

# 10-Year Performance of Cameo® Apple Trees on Three Dwarf Rootstocks in Massachusetts and New Jersey as Part of the NC-140 Regional Rootstock Research Project

Jon M. Clements<sup>1</sup>, Winfred P. Cowgill<sup>2</sup>, Rebecca Magron<sup>2</sup> and Wesley R. Autio<sup>3</sup>

## Planting description and protocol

- In 2002 NC-140 (<http://www.nc140.org>) apple plantings were established at the University of Massachusetts Cold Spring Orchard Research and Education Center in Belchertown, MA and at the Rutgers Snyder Research and Extension Farm in Pittstown, NJ.
- The objective was to evaluate the performance of two new dwarfing apple rootstocks -- Geneva (G.) 16 and Budagovsky (B.) 9 -- compared to the standard commercial dwarf apple rootstock Malling (M.) 9.
- 'Cameo' apple trees (Willow Drive Nursery) on three dwarfing rootstocks -- Geneva (G.) 16, M.9-NAKBT337 (M.9-337), and B.9 -- were planted in a randomized complete block design (10 replications) spaced at 1.2 X 3.6 m. (Massachusetts) and 2.5 X 4.5 m. (New Jersey). All trees are trickle irrigated and have been trained to a vertical axis.
- Annual measurements of trunk circumference, tree height and spread (2006 and 2011 only, reported here for 2011), suckering, fruit yield (beginning in 2003), and fruit size (NJ only in 2004, 05, 08) have been made.
- 2011 (10th-leaf) was the last season for data collection. An article on the performance (2002-2011) of these three commercial dwarf rootstocks will be submitted for publication in Journal of the American Pomological Society, Fruit Notes, and Horticultural News.

## Results

- This report presents data from the 2011 (10<sup>th</sup> and final leaf) growing season and cumulative data from 2003-2011.
- Regarding tree growth (Table 1.), G.16 had the largest trunk cross-sectional area followed by M.9 and B.9. In Massachusetts, G.16 was larger than both M.9 and B.9. (Table 2.). In New Jersey, G.16 and M.9 are both larger than B.9. Trees were much larger in trunk area in New Jersey than Massachusetts, except for B.9. (Figure 1.) G.16 were the tallest trees (tree height), followed by M.9 and B.9. B.9 had a lesser tree spread than G.16 and M.9.
- For root suckers and burr-knots in (Table 1.), M.9 had more root suckers than G.16 and B.9, which did not differ. In Massachusetts, again M.9 had more suckers than the other two rootstocks, however, in New Jersey the rootstocks did not differ in suckering (Table 2, Figure 2.) Overall, Massachusetts had more root suckers than New Jersey. It appears G.16 had more burr-knots than B.9 (Table 1.) but did not differ from M.9 (which did not differ from B.9). But none of the rootstocks really has a large percentage of the above-ground shank covered with burr-knots.
- In 2011, there was no difference in yield per tree between the rootstocks across both states (Table 3.). Yield per tree was much higher in New Jersey (36.3 kg.) than in Massachusetts (15.3 kg.). (Cameo is highly biennial -- in 2010, it was just the opposite, i.e. yield per tree in Massachusetts far exceeded New Jersey.) 2011 cumulative yield (2003-2011) was higher for M.9 compared to B.9, however, M.9 did not differ from G.16 (Table 3.).
- Overall yield efficiency in 2011 was lowest for G.16 compared to M.9 and B.9, which did not differ (Table 3.). This was also true in Massachusetts, however, in New Jersey B.9 had the highest yield efficiency compared to M.9 and G.16 which did not differ from each other (Table 4. and Figure 3.) B.9 had the highest cumulative yield efficiency (2003-2011) followed by M.9 and G.16 (Table 3.). In Massachusetts, however, M.9 and B.9 did not differ but had higher yield efficiency than G.16. In New Jersey, B.9 had the highest cumulative yield efficiency compared to M.9 and G.16, which did not differ (Table 4., Figure 4.)
- Across both states, fruit size (fruit weight) in 2011 did not differ between the rootstocks (Table 3.), however, fruit in New Jersey were significantly larger (228 g.) than those in Massachusetts (207 g.). Within Massachusetts, Cameo fruit from G.16 trees were larger than those from M.9 and B.9, but in New Jersey, fruit were larger from M.9. (Table 4., Figure 5.)

**Table 1.** Overall trunk size, tree height and spread, suckers, and % of rootstock shank covered with burr-knots in 2011 of 'Cameo' apple trees on three rootstocks in the 2002 MA/NJ NC-140 Cameo Dwarf Rootstock trial.

Rootstock	Trunk cross-sectional area (cm <sup>2</sup> )	Tree height (m)	Tree spread (m)	No. root suckers	% burr-knots
G.16	66.2 a	4.2 a	2.5 a	1.3 b	3 a
M.9-337	50.6 b	3.8 b	2.4 a	2.8 a	1 ab
B.9	29.9 c	3.3 c	2.1 b	1.5 b	0 b

Levels not connected by same letter are significantly different. (Tukey HSD P=0.05)

**Table 2.** Trunk size and number of root suckers by state in 2011 of 'Cameo' apple trees on three rootstocks in the 2002 MA/NJ NC-140 Cameo Dwarf Rootstock trial.

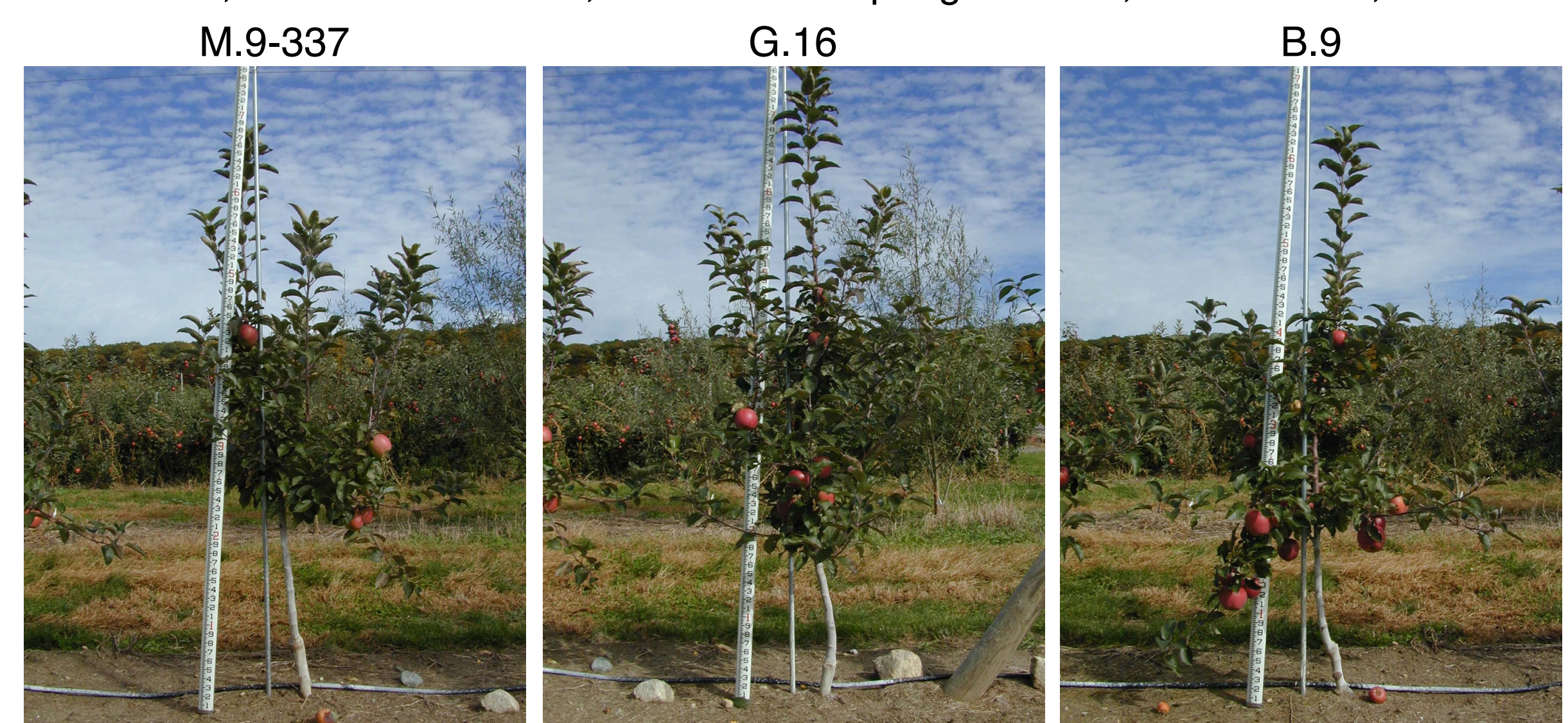
Rootstock	Trunk cross-sectional area (cm <sup>2</sup> )		No. root suckers	
	Mass.	New Jersey	Mass.	New Jersey
G. 16	48.5 a	84.0 a	2.1 b	0.4
M.9-337	26.1 b	75.1 a	5.6 a	0.1
B.9	21.5 b	38.4 b	2.7 b	0.2

Levels not connected by same letter are significantly different. (Tukey HSD P=0.05)

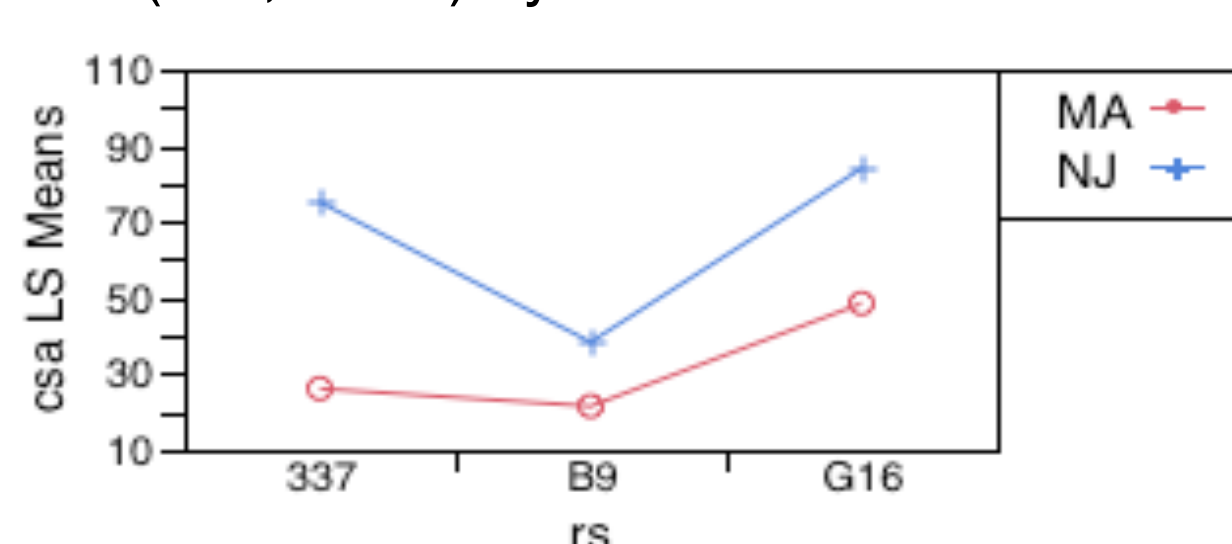
Cameo® (Caudle cv.) apples



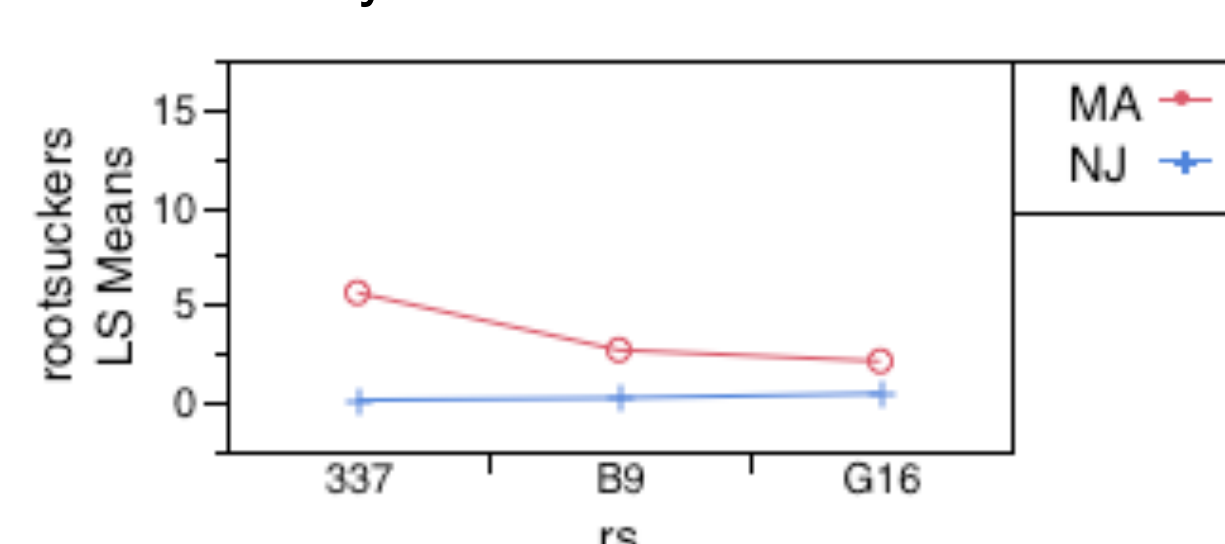
Typical 2nd-leaf Cameo apple trees before harvest (October 14, 2003) on M.9-337, G.16, and B.9 rootstocks, UMass Cold Spring Orchard, Belchertown, MA



**Figure 1.** 2011 trunk cross-sectional area (csa, cm<sup>2</sup>) by state and rootstock



**Figure 2.** 2011 number of root suckers by state and rootstock



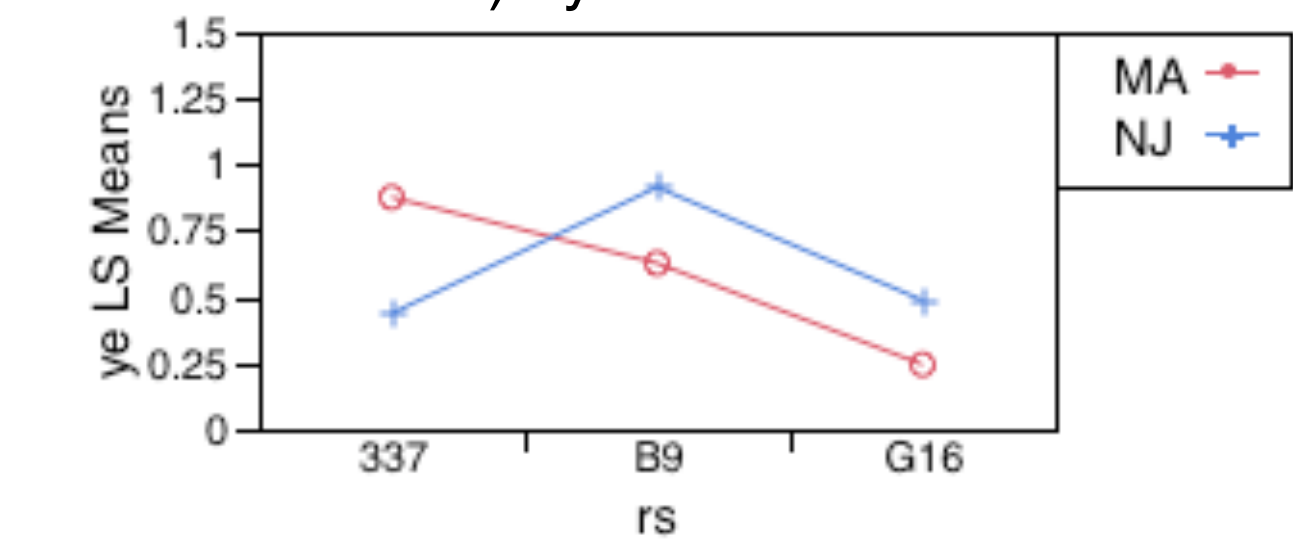
**Table 3.** Overall fruit yield, cumulative yield, yield efficiency, cumulative yield efficiency, and fruit weight in 2011 of 'Cameo' apple trees on three rootstocks in the 2002 MA/NJ NC-140 Cameo Dwarf Rootstock trial.

Rootstock	Yield per tree (kg)	Cum. yield (2003-11) per tree (kg)	Yield efficiency (kg/cm <sup>2</sup> TCA)	Cum. yield efficiency (2003-11) (kg/cm <sup>2</sup> TCA)	Fruit weight (g)
G.16	26.2	181.5 ab	0.37 b	3.84 c	223
M.9-337	27.4	194.4 a	0.66 a	5.03 b	220
B.9	23.8	156.3 b	0.77 a	6.78 a	209

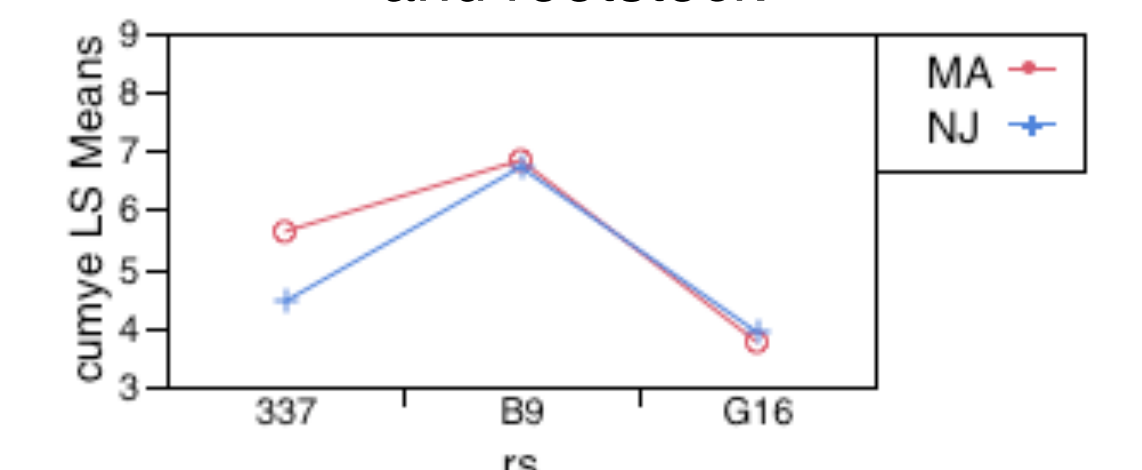
**Table 4.** Yield efficiency and fruit size by state in 2011 of 'Cameo' apple trees on three rootstocks in the 2002 MA/NJ NC-140 Cameo Dwarf Rootstock trial.

Rootstock	Yield per tree (kg)		Cum. yield (2003-11) per tree (kg)		Yield efficiency (kg/cm <sup>2</sup> TCA)		Cum. yield efficiency (2003-11) (kg/cm <sup>2</sup> TCA)		Fruit weight (g)	
	Mass.	New Jersey	Mass.	New Jersey	Mass.	New Jersey	Mass.	New Jersey	Mass.	New Jersey
G. 16	11.4	41.0	167	196	0.24 b	0.49 b	3.76 b	3.92 b	230 a	215 b
M.9-337	21.2	33.6	196	193	0.88 a	0.44 b	5.63 a	4.44 b	193 b	248 a
B.9	13.4	34.3	148	164	0.63 a	0.91 a	6.84 a	6.72a	199 b	221 b

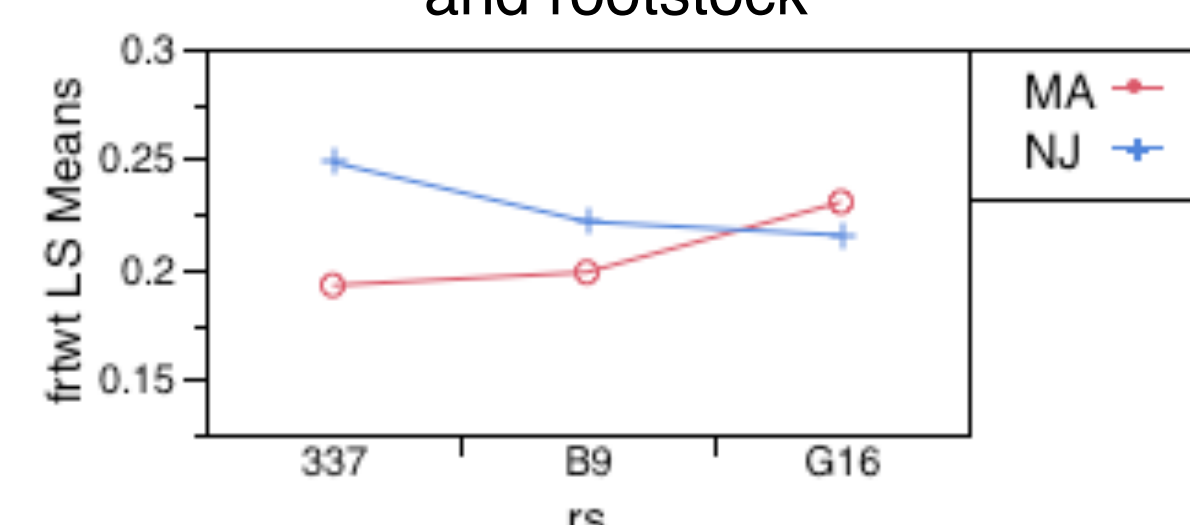
**Figure 3.** 2011 yield efficiency (ye, kg fruit per cm<sup>2</sup> csa) by state and rootstock



**Figure 4.** 2003-2011 cumulative yield efficiency (cumye, kg fruit per cm<sup>2</sup> csa) by state and rootstock



**Figure 5.** 2011 fruit weight (frwt, kg) by state and rootstock



Typical 10th-leaf Cameo trees after harvest (October 11, 2011) on M.9-337, G.16, and B.9 rootstocks, UMass Cold Spring Orchard, Belchertown, MA



<sup>1</sup>University of Massachusetts Amherst, Center for Agriculture, Amherst, MA 01003  
<sup>2</sup>New Jersey Agricultural Experiment Station-Rutgers Cooperative Ext. of Hunterdon County, PO Box 2900 Flemington, NJ, 08822-2900  
<sup>3</sup>University of Massachusetts Amherst, Stockbridge School of Agriculture, Amherst, MA 01003

