

EVALUATION OF POTENTIAL NEW, SIZE CONTROLLING ROOTSTOCKS FOR EUROPEAN PEARS



Bartlett – 4/2006



Bartlett – 8/2012

Rachel Elkins
University of California Cooperative Extension
Lake & Mendocino Counties

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.

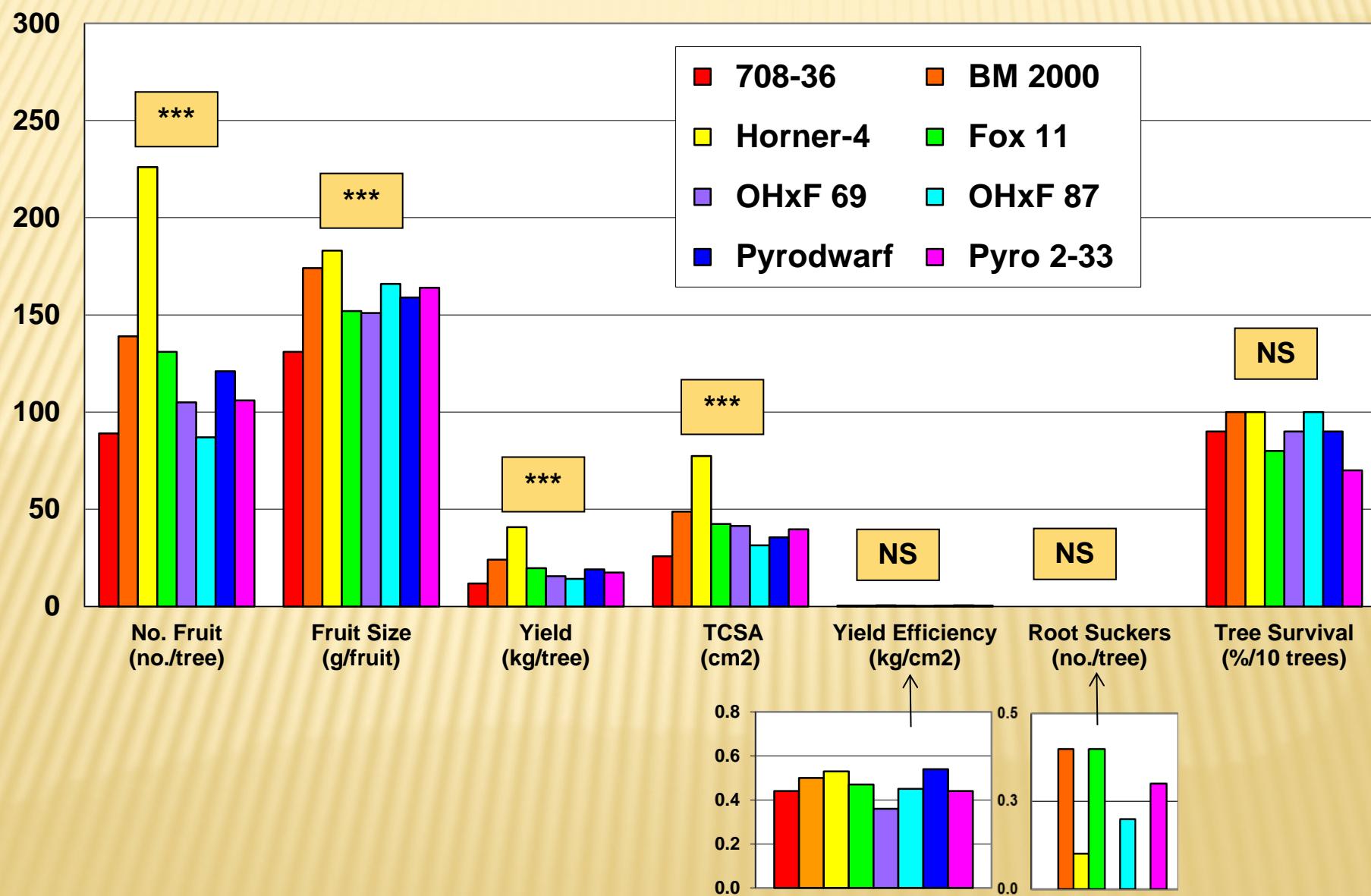
NC-140 PROCEDURES

- 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 (2005-2014)

	Tree Survival (%)	Root Suckers (Cum. no./tree)
ROOTSTOCK		
708-36	90	0.4 ab
BM 2000	100	3.1 ab
Horner 4	100	0.3 ab
Fox 11	80	3.5 a
OHxF 69	90	1.9 ab
OHxF 87	100	0.5 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 (0.23)

Effects of 2005 NC-140 Rootstocks Planting on Tree Growth, Suckering and Harvest of 9-year-old (10th leaf) Bartlett Pear Trees, Talmage, Mendocino County, California, 2014



Bartlett, Talmage, Cumulative (2005-2014)

	Average Fruit Size (g)	Average Cumulative Yield (kg)	2014 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	156 d	60.9 d	25.8 e	2.28 ab	120 d	2.4 c
BM 2000	181 b	113.3 b	48.8 b	2.36 ab	110 abc	4.5 b
Horner 4	197 a	191.9 a	77.4 a	2.50 ab	100 a	7.6 a
Fox 11	180 abc	91.9 bcd	42.4 bc	2.20 b	110 abc	3.6 bc
OHxF 69	158 d	82.0 cd	41.4 bcd	1.93 b	120 d	3.3 bc
OHxF 87	164 cd	81.1 cd	31.4 de	2.58 ab	120 cd	3.3 bc
Pyrodwarf	166 bcd	104.1 bc	35.6 cde	2.98 a	120 bcd	4.3 b
Pyro 2-33	183 ab	93.7 bcd	39.7 bcd	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)	* (0.03)	* (0.05)	* (0.03)	** (<0.01)

Average fruit size based on fruiting years – 2008-2014.

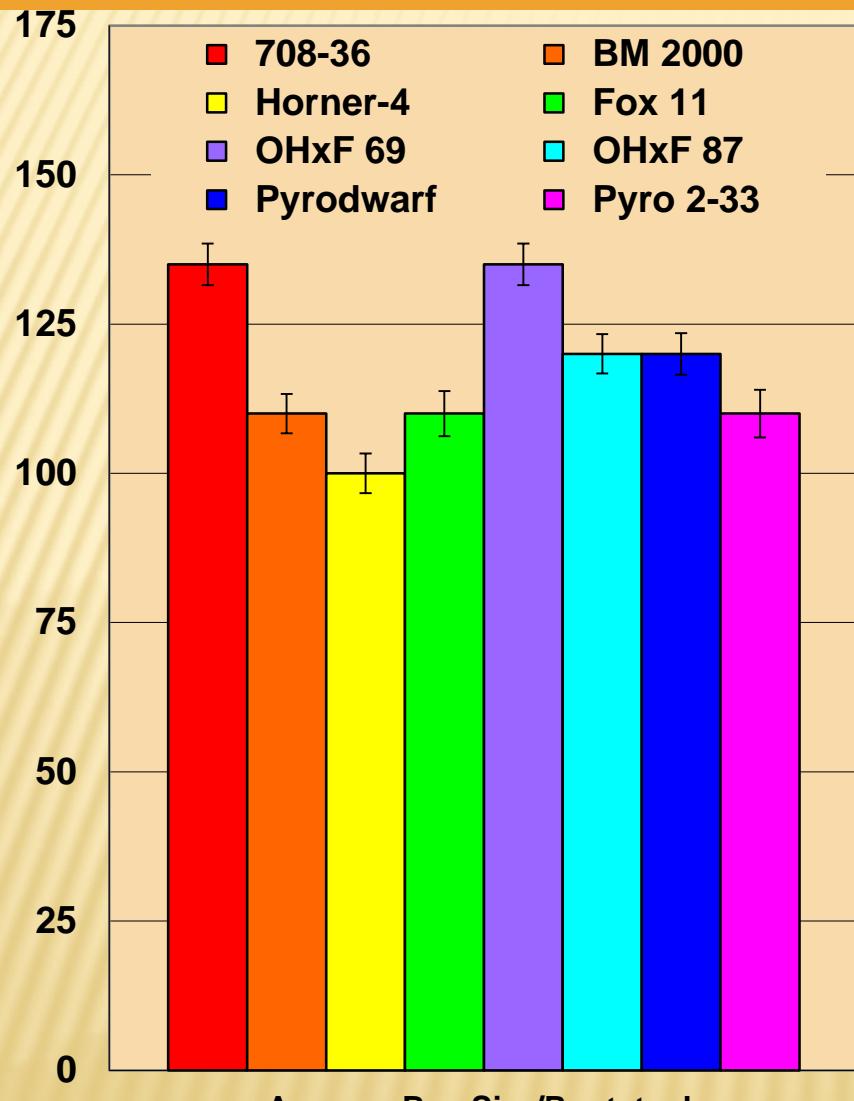
Bartlett, Talmage - 2014

	Yield 8/14/14 (kg/tree)	TCSA 10/13/14 (cm ²)	Yield Efficiency 10/13/14 (kg/cm ²)	Root Suckers 10/21/14 (no./tree)
ROOTSTOCK¹				
708-36	11.8 b	25.8 e	0.44 ab	0.0
BM 2000	24.1 b	48.8 b	0.50 ab	0.4
Horner-4	40.8 a	77.4 a	0.53 a	0.1
Fox 11	19.7 ab	42.4 bc	0.47 ab	0.4
OHxF 69	15.6 b	41.4 bcd	0.36 b	0.0
OHxF 87	14.2 b	31.4 de	0.45 ab	0.2
Pyrodwarf	19.0 ab	35.6 cde	0.54 a	0.0
Pyro 2-33	17.4 ab	39.7 bcd	0.44 ab	0.3
ANOVA²				
Rootstock	*** (<0.001)	*** (<0.001)	NS (0.09)	NS (0.32)
Block	* (0.03)	* (0.03)	NS (0.22)	NS (0.44)

Bartlett, Talmage - 2014

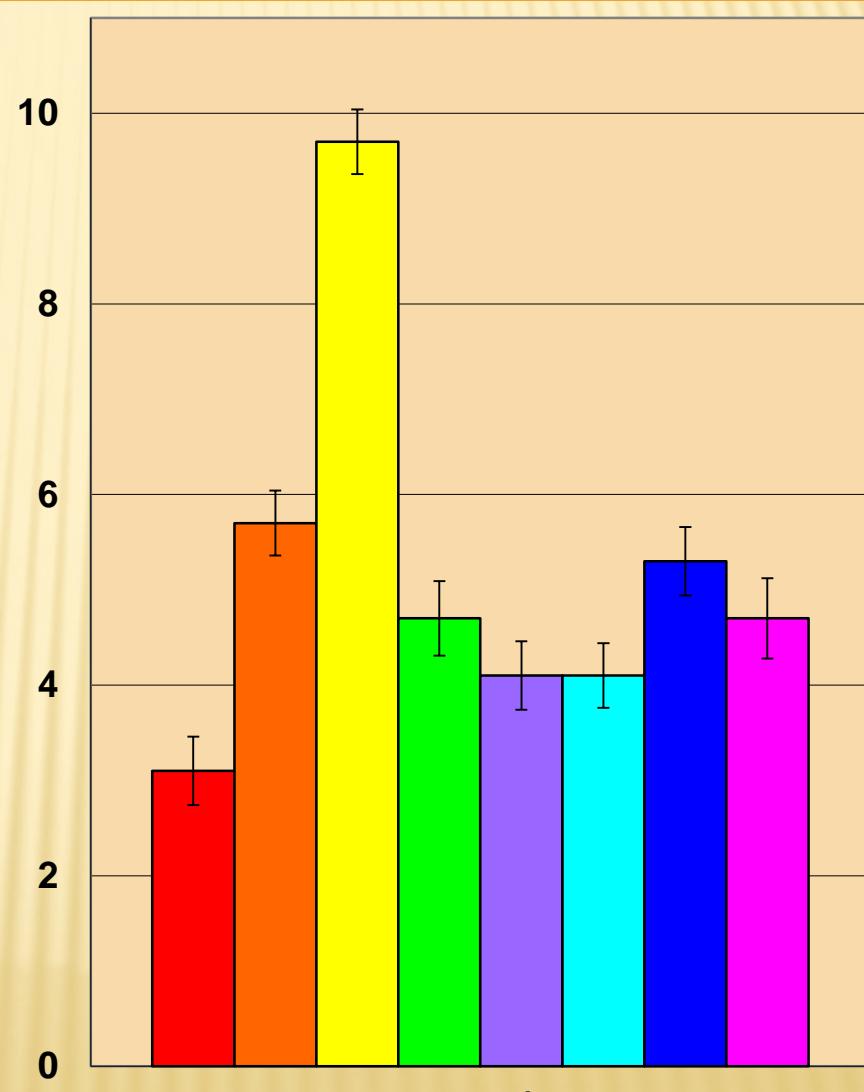
	Tree Survival 8/14/14 (%/10 trees)	No. Fruit 8/14/14 (no./tree)	Fruit Size 8/14/14 (g/fruit)	Average Box Size 8/14/14 (44 lb. box)	Average No. of Boxes 8/14/14 (per tree)
ROOTSTOCK¹					
708-36	90	89 bc	131 d	150 c	0.6 c
BM 2000	100	139 b	174 ab	110 ab	1.2 b
Horner-4	100	226 a	183 a	110 a	2.0 a
Fox 11	80	131 bc	152 bcd	135 bc	1.0 bc
OHxF 69	90	105 bc	151 cd	135 bc	0.8 c
OHxF 87	100	87 c	166 abc	120 ab	0.7 c
Pyrodwarf	90	121 bc	159 bc	135 ab	0.9 bc
Pyro 2-33	70	106 bc	164 abc	120 ab	0.9 bc
ANOVA²					
Rootstock	NS (0.28)	*** (<0.001)	*** (<0.001)	*** (<0.001)	*** (<0.001)
Block	NS (0.56)	NS (0.10)	** (0.01)	** (0.01)	* (0.03)

Average Box Sizes and No. of Boxes Per Tree for Bartlett Pears, Talmage, California 2005 - 2014



*** ($P<0.001$)

Error bars = mean \pm std. error



*** ($P<0.001$)

Bartlett, Talmage, 2014

	Firmness 8/14/14 (kg of force)	Soluble Solids 8/14/14 (°Brix)
ROOTSTOCK		
708-36	9.2 a	11.8 ab
BM 2000	8.2 bc	11.6 ab
Horner-4	7.7 c	10.6 b
Fox 11	8.7 ab	11.7 ab
OHxF 69	8.9 ab	10.5 b
OHxF 87	8.5 abc	12.1 a
Pyrodwarf	9.0 ab	11.3 ab
Pyro 2-33	78.8 ab	12.3 a
ANOVA		
Rootstock	*** (<0.001)	* (0.05)
Block	NS (0.98)	NS (0.78)

Harvest date: 8/14/2014

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



**Bartlett Harvest, August 14, 2014 (10TH leaf)
Talmage, Mendocino County**



**Bartlett Harvest, August 14, 2014 (10TH 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

July 2014 (10th leaf)



Horner 4 (left) Pyrodwarf (right)



Horner 4 (10th leaf)

Bartlett Pears, Talmage, Mendocino County

July 2014 (10th leaf)



Pyrodwarf with fruit (10th leaf)

Bartlett Pears, Talmage, Mendocino County

July 2014 (10th leaf)



OHxF 87 (left) Pyrodwarf (right) (10th 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)



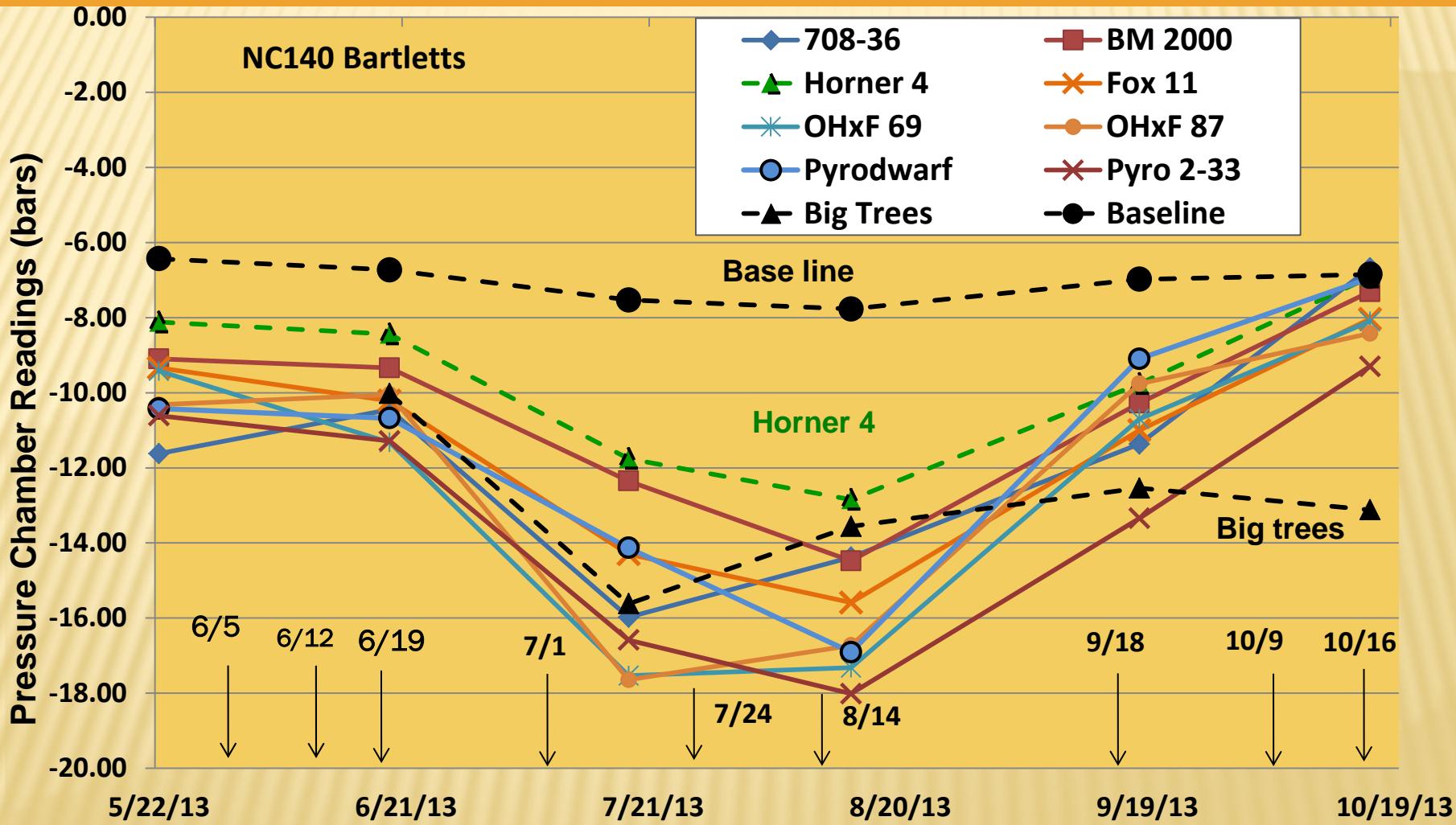
708-36 (9th leaf)

Bartlett Pears, Talmage, Mendocino County

August 2013 (9th leaf)

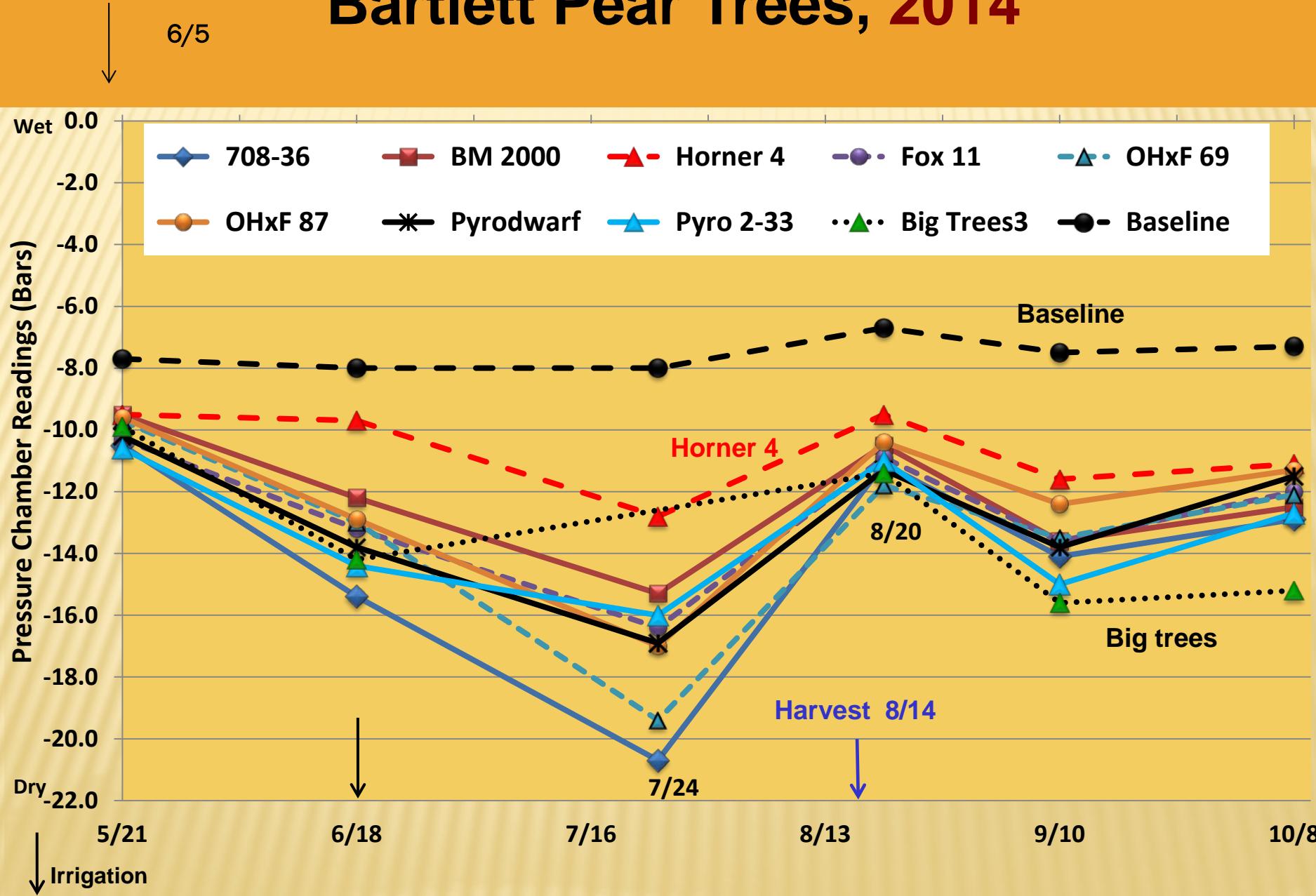


Pressure Bomb Readings Bartlett pear trees, 2013



Mid-day Stem Water Potential Readings

Bartlett Pear Trees, 2014



Golden Russet Bosc, Talmage, Mendocino County, February 2013 (8th leaf)



GOLDEN RUSSET BOSC

Talmage - Cumulative (2005-2014)

	Tree Survival (%)	Root Suckers (Cum. no./tree)
ROOTSTOCK¹		
708-36	80	1.0
BM 2000	60	2.3
Horner 4	100	1.7
Fox 11	60	0.3
OHxF 87	80	0.2
Pyrodwarf	90	0.3
Pyro 2-33	80	0.0
ANOVA²		
Rootstock	NS (0.26)	NS (0.54)
Block	NS (0.30)	NS (0.72)

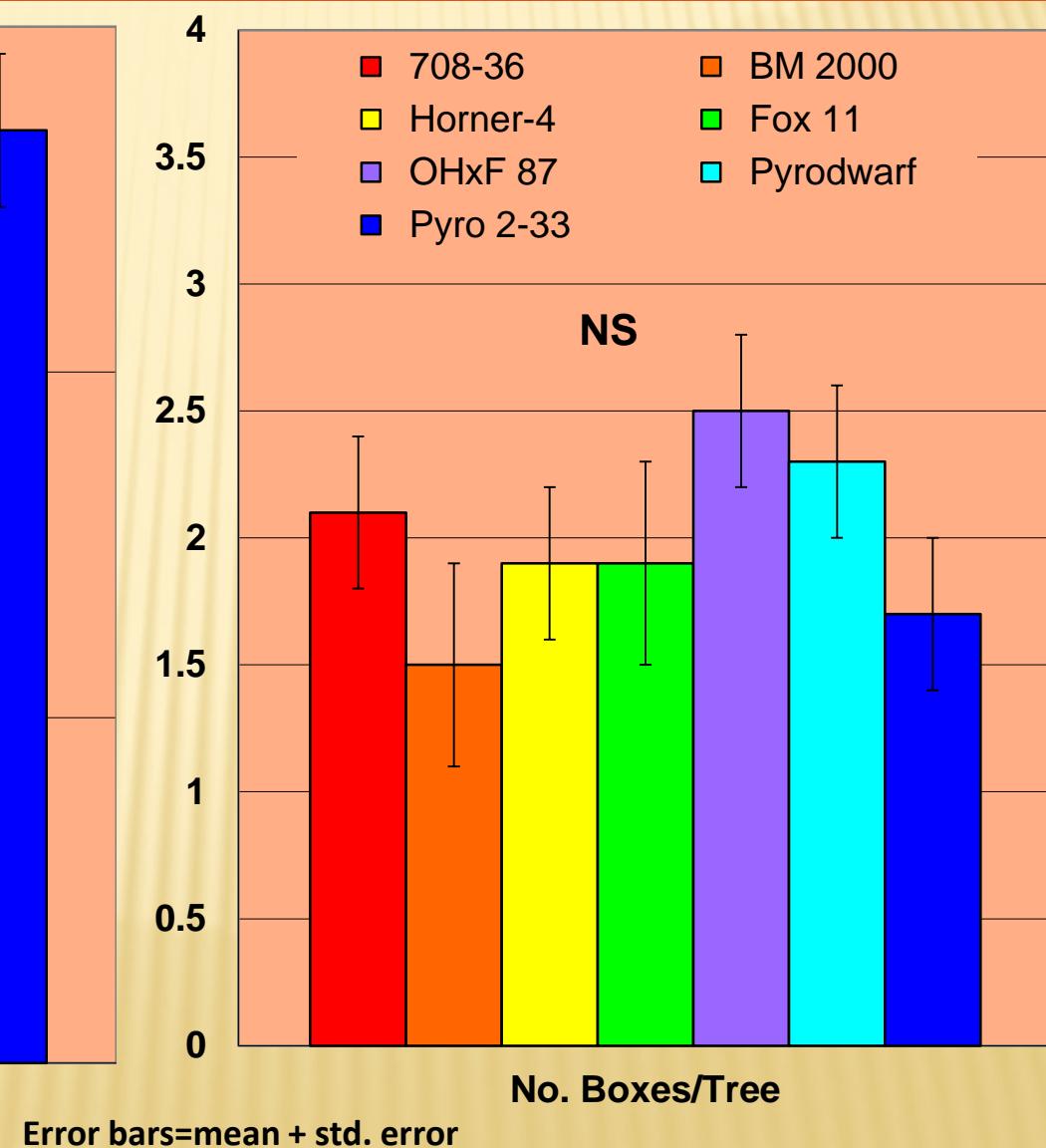
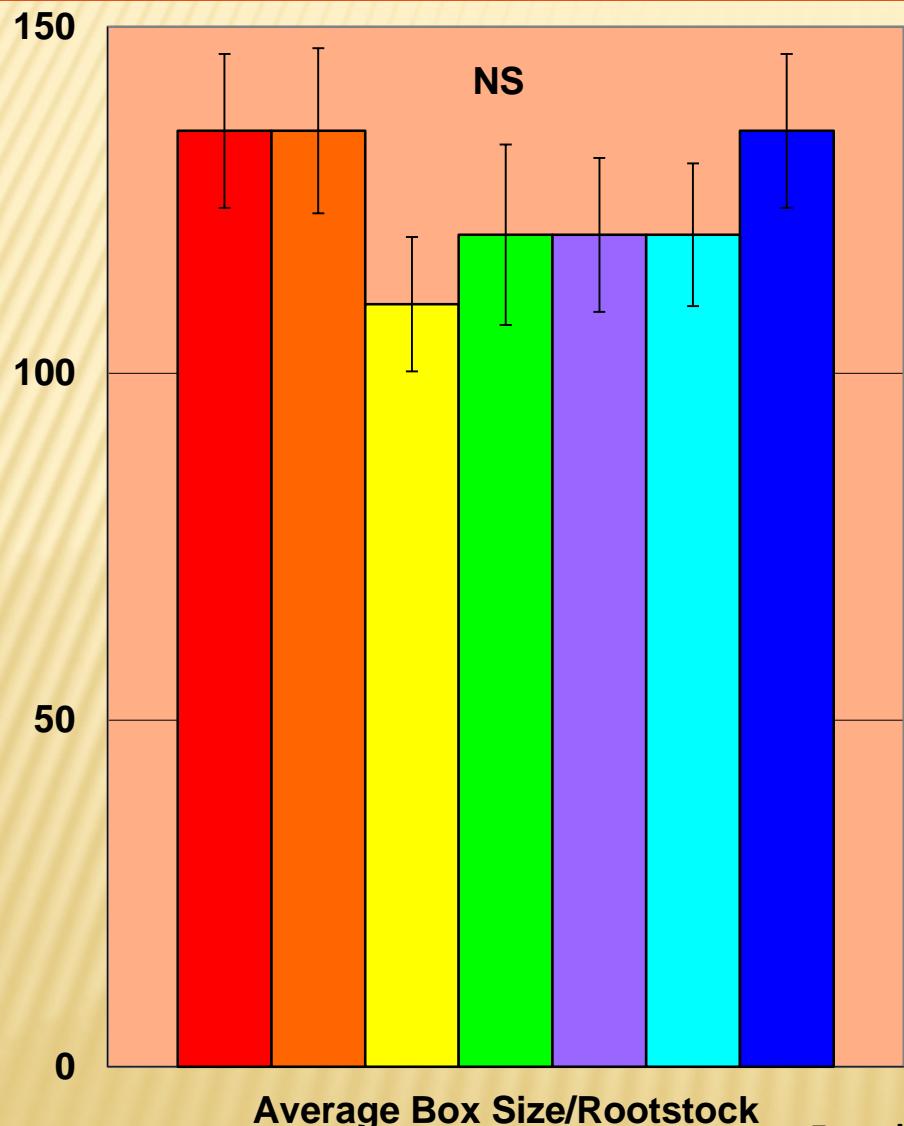
GOLDEN RUSSET BOSC

Talmage - Cumulative (2005-2014)

	Average Fruit Size (g)	Average Cumulative Yield (kg)	2014 TCSA (cm ²)	Average Cumulative Yield Efficiency (kg/cm ²)	Average Box Size (44 lb. box)	Average No. of Boxes (per tree)
ROOTSTOCK						
708-36	147 b	59.8	48.8 b	1.18 ab	150 b	3.0
BM 2000	149 ab	55.4	68.8 ab	0.86 ab	150 ab	2.8
Horner 4	183 a	69.8	96.8 a	0.74 b	110 b	3.5
Fox 11	167 ab	54.4	76.1 ab	0.73 b	120 ab	2.7
OHxF 87	158 ab	73.4	51.9 b	1.35 a	135 ab	3.7
Pyrodwarf	162 ab	72.4	65.4 b	1.12 ab	120 ab	3.7
Pyro 2-33	152 ab	62.9	66.9 b	0.97 ab	135 ab	3.2
ANOVA						
Rootstock	* (0.02)	NS (0.61)	*** (0.001)	*** (0.001)	NS (0.05)	NS (0.61)
Block	* (0.05)	NS (0.37)	* (0.04)	NS (0.53)	NS (0.07)	NS (0.37)



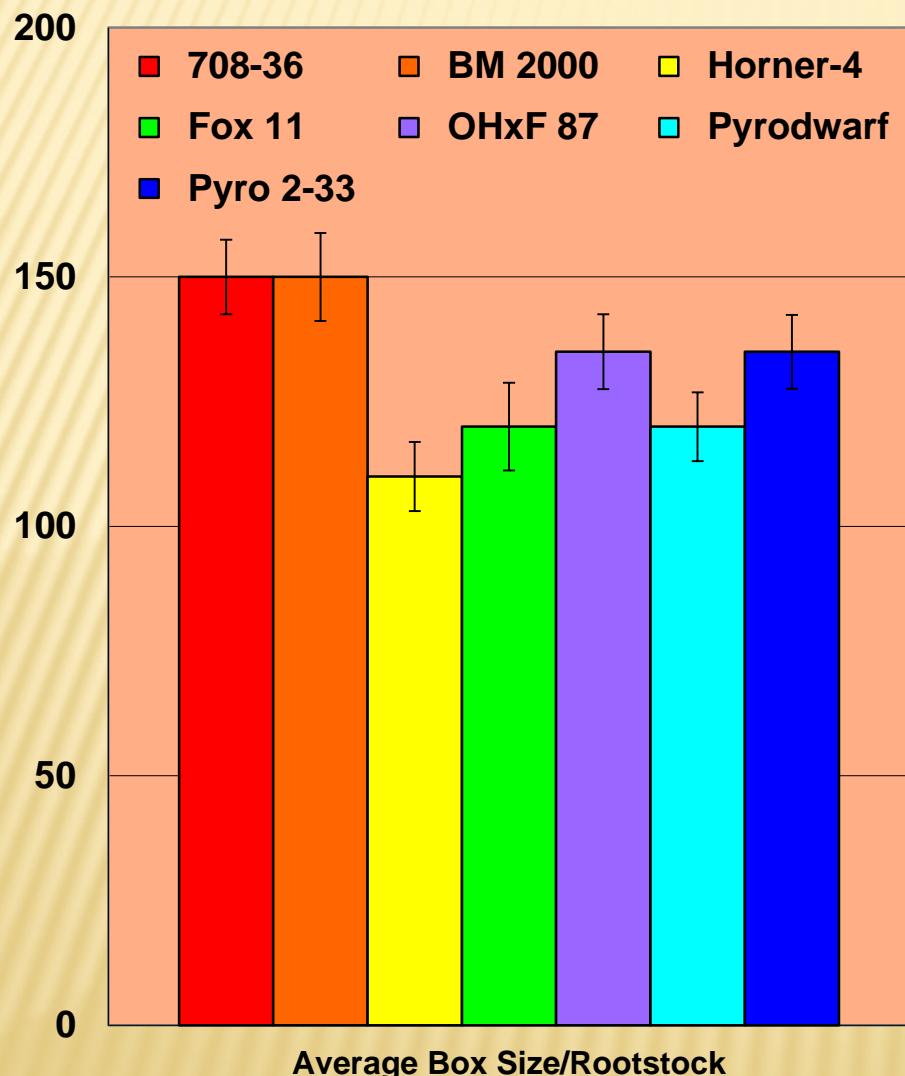
Average Box Sizes and No. of Boxes Per Tree for "Golden Russet" Bosc Pear Yrees Talmage, California 2005-2013



Error bars=mean \pm std. error

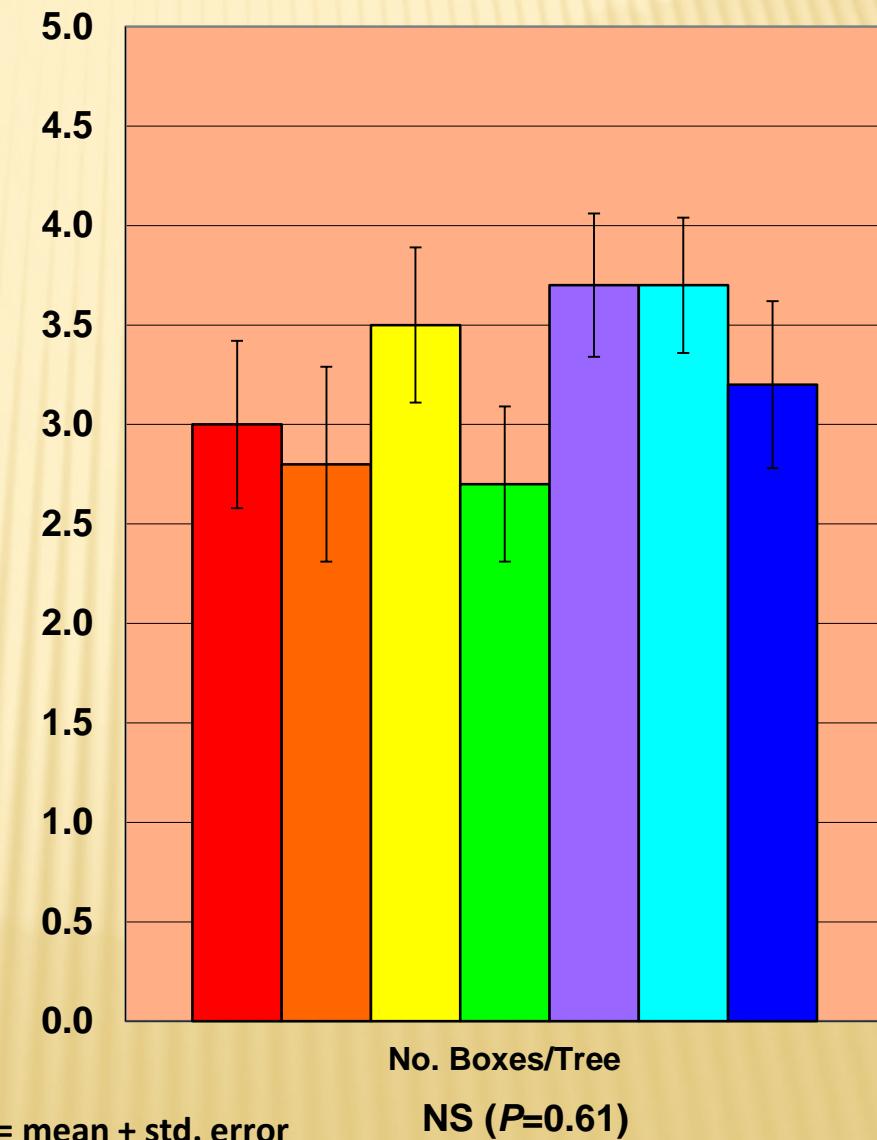


Average Box Sizes and No. of Boxes Per Tree for "Golden Russet" Bosc Pear Trees Talmage, California 2005-2014



* ($P=0.05$)

Error bars = mean \pm std. error



NS ($P=0.61$)

"GOLDEN RUSSET" BOSC - 2014

	Yield 8/29/14 (kg/tree)	TCSA 10/13/14 (cm ²)	Yield Efficiency 10/13/14 (kg/cm ²)	Root Suckers 10/13/14 (no./tree)
ROOTSTOCK¹				
708-36	9.8	48.8 b	0.22 abc	0.3
BM 2000	13.6	68.8 ab	0.21 abc	0.1
Horner-4	13.6	96.8 a	0.14 bc	0.0
Fox 11	9.1	76.1 ab	0.13 c	0.1
OHxF 87	14.0	51.9 b	0.26 a	0.1
Pyrodwarf	15.1	65.4 b	0.24 ab	0.4
Pyro 2-33	15.3	66.9 b	0.23 abc	0.1
ANOVA²				
Rootstock	NS (0.58)	*** (<0.001)	NS (0.09)	NS (0.57)
Block	NS (0.88)	* (0.04)	NS (0.49)	NS (0.63)

"GOLDEN RUSSET" BOSC - 2014

	Tree Survival 8/29/14 (%/10 trees)	No. Fruit 8/29/14 (no./tree)	Fruit Size 8/29/14 (g/fruit)	Average Box Size 8/29/14 (44 lb. box)	Average No. of Boxes 8/29/14 (per tree)
ROOTSTOCK¹					
708-36	80	80	135 ab	135 ab	0.5
BM 2000	60	100	142 ab	120 b	0.6
Horner-4	100	86	167 a	120 b	0.7
Fox 11	60	61	154 ab	135 ab	0.5
OHxF 87	80	116	123 c	135 ab	0.6
Pyrodwarf	90	125	126 b	165 a	0.8
Pyro 2-33	80	115	140 ab	120 ab	0.7
ANOVA²					
Rootstock	NS (0.26)	NS (0.46)	** (0.004)	NS (0.28)	NS (0.77)
Block	NS (0.30)	NS (0.84)	* (0.03)	NS (0.23)	NS (0.80)

"GOLDEN RUSSET" BOSC - 2014

	Firmness 8/29/14 (kg of force)	Soluble Solids 8/29/14 (°Brix)
ROOTSTOCK		
708-36	9.2 ab	15.2 ab
BM 2000	9.3 ab	15.5 a
Horner-4	8.5 ab	13.7 b
Fox 11	6.9 b	13.9 ab
OHxF 87	9.4 a	15.6 a
Pyrodwarf	8.9 ab	14.8 ab
Pyro 2-33	8.6 ab	14.9 ab
ANOVA		
Rootstock	NS (0.10)	** (0.01)
Block	NS (0.60)	** (<0.01)

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)

Bosc Pears, Talmage, Mendocino County

July, 2014 (10th leaf)



Horner 4 fruit (10th leaf)



Horner 4 (left) Pyrodwarf (right)

Bosc Pears, Talmage, Mendocino County

July, 2014 (10th leaf)



OHxF fruit (10th leaf)



OHxF 85 (left), 708-36f (right)

2013 NC-140 PEAR SYSTEMS TRIAL

- March: *Amelanchier* (serviceberry) spp. (A2, A7, A10); plus Quince Eline. Each w/6 cultivars, separate blocks: Bartlett, BPM, Comice, Forelle, Golden Russet Bosc, Super Red (5 single tree reps per block (20 trees))
- May: Bartlett on OHxF 69, 87 and 97. Design: RCB with five replicates (four trees each)
- Both trials: 4' x 20', north to south berms, microsprinklers, trained into “informal” perpendicular “V”
- Survival and growth data to commence winter 2012
- 2013: Systems trial, Hopland: Bartlett, 3 rootstocks, 3 systems, 3 spacings.

2013 NC-140 PEAR SYSTEMS TRIAL



2013 NC-140 PEAR SYSTEMS TRIAL



NC-140 PEAR SYSTEMS TRIAL OBJECTIVES

- Objective 1
- Objective 2
- Objective 3

HOPLAND SYSTEMS TRIAL - 2014

	No. Clusters	No. Fruit ² 5/6 (no./tree)	Fruit Set 8/6 (% fruit/100 clusters)	Cultivar TCSA ³ 10/22 (cm ²)	Rootstock TCSA ⁴ 10/22 (cm ²)	Crop Load ² 10/22 (no./cm ²)	Tree Height 10/21 (cm)	Root Suckers ² 10/6 (no./tree)
TRAINING¹								
2-Leader	3.6 bc	0.6 b	12.0 b	16.6 c	9.6 c	0.04 b	181 b	0.02 ab
Bi-axis	2.8 c	0.3 b	9.1 b	8.2 d	10.6 c	0.04 b	157 c	<0.01 b
Tall Spindle	5.2 ab	1.4 a	22.7 ab	20.3 b	14.1 a	0.08 a	210 a	0.04 a
V-Trellis	6.5 a	1.9 a	29.1 a	23.9 a	12.6 b	0.07 ab	191 b	<0.01 b
SPACING¹								
3 feet	4.9	1.0	18.0	17.4	11.7	0.04	189 a	<0.01
4.5 feet	4.8	1.1	18.8	17.2	11.8	0.07	182 b	0.01
6 feet	3.9	1.1	17.9	17.6	11.6	0.06	184 ab	0.03
ROOTSTOCK¹								
Pyrodwarf 2-33	1.6 c	0.3 b	8.0 b	14.5 b	9.3 b	0.01 c	179 b	0.01 ab
OHxF 69	8.0 a	1.7 a	24.1 a	18.6 a	13.1 a	0.09 a	189 a	0.00 b
OHxF 87	4.1 b	1.2 a	22.5 a	18.6 a	12.7 a	0.06 b	186 ab	0.03 a
ANOVA (P-values)								
Training	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	0.14
Spacing	0.14	0.71	0.62	0.79	0.72	0.19	0.10	0.33
Rootstock	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	0.23
Block	<0.001	<0.001	0.16	<0.001	<0.01	0.16	<0.001	0.20
INTERACTION P-values								
Training x Rootstock	0.001	0.01	0.85	<0.01	0.05	0.54	0.64	0.42

NC-140 PEAR SYSTEMS TRIAL: NORTH VS. SOUTH LATERAL GROWTH IN BI-AXIS AND 2-LEADER TREES - 2014

	New Spurs			New Feathers		
	North	South	P-value*	North	South	P-value*
TRAINING						
Bi-axis (n=112)	0.57	0.46	0.27	0.74	0.68	0.57
2-leader (n=135)	1.16	0.97	0.27	0.71	0.44	0.03
SPACING						
3 feet (n=83)	1.06	0.89	0.47	0.76	0.63	0.42
4.5 feet (n=81)	0.80	0.65	0.29	0.64	0.49	0.29
6 feet (n=83)	0.81	0.67	0.40	0.77	0.53	0.12
ROOTSTOCK						
Pyrodwarf 2-33 (n=85)	0.59	0.32	0.03	0.42	0.41	0.88
OHxF 69 (n=80)	0.94	0.86	0.84	1.00	0.69	0.09
OHxF 87 (n=82)	1.16	1.06	0.54	0.77	0.56	0.15

*Means by T-test, $P \leq 0.05$

NC-140 PEAR SYSTEMS TRIAL: CULTIVAR SELECTIONS - 2014

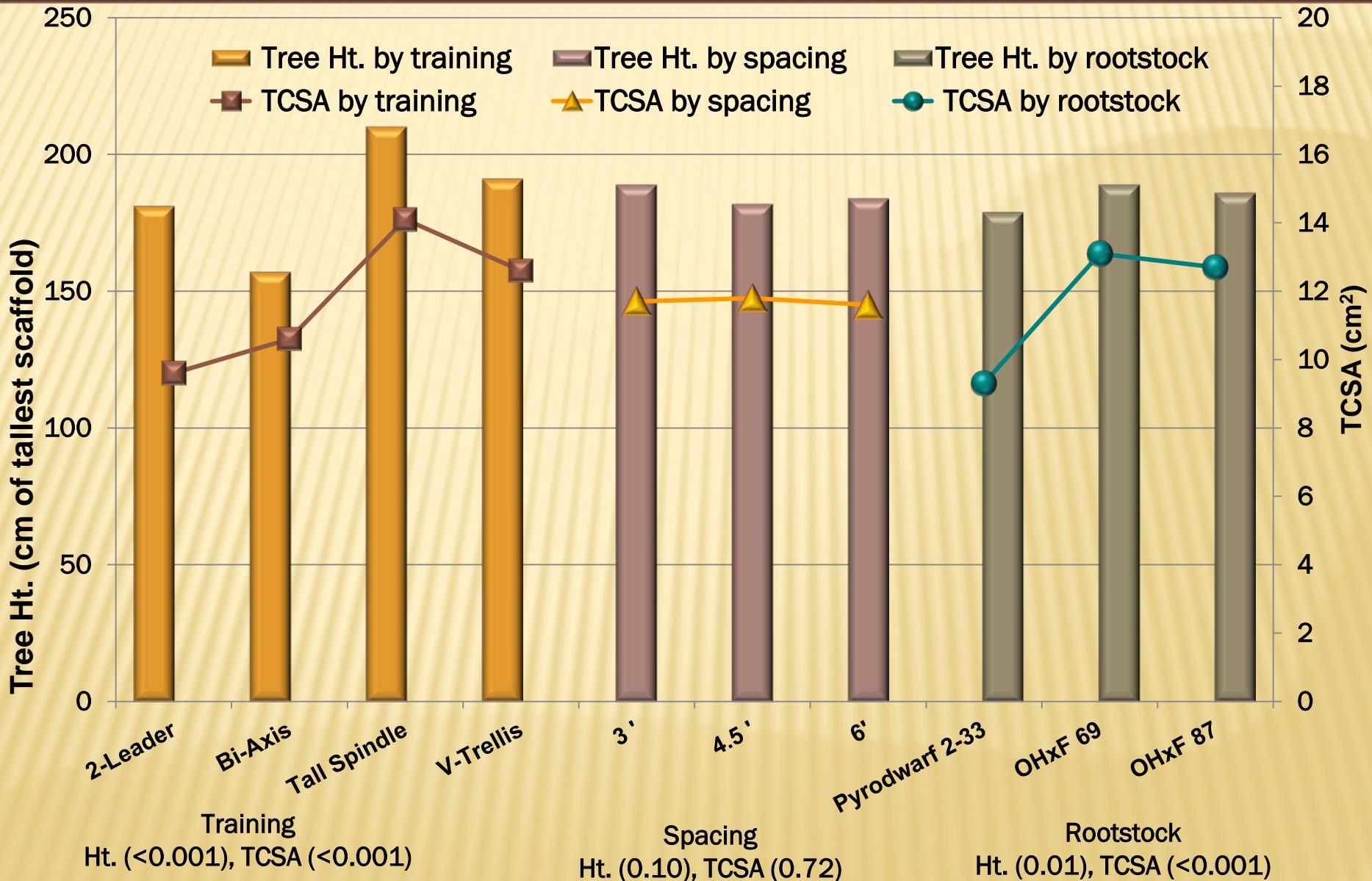
CULTIVAR SELECTIONS	No. of Spurs (per tree)		No. of Feathers (per tree)		Total Clusters (per tree)	No. Fruit (6/12 & 8/6)	Fruit Size (g) (6/12 & 8/6)	Tree Ht. (cm) (10/21)	Cultivar TCSA (cm ²) (10/22)
	New	Old	New	Old					
		(3/11)		(3/11)	(5/6)				
US 69426-038	1.7	0.0	2.3	4.0	0.0	0.0 b	0.0 b	136 ab	5.0 ab
US 84907-069	1.5	0.0	2.7	3.3	0.0	0.0 b	0.0 b	124 b	2.9 b
US 84907-078	1.7	0.0	1.7	4.0	0.0	0.0 b	0.0 b	144 ab	4.8 ab
US 84907-166	1.3	0.0	1.0	3.7	3.3	4.3 a	30.5 a	171 a	4.6 ab
Bartlett	1.1	0.0	1.0	3.3	0.0	0.0 b	0.0 b	153 ab	6.2 a
ANOVA² (P-value)									
Cultivar Selections	NS (0.33)	~	NS (0.39)	NS (0.83)	NS (0.46)	* (0.05)	NS (0.08)	NS (0.23)	NS (0.13)
Block	NS (0.19)	~	NS (0.12)	NS (0.31)	NS (0.41)	NS (0.41)	NS (0.41)	* (0.05)	** (0.01)

NC-140 PEAR SYSTEMS TRIAL: NORTH VS. SOUTH SPREADING TRIAL - 2014

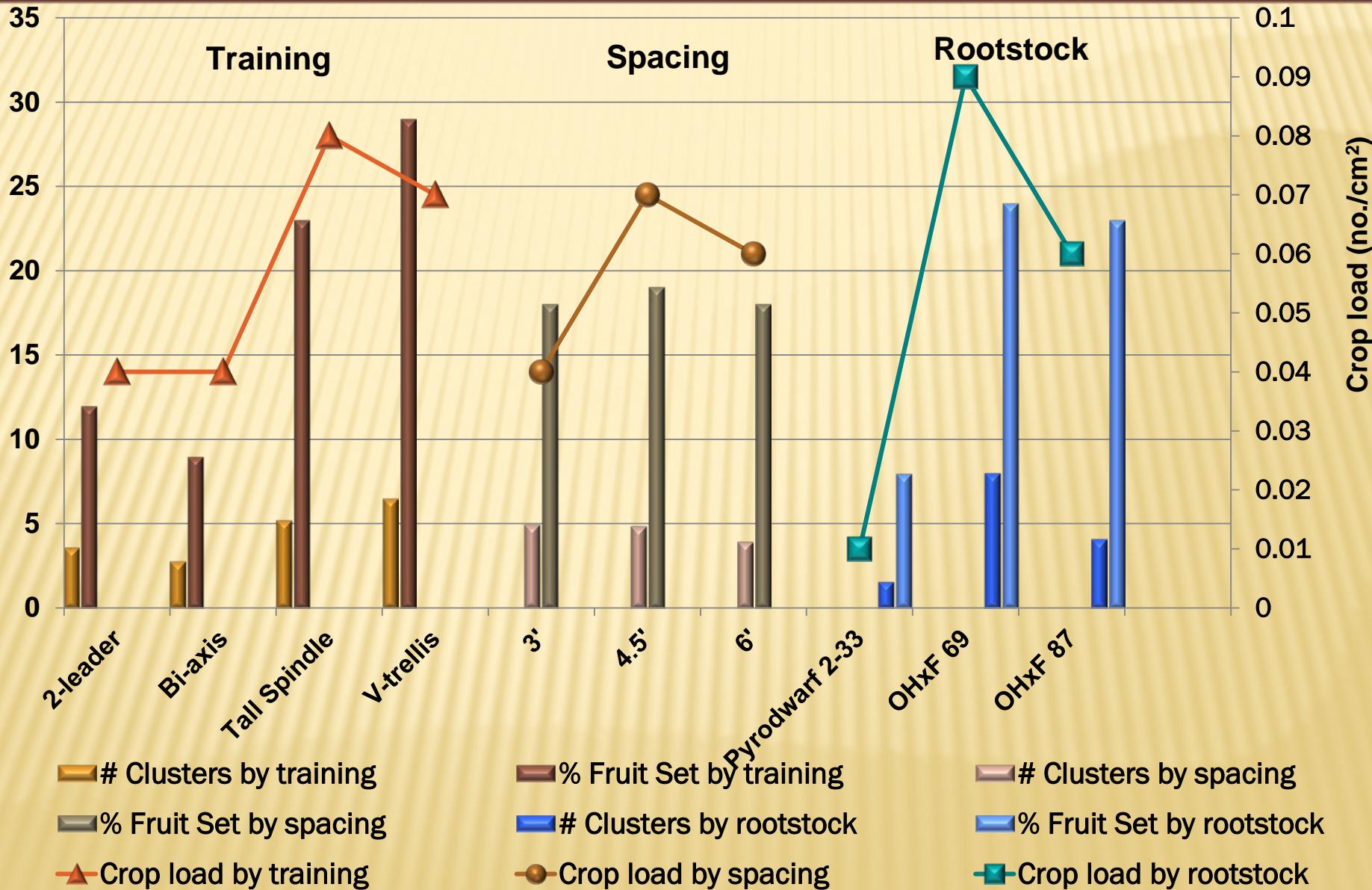
	No. Clusters			No. Fruit (per scaffold)			Fruit Set (%fruit/100 clusters)		
	North	South	Total	North	South	Total	North	South	Total
Spreading	4.4	2.6	7.0	6.0	2.0	8.0	45.3	20.3	34.3
No Spreading	2.6	4.2	6.8	2.0	2.4	4.4	22.0	15.1	19.0
P-value	0.13	0.32	0.92	0.12	0.84	0.35	0.23	0.66	0.21

	Yield (kg/scaffold)			Fruit Size (g)		
	North	South	Total	North	South	Average
Spreading	0.86	0.32	1.07	121	172	146
No Spreading	0.32	0.33	0.65	133	125	129
P-value	0.14	0.95	0.32	0.81	0.2	0.5

NC-140 PEAR SYSTEMS TRIAL: TREE SIZE - 2014



NC-140 PEAR SYSTEMS TRIAL: NO. CLUSTERS, FRUIT SET, AND CROP LOAD - 2014



Training January 2014 (1st leaf)

Hopland, Mendocino County



Bi-axis 'knip'(1st leaf)



2-leader (1st leaf)

Training January 2014 (1st leaf)

Hopland, Mendocino County



01/24/2014 11:30

Bi-axis 'knip' unspread and spread (1st leaf)

Training January 2014 (1st leaf)

Hopland, Mendocino County

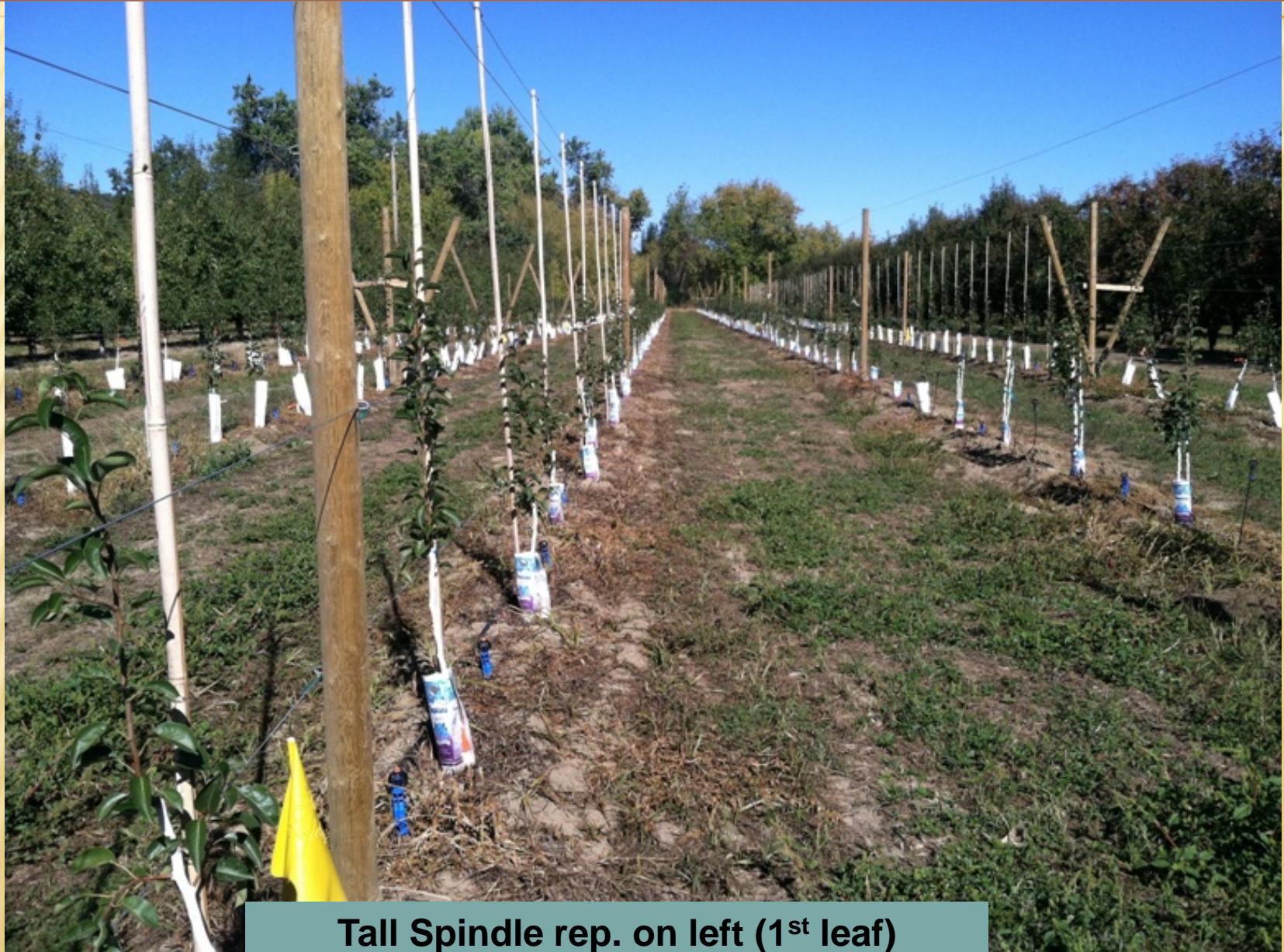


01/24/2014 11:31

Bi-axis spread and unspread (1st leaf); "V" in back

Taining, May 2013 (1st leaf)

Hopland, Mendocino County



Tall Spindle rep. on left (1st leaf)

Training, February, 2014 (2nd leaf)

Hopland, Mendocino County



Training, February, 2014 (2nd leaf)

Hopland, Mendocino County



Data Collection, May, 2014 (2nd leaf)

Hopland, Mendocino County



**June, 2014 (2nd leaf)
Hopland, Mendocino County**



**June, 2014 (2nd leaf)
Hopland, Mendocino County**



**June, 2014 (2nd leaf)
Hopland, Mendocino County**



**June, 2014 (2nd leaf)
Hopland, Mendocino County**



**June, 2014 (2nd leaf)
Hopland, Mendocino County**



**June, 2014 (2nd leaf)
Hopland, Mendocino County**



Field Tour - October, 2014 (2nd leaf)

Hopland, Mendocino County



Field Tour, October, 2014 (2nd leaf)

Hopland, Mendocino County



Field Tour - October, 2014 (2nd leaf)

Hopland, Mendocino County



Field Tour - October, 2014 (2nd leaf)

Hopland, Mendocino County



Field Tour - October, 2014 (2nd leaf)

Hopland, Mendocino County



Field Tour - October, 2014 (2nd leaf)

Hopland, Mendocino County



Field Tour - October, 2014 (2nd leaf)

Hopland, Mendocino County



Field Tour - October, 2014 (2nd leaf)

Hopland, Mendocino County



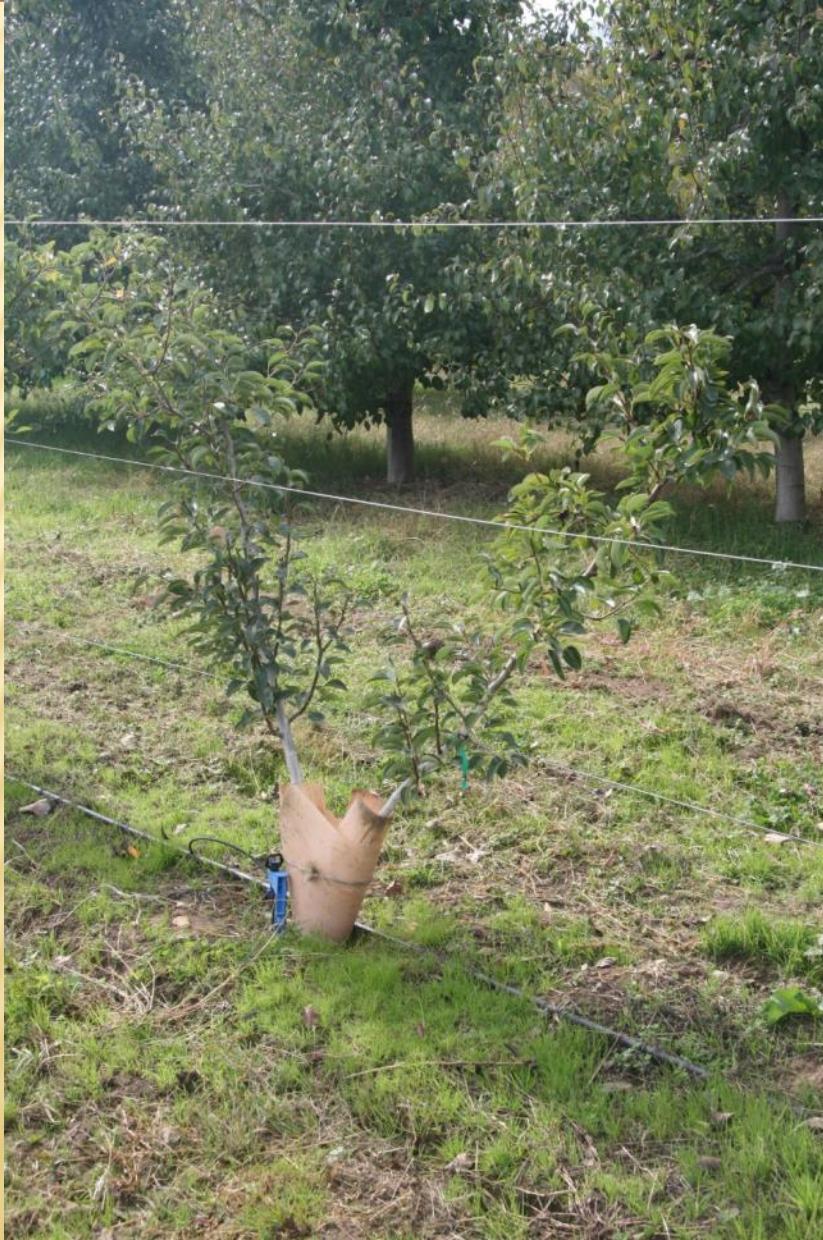
Field Tour - October, 2014 (2nd leaf)

Hopland, Mendocino County



Field Tour - October, 2014 (2nd leaf)

Hopland, Mendocino County



Field Tour - October, 2014 (2nd leaf)

Hopland, Mendocino County



ACKNOWLEDGEMENTS

- 🍐 **Kurt Ashurst and crew,**
- 🍐 **Todd Einhorn, Oregon State University, Hood River; Terence Robinson, Cornell University; Stefano Musacchi, Washington State University TFREC, Wenatchee**
- 🍐 **Bruce Lampinen, Sam Metcalf and Ted DeJong, UC Davis**
- 🍐 **Willow Drive Nursery, Ephrata, WA**
- 🍐 **A&P Ag Systems, Visalia; Mendocino Farm Supply**
- 🍐 **Gustavo Barajas, Lynn Eutenier, Joe Evans, Ryan Keiffer, Alberto Luz, Makaila Rodrigues and Carolyn Shaffer**
- 🍐 **California Pear Advisory Board**

ACKNOWLEDGEMENTS

- 🍐 **Chris and Matt Ruddick, Talmage, Mendocino County**
- 🍐 **John Callis and Balthazar Teyes (Naumes), Marysville**
- 🍐 **Chuck Fleck and John Ireland of Fowler Nurseries, Inc., Newcastle**
- 🍐 **Dave Weil, Tree Connection/Varieties International, Dundee, OR**
- 🍐 **Steve Castagnoli, Todd Einhorn and Gene Mielke, Oregon State University**
- 🍐 **Gustavo Barajas, Lynne Eutenier, Joe Evans, Ryan Keiffer, Alberto Luz, Makaila Rodrigues, Alberto Luz, and Carolyn Shaffer**
- 🍐 **California Pear Advisory Board**
- 🍐 **Travel expenses to the NC140 meetings are partially funded by Agricultural Experiment Station (Hatch Act) Regional Research funds through the UC Davis Department of Plant Sciences**

THANK YOU!!

 University of California
Agriculture and Natural Resources