

**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 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 based on NC-140 trials.

## 2. New Facilities & Equipment

## 3. Unique Project Related Findings

Data collection on tree growth and yield in the 2014 NC-140 apple rootstock planting has been completed for 2022 (9th-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. Next year (2023) will be the final year of data collection. To date, the Geneva rootstocks have generally outperformed the other rootstocks in terms of yield efficiency, except for M9-T337 which has been a smaller tree and therefore may not yield as much on a per acre basis.

## 4. Accomplishments Related to each Objective

*Objective 1. To evaluate the influence of rootstocks on temperate-zone fruit tree characteristics grown under varying environments and training systems using sustainable management practices.*

In 2022 in the 2014 NC-140 apple rootstock planting, the Vineland (V.) rootstocks are the largest trees in terms of trunk area except for V.1, G.890, G.30, and G. 969 which are all statistically comparable in size to the V. rootstocks (Table 1.). M9-T337 grows the smallest tree, however, G.202, G.11, and G.935 are comparable in size. In terms of 2022 yield efficiency, G.11, G.935, G.41, G.890, G.969, G.202, and V.5 were all the most yield efficient, however, numerically G.11 produced the most apples (kg) per cm<sup>2</sup> trunk area. Unfortunately, some of the Geneva rootstocks were prolific root sucker producers, particularly G.890, G.30, G.214, G.935, and G.969. But G.11, G.202, G. 41 as well as the V. rootstocks produced minimal root suckers (as did M9-T337 and M.26). Of general note was the fact the crop load was light two years in a row (particularly in 2022) as measured by the number of apples per sq. cm trunk area (target = 4 to 5 apples, Figure 1.) Fruit rots and bitter pit were also rampant in 2021 and 2022 respectively. In 2022, it was estimated half the apples would not have been acceptable for fresh market sales because of the amount of bitter pit (Figure 2.). The 2015 NC-140 organic apple rootstock planting was discontinued in 2022, the reasons being there was a change in ownership of the orchard and close to 50% of the trees had succumbed to vole damage over the years.

Objective 2. *To develop improved rootstocks for temperate-zone fruit trees, including breeding, using phenomic and genomic tools and acquisition of new rootstocks from global sources.*

Objective 3. *To investigate physiological processes, biotic and abiotic stresses and scion/rootstock interactions on tree growth and productivity.*

Objective 4. *To integrate and disseminate research-based information that facilitates successful stakeholder adoption of rootstock technologies*

The NC-140 website continues to be an important Project and Extension tool to facilitate communication and stakeholder adoption. From the period 1-Nov, 2021 to 30-Oct, 2022, nc140.org/ had 3,879 page views, with the plantings, publications, and state reports pages being visited more often. At the Annual Summer Meeting of the Massachusetts Fruit Growers' Association in July 2022, an on-site presentation at the 2014 and 2010 NC-140 Apple Rootstock Plantings was made to growers, industry reps, and educators at the UMass Orchard.

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

a. Books

b. Refereed Journal Articles

Bradshaw, T., W. Autio, S. Blatt, J. Clements, T. Einhorn, R. Elkins, E. Fallahi, P. Francscatto, J. Lordan, I. Minas, G. Peck, T. Robinson, and S. 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 (in press, Journal of the American Pomological Society, January 2023).

c. Symposium Proceedings

d. Poster Presentations

e. Popular Articles

f. Other Creative Works (ex. Electronic)

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

g. Scientific & Outreach Oral Presentations (relative to NC 140 activities)

MFGA Annual Summer Meeting - Stop 7: NC-140 regional rootstock research project, with Jon Clements, Extension Educator, UMass Amherst. At the UMass Orchard, Belchertown, MA. 14-July, 2022.

<https://www.youtube.com/watch?v=lpXTmlEdd3A>

h. Fund leveraging (relative to NC 140 activities)

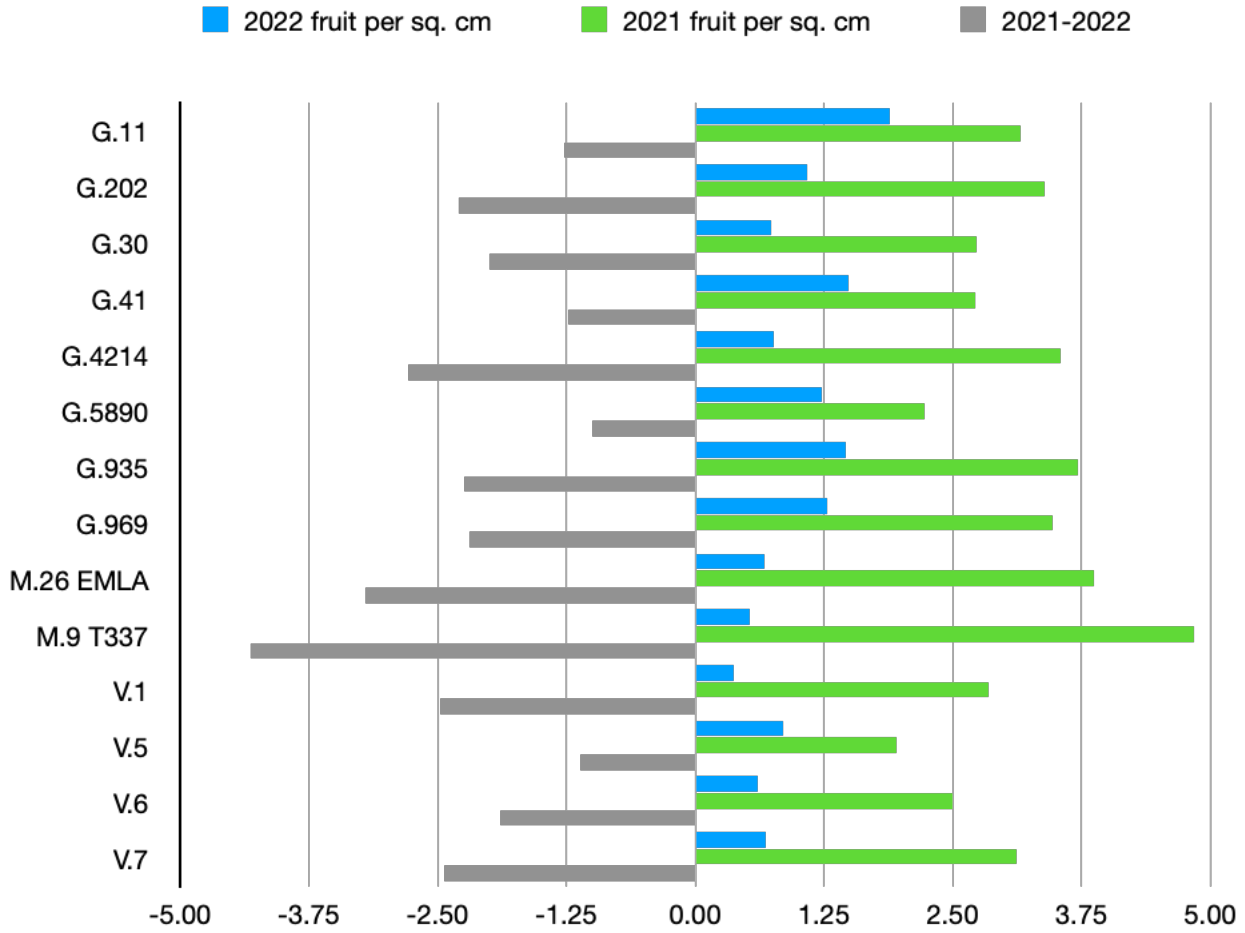
Autio, W., R. Marini, J. Cline, G. Reighard, G. Lang, and T. Einhorn. 2022. NC-140 Rootstock Research Trial Coordinators. International Fruit Tree Association.

**Table 1. Tree and yield characteristics in 2022 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)	Number root suckers
V.1	24.3 cd	2.4 cd	231	0.09 c	3 de
V.5	32.7 ab	8.2 ab	274	0.24 abc	3.6 de
V.6	36.2 ab	5.7 bcd	260	0.17 bc	3.5 de
V.7	30.2 abc	5.6 bcd	247	0.20bc	5.1 cde
G.11	14.6 fgh	7.1 abcd	263	0.50 a	1.8 e
G.30	29 bc	5.69 bcd	270	0.20 bc	13.4 a
G.41	18.9 defg	6.5 bcd	253	0.38 ab	3.2 de
G.202	13.1 gh	4.2 bcd	279	0.31 abc	2.4 e
G.214	21.3 def	4.1 bcd	260	0.21 bc	12 ab
G.890	37.5 a	12.6 a	276	0.356 abc	14.1 a
G.935	17.2 efgh	6.4 bcd	266	0.38 ab	9.2 bc
G.969	23.2 cde	7.8 abc	270	0.34 abc	6.3 cd
M.9-T337	11.1 h	1.9 d	271	0.15 bc	4.8 de
M.26 EMLA	18.6 defg	3.6 bcd	275	0.19 bc	4.2 de

*Mean separation by Tukey HSD P=0.05*

**Figure 1. Number of apples per sq. cm trunk area, 2021 vs. 2022 (target = 4-5 apples)**



**Figure 2. Bitter pit in 2022 in the 2014 NC-140 Honeycrisp apple rootstock planting**

