



# Massachusetts Agricultural Experiment Station

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## 2009 NC-140 Peach

As part of the 2009 NC-140 Peach Rootstock Trial, a planting of Redhaven on 15 rootstocks was established at the University of Massachusetts Cold Spring Orchard Research & Education Center. Trees grew well in their first seven seasons. It is important to note that these trees experienced a heavy snowstorm at the end of October 2011. Leaves were still present, and some scaffold breakage occurred. Where possible, scaffolds were pulled back and bolted into place. The longevity of

some of these trees may be reduced. The planting includes eight replications in a randomized-complete-block design. Means from 2015 (7<sup>th</sup> growing season) are included in Tables 1 and 2.

At the end of the 2015 season, largest trees were on Guardian, Lovell, Atlas, Viking, Krymsk 86, and KV010-127, and smallest trees were on Controller 5, Krymsk 1, and *Prunus americana* (Table 1, Figure 1). Significantly more suckering occurred from trees on *P. americana* than from any other rootstock (Table 1).

Greatest yields in 2015 were harvested from trees on

Table 1. Trunk size, root suckering, yield, yield efficiency, and fruit size in 2015 of Redhaven peach trees in the 2009 NC-140 Peach Rootstock Trial at the UMass Cold Spring Orchard Research & Education Center, Belchertown, MA. All values are least-squares means, adjusted for missing subclasses and for crop load in the case fruit weight.<sup>2</sup>

Rootstock	Trunk cross-sectional area (cm <sup>2</sup> )	Root suckers (no./tree, 2009-15)	Yield per tree (kg)	Yield efficiency (kg/cm <sup>2</sup> )	Fruit weight (g)
Atlas	180 abc	0.1 b	17 ab	0.10 bc	170 a
Brights Hybrid 5	159 bc	0.0 b	15 ab	0.09 bc	171 a
Controller 5	58 c	0.0 b	11 b	0.21 a	168 a
Guardian	211 a	0.3 b	17 ab	0.08 c	178 a
HBOK 10	148 bc	0.5 b	14 ab	0.10 bc	173 a
HBOK 32	144 b	0.3 b	18 ab	0.13 bc	165 a
KV010-123	151 bc	0.5 b	18 ab	0.12 bc	175 a
KV010-127	171 abc	1.5 b	16 ab	0.10 bc	174 a
Krymsk 1	82 c	3.8 b	12 b	0.16 ab	198 a
Krymsk 86	174 abc	0.0 b	16 ab	0.10 bc	175 a
Lovell	186 ab	0.0 b	20 a	0.11 bc	177 a
Mirobac	151 bc	3.3 b	17 ab	0.12 bc	162 a
<i>Prunus americana</i>	88 c	129.8 a	18 ab	0.22 a	171 a
Penta	160 bc	9.4 b	14 ab	0.09 bc	178 a
Viking	174 abc	0.0 b	16 ab	0.10 bc	198 a

<sup>2</sup> Means were separated within columns by Tukey's HSD (P = 0.05).

Table 2. Cumulative yield, cumulative yield efficiency, and average fruit size of Redhaven peach trees in the 2009 NC-140 Peach Rootstock Trial at the UMass Cold Spring Orchard Research & Education Center, Belchertown, MA. All values are least-squares means, adjusted for missing subclasses.<sup>z</sup>

Rootstock	Cumulative yield per tree (2011-15, kg)	Cumulative yield efficiency (2011-15, kg/cm <sup>2</sup> )	Average fruit weight (2011-15, g)
Atlas	109 a	0.62 d	188 a
Brights Hybrid 5	105 a	0.66 d	181 a
Controller 5	57 b	1.02 bc	172 a
Guardian	121 a	0.59 d	190 a
HBOK 10	113 a	0.83 cd	182 a
HBOK 32	116 a	0.81 cd	179 a
KV010-123	117 a	0.78 cd	181 a
KV010-127	119 a	0.71 cd	184 a
Krymsk 1	103 a	1.32 ab	186 a
Krymsk 86	100 a	0.59 d	180 a
Lovell	123 a	0.67 d	186 a
Mirobac	108 a	0.74 cd	176 a
<i>Prunus americana</i>	125 a	1.50 a	188 a
Penta	94 a	0.60 d	186 a
Viking	120 a	0.72 cd	184 a

<sup>z</sup> Means were separated within columns by Tukey's HSD (P = 0.05).

Lovell, and the lowest yields were harvested from those on Controller 5 and Krymsk 1 (Table 1). On a cumulative basis (2011-15), yield was similar among most trees, except that yield from trees on Controller 5 was significantly lower than all others (Table 2, Figure 1). The most yield efficient trees in 2015 were on *P. americana* and Controller 5, and the least efficient trees were on Guradian (Table 1). Cumulatively (2011-15), yield efficiency was greatest for trees on *P. americana* and lowest for trees on Brights Hybrid 5, Lovell, Atlas, Krymsk 86, Penta, and Guardian (Table 2). Fruit size in 2015 and on average (2011-15) was not different among rootstocks (Tables 1 and 2).

### 2010 NC-140 Apple

As part of the 2010 NC-140 Apple Rootstock Trial, a planting of Honeycrisp on 31 rootstocks was established at the University of Massachusetts Cold Spring Orchard Research & Education Center. In 2010, trees in this planting grew relatively little, but growth has been good in the last five seasons. The planting includes four replications in a randomized-complete-block design, with up to three trees of a single rootstock per replication. Means from 2015 (6<sup>th</sup> growing season) are included in Table 3.

At the end of the 2015 growing season, largest trees were on B.70-20-20, and smallest trees were on B.71-7-22 (Table 3). The greatest number of root suckers were produced (cumulatively, 2010-15) by CG.4214, G.202N, and M.9 Pajam 2 (Table 3).

In 2015, yield was greatest from trees on G.202N, B.70-6-8, G.935N, CG.4004, and CG.4013 and least from trees on B.71-7-22 and PiAu 9-90 (Table 3). Cumulatively (2013-15), greatest yields were harvested

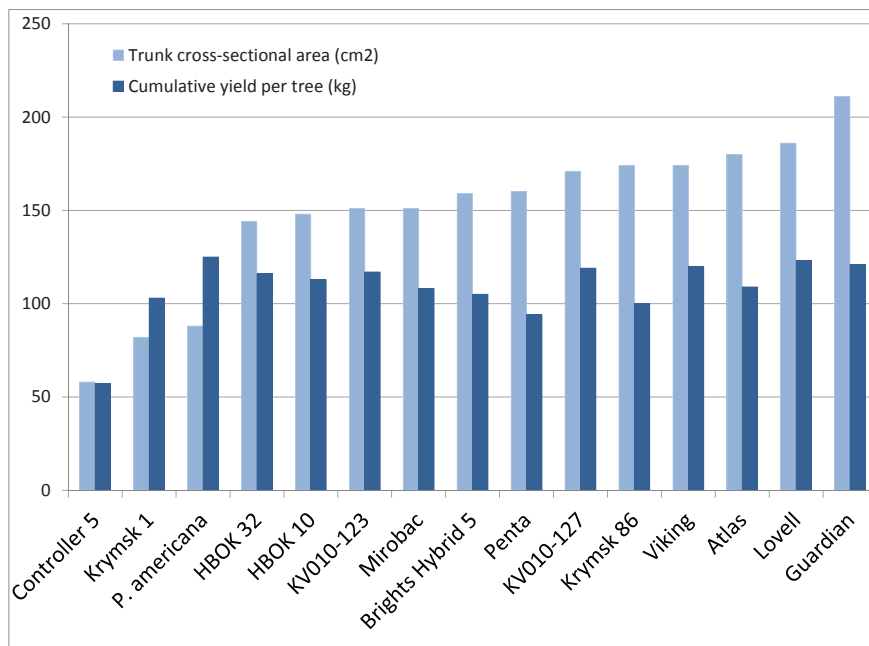


Figure 1. Trunk cross-sectional area (2015) and cumulative yield per tree (2011-15) of Red Haven trees in the Massachusetts planting of the 2009 NC-140 Peach Rootstock Trial.

Table 3. Trunk cross-sectional area, cumulative root sucker number, yield per tree, yield efficiency, and fruit weight in 2015 of Honeycrisp apple trees on various rootstocks in the 2010 NC-140 Honeycrisp Apple Rootstock Trial.<sup>2</sup>

Rootstock	Trunk cross-sectional area (2015, cm <sup>2</sup> )	Cumulative root suckers (2010-15, no.)	Yield per tree (2015, kg)	Cumulative yield per tree (2013-15, kg)	Yield efficiency (2015, kg/cm <sup>2</sup> TCA)	Cumulative yield efficiency (2013-15, kg/cm <sup>2</sup> TCA)	Fruit weight (2015, g)	Average fruit weight (2013-15, g)
B.9	7.6	8.3	9	23	1.3	3.0	298	253
B.10	12.7	0.3	16	39	1.3	3.1	302	243
B.7-3-150	26.2	1.4	17	37	0.7	1.4	329	283
B.7-20-21	22.7	4.9	19	45	1.0	2.1	287	247
B.64-194	29.6	0.0	17	39	0.6	1.3	306	259
B.67-5-32	26.9	1.3	19	38	0.8	1.5	308	267
B.70-6-8	26.9	0.9	24	49	0.9	1.9	309	263
B.70-20-20	45.7	13.2	13	36	0.3	0.8	283	253
B.71-7-22	2.1	5.1	3	5	1.1	2.5	275	213
G.11	10.7	11.3	12	41	1.2	3.8	317	265
G.41N	11.7	0.4	19	45	1.6	3.8	308	266
G.41TC	11.1	11.8	13	31	1.3	2.8	285	259
G.202N	24.3	33.0	26	77	1.1	3.2	287	258
G.202TC	15.8	23.3	16	49	1.0	3.1	309	228
G.935N	15.7	15.8	24	66	1.5	4.2	273	237
G.935TC	11.0	20.9	15	34	1.3	3.0	285	232
CG.2034	8.1	0.0	9	23	1.1	2.7	287	248
CG.3001	24.6	3.4	34	87	1.4	3.5	308	249
CG.4003	8.8	1.5	9	34	1.0	3.8	244	216
CG.4004	21.8	12.3	23	63	1.1	2.9	314	258
CG.4013	15.6	21.5	23	52	1.4	3.1	277	234
CG.4214	17.6	39.0	12	39	0.7	2.2	283	250
CG.4814	15.6	23.1	14	45	0.9	2.9	272	227
CG.5087	15.6	5.2	14	43	0.9	2.6	286	251
CG.5222	18.9	20.1	15	38	0.9	2.0	277	231
Supp.3	10.6	4.7	7	25	0.6	2.3	290	233
PiAu 9-90	21.4	0.1	4	13	0.2	0.6	212	148
PiAu 51-11	18.9	7.2	15	34	0.8	1.8	299	259
M.9 NAKBT337	12.1	17.6	15	40	1.3	3.3	299	256
M.9 Pajam 2	11.1	27.7	12	30	1.3	2.9	288	239
M.26 EMLA	12.3	11.5	11	29	0.9	2.4	274	238
Est. HSD ( $P = 0.05$ )	9.5	23.3	13	26	0.8	1.3	67	51

from trees on CG.3001 and G.202N, and lowest yields were from trees on B.71-7-22 and PiAu 9-90 (Table 3). The most yield efficient trees in 2015 were on G.41N, G.935N, CG.3001, and CG.4013. Cumulatively (2013-15), the most yield efficient trees were on G.935N, G.11, G.41N, CG.4003. The least yield efficient trees in 2015 and cumulatively were on PiAu 9-90 and B.70-20-20 (Table 3). The largest fruit in 2015 were harvested from trees on B.7-3-150, G.11, and CG.4004, and the smallest fruit were from trees on PiAu 9-90 (Table 3). On average (2013-15) the largest fruit were harvested in from trees on

B.7-3-150, B.67-5-32, G.41N, and G.11, and the smallest were harvested from those on PiAu 9-90 (Table 3).

### **2014 NC-140 Apple**

As part of the 2014 NC-140 Apple Rootstock Trial, a planting of Honeycrisp on 13 rootstocks was established at the University of Massachusetts Cold Spring Orchard Research & Education Center. Rootstocks, including four from the Vineland series (V.1, V.5, V.6, and V.7), seven from the Geneva series (G.11, G.202, G.4214,

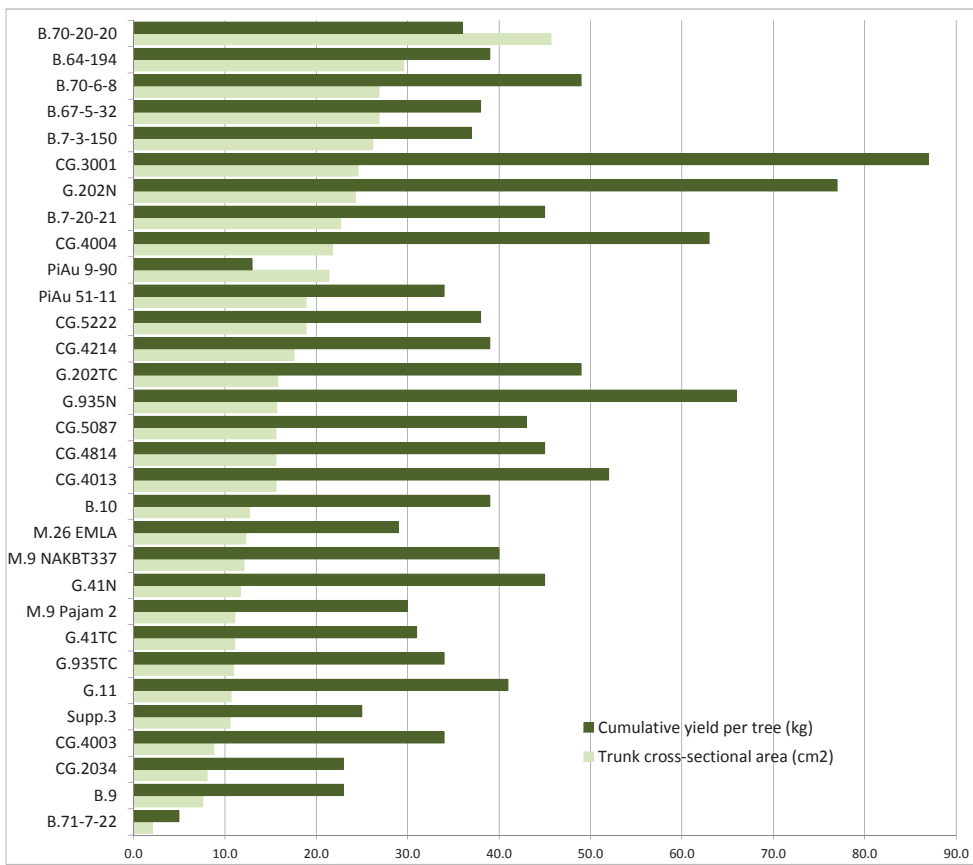


Figure 2. Trunk cross-sectional area (2015) and cumulative yield per tree (2013-15) of Honeycrisp trees in the Massachusetts planting of the 2010 NC-140 Apple Rootstock Trail.

G.30, G.5890, G.935, and G.969), and two standard rootstocks (M.26 EMLA and M.9 NAKBT337). The experimental design is a randomized complete block. Trees were trained and supported as Tall Spindles (spacing 1 x 4m) with trickle irrigation. Tree growth has been good, and only one tree (G.41) was lost to mechanical injury.

Trees grew well in their second growing season (Table 4, Figure 3). Largest trees were on V.6, and the smallest were on G.11. Yield was greatest from trees on G.30 and least from trees on G.202. The most yield efficient trees were on G.30, and least efficient trees were on G.202 and V.7. Fruit weight was large for all rootstocks. Based on these characteristics and the Tall Spindle Acceptability Index, G.30

was a notable standout, while G.202 performed poorly.

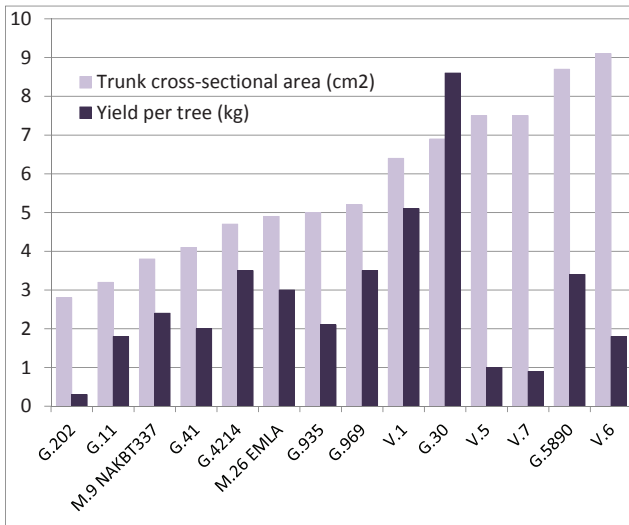


Figure 3. Trunk cross-sectional area (2015) and yield per tree (2015) of Honeycrisp trees in the Massachusetts planting of the 2014 NC-140 Apple Rootstock Trail.

### 2015 NC-140 Organic Apple

As part of the 2015 NC-140 Organic Apple Rootstock Trial a planting of Modi on several Geneva rootstocks was planted at Small Ones Farm, Amherst, MA. Trees generally grew well in their first growing season. Trees on G.16 and G.222 were particularly small at planting, resulting in a smaller-than-expected increase in trunk cross-sectional area during the growing season. These trees are planted on a sandy site but are trickle irrigated. It was noted that Modi foliage (at least) is very susceptible to cedar apple rust. After this first season, trees on G.890 were the largest, and those on G.16 were the smallest (Table 5, Figure 4). Trees on G.41 were rated the highest in the Tall Spindle Acceptability Index, and those on G.16 were rated the lowest.

Table 4. Tree size, root suckers, yield, yield efficiency, and fruit weight of Honeycrisp trees on several rootstocks in the Massachusetts planting of the 2014 NC-140 Apple Rootstock Trial.

Rootstock	Trunk cross-sectional area (cm <sup>2</sup> )	Tree height (m)	Root suckers (no.)	Yield per tree (kg)	Yield efficiency (kg/cm <sup>2</sup> TCA)	Fruit weight (g)	Tall Spindle Acceptability Index (0-3)
V.1	6.4 c	2.7 bc	0 b	5.1 b	0.81 ab	371 ab	1.8 cde
V.5	7.5 bc	2.8 ab	0 b	1.0 cd	0.13 e	388 a	2.6 ab
V.6	9.1 a	2.9 ab	1 b	1.8 cd	0.2 cde	390 a	2.2 abc
V.7	7.5 bc	2.8 abc	1 b	0.9 cd	0.12 e	381 a	2.4 abc
G.11	3.2 f	2.4 cde	0 b	1.8 cd	0.54 bcde	373 ab	1.3 def
G.30	6.9 c	3.0 ab	4 a	8.6 a	1.27 a	380 a	2.7 a
G.41	4.1 def	2.6 bcde	0 b	2.0 cd	0.51 bcde	438 a	1.6 cdef
G.202	2.8 f	2.3 e	0 b	0.3 d	0.13 e	273 b	0.8 f
G.935	5.0 de	2.9 ab	1 b	2.1 cd	0.49 bcde	377 a	2 bcd
G.969	5.2 d	2.7 bc	0 b	3.5 bc	0.71 abcd	403 a	2.1 abc
G.4214	4.7 de	2.7 bcd	1 b	3.5 bc	0.80 abc	350 ab	1.5 abc
G.5890	8.7 ab	3.1 a	0 b	3.4 bc	0.40 bcde	424 a	2.2 abc
M.26 EMLA	4.9 de	2.3 de	0 b	3.0 bcd	0.64 bcde	398 a	1.3 def
M.9 NAKBT337	3.8 ef	2.4 cde	1 b	2.4 bcd	0.59 bcde	412 a	1.2 ef

Mean separation within columns by Tukey HSD, P<0.05

Table 5. Trunk cross-sectional area, graft union height, and tall-spindle-acceptability index in 2015 of Modi trees on several rootstocks in the Massachusetts planting of the 2015 NC-140 Organic Apple Rootstock Trial.

Rootstock	Trunk cross-sectional area (May, 2015, cm <sup>2</sup> )	Trunk cross-sectional area (October, 2015, cm <sup>2</sup> )	Change in trunk cross-sectional area (2015, cm <sup>2</sup> )	Graft union height (cm)	Tall Spindle Acceptability Index (0-3)
G.11	1.3 d	1.7 cd	0.4 b	11 bc	1.3 abcd
G.16	0.2 f	0.6 e	0.4 b	14 ab	0.1 e
G.30	0.9 e	1.5 d	0.6 ab	11 bc	0.8 de
G.41	1.9 ab	2.6 a	0.7 b	11 bc	1.9 a
G.202	1.9 ab	2.5 a	0.6 ab	10 c	1.8 ab
G.214	1.1 e	1.5 d	0.5 ab	12 abc	1.1 cd
G.222	0.4 f	0.8 e	0.4 b	16 a	0.3 e
G.890	2.0 a	2.8 a	0.7 a	9 c	1.9 a
G.935	1.7 bc	2.1 b	0.4 b	10 bc	1.7 abc
G.969	1.4 d	1.8 bcd	0.4 b	9 c	1.2 bcd
M.9 NAKBT337	1.6 cd	2.0 bc	0.4 b	10 bc	1.2 bcd

Mean separation within columns by Tukey's HSD (P = 0.05).

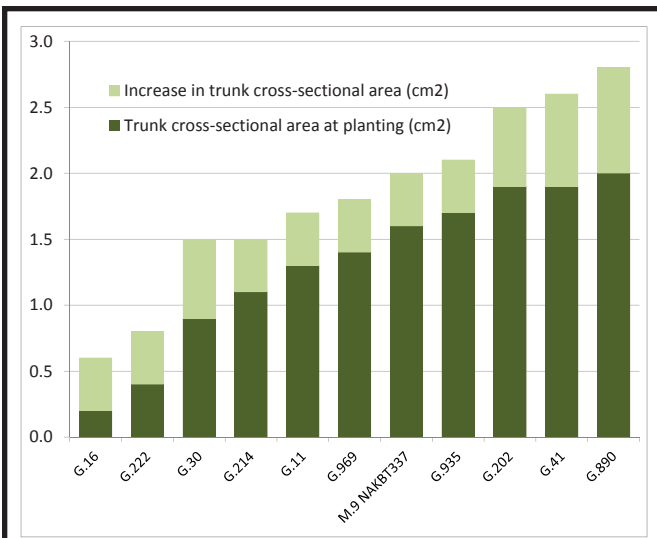


Figure 4. Trunk cross-sectional area at planting and increase in 2015 of Modi trees in the Massachusetts planting of the 2015 NC-140 Organic Apple Rootstock Trail.

## Publications

Autio, W., J. Cline, T. Einhorn, G. Lang, R. Marini, G. Reighard, and T. Robinson. 2015. 2014 Progress Report – Brief summaries of NC-140 rootstock trials. *Compact Fruit Tree* 48(2): 6-8.

Autio, W.R., J.M. Clements, and J.S. Krupa. 2015. An evaluation of Cornell-Geneva and Budagovsky apple rootstocks with Honeycrisp, the 2010 NC-140 Apple Rootstock Trial after five years. *Fruit Notes* 80(2):6-11. Also published as *Horticultural News* 95(2):6-11.

Clements, J.M. and W.R. Autio. 2015. Vineland and Geneva rootstocks in the 2014 NC-140 Apple Trial at UMass Cold Spring Orchard. *Fruit Notes* 80(1):1-3. Also published as *Horticultural News* 95(1):1-3.

Cowgill, W., R. Magron, J.M. Clements, and W.R. Autio. 2015. Two new NC-140 apple trials: Vineland and Geneva rootstocks with Honeycrisp and Fuji at Rutgers Snyder Farm. *Fruit Notes* 80(3):6-8. Also published as *Horticultural News* 95(3):6-8.