

2015 NC-140 Organic Apple Trial- ‘Modi’ cultivar

Annual Report and Data Collection Protocol

November, 2024

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This year was the tenth and final season of the 2015 NC-140 Organic Apple Rootstock Trial. Data collection should occur per the protocol distributed last November. For submission of those data, everyone is encouraged to review their data and make sure that all measurements are the unit requested. Further, include only those data requested in the protocol, with the same columns in the spreadsheet, and in the same order. All data should be submitted in the format and units requested and by the submission deadline. The data to be submitted for 2024 and the format of the data are presented in the Data Submission Protocol on Page 2. Submit these data in an Excel spreadsheet, using the rootstock codes described in the protocol, by **January 15, 2025**.

Data template:

<https://go.uvm.edu/23nc140organicexcel>

Ignore the 2023 in the title, this is the correct file.

Rootstocks, cultivars, and locations involved in the 2015 NC-140 Organic Apple Rootstock Trial. Modi trees are spaced 1x3.5m, and all trees are trained to the Tall Spindle System. Each site includes 12 replications in a randomized, complete block design, with a single tree of each rootstock treatment per replication. Liberty/G.935 is included as a pollinizer. End year indicates the final year that data were collected for each trial.

Rootstock	Sites	End yr
G.11	CA	2019
G.16	CO	2020
G.41	ID	2020
G.202	MA	2021
G.214	MI	2020
G.222	NM	
G.890	NS	
G.935	NYI	
G.969	NYG	
M.9 NAKBT337	VT	
	WI	

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Table 1. Trial locations, cooperators, and final year participating in trial.

<u>State</u>	<u>Trial location</u>	<u>Lead cooperator</u>	<u>Year out</u>
California (CA)	Lakeport	Rachel Elkins	2021
Colorado (CO)	Parma	Ioannis Minas	2021
Idaho (ID)	Grand Junction	Esmail Fallahi	2020
Massachusetts (MA)	Amherst	Jon Clements	2021
Michigan (MI)	East Lansing	Todd Einhorn	2020
New Mexico (NM)	Alcalde	Shengrui Yao	-
Nova Scotia (NS)	Kentville	Suzanne Blatt	-
New York (NYG)	Geneva	Terence Robinson	-
New York (NYI)	Ithaca	Gregory Peck	-
Vermont (VT)	Burlington	Terence Bradshaw	-
Wisconsin (WI)	Sturgeon Bay	Rebecca Wiepz	-

Trial Protocol for 2024

Tree management.

- A. Trees must be supported and trained as Tall Spindles (see Pruning & Training Plan for the Tall Spindle System).
- B. Thin fruit as described in Pruning and Training Plan for the Tall Spindle System.
- C. Manage pests, nutrients, and water per local organic recommendations.

Collect the following data for each tree in 2024.

- A. Root suckers: the number removed and counted, August.
- B. Yield: count all fruit per tree and weigh (to the nearest 0.1 kg).
- C. Trunk size: trunk circumference 30 cm above the graft union (mm), October.
- D. Tree height: from the soil surface (cm), October.**
- E. Canopy spread: average of in-row and across-row width (cm), October.**
- F. Status: 0=dead, 1=alive, and 2=missing data, October.

Pruning and Training Plan for the Tall Spindle System

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|----------|--|
| Dormant | <ol style="list-style-type: none">1. Limit tree height to 11.5' (3.6m) by annually cutting leader aback to a weak fruitful side branch.2. Annually, remove at least two limbs, including lower tier scaffolds, that are more than ¾" in diameter using a bevel cut.3. Simplify each remaining branch on the tree so that it is columnar with no side branches.4. Shorten branches that extend into the row to facilitate movement of equipment and preserve fruit quality on lower limbs. |
| Late May | Chemically thin with two applications of lime sulfur and fish oil during bloom (30% and 60%) and then follow up with hand thinning to ensure regular |

annual cropping and adequate fruit size (target 120 fruit per tree).
Alternately, hand thin within 14 days after fruit set (8-10 mm fruitlet size).

August Lightly summer prune to encourage light penetration and maintain pyramidal tree height.

Please send all 2024 data to [Terence Bradshaw](mailto:tbradsha@uvm.edu) (tbradsha@uvm.edu) by January 15, 2025. Date template: <https://go.uvm.edu/23nc140organicexcel>

General Summary of the Project through 2024:

- The five-year summary of the project was published in the January, 2023 issue of JAPS. Bradshaw T., Autio, W. Blatt, S. Clements, J. Einhorn, T. Elkins, R. Fallahi, E., Francescato, P., Lordan, J., Minas, I., Peck, G., Robinson, T., and Yao, S. 2023. Performance of 'Modi' apple trees after 5 years under Organic management as affected by several dwarf rootstocks in the 2015 NC-140 Apple Rootstock Trial. J Am Pom Soc. (APS) 77:14-27
http://www.pubhort.org/aps/77/v77_n1_a2.htm
- Several cooperators have left the project due to issues with their planting. These include extensive tree death, vole damage, weed management difficulties, and lack of grower interest in adequately maintaining trials. The trial is down to six cooperators with full datasets.
- Data from remaining cooperators will continue to be collected through 2024 after which a ten-year report will be written with expected submission in Spring 2025.

Questions based on preliminary analysis of 2023 data:

- Overall effect of dying trees on cumulative datasets raises questions for when to remove a tree from the project. Keeping dead trees in with cumulative yield of zero would reduce the cumulative mean yield and yield efficiency over time. Removing trees completely would reduce replication and overestimate yield if only the healthiest trees remain in the dataset.
- Tree vigor and fruitfulness continues to be all over the place among the remaining sites hosting this project. We' will be using two-way ANOVA in future analysis to evaluate location effect on individual rootstocks.
Two sites experienced frost and one severe elk damage in 2023 that either eliminated all yield or brought it to near zero. *How should we best analyze data for trial sites that experienced crop loss due to environmental factors?*
- In frost years where crop is lost early, tree size (TCSA) increased substantially, thus reducing yield efficiency by a fairly large amount from prior years.

Table 2. Tree and fruiting characteristics (2022) of Modi trees in the 2015 NC-140 Organic Apple Rootstock Trial. Data represent NM, NS, NYG, NYI, VT, and WI only. All data are least-squares means adjusted for missing subclasses.^z

	2023 % tree survival	2023 TCSA (cm ²)	2023 kg fruit/tree	2023 yield efficiency	Cumulative yield 2015-2023	Cumulative yield efficiency 2015-2023	2023 rootsuckers	2023 fruit weight (g)	
Rootstock	G.11	95.83 NS	12.49 E	8.35 AB	0.56 NS	35.01 BCD	2.83 A	0.20 C	136.6 NS
	G.16	83.33	12.02 E	3.58 B	0.21	19.92 D	1.70 BC	1.57 ABC	110.4
	G.202	95.71	20.20 B	9.48 AB	0.37	33.02 BCD	1.67 C	1.45 BC	117.7
	G.214	90.28	13.46 DE	7.38 AB	0.49	29.70 BCD	2.52 AB	1.00 BC	116.6
	G.222	92.86	13.05 DE	4.15 B	0.33	22.78 D	1.97 BC	1.79 ABC	115.1
	G.30	90.28	18.08 BC	8.12 AB	0.34	40.98 AB	2.35 ABC	1.09 BC	129.8
	G.41	95.71	17.43 BC	7.53 AB	0.33	40.20 AB	2.22 ABC	0.80 BC	117.3
	G.890	93.06	29.11 A	12.53 A	0.38	51.43 A	1.94 BC	3.48 A	130.0
	G.935	90.28	16.51 CD	5.99 B	0.30	37.91 BC	2.34 ABC	2.28 AB	120.2
	G.969	95.83	13.09 E	5.73 B	0.39	29.30 BCD	2.40 AB	0.91 BC	114.3
	M.9T337	89.09	13.66 DE	4.68 B	0.30	26.19 CD	2.12 ABC	0.69 BC	119.1

^zMean separation within columns for location or rootstock by Tukey's HSD (P = 0.05).

Location	2023 % tree survival	2023 TCSA (cm ²)	2023 kg fruit/tree	2023 yield efficiency	Cumulative yield 2015-2023	Cumulative yield efficiency 2015-2023	2023 rootsuckers	2023 fruit weight (g)
NM	94.07 A	14.84 B	1.54 D	0.07 C	18.36 C	1.08 C	4.83 A	69.7 C
NS	95.37 A	13.27 CD	8.49 C	0.66 B	41.58 B	3.06 A	2.05 B	151.0 A
NYG	94.07 A	14.33 BC	0.26 D	0.02 C	20.96 C	1.37 BC	1.03 BC	108.7 B
NYI	96.61 A	13.63 C	nf ^y	nf	22.31 C	1.50 B	0.34 C	Nf
VT	79.66 B	12.45 D	11.81 B	0.89 A	39.34 B	3.37 A	0.08 C	156.9 A
WI	95.80 A	16.24 A	15.83 A	0.74 B	66.84 A	3.26 A	0.00 C	121.0 B

^zMean separation within columns for location or rootstock by Tukey's HSD (P = 0.05).

^yNo fruit in 2023 due to frost

Table 3. Trunk cross-sectional area (TCSA, cm²) computed from measured circumference, 2023. All data represent mean for each rootstock analyzed by location.^z

	NM	NS	NYG	NYI	VT	WI
G.11	13.78 DE	11.27 CD	12.65 C	11.37 D	9.88 D	15.70 D
G.16	11.69 DE	-	10.21 C	9.59 D	9.27 BCD	17.94 CD
G.202	23.30 B	17.00 B	20.14 B	16.64 BC	16.36 BC	26.85 B
G.214	20.44 BC	10.55 CD	12.62 C	11.24 D	9.74 CD	16.57 D
G.222	18.80 BCD	8.63 D	10.86 C	11.22 CD	8.82 CD	20.08 BCD
G.30	16.16 CDE	16.70 B	22.01 B	15.40 BCD	17.80 AB	20.03 BCD
G.41	12.90 DE	16.85 B	16.25 BC	17.46 B	14.70 BCD	25.42 BC
G.890	32.71 A	23.24 A	31.87 A	29.41 A	22.83 A	35.73 A
G.935	17.82 BCD	14.60 BC	13.07 C	17.79 B	12.18 BCD	21.63 BCD
G.969	16.73 CDE	11.48 CD	11.80 C	12.14 CD	8.65 D	17.16 D
M.9T337	10.45 E	11.33 CD	18.76 BC	10.36 D	9.01 D	19.01 CD

^zMean separation within columns for location or rootstock by Tukey's HSD (P = 0.05).

Table 4. Cumulative kg fruit yield per tree, 2015 - 2023. All data represent mean for each rootstock analyzed by location.z

	NM	NS	NYG	NYI	VT	WI
G.11	15.18 BC	42.46 ABC	18.75 BCD	23.30 BCD	35.84 BCD	73.78 ABC
G.16	9.42 C	-	13.96 D	12.17 D	22.65 CD	41.77 C
G.202	14.90 BC	38.75 ABC	18.06 CD	15.93 D	43.01 ABCD	69.27 ABC
G.214	19.12 BC	35.38 BC	19.47 ABCD	16.09 D	38.99 BCD	50.85 BC
G.222	8.84 C	24.17 C	13.33 D	16.16 BCD	30.45 BCD	46.91 BC
G.30	24.25 B	48.30 AB	26.82 ABC	20.26 BCD	57.82 AB	75.12 AB
G.41	15.33 BC	41.54 ABC	27.73 AB	28.59 BC	47.05 ABC	82.87 A
G.890	34.67 A	54.37 A	27.95 A	41.10 A	62.54 A	89.86 A
G.935	22.20 B	48.40 AB	18.64 ABCD	29.94 AB	39.95 BCD	67.06 ABC
G.969	17.68 BC	36.14 BC	17.22 D	16.71 CD	29.45 CD	56.53 BC
M.9T337	9.80 C	36.69 ABC	19.34 ABCD	14.00 D	21.07 D	55.36 BC

^zMean separation within columns for location or rootstock by Tukey's HSD (P = 0.05).

Table 5. Cumulative yield efficiency, (cumulative yield 2015 - 2023/2023 TCSA). All data represent mean for each rootstock analyzed by location.z

	NM	NS	NYG	NYI	VT	WI
G.11	1.06 BC	3.84 A	1.55 AB	2.03 A	3.75 AB	4.82 A
G.16	0.82 BC	-	1.43 AB	1.32 AB	3.36 AB	2.34 B
G.202	0.69 BC	2.36 B	0.91 B	0.96 B	2.69 B	2.62 B
G.214	0.97 BC	3.39 AB	1.62 AB	1.71 AB	4.35 A	3.27 B
G.222	0.50 C	2.82 AB	1.38 AB	1.43 AB	3.81 AB	2.36 B
G.30	1.65 A	2.98 AB	1.35 AB	1.36 AB	3.48 AB	3.77 AB
G.41	1.20 AB	2.66 AB	1.77 A	1.60 AB	3.35 AB	3.28 B
G.890	1.18 ABC	2.60 B	0.90 B	1.38 AB	2.88 B	2.74 B
G.935	1.24 AB	3.38 AB	1.54 AB	1.68 AB	3.38 AB	3.10 B
G.969	1.06 BC	3.23 AB	1.51 AB	1.39 AB	3.73 AB	3.46 B
M.9T337	1.17 ABC	3.23 AB	1.18 AB	1.48 AB	2.48 B	3.00 B

^zMean separation within columns for location or rootstock by Tukey's HSD (P = 0.05).

Table 6. Mean fruit weight in grams calculated from kg fruit harvested per tree*1000 / number of fruit per tree. All data represent mean for each rootstock analyzed by location.z

	NM	NS	NYG	NYI	VT	WI
G.11	74.1 AB	154.8 ABC	103.54 AB	nf ^y	147.4	122.1 A
G.16	62.8 AB	-	183.33 A		143.3	119.4 AB
G.202	72.0 AB	146.8 ABC	96.68 B		162.5	118.5 AB
G.214	71.9 AB	140.4 BC	105.31 AB		145.5	117.3 AB
G.222	61.6 AB	134.2 C	130.76 AB		147.5	116.5 AB
G.30	65.7 AB	156.0 ABC	103.75 AB		157.7	115.5 AB
G.41	59.0 B	167.7 A	128.77 AB		146.6	112.2 AB
G.890	80.1 A	157.1 AB	106.53 AB		164.3	111.5 AB
G.935	77.0 AB	152.3 ABC	65.33 B		147.2	109.6 AB
G.969	66.3 AB	144.3 BC	84.55 AB		161.9	106.4 AB
M.9T337	74.9 AB	153.0 ABC	8.45 C		144.4	105.0 B

^zMean separation within columns for location or rootstock by Tukey's HSD (P = 0.05).

^yNo fruit in 2023 due to spring frost.