Tart Cherry Orchard of the Future: High Density Trial at the NWMHRC

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Need for Technology and Horticultural Modernization in Tart Cherry

- Michigan Cherry Industry faces challenges from globalization
  - Inexpensive labor
  - Favorable growing conditions
  - Accessibility to suitable farmland

- Montmorency: 250+ year-old cultivar
- Mahalab: standard rootstock
- 20ft+ x 20ft+ spacings
- 30 year-old harvest technology

High Density Montmorency Planting

- Concomitantly evaluate:
  - Rootstocks
  - Tree spacing
  - Irrigation
  - Fertilization strategies
  - Tree training and pruning
    - To optimize yields without sacrificing fruit quality

Planting established at NWMHRS in 2010

Rootstocks

- Commercially available dwarfing rootstocks:
  - Gisela 3®
  - Gisela 5®
  - Gisela 6®
  - Mahaleb
  - Montmorency on own root
    - From tissue culture

Montmorency on own root

Spacing

- Planted at 12ft between rows and 4.5ft between trees
- Left 21ft of empty space between five-tree replicates
  - For testing future harvesters

Rainier/G3	Rep 1	Mah	Rep 2	Gi 6	Rep 2	Gi 5	Rep 2	Mah								Rainier/G3
Rainier/G3		Mah		Gi 6		Gi 5		Mah								Rainier/G3
Rainier/G3		Mah		Gi 6		Gi 5		Mah								Rainier/G3
Rainier/G3		Mah		Gi 6		Gi 5		Mah								Rainier/G3
Rainier/G3		Mah		Gi 6		Gi 5		Mah								Rainier/G3
Andersen/G6	Rep 1	G i 3	Rep 1	Mah	Rep 2	Gi 3	Rep 4	Gi 6	Rep 6	Gi 5	Rep 5	Own	Rep 5	Gi 3	Rep 6	Own	Andersen/G6
Andersen/G6		G i 3		Mah		Gi 3		Gi 6		Gi 5		Own		Gi 3		Own	Andersen/G6
Andersen/G6		G i 3		Mah		Gi 3		Gi 6		Gi 5		Own		Gi 3		Own	Andersen/G6
Andersen/G6		G i 3		Mah		Gi 3		Gi 6		Gi 5		Own		Gi 3		Own	Andersen/G6
Andersen/G6		G i 3		Mah		Gi 3		Gi 6		Gi 5		Own		Gi 3		Own	Andersen/G6
Rainier/G3	Rep 2	Own	Rep 2	Gi 6	Rep 3	Mah	Rep 4	Gi 5	Rep 4	Gi 6	Rep 5	Mah	Rep 4	Mah	Rep 6	Gi 5	Rainier/G3
Rainier/G3		Own		Gi 6		Mah		Gi 5		Gi 6		Mah		Mah		Gi 5	Rainier/G3
Rainier/G3		Own		Gi 6		Mah		Gi 5		Gi 6		Mah		Mah		Gi 5	Rainier/G3
Rainier/G3		Own		Gi 6		Mah		Gi 5		Gi 6		Mah		Mah		Gi 5	Rainier/G3
Rainier/G3		Own		Gi 6		Mah		Gi 5		Gi 6		Mah		Mah		Gi 5	Rainier/G3
Andersen/G6	Rep 1	Own	Rep 2	Gi 5	Rep 2	Own	Rep 4	Gi 5	Rep 5	Gi 3	Rep 4	Gi 3	Rep 6	Gi 6	Rep 6	Gi 6	Andersen/G6
Andersen/G6		Own		Gi 5		Own		Gi 5		Gi 3		Gi 3		Gi 6		Gi 6	Andersen/G6
Andersen/G6		Own		Gi 5		Own		Gi 5		Gi 3		Gi 3		Gi 6		Gi 6	Andersen/G6
Andersen/G6		Own		Gi 5		Own		Gi 5		Gi 3		Gi 3		Gi 6		Gi 6	Andersen/G6
Andersen/G6		Own		Gi 5		Own		Gi 5		Gi 3		Gi 3		Gi 6		Gi 6	Andersen/G6
Rainier/G3	Rep 1	Gi 5	Rep 1	Gi 6	Rep 4	Gi 3	Rep 3	Gi 5	Rep 5	Gi 6	Rep 3	Mah	Rep 5	Own	Rep 6	Mah	Rainier/G3
Rainier/G3		Gi 5		Gi 6		Gi 3		Gi 5		Gi 6		Mah		Own		Mah	Rainier/G3
Rainier/G3		Gi 5		Gi 6		Gi 3		Gi 5		Gi 6		Mah		Own		Mah	Rainier/G3
Rainier/G3		Gi 5		Gi 6		Gi 3		Gi 5		Gi 6		Mah		Own		Mah	Rainier/G3
Rainier/G3		Gi 5		Gi 6		Gi 3		Gi 5		Gi 6		Mah		Own		Mah	Rainier/G3
Andersen/G6	Rep 1	Gi 6	Rep 3	Gi 3	Rep 3	Gi 5	Rep 3	Own	Rep 3	Gi 6	Rep 3	Gi 3	Rep 6	Own	Rep 6	Mah	Andersen/G6
Andersen/G6		Gi 6		Gi 3		Gi 5		Own		Gi 6		Gi 3		Own		Mah	Andersen/G6
Andersen/G6		Gi 6		Gi 3		Gi 5		Own		Gi 6		Gi 3		Own		Mah	Andersen/G6
Andersen/G6		Gi 6		Gi 3		Gi 5		Own		Gi 6		Gi 3		Own		Mah	Andersen/G6
Andersen/G6		Gi 6		Gi 3		Gi 5		Own		Gi 6		Gi 3		Own		Mah	Andersen/G6
Rainier/G3	Rep 1	Own	Rep 1	Gi 5	Rep 2	Mah	Rep 3	Gi 6	Rep 5	Gi 5	Rep 6	Gi 3	Rep 5	Gi 6	Rep 6	Gi 3	Rainier/G3
Rainier/G3		Own		Gi 5		Mah		Gi 6		Gi 5		Gi 3		Gi 6		Gi 3	Rainier/G3
Rainier/G3		Own		Gi 5		Mah		Gi 6		Gi 5		Gi 3		Gi 6		Gi 3	Rainier/G3
Rainier/G3		Own		Gi 5		Mah		Gi 6		Gi 5		Gi 3		Gi 6		Gi 3	Rainier/G3
Rainier/G3		Own		Gi 5		Mah		Gi 6		Gi 5		Gi 3		Gi 6		Gi 3	Rainier/G3
Andersen/G6	Rep 1	Gi 3	Rep 2	Gi 3	Rep 3	Own	Rep 4	Mah	Rep 4	Own	Rep 4	Own	Rep 5	Gi 5	Rep 5	Mah	Andersen/G6
Andersen/G6		Gi 3		Gi 3		Own		Mah		Own		Own		Gi 5		Mah	Andersen/G6
Andersen/G6		Gi 3		Gi 3		Own		Mah		Own		Own		Gi 5		Mah	Andersen/G6
Andersen/G6		Gi 3		Gi 3		Own		Mah		Own		Own		Gi 5		Mah	Andersen/G6
Andersen/G6		Gi 3		Gi 3		Own		Mah		Own		Own		Gi 5		Mah	Andersen/G6

Plot Map –

6 reps of each treatment

guard rows are sweet cherries

Pruning Systems

- ***Bush***:
  - Numerous branches were left to help reduce tree vigor, imparting a small tree structure, and encouraging fast and easy tree maintenance
  - With small trees, light can penetrate readily through a properly pruned tree resulting in high fruit quality and high early yields

Pruning Systems, cont.

- ***Central/Single Leader***:
  - Characterized by one main, upright trunk
  - Branching begins on the leader 12-24 inches above the soil surface
  - Selected 3 to 4 branches in first year, which were uniformly spaced around the trunk.
  - Above the first scaffold whorl, we left an area of approximately 18 to 24 inches without any branches to allow light into the center of the tree.
    - This area is followed with another whorl of scaffolds.
  - Alternating scaffold whorls are maintained up the leader to the desired maximum tree height

Irrigation

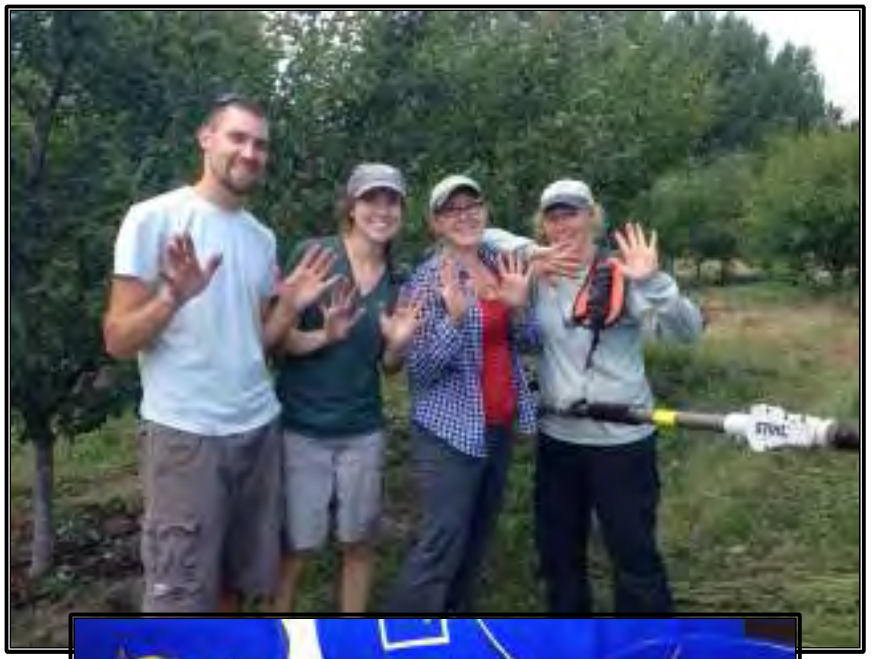
- Double line of RAM tubing
  - emitters are 24” apart
  - emit 0.42gal/hr.
- *2010*: 5/25-7/15--1.5 hrs. of water/day (Mon.-Fri); 7/16-9/3--2.5 hrs of water/day (daily)
- *2011-2013*: 1 May- 1 Sept.--2.5hrs of water/day (daily)

Fertigation

- Double line of RAM tubing
  - emitters are 24” apart
  - emit 0.42gal/hr.
- Soluble fertilizer (28-8-18) was injected through irrigation system
  - May - August

Data Collection

- Amount of bloom
- Leaf area
- Yield – first harvest 2013
  - Used limb shaker
  - No crop in 2012
- Pull force
- Trunk diameter (for trunk cross-sectional area)
- Limb growth
- Tree efficiency



Own Root – Bush

June 2010

August 2010

May 2011

May 2013

Own Root – Central Leader

June 2010

August 2010

May 2013

Gi3 - Bush

June 2010

August 2010

May 2013

Gi3 – Central Leader

June 2010

August 2010

May 2012

Gi5 - Bush

June 2010

August 2010

May 2011

May 2013

Gi5 – Central Leader

June 2010

August 2010

May 2011

May 2013

Gi6 - Bush

June 2010

August 2010

May 2011

May 2013

Gi6 – Central Leader

June 2010

August 2010

May 2011

May 2013

Mahaleb – Central Leader

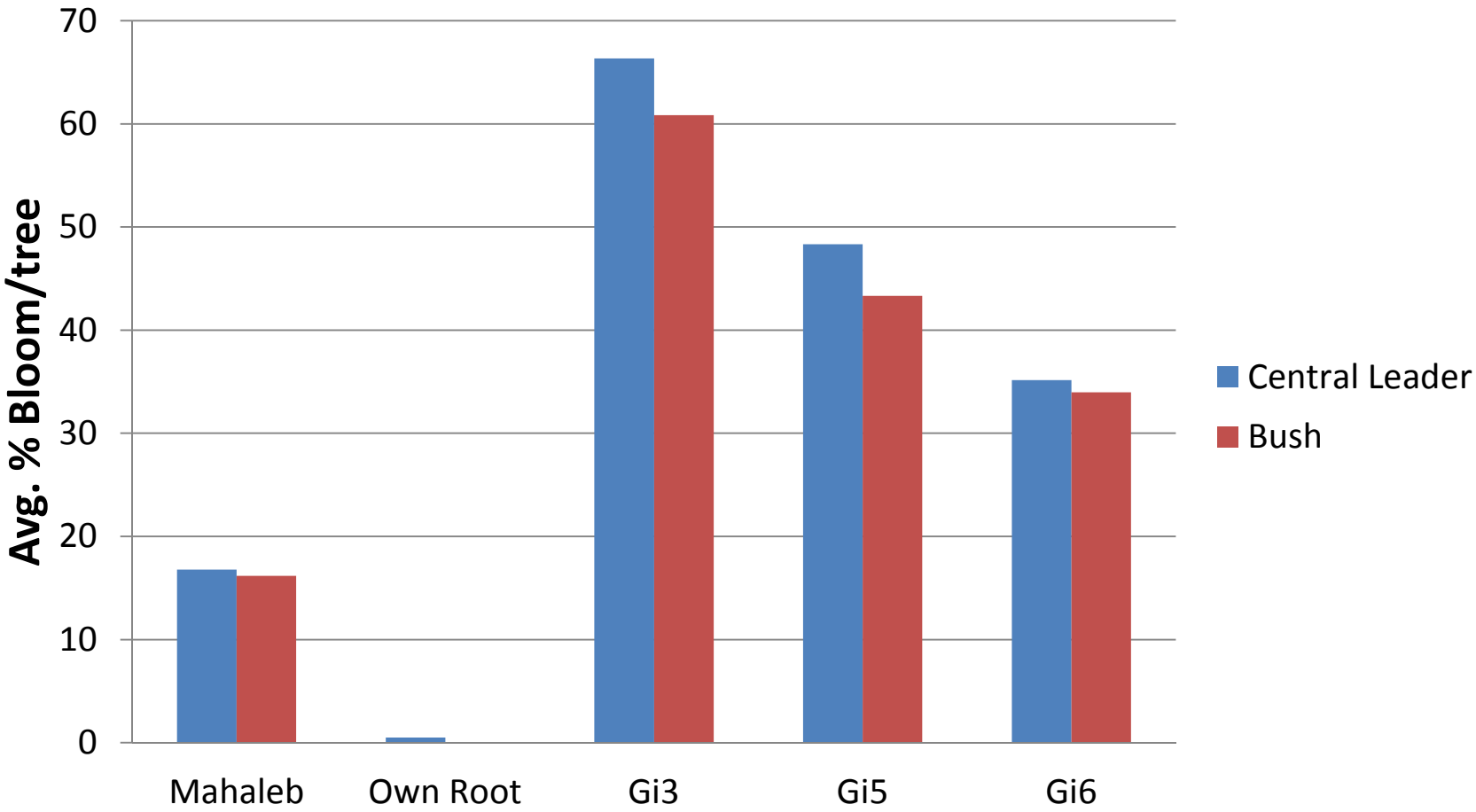
June 2010

August 2010

May 2011

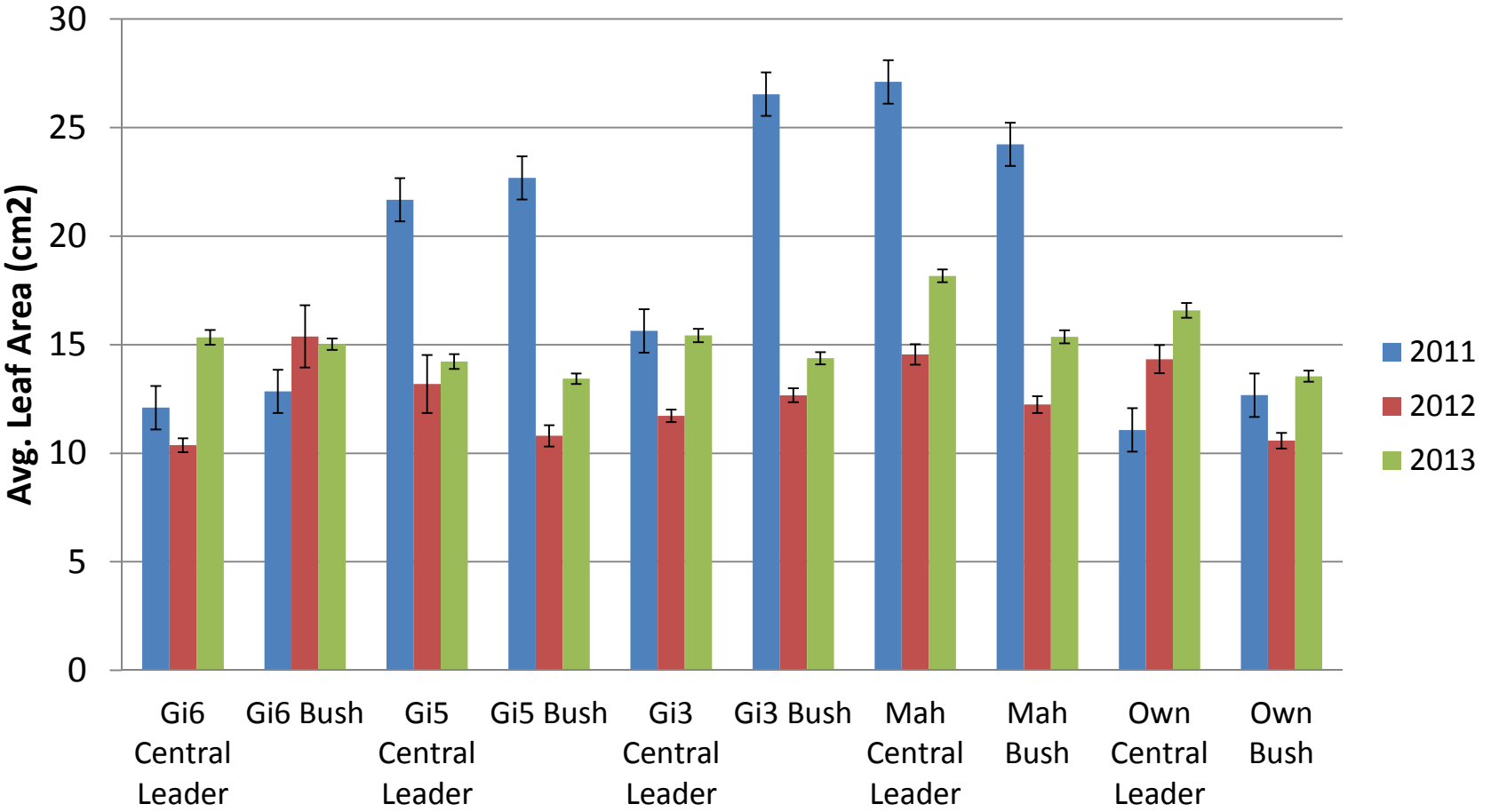
May 2013

Bloom rating – May 16, 2013



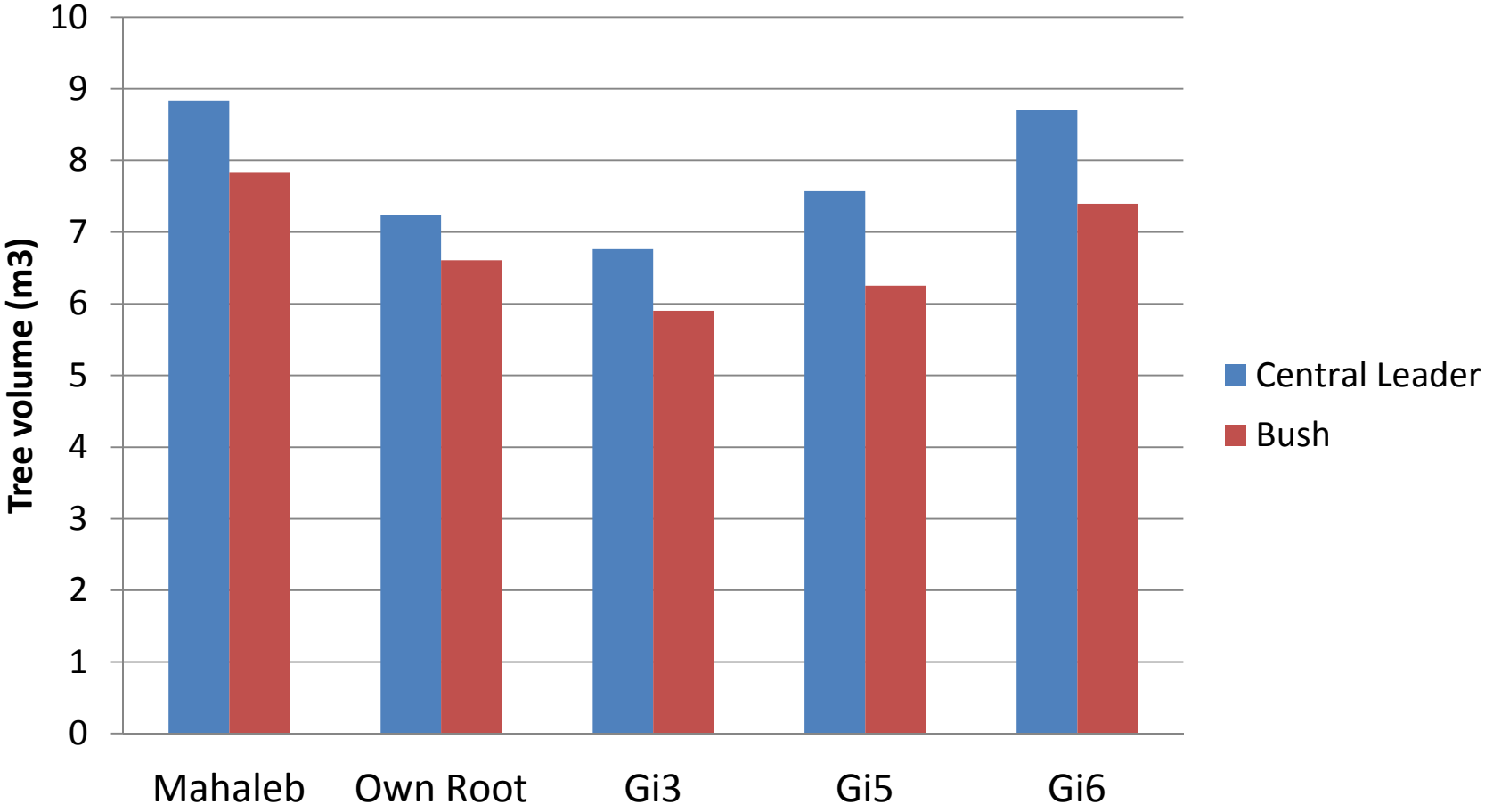
Leaf Area

measure length and width on largest leaf on 2 yr. old, non-fruiting spur, 5 leaves per tree



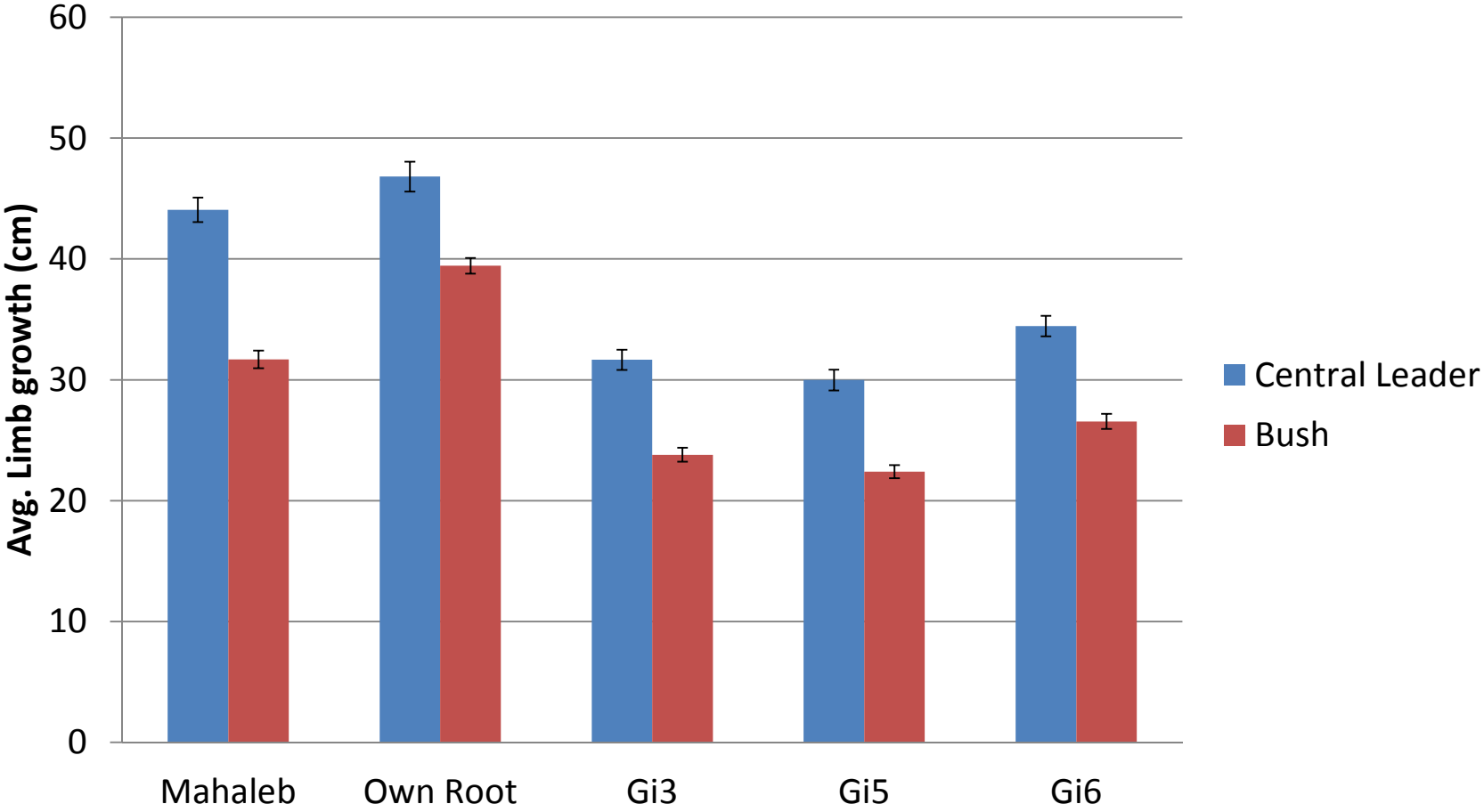
Tree Volume

height x depth x width



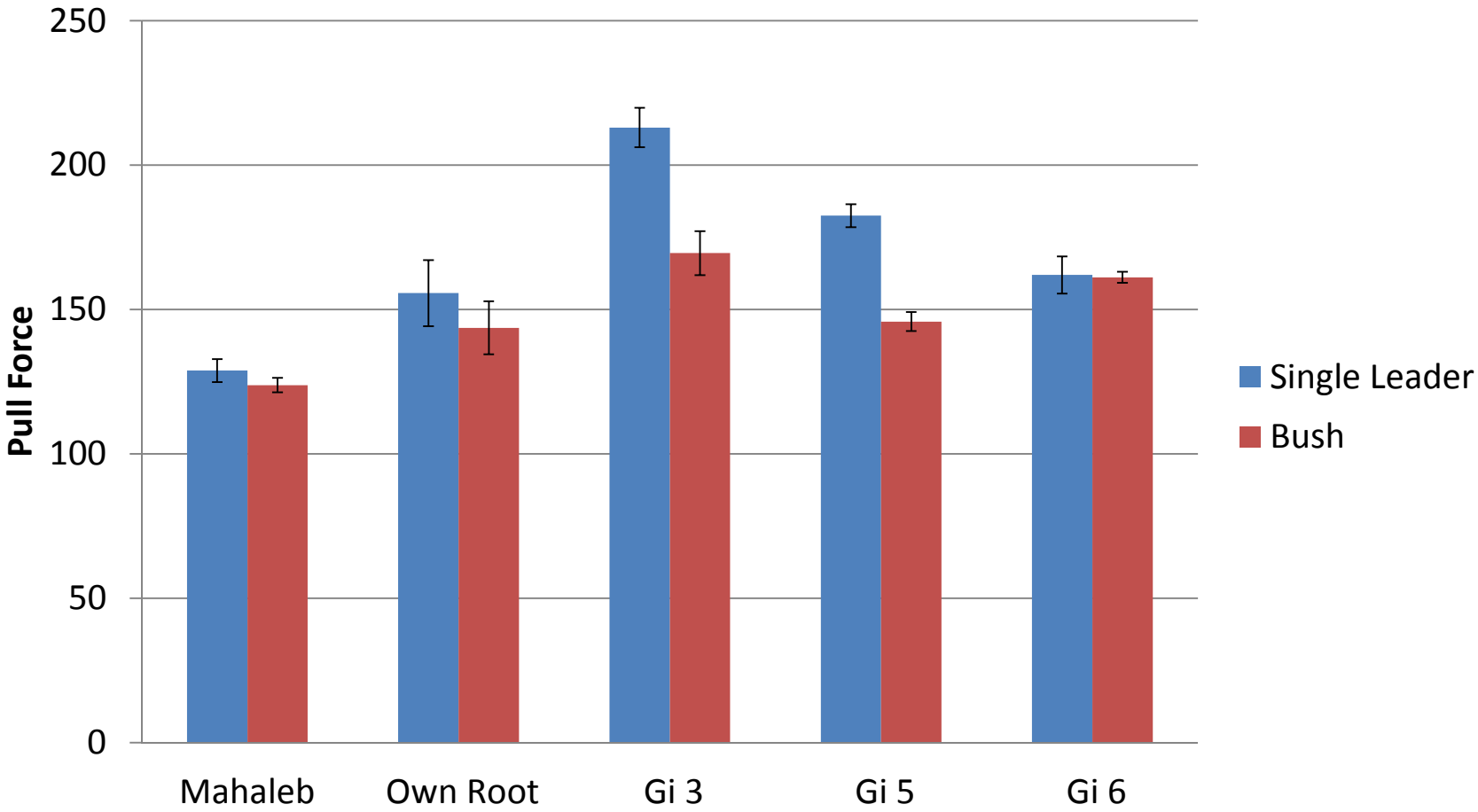
Current season limb growth

measured 4 limbs per tree in each cardinal direction, collected 8/19/13



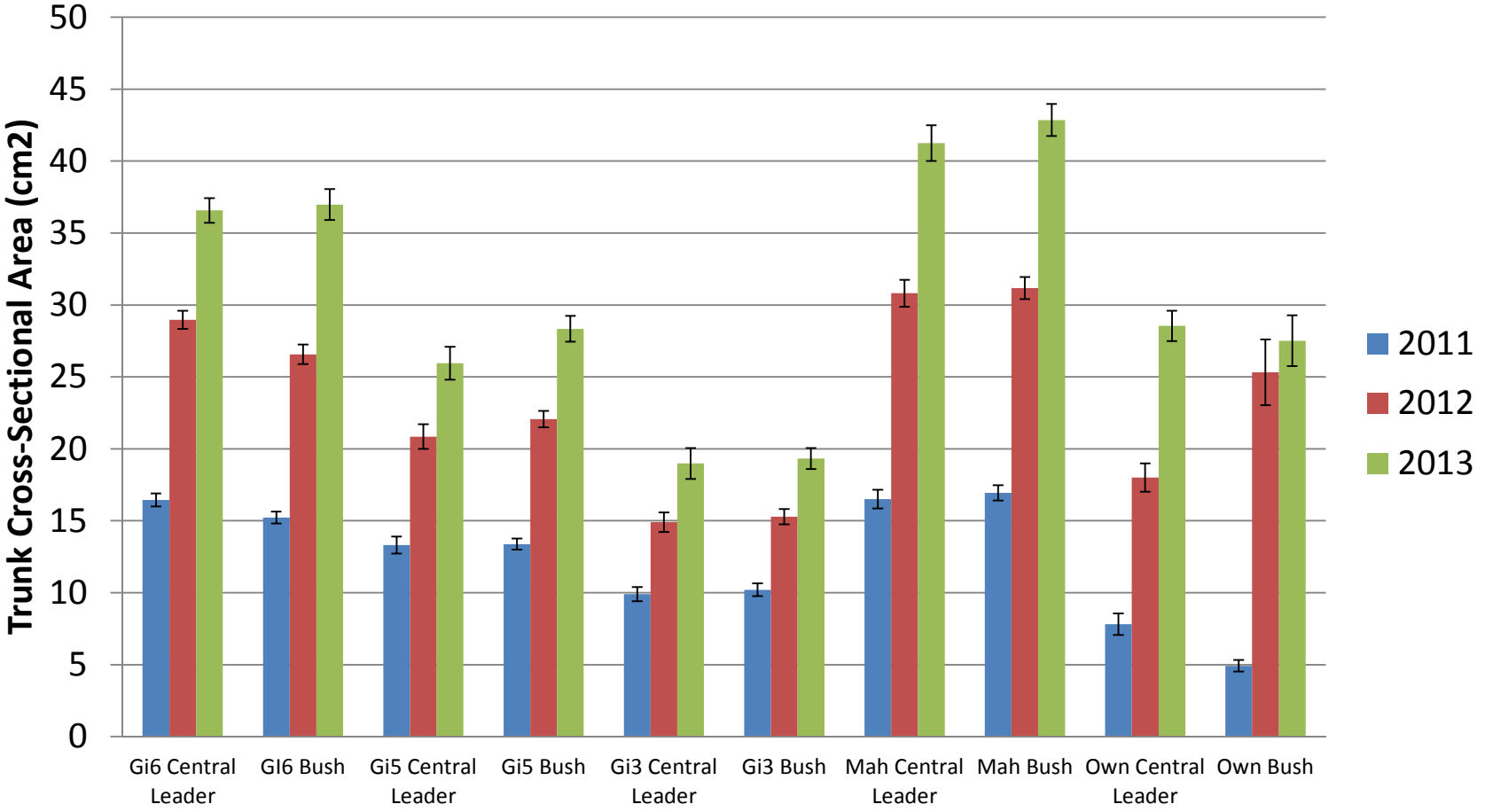
Pull force

collected 5 fruit per tree with stems attached and measured with a pull force meter



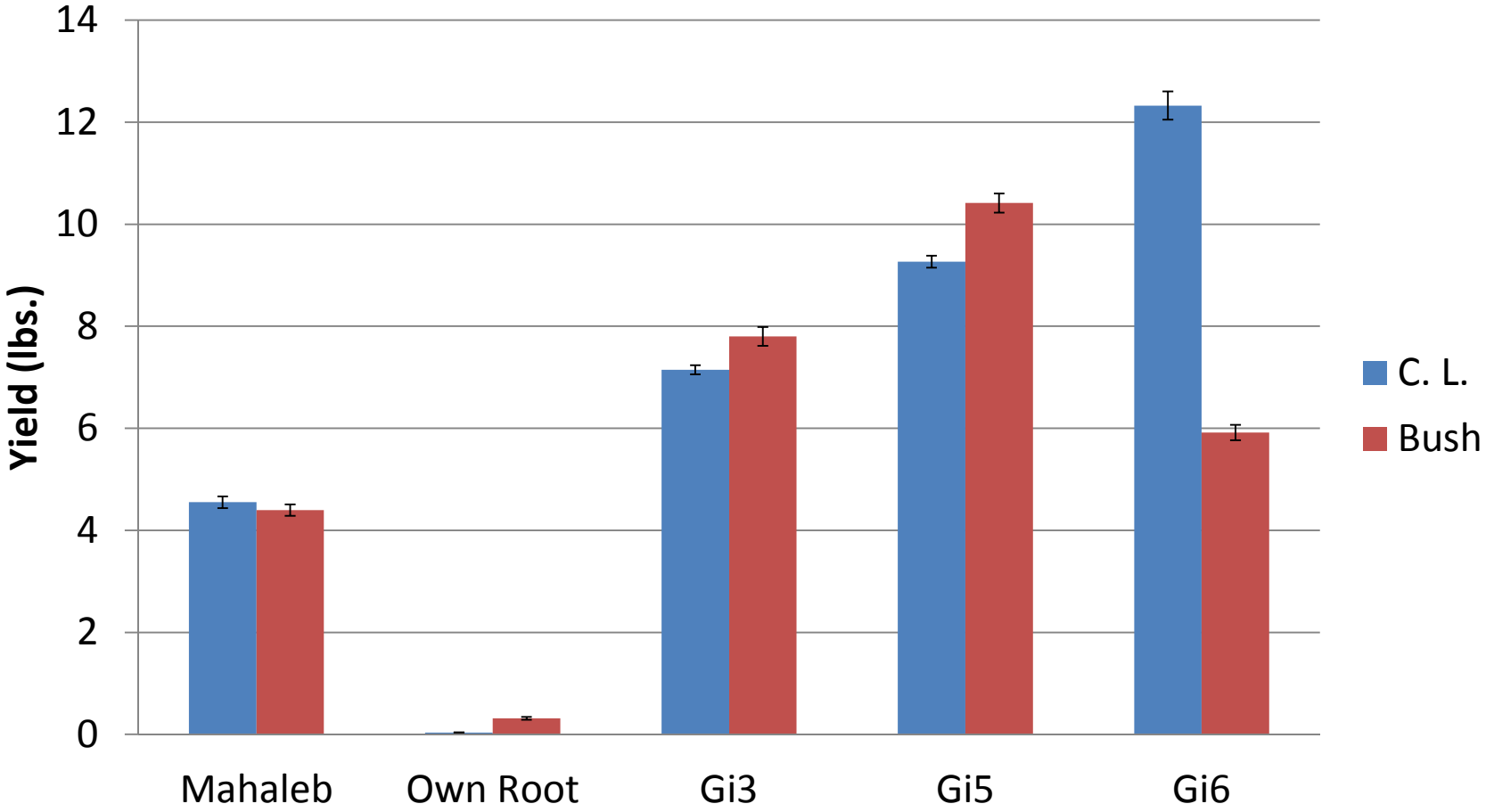
Trunk cross-sectional area (TCSA)

measure trunk diameters in fall on all trees 30cm above graft union



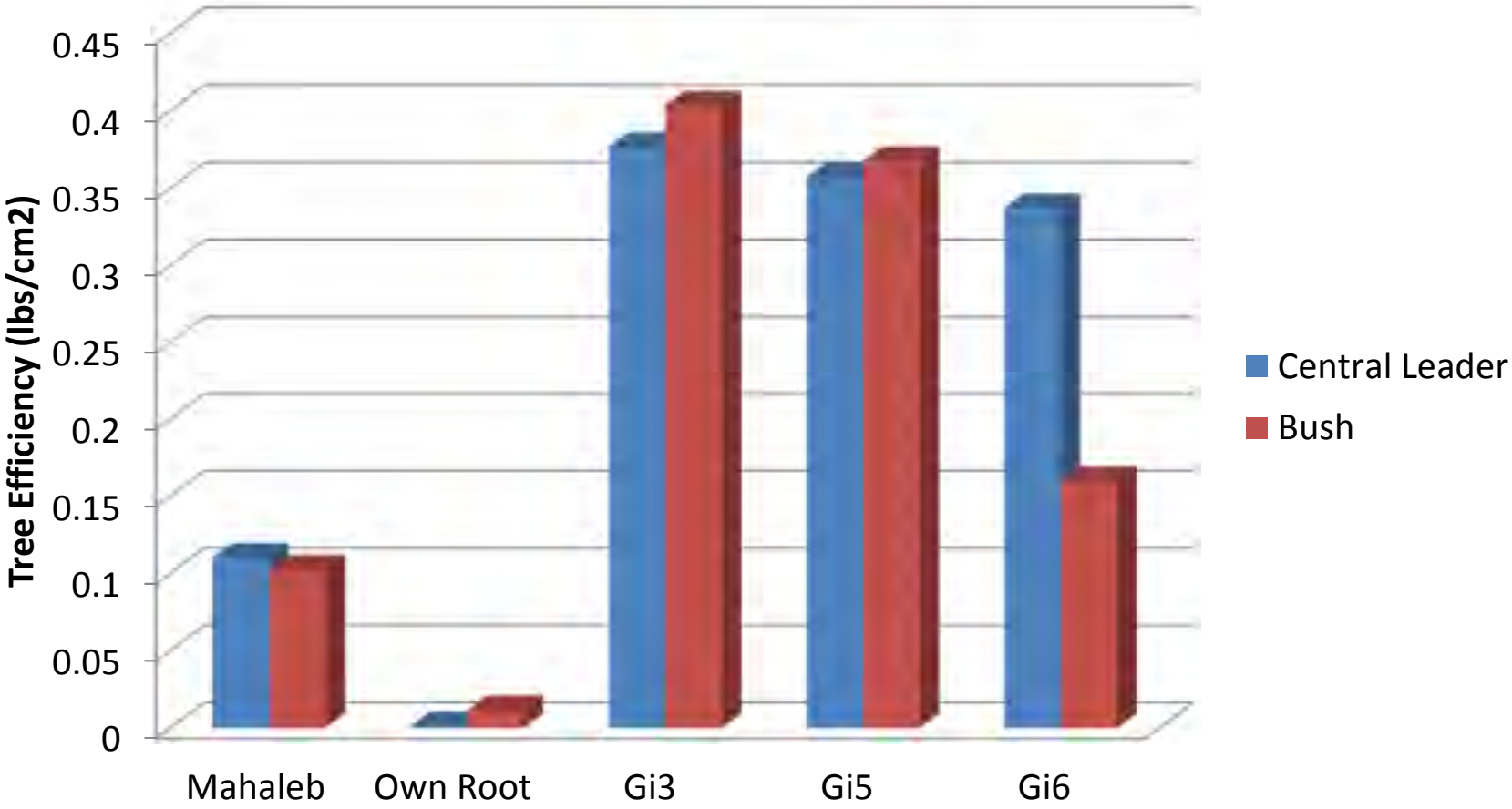
Average Yield/Tree

all fruit was harvested from individual trees with a limb shaker and weighed



Tree Efficiency

tree yield divided by TCSA



Preliminary Conclusions

- Gisela 3 and 5 had highest tree efficiencies
  - No differences between pruning systems
- Gisela 6 pruned to a central leader had a comparable tree efficiency to G3 and G5
  - G6 central leader had significantly higher tree efficiency than G6 bush
- Mahaleb has very low tree efficiency
  - In first 4 years, lots of wood and little fruit set
    - To properly recycle limbs (i.e. cut off the two biggest per year), we will be removing all wood with fruiting potential
- Montmorency on own root had no bloom in 2013

Future Management Considerations

- Issues with recycling limbs—will Montmorency push out a new limb when we leave a stub cut?
  - Evidence suggests Montmorency does not reliably push new limbs like sweet cherries

Considerations, cont.

- Will canopies be too dense to allow for adequate light penetration?
- Will we frost out more often with limbs too close to ground level?
- Is there a place for GA in this new system to manage crop loads?

Thanks!

- Michigan Cherry Committee
- NW Michigan Horticultural Research Foundation
- MSU Team: R. Perry, A. Iezzoni, J. Flore, G. Lang
- Bill Klein