



Massachusetts Agricultural Experiment Station

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2014 NC-140 Apple Rootstock Trial

After an “off” year in 2019, bloom was very heavy in 2020; however, fruit set was generally on the lighter side and variable. Crop-load management of Honeycrisp in this mixed rootstock planting continues to be a challenge.

In terms of 2015-20 cumulative yield efficiency (Table 1 and Figure 1), trees on G. 30, G. 969, G.890, and G.41 are superior. Unfortunately, trees on G.890 and G.30 have a tendency to produce too many

root suckers. Anecdotally, fruit from trees on G.969 seems to suffer from lack of red color, although this has not been documented and they may catch up in red color if left for a later harvest. Trees on G.30 and those on G.890 seem to have the nicest apples in terms of red skin color. But trees on G.890 (and maybe G.30) are too large for a tall-spindle planting at one-meter-between-tree spacing. Overall, the Vineland rootstocks are underperforming compared to the Geneva rootstocks, and all but maybe V.1 are too big a tree for tall-spindle.

Table 1. Tree and yield characteristics in 2020 of Honeycrisp apple trees in the 2014 NC-140 Apple Rootstock Trial at the UMass Cold Spring Orchard Research & Education Center, Belchertown, MA.

Rootstock	Survival (%)	Trunk cross-sectional area (2020, cm ²)	Cumulative root suckers (2018-20, no./tree)	Yield per tree (2020, kg)	Cumulative yield per tree (2015-20, kg)	Yield efficiency (2020, kg/cm ² TCA)	Cumulative yield efficiency (2015-20, kg/cm ² TCA)	Fruit weight (2020, g)
V.1	100 a	15.1 cd	3.0 de	10.8 bcd	37.2 cde	0.73 b	2.49 cd	281 a
V.5	100 a	17.7 ab	1.4 e	17.5 abc	46.7 bcd	0.98 ab	2.64 cd	291 a
V.6	100 a	18.7 ab	2.9 de	18.1 ab	49.3 abc	0.97 ab	2.63 cd	305 a
V.7	100 a	16.9 bc	3.6 de	14.0 abcd	41.5 bcde	0.85 ab	2.47 cd	280 a
G.11	100 a	11.9 efg	2.5 de	14.6 abcd	35.8 cde	1.22 a	2.97 abc	294 a
G.30	100 a	17.0 bc	27.1 ab	14.9 abcd	64.0 a	0.87 ab	3.76 a	299 a
G.41	90 a	13.5 def	4.9 de	10.3 bcd	32.4 def	0.75 ab	2.37 cd	287 a
G.202	100 a	11.0 g	1.7 e	9.0 d	20.9 f	0.78 ab	1.82 d	265 a
G.214	100 a	14.2 de	20.2 bc	9.0 d	39.3 cde	0.64 b	2.78 bc	279 a
G.890	100 a	19.6 a	30.0 a	19.2 a	64.6 a	0.98 ab	3.31 abc	302 a
G.935	100 a	13.3 def	11.3 cd	12.9 abcd	36.7 cde	0.96 ab	2.73 bcd	274 a
G.969	90 a	15.2 cd	7.4 de	14.1 abcd	55.8 ab	0.92 ab	3.67 ab	285 a
M.9 NAKBT337	100 a	11.2 fg	6.0 de	10.3 cd	28.8 ef	0.92 ab	2.60 cd	272 a
M.26 EMLA	100 a	13.5 def	7.4 de	10.2 cd	31.3 ef	0.75 ab	2.33 cd	274 a

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

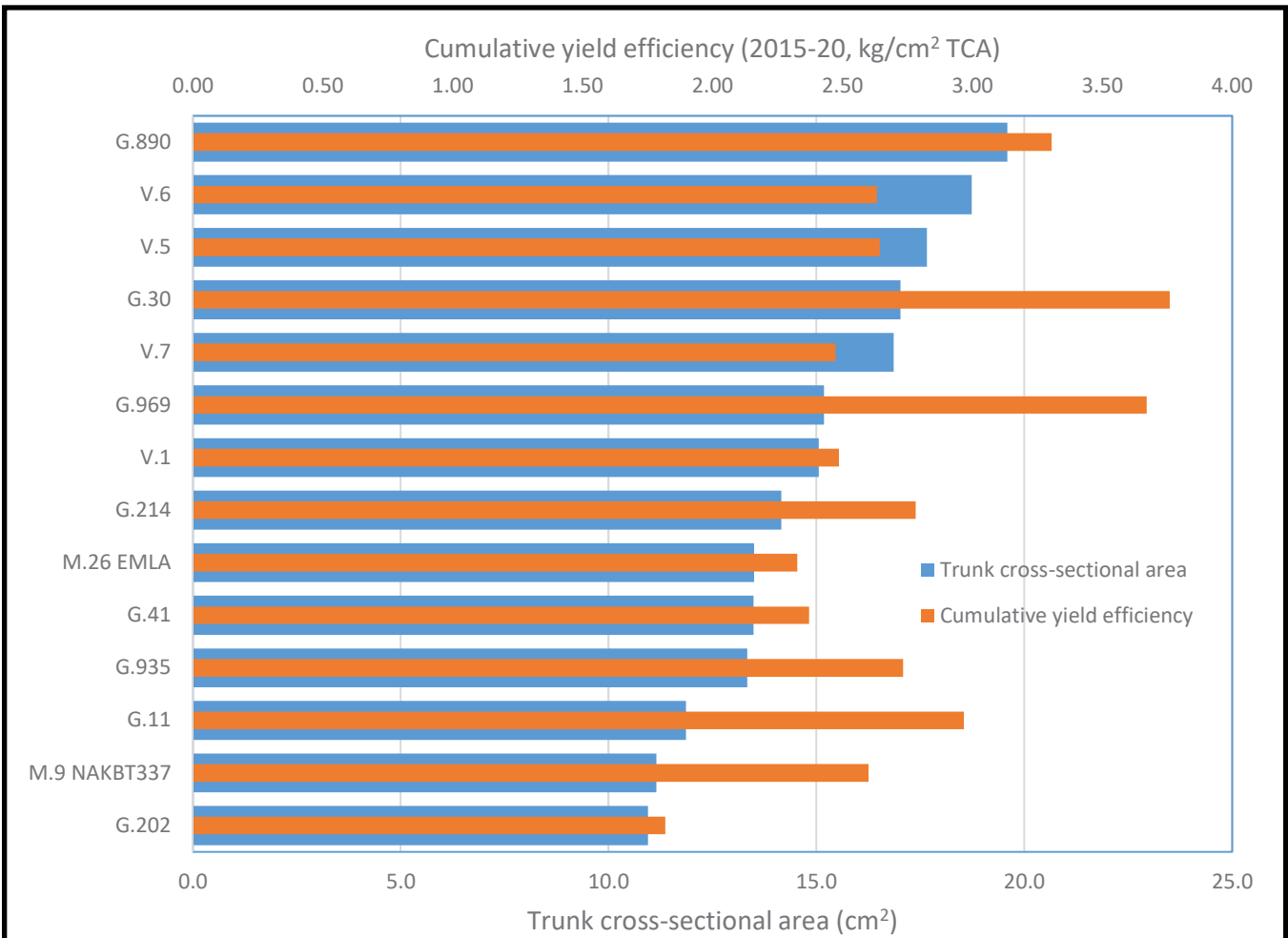


Figure 1. Trunk cross-sectional area (cm²) and cumulative yield efficiency (2015-20, kg/cm² TCA) in 2020 of Honeycrisp apple trees in the 2014 NC-140 Apple Rootstock Trial.

Table 2. Tree and yield characteristics in 2020 of Modi apple trees in the 2015 NC-140 Organic Apple Rootstock Trial at the Small Ones Farm, Amherst, MA. All values are least-squares means adjusted for missing data.

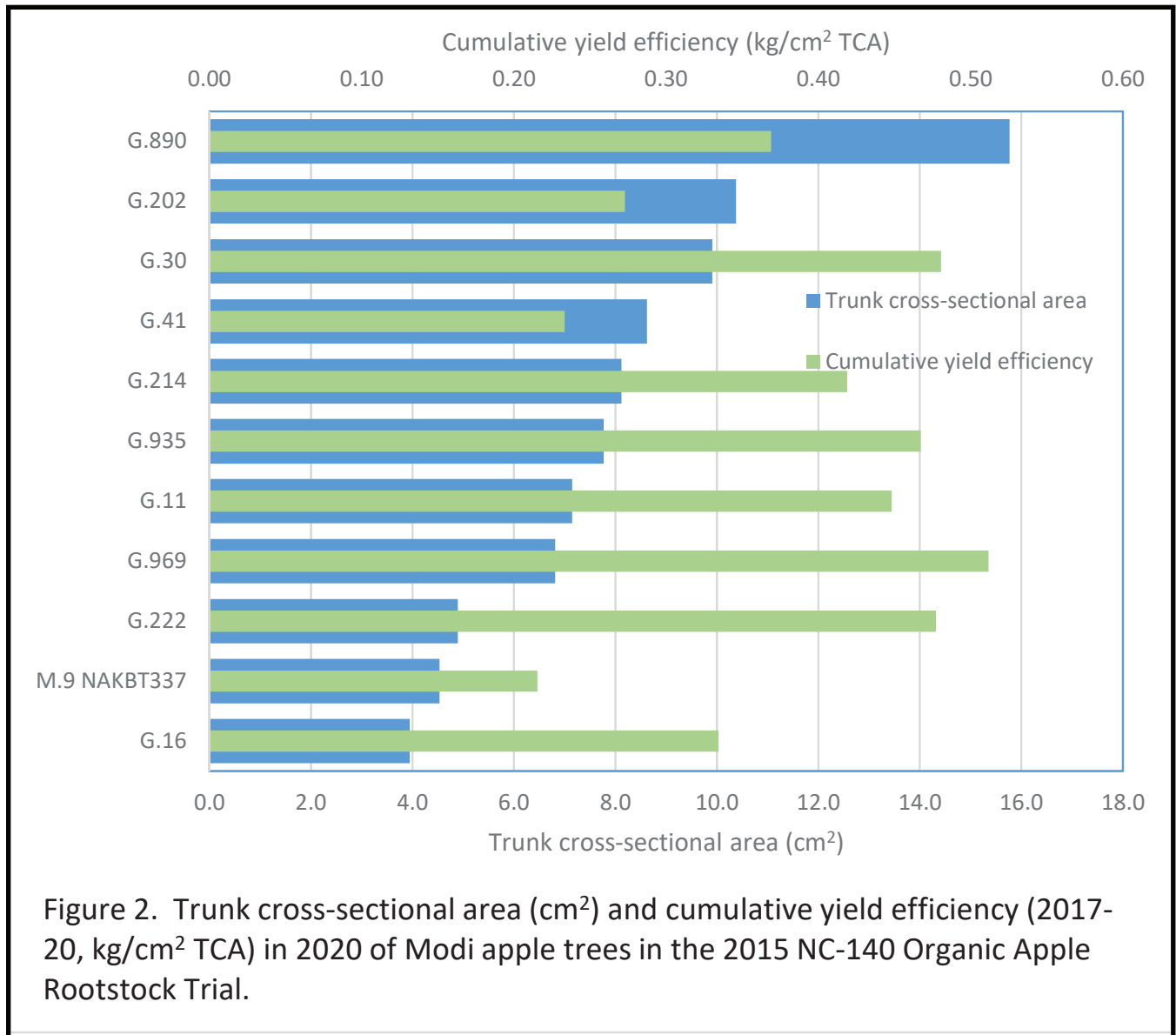
Rootstock	Survival (%)	Trunk cross-sectional area (2020, cm ²)	Root suckers (2015-20, no./tree)	Yield per tree (2020, kg)	Cumulative yield per tree (2016-20, kg)	Yield efficiency (2020, kg/cm ²)	Cumulative yield efficiency (2016-20, kg/cm ²)	Fruit weight (2020, g)	Average fruit weight (2016-20, g)
G.11	58 a	7.2 bcd	1.1 a	1.6 ab	3.4 abc	0.22 a	0.45 a	71 a	86 a
G.16	49 a	3.9 d	5.0 a	1.3 ab	2.0 abc	0.16 a	0.33 a	66 a	77 a
G.30	75 a	9.9 bc	3.1 a	2.4 ab	4.6 ab	0.21 a	0.48 a	87 a	104 a
G.41	58 a	8.6 bcd	4.8 a	0.8 b	1.9 bc	0.09 a	0.23 a	61 a	88 a
G.202	92 a	10.4 b	4.8 a	1.0 b	2.7 abc	0.10 a	0.27 a	80 a	109 a
G.214	75 a	8.1 bcd	1.0 a	1.6 ab	3.4 abc	0.20 a	0.42 a	60 a	82 a
G.222	40 a	4.9 cd	3.1 a	1.0 ab	2.3 abc	0.20 a	0.48 a	64 a	97 a
G.890	92 a	15.8 a	2.9 a	3.2 a	5.6 a	0.20 a	0.37 a	69 a	90 a
G.935	33 a	7.8 bcd	0.8 a	1.7 ab	4.0 abc	0.18 a	0.47 a	69 a	91 a
G.969	75 a	6.8 cd	0.7 a	1.3 ab	3.5 abc	0.16 a	0.51 a	56 a	88 a
M.9 NAKBT337	56 a	4.5 d	0.7 a	0.0 b	0.4 c	0.04 a	0.22 a	57 a	93 a

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

2015 NC-140 Organic Apple Rootstock Trial

This “organic” planting in a Certified Naturally Grown (<https://www.cngfarming.org/>) commercial orchard is suffering. Quite a few trees succumbed in 2020 to vole damage or other unknown causes. Modi apples at harvest were small and malformed with lots of insect damage, mostly from plum curculio. Overall tree vigor is weak with minimal shoot growth each year. So, as expected, rootstocks that present

more vigor have generally fared better than more dwarfing rootstocks (weed control is not good). In this case, trees on G.890, G.202, G.30., G.214, and G.969 have the highest “survival” (despite statistical indifference) and good cumulative yield efficiencies (Table 2 and Figure 2). Modi on G.935 may have a virus issue that results in tree death, as most all the Liberty guard trees planted on G.935 have died. It is questionable whether this planting should be continued or discontinued given its condition.



Accomplishments Related to Objective 1:

2014 NC-140 Apple: Trees generally performed well in 2020 (seventh leaf). Largest trees were on G.890 and V.6, and smallest were on G.41, G.935, G.11, M.9 NAKBT337, and G.202. Because of the measured vigor, it is clear that trees labeled as being on G.202 are actually on some other rootstock. Cumulatively (2015-20), the greatest yields per tree were from trees on G.890, G.30, and G.969, and the lowest were from those on G.202, M.9 NAKBT337, and M.26 EMLA. Cumulatively (2015-20), the most yield efficient trees were on G.30, G.969, G.890, and G.11, and the least were on G.202. In 2020, fruit size was similar for trees on the various rootstocks.

2015 NC-140 Organic Apple: Trees in this trial continue to be challenged and unproductive. After six growing seasons, largest trees were on G.890, and the smallest were on G.16, M.9 NAKBT337, and G.222. Cumulatively (2016-20), the greatest yields per tree were harvested from trees on G.890, and the lowest were harvested from trees on M.9 NAKBT337. In 2020 and cumulatively (2016-20), trees on the various rootstocks were similarly yield efficient and carried fruit of similar size.

Impact Statements:

Planting of 150 acres of trees on dwarfing rootstock occurred during 2019 based on results of NC-140. On this acreage, pruning and harvest labor declined by 50%, fruit quality and size increased by 20%, profit increased by 50%, and because of reduced canopy volume, pesticide use declined by 70%.

Published Written Works:

Autio, W., T. Robinson, S. Blatt, D. Cochran, P. Francescato, E. Hoover, M. Kushad, G. Lang, J. Lordan, D. Miller, I. Minas, R. Parra Quezada, M. Stasiak, and H. Xu. 2020. Budagovsky, Geneva, Pillnitz, and Malling apple rootstocks affect 'Honeycrisp' performance over eight years in the 2010 NC-140 'Honeycrisp' Apple Rootstock Trial. *J. Amer. Pomol. Soc.* 74:182-195.

Autio, W., T. Robinson, B. Black, R. Crassweller, E. Fallahi, S. Hoying, M. Parker, R. Parra Quezada, G. Reig, and D. Wolfe. 2020. Budagovsky, Geneva, Pillnitz, and Malling apple rootstocks affect 'Fuji' performance over eight years in the 2010 NC-140 'Fuji' Apple Rootstock Trial. *J. Amer. Pomol. Soc.* 74:196-209.

Clements, J. 2020. 2015 Modi Organic NC-140 Apple Rootstock Trial and Drapenet Demonstration. <https://jmcextman.blogspot.com/2020/04/2015-modi-organic-nc-140-apple.html>.

Clements, J., E. Garofalo, and W. Autio. 2020. 2015 Modi Organic NC-140 Apple Rootstock Trial and Drapenet Demonstration. *Fruit Notes* 85(3):8-10. *Horticultural News* 100(3):8-10.

G. Reighard, W. Bridges Jr., D. Archbold, A. Atucha, W. Autio, T. Beckman, B. Black, D.J. Chavez, E. Coneva, K. Day, P. Francescato, M. Kushad, R.S. Johnson, T. Lindstrom, J. Lordan, I.S. Minas, D. Ouellette, M. Parker, R. Pokharel, T. Robinson, J. Schupp, and D. Wolfe. 2020. Nine-Year Rootstock Performance of the NC-140 'Redhaven' Peach Trial across 13 states. *J. Amer. Pomol. Soc.* 74:45-56.

Scientific and Outreach Oral Presentations:

Clements, J. 2019. Why am I here? New Brunswick Apple Growers Annual General Meeting, August 2019, Mactaquac, New Brunswick, CANADA. 50 attendees.

Clements, J. 2019. Growing Honeycrisp: the good, the bad, and the ugly? Connecticut Pomological Society Annual Meeting, December, 2019, Middletown, CT. 100 attendees.

Clements, J. 2020. Growing Honeycrisp: the good, the bad, and the ugly? Great Plains Growers Conference, January 2020, St. Joseph, MO. 45 attendees.

Fund Leveraging:

Autio, W, J Cline, I Minas, G Lang, and T Einhorn. 2020. NC-140 Rootstock Research Trial Coordinators. International Fruit Tree Association. \$15,000.