Update on the 2014 NC-140 Honeycrisp and Aztec Fuji Rootstock Trials in New Jersey and Massachusetts

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In 2014, as part of the NC-140 regional rootstock research project (nc140.org), three replicated rootstock trials were established in New Jersey and Massachusetts. One Honeycrisp and one Aztec Fuji trial were grown on a number of rootstocks at the Rutgers University, Snyder Research and Extension Farm in Pittstown, New Jersey. Further, a trial of Honeycrisp trees was grown on similar rootstocks at the University of Massachusetts Cold Spring Orchard Research and Education Center in Belchertown, MA.

The purpose of these trials is to compare standard (M.9 NAKBT337 and M.26 EMLA), and newly released Geneva (G.) rootstocks against four Vineland (V.) rootstocks from the Horticultural Experiment Station at Vineland, Ontario, Canada in 1958 (https://articles.extension.org/pages/60856/apple-rootstock-info:-v1). At the New Jersey site, Honeycrisp trees were planted at a 3-foot in-row spacing on M.26 EMLA, M.9 NAKBT337, B.10, G.11, G.30, G.41, G.202, G.214, G.935, G.969, V.1, V.5, V.6, and V.7 (Table 1). Aztec Fuji were planted (at 5-foot in-row spacing) on the same rootstocks except excluding B.10, G.41, and G.969 (Table 2). In Massachusetts Honeycrisp trees were planted (3-foot in-row spacing) on the same rootstocks as the New Jersey Honeycrisp plus G.890 and the excluding B.10 (Table 3). Ten replications of each

Table 1. Vigor and fruit yield in 2018 of Honeycrisp trees in the 2014 NC-140 Apple Rootstock Trial at the Rutgers University, Snyder Research and Extension Farm in Pittstown, NJ.

Rootstock	Trunk cross-sectional area (cm^2)	Number of fruit[1]	Fruit weight (g) [1]	Yield (kg) [1]	Cumulative yield (2015-18, kg)[1]	Yield efficiency (kg/cm^2)	Cumulative yield efficiency (2015-18 kg/cm^2 TCA)	Number of rootsuckers[1]
G.202	9.4 H	40	262	13.3	13.6	1.09 AB	1.84 AB	0
G.11	10.8 H	42	191	10.0	17.4	1.01 AB	2.35 A	0
B.10	12.1 GH	41	299	12.3	18.0	1.12 AB	1.71 AB	0
G.41	12.8 FGH	61	281	15.7	19.8	1.25 A	1.84 AB	0
G.214	14.3 FGH	76	236	17.7	23.5	1.24 A	1.70 AB	4
M.9 NAKBT337	14.8 FG	39	279	10.7	19.7	0.79 AB	1.78 AB	3
G.935	16.6 EFG	68	225	15.5	24.6	0.99 AB	1.61 ABC	4
M.26 EMLA	18.2 DEF	38	279	11.2	19.0	0.65 AB	1.19 BCD	3
G.969	21.5 CDE	68	278	18.3	22.4	0.88 AB	1.05 BCD	2
G.30	23.2 CD	59	248	15.6	24.9	0.74 AB	1.11 BCD	4
V.1	25.5 BC	53	251	13.3	20.2	0.53 AB	0.75 D	3
V.5	29.2 AB	57	296	15.9	23.6	0.57 AB	0.77 CD	2
V.7	29.5 AB	38	255	8.4	15.8	0.28 B	0.47 D	4
V.6	33.3 A	52	276	14.5	20.5	0.45 AB	0.62 D	4

Means within columns not followed by a common letter are significantly different at odds of 19 to 1.
[1] No significant differences across rootstocks

Table 2. Vigor and fruit yield in 2018 of Aztec Fuji trees in the 2014 NC-140 Apple Rootstock Trial at the Rutgers University, Snyder Research and Extension Farm in Pittstown, NJ.

Rootstock	Trunk cross-sectional area (cm^2)	Number of fruit[1]	Fruit weight (g) [1]	Yield (kg) [1]	Cumulative yield (2015-18, kg)[1]	Yield efficiency (kg/cm^2)	Cumulative yield efficiency (2015-18 kg/cm^2 TCA)	Number of rootsuckers[1]
G.11	20.2	123 AB	175	22.4	32.2 ABC	1.26	0.40 B	0 B
G.202	15.5	99 AB	203	17.7	30.1 ABC	1.16	0.80 AB	1 AB
G.214	16.0	125 AB	193	23.0	35.8 ABC	1.45	1.04 A	0 B
G.30	33.6	125 AB	194	24.0	45.9 A	0.77	0.48 AB	1 B
G.935	20.3	144 A	186	26.8	42.9 AB	1.33	0.73 AB	0 B
M.26 EMLA	25.9	121 AB	184	21.7	31.5 BC	0.88	0.52 AB	1 B
M.9 NAKBT337	18.9	152 A	167	25.7	32.4 ABC	1.40	0.33 B	5 A
V.1	31.6	80 B	235	17.4	32.3 ABC	0.57	0.37 B	3 AB
V.5	33.1	80 B	181	13.0	26.0 C	0.41	0.24 B	2 AB
V.6	38.3	104 AB	203	20.7	37.3 ABC	0.54	0.27 B	2 AB
V.7	39.3	99 AB	192	20.2	33.9 ABC	0.64	0.21 B	2 AB

Means within columns not followed by a common letter are significantly different at odds of 19 to 1.
[1] No significant differences across rootstocks

Table 3. Vigor and fruit yield in 2018 of Honeycrisp trees in the 2014 NC-140 Apple Rootstock Trial at the University of Massachusetts Cold Spring Orchard Research and Education Center in Belchertown, MA.

Rootstock	Trunk cross-sectional area (cm^2)	Number of fruit[1]	Fruit weight (g) [1]	Yield (kg) [1]	Cumulative yield (2015-18, kg)[1]	Yield efficiency (kg/cm^2)	Cumulative yield efficiency (2015-18 kg/cm^2 TCA)	Number of rootsuckers[1]
G.11	7.4 EF	49 BC	270 ABC	12.9 CD	19.5 CDEF	1.69 AB	3.11 ABCD	0 C
G.202	6.5 F	37 C	231 CDE	8.4 D	11.1 F	1.24 B	1.89 EF	0 C
G.30	16.2 C	82 AB	268 ABCD	21.5 AB	43.7 A	1.33 B	3.77 AB	5 AB
G.41	9.5 DEF	54 BC	246 BCDE	13.7 BCD	20.2 CDEF	1.39 B	2.57 BCDEF	1 C
G.214	11.2 D	72 BC	253 ABCDE	18.0 ABC	29.3 BC	1.59 AB	3.35 ABC	3 BC
G.890	21.1 A	84 AB	302 A	24.3 A	39.0 AB	1.16 B	2.33 CDEF	8 A
G.935	9.6 DEF	65 BC	230 CDE	15.1 BCD	22.8 CDE	1.54 AB	2.79 BCDEF	1 C
G.969	12.1 D	121 A	219 DE	24.6 A	40.7 A	2.04 A	4.13 A	1 C
M.26 EMLA	10.2 DE	46 BC	244 BCDE	11.4 CD	18.6 DEF	1.11 B	2.36 CDEF	1 C
M.9 NAKBT337	6.9 F	53 BC	216 E	11.4 CD	17.8 EF	1.63 AB	3.00 ABCDE	1 C
V.1	12.5 D	64 BC	236 BCDE	15.1 BCD	26.0 CDE	1.21 B	2.65 BCDEF	1 C
V.5	17.1 BC	82 AB	274 ABC	22.0 AB	27.8 CDE	1.30 B	1.82 EF	0 C
V.6	19.5 AB	78 BC	283 AB	21.6 AB	29.3 BCD	1.11 B	1.73 F	0 C
V.7	16.8 BC	72 BC	270 ABCDE	19.8 ABC	25.8 CDE	1.20 B	1.82 DEF	0 C

Means within columns not followed by a common letter are significantly different at odds of 19 to 1.

rootstock was planted in each trial. Data collected in 2018, included trunk size, yield, fruit weight, rootstock suckering, tree height, and canopy spread.

Results on vigor and yield of Honeycrisp trees grown in New Jersey are shown in Table 1 and Figure 1. Data showed that the statistically smallest trunk sizes were of trees on B.10, G.11, G.202, G.214, and G.41, while the largest were on V.5, V.6, and V.7. Average fruit per tree, fruit weight, 2018 yield, cumulative yield, and root suckering were shown to be similar across rootstocks. Average yield efficiency was statistically similar across all rootstocks with the exception of V.7, which was significantly lower. The comparison of cumulative yield efficiency showed B.10, G.11, G.202, G.214, G.41, G.935, and M.9 NAKBT337 had the largest efficiency while all of the remaining rootstocks were statistically similar to each other albeit lower than the aforementioned rootstocks.

In the Massachusetts Honeycrisp Trial (Table 3, Figure 1), the smallest trunk cross sectional area was found in rootstocks G.11, G.202, G.41, G.935, and M.9 NAKBT337, the largest trunk cross sectional area was

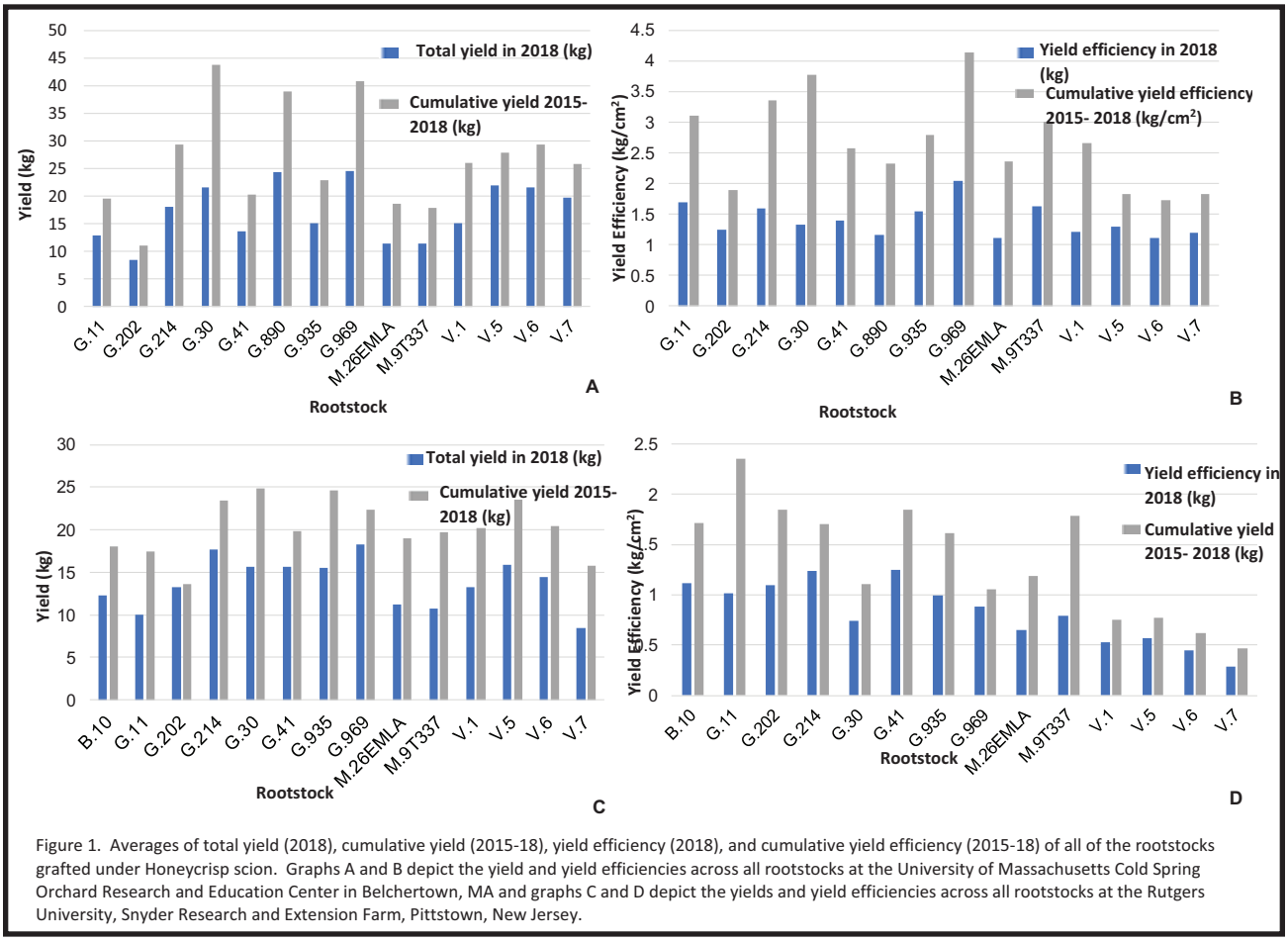

Figure 1. Averages of total yield (2018), cumulative yield (2015-18), yield efficiency (2018), and cumulative yield efficiency (2015-18) of all of the rootstocks grafted under Honeycrisp scion. Graphs A and B depict the yield and yield efficiencies across all rootstocks at the University of Massachusetts Cold Spring Orchard Research and Education Center in Belchertown, MA and graphs C and D depict the yields and yield efficiencies across all rootstocks at the Rutgers University, Snyder Research and Extension Farm, Pittstown, New Jersey.

G.890 (21.1 cm^2). The average number of fruit per tree was greatest in G.30, G.890, G.969, and V.5, all of which were significantly greater than the remaining rootstocks. Average fruit weights varied from 216 to 302 grams, and the rootstocks were statistically split into two groupings. Average yields in 2018 were also statistically split into a higher and lower group. The highest cumulative yields were collected from G.30, G.890, and G.969, while the lowest yields were collected from G.11, G.202, G.41, M.26 EMLA, and M.9 NAKBT337. Average yield efficiencies in 2018 were statistically similar across all rootstocks, while cumulative yield efficiencies were greater in G.11, G.30, G.214, G.969, G.202, G.41, G.890, G.935 and M.9 NAKBT337 and lower in all the remaining rootstocks. Root sucker production was statistically greater in G.30 and G.890 and G.30 had more root suckers than all other rootstocks with the exception of G.214, which did not differ from G.30 in root sucker number.

Interestingly, the data for the Aztec Fuji trial in New Jersey showed no statistical differentiation of any of the data points collected across the rootstocks. (Table 3, Figure 2). This result could be explained by the significant variability in the individual data points within each rootstock this growing season. In comparing the Honeycrisp trials in New Jersey to that of Massachusetts a number of points were made. The trunk cross sectional areas were largest in V.6 at both sites, in addition to V.6 in New Jersey V.5 and V.7 were also statistically larger, and in MA, G.890 was included in the highest range of trunk cross sectional areas. The average number of fruit per tree was equal in New Jersey; however, the Massachusetts site showed G.30, G.890 and G.969 as having larger numbers of fruit. Fruit weight was also shown to be statistically similar at each of the sites, with minor differentiation in Massachusetts.

The average yields for 2018 and cumulative yields (2014-2018) were statistically similar across all rootstocks in the New Jersey trial and fell into two groupings in the Massachusetts trial. Similarly average yield efficiencies were statistically analogous across all

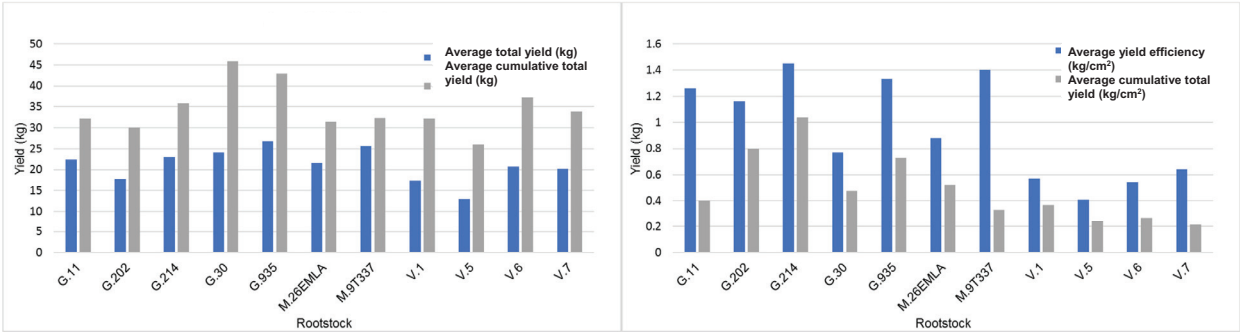

Figure 2. Yield (2018), cumulative yield (2015-18), yield efficiency (2018), and cumulative yield efficiency (2015-18) of all of the rootstocks grafted under Aztec Fuji scion at the Rutgers University, Snyder Research and Extension Farm, Pittstown, New Jersey.

rootstocks at both sites, however the highest cumulative yield efficiencies showed differences between sites, where the highest efficiencies in New Jersey were in B.10, G.11, G.202, G.214, G.41, G.935, and M.9 NAKBT337 and the highest efficiencies in Massachusetts were G.11, G.30, G.214, G.969, and M.9 NAKBT337.

Based on the data thus far, Honeycrisp trees in this study show the most promising results on G.11, G.214, and G.41 rootstocks. In contrast, Aztec Fuji trees in this study show the most efficient yields on G.214 rootstocks. Further data will be needed to determine further rootstock recommendations for growers.

Through the NC-140 regional project, these 2014 plantings were established at plots around the country and will be maintained for 10 years. In 2019, the 5th growing season of these trials, a half-term project report will be complied and published. Ongoing unpublished results for these trials located throughout the county can found at http://www.nc140.org.