

**State:** Massachusetts

## 1. Impact

Massachusetts growers continue to plant high density orchards using dwarfing rootstocks. NC-140 rootstock trial(s) at UMass are essential in making local and regional recommendations as to what rootstock(s) to plant that maximize productivity, provide disease resistance, and improve profitability. Currently, depending on variety, G.11, G. 41, G.969, G.214, G.890 and Bud. 10 apple rootstocks are recommended in Massachusetts and New England based on NC-140 trials.

## 2. New Facilities & Equipment

Three trees on G.11 rootstock in the 2014 NC-140 Honeycrisp Vineland/Geneva planting were outfitted with Treetoscope/TRANSPIRA (<https://www.treetoscope.com/>) direct plant water sensors courtesy of Toro Ag (Figure 3). The sensors will be monitored for quantitative water uptake measurement, plant stress, and provide irrigation insight in 2024 via an online dashboard (Figure 4).

## 3. Unique Project Related Findings

Data collection on tree growth and yield in the 2014 NC-140 apple rootstock planting has been completed for 2023 (10th-leaf). It will be submitted to the trial leader (John Cline) to be combined with other locations data sets to compare the performance of these rootstocks across regions over 10 years. This was the final year of data collection, and it is expected final results will be published in the Journal of the American Pomological Society. To date, the Geneva rootstocks have generally outperformed or equaled the commercial standard rootstock M.9-T337 and M.26 EMLA.

## 4. Accomplishments Related to each Objective

*Objective 1. To evaluate the influence of rootstocks on vegetative and reproductive growth and development of temperate-zone fruit trees, orchard productivity and labor efficiency, and sustainable orchard management practices across diverse soils and climatic regions.*

In 2023 in the 2014 NC-140 apple rootstock planting, G.890 were the largest trees based on trunk area, however, did not differ from V.5, 6 and 7 (Table 1). G.202 were the smallest trees, however, M.9 and 26 are comparable in size. In terms of 2023 yield efficiency, G.11, 41, 935, 214, and M.9 were the most yield efficient. Cumulative yield efficiency over the life of the trial was highest for G.11, 30, 214, 935, 969, and M.9. Some of the Geneva rootstocks continue to be prolific root sucker producers, particularly G.890, G.30, and G.214.

The 2023 NC-140 'Porters Perfection' cider apple planting was established at the UMass Orchard in Belchertown. Unfortunately, the freight carrier lost the initial shipment of trees for 10 days in transit. Replacement trees arrived on time (but late) and there was considerable variation in size and quality of

those trees by rootstock. Trees were slow to take and several died during the growing season, however, at the end of the growing season the trees generally looked good. Tree diameter at planting in late May and in October are shown in Table 2, only to illustrate the variability in tree size which may hobble the value of this rootstock planting over time.

*Objective 5. To integrate and disseminate research-based information and decision support tools that facilitate successful stakeholder adoption of rootstock technologies.*

The NC-140 website ([nc140.org](http://nc140.org)) continues to be an important Project and Extension tool to facilitate communication and stakeholder adoption. It also facilitates and archives Project activities and publications. The NC-140 website also links to the eXtension Apples Community of Practice ([apples.extension.org](http://apples.extension.org)) where practical and research-based information on apple production includes (in addition to Rootstocks): Cultivars, Establishing an Orchard, Managing Orchards, Propagation, Cider Apples, and Regional Resources.

## **5. Published Written Works (relative to NC 140 activities)**

### **b. Refereed Journal Articles**

Terence Bradshaw, Wesley Autio, Suzanne Blatt, Jon Clements, Todd Einhorn, Rachel Elkins, Esmail Fallahi, Poliana Francescato, Jaume Lordan, Ioannis Minas, Gregory Peck, Terence Robinson, and Shengrui Yao 2023. Performance of 'Modi®' apple trees on several Geneva rootstocks managed organically: Five-year results from the 2015 NC-140 Organic Apple Rootstock Trial. J Am Pom Soc. (APS) 77:14-27 [http://www.pubhort.org/aps/77/v77\\_n1\\_a2.htm](http://www.pubhort.org/aps/77/v77_n1_a2.htm)

### **f. Other Creative Works (ex. Electronic)**

NC-140 Regional Rootstock Research Project Website, <http://www.nc140.org>

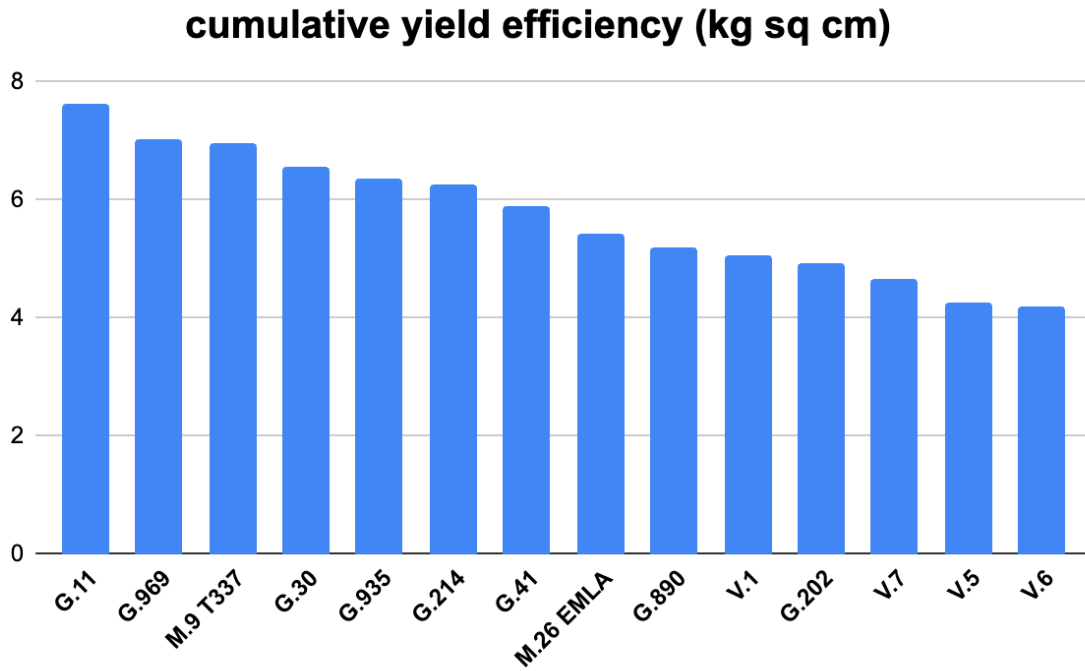
eXtension Apples Community of Practice <https://apples.extension.org/>

**Table 1 - Tree and yield characteristics in 2023 of Honeycrisp apple trees in the 2014 NC-140 apple rootstock trial at the UMass Orchard, Belchertown, MA**

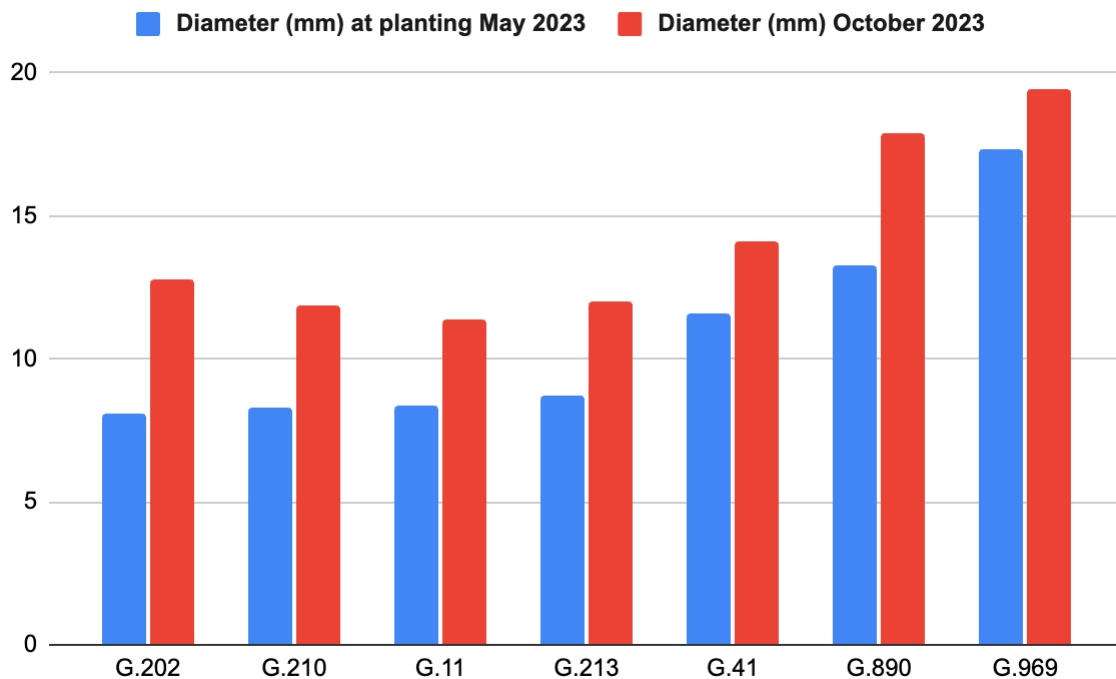
Rootstock	Trunk area (sq. cm)	Yield (kg)	Fruit weight (g)	Yield efficiency (kg/sq. cm.)	Cumulative yield efficiency (kg/sq. cm.)	Number root suckers
V.1	26.6 cd	19.6 bc	212 abc	0.76 cd	5.08 cde	3.9 de
V.5	35.1 ab	22.4 bc	226 a	0.65 d	4.26 e	3.7 de
V.6	39.6 ab	27.2 ab	228 a	0.69 cd	4.19 e	4.3 de
V.7	32.5 abc	27 ab	220 ab	0.87 bcd	4.66 de	5.5 cd
G.11	15.8 fgh	21.7 bc	224 ab	1.38 a	7.64 a	2 e
G.30	31.4 bc	26.5 ab	196 bc	0.85 bcd	6.57 abc	17.1 a
G.41	20.4 defg	22.4 abc	216 abc	1.09 abc	5.89 bcde	4.3 de
G.202	14.9 gh	9.5 d	197 bc	0.66 d	4.94 cde	2.8 e
G.214	22.9 def	23.4 abc	207 abc	1.01 abcd	6.25 abcd	13.5 ab
G.890	39.8 a	32.7 a	201 abc	0.83 cd	5.19 cde	16.5 a
G.935	18.8 efgh	19.8 bc	200 abc	1.07 abc	6.38 abcd	10.4 bc
G.969	25.5 cde	21.1 bc	206 abc	0.84 bcd	7 ab	8.1 cd
M.9-T337	11.8 h	14.8 cd	190 c	1.24 ab	7 ab	6.4 cde
M.26 EMLA	20.1 defg	18.4 bcd	204 abc	0.90 bcd	5.42 cde	5.4 de

Mean separation by Tukey HSD  $P=0.05$

**Figure 1 – Cumulative yield efficiency of Honeycrisp apple trees in the 2014 Vineland/Geneva apple rootstock planting at the UMass Orchard, Belchertown, MA**



**Figure 2 – Trunk diameter at planting and at end of growing season of trees in the 2023 cider apple rootstock plating at the UMass Orchard, Belchertown, MA**



**Figure 3 - ToroAg “treetoscope/TRANSPIRA” direct plant water sensor installed July 2023 on three G.11 Honeycrisp trees in the 2014 NC-140 Vineland/Geneva apple rootstock planting at the UMass Orchard, Belchertown, MA**



**Figure 4 – Treetoscope/TRANSPIRA online dashboard to monitor tree/block actual water consumption and irrigation requirement**

