ANNUAL REPORT TO NC-140

2015 Organic Apple Rootstock Trial

November, 2018 -- Mills River, NC

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

I hope that tree management was reasonably easy. 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 2018 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, 2019**.

In 2019, follow the Pruning and Training Plan (Page 2) and the Trial Protocol for 2019 (Page 2). Please note that a 5-year report will be written based on all data through 2019.

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.30	IA*
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 2017 not submitted.

Send 2018 data via email to Wes Autio (autio@umass.edu) by

January 15, 2019

Trial Protocol for 2019

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 2019.

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.
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.

Explanation of Tree Loss

Tree loss has been relatively low, with 100% survival in MI, NM, NYG, VT, and WI. CA lost the most trees (one G.11, G.890, and G.969, two G.214 and M.9 NAKBT337, and three G.30) all attributed to excessive week competition. CO lost two trees to vole damage, a G.890 and G.934. ID lost one tree (G.214) due to breakage from crop weight and one (G.935) for unknown reasons. MA lost two G.11, one G.41, and one M.9 NAKBT337 for unknown reasons. NS lost two M.9 NAKBT337 to fireblight. NYI lost one G.969 for unknown reasons.

Data Submission Protocol

Submit data via email (autio@umass.edu) by **January 15, 2019.**

Location	ROOT	REP	2015 STATUS (see below)	Trunk circ. at planting (mm)	Side branches (>10cm) after pruning (no.)	Height of the graft union above the 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)
IA	G.11	1	1	X	X	X	X		1	X	X	X	X		1	X	X	X	X		1	X	X	X	X	
IA	G.11	2	0	X	X	X	.	fireblight	0	.	.	.	.		0	.	.	.	.		0	.	.	.	.	
IA	G.11	3	1	X	X	X	X		1	X	X	X	X		1	X	X	X	X		1	X	X	X	X	
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IA	M.9T337	10	1	X	X	X	X		0	.	.	.	.	fireblight	0	.	.	.	.		0	.	.	.	.	
IA	M.9T337	11	3	X	X	X	.		3	.	.	.	.		3	.	.	.	.		3	.	.	.	.	
IA	M.9T337	12	4	X	X	X	.		4	.	.	.	.		4	.	.	.	.		4	.	.	.	.	

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

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

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

When a data point is missing, insert a period in that cell.
Do not replace zeros with periods.
Required data format: Excel

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

Location and rootstock	Suvival (%, 2015-17)	Root suckers (no./tree, 2015-17)	Trunk cross-sectional area (cm^2, 2017)	Yield per tree (kg, 2017)	Cumulative yield per tree (kg, 2016-17)	Yield efficiency (kg/cm^2 TCA, 2017)	Cumulative yield efficiency (kg/cm^2 TCA, 2016-17)	Fruit weight (g, 2017)	Average fruit weight (g, 2016-17)
CA	91 b	1.6 a	2.6 f	0.3 cd	0.3 d	0.11 bcd	0.11 cd	128 b	127 d
CO	97 a	0.3 c	3.9 e	0.1 cd	0.1 d	0.03 cd	0.03 d	120 b	119 d
ID	98 a	2.1 a	6.9 b	1.8 ab	2.0 bc	0.25 b	0.28 bc	175 a	179 a
MA	96 a	0.4 c	4.4 de	1.0 bc	1.0 cd	0.25 b	0.25 bc	127 b	127 d
MI	100 a	0.2 c	5.5 c	0.0 d	0.3 d	0.00 d	0.06 d	---	137 cd
NM	100 a	0.4 bc	6.4 b	0.2 cd	0.4 d	0.03 cd	0.06 d	74 c	88 e
NS	98 a	0.0 c	4.0 d	0.4 cd	0.4 d	0.11 bcd	0.11 cd	170 a	170 ab
NYG	100 a	0.9 b	5.0 cd	0.7 cd	0.7 d	0.15 bc	0.16 cd	171 a	152 bc
NYI	99 a	0.2 c	5.2 cd	0.7 cd	0.7 d	0.14 bcd	0.14 cd	135 b	135 cd
VT	100 a	0.3 c	4.6 cde	2.5 a	2.9 ab	0.56 a	0.67 a	164 a	166 ab
WI	100 a	0.1 c	9.8 a	1.9 ab	3.4 a	0.19 b	0.37 b	162 a	182 a
G.11	98 a	0.4 bc	4.7 e	0.8 cd	1.1 cde	0.16 cde	0.21 cd	139 a	139 ab
G.30	98 a	0.5 bc	5.4 d	0.9 bc	1.2 bcd	0.18 bcd	0.22 c	148 a	146 ab
G.41	99 a	0.3 c	6.1 c	1.2 ab	1.6 ab	0.20 abc	0.24 bc	148 a	150 ab
G.202	100 a	1.0 a	6.6 b	0.9 cd	1.0 de	0.13 de	0.15 def	138 a	139 b
G.214	98 a	0.2 c	3.9 f	0.6 d	0.8 e	0.14 cde	0.18 cde	147 a	153 a
G.222	100 a	1.2 a	2.8 g	0.2 e	0.1 f	0.09 e	0.09 f	135 a	134 b
G.890	98 a	1.0 a	8.7 a	0.9 cd	1.1 de	0.10 e	0.12 ef	151 a	152 a
G.935	98 a	0.7 ab	5.5 d	1.5 a	1.8 a	0.26 a	0.30 ab	140 a	141 ab
G.969	98 a	0.3 bc	4.5 e	1.1 bc	1.5 abc	0.24 ab	0.31 a	141 a	144 ab
M.9 NAKBT337	95 a	0.3 bc	4.6 e	0.7 cd	1.1 de	0.16 cde	0.22 cd	138 a	142 ab

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

Table 2. Survival (%, 2015-17) of Modi trees in the 2015 NC-140 Organic Apple Rootstock Trial.

Rootstock	CA	CO	ID	MA	MI	NM	NS	NYG	NYI	VT	WI
G.11	92 a	100 a	100 a	83 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a
G.16	---	100 a	100 a	100 a	100 a	100 a	---	100 a	100 a	100 a	100 a
G.30	75 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a
G.41	100 a	100 a	100 a	92 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a
G.202	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a
G.214	83 a	100 a	92 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a
G.222	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a
G.890	92 a	92 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a
G.935	100 a	83 a	92 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a
G.969	92 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	92 a	100 a	100 a
M.9 NAKBT337	83 a	100 a	100 a	89 a	100 a	100 a	78 b	100 a	100 a	100 a	100 a

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

Table 3. Trunk cross-sectional area (cm^2, 2017) of Modi trees in the 2015 NC-140 Organic Apple Rootstock Trial.

Rootstock	CA	CO	ID	MA	MI	NM	NS	NYG	NYI	VT	WI
G.11	2.2 d	4.1 bc	6.4 cd	3.9 cd	5.0 cd	5.2 de	3.7 de	4.3 de	4.9 cd	4.0 bcd	8.2 cd
G.16	---	1.0 e	3.6 ef	1.5 f	3.3 f	3.2 f	---	2.0 f	1.8 f	2.1 d	6.7 d
G.30	2.8 bcd	4.0 bc	8.4 ab	4.2 cd	5.3 c	7.3 b	3.8 cd	6.3 b	4.6 cd	4.7 bc	8.4 cd
G.41	3.3 ab	3.8 c	7.7 bc	5.1 bc	6.6 b	7.0 bc	4.6 bc	5.6 bc	6.5 b	5.4 b	11.6 b
G.202	3.8 a	5.3 ab	8.5 ab	5.7 b	7.0 b	7.3 b	5.1 ab	6.4 b	6.7 b	5.2 bc	11.5 b
G.214	2.1 de	2.1 de	5.7 de	4.1 cd	3.7 ef	4.5 ef	2.9 ef	3.3 ef	4.0 de	3.7 bcd	7.0 d
G.222	1.1 e	1.3 e	2.9 f	2.3 ef	3.1 f	3.3 f	2.5 f	2.1 f	2.2 ef	3.2 cd	7.3 cd
G.890	3.2 abc	6.1 a	9.4 a	7.6 a	9.7 a	10.7 a	5.9 a	8.9 a	8.8 a	7.5 a	17.9 a
G.935	2.8 bcd	4.4 bc	6.9 bcd	3.9 d	5.4 c	6.9 bc	4.4 bcd	4.7 cd	5.9 bc	5.2 bc	10.0 bc
G.969	2.3 cd	3.5 cd	6.5 cd	4.0 cd	4.2 def	5.7 cde	3.6 de	4.0 de	4.3 d	3.3 cd	8.0 cd
M.9 NAKBT337	2.2 d	4.2 bc	6.3 cd	3.2 de	4.8 cde	6.1 bcd	3.3 def	4.4 cde	3.9 def	3.9 bcd	8.1 cd

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

Table 4. Cumulative yield per tree (kg, 2016-17) of Modi trees in the 2015 NC-140 Organic Apple Rootstock Trial.

Rootstock	CA	CO	ID	MA	MI	NM	NS	NYG	NYI	VT	WI
G.11	0.4 ab	0.0 a	3.1 ab	0.7 a	0.4 ab	0.2 c	0.3 b	0.7 abc	0.5 b	1.9 bc	3.8 ab
G.16	---	0.0 a	0.5 cd	0.1 a	0.0 c	0.1 c	---	0.0 c	0.1 b	0.2 bc	0.1 c
G.30	0.1 b	0.2 a	1.6 bcd	1.1 a	0.5 a	0.3 bc	0.5 ab	0.9 abc	1.0 ab	3.5 ab	3.8 ab
G.41	0.3 b	0.1 a	1.9 abcd	1.3 a	0.4 ab	0.1 c	1.0 a	1.1 ab	0.9 ab	5.0 a	5.3 a
G.202	0.2 b	0.1 a	3.3 a	1.2 a	0.3 abc	0.2 c	0.1 b	0.4 bc	0.5 b	2.4 bc	2.5 bc
G.214	0.2 b	0.0 a	0.8 cd	0.7 a	0.1 bc	0.2 c	0.2 b	1.0 abc	0.3 b	3.1 bc	2.1 bc
G.222	0.0 b	0.0 a	0.1 d	0.8 a	0.0 c	0.1 c	0.1 b	0.0 c	0.0 b	1.1 c	0.0 c
G.890	0.2 b	0.2 a	2.2 abc	1.0 a	0.3 abc	0.4 bc	0.3 b	0.8 abc	0.2 b	2.5 bc	3.4 ab
G.935	0.7 a	0.2 a	2.6 ab	1.5 a	0.5 a	0.9 a	0.5 ab	1.0 abc	1.9 a	5.0 a	4.8 a
G.969	0.4 ab	0.3 a	2.3 abc	1.6 a	0.3 abc	0.7 ab	0.7 ab	1.3 a	0.9 ab	2.6 bc	5.0 a
M.9 NAKBT337	0.2 b	0.2 a	1.6 bcd	0.5 a	0.7 a	0.7 ab	0.5 ab	0.3 bc	1.3 ab	2.2 bc	3.5 ab

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

Table 5. Cumulative yield efficiency (kg/cm^2, 2016-17) of Modi trees in the 2015 NC-140 Organic Apple Rootstock Trial.

Rootstock	CA	CO	ID	MA	MI	NM	NS	NYG	NYI	VT	WI
G.11	0.17 ab	0.01 ab	0.48 a	0.18 ab	0.08 abc	0.05 b	0.09 abc	0.16 ab	0.10 ab	0.50 ab	0.47 ab
G.16	---	0.01 ab	0.26 ab	0.07 b	0.00 c	0.01 b	---	0.07 b	0.09 ab	0.36 b	0.03 cd
G.30	0.07 b	0.04 ab	0.22 b	0.28 ab	0.09 ab	0.05 b	0.14 abc	0.15 ab	0.19 ab	0.78 ab	0.46 ab
G.41	0.09 b	0.03 ab	0.20 b	0.25 ab	0.08 abc	0.01 b	0.24 a	0.21 ab	0.13 ab	0.96 a	0.45 ab
G.202	0.07 b	0.02 ab	0.39 ab	0.22 ab	0.04 bc	0.02 b	0.02 c	0.07 b	0.08 b	0.47 ab	0.23 bcd
G.214	0.09 b	0.00 b	0.14 b	0.18 ab	0.01 c	0.03 b	0.09 abc	0.29 a	0.08 b	0.75 ab	0.33 bc
G.222	0.02 b	0.00 b	0.13 b	0.32 ab	0.00 c	0.01 b	0.02 bc	0.02 b	0.02 b	0.49 ab	0.00 d
G.890	0.05 b	0.04 ab	0.24 ab	0.14 b	0.03 bc	0.03 b	0.06 bc	0.09 b	0.02 b	0.38 b	0.20 bcd
G.935	0.24 a	0.05 ab	0.36 ab	0.36 ab	0.08 abc	0.14 a	0.11 abc	0.23 ab	0.32 a	0.97 a	0.49 ab
G.969	0.16 ab	0.11 a	0.35 ab	0.43 a	0.07 abc	0.12 a	0.20 ab	0.33 a	0.22 ab	0.80 ab	0.67 a
M.9 NAKBT337	0.13 ab	0.05 ab	0.26 ab	0.16 ab	0.13 a	0.12 a	0.14 abc	0.08 b	0.27 ab	0.61 ab	0.44 ab

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

Table 6. Average fruit weight (g, 2016-17) of Modi trees in the 2015 NC-140 Organic Apple Rootstock Trial.

Rootstock	CA	CO	ID	MA	MI	NM	NS	NYG	NYI	VT	WI
G.11	107 bc	105 a	190 a	143 ab	120 a	87 a	162 a	122 b	142 ab	165 a	181 abc
G.16	---	---	169 a	132 ab	---	62 a	---	140 ab	170 a	177 a	177 abc
G.30	149 ab	153 a	185 a	130 ab	130 a	87 a	188 a	137 ab	132 ab	163 a	195 ab
G.41	136 abc	124 a	176 a	118 ab	148 a	94 a	178 a	177 a	132 ab	166 a	193 ab
G.202	127 abc	61 a	167 a	133 ab	151 a	71 a	129 a	169 ab	120 b	163 a	170 bc
G.214	132 abc	104 a	180 a	144 a	120 a	86 a	191 a	169 ab	131 ab	173 a	203 a
G.222	145 abc	---	149 a	124 ab	205 a	---	191 a	147 ab	111 b	162 a	154 c
G.890	153 ab	181 a	182 a	138 ab	151 a	95 a	153 a	150 ab	156 a	179 a	180 abc
G.935	118 bc	109 a	184 a	109 b	140 a	88 a	180 a	153 ab	134 ab	170 a	171 bc
G.969	165 a	107 a	179 a	133 ab	140 a	80 a	162 a	148 ab	138 ab	157 a	184 abc
M.9 NAKBT337	91 c	137 a	187 a	112 ab	125 a	111 a	173 a	168 ab	138 ab	165 a	186 ab

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