ANNUAL REPORT TO NC-140

Massachusetts Agricultural Experiment Station

November 2000

Wesley R. Autio (leader), Jon Clements, Duane W. Greene, and Daniel R. Cooley

PROGRESS AND PRINCIPAL ACCOMPLISHMENTS

1994 NC-140 Apple Rootstock Trial

As part of the 1994 NC-140 Apple Rootstock Trial, a planting of Gala on 17 rootstock was established at the University of Massachusetts Horticultural Research Center in 1994. The planting included ten replications in a randomized-complete-block design.

TCA, root suckering, yield, and fruit weight all were affected in 2000 by rootstock (Table 1). Largest trees were on V.1, M.26 EMLA, and M.9 Pajam 2, and the smallest trees were on P.22, M.27 EMLA, and B.491. The greatest amount of cumulative (1994-2000) root suckering resulted from trees on P.16, M.9 Pajam 2, and M.9 Fleuren 56, and the least resulted from trees on M.26 EMLA. The greatest yields in 2000

Table 1. Trunk cross-sectional area, suckering, yield, yield efficiency, and fruit weight in 2000 of Gala trees on several rootstocks in the Massachusetts planting of the 1994 NC-140 Apple Rootstock Trial. All values are least-squares means, adjusted for missing subclasses, and fruit-weight means in 2000 were adjusted for crop load.[z]

Rootstock	Trunk cross-sectional area (cm^2)	Root sukers (no./tree, 1994-2000)	Yield per tree (kg)		Yield efficiency (kg/cm^2 TCA)		Fruit weight (g)	
			2000	Cumulative (1996-2000)	2000	Cumulative (1996-2000)	2000	Average (1996-2000)
M.9 EMLA	35.8 def	5.6 bcd	57 ab	132 bcdef	1.66 a	3.85 abc	150 a	169 abcd
M.26 EMLA	53.8 ab	1.0 d	60 ab	151 abcd	1.13 bcde	2.94 c	151 a	165 abcde
M.27 EMLA	9.3 j	3.8 cd	13 f	35 jk	1.31 abcde	3.90 abc	147 a	140 gh
M.9 RN29	42.7 bcd	12.9 abcd	64 a	159 abc	1.45 abcd	3.68 abc	158 a	179 a
M.9 Pajam 1	40.0 cde	13.7 abcd	55 ab	135 bcdef	1.42 abcd	3.45 abc	154 a	173 abc
M.9 Pajam 2	49.5 abc	23.0 a	67 a	168 ab	1.38 abcd	3.44 abc	148 a	180 a
B.9	27.1 efgh	7.0 bcd	40 bcde	96 efghi	1.45 abcd	3.62 abc	147 a	164 abcdef
B.491	12.7 ij	3.6 cd	19 ef	53 ijk	1.55 abc	4.21 ab	148 a	151 defgh
0.3	34.0 def	17.2 abc	53 ab	144 abcde	1.55 abc	4.37 a	147 a	160 bcdef
V.1	61.8 a	10.5 abcd	51 abc	191 a	0.85 e	3.17 bc	159 a	175 abc
P.2	34.6 def	3.4 cd	40 bcde	111 cdefgh	1.15 abcde	3.21 bc	151 a	162 abcdef
P.16	16.3 hij	24.2 a	24 def	68 hijk	1.47 abcd	4.12 ab	150 a	157 cdefg
Mark	25.1 fghi	10.8 abcd	27 cdef	86 fghij	1.06 cde	3.44 abc	136 ab	148 efgh
P.22	6.9 j	4.5 cd	7 f	23 k	0.99 de	3.36 abc	116 b	133 h
B.469	19.1 ghij	5.3 bcd	23 def	74 ghij	1.20 abcde	3.88 abc	133 ab	146 fgh
M.9 Fleuren 56	28.4 efgh	21.2 ab	46 abcd	106 defgh	1.68 a	3.83 abc	151 a	177 ab
M.9 NAKBT337	32.2 defg	9.2 abcd	52 abc	119 cdefg	1.63 ab	3.72 abc	156 a	178 a

[z] Mean separation within columns by Tukey's HSD ($P = 0.05$).

were harvested from trees on M.9 Pajam 2 and M.9 RN29, and the smallest yields were from trees on P.22, M.27 EMLA, and B.491. Cumulatively (1996-2000), the greatest yields came from trees on V.1, and the smallest yields came from trees on P.22, M.27 EMLA, and B.491. The most efficient trees in 2000 were on M.9 Fleuren 56, M.9 EMLA, and M.9 NAKB T337, and the least were on V.1, P.22, and Mark. Cumulatively (1996-2000), the most efficient trees were on O.3, B.491, and P.16, and the least efficient were on M.26 EMLA, V.1, and P.2. Fruit size was similar for trees on most rootstocks but was significantly smaller for trees on P.22. Average fruit size (1996-2000) was greatest for trees on M.9 Pajam 2, M.9 RN29, and M.9 NAKBT337 and smallest for trees on P.22, M.27 EMLA, and B.469.

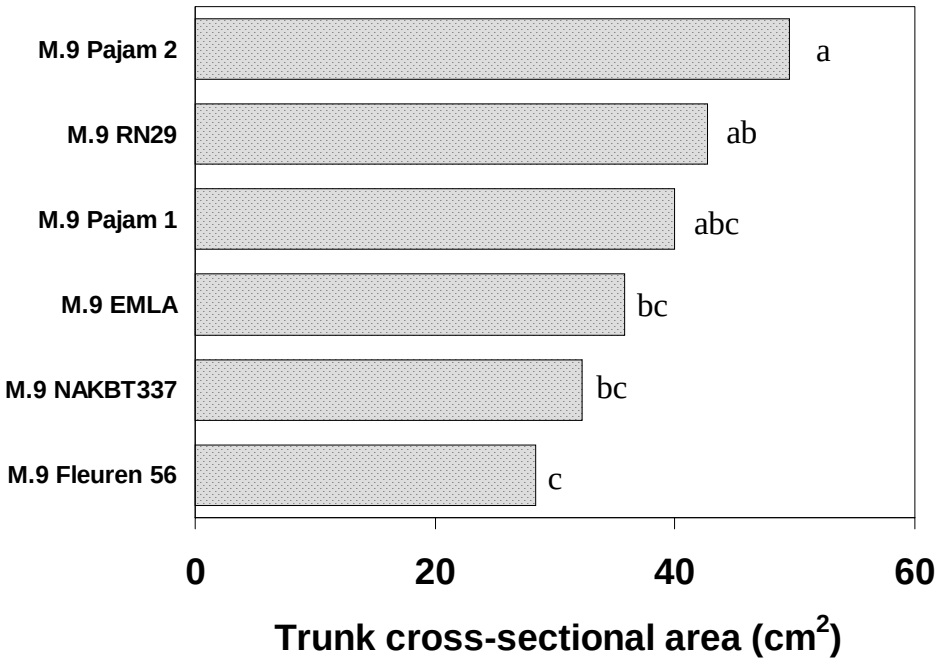

Figure 1. Trunk cross-sectional area of Gala trees on six M.9 strains in the 1994 NC-140 Apple Rootstock Trial in Massachusetts.

Since six strains of M.9 are included in this study, it is interesting to study variation among them. TCA varied significantly among the six strains (Figure 1), with trees on M.9 Pajam 2 being 74% larger than trees on M.9 Fleuren 56. Yield per tree (Figure 2)followed similar trends to TCA; however, trees of the six strains were similarly yield efficient. Root suckering was greatest from trees on M.9 Pajam 2 and M.9 Fleuren 56 and least from trees on M.9 EMLA (Figure 3).

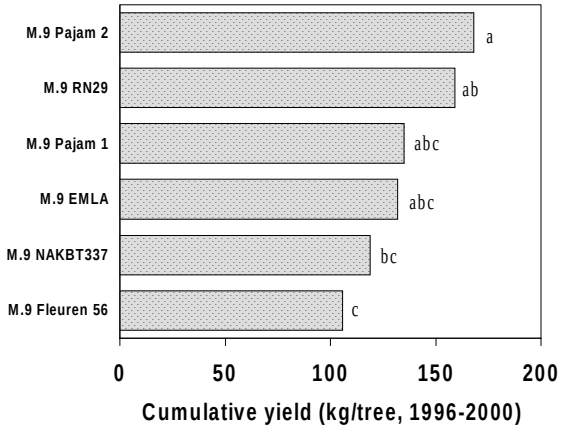

Figure 2. Yield of Gala trees on six M.9 strains in the 1994 NC-140 Apple Rootstock Trial in Massachusetts.

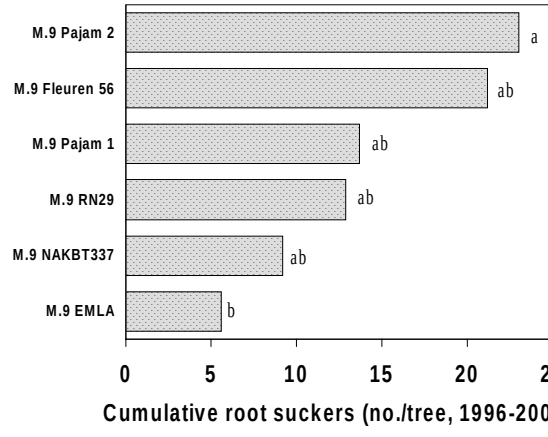

Figure 3. Root suckering of Gala trees on six M.9 strains in the 1994 NC-140 Apple Rootstock Trial in Massachusetts.

1994 NC-140 Peach Rootstock Trial

As part of the 1994 NC-140 Peach Rootstock Trial, a planting of Redhaven on 13 rootstocks was established at the University of Massachusetts Horticultural Research Center in 1994. The planting included eight replications in a randomized-complete-block design.

Rootstock affected TCA of trees at the end of the 2000 growing season (Table 2). Trees on Guardian, Lovell, and Montclar were the largest, and those on H7338019, Rubira, and Ishtara were the smallest. The TCAs of trees on Ishtara were 43% of the TCA of trees on Lovell.

In 2000, rootstock did not affect yield significantly (Table 2) Cumulatively (1996-2000), the greatest yields were harvested from trees on TN281-1, and the least were harvested from trees on Ishtara (Table 2). In 2000, rootstock did not affect yield efficiency significantly. Cumulatively (1996-2000), trees on Ishtara were the most yield efficient, and than those on Lovell, Guardian, Montclar, and TaTao5/Lovell were the least yield efficient. Fruit size in 2000 and the average size over the last five years were not affected significantly by rootstock.

To date, Ishtara appears to be a very interesting rootstock. It produces a small, yield-efficient tree, with good fruit size.

1998 G.16 Trial

In 1998, a small trial was established at the University of Massachusetts Horticultural Research Center including Gala on G.16, M.9, and M.9 EMLA. The experiment was a randomized-complete-block design with ten replications.

Rootstock significantly affected TCA after the third growing season (2000) (Table 3), with trees on G.16 significantly larger than those on M.9 or M.9 EMLA. Yield in 2000 was not affected by rootstock, but trees on M.9 were significantly more yield efficient than those on G.16, with trees on M.9 EMLA intermediate to the two. Fruit size was not affected by rootstock in 2000.

1999 NC-140 Dwarf and Semidwarf Apple Rootstock Trials

As part of the 1999 NC-140 Dwarf Apple Rootstock Trial, a plating of McIntosh on 11 rootstocks was established at the University of Massachusetts Horticultural Research Center in 1999. The planting

Table 2. Trunk cross-sectional area, yield, yield efficiency, and fruit weight in 2000 of Redhaven peach trees planted in Massachusetts as part of the 1994 NC-140 Peach Rootstock Trial. All values are least-squares means adjusted for missing subclasses.[z]

Rootstock	Trunk cross-sectional area (cm^2)	Yield per tree (kg)		Yield efficiency (kg/cm^2 TCA)		Fruit weight (g)	
		2000	Cumulative (1996-2000)	2000	Cumulative (1996-2000)	2000	Average (1996-2000)
Lovell	130 a	34 a	176 ab	0.27 a	1.42 b	248 a	208 a
Bailey	101 ab	34 a	156 abc	0.36 a	1.63 ab	295 a	216 a
TN281-1	110 ab	38 a	177 a	0.35 a	1.63 ab	278 a	207 a
Stark's Redleaf	101 ab	35 a	174 ab	0.35 a	1.75 ab	311 a	221 a
GF305	102 ab	30 a	160 ab	0.29 a	1.60 ab	258 a	204 a
Higama	107 ab	31 a	161 ab	0.29 a	1.50 ab	248 a	191 a
Montclar	116 a	33 a	147 abc	0.29 a	1.30 b	251 a	195 a
Rubira	75 bc	24 a	135 abc	0.31 a	1.81 ab	263 a	205 a
Ishtara	56 c	23 a	110 c	0.42 a	2.00 a	230 a	192 a
H7338019	85 bc	31 a	146 abc	0.35 a	1.69 ab	270 a	206 a
BY520-8	100 ab	35 a	144 abc	0.36 a	1.45 ab	264 a	200 a
Guardian	130 a	34 a	169 ab	0.27 a	1.35 b	237 a	191 a
TaTao5/Lovell	97 ab	27 a	123 bc	0.27 a	1.26 b	218 a	192 a

[z] Mean separation within columns by Tukey's HSD ($P = 0.05$).

Table 3. Trunk cross-sectional area, yield, and fruit weight in 2000 of Gala trees on various rootstocks planted in 1998.[z]

Rootstock	Trunk cross-sectional area (cm^2)	Yield per tree (kg)	Yield efficiency (kg/cm^2 TCA)	Fruit weight (g)
G.16	8.7 a	2.5 a	0.29 b	146 a
M.9	4.1 b	3.3 a	0.82 a	134 a
M.9 EMLA	3.8 b	1.9 a	0.57 ab	135 a

[z] Mean separation within columns by Tukey's HSD ($P = 0.05$).

Rootstock significantly affected TCA after the second growing season (2000) in the dwarf trial (Table 4). Largest trees were on CG.13, and the smallest were on M.9 NAKBT337. TCA also was affected by rootstock in the semidwarf trial (Table 5). Largest trees were on M.7 EMLA and Supporter 4, and the smallest were on CG.707 and M.26 EMLA. Greatest root suckering was observed from trees on CG.814 and M.7 EMLA.

included six replications in a randomized-complete-block design. A second planting was established in 1999, including McIntosh on six rootstocks as part of the 1999 NC-140 Semidwarf Apple Rootstock Trial. It also included six replications in a randomized-complete-block design.

1995 Massachusetts-Maine-Nova Scotia Scion/Rootstock Trial

In 1995, a trial was established at three locations (Belchertown, MA, Monmouth, ME, and Kentville, NS) including Rogers Red McIntosh, Cortland, Macoun, and Pioneer Mac on 12 different rootstocks. The experiment was a randomized-complete-block/split-plot design at each site, with scion as the whole plot and rootstock as the split plot. Each site included seven replications. Only Massachusetts data are

Table 4. Trunk cross-sectional area in 2000 of McIntosh trees on various rootstocks planted in Massachusetts as part of the 1999 NC-140 Dwarf Apple Rootstock Trial. All values are least-squares means adjusted for missing subclasses.[z]

Rootstock	Trunk cross-sectional area (cm^2)
CG.13	6.0 a
CG.179	4.8 ab
CG.202	5.1 ab
CG.41	2.9 bc
G.16N	3.6 abc
G.16T	4.5 abc
M.26 EMLA	2.8 bc
M.9 NAKBT337	2.1 c
Supporter 1	4.2 abc
Supporter 2	4.5 abc
Supporter 3	4.9 ab

[z] Mean separation within columns by Tukey's HSD ($P = 0.05$).

Table 5. Trunk cross-sectional area and root suckering in 2000 of McIntosh trees on various rootstocks planted in Massachusetts as part of the 1999 NC-140 Semidwarf Apple Rootstock Trial. All values are least-squares means adjusted for missing subclasses.[z]

Rootstock	Trunk cross-sectional area (cm^2)	Root suckers (no./tree)
CG.30N	4.9 ab	0.2 bc
CG.707	2.8 c	0.2 bc
CG.814	3.1 bc	3.0 a
M.26 EMLA	2.8 c	0.0 c
M.7 EMLA	5.5 a	2.0 ab
Supporter 4	6.1 a	0.3 bc

[z] Mean separation within columns by Tukey's HSD ($P = 0.05$).

presented in this report.

TCA was not affected by scion cultivar nor the interaction of scion cultivar and rootstock; however, rootstock affected TCA significantly (Table 6). Specifically, across all scion cultivars, the largest trees were on Mark and V.1, and the smallest were on P.22, B.146, and P.16.

Over all rootstocks, Cortland trees yielded the most per tree in 2000 and cumulatively (1997-2000), and Pioneer Mac trees yielded the least (Table 6). Over all scion culitvars, trees on Mark yielded the most in 2000 and cumulatively (1997-2000), and those on P.22 and B.146 yielded the least. Scion cultivar and rootstock interacted significantly to affect yield in 2000 and cumulatively; however, dramatic variation in the overall affect of rootstock was not observed.

Scion cultivar and rootstock affected yield efficiency in 2000 and cumulatively (1997-2000) (Table 6), but they did not interact significantly in either case. Both in 2000 and cumulatively (1997-2000), Cortland trees were the most yield efficient, and Pioneer Mac trees were the least. Further, trees on P.16 were the most efficient, and those on V.1 were the least efficient.

In 2000 and cumulatively (1997-2000), Cortland trees produced the largest fruit, and Pioneer Mac produced the smallest (Table 6). Over all scion cultivars, rootstock had little impact on fruit size in 2000, except that P.22 and B.146 resulted in the smallest fruit. Rootstock and scion interacted significantly to affect fruit size in 2000; however, most rootstocks resulted in similar differences among the scion cultivars. The most notable variation was P.22, which resulted in the smallest or next to smallest fruit for Cortland, McIntosh, and Pioneer Mac and the largest fruit for Macoun. Averaged over all fruiting years (1997-2000), scion cultivar and rootstock did not interact to affect size, and the overall differences were similar to those observed in 2000.

1995 Massachusetts-New Brunswick-Pennsylvania Ginger Gold Rootstock Trial

In 1995, a trial was established in Belchertown, MA, University Park, PA, and Bouctouche, NB

Table 6. Trunk cross-sectional area, yield, yield efficiency, and fruit weight in 2000 of Cortland, Rogers Red McIntosh, Macoun, and Pioneer Mac trees on several rootstocks planted in 1995. All values are least-squares means adjusted for missing subclasses.[z]

Rootstock	Trunk cross-sectional area (cm^2)	Yield per tree (kg)		Yield efficiency (kg/cm^2 TCA)		Fruit weight (g)	
		2000	Cumulative (1997-2000)	2000	Cumulative (1997-2000)	2000	Average (1997-2000)
Cortland	12.7 a	6.7 a	23.0 a	0.59 a	2.09 a	210 a	211 a
Rogers Red McIntosh	13.0 a	2.8 bc	18.8 b	0.23 bc	1.72 ab	115 c	152 bc
Macoun	11.9 a	4.0 b	21.1 ab	0.36 b	2.02 a	151 b	163 b
Pioneer Mac	14.0 a	1.5 c	16.8 b	0.12 c	1.46 b	112 c	147 c
B.491	6.8 fg	2.5 cd	13.2 d	0.43 ab	2.11 bc	139 ab	171 abc
B.146	4.3 g	1.5 d	6.0 d	0.22 b	1.28 de	112 b	149 c
P.2	14.2 de	4.4 bcd	23.8 b	0.30 ab	1.79 bcd	157 a	167 abc
P.22	4.4 g	1.6 d	10.5 d	0.39 ab	2.38 b	123 b	158 bc
V.1	24.6 b	5.7 ab	26.7 b	0.24 b	1.14 e	157 a	173 ab
V.3	12.4 de	3.8 bcd	23.8 b	0.32 ab	1.98 bcd	163 a	179 a
B.469	10.0 ef	3.5 bcd	14.3 cd	0.38 ab	1.51 cde	145 ab	166 abc
P.16	3.9 g	1.7 d	11.9 d	0.47 a	3.22 a	144 ab	164 abc
B.9	18.0 c	5.0 abc	23.8 b	0.30 ab	1.43 de	155 a	169 abc
M.9	13.8 de	3.6 bcd	24.8 b	0.27 b	1.83 bcd	162 a	180 a
M.9 NAKBT337	14.6 d	4.5 abc	22.6 bc	0.32 ab	1.76 cd	156 a	166 abc
Mark	27.8 a	7.2 a	38.0 a	0.28 ab	1.43 de	156 a	174 ab

[z] Mean separation within columns and within cultivar or rootstock by Tukey's HSD ($P = 0.05$).

Table 7. Trunk cross-sectional area, yield, yield efficiency, and fruit weight in 2000 of Ginger Gold trees on various rootstocks planted in 1995. All values are least-squares means adjusted for missing subclasses.[z]

Rootstock	Trunk cross-sectional area (cm^2)	Yield per tree		Yield efficiency (kg/cm^2 TCA)		Fruit weight (g)	
		2000	Cumulative (1997-2000)	2000	Cumulative (1997-2000)	2000	Average (1997-2000)
B.491	5.1 d	8.5 d	12.1 f	1.58 ab	2.24 ab	203 a	227 ab
P.2	12.9 c	19.9 c	30.3 cd	1.56 ab	2.32 ab	199 a	231 ab
P.22	5.5 d	7.6 d	10.7 f	1.40 ab	1.96 ab	194 a	224 ab
V.1	21.2 b	30.5 b	46.1 ab	1.46 ab	2.15 ab	209 a	237 ab
V.3	5.3 d	7.9 d	9.6 f	1.28 ab	1.56 b	197 a	199 bc
B.469	3.5 d	4.2 d	6.2 f	1.11 b	1.61 b	118 b	160 c
P.16	5.3 d	9.7 d	15.0 ef	1.87 a	2.86 a	200 a	227 ab
B.9	16.3 bc	20.5 c	29.7 cd	1.29 ab	1.86 b	216 a	244 a
M.9NAKBT337	13.9 c	23.1 bc	36.9 bc	1.86 a	2.84 a	199 a	237 ab
Mark	27.1 a	41.8 a	61.2 a	1.57 ab	2.28 ab	191 a	238 a

[z] Mean separation within columns by Tukey's HSD ($P = 0.05$).

including Ginger Gold on 10 rootstocks. The experiment was a randomized-complete-block design with 10 replications at each site. Only Massachusetts data are reported here.

At the end of the 2000 growing season, trees on Mark were the largest and those on P.22, P.16, V.3, B.491, and B.469 were the smallest (Table 7). In 2000 and cumulatively (1997-2000), trees on Mark and V.1 yielded the most, and trees on P.16, B.491, V.3, P.22, and B.469 yielded the least. In 2000 and cumulatively (1997-2000), yield efficiency was greatest for trees on P.16 and M.9 NAKBT337 and least for trees on B.469. In 2000, fruit size was not affected by rootstock; however, Mark and B.9 resulted in the largest fruit on average over the last four seasons, and B.469 resulted in the smallest.

Table 8. Trunk cross-sectional area, yield, and yield efficiency in 2000 of Liberty trees on various rootstocks planted in 1995. All means are least-squares means adjusted for missing subclasses, and fruit-weight means in 2000 were adjusted for crop load.[z]

Rootstock	Trunk cross-sectional area (cm^2)	Yield per tree (kg)		Yield efficiency (kg/cm^2 TCA)		Fruit weight (g)	
		2000	Cumulative (1997-2000)	2000	Cumulative (1997-2000)	2000	Average (1997-2000)
M.9 EMLA	16.7 a	9.2 a	26.4 a	0.66 b	1.92 b	121 c	155 a
CG.29	17.4 a	10.4 a	33.7 a	0.64 b	1.96 b	129 bc	147 a
CG.214	14.8 a	9.4 a	25.7 a	0.70 ab	1.86 b	141 abc	155 a
CG.210	9.6 a	12.9 a	28.9 a	1.14 a	2.54 ab	161 a	162 a
CG.710	11.8 a	12.4 a	27.7 a	1.06 ab	2.38 ab	142 abc	157 a
CG.995	13.0 a	14.4 a	38.0 a	1.14 a	2.94 a	145 ab	156 a

[z] Mean separation within columns by Tukey's HSD ($P = 0.05$).

Table 9. Trunk cross-sectional area, yield, yield efficiency, and fruit weight in 2000 of Rogers Red McIntosh Trees on various rootstocks planted in 1996. All values are least-squares means adjusted for missing subclasses.[z]

Rootstock	Trunk cross-sectional area (cm^2)	Yield per tree (kg)		Yield efficiency (kg/cm^2 TCA)		Fruit weight (g)	
		2000	Cumulative (1998-2000)	2000	Cumulative (1998-2000)	2000	Average (1999-2000)
V.1	9.8 b	8.3 a	12.2 a	0.89 ab	1.33 b	160 a	155 a
V.2	12.9 b	8.2 a	11.7 a	0.62 b	0.88 bc	149 a	148 a
V.3	8.1 b	10.6 a	15.0 a	1.35 a	1.92 a	143 a	137 a
V.4	33.9 a	14.0 a	16.4 a	0.46 b	0.54 c	145 a	139 a
V.7	14.6 b	15.6 a	18.6 a	1.10 ab	1.25 b	155 a	136 a
M.26 EMLA	12.7 b	10.8 a	13.7 a	0.90 ab	1.14 b	161 a	149 a

[z] Mean separation within columns by Tukey's HSD ($P = 0.05$).

1995 Liberty Rootstock Trial

A trial was established in 1995 at the University of Massachusetts Horticultural Research Center, including Liberty on five Cornell-Geneva selections in comparison with Liberty on M.9 EMLA. The experiment was a randomized-complete-block design with eight replications.

In 2000, trees on the various rootstocks had similar TCA, yield per tree, cumulative (1997-2000) yield per tree, and fruit size (Table 8). In 2000, yield efficiency was greatest for trees on CG.995 and CG.210 and least for trees on M.9 EMLA and CG.29. Cumulatively (1997-2000), the most yield efficient trees were on CG.995, and the least yield efficient trees were on CG.29, M.9 EMLA, and CG.214. Fruit size in 2000 was greatest for trees on CG.210 and least for trees on M.9 EMLA.

Data in this trial were extremely variable. For instance, a TCA difference of 16.7 vs 9.6 was nonsignificant. There appear to be a number of incorrectly identified trees in the trial, seriously limiting its usefulness.

1996 McIntosh Rootstock Trial

In 1996, a trial was established at the University of Massachusetts Horticultural Research Center including Rogers Red McIntosh on V.1, V.2, V.3, V.4, V.7, and M.26 EMLA. The experiment was a randomized-complete-block design with seven replications.

After the fifth growing season, trees on V.4 had the largest TCA (Table 9). Rootstock did not affect yield in 2000 or cumulatively. Trees on V.3 were the most yield efficient in 2000 and cumulatively, and those on V.2 and V.4 were the least. Fruit size in 2000 and the average fruit size over 1999 and 2000 were not affected by rootstock.

1998 Cultivar/Rootstock Trial

In 1998, a trial was established at a commercial orchards in the Methuen, Massachusetts. It included Cortland, Fortune, and Honeycrisp on V.1, M.9 RN8, B.9, M.9 RN19, M.26 EMLA, M.9 RN29, and M.9 NAKBT337, withsix replications in a randomized-complete-block/split-plot design.

Over all rootstocks, Fortune trees were the largest after three growing seasons, and Honeycrisp trees were the smallest (Table 10). Over the tree scion cultivars, trees on V.1 and those on B.9 were the largest, and those on M.9 RN8 and M.9 NAKBT337 were the smallest. However, rootstock and scion interacted to affect tree size in 2000. Cortland trees on V.1, B.9, and M.9 RN19 were the largest, and those on M.26 EMLA were the smallest. Fortune trees on V.1 and B.9 were the largest, and those on M.9 T337 were the smallest. Honeycrisp trees on V.1, B.9, and M.26 EMLA were significantly larger than those on the other rootstocks, which were similar in TCA.

Table 10. Trunk cross-sectional area in 2000 of Cortland, Fortune, and Honeycrisp trees on various rootstocks planted in 1998. All values are least-squares means adjusted for missing subclasses.[z]

Rootstock	Cortland	Fortune	Honeycrisp	Average
V.1	7.3 a	10.9 a	6.1 a	8.1 a
M.9 RN8	4.9 bc	5.7 c	3.7 b	4.8 d
B.9	6.4 ab	8.6 ab	5.9 a	7.0 ab
M.9 RN19	6.3 ab	7.1 b	3.4 b	5.6 bcd
M.26 EMLA	4.6 c	7.8 b	6.6 a	6.3 bc
M.9 RN29	5.8 abc	6.4 b	3.4 b	5.2 cd
M.9 NAKBT337	6.1 abc	5.0 d	2.6 b	4.6 d
Average	5.9 b	7.3 a	4.5 c	

[z] Overall rootstock means scion cultivar means separated by Tukey's HSD (P = 0.05). Rootstock means within scion cultivar separated by t test (P = 0.01).

USEFULNESS OF FINDINGS

We have defined further the characteristics of several rootstocks grown under Massachusetts conditions with McIntosh, Liberty, Pioneer Mac, Gala, Ginger Gold, Cortland, Macoun, Honeycrisp, and Fortune as apple scion cultivars and Redhaven as a peach scion cultivar. Several rootstocks in the older plantings show great promise for potential commercial adoption.

In addition to the economic benefits associated with the greater yield efficiency and fruit size of trees on some of these dwarfing rootstocks, significant benefits are realized by growers in Massachusetts selling fruit using pick-your-own techniques. These fully dwarf trees seem particularly suited to pick-your-own marketing, providing for significantly less loss due to fruit drop and poor quality.

WORK PLANNED FOR 2001

All existing plantings will be maintained in 2001. No new trials are planned. A five-year report of the Massachusetts-Maine-Nova Scotia Cultivar/Rootstock Trial will be developed for publication.

PUBLICATIONS

Autio, W. R. 1999. Ottawa 3: A summary of twenty years of trial. *Fruit Notes* 64(2):12-13.

Autio, W. R. 2000. Rootstock and scion interact to affect apple tree performance: Results from a 10-year trial by the NC-140 Technical Committee. *HortScience* 35:499-500 (abstract).

Marini, R. P., J. L. Anderson, W. R. Autio, B. H. Barritt, J. A. Cline, W. P. Cowgill, Jr., R. M. Crassweller, P.A. Domoto, D. C. Ferree, J. Garner, A. Gaus, G. . Greene, C. Hampson, P. Hirst, M. M. Kushad, E. Mielke, C. A. Mullins, M. Parker, R. L. Perry, J. P. Privé, G. L. Reighard, T. Robinson, C. R. Rom, T. R. Roper, J. R. Schupp, E. Stover, and R. Unrath. 2000. Performance of 'Gala' apple on18 dwarf rootstocks: Five-year summary of the 1994 NC-140 Dwarf Rootstock Trial. *J. Amer. Pomological Soc.* 54:92-107.

Tuttle, A., D. Smith, J. Hall, M. Frank, D. Cooley, S. Wright, J. Black, S. Lavalle, and W. Autio. 1999. Effects of planting density and IPM level on apple fruit quality. *Fruit Notes* 64(2):6-7.

Tuttle, A., J. Smith, C. Bergweiler, D. McPadden, S. Christle, S. Wright, J. Black, and W. Autio. 1999. Effects of planting density and IPM level on apple fruit quality and crop density, 1999 results. *Fruit Notes* 64(4):1-3.

SPONSORED ACTIVITY

Cooley, D. R., W. R. Autio, R. J. Prokopy, and W. M. Coli. 1997-2000. Integrating high-density orchards and biointensive integrated pest management methods in Northeastern apple production. USDA/SARE Northeast Region, $121,535.

Prokopy, R. J., D. R. Cooley, W. M. Coli, W. R. Autio, A. F. Tuttle, S. E. Wright, D. W. Greene, and W. J. Bramlage. 1999-2000. Initiation of the second phase of third-level IPM in apple orchards. State/Federal IPM Program, $76,815.

Autio, W. R. 2000. Coordination of the 1990 NC-140 Cultivar/Rootstock Trial and the 1999 NC-140 Dwarf and Semidwarf Trials. International Dwarf Fruit Tree Association, $5,100.