FINAL PROJECT REPORT

Project Title: Establishment and testing of MSU sweet cherry rootstocks

PI: Amy Iezzoni
Organization: Mich. State Univ.
Telephone: (517) 355-5191 ext 1391
Email: iezzoni@msu.edu
Address: Dept. of Horticulture
Address 2: Mich. State Univ.
City: East Lansing
State/Zip: MI 48824

Co-PI(2): Matt Whiting
Organization: Wash. State Univ.
Telephone: (509) 786-9260
Email: mdwhiting@wsu.edu
Address: IAREC
Address 2: 24106 N. Bunn Rd.
City: Prosser
State/Zip: WA 99350

Co-PI(3): James Susaimuthu
Organization: National Clean Plant Network
Telephone: (509) 786-9251
Email: james.susaimuthu@wsu.edu
Address: IAREC
Address 2: 24106 N. Bunn Rd
City: Prosser
State/Zip: WA 99350

Co-PD(4): Tom Auvil
Organization: WTFRC
Telephone: (509) 665-8271
Email: auvil@treefruitresearch.com
Address: 1719 Springwater Ave.
Address 2:
City: Wenatchee
State/Zip: WA 98801

Other funding sources: None

Total Project Funding: $ 114,302

Budget History:

WTFRC

Item	2011	2012	2013
Salaries[1]	$9,000	$9,270	$9,550
Benefits[1]	$2,880	$2,966	$3,056
Crew Wages & Benefits[1]	$1,022	$1,533	$2,555
Equipment			
Supplies			
Travel			
Plot Fees			
Miscellaneous			
Total	$ 12,902	$ 13,769	$ 15,161

Footnotes:
[1]This represents an allocation of time of WTFRC salaried and hourly employees to help with the activities associated with the test plots in Wash. and Ore.

Budget 1: Amy Iezzoni
Organization Name: Mich. State Univ**.** **Contract Administrator:** Lorri Busick
Telephone: (517) 355-5191 x 1363 **Email address:** busick@msu.edu

Item	2011	2012	2013
Salaries[1]	$5,650	$5,820	$5,995
Benefits[1]	$2,395	$2,506	$2,622
Wages[2]	$500	$500	$500
Benefits[2]	$38	$38	$38
Equipment			
Supplies	$500	$500	$500
Travel	$1,000	$1,000	$1,000
Misc.			
Plot cost	$1,000	$1,000	$1,000
Total	$11,083	$11,364	$11,655

Footnotes:
[1]Partial salary support for project technician Audrey Sebolt (fringe rates 42.38% 2001, 43.05% 2012, 43.73% 2013).
[2]Funding for an undergraduate student helper (fringe rate 7.65%).

Budget 2: James Susaimuthu
Organization Name: National Clean Plant Network **Contract Administrator:** James Susaimuthu
Telephone: (509) 786-9251 **Email address:** james.susaimuthu@wsu.edu

Item	2011	2012	2013
Virus testing	$ 10,800	$ 0	$ 0
Total	$ 10,800	$ 0	$ 0

Footnotes: Virus testing of the 9 MSU rootstock candidates @ $1,200 selection.

Budget 3: Matt Whiting
Organization Name: WSU - Prosser **Contract Administrator:** Mary Lou Bricker
Telephone: (509) 335-7667 **Email address:** mdeseros@wsu.edu

Item	2011	2012	2013
Salaries[1]	$2,550	$2,652	$2,758
Benefits	$1,250	$1,299	$1,351
Wages	$3,500	3,500	$3,500
Benefits	$336	$336	$336
Equipment			
Supplies	$200	$200	$200
Travel	$200	$200	$200
Plot charges[2]	$1,000	$1000	$1000
Miscellaneous			
Total	$9,036	$9,187	$9,345

Footnotes:
[1]One month technician salary for oversight of orchard, plant measurements, yield and quality assessments and data management
[2]Charges for irrigation and maintenance of the orchard (pesticides, fertilizers, mowing).

OBJECTIVES:

Overall project objective: Identify dwarfing precocious rootstocks that increase the profitability of sweet cherry production in the PNW through the establishment and evaluation of trees in test plots.

Specific objectives

1. Determine if the nine MSU rootstock candidates originally planted at MSU's Clarksville Horticultural Experimental Station continue to show commercial promise.
2. Evaluate the influence of nine candidate rootstocks on 'Bing' fruit quality and productivity in the experimental plot at WSU - Prosser (trees were planted in spring of 2009).
3. Test the five MSU candidate rootstocks at the Clean Plant Center Northwest – Fruit Trees (CPCN-FT) for viruses and other infectious agents to provide a source of commercial propagation material.
4. Conduct DNA fingerprinting to assure that the genetic identity of the rootstock selections is correct.

SIGNIFICANT FINDINGS:

- Five MSU cherry rootstocks were identified that produced dwarf precocious sweet cherry trees with 'Bing' scion based on evaluation of the trees planted at the WSU-Roza Station in spring 2009. These five rootstocks that are named after Michigan counties are CLINTON, CASS, CLARE, LAKE and CRAWFORD. All five MSU rootstocks produced trees of similar size to 'Gisela® 5' (Gi5) measured as trunk cross-sectional area (TCSA), except CLARE which produced trees significantly smaller than Gi5.
- In the third leaf (2011), 'Bing' on all five MSU rootstocks exhibited more flowering spurs than Gi5 and 'Gisela® 6' (Gi6). The MSU rootstocks also induced high flower densities on 'Bing' in the fourth and fifth leaf, 2012 and 2013, respectively.
- In 2012, all five of the MSU candidate rootstocks had yield efficiencies (kg fruit/cm^2) that were not significantly different from that of Gi5. However, in 2013, three MSU rootstocks, CLARE, CLINTON and CRAWFORD, exhibited significantly higher yield efficiencies compared to Gi5.
- Mean fruit size for 'Bing' fruit from all five MSU rootstocks and Gi5 and Gi6 were not significantly different suggesting that producing large fruit is possible on the MSU rootstocks given the proper training system and crop load adjustments.
- Four of the MSU rootstocks were virus-certified by the CPCN-FT (CLARE, CASS, CLINTON, and LAKE). The fifth rootstock, CRAWFORD, is anticipated to be certified in August 2014.
- These five rootstocks were established at commercial liner nurseries for limited propagation trials and the generation of liners for future trials. All plant material originated from the stock plants at the CPCN-FT. To date, liner production appears to be most efficient using tissue culture as opposed to softwood cuttings.
- DNA diagnostic tests confirmed that the identities of the MSU rootstocks at the CPCN-FT and the identities of the liners generated for the next series of experimental trials are correct.

RESULTS and DISCUSSION:

Performance of the MSU candidate rootstocks:

In 2009, a test plot of nine MSU rootstocks with 'Bing' scion was planted at WSU- Prosser Roza Station with (Gi5) and (Gi6) included as controls. The trees were spaced at 8 ft × 15 ft in five-tree replicates and were trained to a multiple leader architecture. Pruning was done annually to achieve three main leaders, with heading and thinning cuts to maintain balanced cropping. Based on performance at this plot, five MSU selections (CASS, CLARE, CLINTON, CRAWFORD, and LAKE) named after Michigan counties to avoid potential confusion with the use of numbers as names, were chosen for future testing. Therefore the data presented in this final report will only include the five promising MSU selections compared to the controls (Gi5 and Gi6).

Tree size: All five of the MSU cherry rootstocks produced ‘Bing’ trees that were significantly smaller than Gi6 based on trunk cross sectional area (TCSA, cm^2)(Fig. 1). TCSA for four of the MSU rootstocks were similar to that for Gi5 while the TCSA for CLARE was significantly smaller than that for Gi5. These differences were consistent for all three years of this project (2011-2013).

Bloom: All five MSU rootstocks induced early and abundant flowering of ‘Bing’ in 2011, 2012 and 2013. For example, in the third leaf (2011), three of the MSU candidate rootstocks had significantly more flowering spurs than ‘Bing’ on Gi5 or Gi6 (data not shown). On average trees on LAKE, CASS, and CLINTON had 79, 74, and 54 flowering spurs/tree compared to 33 and 29 spurs per tree for Gi6 and Gi5, respectively. One MSU rootstock, CLARE had on average 34 flowering spurs/tree which was similar to Gi5 and Gi6.

In the fourth leaf (2012), ‘Bing’ grafted on five of the MSU candidate rootstocks had higher average numbers of flowers per node compared to Gi6 (data not shown) with CRAWFORD, CLINTON and LAKE having an average of over four flowers per node compared to 2.4 flowers per node for ‘Bing’ on Gi6.

In the fifth leaf (2013), LAKE, CLARE and CRAWFORD had significantly more flowers per leader cross-sectional area compared to Gi6 (Fig. 2.A). All five MSU rootstocks had flower numbers per leader cross-sectional area that were not statistically different from each other or from Gi5.

The average number of flowers per spur on ‘Bing’ trees was not significantly different in 2013 for all seven rootstocks evaluated (Fig. 2.B.). In 2011, the only significant difference was a higher number of flowers per spur on CLINTON compared to CLARE. In 2012, the only significant difference was a higher number of flowers per spur on CRAWFORD compared to Gi6.

Fruiting: Unfortunately, due to a spring freeze and subsequent flower death in spring 2011, yield and fruit quality data could not be obtained. Therefore, the fruit data presented is for harvests in 2012 and 2013. In 2012 and 2013, the numbers of flowers per node on the five MSU rootstocks, Gi5 and Gi6 were excessive and would have resulted in small fruit size if left unthinned. Therefore, in 2012, the fruit were thinned to 50% when they were pea-sized. Fruit were also thinned in 2013 based on achieving standard crop loads for each selection.

Cumulative ‘Bing’ tree yields per tree for 2012 and 2013 ranged from ~ 12 kg (26 lbs) for CASS to ~ 18 kg (39 lbs) for CLINTON and CRAWFORD (Fig. 3). ‘Bing’ yields on CLINTON were consistently higher than Gi5, CLARE, and CASS. Despite the yield differences, ‘Bing’ mean fruit weights and row sizes for the different rootstocks were not significantly different in both years (Table 1). In 2012, all five of the MSU rootstocks had yield efficiencies (kg fruit/cm^2) that were not significantly different from that of Gi5 (Table 1). However, in 2013, three MSU rootstocks, CLARE, CLINTON and CRAWFORD, exhibited significantly higher yield efficiencies compared to Gi5.

Evaluations of harvest and post-harvest fruit quality did not identify any consistent fruit quality problems that could be attributed to the MSU rootstocks and not associated with the differing crop loads and harvest maturities. For example, the significant firmness differences seen may reflect differences in crop load maturity reflected as fruit skin color, Brix and percent acidity (Tables 2 and 3). For example, LAKE was harvested earlier that the other selections in 2013 and the data suggests that ‘Bing’ fruit from CASS and CLARE may have been over mature at the time of harvest. In 2013, ‘Bing’ fruit firmness, Brix, storage acidity, cracked fruit, and skin shine for the MSU rootstocks were not significantly different from that of the Gi5 and Gi6 trees (Tables 2, 3 and 4).

In 2012, average tree yields and gross returns were highest with the use of CLINTON and CRAWFORD rootstocks (Table 5). In 2013, CLINTON had the highest tree yield. However, the more dwarfing rootstocks, CASS, CLARE and LAKE, may produce high per acre yields if planted at increased densities compared to CLINTON and CRAWFORD.

Several observations are relevant for considering the use of these rootstocks and for designing future plantings. In general, 'Bing' fruit maturity for the MSU rootstocks and Gi5 was more uniform than that produced on Gi6, presumably due to the better light penetration. All MSU rootstocks produced at least some fruit in the 9 row category indicating that producing large fruit is possible given the proper training system and crop load. Harvest timing also appeared to differ based on rootstocks with fruit on LAKE, CASS, and CLARE exhibiting an earlier harvest maturity. However, the biggest influence on fruit quality was crop load indicating the importance of using appropriate intensive training systems for these dwarf precocious rootstocks.

Generation of virus-certified rootstock budwood for the MSU cherry rootstocks.

Based on the abundant floral display exhibited in the 3rd leaf (2011) for LAKE, CASS, CLARE and CLINTON in comparison to Gi5 and Gi6, these four rootstocks were selected for virus certification and future propagation trials. CRAWFORD was not initially chosen for further testing as it showed symptoms of graft incompatibility with 'Hedelfingen' scion in the original plot at MSU's Clarksville Experiment Station. However, as CRAWFORD performed well in the Prosser plot with 'Bing' scion, and showed no signs of graft incompatibility, it was selected for further testing the following year, 2012.

Four of the MSU cherry rootstocks were virus certified by the CPCN-FT (CASS, CLARE, CLINTON, and LAKE). The fifth rootstock, CRAWFORD, was "provisionally released" meaning that one more year of testing needs to be conducted prior to full certification.

Distribution of rootstock budwood for pilot propagation trials and limited liner production.

Distribution of the MSU candidate rootstocks to liner nurseries was accelerated to provide a mechanism for generating liners for future trials, give the nurseries an opportunity to gain experience propagating these rootstocks, and begin to establish stock plants in case of commercialization. CLINTON, CLARE, and LAKE were distributed to liner nurseries in September 2011 followed by CASS in 2012 and 2013.

- Cameron Nursery, Eltopia, Wash. (Todd Cameron)
- Copenhaven Farms, Gaston, Ore. (Christopher Dolby)
- Duarte Nursery, Hughson, Calif. (John Duarte)
- North American Plants, Lafayette, Ore. (Yongjian Chang)
- Protree Nurseries, Brentwood, Calif. (Richard Chavez)
- Helios Nursery (DBA Teak Nursery) Orondo, Wash. (Tye Fleming & Todd Erickson)
- Willamette Nursery, Canby, Ore. (Devin Cooper)

All seven nurseries were able to establish these rootstocks. Collectively, the nurseries are using a range of propagation techniques that include: softwood cuttings, tissue culture and even stool beds. To date, propagation has been most successful using tissue culture.

CRAWFORD was provisionally released to liner nurseries for establishment in tissue culture with full release anticipated in August 2014. Budwood of CRAWFORD was sent to North American Plants in September 2013 and Duarte Nursery and Protree Nursery in October 2013.

In 2013, liners of CASS, CLARE, CLINTON and LAKE were propagated by North American Plants and shipped to three finished tree nurseries to make trees for the next series of rootstock trials (see Proposal for 2014-2016).

The liner nurseries that have the MSU cherry rootstocks are gaining experience propagating these rootstocks. To date, liner production appears to be most efficient using tissue culture. Since the rootstock materials they have established originated from the virus-certified and genetically verified plant material at the CPCN-FT, liners from these plant materials could be commercialized if a decision is made to release one or more of the MSU sweet cherry rootstocks.

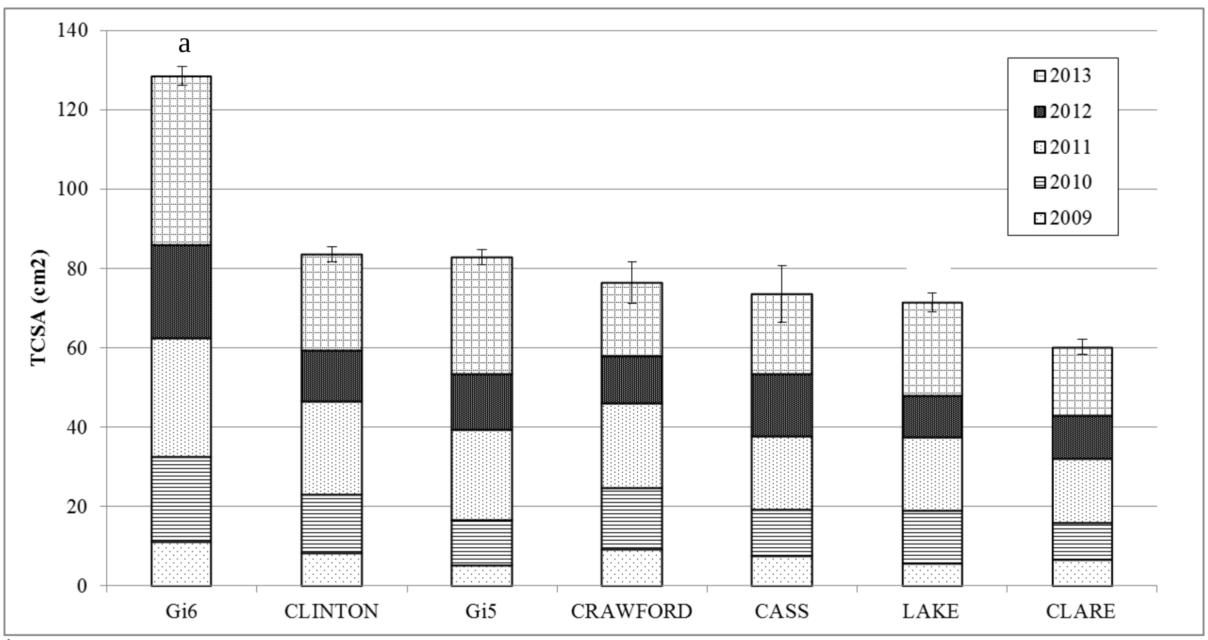
Genetic-verified plant materials.

DNA diagnostic tests were done in the Iezzoni lab at MSU to determine if the identities of the five MSU cherry rootstocks at the CPCN-FT are correct. The rootstocks were screened using four different molecular markers. The genetic tests determined that the identities of the MSU cherry rootstocks at the CPCN-FT are correct.

In preparation for the next series of rootstock trials, North American Plants generated 1000 liners each of CLARE, CLINTON and CASS and 600 liners of LAKE. Three plants of each of these selections were sent to MSU and their identities were verified by DNA tests.

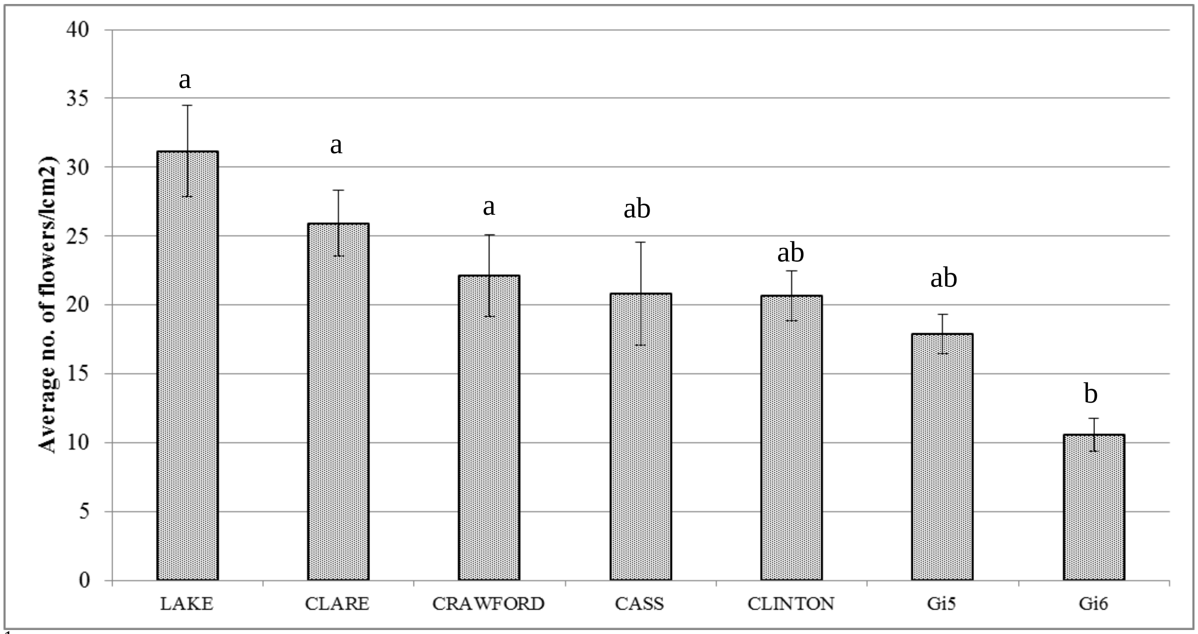
These DNA diagnostic tests have confirmed that the MSU cherry rootstocks are labeled correctly, thereby avoiding any delays and financial losses at the nurseries that would be associated with a plant material mix-up.

Fig. 1. Trunk cross-sectional area (TCSA; cm^2) of 'Bing' trees grafted on 5 MSU rootstocks, Gi5, and Gi6 for trees planted in 2009 at the WSU - Prosser Roza Experiment Station. Boxes represent growth over one season. TCSA measurements were taken on the following dates: March 16, 2010; October 13, 2010; September 28, 2011; July 9, 2012; and July 23, 2013. Bars represent standard error of the means for 2013 TCSA.[1]



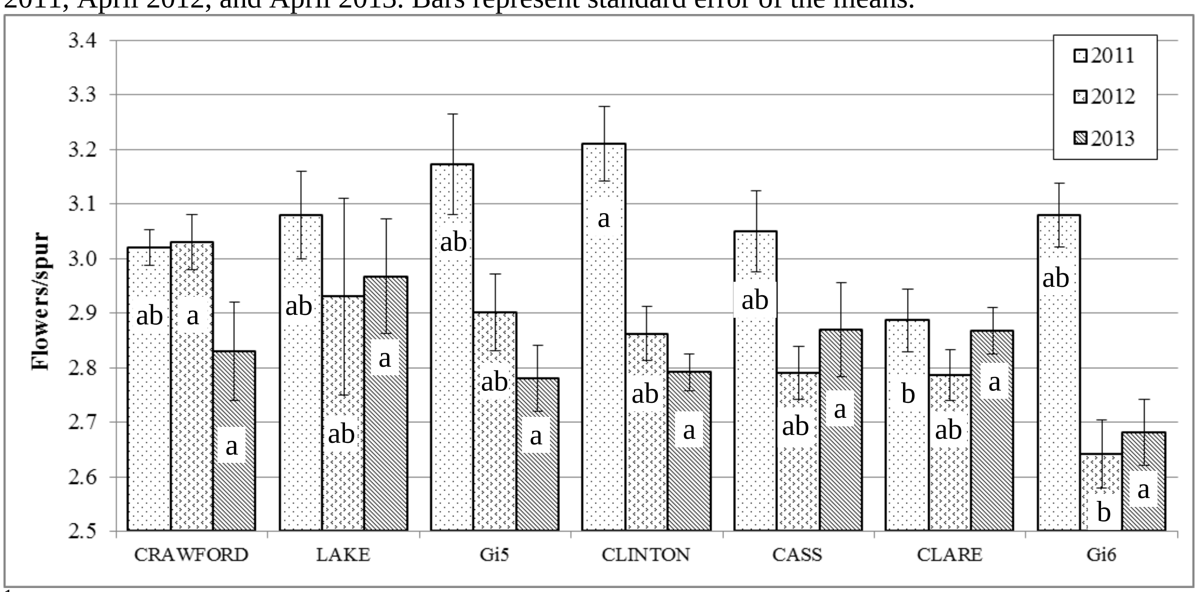
[1]Means that are significantly different for 2013 TCSA ($P < 0.05$) are denoted by different letters.

Fig. 2.A. Average number of flowers per leader cross-sectional area[1] on 'Bing' trees grafted on 5 MSU rootstocks, Gi5, and Gi6 for trees planted in 2009 at WSU - Prosser Roza Experiment Station. Data was taken in April 2013. The values were calculated from two scaffolds per tree using the following equation: average number of flowers ÷ leader cross-sectional area. Bars represent standard error of the means.[2]



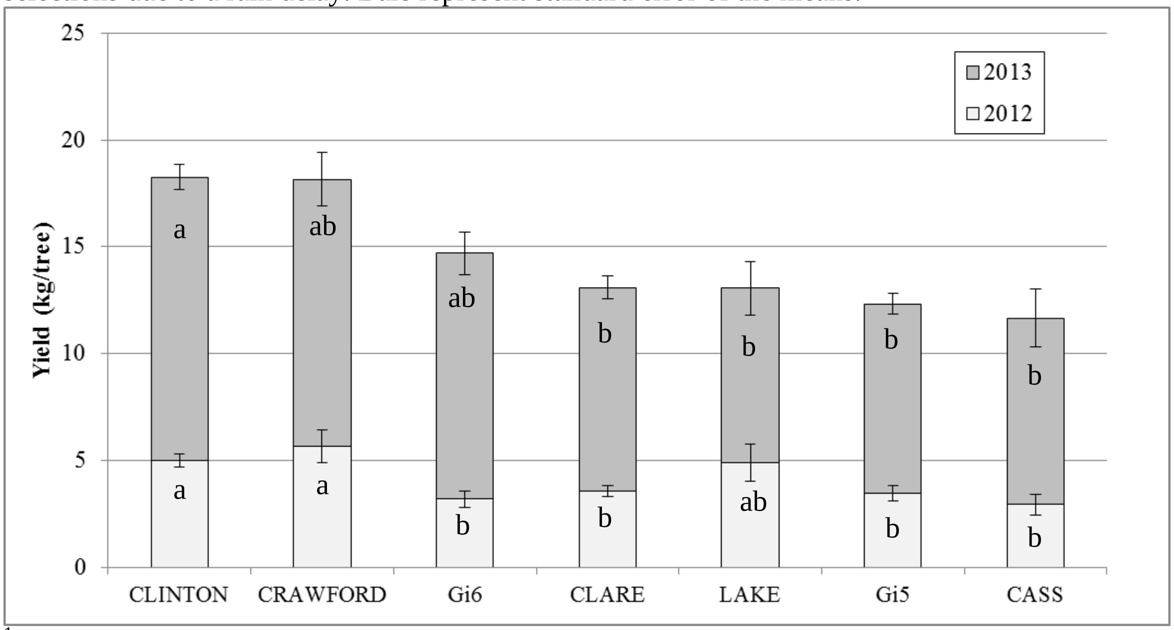
[1]A 30 inch (0.75 meter) segment on two leaders per tree was evaluated.
[2]Means that are significantly different (P < 0.05) are denoted by different letters.

Fig. 2.B. Average number of flowers per spur on 'Bing' trees grafted on 5 MSU rootstocks, Gi5, and Gi6 for trees planted in 2009 at WSU-Prosser Roza Experiment Station. Data was recorded in May 2011, April 2012, and April 2013. Bars represent standard error of the means.[1]



[1]Means that are significantly different (P < 0.05) within years are denoted by different letters.

Fig. 3. Cumulative tree yields (kg) for 2012 and 2013 of 'Bing' trees grafted on 5 MSU rootstocks, Gi5, and Gi6 for trees planted in 2009 at the WSU - Prosser Roza Experiment Station. Fruit were harvested in 2012 on June 28 and in 2013 on June 18 for LAKE and on June 26 for the remaining selections due to a rain delay. Bars represent standard error of the means.[1,2,3]



[1]Pea-sized fruit were thinned by 50% in 2012. In 2013, fruit were thinned based on achieving standard crop loads for each selection.
[2]Means that are significantly different ($P < 0.05$) are denoted by different letters.
[3]Refer to Table 5 for total tree yields in pounds.

Table 1. Fruit weight, mean row size and yield efficiency for 'Bing' grown on five MSU rootstocks, Gi5 and Gi6. Fruit were harvested in 2012 on June 28 and in 2013 on June 18 for LAKE and on June 26 for the remaining selections due to a rain delay.[1]

Rootstock selection	2012 Fruit weight (g)	2013 Fruit weight (g)	2012 Mean row size	2013 Mean row size	2012 Yield efficiency (kg/cm^2)	2013 Yield efficiency (kg/cm^2)
Gi5	10.2 a[2]	11.1 a	9.8 a	9.6 a	0.066 ab	0.107 b
Gi6	9.6 a	10.4 a	9.9 a	9.8 a	0.037 b	0.091 b
CASS	10.3 a	10.7 a	9.7 a	9.8 a	0.059 ab	0.120 ab
CLARE	9.9 a	10.3 a	9.9 a	9.8 a	0.086 a	0.160 a
CLINTON	10.1 a	10.5 a	9.8 a	10.0 a	0.086 a	0.161 a
CRAWFORD	9.5 a	9.3 a	10.0 a	10.2 a	0.099 a	0.173 a
LAKE	9.0 a	9.6 a	10.1 a	10.0 a	0.106 a	0.118 ab

[1]Pea-sized fruit were thinned by 50% in 2012. In 2013, fruit were thinned based on achieving standard crop loads for each selection.
[2]Means that are significantly different ($P < 0.05$) are denoted by different letters.

Table 2. Fresh and post-harvest values for fruit firmness (g/mm^2) and acidity for 'Bing' on five MSU rootstocks, Gi5 and Gi6. Fruit were harvested in 2012 on June 28 and in 2013 on June 18 for LAKE and June 26 for the remaining selections due to a rain delay. Storage acidity and firmness in 2013 was measured from fruit stored at 33°F for 4 days. [1]

Rootstock selection	2012 Firmness (g/mm^2)	2013 Firmness (g/mm^2)	2012 Storage firmness (g/mm^2)	2013 Storage firmness (g/mm^2)	2013 Acidity (%)[2]	2013 Storage acidity (%)[2]
Gi 5	269 ab[3]	235 ab	369 a	261 a	0.86% ab	0.82% ab
Gi 6	262 abc	214 ab	360 a	227 b	0.83% abc	0.81% ab
CASS	231 d	228 ab	332 b	261 a	0.85% ab	0.81% ab
CLARE	252 c	222 ab	357 a	250 a	0.83 abc	0.81% ab
CLINTON	238 d	200 b	333 b	216 b	0.77% bc	0.72% b
CRAWFORD	253 bc	224 ab	312 b	212 b	0.72% c	0.72% b
LAKE	277 a	248 a	311 b	255 a	0.90% a	0.86% a

[1]Pea-sized fruit were thinned by 50% in 2012. In 2013, fruit were thinned based on achieving standard crop loads for each selection.
[2]Data not shown for 2012 because statistical analyses were not possible due to lack of replicated data for CASS and LAKE.
[3]Means that are significantly different ($P < 0.05$) are denoted by different letters.

Table 3. Fruit skin color, Brix and percentage of fruit cracked for 'Bing' grown on five MSU rootstocks, Gi5 and Gi6. Fruit were harvested in 2013 on June 18 for LAKE and on June 26 for the remaining selections due to a rain delay[1,2].

Rootstock selection	2013 Fruit skin color	2013 Brix (%)	2013 Fruit cracked (%)
Gi5	6.3 ab[3]	20.4 ab	38% a
Gi6	6.3 ab	19.6 ab	34% a
CASS	6.8 a	22.0 a	44% a
CLARE	6.8 ab	20.9 ab	38% a
CLINTON	6.6 ab	19.5 ab	40% a
CRAWFORD	5.9 b	18.6 b	44% a
LAKE	4.9 c	19.2 ab	25% a

[1]Pea-sized fruit were thinned by 50% in 2012. In 2013, fruit were thinned based on achieving standard crop loads for each selection.
[2]Data not shown for 2012 because statistical analyses were not possible due to lack of replicated date for CASS and LAKE.
[3]Means that are significantly different ($P < 0.05$) are denoted by different letters.

Table 4. Post-harvest mean values for stem browning, fruit cracking, skin shine, and skin pitting for 'Bing' grown on five MSU rootstocks, Gi5 and Gi6. Fruit were harvested in 2012 on June 28 and in 2013 on June 18 for LAKE and on June 26 for the remaining selections due to a rain delay. Measurements were taken from fruit stored at 33°F for 14 days.[1,2]

Rootstock selection	2013 Stem browning rating[3]	2013Fruit cracked (%)	2013 Fruit 100% skin shine (%)[5]	2013 Skin pitting (%)
Gi5	3.15 ab[4]	41% a	79% ab	7% a
Gi6	3.19 a	36% a	71% ab	6% a
CASS	3.07 ab	44% a	72% ab	21% b
CLARE	2.98 ab	40% a	62% b	12% ab
CLINTON	3.10 ab	39% a	74% ab	13% ab
CRAWFORD	3.17 a	39% a	76% ab	6% a
LAKE	2.41 b	28% a	94% a	8% a

[1]Pea-sized fruit were thinned by 50% in 2012. In 2013, fruit were thinned based on achieving standard crop loads for each selection.
[2]Data not shown for 2012 because statistical analyses were not possible due to lack of replicated data for CASS and LAKE.
[3]Stem browning was rated on a scale of 1-4 with 1=0-25%, 2=26-50%, 3=51-75%, and 4=76-100%
[4]Means that are significantly different ($P < 0.05$) are denoted by different letters.
[5]Skin shine data not available for 2012.

Table 5. Gross returns in 2012 and 2013 for 'Bing' trees grafted on 5 MSU rootstock candidates, Gi5, and Gi6 for trees planted in 2009 at WSU - Prosser Roza Experiment Station.[1]

Rootstock selection	2012 Average Tree Yield (lb)	2013 Average Tree Yield (lb)	2012 Gross Return	2013 Gross Return	Cumulative Yield (lb)	Cumulative Gross Return
Gi5	7.63 b[2]	19.51 b	$16.38	$59.03	27.14	$75.41
Gi6	7.05 b	25.27 ab	$14.21	$75.94	32.32	$90.15
CASS	6.49 b	19.18 b	$14.59	$57.99	25.67	$72.58
CLARE	7.87 b	20.95 b	$16.41	$62.92	28.82	$79.33
CLINTON	11.06 a	29.10 a	$23.14	$85.51	40.16	$108.65
CRAWFORD	12.48 a	27.46 ab	$25.27	$75.21	39.94	$100.48
LAKE	10.82 ab	17.92 b	$20.37	$52.26	28.74	$72.63

[1]Calculated by summing the price per pound for each row size. The returns for each row size was calculated by multiplying the average tree yield (lb) x percent fruit for that row size category x row size price = 2012 Gross Returns: Row size values used are as follows: Row Size 9= $2.50/lb, Row Size 9.5 = $2.50/lb, Row Size 10 = $1.80/lb, Row Size 10.5 = $1.80/lb, Row Size 11 = $1.50/lb, Row Sizes 11.5-13 = $1.20/lb. 2013 Gross Returns: Row size values used are as follows: Row Sizes 8, 8.5, 9, 9.5= $3.08/lb, Row Size 10 = $3.20/lb, Row Size 10.5 = $2.50/lb, Row Size 11 = $2.16/lb, Row Sizes 11.5-13 = $1.76/lb.
[2]Means that are significantly different ($P < 0.05$) are denoted by different letters.

Project Title: Establishment and testing of MSU sweet cherry rootstocks

Executive Summary: Five MSU sweet cherry rootstocks were identified that induce precocious abundant flowering and significantly reduce tree size compared to Gi6. All five MSU rootstocks produced trees of similar size to Gi5 except CLARE which produced trees significantly smaller than Gi5. In 2012, all five of the MSU candidate rootstocks had yield efficiencies (kg fruit/cm^2) that were not significantly different from that of Gi5. However, in 2013, three MSU rootstocks, CLARE, CLINTON and CRAWFORD, exhibited significantly higher yield efficiencies compared to Gi5. 'Bing' fruit size on the MSU rootstocks was not significantly different from that on Gi5 and Gi6 suggesting that premium fruit can be produced on these rootstocks given the proper training system and crop load adjustments.

Based on these observations, the five MSU cherry rootstocks were advanced to provide plant materials for future trials and potentially commercialization. Four of the MSU rootstocks were virus-certified by the Clean Plant Center Northwest - Fruit Trees (CPCN-FT) (CLARE, CASS, CLINTON, and LAKE). The fifth rootstock, CRAWFORD, is anticipated to be certified in August 2014. These five rootstocks were established at commercial liner nurseries for limited propagation trials and the generation of liners for future trials. To date, liner production appears to be most efficient using tissue culture as opposed to softwood cuttings. DNA diagnostic tests confirmed that the identities of the MSU rootstocks at the CPCN-FT and the identities of the liners generated for the next series of experimental trials are correct.