Apple I

Tuesday afternoon 2:00 pm

Where: Ballroom D
MI Recertification credits: 2 (1C, COMM CORE, PRIV CORE)
OH Recertification credits: 0.5 (presentations as marked)
CCA Credits: PM(0.5) CM(1.5)
Moderator: Chris Kropf, MSHS Board, Lowell, MI

2:00 pm	Why, When, and How You Should Transition from A 3-D to A 2-D Canopy? • Mario Miranda Sazo, Lake Ontario Fruit Program, Cornell Cooperative Extension, Newark, NY
2:30 pm	MSU Tree Fruit Entomology Research Summary (OH: 2B, 0.5 hr) • Larry Gut, Entomology Dept., MSU
3:00 pm	Designer Tree Architecture for Orchards of the Future • Courtney Hollendar, Horticulture Dept., MSU
3:30 pm	Increasing Tree Fruit Efficiency and Grower Profitability -- Introduction to a new, applied research and outreach program • Todd Einhorn, Horticulture Dept., MSU
4:00 pm	Session Ends

Why, When, and How You Should Transition from a 3-D to a 2-D Canopy?

Mario Miranda Sazo[1]
[1] Fruit Extension Specialist, Cornell Cooperative Extension, Lake Ontario Fruit Program, Newark, NY

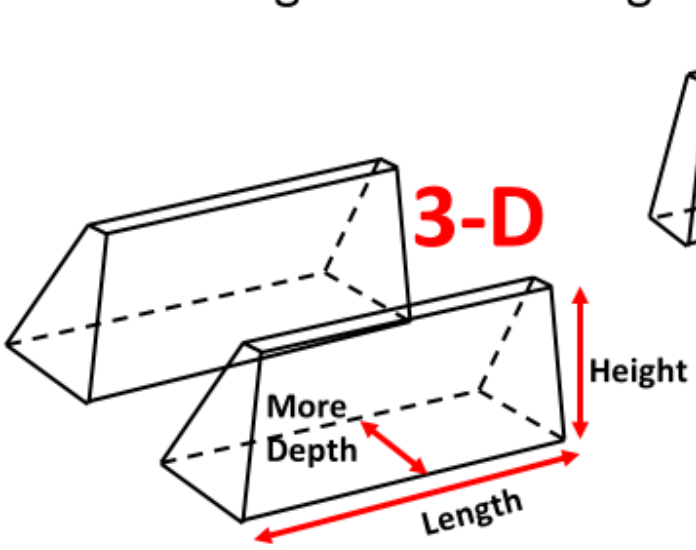
When managed correctly, the Tall Spindle apple system at maturity gives a narrow, tall fruiting wall with good fruit quality due to good light exposure in the narrow canopy. After year 5, partial mechanization of dormant pruning by using labor positioning platforms has increased dormant pruning labor efficiency by 25-40%. Further mechanization of pruning by using side wall shearing of the tree canopy in the summer with a cutter bar can offer further reductions in annual pruning costs of the tall spindle. Although mechanical pruning that was conducted in the 1960's and 70's it was generally unsuccessful because it resulted in excessive regrowth and poor fruit quality due to vigorous rootstocks and the cutting of large limbs. However, current high-density Tall Spindle orchards are now more suitable to mechanized pruning due to the use of dwarfing rootstocks, a better managed and calm tree, and the presence of more small pendant fruiting branches (15-18 branches) at year 5 or 6.

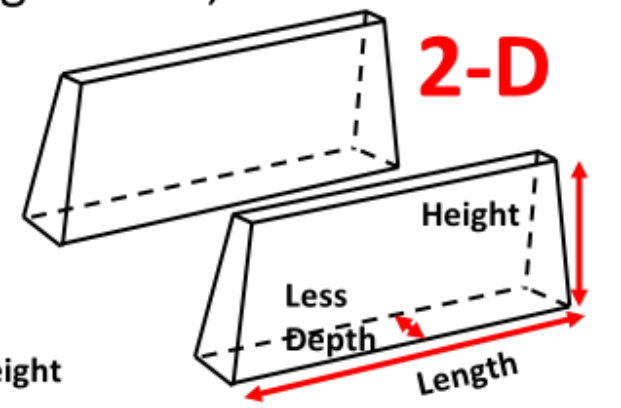
The recent efforts to mechanize pruning were begun by Alain Masseron and Laurent Roche of CTIFL (Center for Techniques of Production and Distribution for Fruit and Vegetables in France) about a decade ago. They began mechanically shearing Tall Spindle trees in the early summer to develop a narrow fruiting wall they named "Le Mur Frutier" (The Fruiting Wall). The trees were sheared in early June (when shoots had about 8-10 leaves) about 15 inches from the trunk. The tops of the trees were also cut mechanically at 10-11 feet height. This left a tall rectangular tree which was confined to a space 32 inches wide by 10 feet tall. Little shoot regrowth occurred at this timing and especially when the trees were carrying a full crop which utilized much of the carbohydrates the tree produces for fruit growth. Some commercial fruit growers who have adopted this system prune only mechanically each year in June with no additional hand pruning. Other commercial fruit growers who have adopted this system implement a follow up dormant hand pruning every third year. The mature fruiting wall tree has many weak and fruitful side branches within the rectangular space allowed by the hedging machine but no branches that extend out into the alleyway between rows.

The initial good success of mechanized summer pruning conducted by CTIFL in France was followed by research trials in Italy (Alberto Dorigoni), Spain (Ramon Montserat), and Germany (Gerhard Baab). In 2011 and 2012 we began several hedging trials in NY State to study the benefits of mechanized summer pruning of NY Tall Spindle orchards. Our experiments involved both Tall Spindle trees and Super Spindle trees on M.9 or B.9 rootstocks.

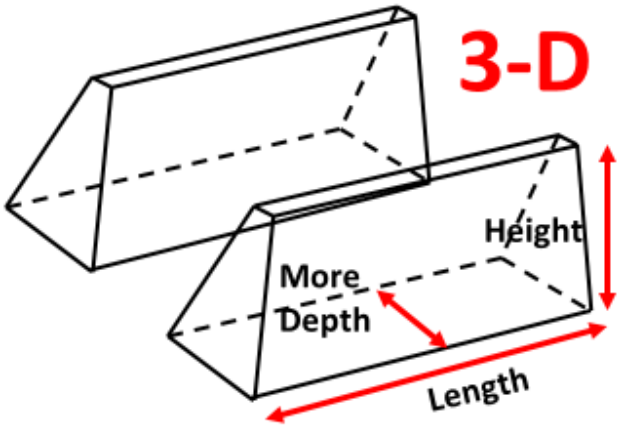
Our main goal of mechanized summer pruning was to have a narrow fruiting wall with good light distribution but not create a vigor response in the tree. A second important research objective was to study the shoot response of several important apple cultivars in NY State to mechanized summer pruning timings and severities.

Some 3-D Spindle-shaped canopies can transition to 2-D Fruiting Walls in Michigan State, USA

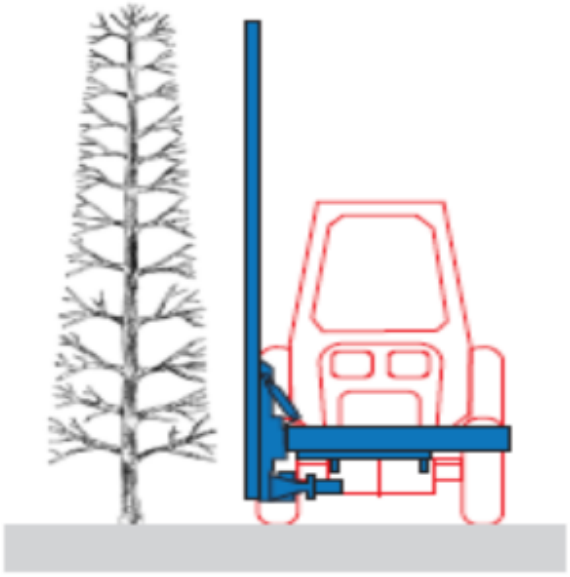




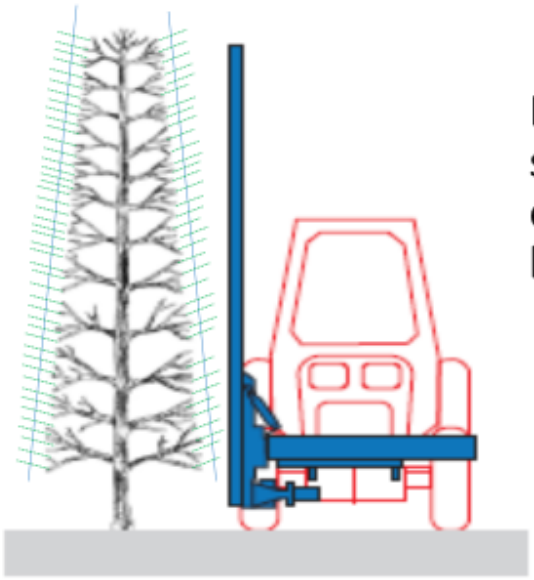
The Challenge



- The minimal pruning concept for years 1, 2, 3, and 4 can be **easily misunderstood**
- **Delayed renewal pruning** can create **dense canopies,** especially for high vigor trees on high soil fertility situations
- The **lack of systematic** pruning for a mature top can create excessive shading

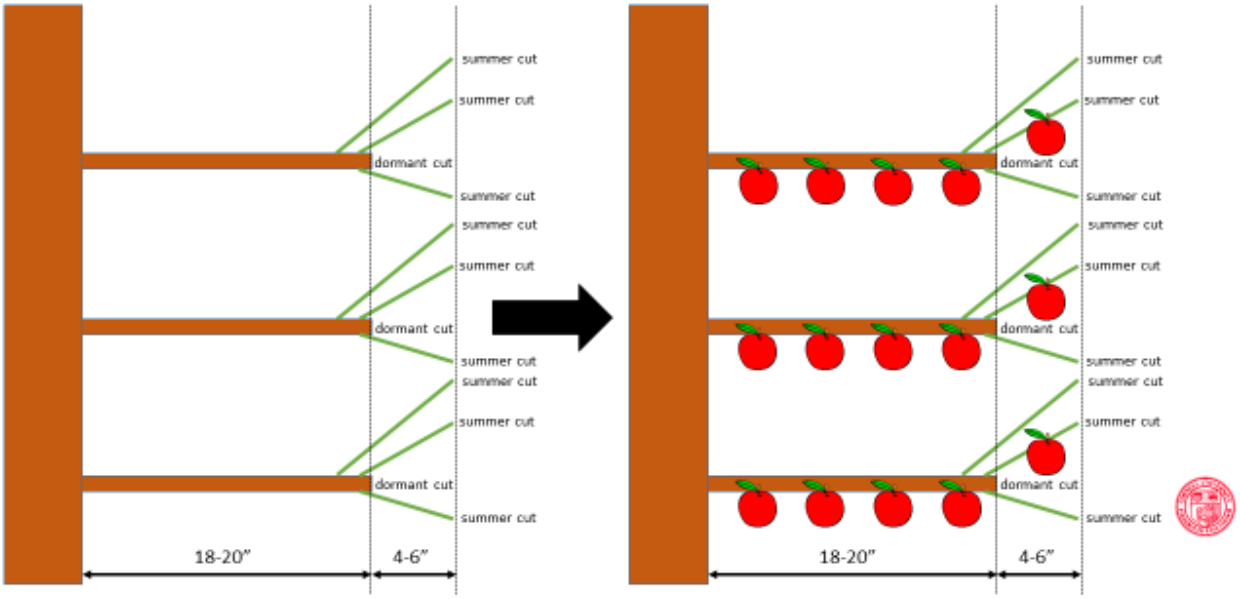


The “box” concept is a system where hedging is conducted at the end of the dormant season to pre-form the trees into a square shape or “box”

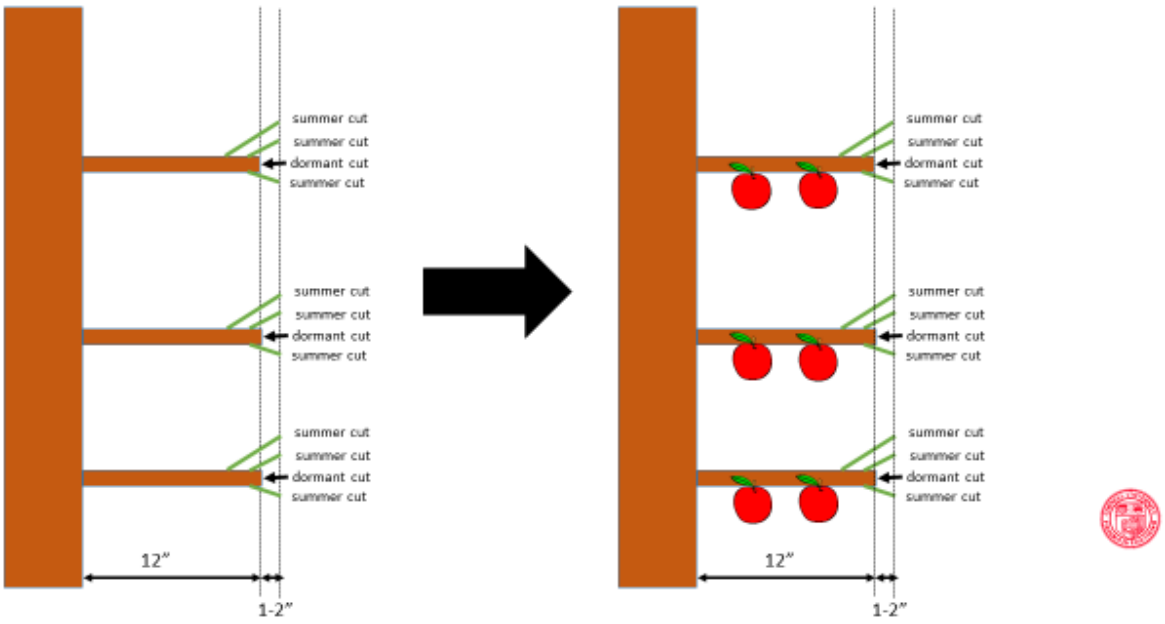


From the pre-formed “box”, shoots (in green color) grow during the season until they are hedged again in the summer

3-D Tall Spindle tree converted to a 2-D Narrow, Fruiting Wall

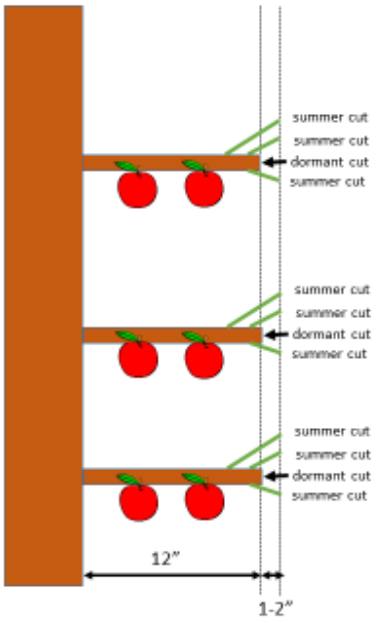


Super Spindle Tree Converted to a 2-D Narrow, Fruiting Wall



Mechanical dormant and summer pruning help to stiffen the weak fruiting laterals that make up the fruiting structure and help give more uniformity for light penetration and fruit size.

Fruit is not produced in one-year old shoots

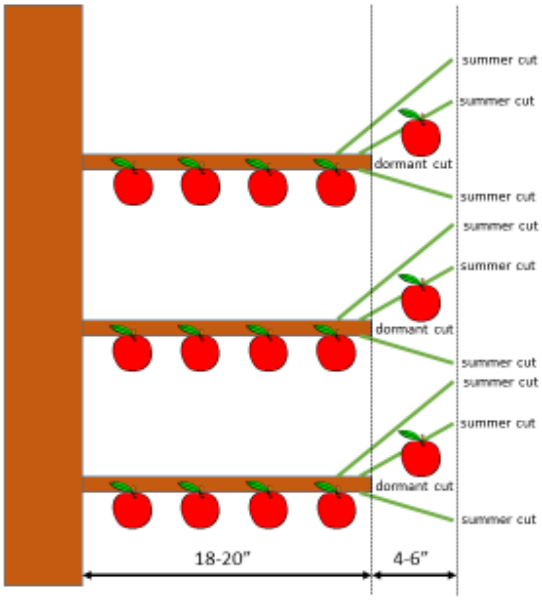


Super Spindle Tree Converted to a 2-D Narrow, Fruiting Wall

Mechanical dormant and summer pruning help to produce fruit in one-year old shoots.

Benefits:

- Fruiting canopy structure is more efficient and simplified
- Light penetration and distribution is improved
- Fruit size is more uniform



3-D Tall Spindle tree converted to a 2-D Narrow, Tall Fruiting Wall

EXAMPLE: Transition or Conversion to a Narrow, Tall, Fruiting Wall with Gala on M.9, 3.5 x 14ft. Orchard planted in 2004 and converted to a fruiting wall via mechanical pruning conducted in 2015.

Need/ Opportunity	• Some 3-D spindle orchards can transition to 2-D canopies via hedging (mechanical pruning) • The transition or conversion to a narrow, semi-tall, or tall fruiting wall can facilitate high yields of high quality fruit due to good light exposure in the narrow canopy from the bottom to the top of a tree • Narrow canopies are more suitable for orchard mechanization and/or robotics (pruning, hand thinning, and harvest) • Mechanical pruning (conducted during the winter or summer) doesn't mean that hand pruning is not needed or is less important
Challenge	• The minimal pruning concept for years 1, 2, 3, and 4 can be easily misunderstood • Delayed renewal pruning can create dense canopies, especially for high vigor trees on high soil fertility situations • The lack of systematic pruning for the lower, middle, and top portions of a single tree can create excessive shading • The growth habit of the cultivar can challenge the management of a 3-D spindle tree • Tall trees are not easy to reach without the use of ladders or platforms for pruning and other orchard tasks • Limb bending is required for vigorous cultivars (i.e. Fuji, Macoun, Linda Mac)
The site	• Gala on M.9 rootstock at 3.5 x 14ft spacing, planted in 2004 (started conversion to a fruiting wall in winter 2015)
Removal of big wood through limb renewal pruning	• 2012 – Dormant pruning to remove big limbs and get renewals (2-3 cuts/tree) • 2013 – Dormant pruning to remove big limbs and get renewals (2-3 cuts/tree) • 2014 – Dormant pruning to remove big limbs and get renewals (2-3 cuts/tree)
Special pruning considerations during 2012-2014	• Gala branches that out grew the in-row space were forced to stay due to a larger number of needed pruning cuts. These branches were headed back and were removed via renewal pruning the next dormant pruning season
Transition or conversion to a fruiting wall on Gala in 2015	• 2015 – Dormant pruning to remove big limbs and get renewals (2-3 cuts/tree) **followed by mechanical pruning** at the end of the dormant season to pre-form the trees into a shape or "box" • The 'box" was formed 18-20 inches from the trunk • From the pre-formed "box" shoots grew during the 2015 season and they were hedged at 24-26 inches from the trunk late July/early August
2016	• Dormant manual pruning to remove any existing big limbs, if any, and conduct precision pruning in the low, middle, and top portion of the canopy • Mechanical summer pruning conducted at 24-26 inches from the trunk and before harvest on August 2016
2017	• Same winter and summer pruning management practices as conducted in 2016

Designer Tree Architecture for the Orchards of the Future

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The combination of traditional breeding methods with 21st century technologies, such as genomic sequencing, marker assisted selection, and gene-editing techniques, has set the stage for a multitude of benefits for the tree fruit industry and consumers. These include the rapid development of elite cultivars that provide increased profitability by reducing management costs and crop loss.

The aim of my new research program is to combine basic research on plant development and modern genomic sequencing technology with plant breeding to directly benefit fruit tree agriculture. One area I am interested in studying is the biology of plant size and shape (or architecture). Plant architecture impacts many aspects of orchard management, including land and spray requirements and labor costs, which in turn impact sustainability and profitability. My previous research on the genetics of tree shape at the USDA ARS Appalachian Fruit Research station in Kearneysville, WV, led to the generation of plum trees with reduced statures as well as trees with architectures that may be useful for high-density plantations, a reduction in labor for training, and increased yield per acre. It also led to the generation of markers for breeding these traits into peaches. I plan on applying and expanding the knowledge of tree shape genetics to the Michigan apple industry to help develop new cultivars for high density planting systems with reduced costs.

In addition to studying plant architecture, I am very interested in studying other aspects of plant development and genetics that would have a positive impact on the Michigan tree fruit production. These may include, but are not limited to, investigating bud dormancy, spur development, cold hardiness, and timing of bud break. While my primary training is in plant molecular biology and genetics, I plan on collaborating with a team of researchers, horticulturists, extension agents, and stakeholders in Michigan over the next 30+ years to ensure that my research is always relevant and directly applicable.

If you have additional ideas about traits in apple that would be benefit the Michigan tree fruit industry, or suggestions about what you would like me to research, please don't hesitate to share them with me.