

EVALUATION OF POTENTIAL NEW, SIZE CONTROLLING ROOTSTOCKS FOR EUROPEAN PEARS



Bartlett – 4/2006



Bartlett – 8/2012

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NC-140 REGIONAL RESEARCH PROJECT

- ❖ Cooperative testing (i.e. multi-institutional) of rootstocks for apple, cherry, peach, pear, and plum.
- ❖ ***Uniform, replicated trials:*** field performance, propagation, breeding/acquisition, physiological stress
- ❖ **WHAT DOES 'NC-140' MEAN?**
- ❖ ***North Central/Regional Association (NCRA) of Agricultural Experiment Station Directors:*** one of four regional associations (California is in Western Association of Agricultural Experiment Station Directors) with responsibility for facilitating cooperation of regional and national research.
- ❖ Associations oversee USDA-NIFA ***Multistate Research Fund (MRF)***: federal appropriation authorized by Hatch Act and disbursed via land-grants. ***Land-grants decide how to spend*** (UC: travel to NC-140 annual meeting). ***Perhaps*** other federal, state, private (i.e. industry, in-kind) sources.
- ✕ Regional priorities identified, developed jointly by State Agricultural Experiment Station (SAES) Directors, Departmental Chairs and participating scientists.

NC-140 PEAR TRIAL OBJECTIVES

- ❑ Evaluate potential precocious, size-controlling rootstocks for varying locations.
- ❑ Evaluate for size, vigor, growth habit, productivity, compatibility with major varieties, susceptibility to diseases and pests, propensity to sucker, etc.
- ❑ Select the best potential candidates for future increased propagation and industry use.

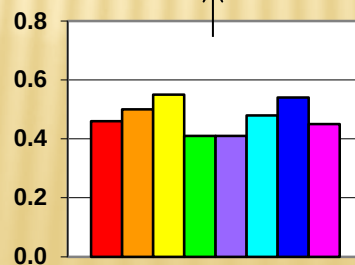
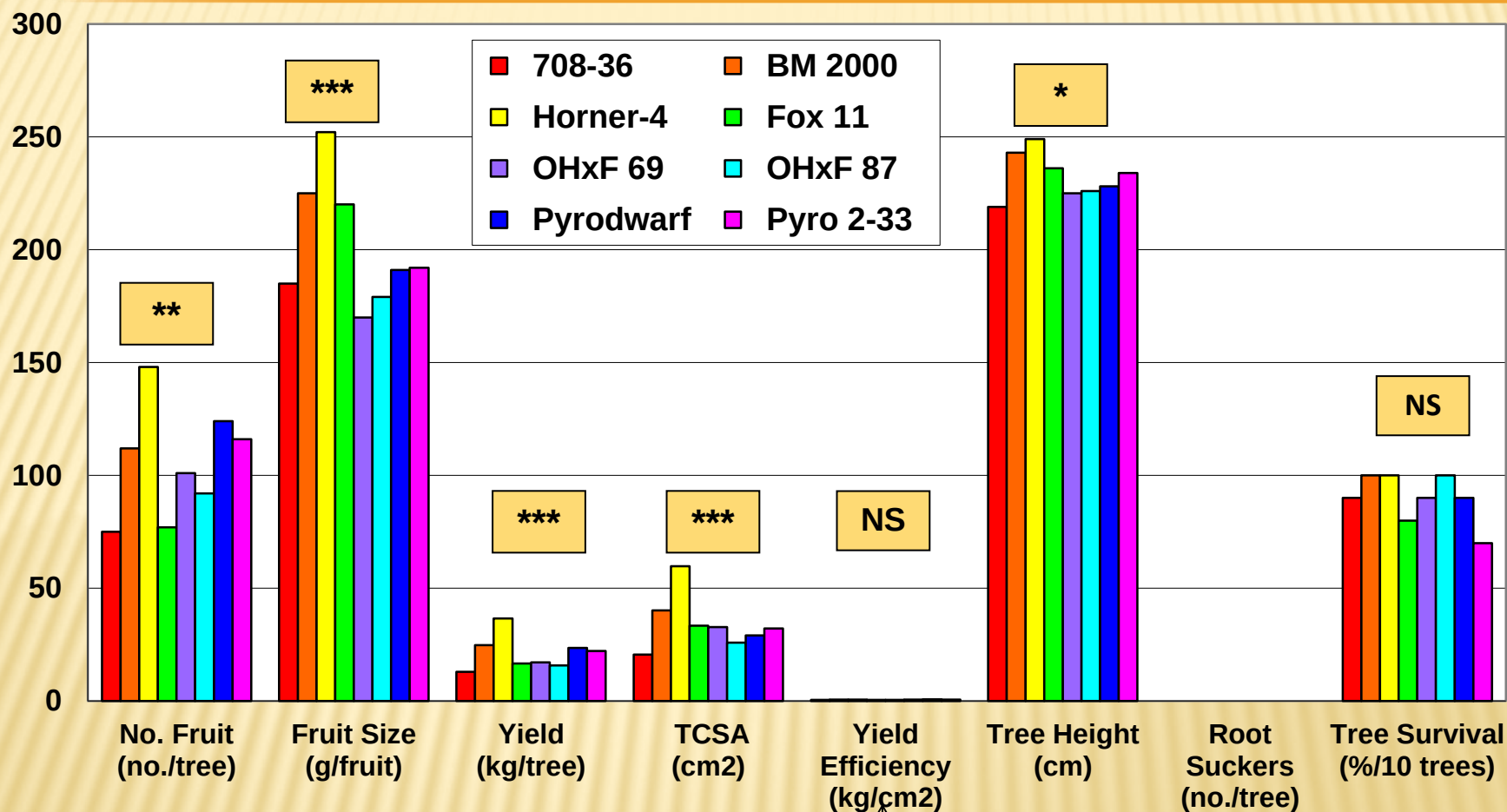
NC-140 PROCEDURES

- ❑ Randomized Complete Block, 10 single tree replicates per rootstock, *10 years*.
- ❑ Pears since 1988 (OR, WA, others); others in 2002 (OR, WA), 2004 (NY, Nova Scotia), 2005 (CA, NY, WA, Mexico, Nova Scotia), 2013 (CA, OR, NY).
- ❑ Rootstock, cultivar selections vary by site, depending on availability and investigator preference (OR and WA Anjou/Bartlett/Bosc; CA and NY Bartlett/Bosc; others Bartlett).
- ❑ 2005 trial (9th year; 2014 final): TCSA, height, no. flower clusters (up to 2010), no. fruit, yield, yield efficiency, no. suckers, and % survival.

Bartlett, Talmage, Cumulative (2005-2013)

	Tree Survival (%)	Root Suckers (Cum. no./tree)
ROOTSTOCK		
708-36	90	0.3 ab
BM 2000	100	2.7 ab
Horner 4	100	0.2 ab
Fox 11	80	3.1 a
OHxF 69	90	1.9 ab
OHxF 87	100	0.3 ab
Pyrodwarf	90	0.0 b
Pyro 2-33	70	0.0 b
ANOVA		
Rootstock	NS (0.28)	** (0.01)
Block	NS (0.56)	NS (0.24)

Effects of 2005 NC-140 Rootstocks Planting on Tree Growth, Suckering and Harvest of 8-year-old (9th leaf) Bartlett Pear Trees, Talmage, Mendocino County, California, 2013

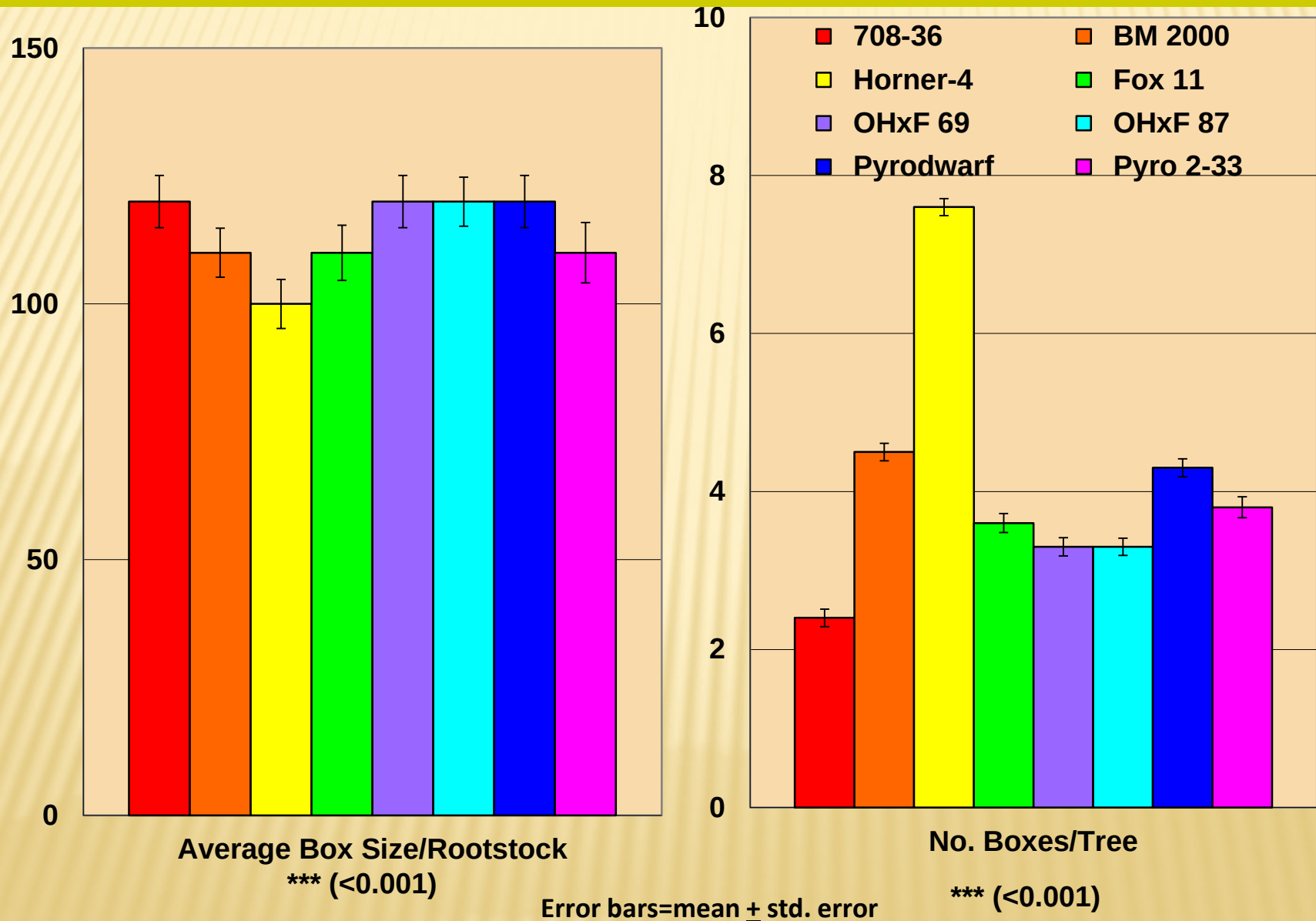


Bartlett, Talmage, Cumulative (2005-2013)

	Average Fruit Size (g)	Average Cumulative Yield (kg)	2013 TCSA (cm ²)	Average Cumulative Yield Efficiency (kg/cm ²)	Average Box Size (44 lb. boxes)	Average No. of Boxes (per tree)
ROOTSTOCK¹						
708-36	160 d	49.1 c	20.6 d	2.41 ab	120 d	2.4 c
BM 2000	182 abc	89.3 b	40.2 b	2.25 ab	110 abc	4.5 b
Horner 4	200 a	151.0 a	59.7 a	2.55 ab	100 a	7.6 a
Fox 11	185 ab	72.2 bc	33.4 bc	2.22 ab	110 abc	3.6 bc
OHxF 69	160 d	66.4 bc	32.8 bc	1.99 b	120 d	3.3 bc
OHxF 87	164 cd	67.0 bc	25.9 cd	2.60 ab	120 cd	3.3 bc
Pyrodwarf	167 bcd	85.1 b	29.1 cd	2.93 a	120 bcd	4.3 b
Pyro 2-33	186 ab	76.3 bc	32.2 bc	2.36 ab	110 ab	3.8 bc
ANOVA²						
Rootstock	*** (<0.001)	*** (<0.001)	*** (<0.001)	** (0.01)	*** (<0.001)	*** (<0.001)
Block	** (0.01)	** (<0.01)	NS (0.10)	* (0.03)	* (0.03)	** (<0.01)

Harvest Date: 8/19/2013

Average Box Sizes and No. of Boxes Per Tree for Bartlett Pears, Talmage, California 2005 - 2013



NC-140 Bartlett HARVEST, Talmage, 2013

	Firmness 8/19/2013 (kg of force)	Brix 8/19/2013 (degrees)
ROOTSTOCK		
708-36	7.9 ab	13.4
BM 2000	7.6 ab	13.7
Horner-4	7.2 b	13.7
Fox 11	7.7 ab	15.2
OHxF 69	8.2 a	15.6
OHxF 87	7.4 ab	15.0
Pyrodwarf	7.2 b	15.6
Pyro 2-33	7.2 ab	14.0
ANOVA		
Rootstock	* (0.04)	NS (0.65)
Block	NS (0.42)	NS (0.82)

Harvest date: 8/19/2013

Bartlett Harvest, August 21, 2012 (8TH leaf) Talmage, Mendocino County



Bartlett Pears, Talmage, Mendocino County

August 2012 (8th leaf)



Horner 4 (8th leaf)



Pyrodwarf (8th leaf)

Bartlett Pears, Talmage, Mendocino County

August 2013 (9th leaf)



Horner 4 (9th leaf)



Pyrodwarf (9th leaf)

Bartlett Pears, Talmage, Mendocino County

August 2012 (8th leaf)



OHxF 69 (8th leaf)



OHxF 87 (8th leaf)

Bartlett Pears, Talmage, Mendocino County

August 2013 (9th leaf)



OHxF 69 (9th leaf)



OHxF 87 (9th leaf)

Bartlett Pears, Talmage, Mendocino County

August 2013 (9th leaf)



Fox 11 (9th leaf)



708-36 (9th leaf)

Bartlett Pears, Talmage, Mendocino County

August 2013 (9th leaf)



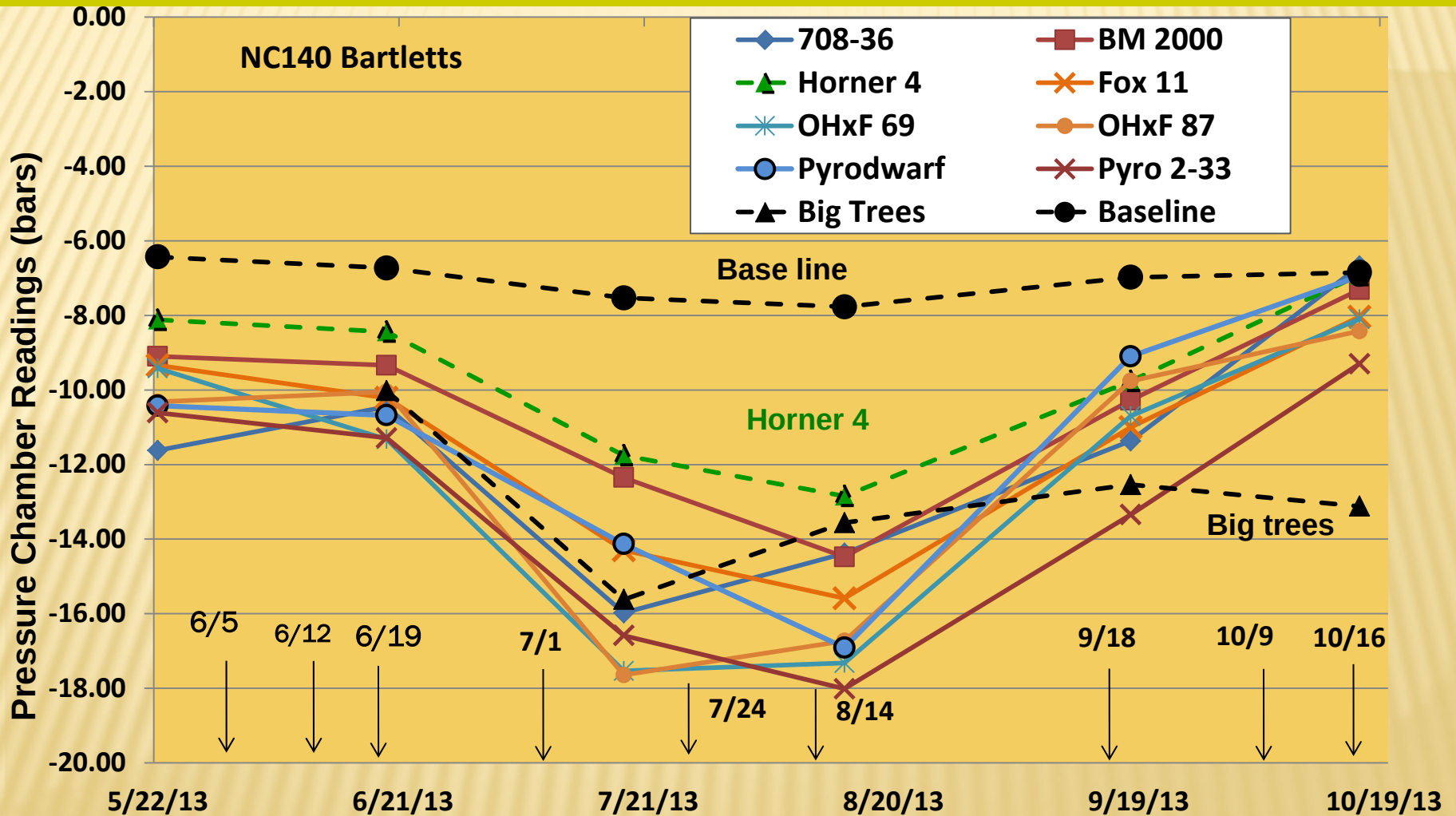
BM 2000 (9th leaf)



Pyro 2-33 (9th leaf)

Pressure Bomb Readings

Bartlett pear trees, 2013



Golden Russet Bosc, Talmage, Mendocino County

February 2013 (8th leaf)



GOLDEN RUSSET BOSCH

Talmage - Cumulative (2005-2013)

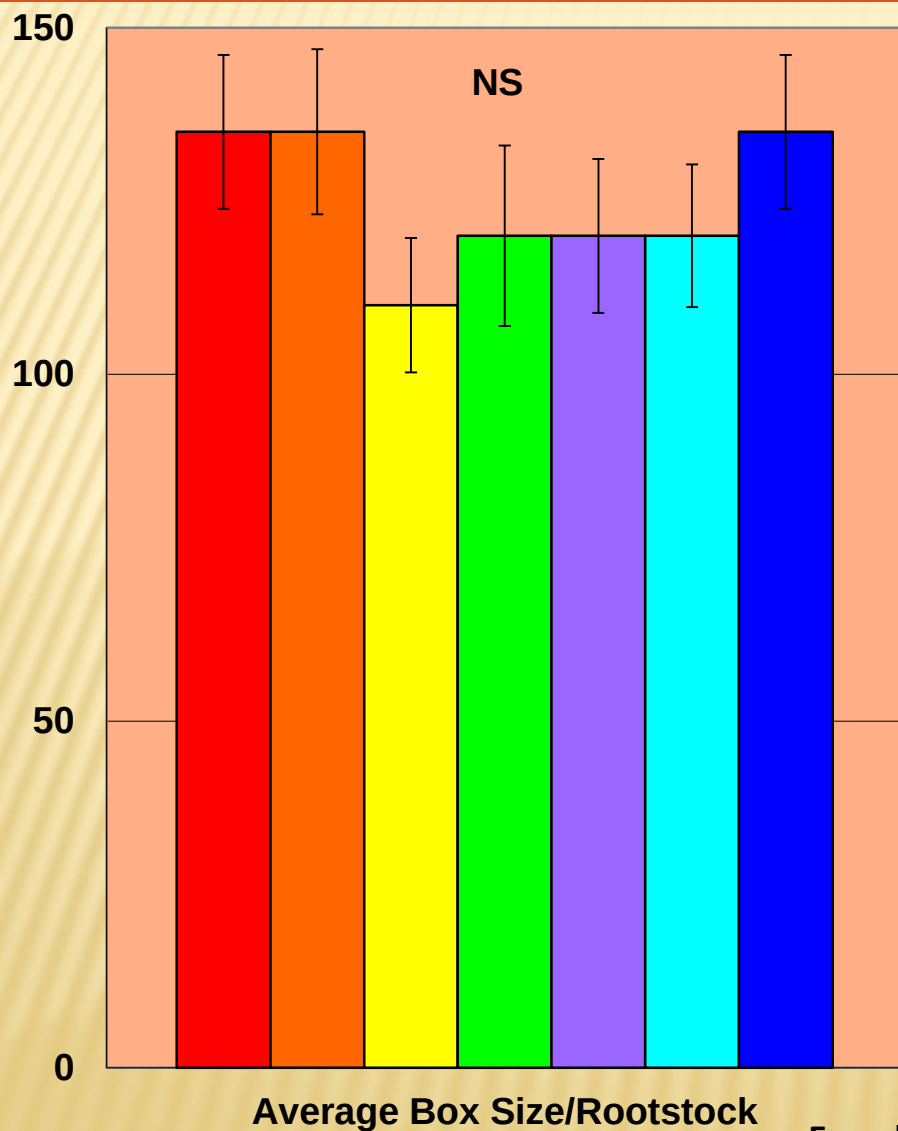
	Tree Survival (%)	Root Suckers (Cum. no./tree)
ROOTSTOCK ¹		
708-36	80	0.5
BM 2000	70	1.4
Horner 4	100	1.5
Fox 11	60	0.4
OHxF 87	80	0.1
Pyrodwarf	90	0.1
Pyro 2-33	80	0.0
ANOVA ²		
Rootstock	NS (0.41)	NS (0.53)
Block	NS (0.43)	NS (0.69)

GOLDEN RUSSET BOSC

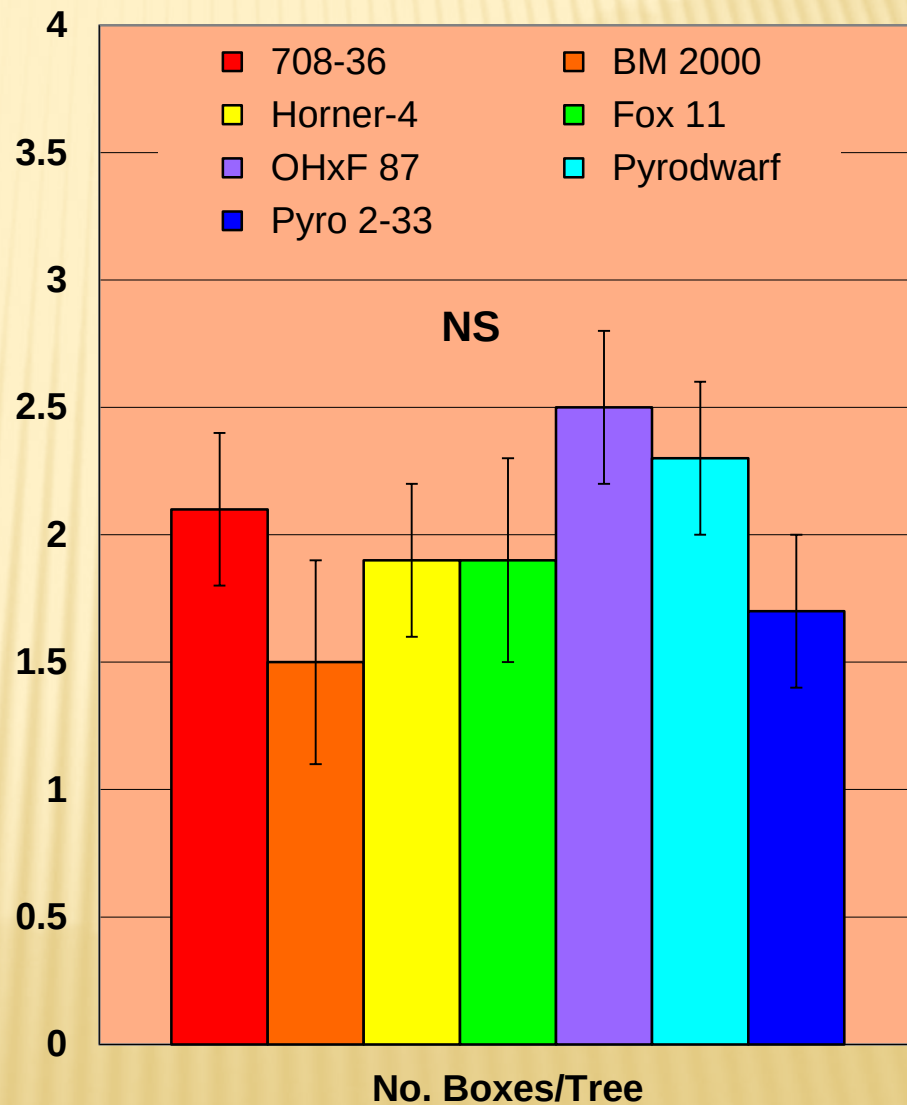
Talmage - Cumulative (2005-2013)

	Average Fruit Size	Average Cumulative Yield	2013 TCSA	Average Cumulative Yield Efficiency	Average Box Size	Average No. of Boxes
	(g)	(kg)	(cm ²)	(kg/cm ²)	(44 lb. box)	(per tree)
ROOTSTOCK						
708-36	150	42.8	34.7 b	1.16	135	2.1
BM 2000	154	30.5	51.1 ab	0.61	135	1.5
Horner 4	179	37.9	68.6 a	0.67	110	1.9
Fox 11	166	38.0	57.5 ab	0.77	120	1.9
OHxF 87	168	50.2	40.3 b	1.20	120	2.5
Pyrodwarf	173	45.5	50.1 ab	0.92	120	2.3
Pyro 2-33	155	34.6	48.6 ab	0.68	135	1.7
ANOVA						
Rootstock	NS (0.25)	NS (0.49)	*** (0.001)	NS (0.30)	NS (0.40)	NS (0.52)
Block	NS (0.08)	NS (0.35)	* (0.04)	NS (0.60)	NS (0.52)	NS (0.33)

Average Box Sizes and No. of Boxes Per Tree for “Golden Russet” Bosc Pear Yrees Talmage, California 2005-2013



Error bars=mean $\pm$ std. error



"GOLDEN RUSSET" BOSC - 2013

	Yield	TCSA	Yield Efficiency	Tree Height	Root Suckers ³
	9/4/2013	10/21/13	10/21/13	10/21/13	10/21/13
	(kg/tree)	(cm ²)	(kg/cm ²)	(cm)	(no./tree)
ROOTSTOCK¹					
708-36	16.9	34.7 b	0.43 ab	240	0.1
BM 2000	13.2	51.1 ab	0.28 b	240	0.1
Horner-4	18.4	68.6 a	0.27 b	240	0.0
Fox 11	15.2	57.5 ab	0.27 b	241	0.1
OHxF 87	17.9	40.3 b	0.41 ab	235	0.0
Pyrodwarf	22.7	50.1 ab	0.46 a	237	0.1
Pyro 2-33	16.6	48.6 ab	0.35 ab	246	0.0
ANOVA²					
Rootstock (P-value)	NS (0.58)	*** (0.001)	NS (0.09)	NS (0.11)	NS (0.75)
Block (P-value)	NS (0.32)	* (0.04)	NS (0.14)	NS (0.32)	NS (0.23)

"GOLDEN RUSSET" BOSC - 2013

	Tree Survival	No. Fruit	Fruit Size	Average Box Size	Average No. of Boxes
	9/4/2013 (%/10 trees)	9/4/2013 (no./tree)	9/4/2013 (g/fruit)	9/4/2013 (44 lb. box)	9/4/2013 (per tree)
ROOTSTOCK¹					
708-36	80	112 ab	153 c	135 c	0.8
BM 2000	70	61 b	215 ab	100 ab	0.7
Horner-4	100	85 ab	227 a	90 a	0.9
Fox 11	60	68 b	216 ab	90 ab	0.8
OHxF 87	80	114 ab	157 c	135 c	0.9
Pyrodwarf	90	129 a	177 bc	110 bc	1.1
Pyro 2-33	80	88 ab	192 abc	110 abc	0.8
ANOVA²					
Rootstock (P-value)	NS (0.41)	NS (0.16)	*** (<0.001)	*** (<0.001)	NS (0.58)
Block (P-value)	NS (0.43)	NS (0.16)	* (0.02)	NS (0.06)	NS (0.33)

"GOLDEN RUSSET" BOSC - 2013

	Firmness 9/11/2013 (kg of force)	Brix 9/11/2013 (degrees)
ROOTSTOCK		
708-36	8.6 ab	15.2 ab
BM 2000	7.5 ab	15.5 a
Horner-4	7.0 b	13.7 b
Fox 11	7.1 ab	13.9 ab
OHxF 87	8.7 a	15.6 a
Pyrodwarf	7.3 ab	14.8 ab
Pyro 2-33	7.0 ab	14.9 ab
ANOVA		
Rootstock	* (0.03)	** (0.01)
Block	NS (0.40)	** (<0.01)

Harvest date: 9/4/2013

Bosc Pears, Talmage, Mendocino County

February 2013 (8th leaf)



Horner 4



OHxF 87

Bosc Pears, Talmage, Mendocino County

September 4, 2013 (9th leaf)



Horner 4 (9th leaf)



BM 2000 (9th leaf)

Bosc Pears, Talmage, Mendocino County

September 4, 2013 (9th leaf)



708-36(9th leaf)



Pyro 2-33 (9th leaf)

***AMELANCHIER* AND OH X F (2012-13; RIP)**

- ❑ March 2012: *Amelanchier* (service (Jberry) spp. (A2, A7, A10); plus Quince Eline. Each w/6 cultivars, separate trials: Bartlett, BPM, Comice, Forelle, Golden Russet Bosc, Super Red (5 single tree reps per trial).
- ❑ May 2012: Bartlett on OHxF 69, 87 and 97. Design: RCB with 5 replicates (4 trees/rep).
- ❑ Both trials: 4' x 20', north to south berms, microsprinklers, trained into “informal” perpendicular “V”.
- ❑ Survival and growth data commenced Winter 2012 through Fall 2013
- ❑ Orchard sold and removed November 2013.

AMELANCHIER AND OHXF PLANTING MARYSVILLE, 2012



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AMELANCHIER AND OHXF PLANTING

MARYSVILLE, 2013



AMELANCHIER SURVIVAL AND ROOT SUCKERS – 2012 & 2013

	Root Suckers		Tree Survival	
	(no./tree)		(%/planted trees)	
	2012	2013	2012	2013
ROOTSTOCK				
A 2	0.0	0.3	97	93
A 7	0.4	0.9	93	93
A 10	0.3	1.4	93	83
CULTIVAR				
Bartlett	0.4	2.2 a	93	87
Golden Russet Bosc	0.0	0.0 b	100	100
Comice	0.3	0.4 b	100	100
Super Red	0.7	2.5 a	93	87
Forelle	0.0	0.0 b	93	80
BPM	0.0	0.2 b	87	87
ANOVA				
Cultivar (P-value)	NS (0.09)	*** (<0.001)	NS (0.65)	NS (0.34)
Rootstock (P-value)	NS (0.35)	* (0.03)	NS (0.82)	NS (0.32)

AMELANCHIER 2012 & 2013

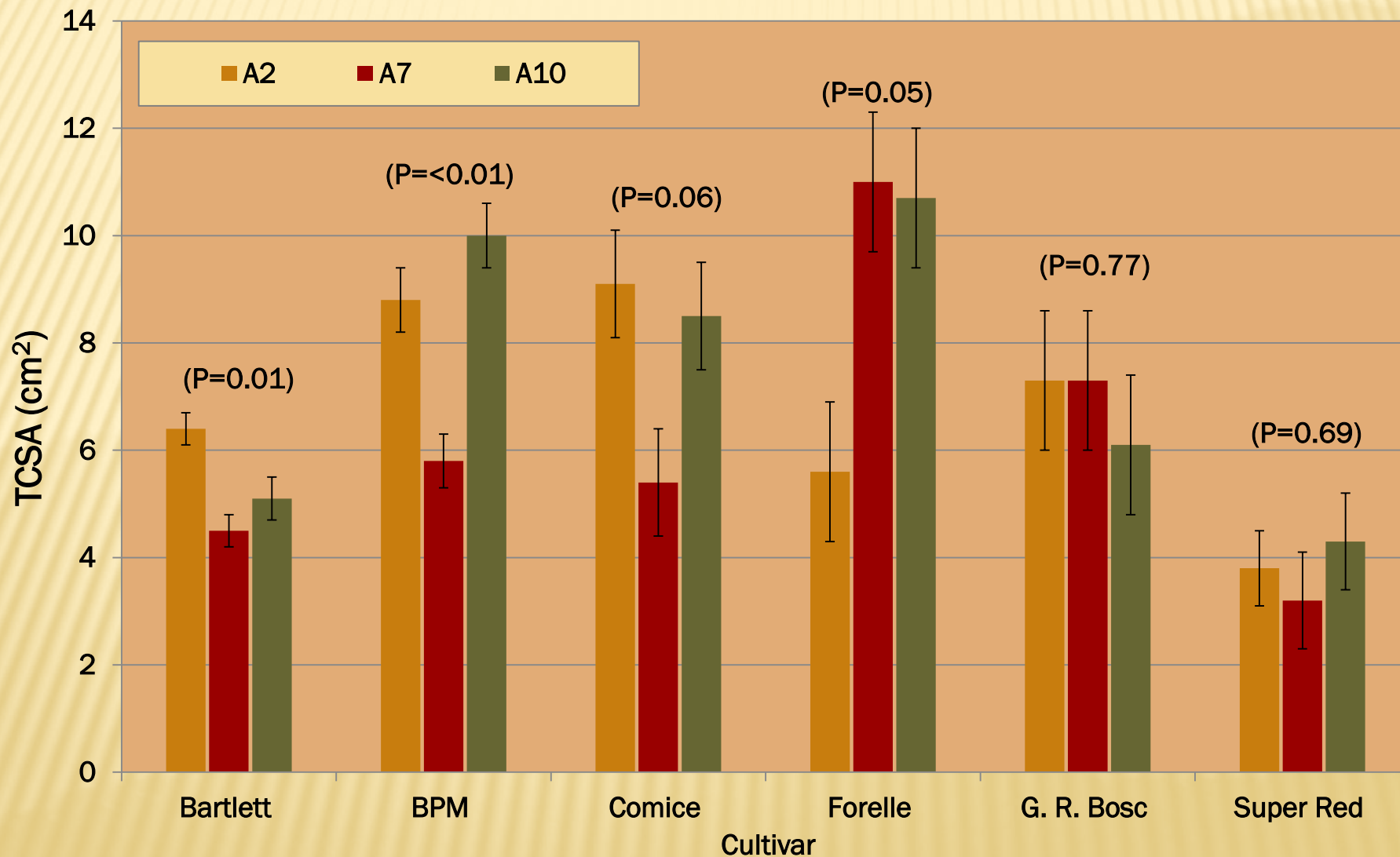
	Flower Clusters	No. Fruit	Fruit Set (%/100 clusters)	Tree Height	
	(no./tree) 3/25/13	(no./tree) 6/10/13	6/10/13	(cm) 2012	(cm) 2013
ROOTSTOCK					
A 2	28.8	10.8	31	170 ab	199 a
A 7	23.9	10.1	43	167 b	180 b
A 10	24.7	10.4	44	181 a	203 a
CULTIVAR					
Bartlett	59.7 a	21.5 a	37 ab	179 abc	190 a
Golden Russet Bosc	1.8 b	0.2 c	8 b	168 bcd	208 a
Comice	5.3 b	3.3 bc	65 a	157 cd	206 a
Super Red	17.7 b	9.2 b	65 a	151 d	161 b
Forelle	0.62 b	1.8 bc	19 ab	196 a	199 a
BPM	69.6 a	26.6 a	42 ab	186 ab	201 a
ANOVA					
Cultivar (P-value)	*** (<0.001)	*** (<0.001)	** (0.01)	***(<0.001)	*** (0.001)
Rootstock (P-value)	NS (0.50)	NS (0.94)	NS (0.56)	* (0.03)	*** (<0.001)

Tree Ht: n=88, all others: n=81

AMELANCHIER 2012 & 2013

	TCSA			Crop Load
	(cm ²)	(cm ²)	% Increase	(no./cm ²)
	2012	2013	2012-2013	2013
ROOTSTOCK				
A 2	4.2	7.0	82	1.68
A 7	3.8	6.1	56	2.06
A 10	4.2	7.4	89	1.49
CULTIVAR				
Bartlett	3.9 abc	5.6 bc	42 ab	3.73 a
Golden Russet Bosc	3.5 bc	7.0 ab	104 a	0.03 b
Comice	4.1 abc	7.5 ab	103 a	0.49 b
Super Red	2.9 c	4.3 c	33 b	2.65 a
Forelle	4.8 ab	8.9 a	100 ab	0.14 b
BPM	5.1 a	8.3 ab	73 ab	3.43 a
ANOVA				
Cultivar (P-value)	*** (<0.001)	*** (<0.001)	* (0.02)	*** (0.001)
Rootstock (P-value)	NS (0.52)	NS (0.15)	NS (0.19)	NS (0.12)

AMELANCHIER TCOSA - 2013



Error bars=mean $\pm$ std. error

QUINCE 'ELINE' 2012 & 2013

CULTIVAR	Flower Clusters	No. Fruit	Fruit Set (%/100 clusters)	Tree Height	
	(no./tree)	(no./tree)		(cm)	(cm)
	3/25/13	6/10/13	6/10/13	2012	2013
Bartlett	4.4 ab	5.9 a	155 a	166	193
Golden Russet Bosc	~	~	~	~	~
Comice	1.2 b	0.0 b	0 b	161	205
Super Red	0.4 b	0.0 b	0 b	148	199
Forelle	0.2 b	0.0 b	0 b	180	219
BPM	6.6 a	7.6 a	103 ab	187	217
ANOVA ²					
Cultivar (P-value)	NS (0.09)	** (<0.01)	** (<0.01)	NS (0.08)	NS (0.28)

QUINCE 'ELINE' TCSA AND CROP LOAD 2013

	TCSA			Crop Load
	(cm ²)	(cm ²)	% Increase	(no./cm ²)
CULTIVAR	2012	2013	2012-2013	6/10/13
Bartlett	3.9	6.5 b	60	1.0 a
Golden Russet Bosc	~	~	~	~
Comice	4.1	6.8 b	83	0.0 b
Super Red	3.7	6.5 b	65	0.0 b
Forelle	3.9	8.1 ab	123	0.0 b
BPM	4.7	9.1 a	122	0.8 a
ANOVA				
Cultivar (P-value)	NS (0.82)	* (0.03)	NS (0.35)	** (0.01)

OH x F 2013



OH x F ROOT SUCKERS AND SURVIVAL 2012-2013

ROOTSTOCK	Root Suckers		Tree Survival	
	(no./tree)		(%/planted trees)	
	2012	2013	2012	2013
	(n=83)	(n=81)	(n=90)	(n=90)
OHxF 97	0.0 b	0.00	100	93
OHxF 87	0.1 ab	0.32	97	90
OHxF 69	0.2 a	0.03	97	90
ANOVA				
Rootstock (P-value)	NS (0.10)	NS (0.14)	NS (0.82)	NS (0.82)

OH x F 2012-2013

	Flower Clusters (no./tree)	No. Fruit (no./tree)	Fruit Set (%/100 fruit)	Tree Height (cm)	
	3/25/13	6/10/13	6/10/13	2012	2013
ROOTSTOCK ¹	(n=82)	(n=82)	(n=82)	(n=89)	(n=81)
OHxF 97	8.0 b	1.9 b	16.3 b	165 ab	244 a
OHxF 87	14.4 ab	6.3 a	77.5 a	144 b	211 b
OHxF 69	15.0 a	4.2 ab	28.7 b	169 a	202 b
ANOVA ²					
Rootstock (P-value)	* (0.02)	*** (0.001)	** (<0.01)	* (0.02)	** (<0.01)

OH x F 2012-2013

	TCSA			Crop Load
	(cm ²)	(cm ²)	% Increase	(no./cm ²)
ROOTSTOCK ¹	2012	2013	2012-2013	7/5/05
	(n=89)	(n=81)	(n=82)	(n=82)
OHxF 97	2.1 a	7.0 a	66	0.3
OHxF 87	1.7 b	5.1 b	64	1.2
OHxF 69	2.1 a	5.3 b	52	0.8
ANOVA ²				
Rootstock (P-value)	** (<0.01)	** (<0.01)	* (0.05)	*** (<0.001)

FORELLE *ON AMELANCHIER* 2013



Forelle on A7 – 8/28/2013



Forelle on A7– 8/28/2013

BARTLETT *ON AMELANCHIER* 2013



Bartlett on A10 – 8/28/2013



Bartlett on A10– 8/28/2013

GR BOSC AND BPM *ON AMELANCHIER* 2013



GR Bosc on A2 – 8/28/2013



BPM on A10– 8/28/2013

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