Final Report of the 2002 NC-140 Apple Rootstock Trial in Massachusetts and New Jersey

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The NC-140 Multi-State Research Committee, with research pomologists from the US, Canada, and Mexico, has assisted tree-fruit growers with rootstock decisions for more than 35 years by evaluating performance of both old and new rootstocks in a range of climates and soils. This article describes the Massachusetts and New Jersey results from the 2002 NC-140 Apple Rootstock Trial, which is planted at a total of ten locations in the US, Canada, and Mexico.

This trial had a number of rootstocks. The first group included different strains of commonly used rootstocks. Several strains of M.9 have been identified, and results, generally, have shown differences in vigor but similar orchard productivity among the M.9 strains. This trial includes M.9 Burgmer 756, M.9 NAKBT337, and M.9 Nic 29. M.9 Burgmer 756 (from Burgmer Nurseries in Germany) has not had significant evaluation in North America:. M.9 NAKB T337 (from the virus indexing program in the Netherlands) has had extensive testing and is the most commonly planted M.9 in North America. M.9 Nic 29 was tested in a NC-140 trial from 1994-2003 and was found to be more vigorous than M.9 NAKB T337.

Other comparisons in this trial included two strains of B.9 (one that is commonly used in Europe and one that is commonly used in North America). It also included two strains of M.26: M.26 NAKB (from the virus indexing program in the Netherlands) and M.26 EMLA (from the virus indexing program in Great Britain).

The new rootstocks in this trial were P.14, (an open-pollinated seedling of M.9, is from the Research Institute of Pomology, Skierniewice, Poland) and Supporter 4, PiAu 51-4, and PiAu 51-11 (all three from the Institut für Obstforschung Dresden-Pillnitz, Germany).

Materials & Methods

In spring, 2002, an orchard trial of apple rootstocks was established under the coordination of NC-140 Multi-State Research Committee in Arkansas, British Columbia (Canada), Chihuahua (Mexico), Illinois, Kentucky, Massachusetts, Michigan, New Jersey, and New York. Data reported here are from Massachusetts (UMass Cold Spring Orchard Research & Education Center, Belchertown) and New Jersey (Rutgers Snyder Research and Extension Farm, Pittstown) only.

Buckeye Gala was used as the scion cultivar, and rootstocks included B.9 Treco (the strain commonly used in North America and propagated in stool beds at Treco Nursery, Woodburn, OR), B.9 Europe (the strain commonly used in Europe), M.26 EMLA, M.26 NAKB, M.9 Burgmer 756, M.9 Nic 29, M.9 NAKB T337, P.14, PiAu 51-11, PiAu 51-4, and Supporter 4. Trees were spaced 8.2 x 14.8 feet and trained as vertical axes. Pest management, irrigation, and fertilization followed local recommendations at each site.

Each year of the trial, trunk cross-sectional area was assessed and root suckers were counted an removed. Beginning with the third season, yield and average fruit size were determined for each tree. At the end of the 2011 growing season (10^{th} leaf), tree height and canopy spread were measured for each tree.

Results

Tree and yield characteristics are presented for Massachusetts in Tables 1 and 2 and for New Jersey in Tables 3 and 4.

After ten growing seasons, relative tree response

Table 1. Trunk cross-sectional area, tree height, canopy spread and root suckering in 2011 of Gala trees on several rootstocks in the Massachusetts planting of the 2002 NC-140 Apple Rootstock Trial.[z]

Rootstock	Trunk cross-sectional area (cm^2)	Tree height (m)	Canopy spread (m)	Root suckers (no./tree, 2002-11)
B.9 (Europe)	30.4 f	3.4 d	2.5 d	22.4 b
B.9 (North America)	37.8 ef	3.8 cd	3.0 cd	15.7 b
M.26 EMLA	75.6 cd	4.3 bcd	3.7 abc	3.6 b
M.26 NAKB	93.2 bcd	4.6 bcd	4.0 ab	5.1 b
M.9 Burgmer 756	75.4 d	4.9 bc	3.6 bc	17.0 b
M.9 Nic 29	61.3 de	4.2 bcd	3.4 bc	53.9 a
M.9 NAKBT337	64.1 de	4.3 bcd	3.4 bc	21.4 b
P.14	122.2 b	5.4 ab	4.2 ab	8.4 b
PiAu51-11	112.9 bc	5.3 ab	4.0 ab	18.4 b
PiAu51-4	174.5 a	6.4 a	4.6 a	24.8 b
Supporter 4	93.2 bcd	5.4 ab	4.1 ab	5.9 b

[z] Means within column not followed by a common letter are significantly different at odds of 19 to 1 (Tukey=s HSD, *P* = 0.05).

to rootstock was similar in Massachusetts and New Jersey. Comparing the two locations, however, we found that trees were more vigorous (+22%) in Massachusetts than in New Jersey, with more root suckers (+110%). Massachusetts trees were slightly more productive in terms of cumulative yield per tree (+3%) but were less cumulatively yield efficient (-15%) than those in New Jersey. Fruit size was smaller (-10%) in Massachusetts than in New Jersey.

Tree size, measured as trunk cross-sectional area (TCA), tree height, and canopy spread, was largest with PiAu 51-4 as the rootstock (Tables 1 and 3). Trees on P.14 and PiAu 51-11 also were larger than those on M.26. Trees

Table 2. Yield per tree, yield efficiency, and fruit weight in 2011 of Gala trees on several rootstocks in the Massachusetts planting of the 2002 NC-140 Apple Rootstock Trial.[z]

	Yield per tree (kg)		Yield efficiency (kg/cm^2 TCA)		Fruit weight (g)	
Rootstock	2011	Cumulative (2004-11)	2011	Cumulative (2004-11)	2011	Average (2004-11)
B.9 (Europe)	7.3 c	90 d	0.27 d	3.0 a	207 ab	161 b
B.9 (North America)	10.4 bc	114 cd	0.29 cd	3.2 a	196 ab	169 ab
M.26 EMLA	48.3 a	199 ab	0.63 ab	2.6 ab	195 ab	178 ab
M.26 NAKB	52.8 a	242 a	0.54 abcd	2.6 ab	194 ab	177 ab
M.9 Burgmer 756	40.0 abc	207 ab	0.56 abc	2.8 a	211 ab	180 ab
M.9 Nic 29	45.5 ab	184 abc	0.70 a	3.0 a	217 a	185 a
M.9 NAKBT337	34.6 abc	183 abc	0.55 abcd	2.9 a	206 ab	185 a
P.14	44.6 ab	216 ab	0.35 bcd	1.8 c	208 ab	182 ab
PiAu51-11	31.5 abc	162 bcd	0.33 bcd	1.6 c	195 ab	176 ab
PiAu51-4	65.3 a	245 a	0.37 bcd	1.4 c	188 b	173 ab
Supporter 4	38.6 abc	182 abc	0.42 abcd	2.0 bc	202 ab	179 ab

[z] Means within column not followed by a common letter are significantly different at odds of 19 to 1 (Tukey=s HSD, *P* = 0.05).

Table 3. Trunk cross-sectional area, tree height, canopy spread and root suckering in 2011 of Gala trees on several rootstocks in the New Jersey planting of the 2002 NC-140 Apple Rootstock Trial.[z]

Rootstock	Trunk cross-sectional area (cm^2)	Tree height (m)	Canopy spread (m)	Root suckers (no./tree, 2002-11)
B.9 (Europe)	18.1 f	2.9 d	1.7 e	30.0 a
B.9 (North America)	29.0 ef	3.5 cd	2.1 de	5.2 b
M.26 EMLA	67.9 cd	4.3 bc	2.6 cd	0.4 c
M.26 NAKB	71.3 cd	4.4 b	2.7 bc	2.3 b
M.9 Burgmer 756	71.1 cd	4.7 b	2.8 bc	5.7 b
M.9 Nic 29	53.3 de	4.5 b	2.7 bc	23.8 ab
M.9 NAKBT337	61.0 d	4.4 b	2.8 bc	8.4 ab
P.14	104.9 ab	5.6 a	3.4 a	1.7 bc
PiAu51-11	95.3 bc	4.7 b	2.9 abc	2.6 b
PiAu51-4	131.8 a	5.6 a	3.2 ab	7.2 ab
Supporter 4	70.1 cd	4.3 bc	2.7 bc	6.2 b

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on Supporter 4 were similar in size to those on the two strains of M.26, which were similar to each other. Trees on M.9 Burgmer 756 were similar to those on M.26 EMLA. The other two strains of M.9 produced a slightly smaller tree, and trees on the two strains of B.9 were the smallest in the trial.

Root suckering was pronounced at both sites from trees on M.9 Nic 29 and B.9 Europe (Tables 1 and 3). In Massachusetts, trees on PiAu 51-4 and those on M.9 NAKBT337 suckered profusely.

On average at both sites, yield per tree was higher from the largest trees than from the smallest (Tables 2 and 4); however, yield efficiency gives a

Table 4. Yield per tree, yield efficiency, and fruit weight in 2011 of Gala trees on several rootstocks in the New Jersey planting of the 2002 NC-140 Apple Rootstock Trial.[z]

	Yield per tree (kg)		Yield efficiency (kg/cm^2 TCA)		Fruit weight (g)	
Rootstock	2011	Cumulative (2004-11)	2011	Cumulative (2004-11)	2011	Average (2004-11)
B.9 (Europe)	10.3 c	78 d	0.60 a	4.3 a	176 a	175 b
B.9 (North America)	13.7 bc	117 c	0.45 ab	4.0 ab	175 a	187 b
M.26 EMLA	16.3 bc	178 b	0.26 b	2.6 cde	166 a	186 b
M.26 NAKB	21.3 bc	200 ab	0.31 ab	2.9 cde	199 a	196 ab
M.9 Burgmer 756	21.6 bc	188 ab	0.33 ab	2.8 cde	179 a	197 ab
M.9 Nic 29	31.5 b	167 bc	0.58 a	3.1 bcd	187 a	202 ab
M.9 NAKBT337	19.3 bc	191 ab	0.32 ab	3.2 bc	173 a	188 b
P.14	32.8 b	239 a	0.32 ab	2.3 def	192 a	205 ab
PiAu51-11	28.1 bc	182 ab	0.33 ab	2.1 ef	193 a	210 ab
PiAu51-4	51.6 a	220 ab	0.40 ab	1.7 f	192 a	223 a
Supporter 4	23.8 bc	197 ab	0.35 ab	2.8 cde	190 a	202 ab

[z] Means within column not followed by a common letter are significantly different at odds of 19 to 1 (Tukey=s HSD, $P = 0.05$).

better indication of productivity, since it relates yield to tree size. It is predicted that a tree with higher yield efficiency, planted at an appropriate density, will outyield a less yield efficient tree, planted at an appropriate density. Trees on B.9 and those on M.9 were the most yield efficient trees in this trial (Tables 2 and 4). Trees on Supporter 4 were similarly efficient to those on M.26, and trees on P.14, PiAu 51-11, PiAu 51-4 were the least efficient.

Fruit size varied quite a bit among trees on the various rootstocks (Tables 2 and 4). Few important results were observed, except that fruit from trees on B.9 Europe tended to be the smallest in the trial.

Conclusions

B.9 Strains. The two strains of B.9 were statistically similar for all but one measure (excessive root suckering in New Jersey). Data from all NC-140 cooperators suggest that the North American strain is more vigorous than the European strain and develops fewer root suckers.

M.26 Strains. In Massachusetts and New Jersey, M.26 EMLA and M.26 NAKB performed similarly.

M.9 Strains. In this trial, no differences among these strains were statistically significant, except M.9 Nic 29's enhanced ability to produce root suckers. That said, there is a trend toward greater vigor of trees on M.9 Burgmer 756 than the other two strains.

P.14. Trees on P.14 were reasonably productive for what likely is semidwarf in size, but there was nothing observed that makes it a particularly desirable rootstock.

PiAu 51-11 and 51-4. The two un-named selections from the Pillnitz breeding program produced semidwarf trees, with the lowest yield efficiency in the trial. There are no characteristics which suggest that these rootstocks should be considered for commercial planting.

Supporter 4. Trees on Supporter 4 were in all ways similar to those on M.26. They performed reasonably well and likely could be used to produce a large dwarf or small semidwarf tree.