profitable when planted at the densities used in the Tall Spindle 900-1,300 trees/acre.
- Less expensive sleeping eye trees are more profitable when planted at the very high densities from 2,000-3,000 trees/acre (Super Spindle system).

Typical feathered trees in the USA have ~ 5 large feathers These require some pruning and significant branch tying.

With wide spacing as used with Vertical Axis we suggested tipping leader and feathers

With the Tall Spindle we suggest removing the 2 largest diameter feathers but leaving the leader and feathers unheaded. All remaining feathers must be tied down to prevent them from becoming large branches.



Large feathers, if tied down, can be cropped for several years without becoming dominant branches.



Tree Training of the Tall Spindle

- Do not head leader.
- Do not head feathers.
- Remove feathers that compete with leader using a bevel cut.
- Tie down 5-8 feathers below horizontal at planting or in July.
 - Remove narrow angled branches.
 - Remove scaffolds that are larger than $\frac{2}{3}$ diameter of leader.
 - Remove side branches that are longer than 2'.
 - Remember "**large branches create large trees**"
- Remove branches larger than $\frac{3}{4}$ inch diameter.

The Tall Spindle has fruiting branches that remain for 3-6 years but no permanent scaffold branches



Mature Tall Spindle/M.9 3' x 11' 11' tall

Older Tall Spindle Orchard



Rootstocks Suggestions for Tall Spindle

- M.9
 - Fire blight is a risk in NY and winter damage is a risk in colder areas.
 - Use weaker clone of M.9 (T337) with vigorous scion varieties or with vigorous or virgin soil.
 - Use the vigorous clones (Nic29, Pajam2) with weak varieties or with weak soils or on replant soils or in hot climates.
- B.9
 - Is weaker than M.9 and must be spaced very close to achieve high yields per acre. It may be too weak with weak scions.
 - More winter hardy than M.9.
 - Has field resistance to fire blight.
 - Very susceptible to apple replant disease.
- G.11, G.41, G.16
 - Similar in vigor to M.9.
 - As productive or more productive than M.9.
 - Fire blight resistant.

Three Dwarfing Geneva® Rootstocks

- G.11
 - Tree size and productivity are similar to M.9.
 - Large fruit size.
 - It is fire blight resistant but is not immune.
 - In European CG trial it has looked the best.
 - Commercial sales in the US are strong.
- G.16
 - Tree size is similar to vigorous clones of M.9
 - Large fruit size.
 - It is fire blight immune.
 - Good resistance to replant disease
 - Requires virus free budwood.
 - Currently available from most nurseries.
- G.41
 - Tree size is similar to M.9 but productivity is better.
 - It is resistant to fire blight and crown rot
 - It is very winter hardy
 - Good resistance to replant disease
 - Will be available in 2-3 years.



Conclusions

- 1) The tall spindle system appears to be the most profitable system for New York growers.
- 2) **Highly feathered trees** are the key to the system
- 3) **Branch angle management.** Bending feathers below horizontal at planting induces early cropping and limits branch size.
- 4) **Branch caliper management.** Removal of large branches keeps trees manageable.
- 5) **Restrict vegetative growth by partitioning a high proportion of photosynthates into apples.**

