ANNUAL REPORT TO NC-140

2014 'Honeycrisp' Rootstock Trials – Report for 2018 data

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2018 was the fifth year of the 2014 NC-140 Apple Rootstock Trials. Rootstocks included in this experiment are listed below. All data presented in this report were collected in 2018 and analyzed by the data coordinator. All cooperators submitted data except

An Excel data template worksheet was provided to all cooperators to submit data. This generally worked well, however there were some data issues at some sites. Please use the Excel data template when submitting data -- a new worksheet template will be provided each year. Participants are encouraged to review their data and make sure that all measurements are in the units requested. Include only those data requested in the protocol – which is provided in addition to the data template.

Summary of Data Submission for 2019 Data
1. Review the data protocol located on the NC-140 website
2. Be sure to correct any errors in the data structure (treatments, reps) communicated by the data coordinator to you in 2019.
3. Submit only the data requested using the Excel data template worksheet, which can be found on the NC-140 website
4. Submit **only** data collected in **2019** (not prior years) and use the correct units using the data template provided for 2019 (see website).

NC 140 Accomplishments Report Statement

2014 NC-140 Apple Rootstock Planting

The 2014 Apple rootstock planting was established in 15 locations in the United States (AL, ID, IN, MA, ME, MI, MN, GA, NJ, NY, PA, SC, UT, VA, WA, WI), two in Canada, and one in Mexico (http://bit.ly/1zv3wCc). The trial consists of the following rootstocks: B.10, G.11, G.202, G.214, G.30, G.41, G.5890, G.935, G.969, M.26 EMLA, M.9 T337, V.1, V.5, V.6, and V.7. Trial coordination and data analyse are being coordinated by John Cline. Trees were planted to a 'tall spindle' systems at a 4 x 12 ft spacing. Trees are planted in a randomized block design with single trees serving as experimental units. There are 10 replicates of each treatment. Each site selected their own pollinizer varieties. The trees were propagated by Willow Drive Nursery, WA and planted in the spring of 2014.

Data protocols have been established and made available to study participants each year the data that has been collected is summarized below.

Key findings:

Measurement	2014	2015	2016	2017	2018	2019
1) initial trunk diameter measured at planting 30cm above graft union	X					
2) number of side branches >10 cm at planting	X					
3) trunk circumference in the fall	X	X	X	X	X	X
4) height of the graft union above soil;	X					
5) tree status at the end of the growing season	X	X	X	X	X	X
6) date of full bloom		X	X	X	X	X
7) date of harvest		X	X	X	X	X
8) total yield per tree		X	X	X	X	X
9) flower clusters per tree	X					
10) total number of fruit per tree		X	X	X	X	X
11) total number of rootstock suckers per tree		X	X	X	X	X
12) tree height in the fall					X	
13) tree spread in the fall (in-row and perpendicular to the row)					X	

Figure 1. Location of participants of the 2014 NC-140 Apple rootstock planting evaluation of 'Aztec Fuji' (red) and 'Honeycrisp' (teal) in Canada, the United States, and Mexico. Map updated as of Nov 10, 2014 (not all participants provided gps coordinates). For an updated interactive map visit http://bit.ly/1zv3wCc

Important points to discuss at the 2019 NC-140 annual meeting

- Protocol and data to collect in 2019
- We are missing site details for several planting (see table below)
- All sites submitted their 2018 data
- 5-year manuscript (2014-2018 data) in progress

Table x. Cooperators in the 2014 NC-140 Honeycrisp apple planting

Location	Name	Affilitation	Longitude	Latitude	Soil type	Irrigated ?
(CH) Cuauhtémoc, Chihuahua, Mexico	Rafael A. Parra-Quezada.	Universidad Autónoma de Chihuahua	106º 58' 58" W	28º 28' 32" N	Clay loam	yes
(ID) Idaho	Essie Fallahi	University of Idaho				
(MA) Blecherton, MA	J. Clements, W. Autio	University of Massachusetts	Lat. 42 15 14 N	Long. 72 21 37 W	Sandy loam	yes
(ME) Monmouth, Maine	Renae E. Moran	University of Maine	77°04'4.8" W	44° 13' 50" W	Sandy loam	Yes
(MI) Traverse Cite, MI	T. Einhorn	Michigan State University				
(NJ) Pittstown, New Jersey	Megan F. Muehlbauer	Rutgers University	43° 33' 38" N	74° 57' 24" W	Silt Loam	yes
(NY) Geneva, NY	Terence Robinson, Jaume Lordan, Poliana Francescatto	Cornell University	42°51'44.7" N	77°01'48" W	Silt Loam	yes
(ONB) Blenheim, Ontario	John Zandstra	University of Guelph	42°14' 58" N	82° 1' 4" W	Gravelly loam	yes
(ONS) Simcoe, Ontario	John Cline	University of Guelph	42°51' 37" N	80° 16' 18" W	Sandy loam	yes
(PA) Rock Springs, PA	R. Crassweller	PennState University	77°57' 22" W	40° 42' 44" N	Silt Loam	
(VA) Piney River, VA	Sherif M. Sherif	Virgina Tech				
(WA) Wenatchee, WA	Stefano Musacchi	Washington State University	120°03'59.6"W	47°18'35.4"N	Silt Loam	yes
(WI) Sturgeon Bay, WI	Matt Stasiak	University of Wisconsin				
(MN) Chanhassen, MN	E. Hoover	University of Minnesota	44° 51' 42.84'' N	93°36'54.72'' W	Loam	Yes

2018 'HONEYCRISP' DATA

Table 1. Growth of 'Honeycrisp' trees, as indicated by trunk cross-sectional area, as of 2018 from the NC-140 apple rootstock trial planted in 2014 at 14 locations.

Rootstock[y]	ID	IN	MA	ME	MEX	MI	MN	NJ	NY	ON-R	ON-S	PA	VA	WA	WI	Mean
B.10						6.2 de		12.5 e	10.4 def		15.8 abc		10.5 ef		13.5 def	11.5
G.11			7.5 ef	7.0 de	10.9 bc	5.3 de	9.4 d	10.7 e	8.3 f	9.2 d	8.2 gh		9.9 f	9.5 f	11.8 ef	9.0
G.202	10.0 c[z]		6.5 f	5.5 e	7.7 c	5.0 e	9.0 d	9.4 e	9.6 def	9.0 d	6.2 h		11.1 ef	12.1 ef	9.0 f	8.5
G.214						7.9 cd	9.9 d	14.4 e	12.5 de		13.4 cde		14.2 de	12.4 ef	15.7 de	12.5
G.30	34.5 a		16.2 c	16.7 a	18.4 a	11.9 b	12.7 cd	25.7 cd	18.8 b	15.4 b	18.1 a		18.5 bc	20.1 a-e	23.3 bc	19.3
G.41			9.6 def		11.2 bc	6.7 de	10.9 d	12.8 e	9.8 def	8.2 d	9.0 e-h		9.5 f	9.9 f	12.8 ef	10.0
G.5890			21.2 a				22.0 a		23.7 a			23.1 b		20.3 a-d	26.8 ab	22.8
G.935			9.6 def	7.9 de		7.6 cde	10.2 d	17.0 de	8.6 ef	14.2 bc	7.5 gh		10.2 ef	13.2 def	14.3 def	10.9
G.969	16.2 bc		12.1 d	9.8 cd	10.5 bc	6.1 de	12.1 cd	25.7 cd	11.3 def	12.4 bcd	10.9 d-g	15.3 c	15.3 cd	12.0 c-f	14.9 def	13.2
M.26 EMLA	13.4 bc		10.3 de	8.4 de	8.4 c	7.1 cde	10.5 d	18.7 de	11.2 def	14.6 bc	12.6 c-f	15.3 c	11.9 def	12.2 ef	14.0 def	12.0
M.7											12.7 c-f					12.7
M.9 T337			6.9 f		9.7 bc	5.9 de	9.2 d	14.9 e	7.4 f	10.3 cd	9.1 fgh	11.8 c	10.7 ef	9.3 f	9.8 ef	9.6
MM.106											13.7 bcd					13.7
V.1	23.0 ab		12.5 d	12.4 bc		9.8 bc	16.0 bc	33.5 bc	13.8 cd			22.2 b	19.6 b	19.3 b-e	19.2 cd	18.3
V.5			17.1 bc	17.4 a		15.4 a	23.0 a	40.6 ab	21.5 ab	24.4 a	18.6 a	25.1 ab	19.8 ab	27.5 a	31.4 a	23.5
V.6			19.6 ab		14.1 ab	10.7 b	18.5 ab	49.7 a	17.7 bc	23.1 a	18.3 a	28.6 a	23.7 a	22.1 abc	28.1 ab	22.8
V.7			17.0 bc	14.0 ab		11.7 b	18.3 ab	43.0 ab	19.7 ab	23.2 a	18.3 ab	21.7 b	20.1 ab	24.7 ab	24.3 bc	21.3
Mean	19.4	ND	12.8	11.0	11.4	8.4	13.7	23.5	13.6	14.9	12.8	20.4	14.6	16.0	17.9	14.8
P-value	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	

[y] Rootstocks ranked in alphabetical order.

[z] Mean values with the same letter within a given column are not significantly different according to the Tukey-Kramer test at P=0.05.

Table 2. Percent survival of 'Honeycrisp' trees as of 2018 from the NC-140 apple rootstock trial planted in 2014 at 14 locations.

Rootstock[y]	ID	IN	MA	ME	MEX	MI	MN	NJ	NY	ON-R	ON-S	PA	VA	WA	WI	Mean
B.10						100	100 a		100		100		100		100	100
G.11			100	100	70	90	100 a[z]	100 a	100	100	100		90	100	100	96
G.202	100		100	100	88	80	90 a	100 a	90	100	100		90	100	100	95
G.214						100	90 a	100 a	100		100		100	100	100	99
G.30	100		100	90	50	100	100 a	100 a	100	88	100		90	100	100	94
G.41			90		70	90	100 a	100 a	90	90	80		90	100	90	90
G.5890			100				89 a		100			100	100		100	98
G.935			100	89		73	100 a	100 a	100	100	90		100	100	100	96
G.969	100		100	70	80	100	100 a	100 a	100	100	100	100	100	100	100	96
M.26 EMLA	100		100	100	78	89	100 a	100 a	100	100	100	100	89	100	100	97
M.7											100					100
M.9 T337			100		40	90	100 a	100 a	100	100	100	100	100	100	100	94
MM.106											90					90
V.1	100		100	100		90	100 a	100 a	90			100	100	100	100	98
V.5			100	100		89	100 a	100 a	100	100	100	100	100	100	100	99
V.6			100		75	89	67 a	78 a	100	100	100	100	100	100	100	92
V.7			100	86		88	78 a	88 a	100	88	88	100	100	100	88	92
Mean	100	ND	99	93	69	90	94	98	98	97	97	100	96	100	99	96
P-value			0.4968	0.1833	0.3702	0.7576	0.0327	0.0355	0.6482	0.5376	0.2740		0.7912		0.4083	

[y] Rootstocks ranked in alphabetical order.
[z] Mean values with the same letter within a given column are not significantly different according to the Tukey-Kramer test at P=0.05.

Table 3. Cumulative number of rootstock suckers (2015-2018) from 'Honeycrisp' trees from the NC-140 apple rootstock trial planted at 14 locations.

Rootstock[y]	ID	IN	MA	ME	MEX	MI	MN	NJ	NY	ON-R	ON-S	PA	VA	WA	WI	Mean
B.10		0.0				0.0 b		0.1	0.0 b		0.0 b		1.2 bc		0.2 b	0.2
G.11		0.0	1.1 d	0.1	0.0 a	0.0 b	1.1	0.4	0.0 b	0.0	0.0 b		0.1 c	0.4 ab	1.5 b	0.4
G.202	0.4 b[z]	0.1	0.8 d	0.0	0.0 a	0.0 b	0.1	1.3	0.0 b	0.2	0.0 b		3.8 abc	0.1 ab	1.9 b	0.6
G.214		0.2	12.4 bc	0.0		0.0 b	2.8	6.3	0.2 ab		2.0 b		7.9 ab	2.8 ab	6.9 a	3.8
G.30	13.4 a	0.4	22.6 a	0.3	1.7 a	0.0 b	0.7	7.6	0.3 ab	0.2	0.2 b		5.4 abc	2.7 ab	1.0 b	4.0
G.41		0.0	2.2 d		0.0 a	0.0 b	0.3	0.9	0.0 b	0.1	0.1 b		2.5 bc	1.7 ab	0.5 b	0.7
G.5890		0.7	15.4 ab					2.6	1.0 a				18.2 a	6.3 a	1.8 b	6.6
G.935		0.1	6.0 cd	0.0	0.6 a		0.4	7.3	0.2 ab	0.1	0.0 b		10.1 a	5.7 ab	3.5 ab	2.8
G.969	2.5 ab	0.3	3.1 cd	0.3	3.1 a	0.1 ab	0.5	4.6	0.1 b	0.0	0.1 b	3.8 b	3.4 abc	3.6 ab	0.1 b	1.7
M.26 EMLA	0.3 b	0.3	4.0 d	0.3	0.8 a	0.0 b	1.0	6.2	0.0 b	0.2	0.0 b		1.5 b	0.6 c	0.0 b	1.1
M.7											7.0 a					7.0
M.9 T337		0.2	5.9 cd		0.6 a	0.0 b	2.4	5.3	0.0 b	0.1	0.1 b	5.1 b	7.0 abc	1.6 ab	0.7 b	2.2
MM.106											0.0 b					0.0
V.1	0.6 b	0.3	2.5 d	0.0		0.1 ab	0.3	5.0	0.1 b			7.2 ab	1.1 bc	1.5 ab	1.0 b	1.6
V.5		0.4	2.4 d	0.0		0.0 b	0.2	3.3	0.1 b	0.2	0.1 b	10.0 ab	1.9 bc	1.9 ab	0.1 b	1.6
V.6		0.1	3.1 d		3.7 a	0.0 b	0.2	5.9	0.1 b	0.6	0.0 b	4.0 b	1.4 bc	2.1 ab	0.2 b	1.6
V.7		0.5	4.7 cd	0.3		0.0 b	0.3	4.6	0.6 ab	0.6	0.3 b	9.5 ab	1.6 bc	1.0 ab	0.4 b	1.9
Mean	3.4		6.2	0.1	1.2	0.1	0.9	4.2	0.2	0.2	0.7	7.4	3.4	2.2	1.4	2.2
P-value	0.0141	0.7780	<0.0001	0.4451	0.0081	0.0445	0.2338	0.0697	0.0028	0.7349	<0.0001	0.0023	<0.0001	0.0258	<0.0001	

[y] Rootstocks ranked in alphabetical order.

[z] Mean values with the same letter within a given column are not significantly different according to the Tukey-Kramer test at P=0.05.

Table 4. Cumulative yield (2015-2018; kg/tree) of 'Honeycrisp' trees from the NC-140 apple rootstock trial planted in 2014 at 14 locations.

Rootstock[y]	ID	IN	MA	ME	MEX	MI	MN	NJ	NY	ON-R	ON-S	PA	VA	WA	WI	Mean
B.10		7.3 bc				18.1 cde	17.9 b-e	19.1 ab	38.6 b-f		9.5 ab		9.5 abc		37.4 fgh	19.9
G.11		4.9 bc	19.5 def	20.5 bc	5.8 ab	19.5 cde	17.9 b-e	19.4 ab	34.8 c-f	25.1 abc	5.8 b		7.3 c	22.8 bc	36.7 gh	18.5
G.202	21.6 c[z]	2.1 bc	11.1 f	7.9 d	2.8 b	8.1 e	11.8 e	13.3 b	31.0 def	17.3 c	5.2 b		9.0 bc	20.4 c	26.1 h	13.4
G.214		6.3 bc	11.3 f	15.0 bcd		24.0 bcd	15.0 de	24.5 ab	36.4 c-f		8.3 ab		18.7 a	32.9 abc	39.0 e-h	21.0
G.30	55.4 a	7.5 bc	43.7 a	45.5 a	10.4 ab	33.1 ab	25.6 ab	27.5 a	53.6 ab	23.8 abc	7.0 ab		14.1 abc	41.4 ab	75.8 a	33.2
G.41		3.8 bc	20.4 def		2.8 b	15.0 cde	16.3 cde	20.5 ab	40.9 b-f	17.5 c	5.8 b		6.2 c	16.1 c	46.4 c-g	17.7
G.5890		15.0 a	39.4 abc				24.9 abc		64.4 a			79.3 a		51.4 a	72.5 ab	49.6
G.935		3.6 bc	22.8 de	22.1 b		15.9 cde	15.6 de	25.6 a	26.1 f	23.3 abc	6.9 ab		7.4 c	32.3 abc	52.2 c-f	21.1
G.969	42.2 ab	8.1 b	40.7 ab	24.3 b	10.5 a	21.3 cd	22.3 a-d	23.9 ab	47.7 a-d	18.8 bc	8.6 ab	61.2 bc	17.6 ab	18.3 bc	53.1 cde	27.9
M.26 EMLA	27.9 bc	5.0 bc	18.6 def	10.9 cd	7.2 ab	16.0 cde	14.6 de	21.2 ab	33.0 def	23.6 abc	5.8 b	29.1 e	6.8 c	20.0 c	31.5 gh	18.1
M.7											6.4 ab					6.4
M.9 T337		3.8 bc	17.8 ef		6.4 ab	14.0 de	12.7 e	20.1 ab	27.2 ef	20.6 bc	8.0 ab	39.8 de	9.2 bc	22.1 bc	38.3 e-h	18.5
MM.106											6.5 ab					6.5
V.1	37.2 b	1.5 c	26.0 de	15.5 bcd		22.4 bcd	21.1 a-d	22.1 ab	34.4 c-f			52.1 bcd	10.4 abc	34.4 abc	40.1 d-h	26.4
V.5		2.9 bc	27.8 cde	26.0 b		40.2 a	26.6 a	24.5 ab	46.7 bcd	34.0 a	10.6 a	47.1 cd	15.0 abc	44.5 a	54.7 cd	30.8
V.6		3.7 bc	29.7 bcd		5.9 ab	24.2 bcd	23.1 a-d	21.5 ab	44.1 b-e	28.7 ab	9.7 ab	66.2 ab	13.6 abc	33.9 abc	56.6 c	27.8
V.7		3.8 bc	27.0 cde	22.5 b		26.2 bc	19.4 a-e	16.5 ab	52.0 abc	34.3 a	7.1 ab	56.3 bc	14.4 abc	43.6 ab	58.5 bc	29.3
Mean	36.8	5.3	25.4	21.0	6.5	21.3	19.1	21.4	40.7	24.3	7.4	53.9	11.4	31.0	47.9	22.7
P-value	<0.0001	<0.0001	<0.0001	<0.0001	0.0075	<0.0001	<0.0001	0.0091	<0.0001	<0.0001	0.0004	<0.0001	<0.0001	<0.0001	<0.0001	

[y] Rootstocks ranked in alphabetical order.

[z] Mean values with the same letter within a given column are not significantly different according to the Tukey-Kramer test at P=0.05.

Table 4. Cumulative yield efficiency (2015-2018; kg/tree/cm^2 TCSA^x 2018) of 'Honeycrisp' trees from the NC-140 apple rootstock trial planted in 2014 at 14 locations.

Rootstock[y]	ID	IN	MA	ME	MEX	MI	MN	NJ	NY	ON-R	ON-S	PA	VA	WA	WI	Mean
B.10						3.0 abc		1.6 ab	3.8 abc		0.7 bcd		0.9 abc		2.8 b-e	2.1
G.11			2.5 abc	3.0 a	0.5 bcd	3.7 a	2.0 ab	1.9 a	4.3 a	2.9 a	0.7 bcd		0.8 abc	2.3 ab	3.2 a-d	2.3
G.202	2.2 ab[z]		1.7 cd	1.4 b	0.4 cd	1.5 d	1.3 ab	1.5 abc	3.3 a-d	2.1 b	0.9 ab		0.8 abc	1.7 b	2.8 b-e	1.6
G.214						3.0 abc	1.6 ab	1.7 ab	3.0 a-d		0.6 bcd		1.3 a	2.7 a	2.5 de	2.1
G.30	1.8 ab		2.7 ab	2.8 a	0.7 a-d	2.8 abc	2.1 a	1.1 a-d	2.9 bcd	1.5 bc	0.4 d		0.8 abc	2.3 ab	3.3 a-d	2.0
G.41			2.1 bcd		0.3 d	2.5 a-d	1.5 ab	1.7 ab	4.2 ab	2.2 b	0.8 abc		0.7 abc	1.6 ab	4.1 a	2.0
G.5890			1.9 bcd				1.2 ab		2.7 bcd			3.6 ab		2.5	2.8 b-e	2.4
G.935			2.4 bcd	3.2 a		2.2 cd	1.5 ab	1.6 ab	3.1 a-d	1.7 bc	1.1 a		0.7 bc	2.5 ab	3.7 ab	2.2
G.969	2.6 a		3.4 a	3.0 a	1.2 a	3.5 ab	1.9 ab	1.0 bcd	4.3 a	1.5 bc	0.8 abc	4.0 a	1.2 ab	1.9 ab	3.6 abc	2.4
M.26 EMLA	2.1 ab		1.8 bcd	1.4 b	1.0 abc	2.3 bcd	1.6 ab	1.2 a-d	3.0 a-d	1.6 bc	0.5 d	1.9 c	0.5 bc	1.8 ab	2.3 de	1.6
M.7											0.5 cd					0.5
M.9 T337			2.6 abc		1.2 ab	2.4 bcd	1.4 ab	1.5 abc	3.7 abc	2.0 bc	0.9 ab	3.4 ab	0.9 abc	2.6 ab	3.9 a	2.2
MM.106											0.5 cd					0.5
V.1	1.7 b		2.1 bcd	1.2 b		2.3 bcd	1.4 ab	0.7 cd	2.5 cd			2.4 c	0.5 c	1.8 ab	2.2 e	1.7
V.5			1.6 cd	1.5 b		2.6 a-d	1.2 b	0.6 cd	2.3 d	1.4 bc	0.7 bcd	2.0 c	0.8 abc	1.6 b	1.8 e	1.5
V.6			1.5 d		0.4 cd	2.3 bcd	1.4 ab	0.5 d	2.7 bcd	1.3 c	0.5 cd	2.4 c	0.6 bc	1.7 ab	2.2 e	1.5
V.7			1.7 cd	1.9 b		2.3 bcd	1.1 b	0.4 d	2.7 cd	1.5 bc	0.6 bcd	2.6 bc	0.7 abc	1.8 ab	2.6 cde	1.6
Mean	2.1	ND	2.2	2.2	0.7	2.6		1.2	3.2	1.8	0.7	2.8	0.8	2.1	2.9	1.8
P-value	0.0286		<0.0001	<0.0001	<0.0001	<0.0001	0.0019	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0009	0.0001	<0.0001	

^{x} Trunk cross-sectional area.

^{y} Rootstocks ranked in alphabetical order.

^{z} Mean values with the same letter within a given column are not significantly different according to the Tukey-Kramer test at P=0.05.

Table 6. Fruit weight (g), averaged over all cropping years (2015-2018) for 'Honeycrisp' trees from the NC-140 apple rootstock trial planted in 2014 at 14 locations.

Rootstock[y]	ID	IN	MA	ME	MEX	MI	MN	NJ	NY	ON-R	ON-S	PA	VA	WA	WI	Mean
B.10		323 ab				197 bc		308	269 a		207 abc		206 a		269 abc	254
G.11		255 ab	265 ab	247 a	234	226 abc	163 a	257	296 a	289	211 abc		206 a	262 ab	253 a-d	243
G.202	197 b[z]	270 ab	209 c	167 b	226	209 abc	142 ab	249	269 a	262	175 c		191 a	228 b	239 a-d	217
G.214		259 ab	259 ab	224 a		257 a	102 b	239	273 a		232 ab		202 a	247 ab	216 d	228
G.30	281 a	293 ab	263 ab	237 a	218	252 ab	147 a	270	296 a	264	240 a		191 a	278 a	265 abc	250
G.41		288 ab	259 ab		220	260 a	151 a	271	294 a	265	210 abc		208 a	244 ab	265 abc	245
G.5890		300 ab	280 a				154 a		299 a			261 a		270 ab	282 a	264
G.935		278 ab	233 bc	207 ab		253 ab	137 ab	252	251 a	270	187 c		214 a	263 ab	217 d	230
G.969	192 b	261 ab	229 bc	210 ab	209	210 abc	149 a	282	268 a	258	198 abc	230 b	203 a	225 b	229 cd	223
M.26 EMLA	248 a	327 a	253 abc	213 a	216	216 abc	133 ab	298	296 a	302	209 abc	257 a	223 a	236 ab	277 ab	247
M.7											196 bc					196
M.9 T337		245 b	229 bc		217	194 c	149 a	289	272 a	281	206 abc	236 ab	224 a	244 ab	236 bcd	232
MM.106											187 c					187
V.1	242 a	283 ab	244 abc	216 a		214 abc	142 ab	271	277 a			238 ab	209 a	265 ab	251 a-d	238
V.5		258 ab	268 ab	255 a		263 a	149 a	284	303 a	274	214 abc	249 ab	227 a	264 ab	280 a	253
V.6		255 ab	280 a		204	243 abc	160 a	290	296 a	265	217 abc	256 ab	223 a	263 ab	275 ab	248
V.7		261 ab	258 ab	215 a		236 abc	160 a	255	295 a	281	216 abc	249 ab	222 a	253 ab	265 abc	244
Mean	232	277	252	219	218	231	145	272	284	274	207	247	211	253	255	235
P-value	<0.0001	0.0131	<0.0001	<0.0001	0.6102	<0.0001	0.0032	0.0527	0.0393	0.0866	<0.0001	0.0037	0.0495	0.0048	<0.0001	

[y] Rootstocks ranked in alphabetical order.

[z] Mean values with the same letter within a given column are not significantly different according to the Tukey-Kramer test at P=0.05.

Table 6. Tree height (m), as of 2018 for 'Honeycrisp' trees from the NC-140 apple rootstock trial planted in 2014 at 14 locations.

Rootstock[y]	ID	IN	MA	ME	MEX	MI	MN	NJ	NY	ON-R	ON-S	PA	VA	WA	WI	Mean
B.10						2.5 e		2.8 d	3.0 cd	3.0	1.5 a-d		2.6 de		3.0 cde	2.6
G.11			2.9 ef	2.4 d	2.3 ab	2.8 cde	2.5 bcd	2.9 cd	3.1 cd	3.0	1.4 cde		2.9 a-e	3.2 ab	2.9 e	2.7
G.202	3.1 bc[z]		2.8 f	2.3 d	2.0 b	2.7 de	2.6 a-d	2.7 d	3.1 bcd	3.0	1.1 e		2.9 a-d	3.3 ab	2.9 e	2.7
G.214						3.5 ab	2.5 bcd	3.4 abc	3.3 bc		1.5 a-d		3.2 a	3.3 ab	3.2 a-e	3.0
G.30	3.9 a		3.5 abc	3.1 a	2.5 a	3.4 abc	2.6 abc	3.5 ab	3.5 ab	3.0	1.7 a		3.2 a	3.5 a	3.5 a	3.1
G.41			3.1 c-f		2.2 ab	2.9 b-e	2.6 a-d	2.9 cd	3.1 bcd	3.0	1.3 de		2.7 b-e	3.1 ab	3.1 a-e	2.7
G.5890			3.8 a					2.9 a	3.7 a			3.7 ab		3.5 a	3.4 abc	3.5
G.935			3.3 b-e	2.5 d		3.2 a-e	2.5 bcd	3.2 a-d	2.8 de	3.2	1.4 b-e		2.9 a-d	3.2 ab	2.8 e	2.8
G.969	3.2 b		3.4 a-d	2.6 bcd	2.3 ab	2.9 b-e	2.8 ab	3.7 a	3.2 bcd	3.1	1.3 de	3.2 cd	3.1 a	3.3 ab	3.1 b-e	2.9
M.26 EMLA	2.5 c		2.9 ef	2.4 d	2.0 b	2.6 e	2.2 d	3.0 bcd	3.0 cd	3.0	1.5 a-d	3.0 d	2.5 e	2.9 b	2.8 e	2.6
M.7											1.4 a-d					1.4
M.9 T337			2.7 f		2.2 ab	2.5 e	2.4 cd	3.0 bcd	2.6 e	3.0	1.3 de	2.9 d	2.6 cde	3.0 b	2.8 e	2.6
MM.106											1.3 de					1.3
V.1	3.2 b		3.0 def	2.5 cd		2.8 cde	2.7 abc	3.4 abc	2.8 de			3.3 bcd	3.0 abc	3.6 a	3.0 de	3.0
V.5			3.6 ab	2.9 abc		3.7 a	2.8 ab	3.8 a	3.5 ab	3.1	1.6 ab	3.6 abc	3.1 ab	3.5 a	3.4 ab	3.2
V.6			3.7 ab		2.2 ab	3.4 a-d	2.8 ab	3.7 a	3.4 abc	3.1	1.6 abc	4.0 a	3.1 a	3.4 ab	3.3 a-d	3.1
V.7			3.6 abc	2.9 ab		3.4 a-d	2.7 abc	3.8 a	3.5 ab	3.4	1.6 a-d	3.5 bc	3.0 a-d	3.6 a	3.1 a-e	3.2
Mean	3.2	ND	3.3	2.6	2.2	3.0	2.6	3.3	3.2	3.1	1.4	3.4	2.9	3.3	3.1	2.7
P-value	<0.0001		<0.0001	<0.0001	0.0005	<0.0001	<0.0001	<0.0001	<0.0001	0.0834	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	

[y] Rootstocks ranked in alphabetical order.

[z] Mean values with the same letter within a given column are not significantly different according to the Tukey-Kramer test at P=0.05.

Table 6. Tree width (m), as of 2018 for 'Honeycrisp' trees from the NC-140 apple rootstock trial planted in 2014 at 14 locations.

Rootstock[y]	ID		IN	MA		ME		MEX		MI		MN		NJ		NY		ON-R		ON-S		PA		VA		WA		WI		Mean
B.10										1.1	d-h	1.8	ab	1.2	ef	1.8	bcd			2.3	abc			1.6	f			1.9	bcd	1.6
G.11				1.7	cd	1.7	ab	1.3	ab	1.1	e-h	1.8	ab	1.2	c-f	2.0	abc	1.5	c	2.2	bcd			1.8	c-f	0.9	de	1.9	cd	1.6
G.202	1.0	bc[z]		1.5	d	1.3	c	1.0	b	1.1	gh	1.5	b	1.1	f	2.1	abc	1.7	abc	1.9	d			1.8	def	1.0	cde	1.6	d	1.4
G.214										1.4	b-f	1.5	b	1.4	a-e	2.1	abc			2.5	ab			2.2	abc	1.1	cde	2.0	abc	1.8
G.30	1.6	a		2.1	abc	2.2	a	1.4	a	1.7	a	1.8	ab	1.3	b-f	2.3	ab	1.8	abc	2.5	a			2.3	ab	1.2	abc	2.3	a	1.9
G.41				1.9	bcd			1.2	ab	1.2	d-h	1.7	ab	1.4	a-e	1.9	abc	1.5	c	2.3	abc			1.8	c-f	1.0	cde	2.0	abc	1.6
G.5890				2.5	a							1.9	a			2.4	a					2.4	a			1.2	abc	2.3	a	2.1
G.935				1.8	bcd	1.6	bc			1.5	a-e	1.6	ab	1.5	abc	1.8	bcd	1.6	c	2.0	cd			2.0	b-e	1.1	b-e	1.9	bcd	1.7
G.969	1.2	b		2.1	abc	1.7	ab	1.3	ab	1.1	fgh	1.8	ab	1.5	a-d	1.8	bc	1.8	abc	2.2	bcd	1.9	bc	2.0	a-e	0.9	cde	2.0	abc	1.7
M.26 EMLA	0.9	c		1.8	cd	1.3	bc	1.1	b	1.1	e-h	1.6	ab	1.2	def	1.7	cd	1.6	bc	2.1	cd	1.7	c	1.7	ef	1.0	cde	1.8	cd	1.5
M.7																				2.2	bcd									2.2
M.9 T337				1.5	d			1.2	ab	0.9	h	1.5	b	1.3	b-f	1.3	d	1.6	c	2.1	cd	1.7	c	1.6	f	0.9	e	1.8	cd	1.5
MM.106																				2.1	cd									2.1
V.1	1.2	b		1.8	cd	1.4	bc			1.3	c-g	1.7	ab	1.5	a-d	1.8	cd					2.0	bc	2.1	a-d	1.1	a-d	1.9	bcd	1.6
V.5				2.1	abc	1.8	ab			1.7	ab	1.8	ab	1.6	a	2.2	abc	2.0	a	2.5	a	2.3	a	2.3	ab	1.3	ab	2.3	a	2.0
V.6				2.1	abc			1.2	ab	1.5	abc	1.8	ab	1.6	ab	2.2	abc	2.0	ab	2.4	ab	2.3	a	2.3	a	1.3	a	2.3	ab	1.9
V.7				2.3	ab	1.7	ab			1.5	a-d	1.9	a	1.7	a	2.2	abc	2.0	a	2.5	ab	2.2	ab	2.1	a-d	1.2	abc	2.1	abc	1.9
Mean	1.2	ND		1.9		1.6		1.2		1.3		1.7		1.4		2.0		1.7		2.3		2.1		2.0		1.1		2.0		1.8
P-value	<0.0001			<0.0001		<0.0001		0.0074		<0.0001		<0.0001		<0.0001		<0.0001		<0.0001		<0.0001		<0.0001		<0.0001		<0.0001		<0.0001	

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