Alternative Approaches to Growing and Harvesting Tart Cherry

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HISTORY:
Traditional Harvesting System Developed in 1960s

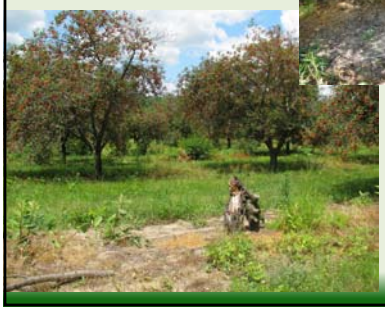
- Growth of the tart cherry industry accelerated in early 1960s with adoption of new technology which deployed branch and trunk shakers and catch-frame/tarps.
- The protocols called for growing large trees of the 'Montmorency' variety, planted at typical spacings of 15 X 20 feet (145 Trees / Acre)

Traditional Trunk-Shake Harvest System Used for Montmorency Cherry in Michigan Since the 1960's

Double-incline harvester

Tree / Orchard Longevity reduced – productive capacity years 6-22

Tree / Orchard Longevity reduced



Jacob McManus
"GROWER DECISION SUPPORT TOOL FOR CONVERSION TO A HIGH-EFFICIENCY TART CHERRY ORCHARD SYSTEM"
MS Thesis, MSU, AFRE, 2012

Standard Yield average peak per acre 8200 lbs / acre, mature trees.

NASS shows 6500 lbs/A 1984-2010

- ? profitability in the future
- Need to minimize input costs and/or maximizing returns.
- Produce with a minimal environmental footprint

Project objective initiated in 2008

"Investigate and develop alternative approaches to overall tart cherry production systems that address economic and environmental sustainability challenges through a combined/integrated approach of automation and orchard production systems"

Dr. Dan Guyer, Professor, BSAE, and Ron Perry, Professor, Hort, MSU

Michigan Cherry Producers – "Charge"

- Improve Economics/Profitability
  - Yield / Acre
  - Fruit uniformity
  - Years to commercial production / output
  - Extend orchard longevity?
- Sustainability
  - Productive cherry land = productive real estate
  - Avoid use of "Ethephon" to induce ripening and pedicel abscission
  - Spray drift / noise (smaller canopy = smaller sprayer)
- Fruit Quality
  - Returns to growers
  - Market utilization (including pit issue)

Continuous or Over The Row Harvesters

1. **High pressure air**
2. **Rotary-Tine, Spindle Tower**
3. Grape / Berry harvesters: Bow–Rod or Slap-Bar harvesters
4. Sideways Harvesters

"Side-ways" Harvester

Used successfully to harvest Haskap and Bush Cherries in Canada

Dr. Bob Bors, Department of Plant Sciences, University of Saskatchewan

Bow-Rod Grape Harvesters tested in Germany on Tart Cherry

No Success !!!

Olive Harvesters viewed in Calif; all Bow-Rods

Viewed several Olive harvesters in operation in Northern Sac Valley, Calif, F 2010
All were Bow-Rod mechanism (Grapes) and none appeared to have value for Cherry. Narrow threshold and Canopy of Olive much more willowy than cherry.

Oxbo Bow-Rod harvester which is a grape harvester modified to accommodate olives.

Oxbo tested On Monts in WA

BEI Blueberry Slap Harvester, attempted but failed to source for test in 2011

BEI Black Ice Berry Harvester Tested July 2010
High Power Air mechanism tested at Cherry Bay Orchards and Coloma on Tarts and Sweets

BEI Black Ice Berry Harvester Tested July 2010
High Power Air mechanism tested at Cherry Bay Orchards and Coloma on Tarts and Sweets; Not effective

Pomegranate harvester; Coe Co., Live Oak, CA

Preliminary Evaluations……..Tart Cherry

Poland 1992
Tractor Driven Continuous Move Harvester for Sour Cherry
Rotary-tine raspberry harvester

P. Wawrzyńczak, et. al, Research Institute of Pomology and Floriculture, Dept. of Horticultural Engineering, Skierniewice, Poland

Over The Row Harvest of Tart Cherry research began July 2008
Oxbo International 7420 @ Clarksville Research Center

Oxbo 930 Tested at CHES July 2009
proved too narrow thresh hold and aggressive…
severe damage to trees

Oxbo 9000 Tested at CRC July 2009
proved effective and efficient in harvesting MSU tart selections, seedlings and Monts in bush form, without damaging trees

Oxbo 9000 Tested at Wright Orchard, Belding, MI July 2009
harvested 4 acres of 5 yr old Monts efficiently and little tree damage

Oxbo 9000 Tested at Wright Orchard, Belding, MI July 2009
Rotary-Tine Tower Mechanism

BEI 3000 Tested July 2010
Rotary-Tine Tower harvester tested at Cherry Bay Orchards, Hartford, MI of 4 yr old Monts.

BEI 3000 Tested July 2010
Rotary-Tine Tower harvester tested at Cherry Bay Orchards, Rotary-Tine Tower mechanism

Alternative Approaches

- Reducing canopy volume to accommodate berry harvesters
  1. Compact scion genotypes
  2. Practices such as pruning, summer hedging, root pruning
  3. Dwarfing rootstocks
- Larger dimension harvesters – Rotary - Tine
  - Current commercial harvesters have tunnel dimensions 48" X 96" (exception; Littau ORXL 55"X96")

Challenges and Future Work

- 'Montmorency' standard tart cherry is a **large tree** – can we manage to **keep it compact** for **current berry harvesters?**
- Will equipment manufacturers build a larger dimension model to accommodate Montmorency?
- Need to evaluate **genetically compact varieties** to fit berry harvesters. Can they satisfy processing market?
- Is there a **rootstock that can dwarf canopies**?
- Can we harvest in research plots and retain treatment integrity?

1. Determine tart cherry genotypes that are naturally compact.

2. Identify practices that compact canopy volume to accommodate harvester.

3. Identify desirable canopy architecture that facilitates efficient fruit removal using berry harvesters.

Korvan / OXBO self propelled Spindle/tine shaker (commercial blueberry harvester – unmodified)

Early Adopters
Oxley Farms, Lawton, MI

Compact scion genotypes

- Carmine Jewel and others Univ of Sasketchewan
- P. Cerasus x Fruticosa hybrids

MSU Tart Cherry Breeding program, A. Iezzoni

Compact scion genotypes – Canopy Morphology

Spur type selections

Willowy type selections

Horticultural Practices

- Bush form
- Recycling branches
- Avoid branches perpendicular to row
- Summer Hedge
- Root pruning?

Early Adopters

Oxley Farms
Lawton, MI

Ken Engle, Williamsburg
20 acres

Ed Oxley, Lawton
20 acres

Calvin and Calvin Jr. Lutz
Bear Lake
17 acres +

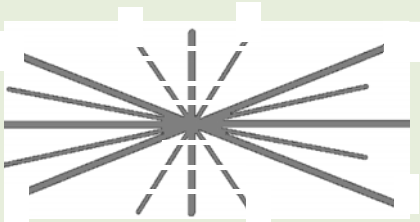
Ken Engle
Tall Spindle System
Williamsburg, MI
20 acres

Hypotheses

- Bush form will lead to compact canopy
- Pruning in winter
  - Hedging
  - Recycling branches > 1" diameter
- Summer hedging at 45 days post bloom will reduce canopy vigor.
- Core frame of branches @ 3' X 6'
- Varieties, including Montmorency respond differently to pruning
- Root pruning maybe an alternative treatment to check canopy vigor.

Top View

2' - 3'



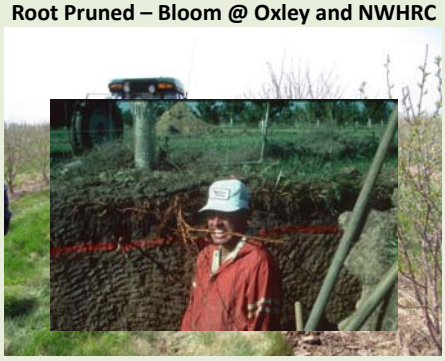
Dotted branches are recyclable, maintained within the 2' – 3' threshold for O.T.R. harvest. Jamie Burns, Res. Assistant, MSU, BSAE

Winter Hedge

Summer Hedge

Summer Hedging Treatment; 45 days Post Bloom

Root Pruned – Bloom @ Oxley and NWHRC



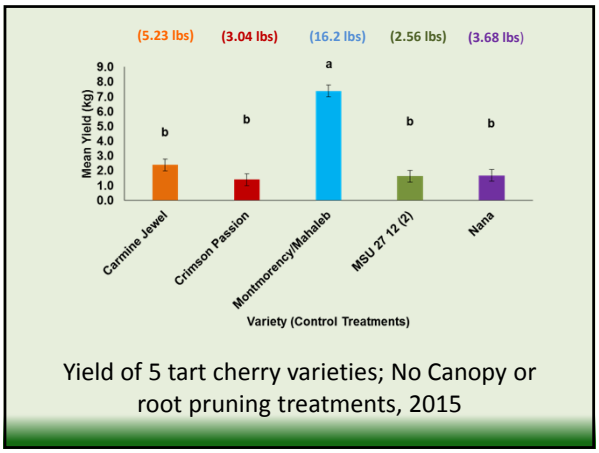
Separate study: Accomplished twice on Mont/Mah guard trees at NWHRC: Bloom and Pit Hardening

Univ. of Saskatchewan, Bush Varieties 2013

2015; Littau ORXL Berry Harvester supplied by Spring Brook Supply, South Haven, MI

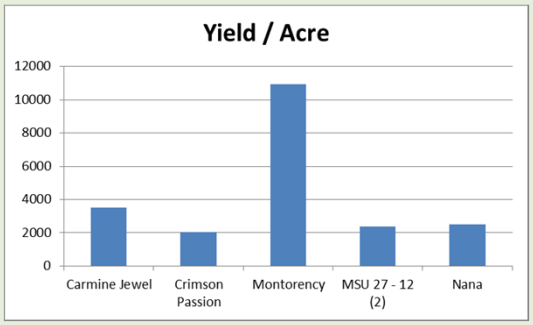
Video OTR Harvest

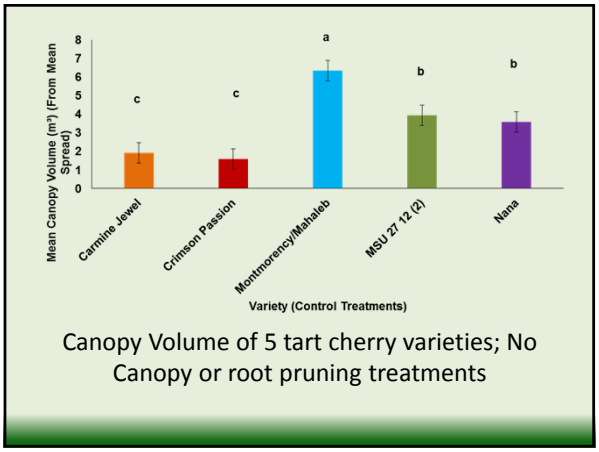
Cursory fruit quality assessment



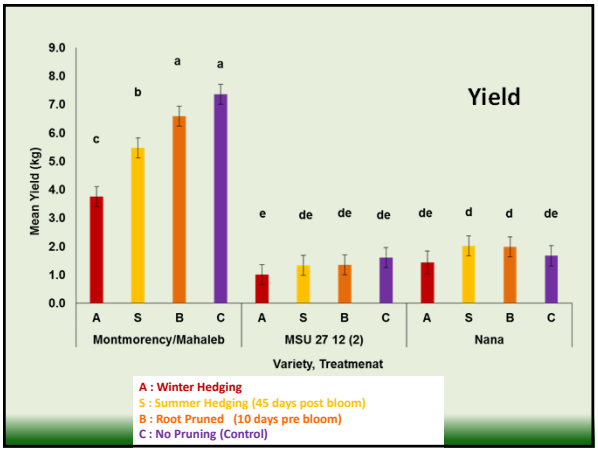
Yield of 5 tart cherry varieties; No Canopy or root pruning treatments, 2015

Yield in pounds of 5 varieties per acre, control treatment, 2015 at NWMHRC





Canopy Volume of 5 tart cherry varieties; No Canopy or root pruning treatments

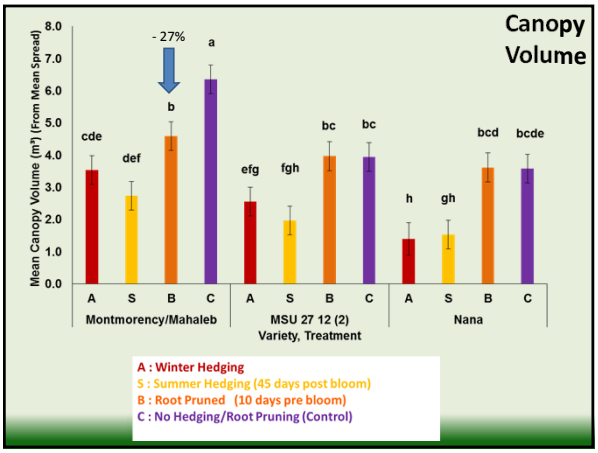


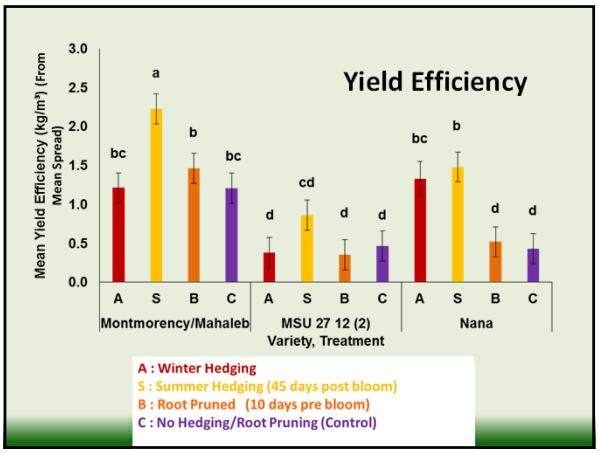
Yields per acre, 4&5th Growing Seasons

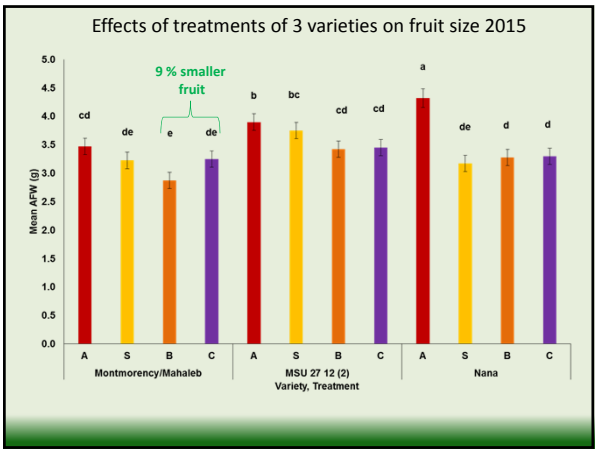
		Year 4	Year 5			*
Variety	Treatment	2014 (kg)	2015 (kg)	Total (kg)	lbs	lbs/Acre*
Mont/Mah	Winter Hedge	4.37	3.76	8.12	17.90	12045
	Sum Hedge	5.64	5.47	11.11	24.48	16474
	Root Prune	2.81	6.59	9.40	20.70	13931
	Control	8.51	7.36	15.87	34.95	23522
MSU 27 12 (2)	Winter Hedge	1.90	1.01	2.91	6.40	4307
	Sum Hedge	2.52	1.35	3.87	8.52	5732
	Root Prune	2.78	1.35	4.13	9.09	6116
	Control	2.98	1.62	4.59	10.11	6807
Nana	Winter Hedge	4.12	1.44	5.56	12.26	8250
	Sum Hedge	6.64	2.03	8.66	19.08	12843
	Root Prune	6.07	1.99	8.05	17.73	11935
	Control	5.80	1.67	7.47	16.46	11078

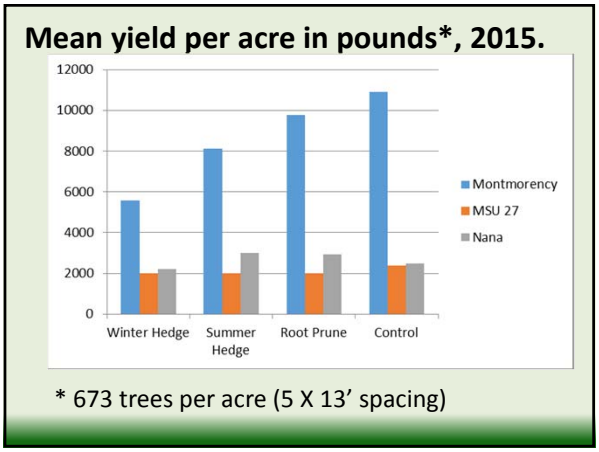
* At 673 trees / acre 5 X 13 feet spacing

Standard Yield average peak per acre 8200 lbs / acre, mature trees (McManus, 2012) * 5 X 13 feet spacing = 670 trees / Acre

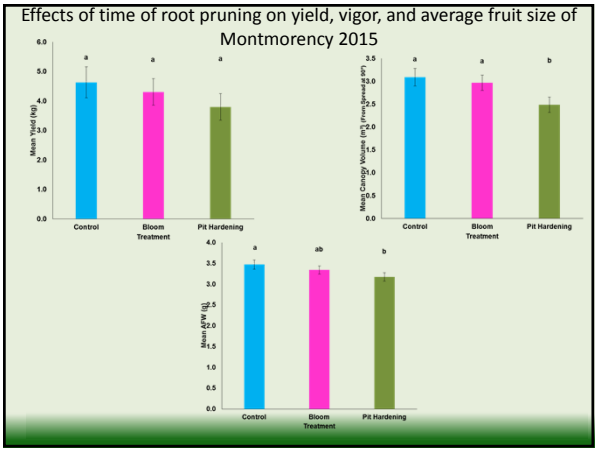






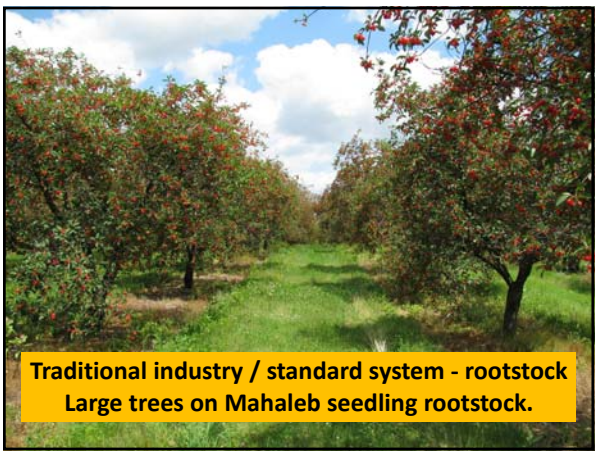


* 673 trees per acre (5 X 13' spacing)



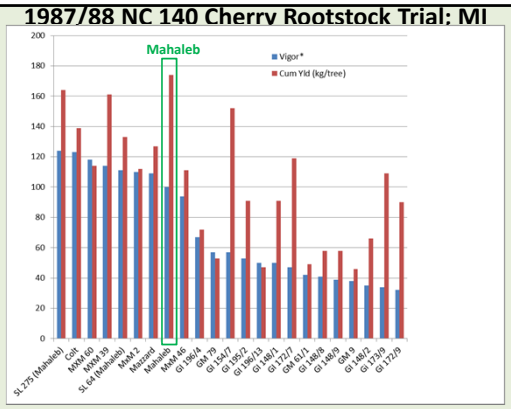
High Density apple and sweet cherry systems today, owe success to adoption of dwarfing rootstocks!!

Dwarfing rootstocks may be critical to success of high density tart cherry Over The Row Harvest systems in the future?

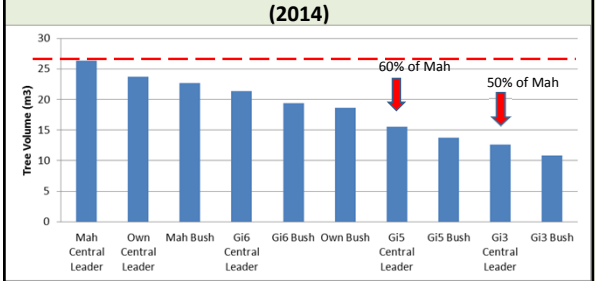


Traditional industry / standard system - rootstock
Large trees on Mahaleb seedling rootstock.

1987/88 NC 140 Cherry Rootstock Trial: MI



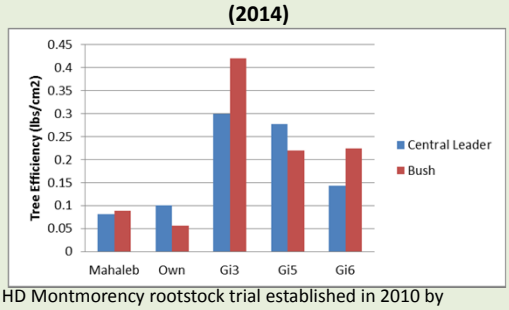
Canopy vigor of Montmorency on 5 rootstocks at NWHRC (2014)



HD Montmorency rootstock trial established in 2010 by Rothwell and Lang at NWHRC, Traverse City, MI

From: Report to MCC by N. Rothwell, 2015

Yield Efficiency of Montmorency on 5 rootstocks at NWHRC (2014)



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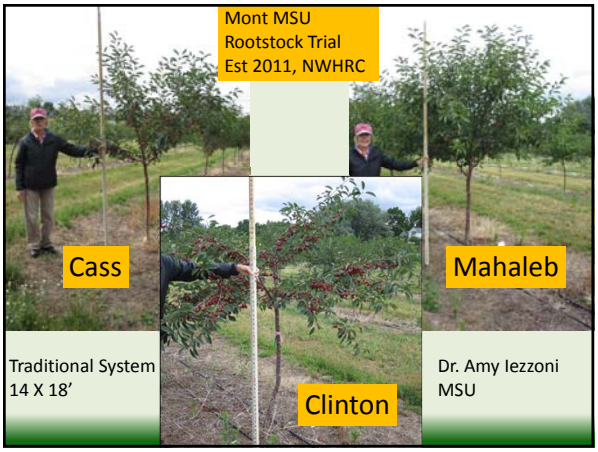
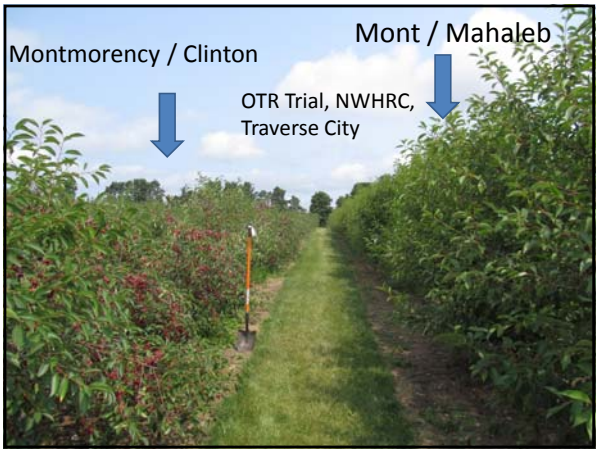
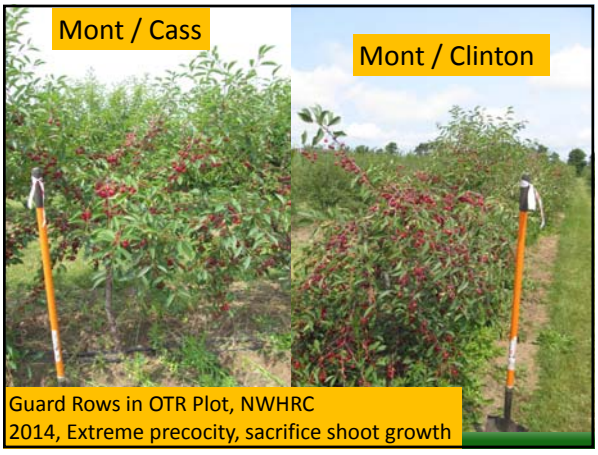
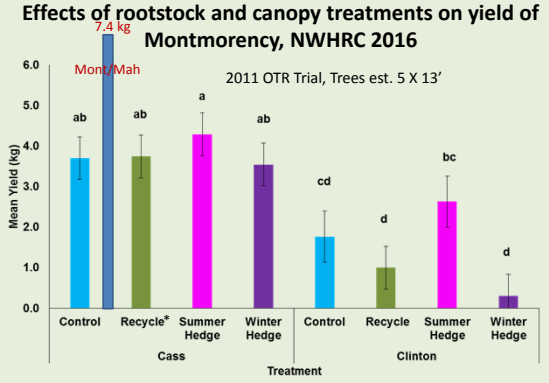




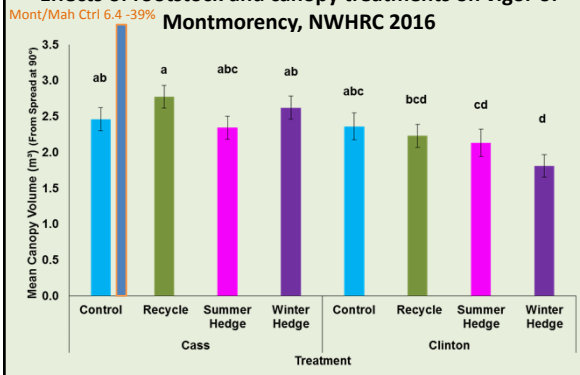


Effects of rootstock and canopy treatments on yield of Montmorency, NWHRC 2016

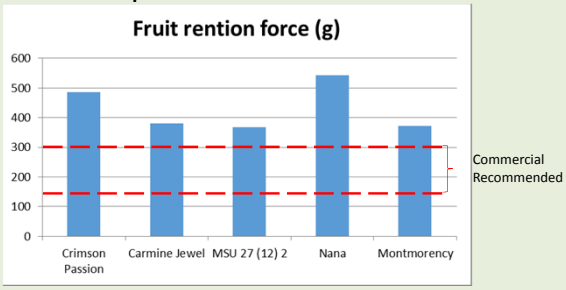


*2 large branches cut back to 8" stubs

Effects of rootstock and canopy treatments on vigor of Montmorency, NWHRC 2016



Pull force (g) required to separate fruit from pedicels* at NWHRC 2015**



* 50 randomly selected, fruit samples
** Control treatments only, no Ethephon treatment

Benefits of OTR System

- Gentler system – can work with trees/plants in 2nd leaf vs 5th-6th leaf after planting
- Less drop height (collection point)
- Will affect fruit quality and condition
- Can possibly avoid application of Ethephon
- Decrease trunk damage / disease
- Increase harvest efficiency w/ continuous harvest
- Increased fruit uniformity
- Can need less labor for harvest

Preliminary Conclusions

- **Rotary-Tine Harvesters are very effective and efficient in fruit removal with minimal damage to canopy.**
- **Ethephon applications to induce fruit abscission may not be necessary**
  - **Harvested fruit at Oxley Farms at 95%+ rate @ 650-750 g pull force**
  - **Harvested fruit at NWHRC at 98%+ rate @ 360-540 g pull-force**
- **Fruit is removed and delivered in clean state with little damage and few stems and leaves.**
  - **Need to demonstrate empirical evidence of improved delivered product re: fruit quality in future research. "perceived" or "real"**
- **Questions…..??????????????**
  - **To keep trees compact for smaller harvesters as trees age, what will be the horticultural protocol omitting use of dwarfing rootstocks??**
  - **Do we need to canopy prune / root prune annually or biennially???**

Thank You..s

- Ed and Chris Oxley; plot cooperator and management Oxley Farms, Lawton, MI
- Nikki Rothwell; plot cooperator NWHRC
- Luis Hull; 2015 harvester operator
- Tammy Wilkinson; data processing
- NWHRC Farm manager Bill Klein and staff
- Spring Brook Supply; harvester source and cooperator
- MSU Research Team – D.Guyer, ABE, N. Rothwell, NWHRC, A. Iezzoni, Hort, G. Lang, Hort, J. Flore, Hort


Tammy Wilkinson
Dan Guyer
Amy Iezzoni
NWHRC
Hand Harvest
July 28, 2014
NWHRC Crew
Nikki Rothwell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MICHIGAN CHERRY COMMITTEE
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Project GREEEN
Michigan State Horticultural Society
Michigan Tree Fruit Commission