

Update on the MSU Dwarfing Cherry Rootstocks

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CASS



CLARE



CLINTON



CRAWFORD



LAKE

FRUIT SCHOOL, Feb. 12, 2019

Outline

- History
- Performance with sweet cherry
- Performance with Montmorency
- Availability

History



Tart cherry is a hybrid species with sweet cherry and ground cherry as its parents.

To start the MSU tart cherry breeding program, plant materials were collected in the center of diversity, Europe and Russia.

The MSU rootstocks were selected at Clarksville from this germplasm.



Selection Criteria

- Propagated vegetatively
- Tolerant to PDV and PNRSV
- Dwarfs the scion
- Induces early scion flowering and fruiting
- Graft compatible



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MSU Cherry Rootstocks Were Tested with 'Bing' Scion in Prosser, WA

MSU rootstocks planted in 2009. Photos taken in 2011.

Five rootstocks were selected and temporarily named after Michigan counties.



A replicate trial was also planted at Clarksville with 'Hedelfingen' scion.

In Year 2, Four Precocious MSU Rootstocks Were Advanced

Gi6



CASS



CLARE



CLINTON



LAKE

In Year 3 (2013) the 5th Dwarfing Precocious MSU Cherry Rootstocks Were Selected

Gi5



CASS



CLARE



CLINTON



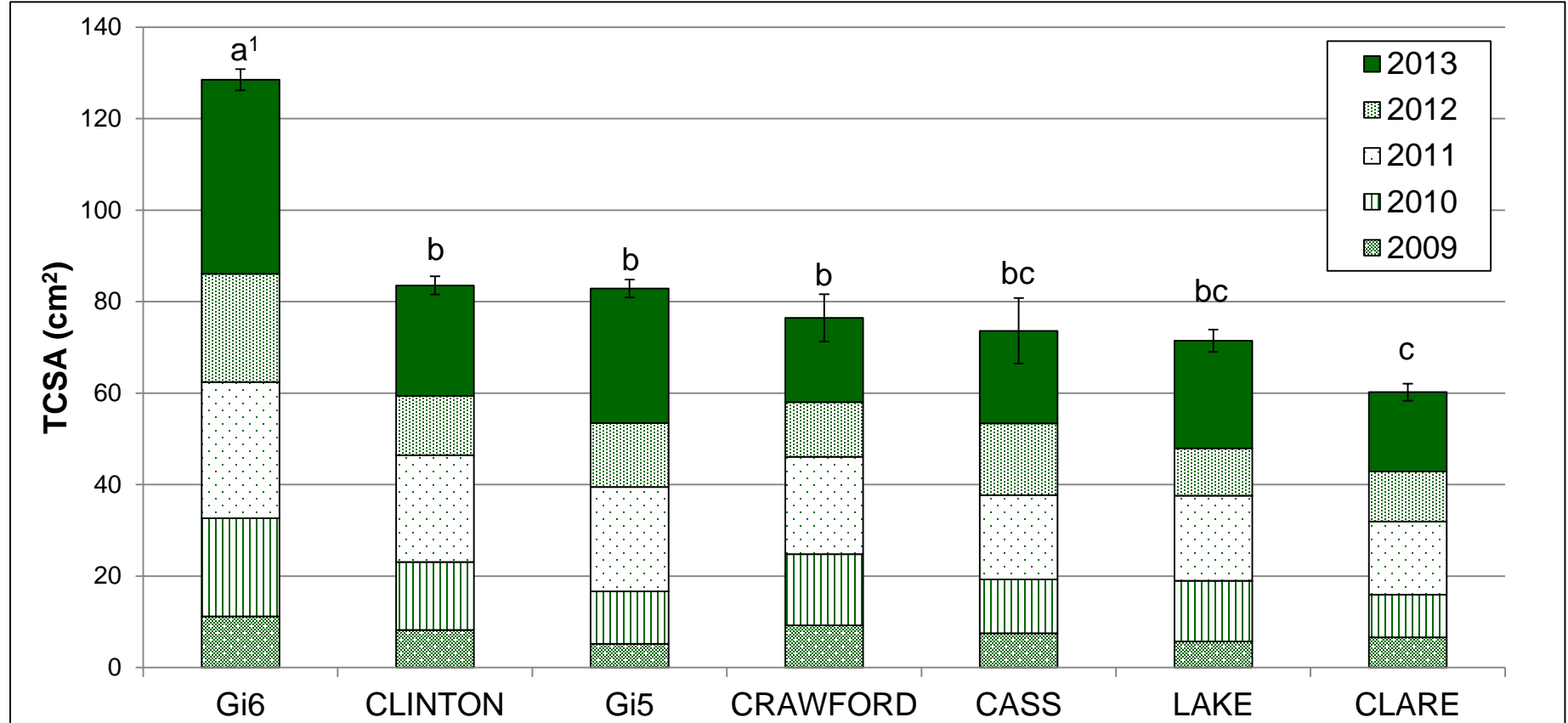
LAKE



CRAWFORD

All 5 MSU cherry rootstocks result in trees that are either the size of Gi5 or smaller

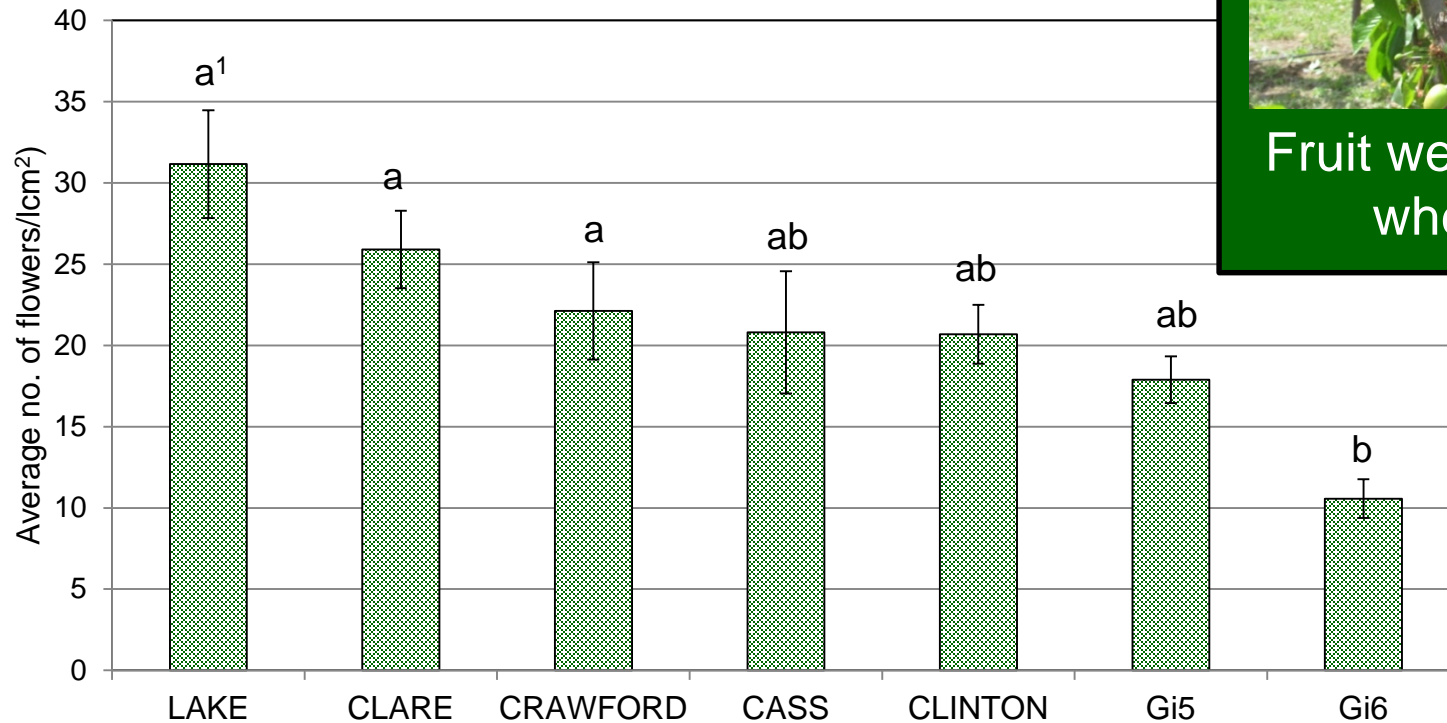
Trunk cross-sectional area of 'Bing' trees grafted on 5 MSU rootstock and Gi5 and Gi6 controls planted in 2009 at WSU-Prosser.



¹Means that are significantly different for 2013 TCSA ($P < 0.05$) are denoted by different letters.

All 5 MSU cherry rootstocks have continued to induce abundant flowering

2013: Average number of flowers per leader cross-sectional area



Fruit were hand thinned when pea-size

¹Means that are significantly different ($P < 0.05$) are denoted by different letters.

The yield efficiencies of all 5 MSU rootstocks are either equivalent to or higher than that with Gi5 and Gi6

Yield efficiencies (kg/cm²) measured in 2012 and 2013

Rootstock selection	2012 Yield efficiency (kg/cm ²)	2013 Yield efficiency (kg/cm ²)
Gi5	0.066 ab	0.107 b
Gi6	0.037 b	0.091 b
CASS	0.059 ab	0.120 ab
CLARE	0.086 a	0.160 a
CLINTON	0.086 a	0.161 a
CRAWFORD	0.099 a	0.173 a
LAKE	0.106 a	0.118 ab



¹Pea-sized fruit were thinned by 50% in 2012. In 2013, fruit were thinned based on achieving standard crop loads for each selection.

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There were no significant differences in 'Bing' fruit size among any of the rootstocks.

Fruit weight and row size for 'Bing' in 2012 and 2013

Rootstock selection	2012 Fruit weight (g)	2013 Fruit weight (g)	2012 Mean row size	2013 Mean row size
Gi5	10.2 a ²	11.1 a	9.8 a	9.6 a
Gi6	9.6 a	10.4 a	9.9 a	9.8 a
CASS	10.3 a	10.7 a	9.7 a	9.8 a
CLARE	9.9 a	10.3 a	9.9 a	9.8 a
CLINTON	10.1 a	10.5 a	9.8 a	10.0 a
CRAWFORD	9.5 a	9.3 a	10.0 a	10.2 a
LAKE	9.0 a	9.6 a	10.1 a	10.0 a

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Second Set of Sweet Cherry Trials With Bernardita Sallato - WSU

Compare the performance of the MSU cherry rootstocks to currently available rootstocks using intensive cherry production systems.

2015 plantings (The Dalles, OR; Mattawa & Wenatchee, WA) – CASS, CLARE, CLINTON and LAKE – ‘Early Robin’, ‘Regina’, ‘Sweetheart’



The Dalles



Mattawa

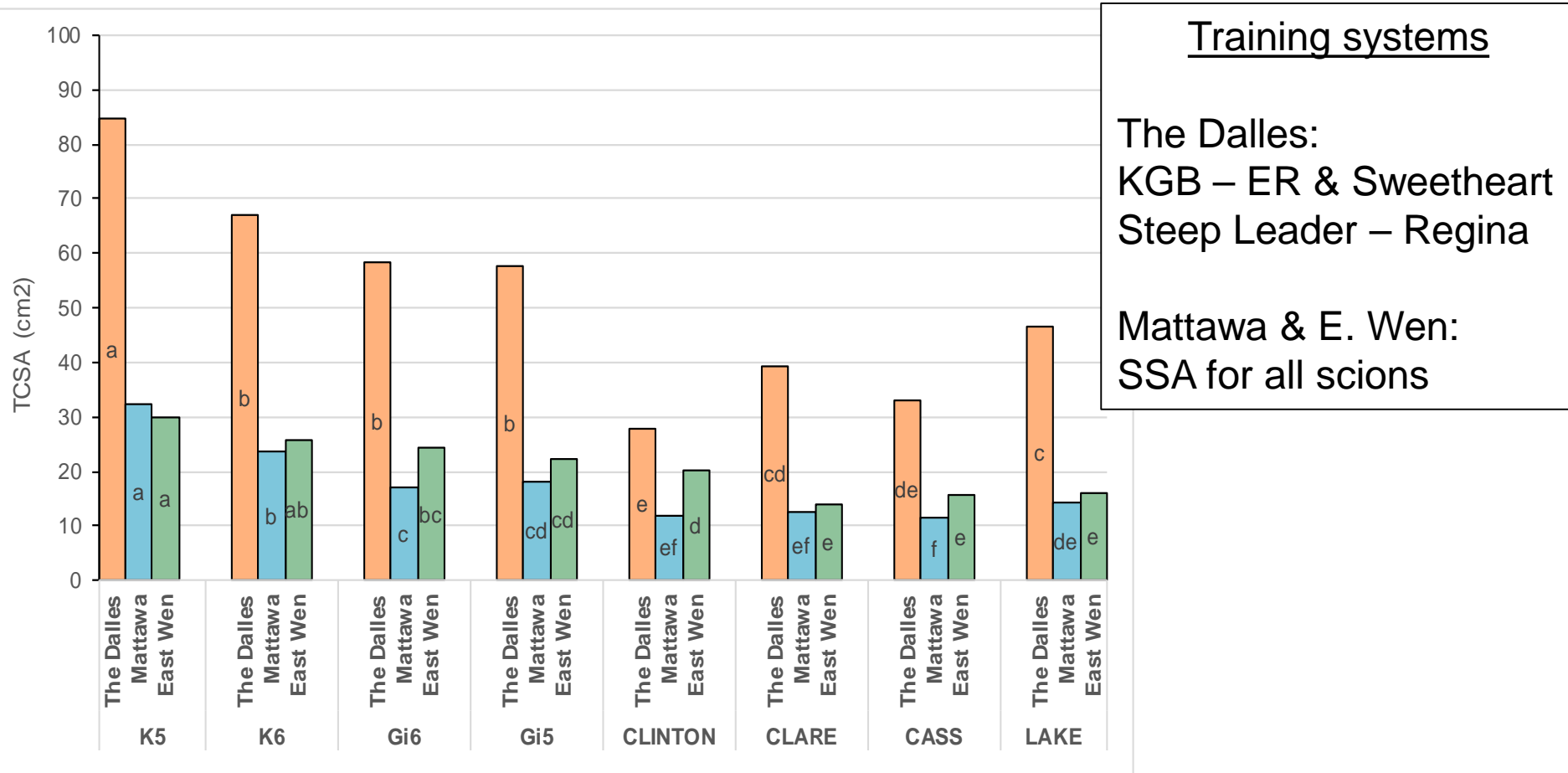


East Wenatchee

2017 planting (The Dalles, OR; Mattawa & Wenatchee, WA) – CRAWFORD, CLINTON and ‘Regina’ on CASS

TCSA Summed Across the Three Scions

Trees on MSU rootstocks are significantly smaller than trees on the control rootstocks for the 2015 plantings.



Spring Crop Load Ratings for 'Early Robin'

The Dalles, 0=no crop, 7=perfect crop load

Rootstock selection	Crop Load Rating
Gi5	8.0 ab ¹
Gi6	8.3 ab
K6	5.3 d
CASS	7.2 bc
CLARE	7.3 bc
CLINTON	8.6 a
LAKE	6.5 c

¹Means that are significantly different ($P < 0.05$) are denoted by different letters.



The Dalles – ‘R’ (Steep leader), ‘SH’ (KGB)

With both cultivars, the highest tree yields were obtained with Gi5 & Gi6. However, projected per acre yields tended to level out based on different tree spacings¹.

Rootstock selection	Regina			Sweetheart		
	Tree yield (lb)	Tons per acre	Fruit weight (g)	Tree yield (lb)	Tons per acre	Fruit weight (g)
Gi5	23.8 ab ²	7.4 a	10.9 a	51.2 a	15.9 a	8.9 ab
Gi6	30.1 a	9.4 a	9.9 ab	45.2 ab	14.1 ab	9.0 ab
K6/K5	22.2 ab	6.9 a	11.3 a	19.0 d	4.9 c	10.0 a
CASS	23.6 ab	9.2 a	10.2 ab	27.8 cd	10.8 b	8.6 b
CLARE	13.6 b	5.3 a	11.2 a	29.5 cd	11.5 b	9.7 ab
CLINTON	22.7 ab	8.8 a	9.5 b	32.9 bc	12.8 b	8.7 b
LAKE	15.0 b	5.9 a	11.3 a	34.2 bc	13.3 ab	9.4 ab

¹1519 trees/acre (6 ft x 14 ft) for K5; 622 trees/acre (5 ft x 14 ft) for K6, Gi5 and Gi6, and 778 trees/acre (4 ft x 14 ft) for Clare, Cass, Clinton and Lake.

²Means that are significantly different (P < 0.05) are denoted by different letters.

MSU rootstocks induce scion dwarfing & precocity; but, success will depend upon the implementation of cultural practices tailored to the cultivar & training system

Track the MSU rootstock performance in trials with PNW grower cooperators that are experimenting with a wider range of scions and orchard systems.

PNW trials planted in 2016 and 2017



'Coral' – Pasco, WA



'Benton' – Mattawa, WA

Plantings encompass 7 scions & 4 training systems

Outline

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- Performance with Montmorency
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Over-the-row Harvesting in 2016

'Montmorency'/Cass Planted in 2011 (Mich)



Clare Pruned in an Over-the-Row Plot (2015)



Comparison of Bloom Timing



'Montmorency'/Cass

'Montmorency'/Clinton

Evaluate production and fruit quality of Montmorency on MSU dwarfing rootstocks and OTR harvesting

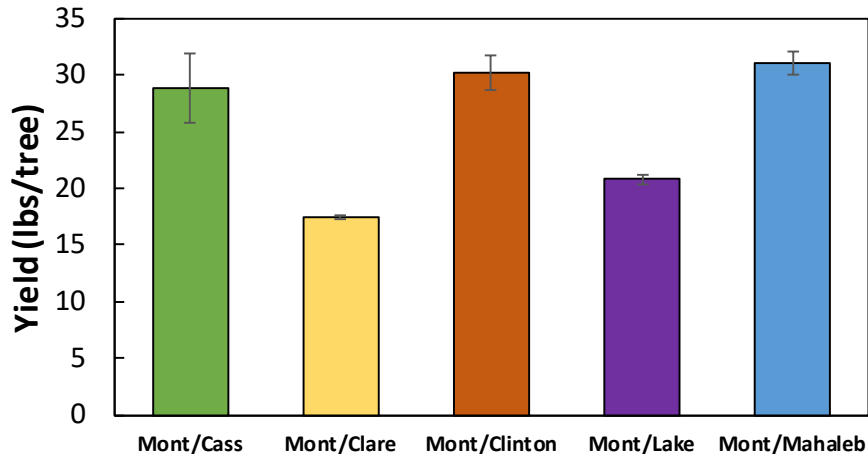
Experimental Design:

- 2011 planting
- Spacing: 5 x 13 ft. (670 trees per acre)
- Rootstocks: Lake, Clare, Cass, Clinton, Mahaleb
- Harvested Over the Row



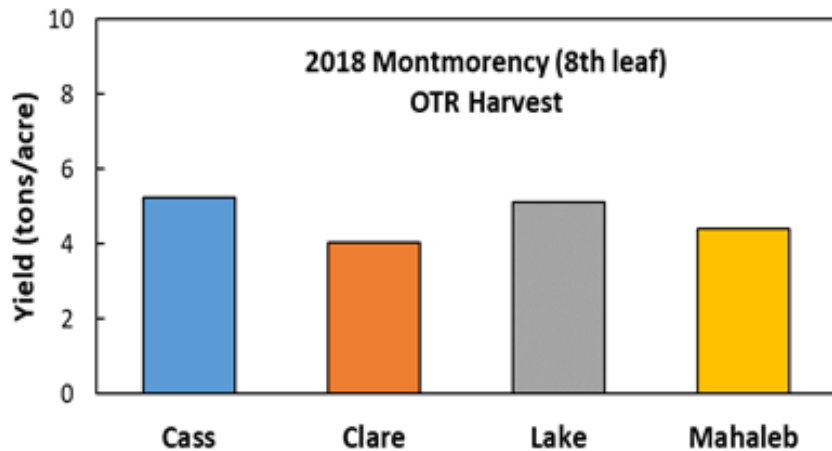
Evaluate production of Montmorency on MSU dwarfing rootstocks and OTR harvesting

2017 Mont/MSU Rootstocks OTR Harvest



- 7th leaf yields on dwarfing rootstocks similar to Mahaleb (as high as 10 tons per acre)
- 8th leaf Montmorency trees on MSU rootstocks are ~40% the size of Mont/Mahaleb trees.

2018 Montmorency (8th leaf) OTR Harvest



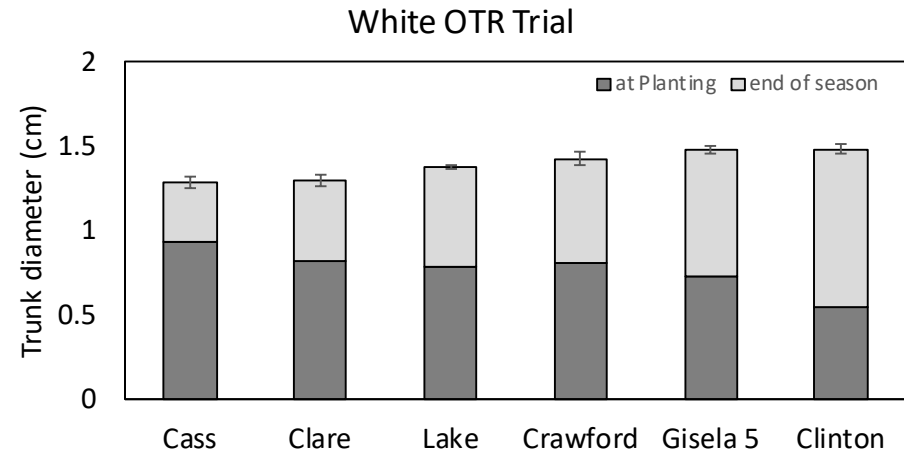
- Despite their compact canopies, Montmorency trees on dwarf roots continued to yield similarly to Mahaleb, projected as ~5 tons per acre
- Consider different spacings?

Experimental Design:

- Montmorency trees planted in spring 2017
- 2 Sites: Manistee, Elk Rapids
- Tree spacing: 5 ft. x 12 ft.
- 4 blocks, 20 trees/rep
- Training systems
 - Bush, Vertical axe
- Rootstocks
 - Clare, Clinton, Crawford, Cass, Lake
 - Gisela 5

Tree (no.)	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8	Row 9	Row 10
1	Guard row	Rep 1		Rep 2		Rep 3		Rep 4		Guard row
2	Mont/Mahaleb	Guard tree	Guard tree	Guard tree	Guard tree	Guard tree	Guard tree	Guard tree	Guard tree	Mont/Mahaleb
3	Mont/Mahaleb	Guard tree	Guard tree	Guard tree	Guard tree	Guard tree	Guard tree	Guard tree	Guard tree	Mont/Mahaleb
4	Mont/Mahaleb	TS 2	TS 1	TS 1	TS 2	TS 1	TS 2	TS 2	TS 1	Mont/Mahaleb
5	Mont/Mahaleb									
6	Mont/Mahaleb									
7	Mont/Mahaleb									
8	Mont/Mahaleb									
9	Mont/Mahaleb	TS 2	TS 1	TS 1	TS 2	TS 1	TS 2	TS 2	TS 1	Mont/Mahaleb
10	Mont/Mahaleb									
11	Mont/Mahaleb									
12	Mont/Mahaleb									
13	Mont/Mahaleb									
14	Mont/Mahaleb	TS 2	TS 1	TS 1	TS 1	TS 1	TS 2	TS 2	TS 1	Mont/Mahaleb
15	Mont/Mahaleb									
16	Mont/Mahaleb									
17	Mont/Mahaleb									
18	Mont/Mahaleb									
19	Mont/Mahaleb	TS 2	TS 1	TS 1	TS 2	TS 1	TS 1	TS 2	TS 1	Mont/Mahaleb
20	Mont/Mahaleb									
21	Mont/Mahaleb									
22	Mont/Mahaleb									
23	Mont/Mahaleb									
24	Mont/Mahaleb	TS 2	TS 1	TS 1	TS 2	TS 1	TS 1	TS 2	TS 1	Mont/Mahaleb
25	Mont/Mahaleb									
26	Mont/Mahaleb									
27	Mont/Mahaleb									
28	Mont/Mahaleb									
29	Mont/Mahaleb	TS 1	TS 1	TS 1	TS 2	TS 1	TS 2	TS 2	TS 1	Mont/Mahaleb
30	Mont/Mahaleb									
31	Mont/Mahaleb									
32	Mont/Mahaleb									
33	Mont/Mahaleb									
34	Mont/Mahaleb	TS 1	TS 1	TS 1	TS 2	TS 1	TS 2	TS 2	TS 1	Mont/Mahaleb
35	Mont/Mahaleb									
36	Mont/Mahaleb									
37	Mont/Mahaleb									
38	Mont/Mahaleb									
39	Mont/Mahaleb	TS 2	TS 1	TS 1	TS 2	TS 1	TS 2	TS 1	TS 1	Mont/Mahaleb
40	Mont/Mahaleb									
41	Mont/Mahaleb									
42	Mont/Mahaleb									
43	Mont/Mahaleb									
44	Mont/Mahaleb	TS 2	TS 1	TS 1	TS 2	TS 1	TS 2	TS 1	TS 1	Mont/Mahaleb
45	Mont/Mahaleb									
46	Mont/Mahaleb									
47	Mont/Mahaleb									
48	Mont/Mahaleb									
49	Mont/Mahaleb	Guard tree	Guard tree	Guard tree	Guard tree	Guard tree	Guard tree	Guard tree	Guard tree	Mont/Mahaleb
50	Mont/Mahaleb									
51	Mont/Mahaleb									
52	Mont/Mahaleb									
53	Mont/Mahaleb									
54	Mont/Mahaleb	Guard tree	Guard tree	Guard tree	Guard tree	Guard tree	Guard tree	Guard tree	Guard tree	Mont/Mahaleb
55	Guard row	Rep 1		Rep 2		Rep 3		Rep 4		Guard row

- Very low mortality rates for all rootstocks (< 3%)
- Differences in trunk growth were relatively minor
- Trees under-sized from nursery



MSU Rootstock Plot – Bloom 2015



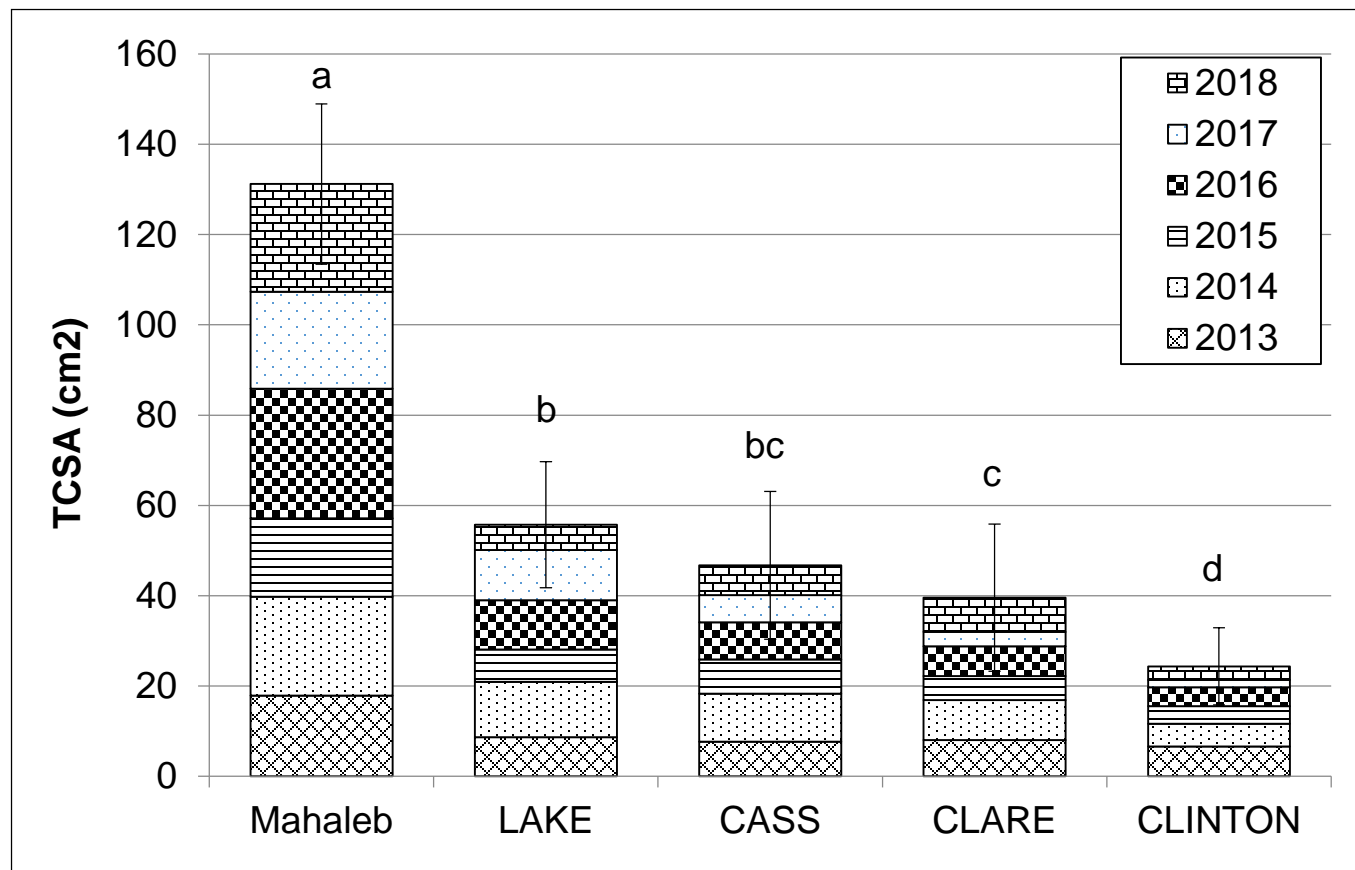
Trees planted in 2011

MSU Rootstock Plot

'Montmorency'/Cass
Picture taken in 2014, tree
planted in 2011



TCSA for MSU Rootstocks Planted at the NWMHRS



¹Means that are significantly different ($P < 0.05$) are denoted by different letters.

Yield per Acre for MSU Rootstocks planted at NWMHRC

Rootstocks	2013	2014	2015	2016	2017	2018	Total
LAKE	125 b	4573 a	9559 a	10,175 ab	22,262 a	43,914 a	90,512 a
CASS	156 b	4573 a	9501 a	11,036 a	19,903 a	28,024 bc	72,457 a
CLARE	161 b	5509 a	8446 ab	5695 bc	20,439 a	36,003 ab	75,708 a
CLINTON	464 a	6092 a	5479 bc	2308 c	16,301 a	9,070 d	38,799 b
Mahaleb	12 b	1200 b	4410 c	5166 c	13,388 a	21,775 c	45,952 b

¹Corresponds to 14 × 18 foot spacing

²Corresponds to 5 × 13 foot spacing

³Means that are significantly different ($P < 0.05$) are denoted by different letters

Fruit Quality Measurements for MSU Rootstocks planted at NWMHRC

Rootstock	Pull force (g) ²					SSC ³				
	2014	2015	2016	2017	2018	2014	2015	2016	2017	2018
Mahaleb	328 b ¹	347 a	322 b	370 a	213 a	13.8 b	13 a	14.0 ab	12.5 a	12.6 a
LAKE	357 ab	354 a	398 ab	387 a	228 a	14.6 ab	14 a	14.4 ab	13.6 a	13.3 a
CASS	376 ab	396 a	409 ab	343 a	247 a	14.3 ab	14 a	14.8 ab	13.0 a	13.6 a
CLARE	445 a	330 a	418 ab	343 a	222 a	14.6 ab	15 a	13.7 b	13.7 a	13.7 a
CLINTON	318 b	376 a	502 a	400 a	248 a	15.2 a	15 a	15.1 a	13.3 a	13.9 a

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²Pull force was measured from 10 fruit per tree and averaged

³Soluble solids content was measured from the bulk juice of 20 fruit

Fruit Quality Measurements for MSU Rootstocks planted at NWMHRC

Rootstock	Fruit weight (g) ¹					Fruit firmness (g/mm) ²				
	2014	2015	2016	2017	2018	2014	2015	2016	2017	2018
Mahaleb	4.3 ab ³	4.0 b	5.2 ab	4.9 a	4.7 a	131 a	126 a	122 a	121 a	117 a
LAKE	4.5 a	4.9 ab	5.1 ab	5.0 a	4.9 a	125 b	123 a	122 a	119 a	118 a
CASS	4.3 ab	4.6 ab	5.3 ab	4.7 a	4.6 a	125 ab	126 a	120 a	122 a	120 a
CLARE	4.0 b	4.3 b	4.4 b	4.7 a	5.1 a	123 b	120 a	124 a	117 a	111 a
CLINTON	4.4 ab	5.3 a	5.7 a	4.5 a	4.6 a	123 b	125 a	122 a	252 a	123 a

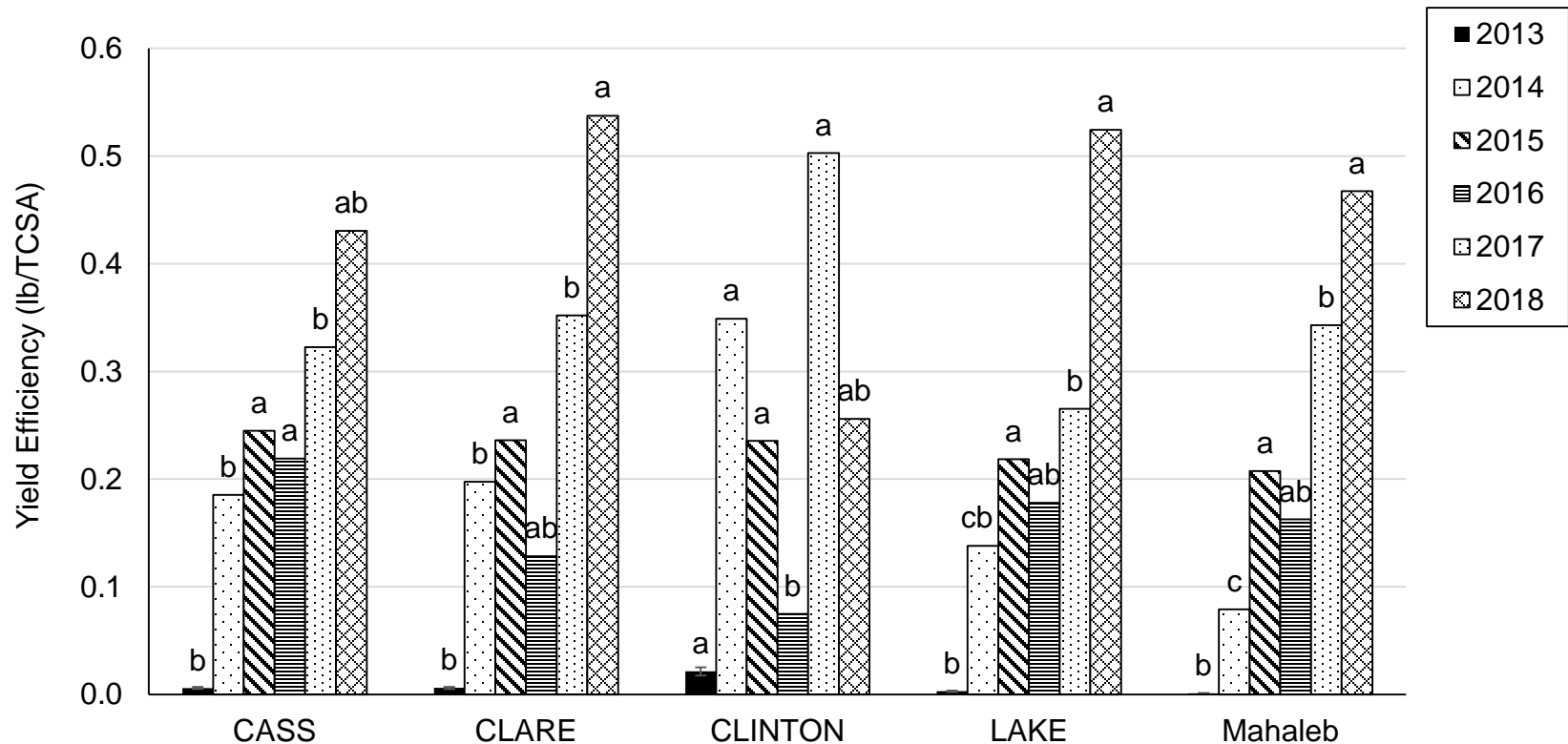
¹Fruit weight was measured as the bulk weight of 20 fruit

²Fruit firmness was measured from 25 fruit per tree

³Means that are significantly different ($P < 0.05$) are denoted by different letters

Yield Efficiency

MSU Rootstocks planted at NWMHRC



¹Yield efficiency (kg/cm²) for 2013 is as follows: CASS 0.006, CLARE 0.006, CLINTON 0.022, LAKE 0.003, and Mahaleb 0.001

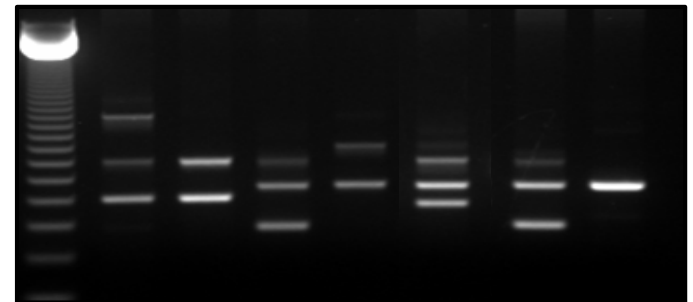
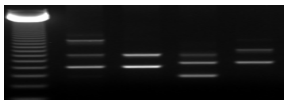
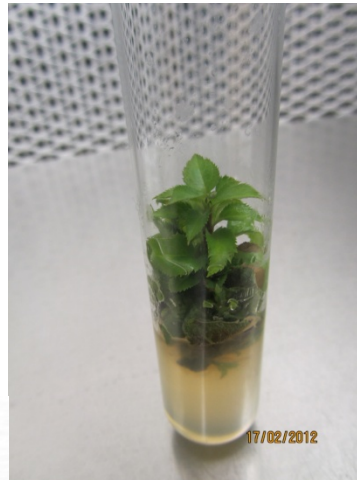
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- Performance with Montmorency
- **Availability**

A pipeline was put in place for virus certification & genetic verification

Virus certified and genetically verified plant materials (true-to-type) of all 5 MSU rootstocks were provided to 9 collaborating liner and finish tree nurseries to test nursery performance.



No barriers to nursery performance have been identified

Liner
performance -
Good



Bud take and
finished tree
performance –
Excellent
(extra trees
obtained due to the
high bud take)



Commercialization

Collaborate with nurseries and the Clean Plant Center NW – Fruit Trees to ensure MSU cherry rootstocks are available as virus certified and genetically verified.

Outcomes:

- The MSU rootstocks were trademarked under the name Corette™, patents were applied for, and the rootstocks are commercially available.
- The Iezzoni lab provides DNA diagnostic support as needed at no cost to the collaborating nurseries to assure rootstock trueness-to-type at various stages of liner and finished tree production.

Licensed Nurseries

In the U.S. our current licensees are:

- Sierra Gold
- ProTree
- Gold Crown Nursery
- North American Plants
- Phytelligence



CASS



CLARE



CLINTON



CRAWFORD



LAKE

Corette® Series Rootstock Availability

MSU released the Corette® series of dwarfing cherry rootstocks on a limited basis.

- Licensee's are limited to selling less than or equal to 2000 plants of each line per year, and no more than 1000 of those plants may be grafted to the same scion.
- This limitation applies while I complete field evaluation and the NC-140 trials are completed.
- MSU is willing to grant increases to these limits as justified by the circumstances.
- We are continuing to collect data from purchasers of the trees and from the licensed nurseries on rootstock and scion performance.

Acknowledgements

- Todd Einhorn, Lynn Long, Tom Auvil, Bernardita Sallato, Audrey Sebolt, Nikki Rothwell, Karen Powers and the NWMHRC crew
- Ron Perry
- Washington Tree Fruit Research Commission, Oregon Sweet Cherry Commission, Michigan Cherry Committee