

# Impact of Delays to Cool on Shelf Life of Broccoli

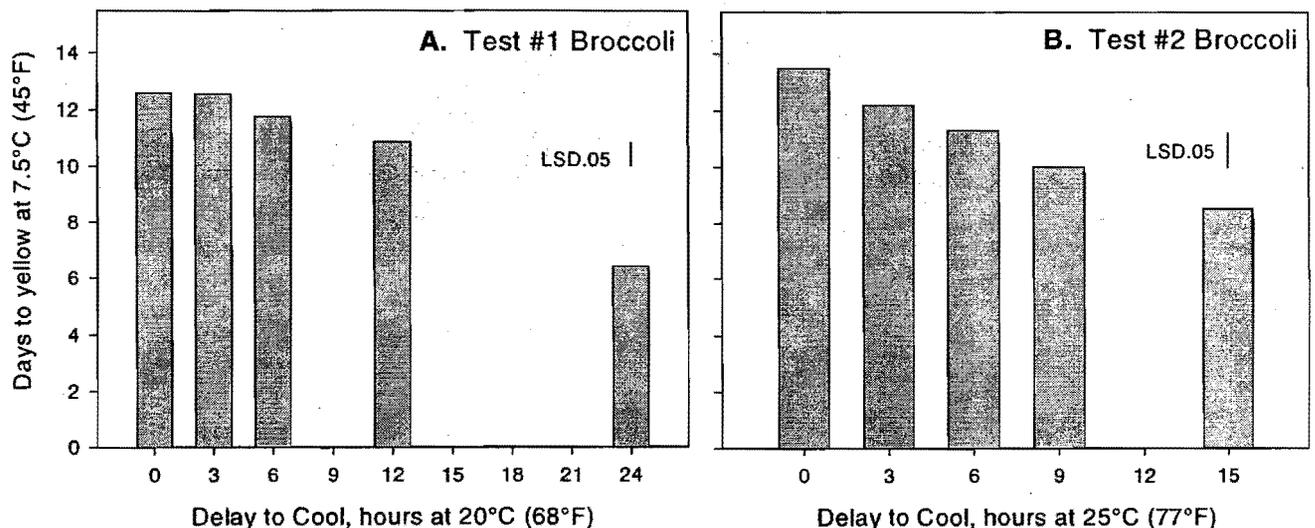
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Very rapid quality and biochemical changes occur within a few hours of harvest in most fresh produce. Although our general recommendation is "cool as soon as possible," we lack specific data for most products on the effects of cooling delays. Broccoli is a very perishable vegetable. Currently it is field-packed and in most cases, cooled by liquid icing. Delays of several hours may occur but liquid-ice cooling ensures ice around the broccoli during most of the transport and distribution period, and probably mitigates any detrimental effect delays to cool might have. However, if we are interested in handling broccoli without ice and cool by forced air or hydrocooling, delays to cool may be expected to have more impact on shelf life.

We ran two cooling delay tests on broccoli (cv. Marathon) in the Salinas Valley recently. In the first test, the broccoli was cut, placed in plastic trays that were stacked inside a van in the field and during transport to the lab. Temperature was monitored and averaged 20°C (68°F), and the broccoli lost an average of 0.4% weight per hour. After specific periods, the broccoli was air or hydrocooled, and then placed in polyethylene bags in coolers with gel ice packs. Hydrocooling involved immersion in a slurry of water and ice for 20 minutes, and for air cooling, the broccoli was placed in perforated polyethylene bags inside a large cooler in the field [temp=0-5°C (41°F)] or inside a cold room at the lab. Weight loss during air cooling

was negligible but hydrocooled broccoli had a 4-6% increase in weight in the 1st test and a 5-10% increase in the 2nd test. After all samples were cooled, the individual heads were tagged and placed on trays inside perforated polyethylene bags at 7.5°C (45°F). The basis for determination of shelf life was the number of days to show any yellow beads or florets. The second test was done on broccoli harvested from the same field, but it was only hydrocooled. Average pulp temperature was 25°C (77°F), and average weight loss in the 2nd test was 0.6% per hour.

Figure 1 shows that cooling delays at 20°C (68°F) did not affect shelf life until 6 hours or more (Figure 1A. Test #1). There was not a



**Figure 1.** Shelf life (days to show first yellow beads) of broccoli in relation to delays to cool at two temperatures [20°C (68°F), Figure 1A and 25°C (77°F), Figure 1B]. In Test #1, heads were hydrocooled and air-cooled; in Test #2, heads were hydrocooled.

significant difference in shelf life between the air-cooled and the hydrocooled broccoli and the data were combined in Figure 1. However, since the hydrocooled broccoli absorbed some water (4-6% of fresh weight), there were differences in head firmness at the end of shelf life. At 25°C (77°F), a significant loss in shelf life occurred after a 3 hour cooling delay

(Figure 1B. Test #2). We could expect that if the broccoli were held at 15°C (59°F) after harvest, we would not be able to observe a difference in shelf life unless cooling delays were more than 9-12 hours.

Although shelf life was measured at 7.5°C, the trend in loss of shelf life with increased delays to cool

would remain at lower storage temperatures. Figure 2 shows expected shelf life of broccoli at different temperatures. The broccoli cultivars Marathon and Legacy have relatively long shelf-lives. If shorter shelf life cultivars were used, the impact of delays to cool would likely be greater.

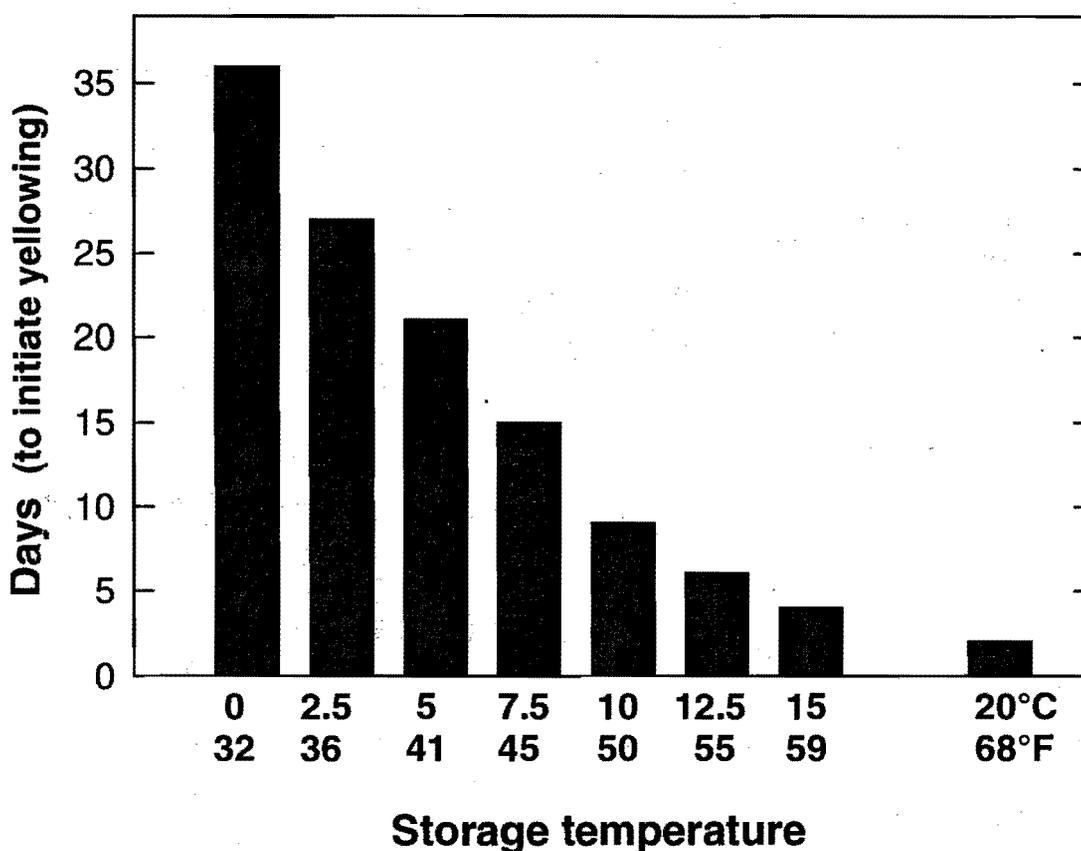


Figure 2. Shelf life of broccoli (cv. Legacy) stored in humidified air at different temperatures.