Tall Spindle Performance
CHES
Thanks to:
Michigan Apple Research Committee
Michigan State Hort Society
International Fruit Tree Association
Supporting Growers
Summit Tree Sales
Willow Drive Nursery
Walfer Nursery
New Orchards
A 20+ year commitment

- Planting time decisions determine the potential of the orchard. The most important decisions are:
  - cultivar,
  - rootstock,
  - tree spacing and
  - tree training system
- Plant 5% of the orchard each year.
- 3 Important Factors
  - System
  - Irrigation
  - Fertility
Tall Spindle Performance
CHES
Why Consider Tall Spindle?

• Best early and gross dollar return.
• A new apple orchard is a long term investment, 20+ years.
• It is highly adaptable to future machine assisted practices (pruning, harvest).
• It is proving to be the most efficient, cost effective apple training system.
• It is highly productive of high quality fruit in early and mature bearing years.
• It is a simple training system, easy for employees to learn.
Kropf Tall Spindle
Why Consider Tall Spindle?

• It fits the natural growing characteristics of a high density apple tree.
• It maximizes the trees ability to capture of sunlight.
• It has little to no wasted space (shaded) in a tree.
• It maximizes yield/acre due to its tall (10-11’’) tree height.
• It has one the best carbon footprint apple production systems.
• Apogee treated Tall Spindle can be protected from FireBlight and yet yield nearly as well as non-treated trees.
Sparta Tall Spindle
Sparta Tall Spindle
NY targets for early yield:

- 200 bu/acre  
- 500 bu/acre  
- 900 bu/acre  
- 1400 bu/acre

second leaf  
third leaf  
fourth leaf  
fifth leaf  

Accumulate a total of 3,000 bu/acre over the first 5 years
2000 bu/acre
Fuji/M9
4\textsuperscript{th} Leaf
When profitability was calculated per unit land area with traditional fruit prices, profitability over 20 years increased with increasing tree density up to a density of 2,500 trees/ha.

NY Economic Studies

![Graph showing Net Present Value (Net/Present Value) vs. Planting Density (trees/ha)].

- **Feathered trees + steel support pole**
- **Feathered tree + 4 wire trellis**
- **Inexpensive feathered tree + 4 wire trellis**

Legend:
- **1000-1300 Trees/Acre**

The graph illustrates the net present value ($) per hectare for different planting densities and tree support methods. The optimal planting density for maximized profitability seems to be around 2,500 trees/ha.
Tying Branches down in year one
Mechanical Summer Pruning with the Tall Spindle

Reduction of costs,
Improved fruit quality.

Timing: June, July, August
Tall Spindle Trial CHES

- 2006 Planting
- Direct comparison of TS and VA.
- Very Productive
- Easy to Learn System
Tall Spindle Apogee, Planted 2006

<table>
<thead>
<tr>
<th></th>
<th>Tall Spindle</th>
<th>Vertical Axe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spacing</td>
<td>3’x11’</td>
<td>5’x14</td>
</tr>
<tr>
<td>Trees/Acre</td>
<td>1320</td>
<td>622</td>
</tr>
<tr>
<td>Varieties (7)</td>
<td>Empire, Fuji, Gala, Honeycrisp, Jonagold, Jonathan, N. Spy</td>
<td></td>
</tr>
<tr>
<td>Well Feathered</td>
<td>Gala, Honeycrisp, Jonagold, Jonathan, Fuji</td>
<td></td>
</tr>
</tbody>
</table>
# Tall Spindle Yields

Table 1. Yield/Acre (bushels) of Tall Spindle and Vertical Axe.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Gala</th>
<th>Honeycrisp</th>
<th>Jonagold</th>
<th>Jonathan</th>
<th>Empire</th>
<th>Fuji</th>
<th>N Spy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>UTC</td>
<td>Apogee</td>
<td>UTC</td>
<td>Apogee</td>
<td>UTC</td>
<td>Apogee</td>
<td>UTC</td>
</tr>
<tr>
<td>Tall S.</td>
<td>951</td>
<td>951</td>
<td>566</td>
<td>512</td>
<td>1018</td>
<td>972</td>
<td>1132</td>
</tr>
<tr>
<td>V. Axe</td>
<td>1124</td>
<td>742</td>
<td>558</td>
<td>580</td>
<td>917</td>
<td>492</td>
<td>565</td>
</tr>
<tr>
<td>Tall S.</td>
<td>1300</td>
<td>1232</td>
<td>890</td>
<td>459</td>
<td>796</td>
<td>880</td>
<td>876</td>
</tr>
<tr>
<td>V. Axe</td>
<td>554</td>
<td>558</td>
<td>64</td>
<td>160</td>
<td>286</td>
<td>255</td>
<td>379</td>
</tr>
<tr>
<td>Tall S.</td>
<td>1293</td>
<td>1431</td>
<td>437</td>
<td>605</td>
<td>993</td>
<td>770</td>
<td>735</td>
</tr>
<tr>
<td>V. Axe</td>
<td>838</td>
<td>647</td>
<td>221</td>
<td>217</td>
<td>452</td>
<td>358</td>
<td>482</td>
</tr>
<tr>
<td>Tall S.</td>
<td>294</td>
<td>329</td>
<td>298</td>
<td>259</td>
<td>378</td>
<td>411</td>
<td>332</td>
</tr>
<tr>
<td>V. Axe</td>
<td>117</td>
<td>89</td>
<td>69</td>
<td>50</td>
<td>142</td>
<td>98</td>
<td>203</td>
</tr>
<tr>
<td>Tall S.</td>
<td>22</td>
<td>43</td>
<td>66</td>
<td>92</td>
<td>36</td>
<td>53</td>
<td>72</td>
</tr>
<tr>
<td>V. Axe</td>
<td>7</td>
<td>34</td>
<td>34</td>
<td>27</td>
<td>9</td>
<td>0</td>
<td>33</td>
</tr>
</tbody>
</table>
Early Cropping

• Cropping must begin:
  – In the second year with the Tall Spindle system.

• Cropping targets (NY) for the Tall Spindle

New York

<table>
<thead>
<tr>
<th>Year</th>
<th>CHES</th>
<th>Fruits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>1-5 fruits</td>
<td>0 to 3 06</td>
</tr>
<tr>
<td>Year 2</td>
<td>20 fruits</td>
<td>0 to 33 07</td>
</tr>
<tr>
<td>Year 3</td>
<td>40 fruits</td>
<td>0 to 72 08</td>
</tr>
</tbody>
</table>
All Apogee, all years, applied at 12 oz/100 by handgun at KBPF.
Apogee, half of the trees treated 2006 to 2009, half untreated.
Apogee, all trees treated 2010 and 2011.
Early Spy Production

2nd, 3rd, 4th leaf, Spy

UTC

Apogee

Bushel

2007  2008  2009

0  13  0  38  0  83  784

Honeycrisp PGR Report 2007.ppt
Tall Spindle
N. Spy
Tall Spindle Apogee Accumulated Yield/Acre as % of UTC

Gala Honeycrisp Jonagold Jonathan Empire Fuji N. Spy All Varieties

Percent

Gala Honeycrisp Jonagold Jonathan Empire Fuji N. Spy All Varieties
Tall Spindle-Vertical Axe

CHES Gala Accumulated Gross Dollar Income/Acre

UTC V. Axe  V. Axe Apogee  Tall S. UTC  Tall S. Apogee

$15  $20  $25
Profit of Systems with Actual Yields

![Graph showing profit of systems over years with different lines for Central Leader, Vertical Axe, Tall Spindle, Tall Spindle Actual, and Vertical Axe Actual.](image-url)
CHES Performance
Tree, Acre, Accumulated Yields

- Average of all varieties
- Gala
- Honeycrisp
- Spy
Ave All Varieties Bu/Tree

Average All Varieties

2007 2008 2009 2010 2011

Bushel/Tree

2007 2008 2009 2010 2011

1 to 2 Bushel/Tree

1 to 2 Bushel/Tree

0.00 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60

Honeycrisp PGR Report 2007.ppt
Ave All Varieties Accumulated Bu/Acre

Average All Varieties

Accumulated Bushel/Acre

2007 2008 2009 2010 2011

NY Target
Gala Bushel/Tree

Bushel/Tree

2007 2008 2009 2010 2011

0.00 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00

Gala TS
Gala TS Apo
Gala VA
Gala VA Apo
Gala Accumulated Bu/Acre

Accumulated Bushel/Acre

NY Target

Gala TS
Gala TS Apo
Gala VA
Gala VA Apo

Honeycrisp PGR Report 2007.ppt
Honeycrisp Accumulated Bu/Acre

Accumulated Bushel/Acre

- Honeys TS
- Honeys TA Apo
- Honeys VA
- Honeys VA Apo

Y-axis: Accumulated Bushel/Acre
N. Spy Bushel/Tree

![Graph showing the production of N. Spy Bushel/Tree over the years from 2007 to 2011. The graph compares four different strains: Spy TS, Spy TS Apo, Spy VA, and Spy VA Apo. The x-axis represents the years from 2007 to 2011, and the y-axis represents Bushel/Tree. The production varies significantly across the years and strains.]
Summary

• Tall Spindle production increases quickly.
• TS production is 166% of VA.
• Apogee increases early production (some varieties).
• Apogee 5 year production was not significantly different to UTC.
• Must have good trees, nutrition, irrigation.
• TS produces high quality fruit.
• Spy responds well to Apogee and TS.
Why Consider Tall Spindle?

• Best early and gross dollar return.
• A new apple orchard is a long term investment, 20+ years.
• It is highly adaptable to future machine assisted practices (pruning, harvest).
• It is proving to be the most efficient, cost effective apple training system.
• It is highly productive of high quality fruit in early and mature bearing years.
• It is a simple training system, easy for employees to learn.
Why Consider Tall Spindle?

• It fits the natural growing characteristics of a high density apple tree.
• It maximizes the trees ability to capture of sunlight.
• It has little to no wasted space (shaded) in a tree.
• It maximizes yield/acre due to its tall (10-11’) tree height.
• It has one the best carbon footprint apple production systems.
• Apogee treated Tall Spindle can be protected from FireBlight and yet yield nearly as well as non-treated trees.
Super Spindle/M9
Tree Training of the Tall Spindle

First Year
- Do not head leader.
- Do not head feathers.
- Remove feathers that compete with leader using a stub cut.
- Tie down 5-8 feathers below horizontal at planting or in July.
- Trees with many short, flat feathers need no pruning.
Pruning Years 2-5

- Remove any branch that is larger than ¾” diameter.
- Removal of large branches helps keep trees small and manageable.
- Large branches create large trees by exporting carbohydrates to the rest of the tree.
Irrigation and fertigation improve growth and early cropping of the Tall Spindle trees

- Highly feathered trees experience water stress

- Trickle irrigation should be installed within 2 weeks of planting and water should be applied frequently to limit water stress.

- Newly planted trees that get fertigation can significantly improve tree growth.
3 Yr. Old Empire (Unirrigated)

3 Yr. Old Empire (Fertigated)
Characteristics of G.11

- Tree size similar to M.9 T337.
- Very productivity, and precocious.
- Outperformed M9 clones.
- Resistant to Fire Blight.
- Resistant to Crown Rot
- Not tolerant to replant
- Susceptible to Wooly Apple Aphid

Geneva® 11     M9-T337

Golden Reinders Bologna, ITALY
Courtesy of Stefano Musacchi
Characteristics of G.41

- M.9 vigor, Slightly larger than 337
- Highly yield efficient
- Highly productive, yields 100-125% of M.9)
- Very precocious
- Very cold hardy
- Excellent fruit size
- Wide branches
- Immune to Fire Blight, Crown Rot, Wooly Apple Aphid
- Replant tolerant
- Tends to be less biennial on Honeycrisp.
- In the USA new stoolbeds were planted in 2009 and 2010 (100,000 plants).
Characteristics of G.935

- Vigor between M.9 Pajam 2 and M.26
- More productive than 26, like 9.
- Wide branch angles.
- Very cold hardy
- Good graft union and propagation characteristics
- Resistant to Fire Blight and Crown Rot
- Tolerant to Replant Disease Complex
- Susceptible to Wooly Apple Aphid
- Best semi-dwarf rootstock in NY trials
- Fruit size is smaller than M9.
Characteristics of G.202

- It is similar in size to M.26
- Precocious, productive
- It is resistant to woolly apple aphid, fire blight, and crown rot
- Good choice for weak growing cultivars like Honeycrisp
- Tolerance to apple replant disease
- Good hardiness.
Characteristics of G.214

Vigor similar to M.9 Pajam2
Highly yield efficient
Highly productive, yields 100-125% of M.9.
Good precocity
Resistant to Fire Blight, Crown Rot and Wooly Apple Aphid
Replant tolerant
Good for weak varieties.
Characteristics of G.969, G.210 and G.890

- Vigor between M.7 and MM.106
- Replacements for G.30
- Free standing
- Precocious, productive
- Yield efficiency similar or better than M.9
- Resistance to woolly apple aphid, fire blight, and crown rot.
- Tolerance to apple replant disease.
- Good rooting in stoolbed few spines.
- Mostly for processing industry
Released Geneva® Apple Rootstocks
Arranged by Tree Size

M.27 Size
M.9 T337
G.65

M.9 PAJ 2
G.11
G.41
G.16

G.935
G.214

M.26 Size
G.202

M.7-MM106 Size
G.30

Seedling Size
G.969
G.210
G.890

New Releases
# Rootstock Guide

<table>
<thead>
<tr>
<th></th>
<th>G11</th>
<th>G41</th>
<th>G214 G16</th>
<th>G935 G202 G30</th>
<th>G969 G210 G890</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vigor</td>
<td>337</td>
<td>337 to Pajam 2</td>
<td>Pajam 2</td>
<td>Pajam 2 to M26</td>
<td>M26</td>
</tr>
<tr>
<td>Fireblight</td>
<td>Resistant</td>
<td>Immune</td>
<td>Resistant</td>
<td>Resistant</td>
<td>Resistant</td>
</tr>
<tr>
<td>Crown Rot</td>
<td>Resistant</td>
<td>Immune</td>
<td>Resistant</td>
<td>Resistant</td>
<td>Resistant</td>
</tr>
<tr>
<td>Replant</td>
<td>Not Tolerant</td>
<td>Tolerant</td>
<td>Tolerant</td>
<td>Tolerant</td>
<td>Tolerant</td>
</tr>
<tr>
<td>Wooly AA</td>
<td>Susceptible</td>
<td>Immune</td>
<td>Resistant</td>
<td>Susceptible</td>
<td>Resistant</td>
</tr>
</tbody>
</table>
Why Consider Tall Spindle?

• Best early and gross dollar return.
• A new apple orchard is a long term investment, 20+ years.
• It is highly adaptable to future machine assisted practices (pruning, harvest).
• It is proving to be the most efficient, cost effective apple training system.
• It is highly productive of high quality fruit in early and mature bearing years.
• It is a simple training system, easy for employees to learn.
Why Consider Tall Spindle?

• It fits the natural growing characteristics of a high density apple tree.
• It maximizes the trees ability to capture of sunlight.
• It has little to no wasted space (shaded) in a tree.
• It maximizes yield/acre due to its tall (10-11’) tree height.
• It has one the best carbon footprint apple production systems.
• Apogee treated Tall Spindle can be protected from FireBlight and yet yield nearly as well as non-treated trees.
IFTA 2013 Boston

Saturday, February 23

2 Pre-Conference Intensive Workshops (Concurrent)
IFTA 2013 Boston

Saturday, February 23
Workshop 1 - Strategies for Improving Production Practices

Flowering, Pollination, Modeling, Fruit Set
IFTA 2013 Boston

Saturday, February 23

Workshop 2 - Managing Pick Your Own Tree Fruit Operations

Keeping Sane While Chasing Fabulous Wealth
IFTA 2013 Boston

Sunday, February 24
Hi-Density Cherry and Peach Pruning Demonstration
  • Tougas Family Farm
  • Greg Lang/Lynn Long/Jim Schupp
IFTA 2013 Boston

Monday, February 25
Education Session I and II
  • I – Innovation in Production
  • II – Innovation in Automation
IFTA 2013 Boston

Tuesday, February 26
Field Learning Tours

• Belkin Lookout Farm, MA
• Tougas Family Farm, MA
• Tower Hill Botanic Garden (lunch)
• Brookdale Fruit Farms, NH
• Parlee Farms, MA
IFTA 2013 Boston

Tuesday, February 26
Banquet and Awards Ceremony

- New England Boiled Dinner
- Research, Extension, and Grower Awards
- Jokes and fun!
IFTA 2013 Boston

Wednesday, February 27

Education Session III and IV

- III – Innovation in Technology and Varieties
- IV – Innovation in Climate Change Strategies and Production
IFTA 2013 Boston

Thursday – Saturday  
February 28 – March 1  
Post Conference Tour,  
Hudson Valley, NY

- UMass Research Orchard  
- Cornell Hudson Valley Lab  
- Innovative Hudson Valley Orchards  
- Storage & Packing, PYO, Retail, Cider
IFTA 2013 Boston

Registration is now open
Go to http://ifruitttree.org
See you in Boston!
IFTA 2013 Boston

If that’s not enough incentive...
Tree Fruit Irrigation/Fertigation/Frost Workshop

• NW Hort Research Station, Suttons Bay
  – Feb 5th, Tuesday
Thanks to:
Michigan Apple Research Committee
Michigan State Hort Society
International Fruit Tree Association
Supporting Growers
Summit Tree Sales
Willow Drive Nursery
Walfer Nursery