Comparing Strains of B.9, M.26, and M.9, P.14, and Three Pillnitz Rootstocks: 2002 NC-140 Apple Rootstock Trial in Massachusetts and New Jersey

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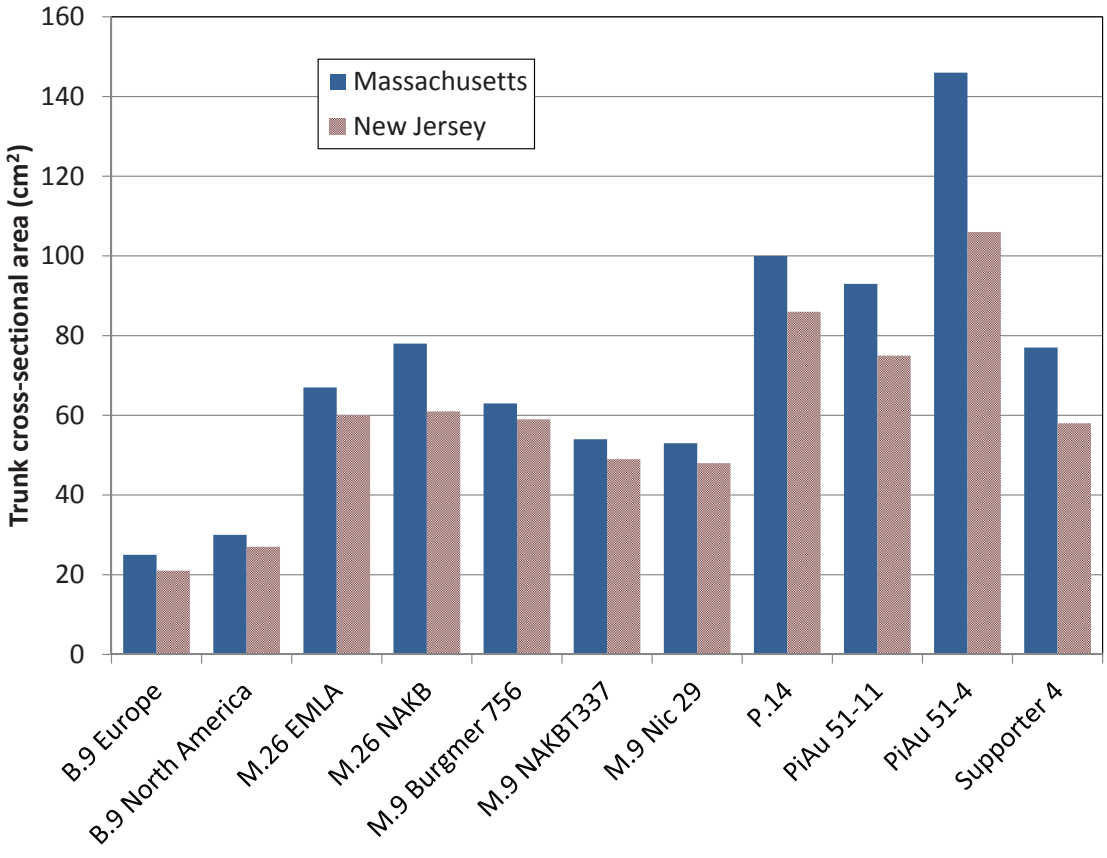


Figure 1. Rootstock effects on Buckeye Gala tree size (trunk cross-sectional area, 2010) in the 2002 NC-140 Apple Rootstock Trial in Massachusetts and New Jersey.

Table 2. Trunk cross-sectional area, cumulative number of root suckers (2002-10), yield per tree in 2010 and cumulatively (2004-10), yield efficiency in 2010 and cumulatively (2004-10), and fruit weight in 2010 and on average (2004-10) of Gala apple trees in the 2002 NC-140 Apple Rootstock Trial in Massachusetts and New Jersey. Fruit weight was adjusted for variation in crop load.[z]

Rootstock	Trunk cross-sectional area (2010, cm^2)	Root suckers (no./tree, 2002-10)	Yield per tree (kg)		Yield efficiency (kg/cm^2 TCA)		Fruit weight (g)	
			2010	Cumulative (2004-10)	2010	Cumulative (2004-10)	2010	Average (2004-10)
Massachusetts								
B.9 Europe	25 f	18 b	17 c	76 c	0.7 ab	3.0 ab	181 a	172 b
B.9 North America	30 ef	10 b	23 bc	94 bc	0.8 a	3.2 a	192 a	180 ab
M.26 EMLA	67 cd	5 b	29 abc	125 abc	0.4 cd	1.8 cde	192 a	182 ab
M.26 NAKB	78 bcd	4 b	39 a	161 a	0.5 bc	2.2 cd	191 a	184 ab
M.9 Burgmer 756	63 cd	14 b	29 abc	127 ab	0.5 bc	2.0 cde	199 a	193 a
M.9 Nic 29	53 def	44 a	25 abc	111 bc	0.5 bc	2.2 c	201 a	195 a
M.9 NAKBT337	54 de	14 b	30 abc	122 abc	0.6 abc	2.3 bc	204 a	196 a
P.14	100 b	5 b	35 ab	135 ab	0.4 cd	1.4 def	194 a	184 ab
PiAu 51-11	93 bc	11 b	25 abc	99 bc	0.3 cd	1.2 ef	183 a	175 ab
PiAu 51-4	146 a	21 b	28 abc	118 abc	0.2 d	0.8 f	197 a	175 ab
Supporter 4	77 bcd	4 b	32 abc	120 abc	0.4 cd	1.6 cdef	186 a	179 ab
New Jersey								
B.9 Europe	21 e	29 a	13 c	73 c	0.7 ab	3.9 a	158 a	163 a
B.9 North America	27 e	5 b	20 abc	100 c	0.7 ab	3.8 a	173 a	170 a
M.26 EMLA	60 cd	0 b	38 abc	162 ab	0.6 ab	2.7 bc	166 a	164 a
M.26 NAKB	61 cd	1 b	38 abc	179 ab	0.6 ab	3.0 abc	169 a	171 a
M.9 Burgmer 756	59 cd	5 b	39 abc	169 ab	0.7 ab	2.9 abc	174 a	171 a
M.9 Nic 29	48 d	17 ab	25 abc	151 b	0.5 ab	3.1 abc	162 a	172 a
M.9 NAKBT337	49 d	7 b	40 ab	172 ab	0.8 a	3.5 ab	173 a	174 a
P.14	86 ab	1 b	49 a	206 a	0.6 ab	2.4 cd	176 a	171 a
PiAu 51-11	75 bc	2 b	35 abc	153 b	0.5 ab	2.2 cd	166 a	170 a
PiAu 51-4	106 a	5 b	24 abc	171 ab	0.2 b	1.6 d	160 a	161 a
Supporter 4	58 cd	4 b	39 abc	171 ab	0.7 ab	3.0 abc	179 a	177 a

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

Selection of the most appropriate rootstock for new apple plantings has become increasingly complicated with the introduction of new rootstocks potentially with better yield performance, size control, and pest resistance and with the continual movement toward higher and higher planting densities. The NC-140 Multi-State Research Committee has assisted tree-fruit growers with this decision for more than 35 years by evaluating performance of both old and new rootstocks in a range of climates and soils.

In additional to the development of new rootstocks, new strains of older rootstocks become available from time to time. These strains arise from chance mutations in the field and those induced in tissue culture. Several strains of M.9 have been identified and six have been evaluated previously by NC-140. Results showed differences in vigor but similar orchard productivity among the M.9 strains. One strain of M.9 has not had significant evaluation in North America: M.9 Burgmer 756 (from Burgmer Nurseries in Germany). M.9 NAKB T337 (from the virus indexing program in the Netherlands) has had extensive testing and is the most

commonly planted 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.

Nursery observation has suggested that the strain of B.9 used in North America may be different than what is used in Europe. The European strain of B.9 has a trailing growth habit, while the North American strain is more erect.

Two strains of M.26 are available, M.26 NAKB (from the virus indexing program in the Netherlands) and M.26 EMLA (from the virus indexing program in Great Britain).

New rootstocks are also regularly available for testing, either after initial release or after their introduction to North America. P.14, an open-pollinated seedling of M.9, is from the Research Institute of Pomology, Skierniewice, Poland. Trials in Poland suggested that trees on P.14 are somewhat larger than those on M.26 and comparably productive.

Supporter 4 is from the Institut für Obstforschung Dresden-Pillnitz, Germany, and is reported to produce a tree similar to or slightly larger than those on M.26 but with greater yield efficiency. PiAu rootstocks, likewise, are from the Pillnitz program but are not yet named and released.

The objectives of this trial were to assess and compare the performance of P.14, Supporter 4, two new Pillnitz rootstocks, and different strains of B.9, M.26, and M.9.

Materials & Methods

In spring, 2002, an orchard trial of apple rootstocks was established under the coordination of NC-140

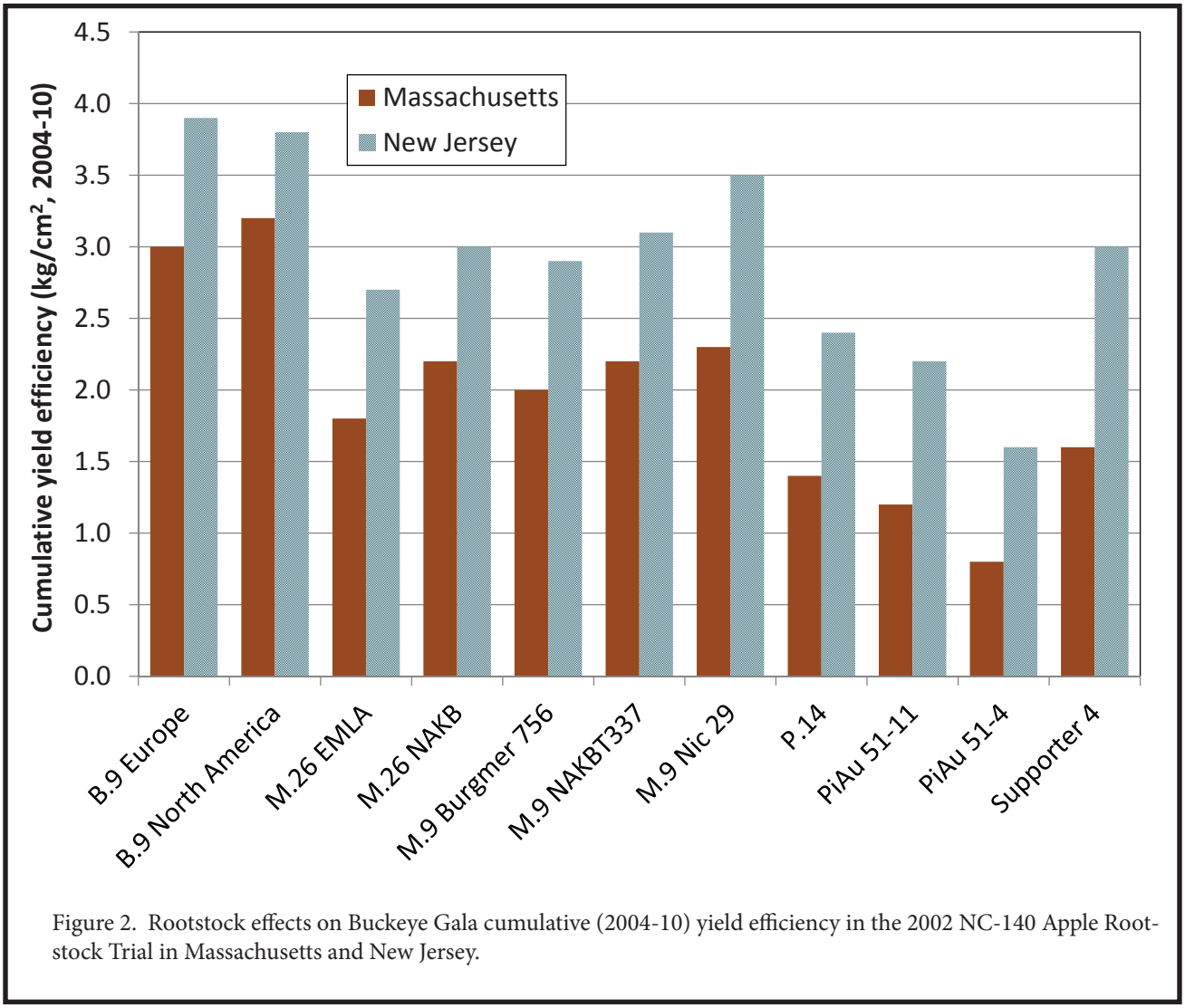


Figure 2. Rootstock effects on Buckeye Gala cumulative (2004-10) yield efficiency in the 2002 NC-140 Apple Rootstock Trial in Massachusetts and New Jersey.

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 and New Jersey 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 (the last three from the Institut für Obstforschung Dresden-Pillnitz, Germany). 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.

Results

After nine growing seasons, relative tree response to rootstock was similar in Massachusetts and New Jersey. Comparing the two locations, however, we found that trees were more vigorous (+18%) in Massachusetts than New Jersey, with more root suckers (nearly double). This difference in vigor was likely due to lower productivity (-24% in cumulative yield and -31% in yield efficiency) in Massachusetts than New Jersey. Fruit size was greater (+5%) in Massachusetts than New Jersey.

Tree size, measured as trunk cross-sectional area (TCA), was largest with PiAu 51-4 as the rootstock (Table 1, Figure 1). Trees on P.14 and PiAu 51-11 also were larger than those on M.26. Trees on Supporter 4 were similar in size to those on the two strains of M.26,

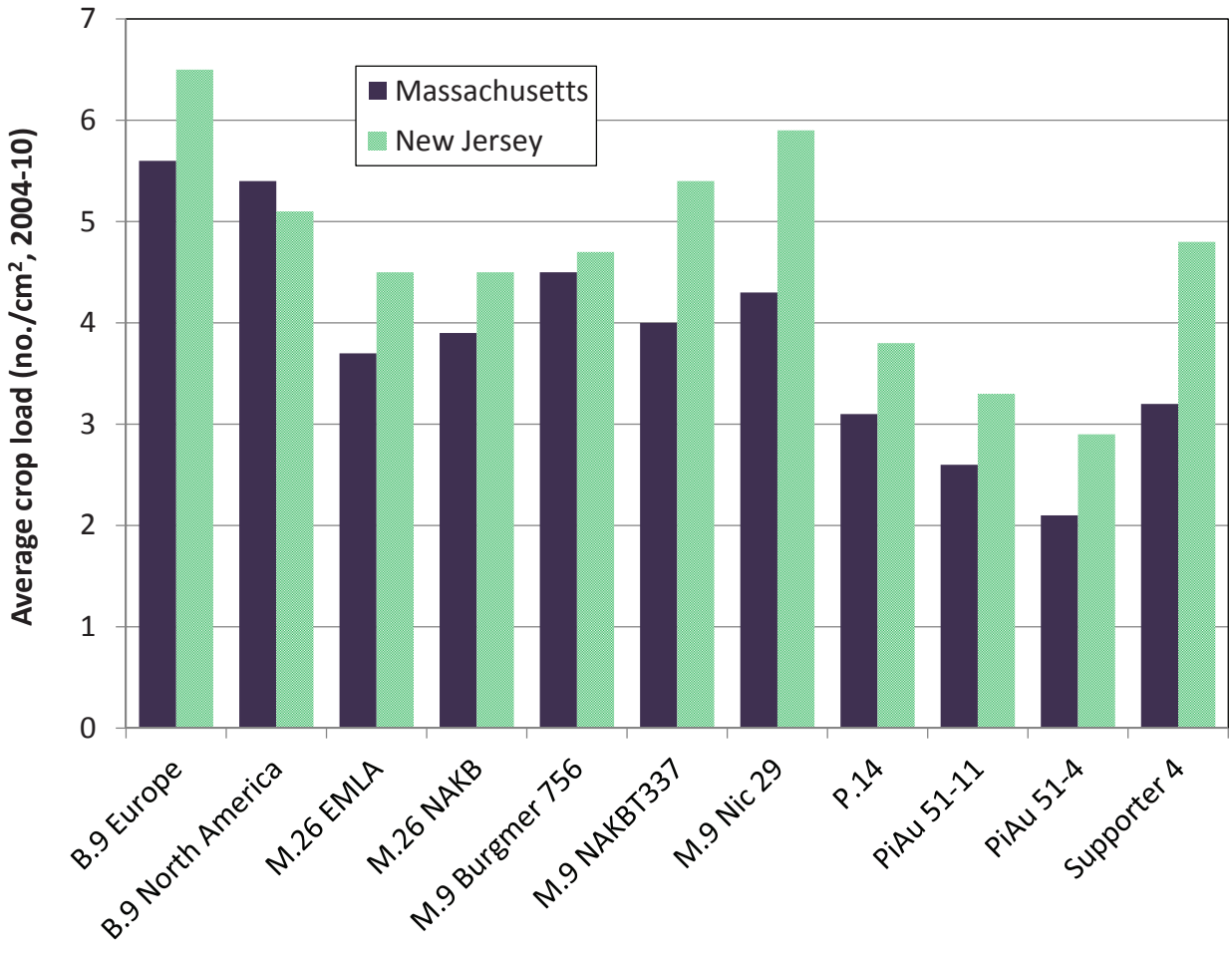


Figure 3. Rootstock effects on Buckeye Gala average (2004-10) crop load in the 2002 NC-140 Apple Rootstock Trial in Massachusetts and New Jersey.

which were similar to each other. 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 (Table 1). It also was high from trees on B.9 Europe, and in Massachusetts, trees on PiAu 51-4 suckered profusely.

On average at both sites, yield per tree was higher from the largest trees than from the smallest (Table 1); however, yield efficiency gives a 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 trees likewise planted at an appropriate density. Trees on B.9 were the most yield efficient trees in this trial (Table 1, Figure 2). Next most efficient were trees on the M.9 strains and those on the M.26 strains. Trees on Supporter 4 were similarly yield 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, but most of that variation was related to crop load (Figure 3). When the fruit size was adjusted statistically for crop load, then few substantial differences were seen relative to rootstock (Table 1).

Conclusions

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

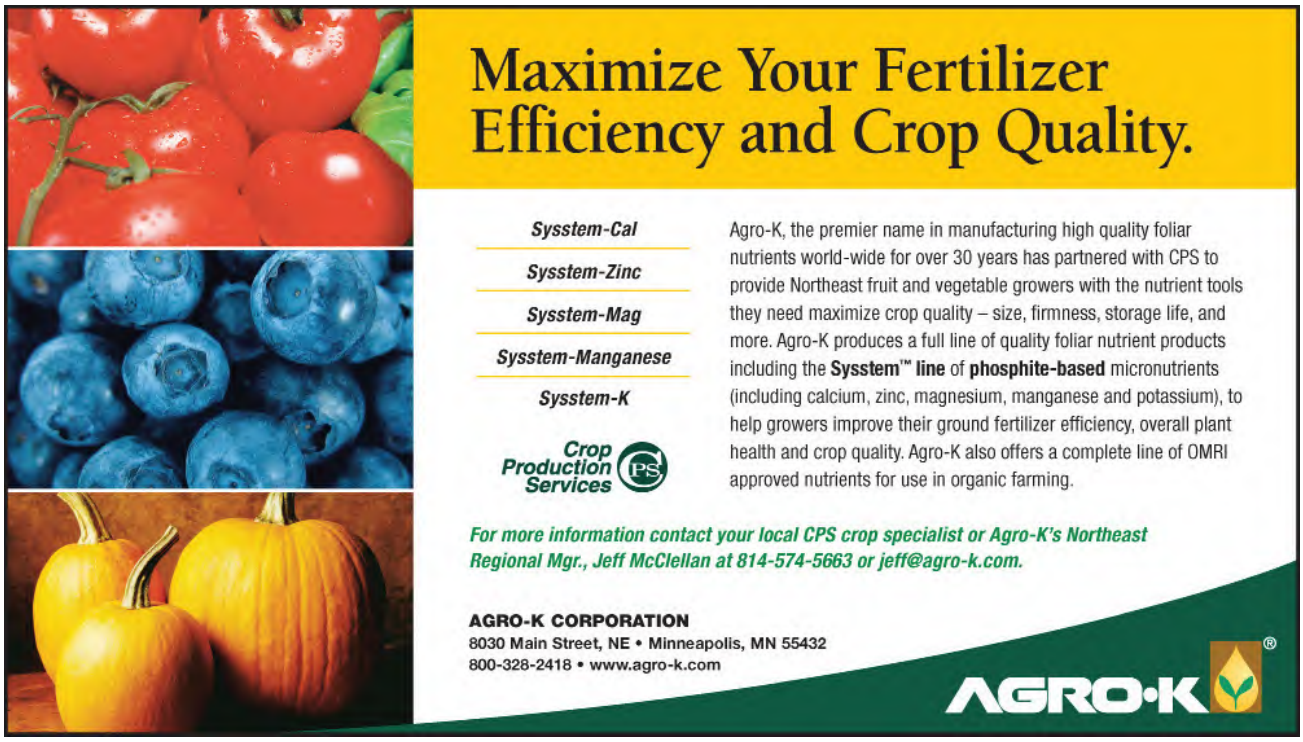
M.26 Strains. In Massachusetts and New Jersey, M.26 EMLA and M.26 NAKB performed similarly.

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 productivity 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.



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