

FINAL PROJECT REPORT

Project Title: Ripening capacity and decay control in winter pears

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Other funding sources: None

Total Project Funding:

Item	2012	2013
Salaries	19,853	19,853
Benefits	13,102	13,102
Wages		
Benefits		
Equipment		
Supplies	2,000	2,000
Travel		
Miscellaneous		
Total	34,955	34,955

OBJECTIVES

1. Determine appropriate durations of ethylene conditioning, 50 °F conditioning, and ethylene followed by 50 °F conditioning of Anjou pears after 1, 3, 5 months of storage at 30-31 °F, and of Comice pears after 2, 4, and 8 weeks of storage at 30-31 °F. Evaluate the treatment effects on fruit ripening ability, shipping firmness, and eating quality.
2. Evaluate new treatment options for postharvest decay control, with emphasis on preparing fruit for long-term field-run storage through combinations of orchard treatments, in-orchard bin drenches, and packinghouse line-sprays.

SIGNIFICANT FINDINGS:

Objective 1:

1. Ethylene conditioning for 72 hours, 50 °F temperature conditioning for 10 days, or 24-48 hours in ethylene followed by 5 days at 50 °F can induce earlier and more complete ripening capacity and enhance eating quality in Anjou and Comice pears than conventional cold temperature conditioning.
2. The benefits of ethylene and temperature conditioning Anjou and Comice pears were still significant after 1-3 months (Anjou) and 2-4 weeks (Comice) at 31 °F.
3. Conditioning after 5 months (Anjou) and 6 weeks (Comice) at 31 °F was of little or no benefit to ripening.
4. Shipping firmness may be compromised by excess conditioning. Charts relating specific conditioning regimes to shipping firmness were developed for three harvest dates.

Objective 2:

1. Summer calcium and 1-week-pre-harvest fungicide sprays were highly beneficial in reducing postharvest decay.
2. Pre-harvest treatment with Fungiphite (potassium phosphite) significantly reduced postharvest decay, though to a lesser extent than Pristine fungicide.
3. Summer calcium and pre-harvest Pristine and Fungiphite mitigated a delay in postharvest line-spray treatment with Penbotec.
4. Thermofog treatment with pyrimethanil or fludioxonil reduced postharvest decay, especially gray mold and side rot.

RESULTS AND DISCUSSION:

Objective 1:

Successful ethylene conditioning of Anjou and Comice pears harvested at the onset of maturity required 72 hours in ethylene at ~68 °F to induce the capacity to ripen fully within 7 days at room temperature. When using temperature alone to condition pears, 50 °F was a more efficient temperature than either warmer or colder temperatures. Ethylene and 50 °F conditioning can be combined using shorter durations of each. The benefits of these treatments are to facilitate earlier marketing of pears with the capacity to ripen, and to enhance the eating quality of the pears when ripe. Conditioning regimes for Anjou and Comice pears that include time at 50 °F can result in enhanced fruit aroma and an improved eating experience.

Ethylene and 50 °F conditioning applied to Anjou and Comice pears were still beneficial in inducing full ripening within 7 days at room temperature after the fruit had been stored for 1-3 months (Anjou) and 2-4 weeks (Comice) at 31 °F (Figs. 1-6). After 5 months (Anjou) and 6 weeks (Comice) at 31 °F, subsequent conditioning was of little or no benefit to ripening. Harvest date influences the amount of conditioning needed to induce full ripening capacity.

Although ethylene and 50 °F conditioning enhance ripening capacity, excess exposure to either ethylene or 50 °F can result in fruit with compromised shipping firmness. In Figs. 1-6 below, two thresholds of shipping firmness are indicated: 10 lbf and 8 lbf. Assuming that these reflect a typical range of acceptable firmness values for domestic shipping, there are conditioning regimes that result in adequate shipping firmness and other conditioning regimes that result in shipping firmness values too soft to safely ship. For example, in Comice harvested at the onset of maturity and stored 2 weeks before conditioning, pears conditioned for 5 days at 50 °F without ethylene retained shipping firmness > 10 lbf, and after 10 days at 50 °F had shipping firmness ~8 lbf. With later harvest dates, both the duration of conditioning necessary to achieve full ripeness and the shipping firmness decreased.

It is notable that in Anjou pears, even after 1 month at 31 °F prior to conditioning, full ripeness within 7 days at room temperature was not achieved by ethylene treatments shorter than 72 hours. Without ethylene, in Anjou pears stored 1 month at 31 °F prior to conditioning, 10 days at 50 °F induced ripening capacity, and a shipping firmness > 10 lbf was retained in fruit from all three harvest dates tested (Fig. 4).

Objective 2:

Summer calcium chloride treatments and 1-week-pre-harvest fungicide sprays have consistently reduced postharvest decay in Bosc pears (Figs. 7 & 8). This approach has been most effective against side rot (*Cladosporium*, *Alternaria*, and *Phialophora*) and blue mold (*Penicillium*), while of little benefit against gray mold (*Botrytis*). Only Pristine was used as a pre-harvest fungicide in 2012 and 2013 trials, although in previous results Topsin-M has also been effective. Pre-harvest treatments reduced overall decay and mitigated the effect of delays in application of postharvest line-sprays with Penbotec.

In both 2012 and 2013, a putative resistance-stimulant, Fungiphite (potassium phosphite), reduced postharvest decay following treatments applied 1 week before harvest (Figs. 7 & 8). The level of decay control was not as great as that provided by Pristine, but decay reduction was significant.

Thermofog treatments with pyrimethanil (Fig. 9) and fludioxonil (Fig. 10) in CA rooms reduced decay in Bosc pears in 2012 and 2013, respectively. In 2013, decay appeared to be further reduced by SmartFresh application.

Fig. 1. **Comice** pears stored **2 weeks** at 31 °F before conditioning. Left column indicates degree of ripeness achieved in 7 days following ethylene + 50 °F conditioning. Horizontal line at 4 lbf indicates onset of ripeness with buttery-juicy texture. Right column indicates shipping firmness immediately following conditioning treatments. Horizontal lines at 10 and 8 lbf indicate estimated thresholds for safe shipping. Rows differ in harvest date: 0, 7, or 14 days after entering the maturity range.

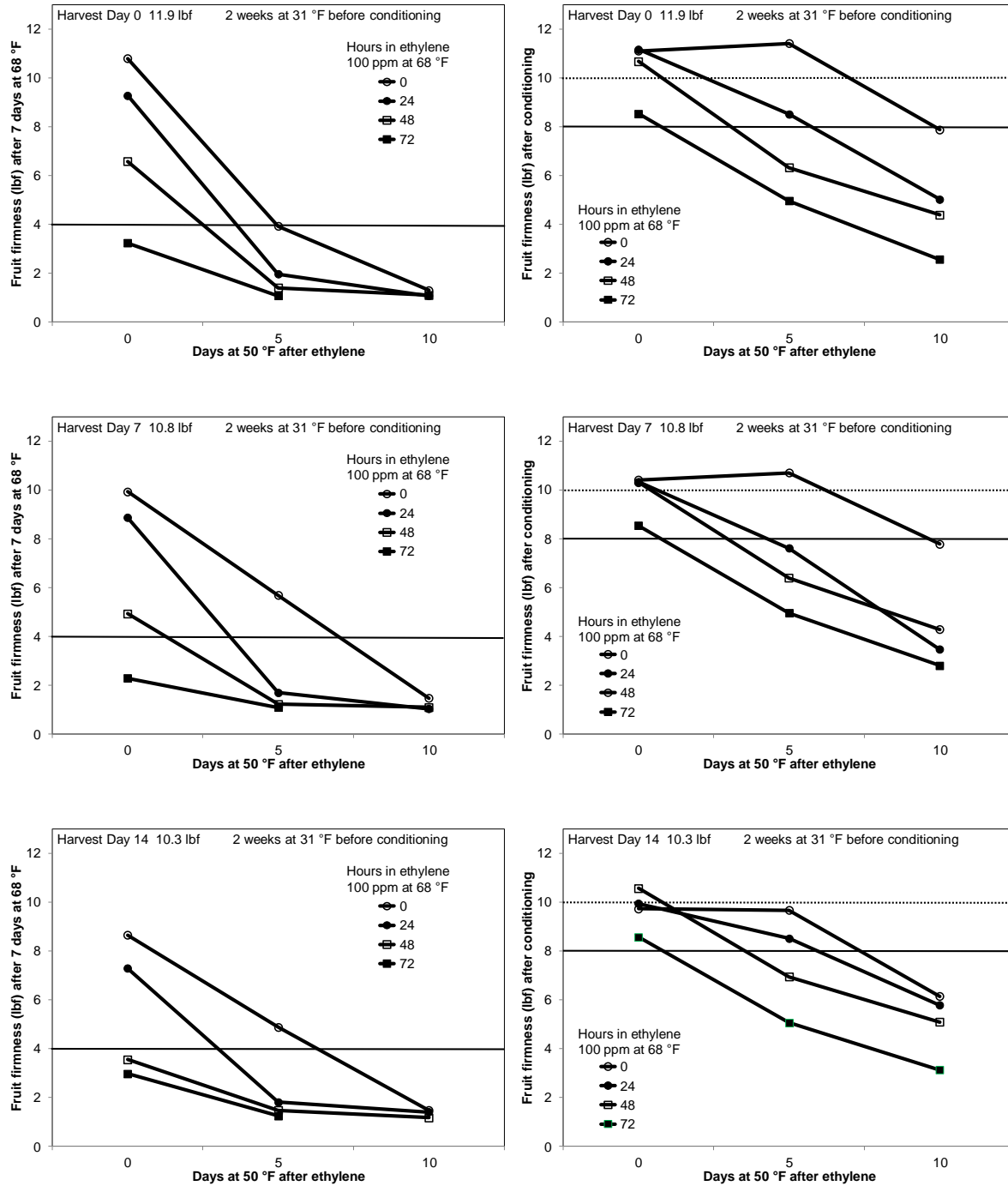


Fig. 2. **Comice** pears stored **4 weeks** at 31 °F before conditioning. Left column indicates degree of ripeness achieved in 7 days following ethylene + 50 °F conditioning. Horizontal line at 4 lbf indicates onset of ripeness with buttery-juicy texture. Right column indicates shipping firmness immediately following conditioning treatments. Horizontal lines at 10 and 8 lbf indicate estimated thresholds for safe shipping. Rows differ in harvest date: 0, 7, or 14 days after entering the maturity range.

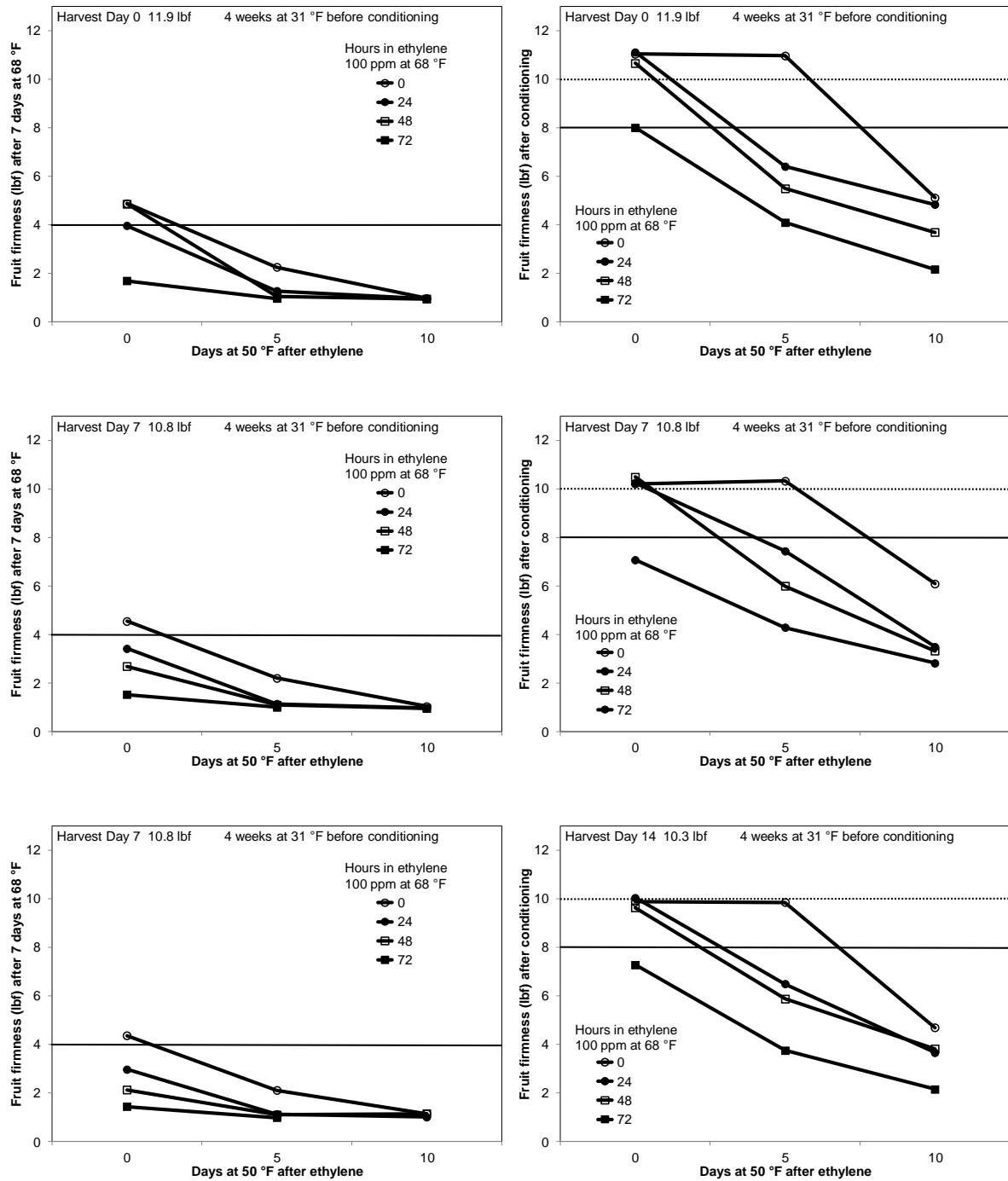


Fig. 3. **Comice** pears stored **6 weeks** at 31 °F before conditioning. Left column indicates degree of ripeness achieved in 7 days following ethylene + 50 °F conditioning. Horizontal line at 4 lbf indicates onset of ripeness with buttery-juicy texture. Right column indicates shipping firmness immediately following conditioning treatments. Horizontal lines at 10 and 8 lbf indicate estimated thresholds for safe shipping. Rows differ in harvest date: 0, 7, or 14 days after entering the maturity range.

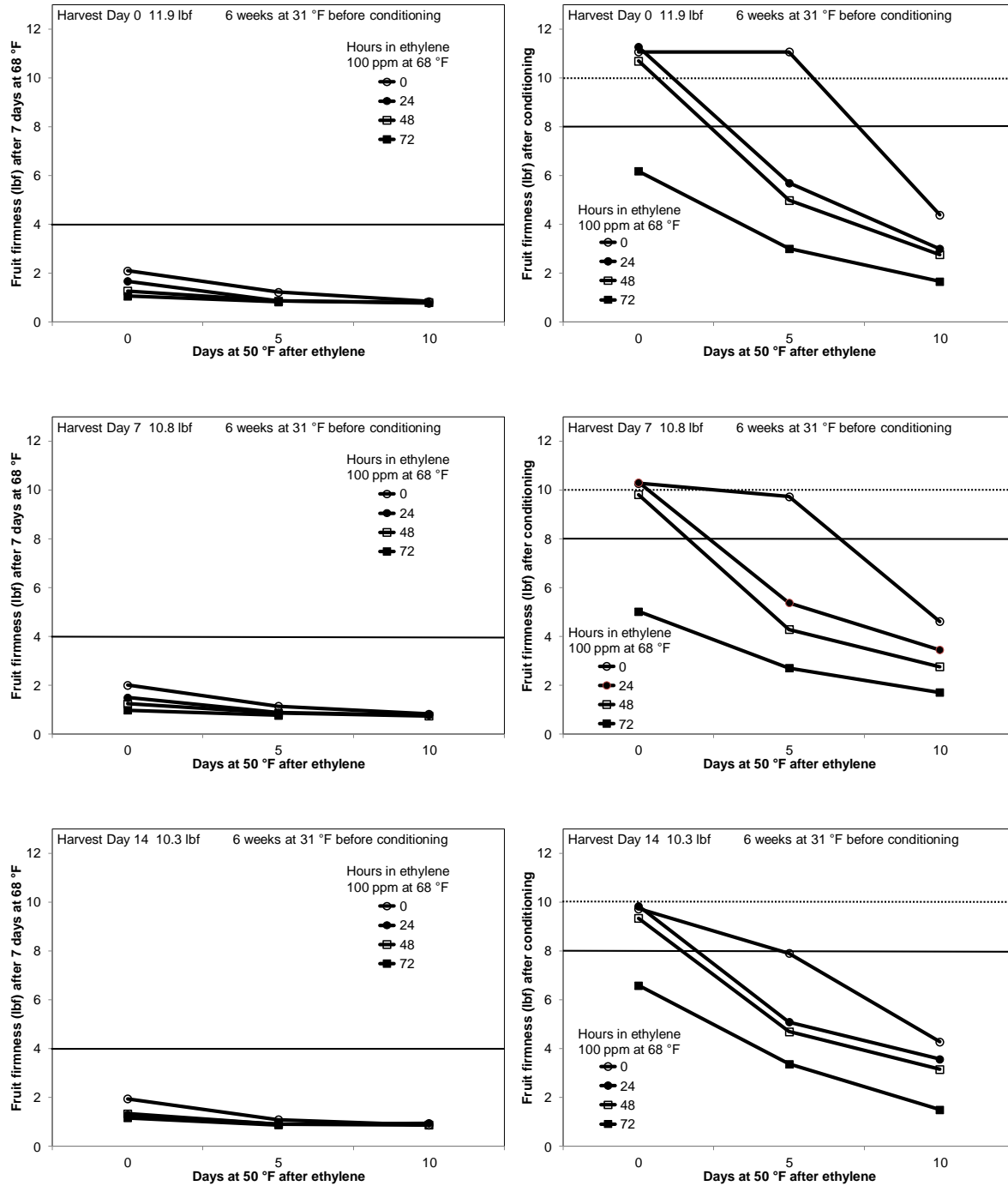


Fig. 4. **Anjou** pears stored **1 month** at 31 °F before conditioning. Left column indicates degree of ripeness achieved in 7 days following ethylene + 50 °F conditioning. Horizontal line at 4 lbf indicates onset of ripeness with buttery-juicy texture. Right column indicates shipping firmness immediately following conditioning treatments. Horizontal lines at 10 and 8 lbf indicate estimated thresholds for safe shipping. Rows differ in harvest date: 0, 7, or 14 days after entering the maturity range.

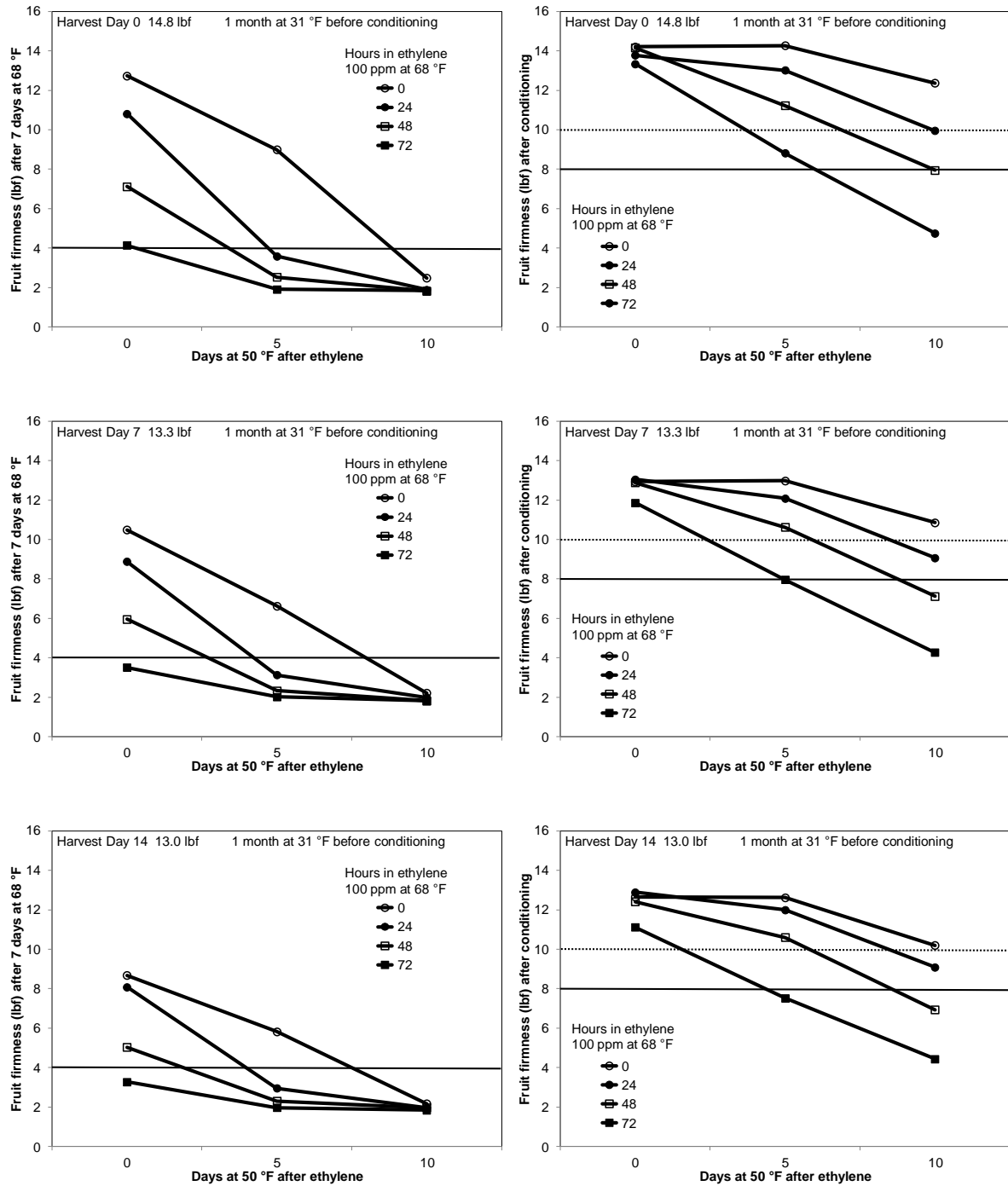


Fig. 5. Anjou pears stored 3 months at 31 °F before conditioning. Left column indicates degree of ripeness achieved in 7 days following ethylene + 50 °F conditioning. Horizontal line at 4 lbf indicates onset of ripeness with buttery-juicy texture. Right column indicates shipping firmness immediately following conditioning treatments. Horizontal lines at 10 and 8 lbf indicate estimated thresholds for safe shipping. Rows differ in harvest date: 0, 7, or 14 days after entering the maturity range.

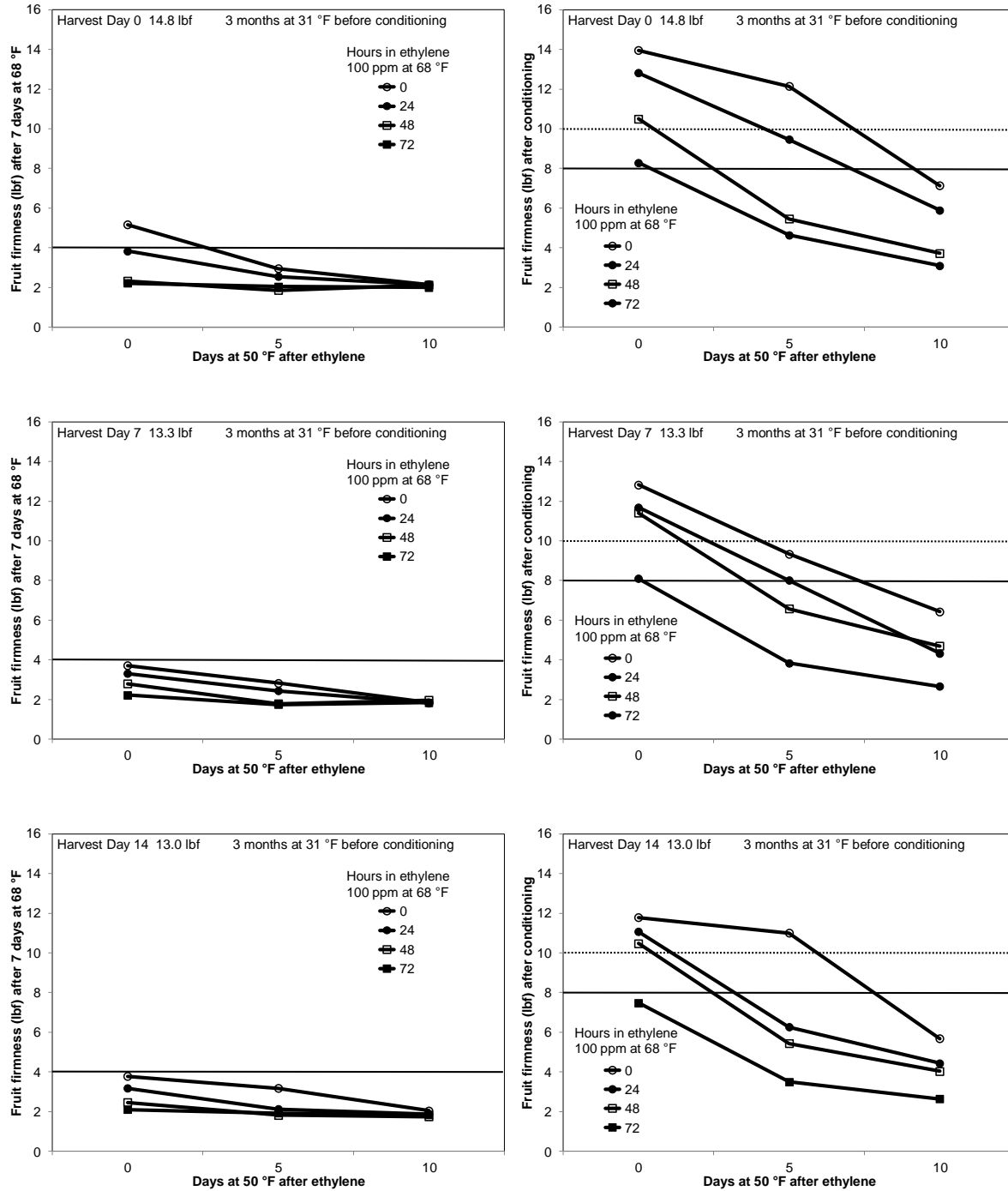


Fig. 6. **Anjou** pears stored **5 months** at 31 °F before conditioning. Left column indicates degree of ripeness achieved in 7 days following ethylene + 50 °F conditioning. Horizontal line at 4 lbf indicates onset of ripeness with buttery-juicy texture. Right column indicates shipping firmness immediately following conditioning treatments. Horizontal lines at 10 and 8 lbf indicate estimated thresholds for safe shipping. Rows differ in harvest date: 0, 7, or 14 days after entering the maturity range.

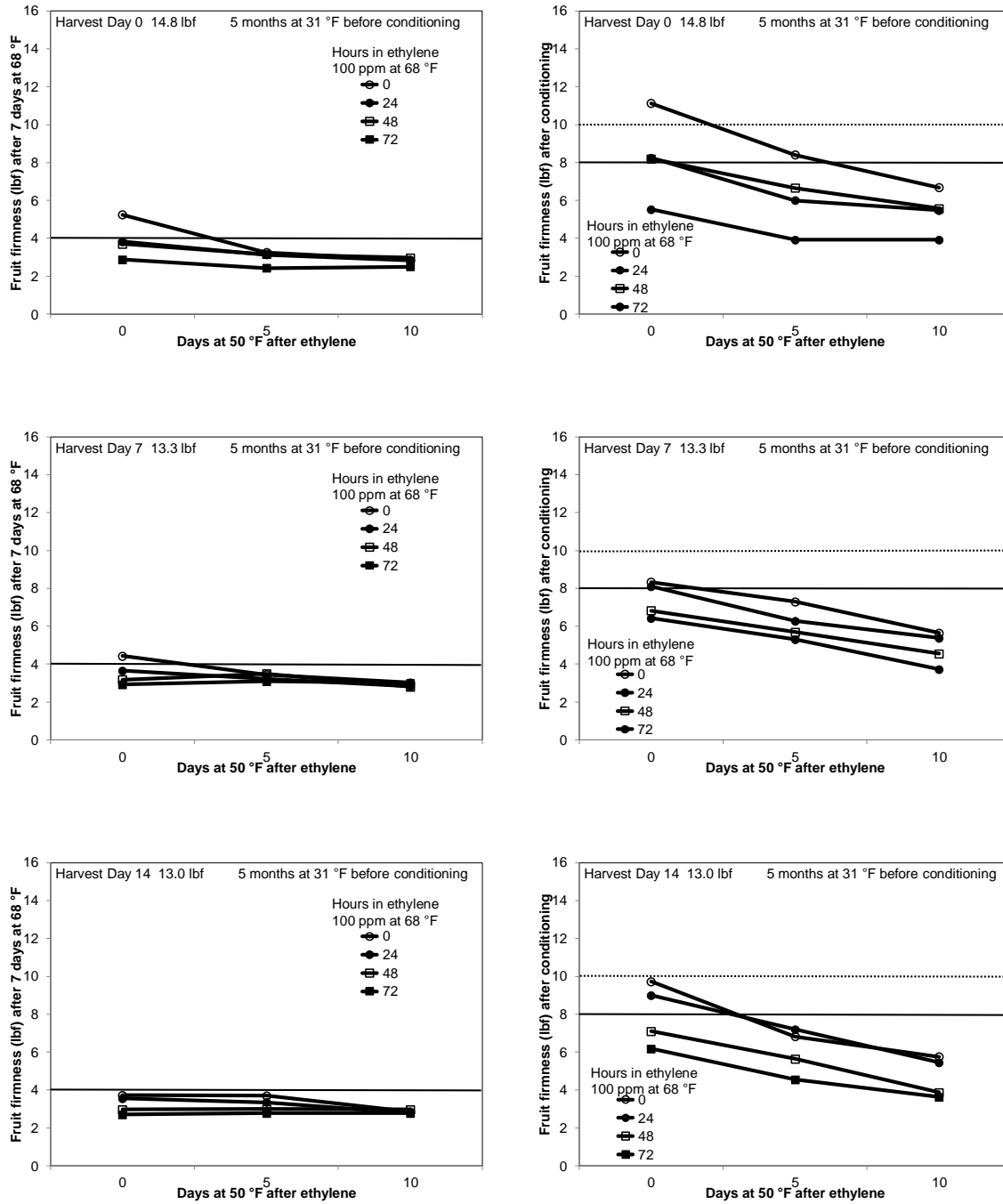


Fig. 7. Effect of orchard treatments with **Fungiphite, Pristine, or Pristine + Fungiphite** on incidence of decay at wounds in Bosc pears when postharvest line-spray application of pyrimethanil (Penbotec) was delayed for up to 9 weeks after harvest and wounding. Combined data 2012 and 2013.

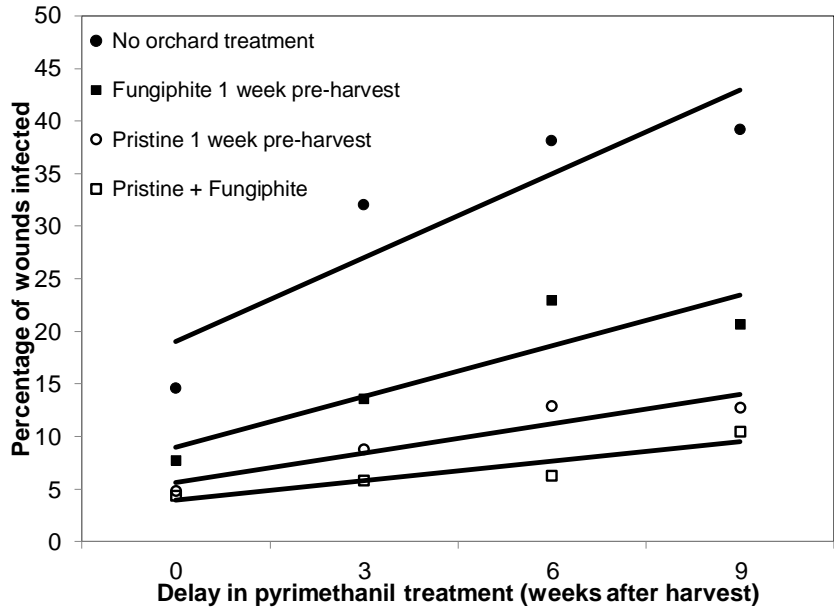


Fig. 8. Effect of summer orchard treatments with **calcium chloride** followed by pre-harvest **Fungiphite, Pristine, or Pristine + Fungiphite** on incidence of decay at wounds in Bosc pears when postharvest line-spray application of pyrimethanil (Penbotec) was delayed for up to 9 weeks after harvest and wounding. Combined data 2012 and 2013.

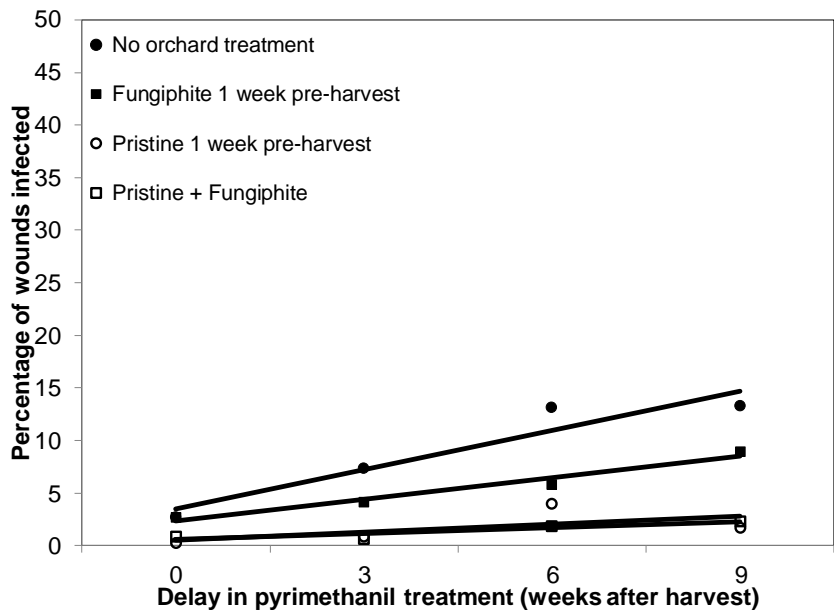


Fig. 9. Effects of **thermofog** treatment with **pyrimethanil** followed by CA storage on gray mold (*Botrytis cinerea*) decay in artificially inoculated Bosc pears, with and without additional **SmartFresh** treatment. 2012-2013 data.

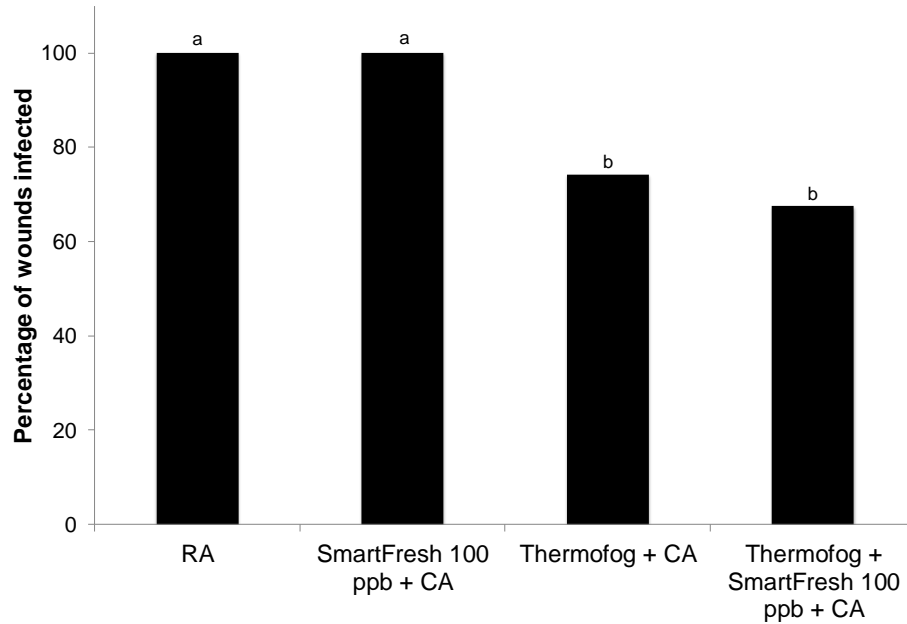
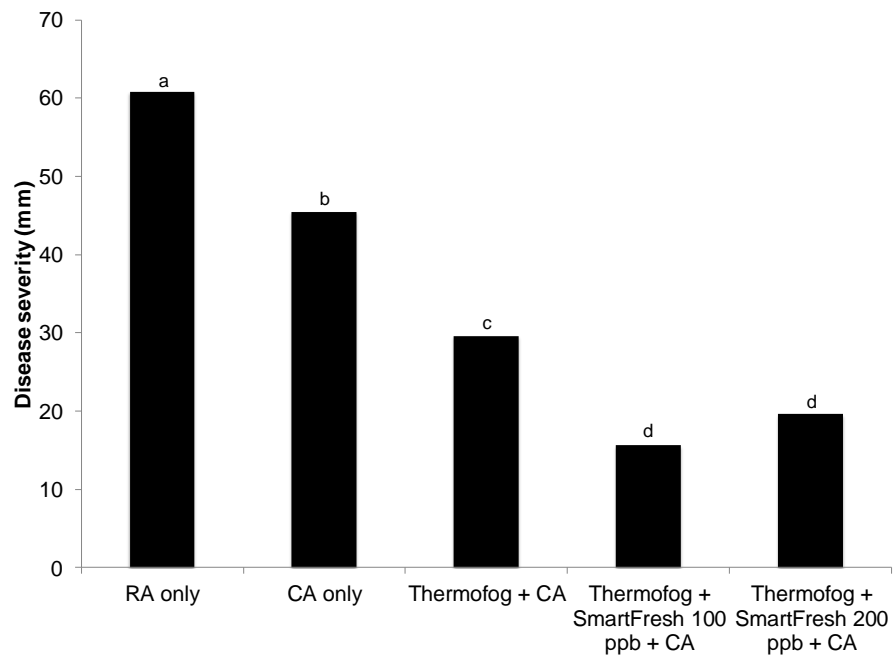


Fig. 10. Effects of **thermofog** treatment with **fludioxonil** followed by CA storage on gray mold (*Botrytis cinerea*) decay in artificially inoculated Bosc pears, with and without additional **SmartFresh** treatment. 2013-2014 data.



EXECUTIVE SUMMARY:

Successful conditioning of Anjou and Comice pears harvested at the onset of maturity to induce full ripening capacity was accomplished by either 72 hours in ethylene, 10 days at 50 °F, or 24-48 hours in ethylene plus 5 days at 50 °F. Charts relating specific ethylene or 50 °F conditioning regimes to ripening and shipping firmness were developed. Postharvest decay in Bosc pears was significantly reduced by summer calcium chloride sprays, Pristine fungicide applied 1 week pre-harvest, and Fungiphite putative resistance stimulant applied 1 week pre-harvest. The most effective decay control was achieved by combinations of these treatments. Thermofog application of pyrimethanil or fludioxonil followed by CA storage and SmartFresh treatments reduced gray mold decay and side rot in Bosc pears.

I wish to express my gratitude to the Research Subcommittee, the Fresh and Processed Pear Committees, the previous Winter Pear Control Committee, the Washington Tree Fruit Research Commission, and Pear Bureau Northwest for many years of support for my research. I have very much enjoyed being part of the pear community during my tenure at Oregon State University, and wish the pear industry continued success and advancement.