

**FINAL PROJECT REPORT**

**YEAR:** 1 of 1

**WTFRC Project Number:** PR08-804

(WSU Project # 13C-4164-1211)

**Project Title:** Comparison of commercial Anjou ripening and conditioning methods

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**Cooperators:** Select packinghouses

**Other funding sources**

**Agency Name:** Pear Bureau Northwest  
**Amount awarded:** \$5,000

**WTFRC Collaborative Expenses:** None

**Total Project Funding:**            **Year 1: \$24,227**

**Budget History:**

<b>Item</b>	<b>2008-2009</b>
<b>Salaries<sup>1</sup></b>	4,188
<b>Benefits</b>	1,508
<b>Wages</b>	5,040
<b>Benefits</b>	791
<b>Equipment</b>	0
<b>Supplies<sup>2</sup></b>	1,200
<b>Travel<sup>3</sup></b>	1,500
<b>Miscellaneous<sup>4</sup></b>	10,000
<b>Total</b>	24,227

**Footnotes:**

<sup>1</sup> Chris Sater, Associate in Research.

<sup>2</sup> Fruit, laboratory supplies.

<sup>3</sup> Travel to warehouses and to Portland for the consumer tests.

<sup>4</sup> Fee for two consumer tests done at the Food Innovation Center, Portland.

## GOAL

Provide methods by which Anjou pears in retail markets are just 2 to 3 days away from being of excellent eating quality (EEQ). The premise is that pears must be ‘conditioned’ by the shipper or wholesaler prior to being shipped to retail stores where they will be kept cold then ‘ripened’ by the consumer at room temperature for 2 to 3 days depending on how soft the consumer wants them.

## OBJECTIVES

- 1) **Consumers:** Define EEQ for Anjou pears by addressing the following questions:
  - a) What is the ideal firmness of an EEQ pear?
    - 1) Is there a difference in acceptability between pears of the same firmness from different conditioning regimes?
  - b) What is the ideal soluble solids level?
  - c) What is the ideal juiciness?
  - d) How long are consumers willing to wait for a pear to ripen?
- 2) **Conditioning:** Determine the best methods to condition pears that lead to EEQ upon ripening by addressing the following questions:
  - a) What is the most economical method of conditioning?
    - 1) How long do pears need to be conditioned?
    - 2) What is the best method of conditioning?
    - 3) Do pears soften during conditioning?
    - 4) How does time in storage (length of chilling) affect method?
    - 5) How do quality attributes (firmness, acidity, soluble solids) after conditioning (with and w/o ethylene) compare with pears that have been ripened but not conditioned?
  - b) Are pears conditioned with ethylene superior?
    - 1) Does ethylene reduce variability in pear quality?
    - 2) Is conditioning with the Ethylene Release Canister (ERC) realistic?
      - i. Effect of high (13%) CO<sub>2</sub> levels on internal quality.
    - 3) Will the same ethylene conditioning protocol produce EEQ pears throughout the packing season?
  - c) How does the conditioning of pears in standard hand-wrapped poly-lined boxes compare to pears in vented boxes?
    - 1) What is the temperature profile within the box?
    - 2) Will ethylene penetrate the poly-lined carton?
- 3) **Determine the difference in the quality of Anjou pears ripened in commercial chambers that use different systems to condition fruit.**

## SIGNIFICANT FINDINGS

### *Consumer Experiment 1—Anjou Pears That Had Not Met Their Chilling Requirement*

Conditioning treatments were: 2, 4 or 6 days in ethylene or 7 days in air, followed by 48 hours cooling then ripening for 3 days in warm. Consumers overwhelmingly preferred the 6-day ethylene-conditioned pears to other conditioning treatments.

- The 6-day ethylene pears scored highest in every preference category (overall, pear flavor, sweetness, juiciness, firmness and texture liking).
- The 6-day ethylene pears were ranked first (“best”) by 74% of consumers.
- The 4-day ethylene pears were ranked first by 17% of consumers, and scored the second highest in every preference category.
- The 2-day ethylene and 7-day air pears scored lowest in the preference categories and were ranked first by 2% and 7% of consumers, respectively.

### ***Consumer Experiment 2—Anjou Pears That Had Met Their Chilling Requirement (Mid-Season)***

Conditioning treatments were: 1, 2 or 4 days in ethylene or 5 days in air, followed by 72 hours cooling then ripening for 2 days in warm. Consumers overwhelmingly preferred the 4-day ethylene-conditioned pears to other conditioning treatments.

- The 4-day ethylene pears scored highest in every preference category (overall, pear flavor, sweetness, juiciness, firmness and texture liking).
- The 4-day ethylene pears were ranked first (“best”) by 50% of consumers.
- The 5-day air and 2-day ethylene pears scored in the middle of the preference categories and were ranked first by 23% and 16% of consumers, respectively.
- The 1-day ethylene pears scored the lowest in the preference categories and were ranked first by 11% of consumers.
- More consumers liked air conditioned pears once the chilling requirement had been met than in the previous experiment (23% vs 7%), but less than the ethylene conditioned pears.

### ***Consumer Experiment 3—Anjou Pears That Had Met Their Chilling Requirement (Late-Season)***

Treatments were: 1 day in ethylene, 1 day in ethylene plus 1 day in warm air, 1 or 2 days in warm air or 5 days ripening (no conditioning). Following conditioning all fruit was held in cold storage (33 °F) for 7 or 8 days to simulate transit to retail market. Three days prior to consumer evaluation all fruit was removed from cold storage and held at 72 °F until testing. The ripening only treatment was removed from cold storage 5 days prior to consumer evaluation and held at 72 °F until testing. Consumers scored the 2-day conditioned fruit (2-day air and 1-day ethylene + 1-day air) higher in pear flavor, sweetness, juiciness and texture as compared with the other treatments.

- The 2-day air and 1-day ethylene + 1-day air pears were ranked first (“best”) by a 2:1 margin over the 1-day air and 5-day ripening pears (30% and 32% vs. 17% and 16%, respectively). The 1-day ethylene pears came in last.
- The 2-day air and 1-day ethylene + 1-day air pears scored significantly higher in the sweetness liking category, even though the soluble solids for all treatment was the same.

### ***Commercial Conditioning Systems***

Conversations with packers in Wenatchee, Yakima and Hood River determined that all packers who condition pears use a similar system: 12 to 24 hours warming with forced air to a pulp temperature of 65 °F, followed by 24 hours of 100 ppm ethylene at 65 °F. Because previous research by our lab has shown that ethylene will penetrate all box types (Euro, standard, poly-lined) equally, it was not necessary to ripen Anjou pears in commercial chambers.

## **MATERIALS AND METHODS**

To address objectives 1 and 2, consumer testing on conditioned Anjou pears was done three times: once with Anjou pears that had not met their chilling requirement (October) and twice with pears that had met their chilling requirement (December and April).

Consumer evaluation occurred at the Food Innovation Center, Oregon State University, Portland Oregon. Qualification criteria for consumer participation were: the consumers fall between the ages of 24 to 65 yrs, had purchased fresh pears in season at least twice in the past month, 75 to 80% females, 20 to 25% males, at least 70% Caucasian, annual household income of at least \$25K, and at least a college degree. A panelist incentive of \$25 was paid to participants of the consumer taste test.

Each consumer was served one-third of a pear; the rest of the pear was used for firmness and soluble solids testing on the same day of the consumer evaluation. Consumers rated the pears for overall liking, pear flavor, sweetness, juiciness, firmness, texture and purchase intent. Consumers then ranked the pears for overall preference and were asked a series of marketing and demographic questions. Consumers also answered a number of comment questions.

**Consumer Experiment 1—Anjou Pears That Had Not Met Their Chilling Requirement**

Anjou pears from a single grower lot harvested between Sept 15<sup>th</sup> and Sept 21<sup>st</sup> were packed into Euro boxes with plastic trays by a commercial packer. The pears were obtained on Sept 29<sup>th</sup> so they had not received sufficient time in storage to have completed their chilling requirement. Fruit quality was evaluated at time of receipt, with the pears averaging 13.4 lbf with a color rating of 4.8 on a 1 to 10 scale (1 = dark green to 10 = yellow).

There were four conditioning treatments for the consumer trials in Portland; ethylene conditioning for 2, 4, or 6 days, or warm air conditioning for 7 days. Conditioning was done at 65 °F using an Ethy-Gen catalytic ethylene generator and Ethy-Gen II concentrate (generator and concentrate from Catalytic Generators LLC, Norfolk, VA). The conditioning room averaged 131 ppm ethylene over the 6-day conditioning period.

Following conditioning, all fruit was returned to cold storage (33 °F) for 48 hours to simulate transit to retail market. Three days prior to consumer evaluation all fruit was removed from cold storage and held at 70 °F until testing.

**Consumer Experiment 2—Anjou Pears That Had Met Their Chilling Requirement (Mid-Season)**

Anjou pears from a single grower were packed into Euro boxes with plastic trays by a commercial packer. Pears were obtained on November 13<sup>th</sup> and fruit quality was evaluated at time of receipt. The pears averaged 12.9 lbf with a color rating of 4.9 on a 1 to 10 scale (1 = dark green to 10 = yellow).

There were four conditioning treatments for the consumer trials in Portland; ethylene conditioning for 1, 2, or 4 days, or warm air conditioning for 5 days. Conditioning was done at 74 °F in shroud covered box pallets using Ethylene Release Capsules (Balchem Corporation, New Hampton, NY). The conditioning atmospheres for the ethylene treatments are listed in Table 1. For the fruit conditioned in air, the natural ethylene (C<sub>2</sub>H<sub>4</sub>) levels in the boxes averaged less than 1 ppm, the oxygen (O<sub>2</sub>) levels averaged above 20%, and the carbon dioxide (CO<sub>2</sub>) levels averaged less than 1% during each treatment.

Following conditioning, all fruit was returned to cold storage (33 °F) for 72 hours to simulate transit to retail market. Two days prior to consumer evaluation all fruit was removed from cold storage and held at 70 °F until testing.

**Table 1.** Experiment 2 (December 2008) atmospheres in the pallet shroud and boxes during ethylene treatment using ERCs.

Treatment (days)	Pallet shroud				Boxes			
	24 hrs	End of treatment			24 hrs	End of treatment		
	C <sub>2</sub> H <sub>4</sub> (ppm)	C <sub>2</sub> H <sub>4</sub> (ppm)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)	C <sub>2</sub> H <sub>4</sub> (ppm)	C <sub>2</sub> H <sub>4</sub> (ppm)	O <sub>2</sub> (%)	CO <sub>2</sub> (%)
1	252	252	19.5	1.4	179	179	18.4	2.5
2	255	490	18.2	2.5	241	411	16.9	3.9
4	262	988	15.4	4.8	270	816	14.5	5.8

**Consumer Experiment 3—Anjou Pears That Had Met Their Chilling Requirement (Late-Season)**

Anjou pears from a single grower lot harvested between Sept 27<sup>th</sup> and Sept 29<sup>th</sup> were packed into Euro boxes with plastic trays by a commercial packer. The pears were obtained on March 16<sup>th</sup>. Fruit quality was evaluated at time of receipt, with the pears averaging 12.6 lbf.

There were five conditioning treatments for the consumer trial in Portland: conditioning for 1 day with ethylene, 1 day ethylene plus 1 day in warm air, 1 or 2 days in warm air and 5 days ripening (no conditioning). Prior to conditioning all fruit was stored in the cold (33 °F). Twenty-four hours prior to conditioning the fruit was placed into a warm room (72 °F). Conditioning was done in shroud covered box pallets using Ethylene Release Canisters (ERCs) (Balchem Corporation, New Hampton, NY). The conditioning treatments reached at least 50 ppm ethylene within 6 hours in the shrouds.

Following conditioning, all fruit was returned to cold storage (33 °F) for 7 or 8 days to simulate transit to retail market. Three days prior to consumer evaluation all fruit was removed from cold storage and held at 72 °F until testing. The ripening only treatment was removed from cold storage 5 days prior to consumer evaluation and held at 72 °F until testing.

## RESULTS AND DISCUSSION

### *Consumer Experiment 1—Anjou Pears That Had Not Met Their Chilling Requirement*

The 6-day ethylene pears scored highest in every preference category and were ranked first (“best”) by 74% of consumers (Table 2). Reasons for liking and disliking are listed in Table 8. Overall, 32 out of 480 pears were given an overall liking score of 9 (highest possible score) and 26 pears were given an overall liking score of 1 (lowest possible score). The average scores for all the preference categories, along with the average firmness and soluble solids values for these fruit are shown in Table 3.

**Table 2.** Consumer liking scores for six Anjou pear attributes and pear quality measurements for each treatment; consumer sensory trials at the OSU FIC, Portland Oregon, **October 15-16, 2008.**

Treatment	Consumer Liking Scores*						Ranked First**	Pear Quality	
	Overall	Pear flavor	Sweetness	Juiciness	Firmness	Texture		Soluble solids (%)	Firmness (lbf)
6-day ethylene	7.48 a	7.46 a	7.11 a	7.95 a	6.97 a	7.26 a	74%	14.5 b	2.23 d
4-day ethylene	6.33 b	6.43 b	5.71 b	5.82 b	6.38 a	6.03 b	17%	14.6 b	3.46 c
2-day ethylene	4.49 c	4.82 c	3.93 c	3.17 c	4.96 b	4.13 c	2%	14.6 b	6.11 b
7-day air	4.33 c	4.74 c	3.73 c	2.47 d	4.24 c	4.08 c	7%	14.9 a	11.13 a

Scale for liking is 1 =dislike extremely to 9 = like extremely

\* Scale for sweetness/juiciness is 1 =not sweet/juicy to 9 = ideally sweet/juicy

\*\* Percentage of fruit in each treatment ranked first (“best”)

**Table 3.** Average preference scores, firmness values, and soluble solids levels for the highest (9) and lowest (1) scored fruit over 2 days of sensory testing at the OSU FIC, Portland Oregon, **October 15-16, 2008.**

Overall Liking	Pear Flavor	Sweetness	Juiciness	Firmness	Texture	Firmness (lbf)	Soluble solids (%)
9.0	8.6	8.4	8.5	8.1	8.3	2.6	14.6
1.0	2.4	2.2	1.5	1.6	1.4	9.2	14.7

Scale for liking is 1 =dislike extremely to 9 = like extremely

Scale for sweetness/juiciness is 1 =not sweet/juicy to 9 = ideally sweet/juicy

Fruit with an overall liking score of 9 (liked extremely) consisted mostly of 6-day ethylene-treated fruit (81%) and was most often described as “sweet” (53%). Other words consumers used to describe the characteristics of this fruit included, “perfect pear,” “sweet and juicy,” and texture that “melts.” The soluble solids levels of the highest scored fruit, was actually slightly lower than that of the lowest scored fruit, so the characteristic described as “sweet” by consumers is not necessarily related to the measurable solids content of the fruit.

Fruit with an overall liking score of 1 (disliked extremely) consisted mostly of 7-day air -treated fruit (62%). The most common reason given for disliking the fruit was “flavor” (58%). Other words consumers used to describe the characteristics of this fruit included, “bland,” “no pear flavor,” and “mealy.”

### *Consumer Experiment 2—Anjou Pears That Had Met Their Chilling Requirement (Mid-Season)*

The 4-day ethylene pears scored highest in every preference category and were ranked first (“best”) by 50% of consumers (Table 4). Reasons for liking and disliking are listed in Table 8.

**Table 4.** Consumer liking scores for six Anjou pear attributes and pear quality measurements for each treatment; consumer sensory trials at the OSU FIC, Portland Oregon, **December 9-10, 2008.**

Treatment	Consumer Liking Scores*						Ranked First**	Pear Quality	
	Overall	Pear flavor	Sweetness	Juiciness	Firmness	Texture		Soluble solids (%)	Firmness (lbf)
4-day ethylene	7.46 a	7.47 a	6.83 a	7.57 a	6.62 a	6.88 a	50%	15.1 a	2.47 c
2-day ethylene	6.13 bc	6.03 bc	5.06 c	4.97 c	6.17 ab	5.94 b	16%	14.7 bc	4.56 b
1-day ethylene	5.58 c	5.73 c	4.34 d	3.67 d	5.65 b	5.23 c	11%	14.5 c	6.71 a
5-day air	6.42 b	6.45 b	5.92 b	6.43 b	5.89 b	5.82 bc	23%	14.8 b	2.75 c

Scale for liking is 1 =dislike extremely to 9 = like extremely

\* Scale for sweetness/juiciness is 1 =not sweet/juicy to 9 = ideally sweet/juicy

\*\* Percentage of fruit in each treatment ranked first (“best”)

Overall, 37 out of 448 pears were given an overall liking score of 9 (highest possible score) and 20 pears were given an overall liking score of 1 or 2 (lowest scores). The average scores for all the preference categories, along with the average firmness and soluble solids values for these fruit, are shown in Table 5.

Fruit with an overall liking score of 9 (liked extremely) consisted mostly of 4-day ethylene-treated fruit (60%) and was most often described as having good “texture” (54%), followed closely by “sweetness” (51%). Other words consumers used to describe the characteristics of this fruit included, “smooth and buttery,” “just right,” and “very good.”

Fruit with an overall liking score of 1 or 2 (disliked extremely and disliked very much) consisted mostly of 1-day ethylene -treated fruit (60%). The most common reason given for disliking the fruit was “texture” (60%). Other words consumers used to describe the characteristics of this fruit included, “mealy,” “too firm,” and “grainy.”

**Table 5.** Average preference scores, firmness values, and soluble solids levels for the highest (9) and lowest (1 and 2) scored fruit over two days of sensory testing at the OSU FIC, Portland Oregon, **December 9-10, 2008.**

Overall Liking	Pear Flavor	Sweetness	Juiciness	Firmness	Texture	Firmness (lbf)	Soluble solids (%)
9.0	8.5	7.8	8.2	8.1	8.3	2.8	15.2
1.9	2.7	2.1	2.4	3.0	2.6	6.0	14.6

Scale for liking is 1 =dislike extremely to 9 = like extremely

\* Scale for sweetness/juiciness is 1 =not sweet/juicy to 9 = ideally sweet/juicy

**Consumer Experiment 2—Anjou Pears That Had Met Their Chilling Requirement (Late-Season)**

The 2-day air and 1-day ethylene + 1-day air pears were ranked first (“best”) by a 2:1 margin over the 1-day air and 5-day ripening pears (30% and 32% vs. 17% and 16%, respectively). The 1-day ethylene pears came in last (Table 6). Reasons for liking and disliking are listed in Table 8.

**Table 6.** Consumer liking scores for six Anjou pear attributes and pear quality measurements for each treatment; consumer sensory trials at the OSU FIC, Portland Oregon, **March 31 – April 1, 2009.**

Treatment	Consumer Liking Scores*						Ranked First**	Pear Quality	
	Overall	Pear flavor	Sweetness	Juiciness	Firmness	Texture		Soluble solids (%)	Firmness (lbf)
1-day air	6.2 a	6.0 abc	5.0 b	5.6 b	6.3 a	6.1 ab	17%	14.0	3.9
1-day ethylene	6.1 a	5.8 c	5.2 b	5.6 b	6.2 a	5.8 b	6%	13.9	4.0
2-day air	6.6 a	6.6 a	6.0 a	6.8 a	6.6 a	6.7 a	30%	14.1	3.1
1-day ethylene + 1-day air	6.6 a	6.4 ab	6.1 a	6.7 a	6.7 a	6.6 a	32%	14.0	3.1
5-day ripening	6.0 a	5.9 bc	5.3 b	5.8 a	6.2 a	5.8 b	16%	13.9	3.4

Scale for liking is 1 =dislike extremely to 9 = like extremely

\* Scale for sweetness/juiciness is 1 =not sweet/juicy to 9 = ideally sweet/juicy

\*\* Percentage of fruit in each treatment ranked first (“best”)

Overall, 26 out of 600 pears were given an overall liking score of 9 (highest possible score) and 22 pears were given an overall liking score of 1 or 2 (lowest scores). The average scores for all the preference categories, along with the average firmness and soluble solids values for these fruit, are shown in Table 7.

Fruit with an overall liking score of 9 (liked extremely) was split evenly between 1-day ethylene + 1-day air, 2-day air and 5-day ripening treatments. This fruit was described as “perfect” or “nearly perfect” by 65% of consumers.

Fruit with an overall liking score of 1 or 2 (disliked extremely and disliked very much) was split evenly between 1-day ethylene + 1-day air, and 1-day ethylene treatments. The most common reason given for disliking the fruit was a flavor component (82%). Words consumers used to describe the characteristics of this fruit included, “too tart,” “bitter,” and “not ripe.”

**Table 7.** Average preference scores, firmness values, and soluble solids levels for the highest (9) and lowest (1 and 2) scored fruit over two days of sensory testing at the OSU FIC, Portland Oregon, **March 31 – April 1, 2009.**

Overall Liking	Pear Flavor	Sweetness	Juiciness	Firmness	Texture	Firmness (lbf)	Soluble solids (%)
9.0	8.7	8.3	8.5	8.5	8.5	3.1	14.2
1.6	2.0	1.8	3.2	3.9	3.3	4.1	13.6

Scale for liking is 1 =dislike extremely to 9 = like extremely

\* Scale for sweetness/juiciness is 1 =not sweet/juicy to 9 = ideally sweet/juicy

### **Consumer Comments**

In Experiment 1 (October), the most common reason for liking was juiciness (42%), followed by sweetness (35%). In Experiment 2 (December), these attributes were reversed, with sweetness the most common (42%) followed by juiciness (23%). The results for Experiment 3 (April) were similar to Experiment 2, with sweetness by far the most common reason for liking (56%). It is interesting that firmness is only the third most common reason for liking, below sweetness and juiciness. In all three experiments, lack of flavor was the most common reason for disliking (33%, 35% and 43%, respectively) (Table 8).



**Table 8.** Reasons for liking and disliking pears

	Reasons for Liking/Disliking Fruit		
	Experiment 1, Oct. 2008	Experiment 2, Dec. 2008	Experiment 3, Apr. 2009
<b>Reasons for Liking</b>			
Juiciness	<b>42%</b>	23%	11%
Sweetness	35%	<b>42%</b>	<b>56%</b>
Firmness	17%	21%	13%
Tartness/sourness	3%	5%	8%
Other	3%	8%	9%
Smell/aroma	1%	0%	3%
<b>Reasons for Disliking</b>			
Lack of flavor	<b>33%</b>	<b>35%</b>	<b>43%</b>
Too hard	29%	18%	8%
Gritty texture	16%	13%	11%
Too soft	7%	14%	3%
Lack of sweetness	5%	2%	8%
Too tart or sour	4%	7%	16%
Lack of juiciness	4%	6%	3%
Other	2%	3%	4%
Not tart or sour enough	0%	1%	2%
Skin color	0%	1%	3%

***Ripening Expectation***

To further define the target consumer's expectations they were asked how long they would be willing to wait for pear to ripen after purchase. Their response was resoundingly 4 days or less.

Days to Ripen	Dec. 2008 Test	Apr. 2009 Test
1 to 2	36%	27%
3 to 4	54%	58%
5 to 6	10%	15%

***Response to Ethylene as a Conditioning Agent***

Ethylene used during conditioning speeds the ripening of Anjou pears as compared to warm room conditioning as shown in Tables 2 and 4. An additional contribution of ethylene conditioning is the promotion of uniformity of ripening. Thus a box, pallet or truckload of Anjou pears conditioned with ethylene can be expected to ripen more uniformly. This can be seen by comparing the standard deviations in both the tests performed with the fruit conditioned for the consumer trials, but also in more detailed laboratory studies that were run concurrently (Tables 9 and 10).

**Table 9.** Comparisons of firmness and standard deviations between the most acceptable ethylene and the most comparable air conditioned fruit used in the consumer trials.

Firmness	Experiment 1		Experiment 2		Experiment 3	
	6-day ethylene	7-day air	4-day ethylene	5-day air	1-day ethylene +1-day air	5-day ripe only
Minimum	1.4	6.4	1.4	1.3	1.8	1.9
Maximum	4.8	19.3	4.1	7.0	5.0	6.4
Average	<b>2.4</b>	<b>11.6</b>	<b>2.5</b>	<b>2.7</b>	<b>3.1</b>	<b>3.4</b>
Std Dev	<b>0.6</b>	<b>1.9</b>	<b>0.5</b>	<b>1.3</b>	<b>0.6</b>	<b>0.9</b>

**Table 10.** Standard deviations after various conditioning treatments followed by ripening to ideal eating firmness of approximately 2 lbf.

Treatment	Days			Firmness (lbf)			Std Dev
	Conditioned	Cooling	Ripening	Minimum	Maximum	Average	
Air	7	3	1	1.54	6.07	<b>2.58</b>	<i>1.30</i>
Air	7	3	3	1.01	1.72	<b>1.36</b>	<i>0.23</i>
Air	5	3	3	1.17	6.54	<b>2.55</b>	<i>1.73</i>
Air	5	3	5	1.38	4.10	<b>2.45</b>	<i>0.86</i>
Ethylene	4	0	0	1.78	4.88	<b>2.83</b>	<i>0.90</i>
Ethylene	4	3	1	1.70	2.99	<b>2.13</b>	<i>0.39</i>
Ethylene	2	3	3	2.44	3.09	<b>2.85</b>	<i>0.23</i>
Ethylene	2	3	5	1.36	2.68	<b>1.83</b>	<i>0.38</i>
Ethylene	1	3	7	1.67	2.84	<b>2.03</b>	<i>0.37</i>

This research proposal is property of Washington State University.

## **EXECUTIVE SUMMARY**

This research centered on comparing different conditioning treatments at three time periods: immediately after harvest when chilling has not been met (early October), after mid-term storage (December) and after long term storage (April), when chilling requirements had been met. Pears were conditioned and ripened for 3 to 4 days then served to consumers (120 consumers per date). This large number of consumers allowed us to obtain solid information on conditioning preference, the expectation for time to ripen and ideal firmness when ripe and to pair this data with our objective evaluations of pear quality.

### **Defining the Target.**

Consumers (360) preferred Anjou pears that were between 2.2 and 3.9 lb firmness at time of consumption. They defined an excellent quality pear as being sweet and juicy. They desired a pear that will ripen to that firmness within 4 days of purchase. Consumers gave sweetness as the most important reason for liking a pear—above firmness or juiciness. Lack of flavor was the principle reason stated for disliking a pear.

### **Conditioning to Reach the Target**

Early season (October) Anjous at this time had not obtained sufficient chilling to ripen quickly. Therefore, conditioning treatments were 2, 4, or 6 days with ethylene or 7 days without ethylene followed by 3 days of ripening. The fruit not conditioned with ethylene did not reach edible firmness and remained at 11 lbf even after a total of 10 days in warm air. Ethylene accelerated conditioning, but the pears conditioned for 6 days were the only ones that reached the target firmness (2.2 lbf). These fruit scored higher than that of any other treatments.

Mid-season (December) Anjous were easier to condition. Conditioning treatments were 1, 2 and 4 days with ethylene compared with 5 days in warm air without ethylene followed by ripening, Pears conditioned with ethylene for 4 days were 2.5 lbf after ripening and scored highest in all categories.

Long-term stored (March) Anjous were also easy to condition. Conditioning treatments were 1 day in ethylene, 1 day in ethylene followed by 1 day in warm air, or 1 and 2 days in warm without ethylene followed by ripening, compared with 5 days ripening only (no conditioning). There was no difference in overall liking or firmness liking for any treatment. Consumers scored the 2-day conditioned fruit (2 days in air and 1 day in ethylene followed by 1 day in air) higher in pear flavor, sweetness, juiciness and texture as compared with the other treatments. They also ranked fruit in these treatments higher. Thus, ethylene conditioning did not improve consumer liking or ranking of the 2-day conditioned fruit at this time of year.

Consumers preferred ethylene-treated fruit to those conditioned with warm air even at the same firmness during the first two trials (October and December). In the third trial (April) consumers preferred fruit that had been conditioned for a total of 2 days (with or without ethylene) over fruit that was conditioned for 1 day or ripened only.