

## RE-THINKING THE CHILL REQUIREMENT FOR PEAR RIPENING

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### INTRODUCTION

Pears harvested when “mature” will typically ripen to a buttery-juicy texture only when they have been exposed after harvest to conditions that will induce ripening capacity, followed by actual ripening at room temperature. Traditionally, conditioning to develop ripening capacity has been accomplished through cold storage, so this process has been known as “satisfying the chill requirement”. Since long-term storage typically takes place at 30 to 31°F, each pear variety has been associated with a minimum number of days that they should be held in storage at that temperature before being marketed with full ripening capacity. For fruit harvested at the earliest maturity, Bartlett and Bosc will typically need cold storage for approximately 14 days, Comice 30 days, and Anjou at least 60 days. Actual times can vary somewhat from year to year.

Cold-temperature conditioning stimulates pears to internally produce their own ethylene gas, which drives the subsequent ripening process. However, exposing pears to an external atmosphere of around 100 ppm of ethylene gas in a sealed room at temperatures near 68°F can dramatically reduce or eliminate the chill requirement and facilitate pear ripening early in the storage season. Recent work led by Eugene Kupferman at WSU has demonstrated that exposing Anjou pears to ethylene for 4 to 6 days, without cold storage, can stimulate ripening of early season fruit to excellent eating quality.

In addition to the external application of ethylene, recent research has found that the “chill requirement” for pears can be substantially affected by the maturity of the fruit at harvest, and by the temperature at which “chill” is provided.

### MATURITY AT HARVEST

While it has generally been thought that later-harvested pears need less “chill” than earlier-harvested pears, specific information has been lacking. In two years of work with Comice pears in southern Oregon in cooperation with Harry & David, Inc., we found that the chill requirement decreased steadily with later harvest. Comice picked at the earliest maturity (average firmness of 13 lbf) indeed needed approximately 30 days at 31°F to develop ripening capacity, but for every day that harvest was delayed after the average fruit firmness in the orchard reached 13 lbf, the minimum chilling time at 31°F decreased by 0.6 days. For example, Comice pears picked 10 days after the orchard reached 13 lbf would need 6 fewer days at 31°F to be capable of ripening than those picked when the orchard first reached 13 lbf. The relationship of Comice fruit maturity to the number of days of chill required at 31°F is shown in Figure 1. Similar studies are currently underway with Bosc and Anjou pears. The role that orchard temperatures may play in this process is also being investigated.

## INTERMEDIATE TEMPERATURES

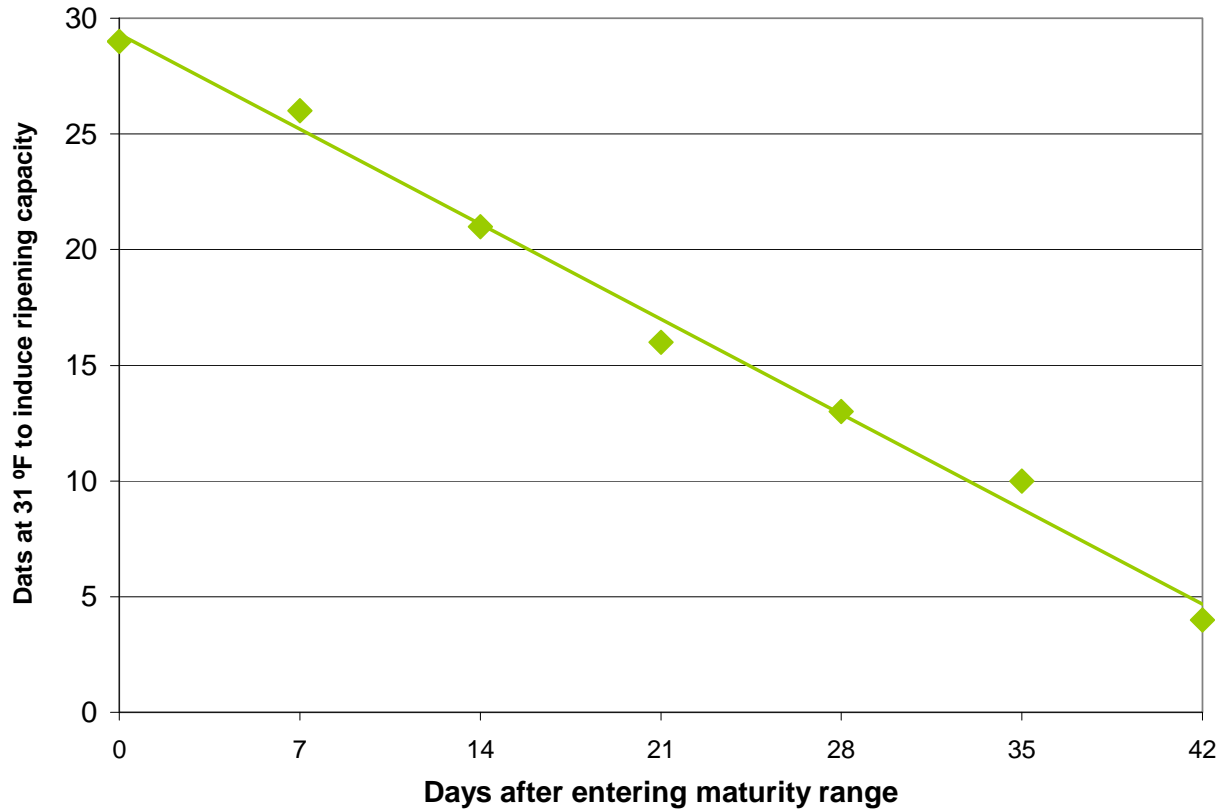
It is easy to imagine that the “chill” requirement would be best satisfied by keeping pears as cold as possible. However, research with winter pears at OSU in Medford and with Bartlett at UC Davis has found that the “chill” requirement can be satisfied in a shorter period of time at 41 °F than at 31 °F, and in an even shorter period at 50°F. Our preliminary results with Comice showed that peak efficiency was at 50 °F; as the conditioning temperature increased above 50 °F, increasingly more time was necessary. Results from a single season’s experiments comparing conditioning at 31, 41, and 50 °F with each of four pear varieties are summarized in Figure 2. Note that Bartlett pears harvested at 21 lbf did not soften appreciably after seven days at 31 °F followed by seven days at room temperature, but successfully ripened after seven days storage at 41 or 50 °F. Anjou pears did not fully ripen after 60 days at 31 °F, but conditioning times were substantially reduced at 41 and 50 °F.

## COMBINED ETHYLENE AND TEMPERATURE CONDITIONING

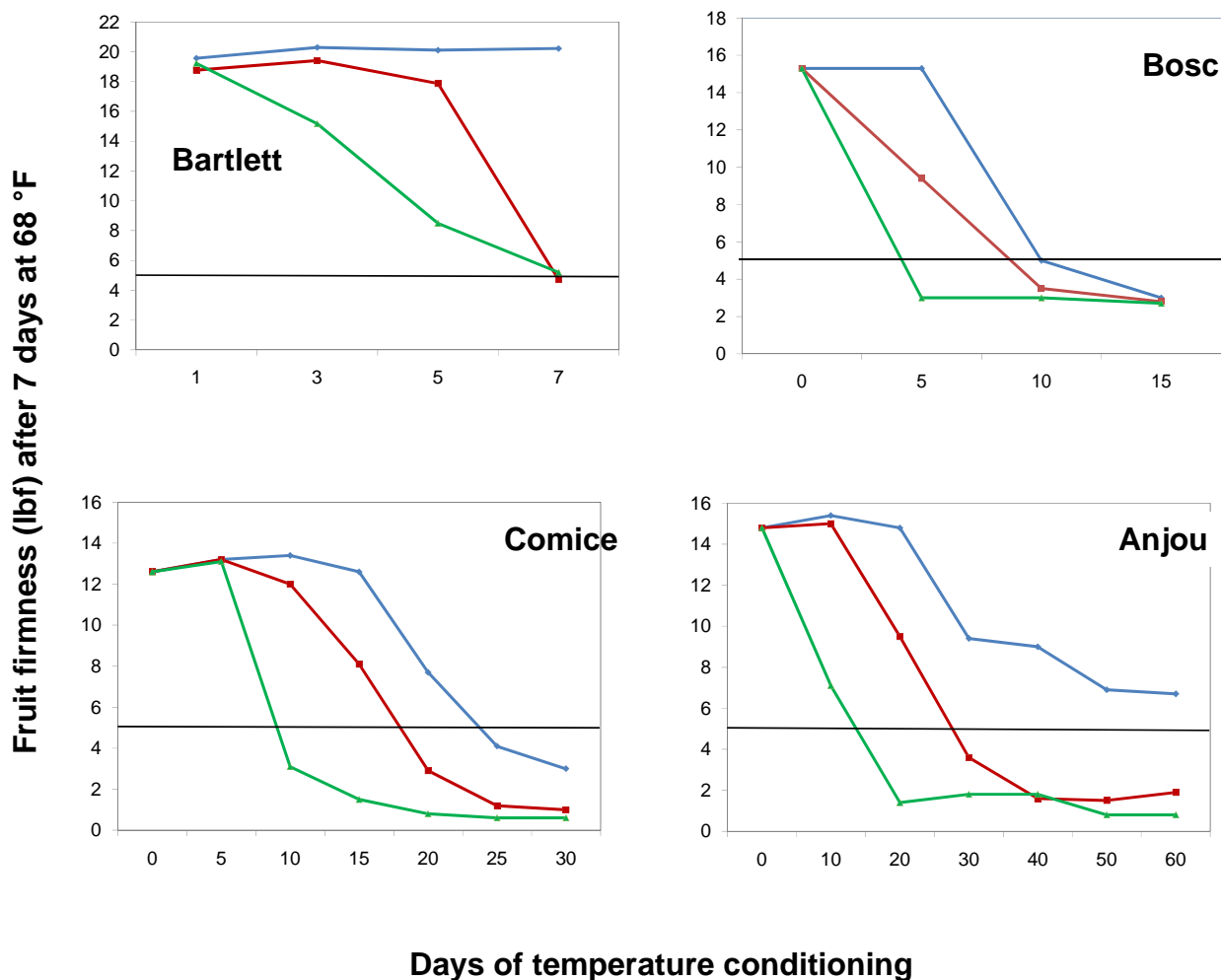
Pears may be partially conditioned with ethylene and complete the conditioning during subsequent low temperature storage. The length of storage needed depends on the temperature. Table 1 summarizes results of studies on conditioning early-harvested Bosc, Comice, and Anjou pears at three temperatures, without ethylene or after ethylene exposure for 24 or 48 hours. Bosc pears exposed to ethylene for 24 hours or more needed no further temperature conditioning. Ethylene for 24 hours reduced the Comice pear conditioning time at 31°F by half, while only 3 days were needed at 50 °F after 24 hours in ethylene. Anjou pear conditioning time at 50 °F was less than 10 days (the minimum time in this experiment) following 24 or 48 hours in ethylene. Note that in our studies, conditioning treatments began within one day of harvest, without pre-cooling.

The reasons for speeding up pear conditioning are to facilitate early marketing and to improve the eating quality of fruit harvested early in the maturity period. Pears that have been stored at 31 °F long enough to satisfy their chilling requirement may not benefit from further treatment. It is important to bear in mind that once pear ripening capacity has been fully induced by ethylene or intermediate temperature conditioning, the subsequent storage life may be reduced. It is not yet clear whether combining ethylene and temperature conditioning offers advantages over ethylene conditioning alone. Studies to determine the firmness and storage life of pears following various possible conditioning regimes are in progress.

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**Figure 1.** Relationship of Comice pear fruit maturity to the length of storage at 31°F needed to induce ripening capacity. Maturity range begins at 13 lbf.



**Figure 2.** Effect of conditioning at 31 °F(◆ blue), 41 °F(■ red), or 50 °F (● green) on firmness of Bartlett, Bosc, Comice, and Anjou pears after seven days of ripening at 68 °F. Fruit of all cultivars were harvested at the top of the maturity range (Bartlett 21 lbf, Bosc 16 lbf, Comice 13 lbf, Anjou 15 lbf). Firmness of 5 lbf (horizontal line) estimates the onset of a buttery, juicy texture.

**Table 1.** Number of days of conditioning at 31, 41, or 50 °F needed to induce ripening capacity in Bosc, Comice, and Anjou pears harvested at earliest maturity, either without ethylene treatment or following 24 or 48 hours in 100 ppm ethylene at 68 °F. Treatments began within one day of harvest, without pre-cooling. Data from 2008 crop year.

**Approximate number of days needed to induce ripening capacity  
(Harvested at earliest maturity – No pre-cooling before conditioning)**

Variety	No ethylene			After 24 hr in ethylene at 68°F			After 48 hr in ethylene at 68 °F		
	31 °F	41 °F	50 °F	31 °F	41 °F	50 °F	31 °F	41 °F	50 °F
Bosc	15	9	5	0	0	0	0	0	0
Comice	30	19	12	15	7	3	7	2	2
Anjou	>60	35	17	44	18	<10	38	12	<10