ANNUAL REPORT TO NC-140

2015 Organic Apple Rootstock Trial

November, 2021

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This year is the Seventh season of the 2015 NC-140 Organic Apple Rootstock Trials.

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 2021 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, 2022**.

In 2022, follow the Pruning and Training Plan (Page 2) and the Trial Protocol for 2022 (Page 2).

To avoid problems during the compilation of the data, please pay particular attention to the following points:

1. **Submit only the data requested.**
2. **Use the correct units.**
3. **Columns must be consistent with the protocol.**
3. **Make sure that all data make sense -- proofread your data set.**
4. **For rootstock and replication designations, follow the protocol exactly -- rootstock names should appear as they are listed in the Data Submission Protocol (Page 2) -- please note that there are no spaces in any of these names.**

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.

Rootstocks	Sites
G.11	CA
G.16	CO*
G.41	ID*
G.202	MA
G.214	MI*
G.222	NM
G.890	NS
G.935	NY–Ithaca
G.969	NY–Geneva*
M.9 NAKBT337	VT
	WI

* Data for 2020 not submitted.

Send 2021 data via email to Terry Bradshaw (tbradsha@uvm.edu) by

January 15, 2022

Trial Protocol for 2022

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.
B. Manage pests, nutrients, and water per local organic recommendations.

Collect the follow data for each tree in 2022.

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. Status: 0=dead, 1=alive, and 2=missing data, October.

Pruning and Training Plan for the Tall Spindle System

Dormant	1. Limit tree height to 11.5' (3.6m) by annually cutting leader back to a weak fruitful side branch. 2. Annually, remove at least 2 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 major side branches. 4. Shorten branches that extend into the row to facilitate movement of equipment and preserve fruit quality on the lower limbs.
Late May	Chemically thin with 2 applications of lime sulfur and fish oil during bloom (30% and 60%), and then follow up with hand thinning to appropriate levels to ensure regular annual cropping and adequate fruit size (target = 120 fruit per tree).
August	Lightly summer prune to encourage light penetration and maintain pyramidal tree shape.

Data Submission Protocol
Submit data via email (tbradsha@uvm.edu) by **January 15, 2022.**

Location	ROOT	REP	2015 STATUS (see below)	Trunk circ. at planting (mm)	Side branches (>2.5cm) after pruning (no.)	Height of the graft union on soil at planting (mm)	Fall trunk circ. 2015 (mm)	Comments regarding trees which died during 2015 (those with status = 0)	2016 STATUS (0=dead, 1=alive, 2=missing data)	2016 Root sucker (no./tree)	2016 Trunk circ. (mm)	2016 Yield (no./tree)	2016 Yield (kg/tree)	Comments regarding trees which died during 2016 (those with status = 0)	2017 STATUS (0=dead, 1=alive, 2=missing data)	2017 Root sucker (no./tree)	2017 Trunk circ. (mm)	2017 Yield (no./tree)	2017 Yield (kg/tree)	Comments regarding trees which died during 2017 (those with status = 0)	2018 STATUS (0=dead, 1=alive, 2=missing data)	2018 Root sucker (no./tree)	2018 Trunk circ. (mm)	2018 Yield (no./tree)	2018 Yield (kg/tree)	Comments regarding trees which died during 2018 (those with status = 0)	2019 STATUS (0=dead, 1=alive, 2=missing data)	2019 Root sucker (no./tree)	2019 Trunk circ. (mm)	Tree height (cm)	Canopy width (cm)	2019 Yield (no./tree)	2019 Yield (kg/tree)	Comments regarding trees which died during 2019 (those with status = 0)	2020 STATUS (0=dead, 1=alive, 2=missing data)	2020 Root sucker (no./tree)	2020 Trunk circ. (mm)	2020 Yield (no./tree)	2020 Yield (kg/tree)	Comments regarding trees which died during 2020 (those with status = 0)	2021 STATUS (0=dead, 1=alive, 2=missing data)	2021 Root sucker (no./tree)	2021 Trunk circ. (mm)	2021 Yield (no./tree)	2021 Yield (kg/tree)	Comments regarding trees which died during 2021 (those with status =0)
MA	G.11	1	0	X	X	X	X	X	finelight	1	X	X	X	X	X	0	X	X	X	X	X	1	X	X	X	X	X	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MA	G.11	2	0	X	X	X	X	X		0	X	X	X	X	X	1	X	X	X	X	X	1	X	X	X	X	X	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MA	G.11	3	1	X	X	X	X	X		1	X	X	X	X	X	1	X	X	X	X	X	1	X	X	X	X	X	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
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MA	M.9T337	10	1	X	X	X	X	X		0	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.
MA	M.9T337	11	3	X	X	X	X	X	finelight	3	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.
MA	M.9T337	12	4	X	X	X	X	.		4	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.

Special requirements for the 2015 status assessment:
0 = dead after it was clearly growing well
1 = alive
2 = considered to be a non-data tree because of human erro
3 = planted but broke at the union before it was fully supporte
4 = leafed out but quickly shut dowr
5 = never leafed and began to grow

Appropriate Rootstock Codes (do not include spaces in the rootstock name):

G.11	G.222
G.16	G.890
G.30	G.935
G.41	G.969
G.202	M.9T337
G.214	

When a data point is missing, insert a period in that cell.
Do not include units in the cells
Required data format: Excel

Table 1. Tree and fruiting characteristics (2020) of Modi trees in the 2015 NC-140 Organic Apple Rootstock Trial. All data are least-squares means adjusted for missing subclasses.[z]

Location and rootstock	Suvival (%, 2015-20)	Trunk cross-sectional area (cm^2, 2020)	Root suckers (no./tree, 2015-20)	Yield per tree (kg, 2020)	Cumulative yield per tree (kg, 2016-20)	Yield efficiency (kg/cm^2 TCA, 2020)	Cumulative yield efficiency (kg/cm^2 TCA, 2016-20)	Fruit weight (g, 2020)	Average fruit weight (g, 2016-20)
G.11	92 ab	8.5 d	0.7 d	4.5 bcd	15.5 cd	0.54 a	1.71 a	119 abc	120 b
G.30	85 ab	11.4 c	1.8 bcd	5.5 b	18.5 bc	0.51 ab	1.64 abc	128 a	132 a
G.41	87 ab	12.0 bc	1.1 cd	5.2 bc	19.2 b	0.41 bc	1.44 cd	114 abc	122 ab
G.202	94 a	12.7 b	2.9 ab	4.4 bcd	14.0 d	0.37 c	1.07 e	116 abc	118 b
G.214	95 a	8.3 d	1.1 cd	3.2 e	13.1 de	0.42 bc	1.60 abc	107 c	116 b
G.222	89 ab	7.3 d	3.5 a	3.3 de	10.0 e	0.40 bc	1.27 de	116 abc	122 ab
G.890	93 a	18.4 a	2.7 ab	6.9 a	24.0 a	0.43 abc	1.33 d	122 ab	123 ab
G.935	86 ab	11.1 c	2.4 abc	5.7 ab	20.8 b	0.47 abc	1.77 a	107 c	118 b
G.969	96 a	8.3 d	0.9 d	4.0 cde	14.1 d	0.48 abc	1.67 ab	108 c	117 b
M.9 NAKBT337	78 b	7.6 d	0.8 d	3.3 de	12.7 de	0.38 bc	1.45 bcd	111 bc	122 ab
MA	68 b	8.4 cd	2.3 b	1.5 b	3.1 d	0.16 d	0.39 d	70 d	93 d
NM	95 ab	11.7 b	4.2 a	2.4 b	11.9 c	0.21 d	1.01 c	97 c	87 d
NS	92 ab	8.4 cd	2.8 b	7.6 a	18.0 b	0.88 a	2.13 a	117 b	128 c
NYI	97 a	9.8 c	0.7 c	6.5 a	14.3 bc	0.65 b	1.45 b	140 a	156 a
VT	89 ab	7.9 d	0.4 c	2.0 b	12.9 c	0.27 d	1.71 b	134 a	124 c
WI	98 a	17.2 a	0.3 c	7.6 a	37.1 a	0.47 c	2.27 a	131 a	139 b

[z]Mean separation within columns for location or rootstock by Tukey's HSD ($P = 0.05$).

Table 2. Survival (%, 2015-20) of Modi trees in the 2015 NC-140 Organic Apple Rootstock Trial.[z]

Rootstock	CA	MA	NM	NS	NYI	VT	WI
G.11	50 a	58 a	100 a	92 a	100 a	100 a	100 a
G.16	---	49 a	100 a	---	84 a	91 a	100 a
G.30	33 a	75 a	92 a	100 a	89 a	55 b	100 a
G.41	67 a	58 a	100 a	83 a	100 a	82 ab	100 a
G.202	58 a	92 a	100 a	83 a	100 a	92 a	100 a
G.214	16 a	85 a	100 a	100 a	100 a	92 a	92 a
G.222	35 a	38 a	99 a	100 a	100 a	90 a	100 a
G.890	42 a	92 a	92 a	100 a	100 a	92 a	83 a
G.935	42 a	39 a	100 a	83 a	100 a	95 a	100 a
G.969	33 a	85 a	100 a	100 a	92 a	100 a	100 a
M.9 NAKBT337	17 a	55 a	66 b	69 a	87 a	92 a	100 a

[z]Mean separation within columns by Tukey's HSD (P = 0.05).

Table 3. Trunk cross-sectional area (cm^2, 2020) of Modi trees in the 2015 NC-140 Organic Apple Rootstock Trial.[z]

Rootstock	CA	MA	NM	NS	NYI	VT	WI
G.11	---	7.2 bcd	9.2 def	6.9 d	8.2 cd	6.5 cde	13.2 e
G.16	---	3.9 d	6.7 f	---	5.3 d	4.2 e	12.4 e
G.30	---	9.9 bc	14.4 b	9.1 bc	9.8 bc	9.0 bc	16.0 cde
G.41	---	8.6 bcd	12.7 bc	9.4 bc	11.5 b	10.0 b	19.7 bc
G.202	---	10.4 b	13.3 bc	10.3 b	11.2 b	9.6 b	21.7 b
G.214	---	8.1 bcd	8.6 ef	6.4 d	7.3 cd	6.6 cde	12.6 e
G.222	---	4.9 cd	7.4 ef	6.0 d	6.2 d	4.4 de	14.8 cde
G.890	---	15.8 a	19.9 a	13.2 a	18.4 a	13.8 a	29.3 a
G.935	---	7.8 bcd	12.0 bcd	9.1 bc	12.0 b	8.1 bcd	17.7 bcd
G.969	---	6.8 cd	10.5 cde	6.9 d	7.3 cd	5.5 cde	12.6 e
M.9 NAKBT337	---	4.5 d	8.4 ef	7.1 cd	6.1 d	5.5 cde	14.2 de

[z]Mean separation within columns by Tukey's HSD (P = 0.05).

Table 4. Cumulative yield per tree (kg, 2016-20) of Modi trees in the 2015 NC-140 Organic Apple Rootstock Trial.[z]

Rootstock	CA	MA	NM	NS	NYI	VT	WI
G.11	1.4 a	3.4 abc	9.3 de	16.9 cd	14.7 bcd	11.4 bcd	37.7 bcde
G.16	---	2.0 bc	6.6 de	---	5.3 ef	5.7 d	22.7 f
G.30	2.0 a	4.6 ab	15.3 bc	20.3 bc	14.6 bcd	16.2 ab	40.0 bcd
G.41	3.2 a	1.9 bc	10.1 de	17.6 bcd	18.1 bc	15.5 ab	52.2 a
G.202	3.5 a	2.7 bc	7.4 de	16.7 cd	13.7 cd	11.7 bc	31.8 def
G.214	0.9 a	3.4 abc	11.8 bcd	14.9 cd	9.8 def	14.2 ab	24.8 f
G.222	0.6 a	2.3 bc	5.6 e	11.1 d	5.2 f	8.5 cd	27.3 ef
G.890	2.4 a	5.6 a	23.5 a	28.5 a	23.7 a	18.4 a	44.3 abc
G.935	3.7 a	4.0 abc	15.6 b	23.8 ab	19.9 ab	15.1 ab	46.6 ab
G.969	2.9 a	3.5 abc	11.1 cde	14.9 cd	12.4 de	10.8 bcd	32.0 def
M.9 NAKBT337	0.7 a	0.4 c	8.7 de	15.0 cd	10.7 def	7.1 cd	34.5 cdef

[z]Mean separation within columns by Tukey's HSD (P = 0.05).

Table 5. Cumulative yield efficiency (kg/cm^2, 2016-20) of Modi trees in the 2015 NC-140 Organic Apple Rootstock Trial.[z]

Rootstock	CA	MA	NM	NS	NYI	VT	WI
G.11	---	0.4 a	1.0 bc	2.4 ab	1.8 a	1.8 abc	2.9 a
G.16	---	0.3 a	1.0 bc	---	0.9 c	1.5 abc	1.9 bcd
G.30	---	0.5 a	1.1 abc	2.2 abc	1.5 ab	2.0 abc	2.6 ab
G.41	---	0.2 a	0.8 cd	1.9 bc	1.6 ab	1.5 abc	2.7 a
G.202	---	0.3 a	0.6 d	1.6 c	1.2 bc	1.2 c	1.5 cd
G.214	---	0.4 a	1.4 a	2.3 abc	1.4 abc	2.2 a	2.0 bcd
G.222	---	0.5 a	0.7 cd	1.8 bc	0.9 c	1.9 abc	1.9 cd
G.890	---	0.4 a	1.2 ab	2.2 abc	1.3 abc	1.4 bc	1.5 d
G.935	---	0.5 a	1.3 ab	2.6 a	1.7 a	1.9 abc	2.6 a
G.969	---	0.5 a	1.0 bc	2.2 abc	1.7 a	2.1 ab	2.5 ab
M.9 NAKBT337	---	0.2 a	1.0 bc	2.1 abc	1.5 abc	1.3 bc	2.5 abc

[z]Mean separation within columns by Tukey's HSD (P = 0.05).

Table 6. Average fruit weight (g, 2016-20) of Modi trees in the 2015 NC-140 Organic Apple Rootstock Trial.[z]

Rootstock	CA	MA	NM	NS	NYI	VT	WI
G.11	80 ab	87 a	82 cd	129 a	158 a	127 ab	139 abc
G.16	---	77 a	81 cd	---	164 a	134 a	138 abc
G.30	80 ab	105 a	93 ab	136 a	174 a	136 a	151 a
G.41	78 ab	88 a	92 abc	127 a	154 a	129 ab	144 ab
G.202	59 ab	109 a	78 d	125 a	139 a	117 bc	142 abc
G.214	26 b	82 a	89 abc	123 a	155 a	122 abc	127 c
G.222	63 ab	103 a	87 abcc	119 a	155 a	127 abc	142 abc
G.890	64 ab	90 a	96 a	137 a	159 a	125 abc	132 bc
G.935	66 ab	91 a	93 ab	133 a	151 a	112 c	129 bc
G.969	88 a	88 a	83 bcd	118 a	154 a	124 abc	135 abc
M.9 NAKBT337	90 a	93 a	79 cd	129 a	159 a	122 abc	148 ab

[z]Mean separation within columns by Tukey's HSD (P = 0.05).