



New Fire Blight Resistant Pear Cultivars

Mid-Atlantic Fruit and Vegetable Convention
January 2013

Fire Blight



- Caused by the bacterium *Erwinia amylovora*
- Endemic to North America – an annual threat in the Midwest and Eastern US
- First plant disease shown to be caused by a bacterium (1884).
- Infects blossoms, young leaves and shoots, fruit, and wounded limbs and trunks
- Serious loss of fruit, bearing wood, or whole trees
- Cannot be easily eradicated

Resistance of European Pears

Most

Moderate

Least

Alexander Lucas
Blake's Pride*
Harrow Delight*
Harrow Sweet*
Honeysweet*
Magness*
Moonglow*
Potomac*
Tyson
Warren!

Bonne Louise d'Avr.
Conference*
Dawn*
Duchesse d'Angouleme
Harvest Queen*
Luscious*
Seckel
Shenandoah*
Starking Delicious
(syn. Maxine)
Sunrise*
US71655-014*

Abate Fetel
Aurora*
Bartlett
Beurre Bosc
Beurre d'Anjou
Blanquilla
Starkrimson
Coscia
Doyenné du Comice
Flemish Beauty
Forelle
Gorham*
Jules Guyot
Packham's Triumph
Passe Crassane
Winter Nelis

* Breeding Program Releases

! Possible sister seedling of Magness

Fire Blight Resistance

- Sources of resistance:

Pyrus communis: 'Seckel', 'Old Home',
'Maxine', Farmingdale

Pyrus ussuriensis: Illinois 76, Illinois 65,
Summercrisp, David

Pyrus pyrifolia: 'Kieffer', NJ 1

Pyrus ×bretschneideri: 'Pai Li' and others

‘Potomac’ Pear



- **Highly resistant to fire blight**
- **Glossy, light green skin; calyx end russet**
- **Aromatic, sub-acid flavor**
- **Harvest 2 weeks after ‘Bartlett’**
- **Storage life: 2-3 months**

'Blake's Pride' Pear



- Flavor and aroma similar to 'Comice'
- Fruit size equal to 'Bartlett'
- Fire blight resistant
- Harvest date: 2 weeks after 'Bartlett'
- Storage Life: 3-4 months
- Moderate vigor; upright-spreading tree habit

FIRE BLIGHT RESPONSE OF 'BLAKE'S PRIDE ' AND 'BARTLETT'

Infection type	Cultivar			
	n	Blake's Pride	n	Bartlett
Natural	4	8.0 a	6	2.3 b
Shoot inoculation				
Frequency (%)	90	68 b	87	99 a
% Lesion length	90	14 b	87	114 a
Age of infected	90	.01 b	87	1.3 a
Blossom severity	40	2.9 b	40	5.5 a

Blossom infection severity scale based on tissue infected: 0 = no infection; 1 = receptacle; 2 = pedicle; 3 = basal tissue of cluster; 4 = spur of 1-year old wood; 5 = spur-bearing or 2-year old wood; 6 = wood 3-year old or older.

'Shenandoah' Pear



- **Aromatic, sub-acid to acidic flavor which mellows in storage.**
- **Large fruit**
- **Fire blight resistance equal to 'Seckel'**
- **Harvest 4 to 5 weeks after 'Bartlett'**
- **Storage life: 5 months**

MEAN YEARLY AND CUMULATIVE YIELD OF 'SHENANDOAH' AND BARTLETT'

Cultivar	n	Mean yield per tree (kg)							Cumulative Yield (kg)	Fruit Weight (g)
		2000	2001	2002	2004	2005	2006	2007		
Shenandoah	9	7.1a	3.8a	2.8a	28.3a	17.1a	63.8a	13.8a	136.7 a	231.4 a
Bartlett	7	0.3a	1.9a	2.6a	17.2a	13.0a	19.4b	7.5a	59.8 b	186.6 b

Trees were propagated on 'Bartlett' seedling rootstock. Randomized block design planted in 1977. Fire blight reduced the number of 'Bartlett' trees to three in 2007. No yield in 2003 due to frost. Severe pruning in winter of 2006/2007 reduced yield in 2007.

RESPONSE OF 'SHENANDOAH' AND 'BARTLETT' TO FIRE BLIGHT

<u>Cultivar</u>	<u>Natural Infection</u>		<u>Artificial Shoot Inoculation</u>			
	<u>No. trees</u>	<u>Mean score</u>	<u>Mean no. shoots</u>	<u>Percent Infection</u>	<u>% Lesion length</u>	<u>% Old wood</u>
Bartlett	15	2.3 a	17.50	89 a	107 a	67 a
Shenandoah	15	7.3 b	16.25	67 a	47 b	15 b

Natural infection scale: 1 = dead tree; 7 = some infection in 2-year old wood; 10 = no infection.

FREQUENCY AND SEVERITY OF ARTICIAL BLOSSOM INFECTION OF 'SHENANDOAH' AND 'BARTLETT'

<u>Year</u>	<u>Cultivar</u>	<u>% Infected blossoms</u>	<u>% Infected spurs/wood</u>	<u>Lesion length (mm)</u>
1998	Bartlett	92 a	64 a	230 a
	Shenandoah	84 a	13 b	160 a
2004	Bartlett	95 a	98 a	664 a
	Shenandoah	98 a	85 b	238 b

'Sunrise'



- **Aromatic, sweet flavor; 14-16% SS; high consumer sensory ratings**
- **Attractive; frequent blush**
- **Productive; 2-3 fruit/spur**
- **Moderately resistant to fire blight**
- **Matures 2 weeks before 'Bartlett' (Clapp's season)**
- **Stores for 2-3 months without core breakdown**
- **Named and released in 2006 by USDA-ARS and The Ohio State University, OARDC**
- **Certified budwood source: NRSP-5**

FRUIT DESCRIPTIVE AND SENSORY TRAITS OF 'SUNRISE' AND 'BARTLETT'.

Trait	Cultivar	
	Sunrise	Bartlett
Harvest (days +/- Bartlett)	-14	0
Fruit size		
Diameter	2 1/2"	2 1/2"
Length	3 3/8"	3 1/8"
Weight (g)	205	187
Core diameter	2/3"	7/8"
Flavor (1-9)	7.0	6.4
Aroma (1-3)	1.6	1.8
Texture (1-9)	6.9	6.2
Grit (1-9)	7.0	6.4
Juiciness (1-9)	6.1	6.1
Russet (1-9)	7.3	6.5
Appearance (1-9)	7.8	6.5
Storage life (days)	84	92

FIRE BLIGHT INFECTION IN 'SUNRISE' AND 'BARTLETT'

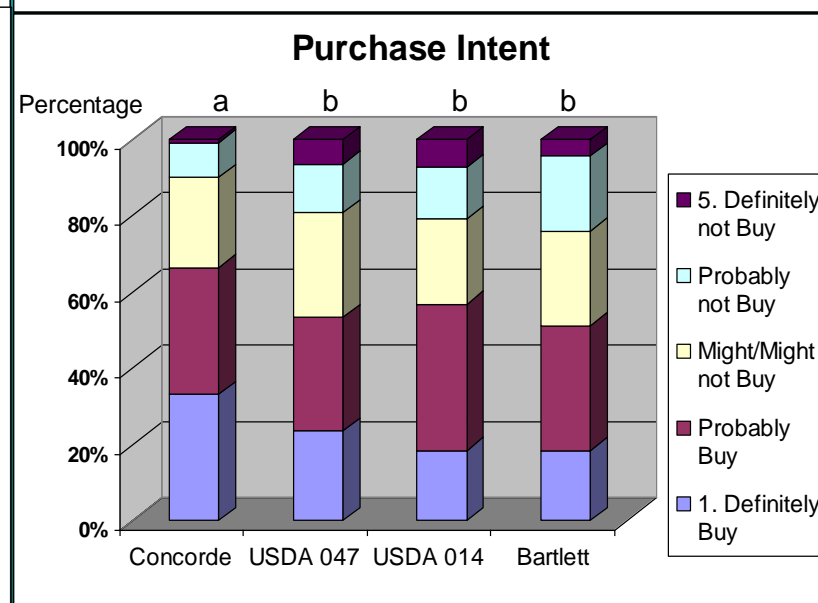
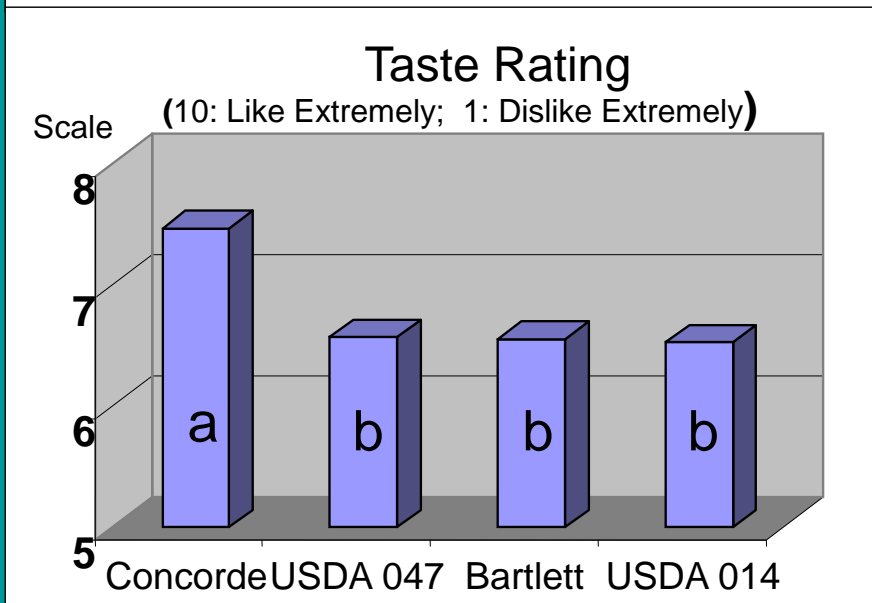
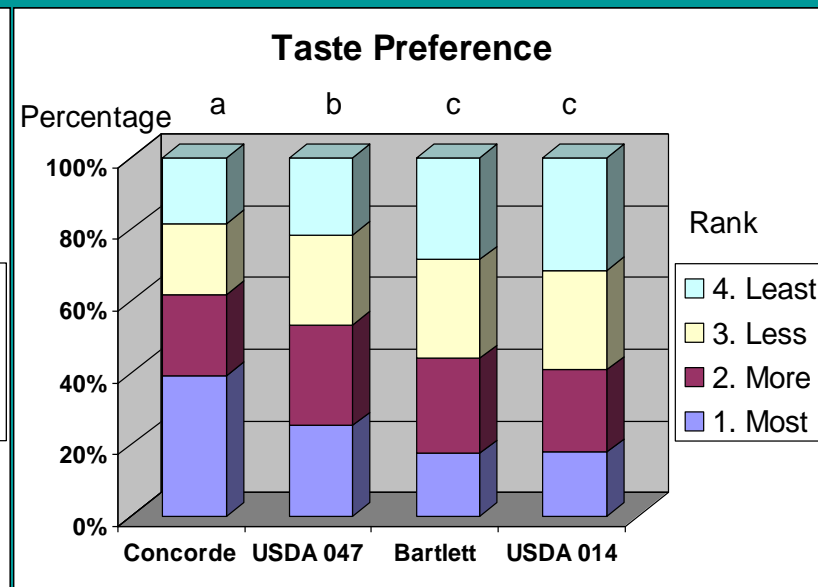
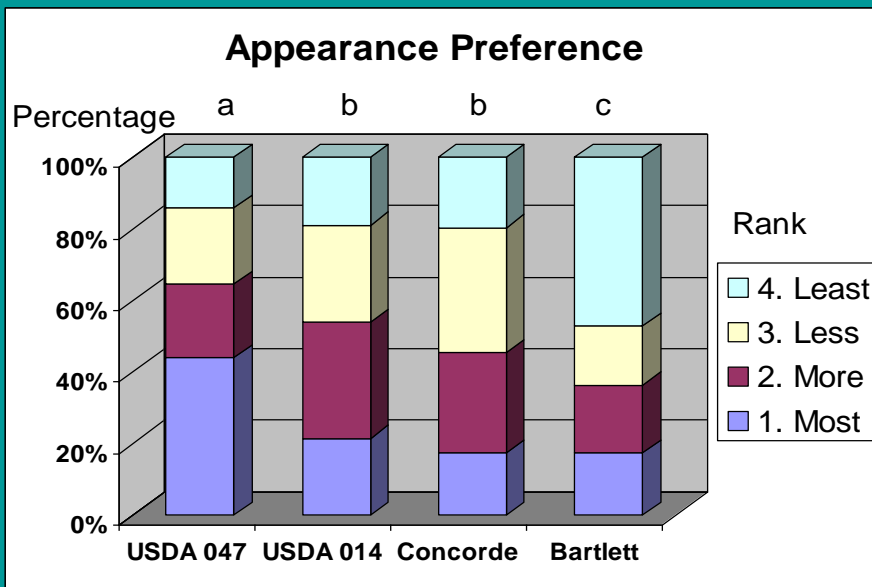
<u>Infection type</u>	<u>No. years</u>	<u>'Sunrise'</u>	<u>'Bartlett'</u>
Natural (USDA score)	10	7.7 a	3.4 b
Artificial	3		
Lesion length (mm)		66 a	311 b
% Lesion length		9 a	81 b



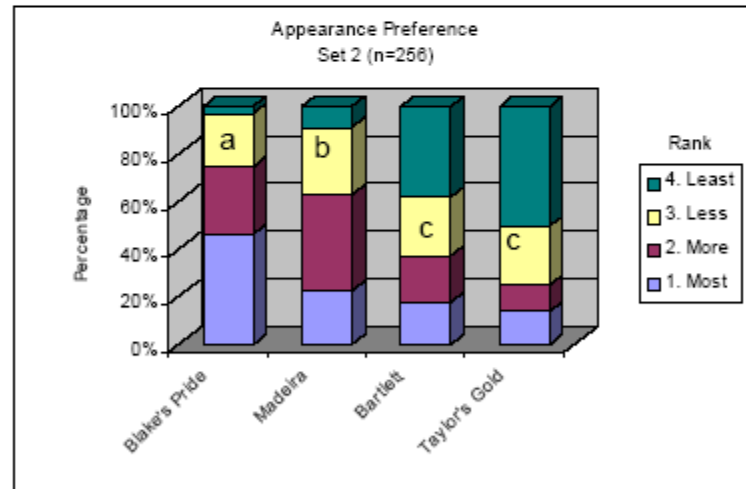
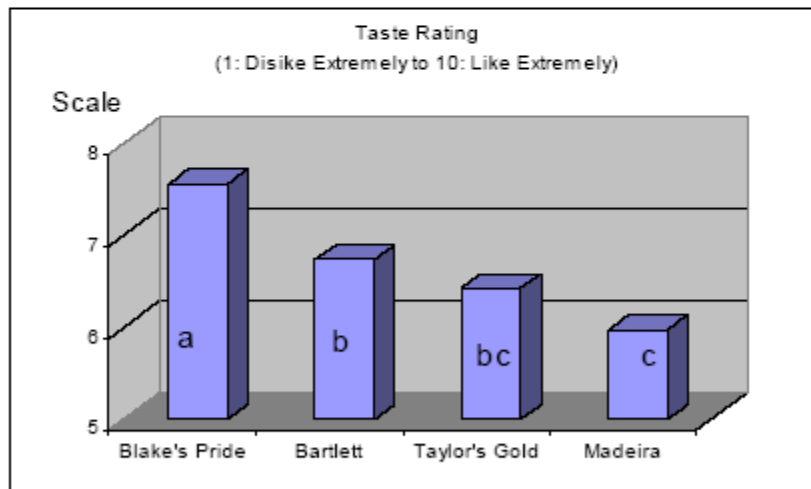
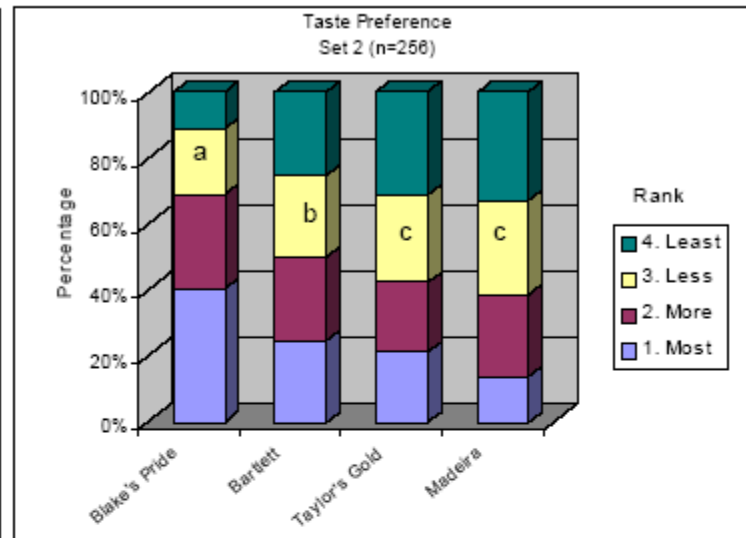
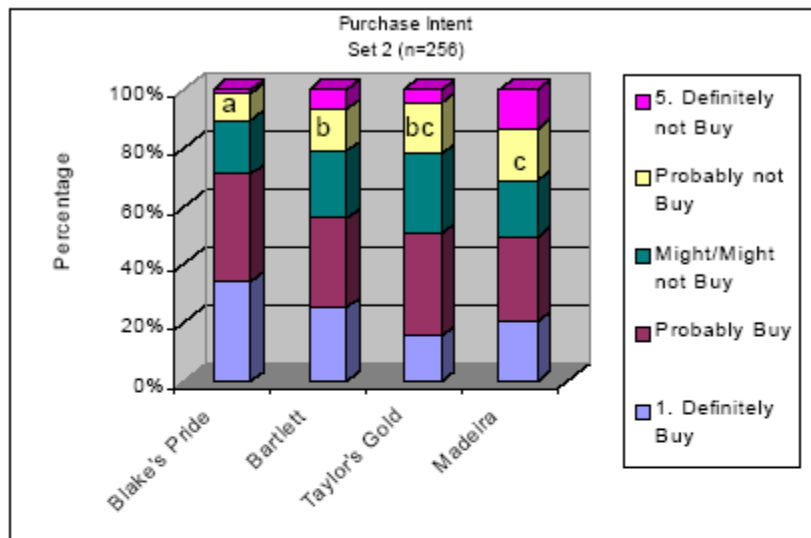
US 71665-014

good sensory scores, long storing, productive
very little superficial scald, no russet

SET 1 Results

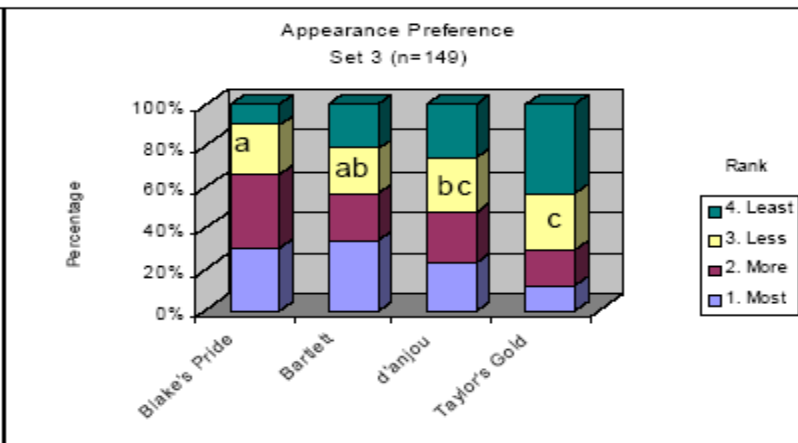
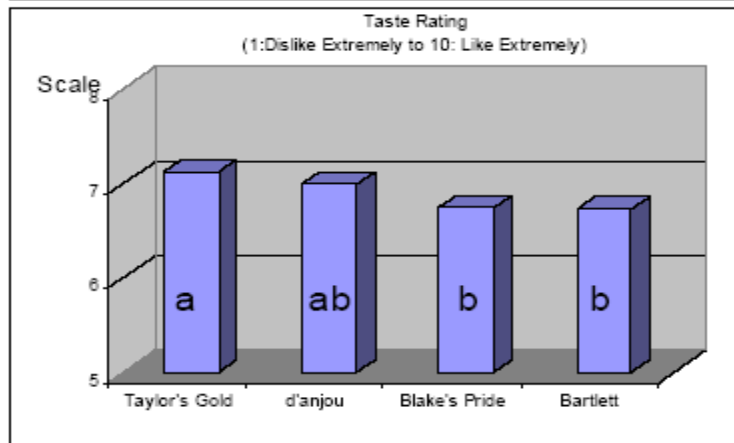
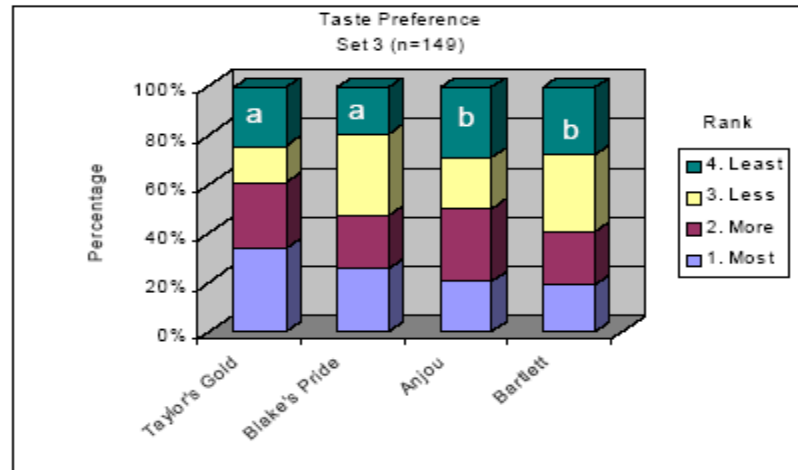
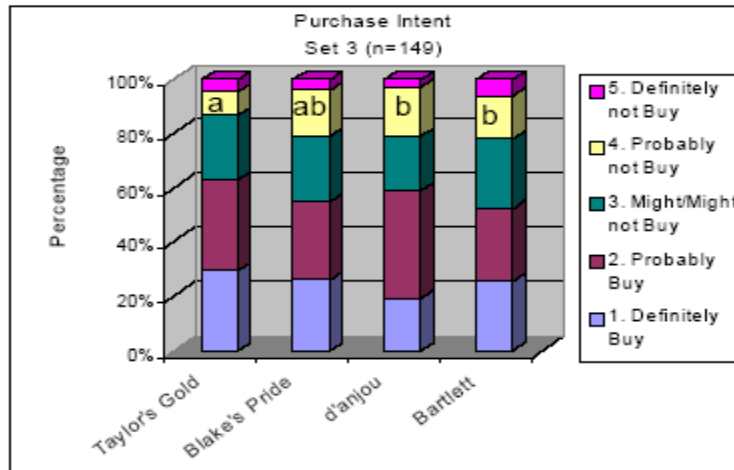


Survey Result 2003 – Set 2

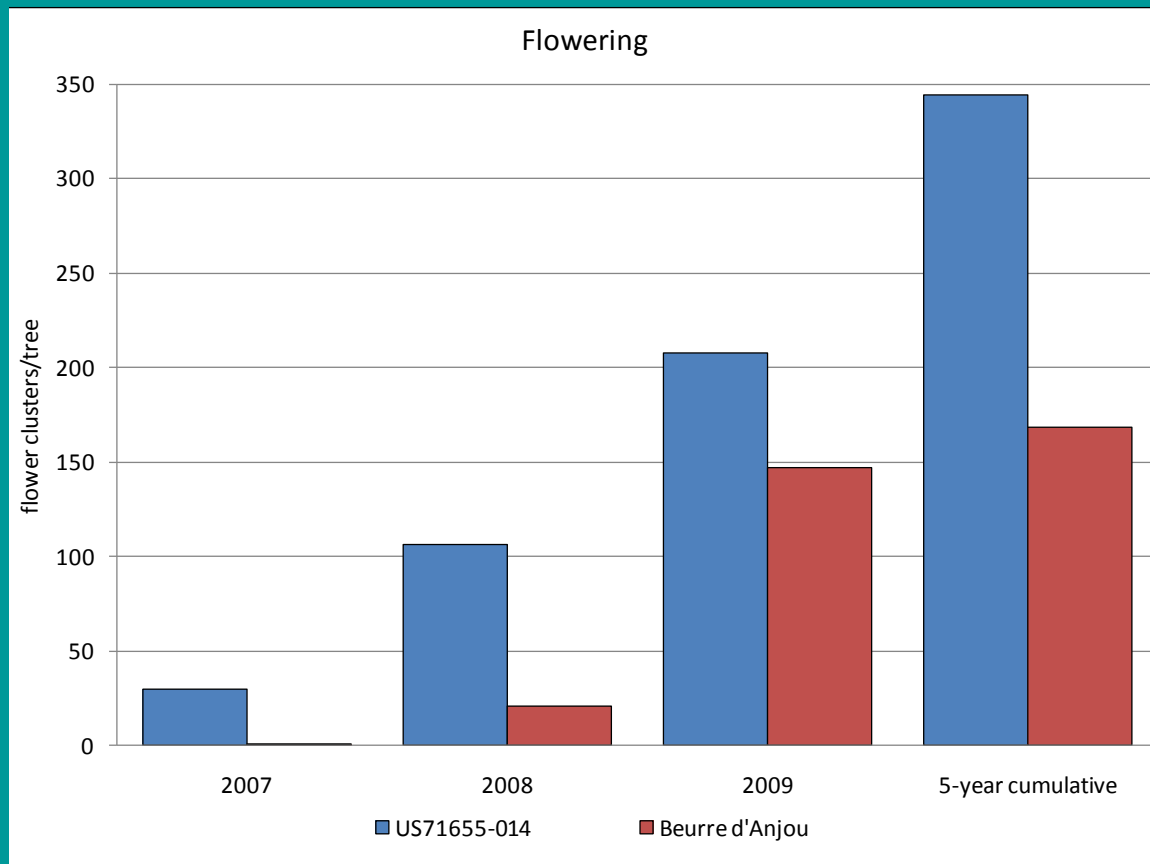


Set 2. Results for sample set 2 (N=256). 'Blake's Pride' rated highest for all four categories of appearance, taste, taste preference, and purchase intent. When ripened, 'Blake's Pride' has a golden ground color underneath a fine, overall russet. 'Madeira' rated lowest in all the categories.

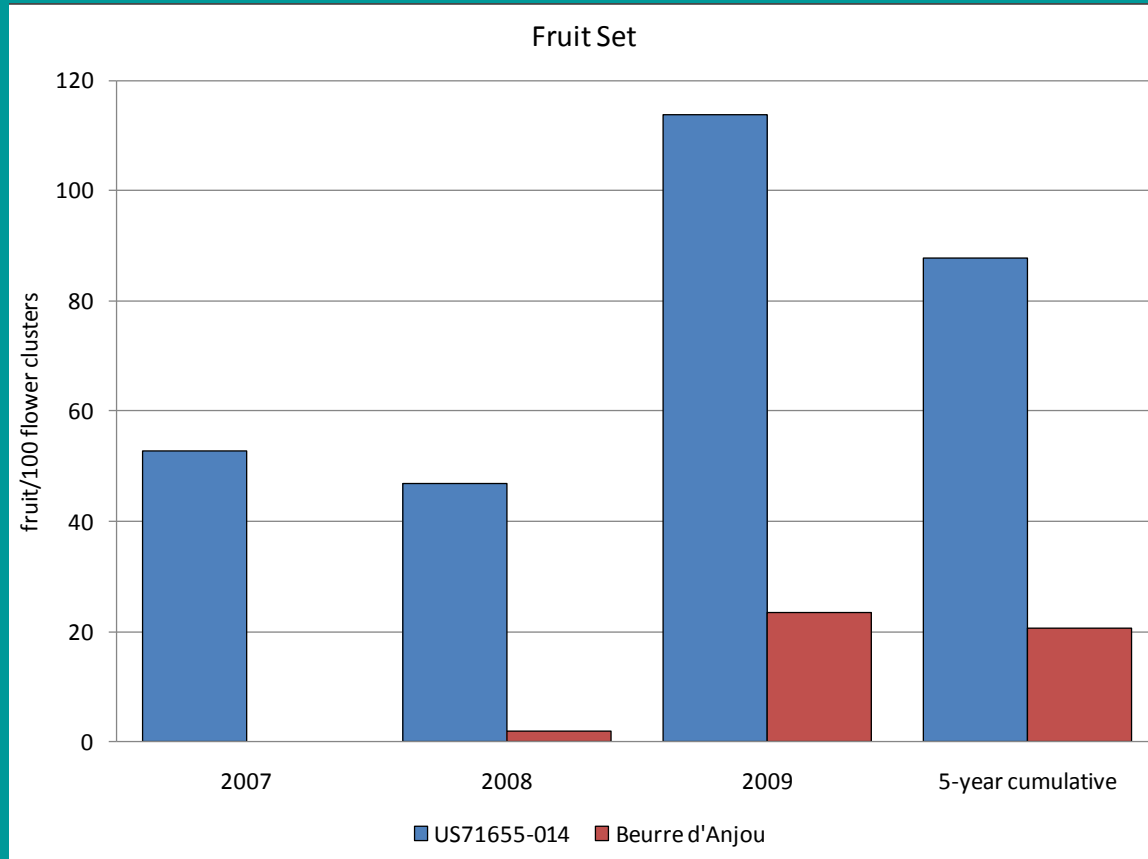
Survey Results 2003 – Set 3



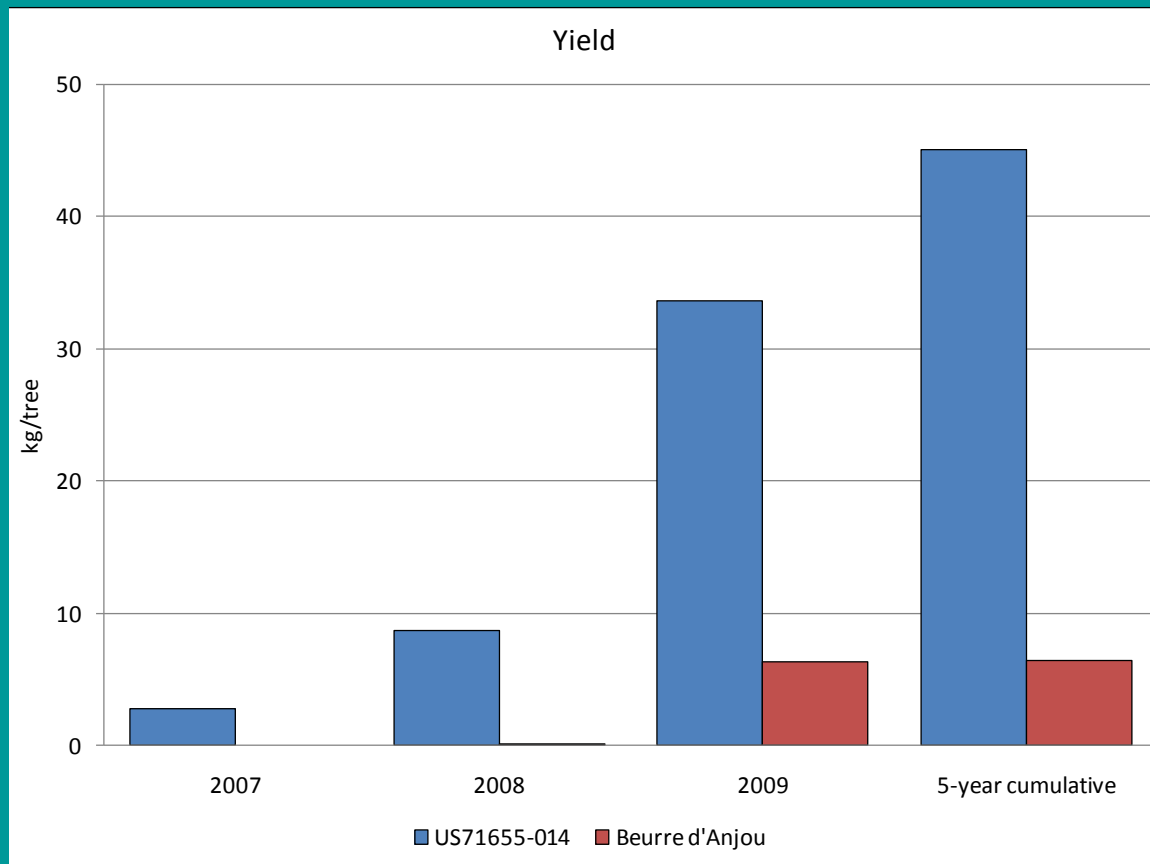
Set 3. Results for sample set 3 (N=149). 'Taylor's Gold' rated highest in taste preference but the lowest in appearance. 'Blake's Pride' ranked high in appearance, taste preference, and purchase intent. 'Bartlett' and 'd'anjou' rated only slightly lower in taste preference than the other two samples.



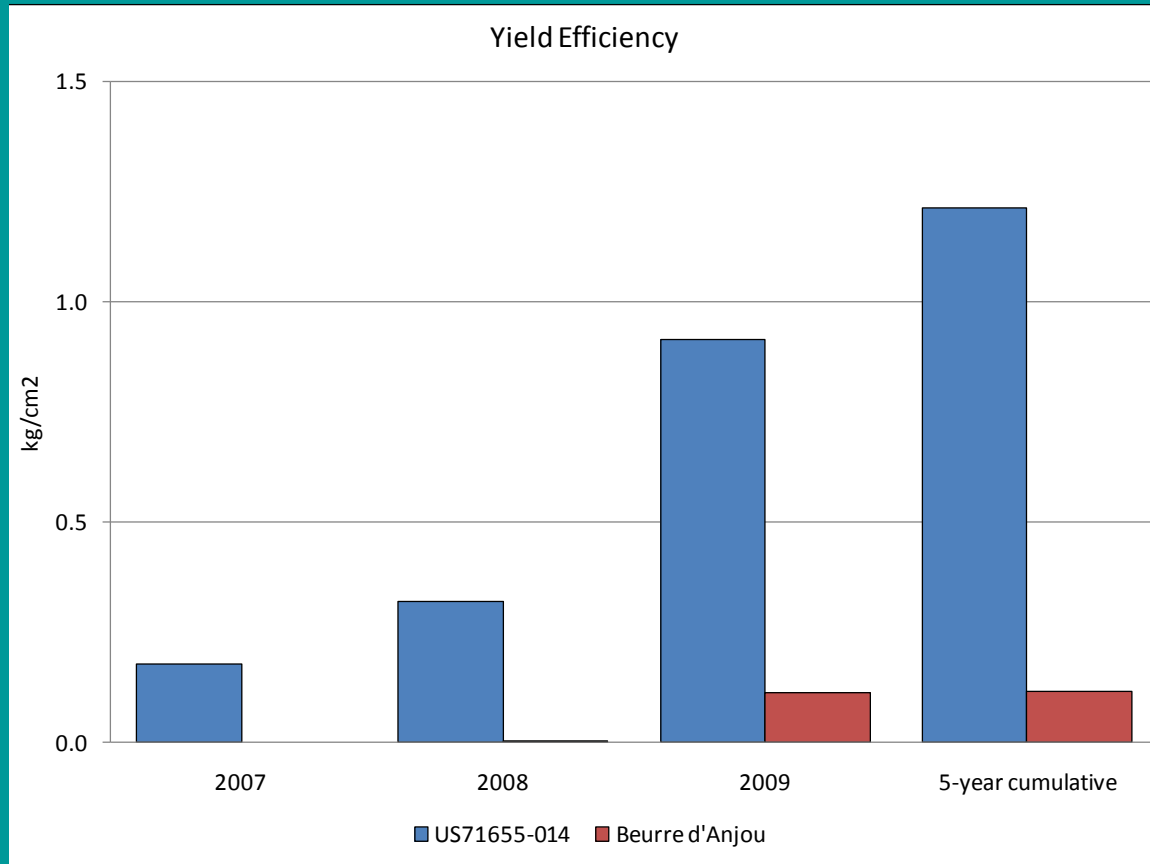
Flowering of US71655-014 and Anjou



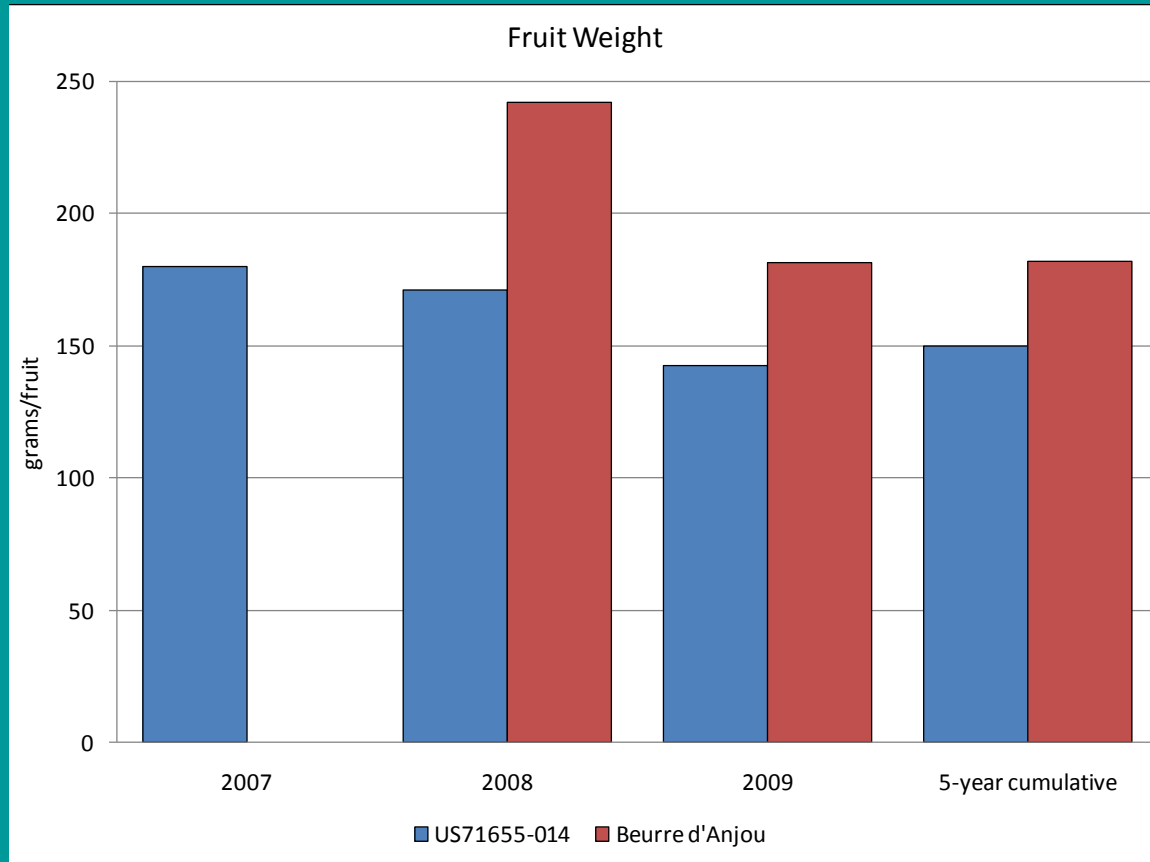
Fruit Set of US71655-014 and Anjou



Fruit Yield of US71655-014 and Anjou



Yield Efficiency of US71655-014 and Anjou

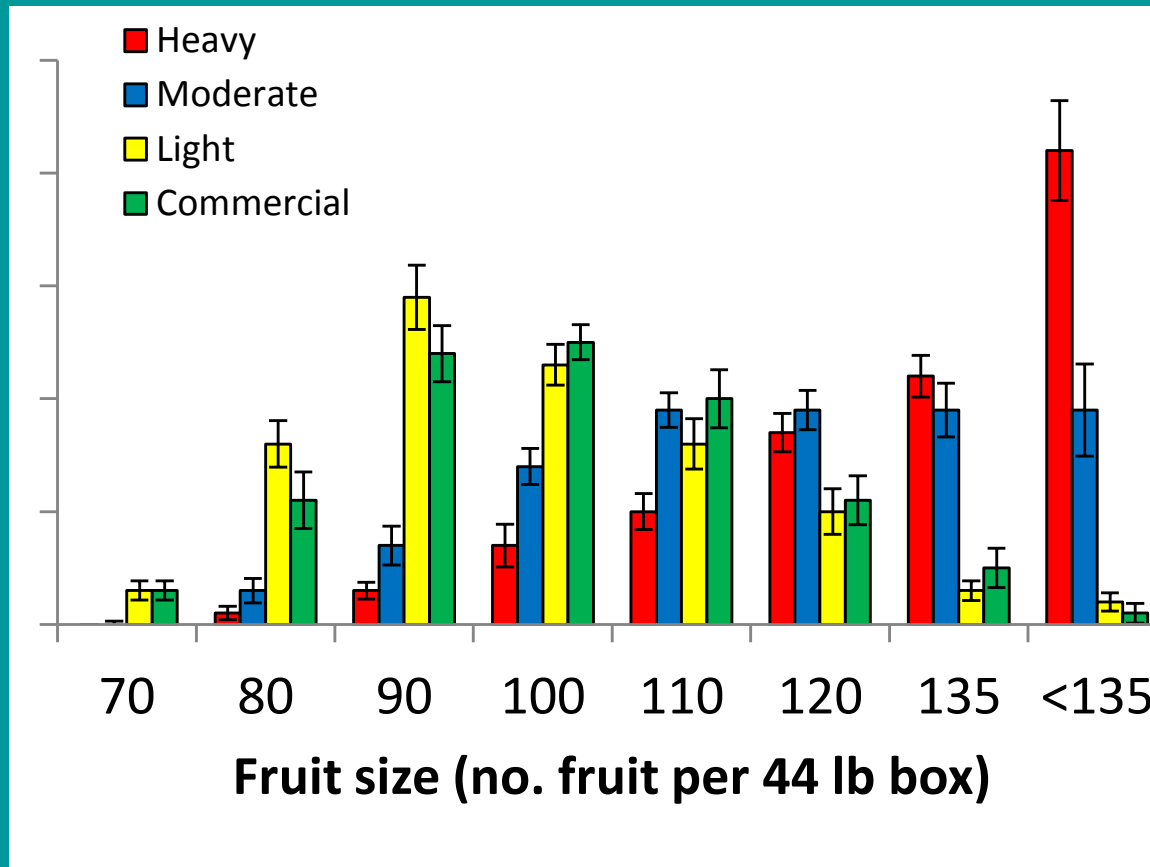


Fruit Weight of US71655-014 and Anjou

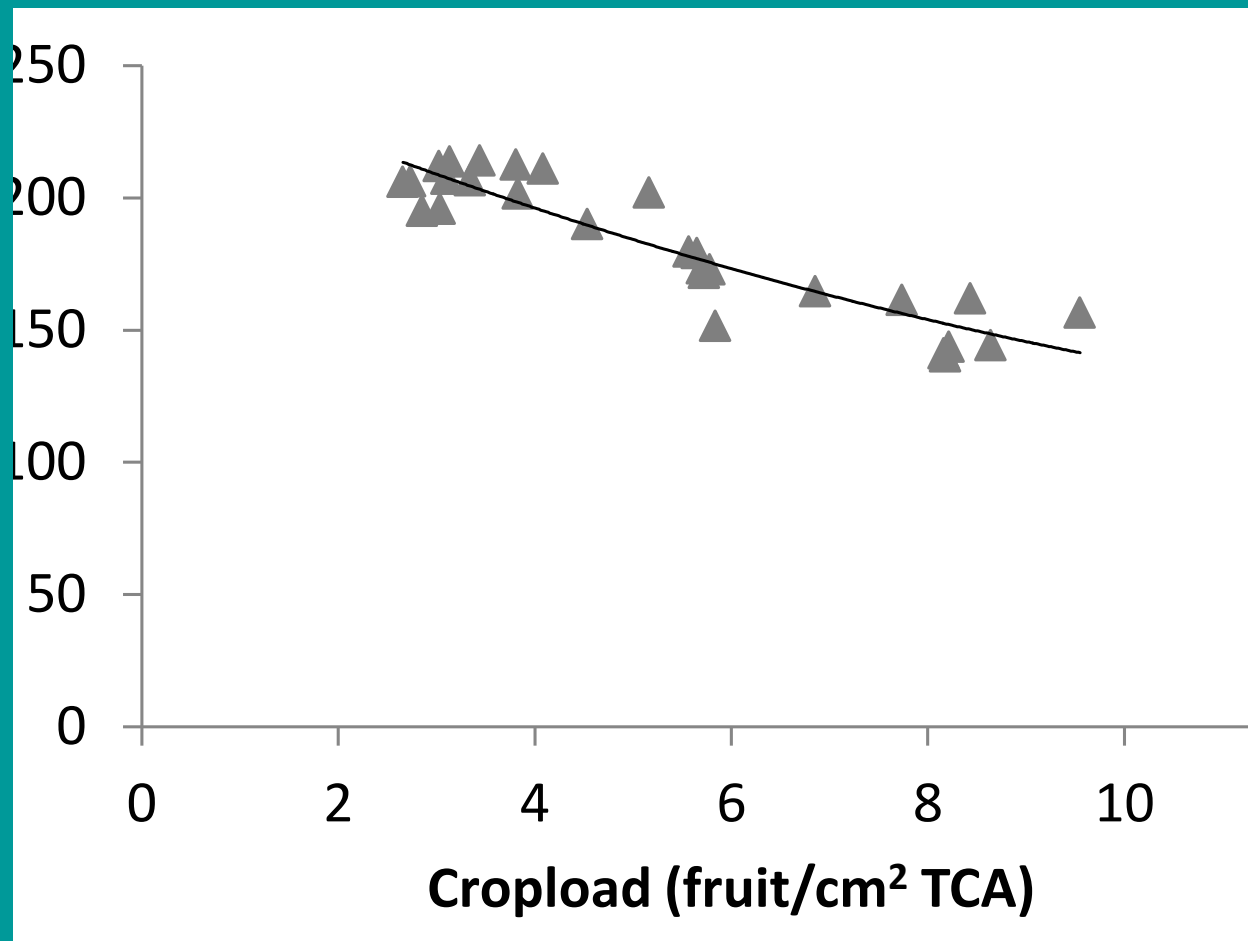
Yield of US71655-014 in 2011 thinning trial

Treatment	Yield	Projected yield	Avg. fruit wt.	Avg. fruit size	Yield efficiency	Trunk growth
Cropload	(lbs/tree)	(bins/acre)	(g)	(no. per 44lb box)	(lb cm ⁻² TCA)	(%)
Heavy	120.2 a	40	149.9 c	135 c	2.8 a	14.9 b
Moderate	88.1 b	29	170.4 b	120 b	2.2 ab	23.4 ab
Light	54.1 c	18	207.8 a	100 a	1.4 bc	27 a
Commercial	65.4 c	22	202.7 a	100 a	1.7 b	28.1 a

Cropload was adjusted to 5, 9, 11 fruit/cm² TCSA, and “Bartlett commercial” (3-5 fruit/cm² TCSA) . Thinning was at ~60 days post full bloom. Eight single tree replicates.



Fruit size distribution as affected by thinning.



Effect of cropload on fruit size.

Fruit size improved with intensity of thinning. Fruit size can be managed to produce targeted fruit classes.

Effect of delayed harvest on fruit firmness and fruit size

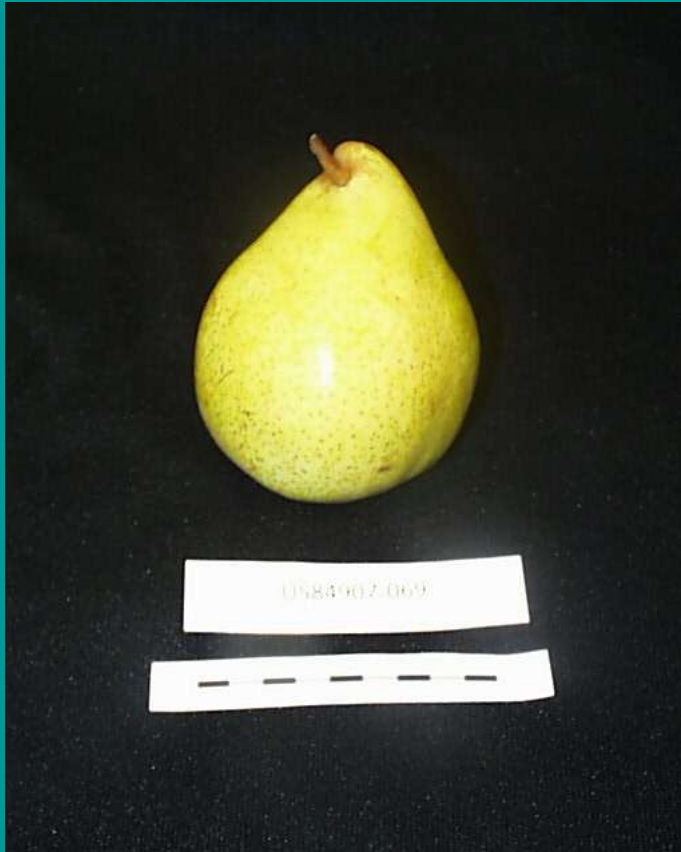
Harvest Timing	Firmness (lbs)	Avg. fruit wt. (g)	Avg. fruit size (no. per 44lb box)
1	12.3 a	217 c	90
2	11.1 b	220 c	90
3	10.7 bc	239 b	80
4	9.9 c	259 a	80

Harvests were one week apart.

Postharvest storage and ripening

- US71655-014 maintained firmness in storage up to 6 months regardless of harvest date, and up to 7 months after the earliest harvest.
- After 7 days of ripening, following 1 month of storage, firmness was correlated with harvest date, with earlier harvested fruit being firmer.
- After 2-6 months of storage, there was a slight upward trend in firmness after 5 months, but no significant differences due to harvest date.
- Fruit texture at harvest and immediately after storage is crisp, and the fruit can be eaten without ripening; however, following a period of ripening at room temperature, it softens to ~3 lbs. firmness and develops typical pear flavor.

US 84907-069



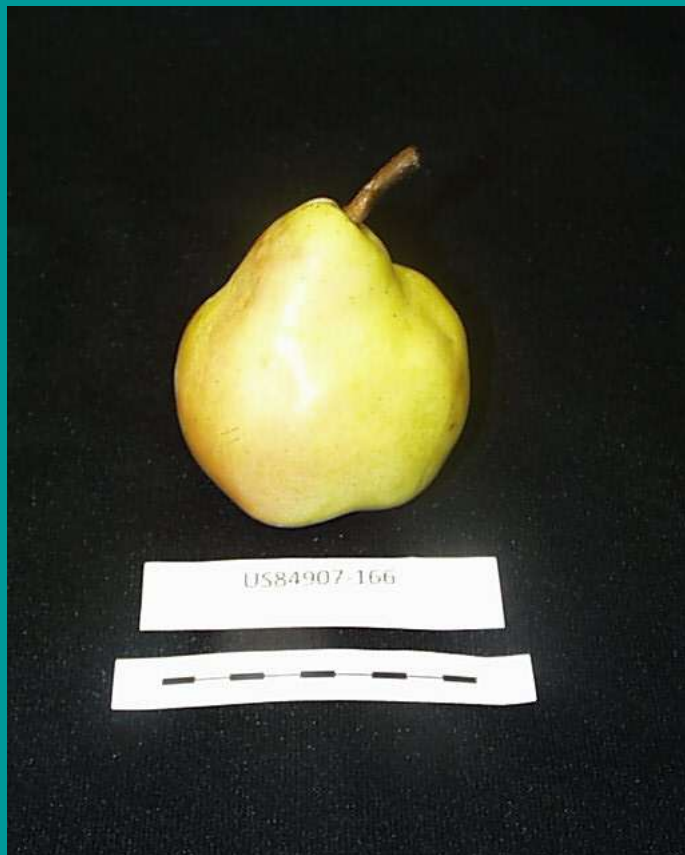
- **Parentage** Bartlett × US65062-040
- **Fruit Shape** Round-pyriform
- **Skin Color** Yellow
- **Size** 3.6" x 3.1"
- **Appearance** Good; Sparse, smooth, tan russet
- **Texture** Moderately fine; juicy
- **Grit** Sparse; small
- **Flavor** Good; subacid; Bartlett-type; aromatic
- **Scald** None observed
- **Breakdown** Moderate in late-harvested fruit stored over 3 months
- **Harvest Date** August 21
- **Storage Life** At least 3 months
- **(-1°C, air)**
- **Precocity** Moderately early, similar to Bartlett
- **Production** Moderately high
- **Fire blight** Very resistant (9 on 1 -10 USDA scale)
- **Psylla** Susceptible
- **Canopy type** Upright-spreading
- **Tree vigor** Moderately vigorous

US 84907-160



- **Parentage** Bartlett x US65062-040
-
- **Fruit**
- **Shape** Round-pyriform
- **Skin Color** Yellow; occasional red blush
- **Size** 3.5" x 3.0"
- **Appearance** Very good; light tan lenticel russet
- **Texture** Very fine; buttery
- **Grit** Very sparse; very small
- **Flavor** Very good; subacid; aromatic; Bartlett-type
- **Scald** None observed
- **Breakdown** Very little observed after 3 months storage
- **Harvest Date** August 30
- **Storage Life** At least 3 months (-1°C, air)
-
- **Tree Traits**
- **Precocity** 1st fruit 3 years after planting
- **Production** Productive
- **Fire blight** Resistant (8 on USDA 1 – 10 scale)
- **Psylla** Susceptible
- **Canopy type** Upright-spreading
- **Tree vigor** Moderate

US 84907-166



- **Parentage** Bartlett x US65062-040
-
- **Fruit**
- **Shape** Round-pyriform
- **Skin Color** Yellow; 5-40% pink or red blush
- **Size** 3.7" x 3.1"
- **Appearance** Good; usually little russet; regular contour
- **Texture** Fine to very fine; fine-grained or buttery
- **Grit** Sparse; small to very small
- **Flavor** Sweet to subacid; Bartlett-type
- **Scald** Rare
- **Breakdown** Observed in late-harvested fruit only
- **Harvest Date** August 20
- **Storage Life** Only tested up to 3 months
- **(-1°C, air)**
-
- **Tree Traits**
- **Precocity** 1st fruit 2 years after planting
- **Production** Moderately high
- **Fire blight** Very resistant
- **Psylla** Susceptible
- **Canopy type** Upright-spreading
- **Tree vigor** Moderately vigorous

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PURDUE UNIVERSITY

- Green Jade (2004)
- Ambrosia (2005)
- Honeysweet (1977)

'Green Jade'

- Parentage: US 386 x Star
- Fruit Description: Round or ovate-pyriform, uneven contour, moderately large, yellow-green, uneven russet
- Fruit Quality: Mildly sweet, buttery to melting, slight aroma
- Maturity: 1st week of August (southern Indiana)
- Storage Life: ~ 2months
- Tree: Moderately vigorous, upright-spreading
- Fire blight resistance: Tolerant, similar to Honeysweet

'Green Jade' ('Crisp n' Sweet')



'Ambrosia'



- Large pyriform fruit
- Matures mid-August
- Spreading habit
- Productive
- High quality fruit, with sweet flavor and no grit
- Tolerant of fire blight
- Some russet

'Honeysweet'



- Medium size: 2 ½ “ diameter
- Excellent “Seckel’-like flavor and texture
- Good fire blight resistance
- Self-fertile or parthenocarpic
- Matures early September
- Fine overall russet, sometimes with slight red blush

AGRICULTURE AND AGRI-FOOD CANADA AT HARROW & VINELAND

‘HARVEST QUEEN’ (1982)

‘HARROW DELIGHT’ (1982)

‘HARROW SWEET’ (1991)

‘AC HARROW GOLD’ (1999)

‘AC HARROW CRISP’ (1999)

‘HAROVIN SUNDOWN (2008)

'HARROW SWEET'

- **PURDUE 80-51 x 'BARTLETT'**
- **HARVEST: 'BARTLETT' + 3 WEEKS**
- **MEDIUM SIZE (140 – 190 g), PYRIFORM**
- **YELLOW SKIN, PROMINENT LENTICLES, AND SLIGHT RED BLUSH**
- **PRECOCIOUS AND PRODUCTIVE**
- **EXCELLENT FLAVOR ('BARTLETT'-LIKE)**
- **GOOD PROCESSING QUALITY**
- **MODERATE FIRE BLIGHT RESISTANCE
(APPEARS MORE SUSCEPTIBLE HERE THAN IN CANADA)**

'Harrow Sweet'



‘AC HARROW GOLD’

- **‘HARVEST QUEEN x ‘HARROW DELIGHT’**
- **‘BARTLETT’ + 10 DAYS**
- **STORAGE LIFE: 4 – 6 WEEKS**
- **GOOD PROCESSING QUALITY**
- **PRECOCITY SIMILAR TO ‘BARTLETT’**
- **EXCELLENT FIRE BLIGHT RESISTANCE (9.6)**
- **PBR APPLIED FOR**
- **INTER-PLANT PATENT MARKETING**



AC HARROW GOLD

' AC HARROW CRISP'

- **'BARTLETT' x US 56112-146**
- **'BARTLETT' SEASON**
- **2 WEEK HARVEST WINDOW**
- **STORAGE LIFE: 8 WEEKS**
- **CRISP FLESH**
- **PRODUCTIVE**
- **POOR POLLINATOR**
- **EXCELLENT FIRE BLIGHT RESISTANCE (9.5)**
- **PBR APPLIED FOR**



AC HARROW CRISP

'HAROVIN SUNDOWN'

- FIRE BLIGHT TOLERANT
- LATE SEASON: 3 WEEKS AFTER 'BARTLETT'
- HIGH FRUIT QUALITY: SWEET FLAVOR, LITTLE GRIT
- BEST AFTER 3-4 WEEKS OF COLD STORAGE
- ATTRACTIVE: YELLOW WHEN RIPENED, WITH RED BLUSH ON CHEEK
- LARGE FRUIT SIZE (196 GRAMS)
- NOT SUITABLE FOR PROCESSING

'Harovin Sundown'



INSTITUT SPERIMENTRALE PER LA FRUTTICOLTURA FORLI, ITALY

- **TOSCA (1993)**
- **TURANDOT (2000)**
- **NORMA (2000)**
- **CARMEN (2000)**
- **BOHEME (2003) – Fire blight tolerant**
- **AIDA (2004) – Fire blight tolerant**

'Bohème'



- **'Conference' x 'Dr. Jules Guyot'**
- **Introduced in 2003**
- **Medium size, truncate-pyriform fruit (160g)**
- **Light green-yellow at maturity**
- **Matures 35 days before 'Bartlett'**
- **Sweet aromatic flavor**
- **Productive**
- **Moderately vigorous tree, but with short internodes**
- **Moderately resistant to fire blight**

'Aida'



- **'Coscia' x ' Dr. Jules Guyot'**
- **Introduced in 2003**
- **Large pyriform fruit (250g), yellow-green with 30% blush**
- **Moderately fine juicy texture**
- **Aromatic flavor**
- **Matures 15 days after 'Bartlett'**
- **Moderately vigorous tree**
- **Moderately productive**
- **Slightly susceptible to fire blight**

IPK Gatersleben, Naumburg/Pillnitz, Germany

'Uta'

- 'Madame Verte' x 'Beurre Bosc'
- Dwarf growth habit with pyramidal canopy
- Late maturity with storage until February and March
- Excellent fruit quality
- Large (280 g), attractive, fully russeted fruit
- Precocious cropping; high yields; annually productive
- Resistant to powdery mildew and pear scab, and tolerant of fire blight
- Not compatible on quince rootstock
- Pollinated by 'Bartlett', 'Clapp's Favorite; incompatible with Anjou

University of California – Davis

‘Elliot’

- Named and released in 1989
- Recently evaluated in Europe
- High soluble solids (~18%) and acidity
- Stores well (up to 4 months)
- Heavily russeted
- Matures 2-4 weeks after ‘Bartlett’
- Fire blight tolerant, but not immune

THANK YOU

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