Growing Quality Cherries

Lynn E. Long
Oregon State University Extension Horticulturist

The United States is one of the leading producers of sweet cherries in the world. In 2000 the U.S. was second in overall production worldwide with 203,000 metric tons of cherries with Iran leading the way with 229,000 tons. Germany was fifth with 133,000 tons, behind Turkey and Italy (Ing and Ing, 2000).

In the U.S. the majority of cherries are produced in the Pacific Coast states of Washington, Oregon and California with the greatest volume of production in the north. The five year average, ending in 2000 shows Washington averaging 86,000 metric tons, Oregon a distant second at 50,000 tons and California at 36,000 tons. The only other significant cherry production region in the United States is Michigan in the north-central region with 18,000 tons, most of which is grown for the processing market (Ing and Ing, 2000).

The export market is a major outlet for cherries grown in the Pacific Northwest. The Far East is our largest export market, with 61% of all exported cherries going to that region in 2001. Japan, Taiwan, and Hong Kong are our biggest markets in this region. Our other large export markets are Canada and the United Kingdom receiving 20% and 10% of total exports, respectively (Thurlby, 2001).

For the most part, our best quality cherries are sent to these export markets. There are two reasons for this. Only the best quality cherries can withstand the rigors of a three-week journey by boat to the Far East. Secondly, we are often paid more for cherries to our export markets than our domestic markets, up to 25% more.

It must be remembered, however, that growers in the Pacific Northwest, do not have any local markets. The Pacific Northwest is one of the more sparsely populated regions in the United States. Seattle is our largest city, but cannot begin to consume all of the cherries that we produce. Consequently, all of our markets are located some distance from the region of production. For example, Los Angeles is 1600 km away, and New York is 5000 km distance. For this reason all of our cherries, including domestic cherries, must be of high quality in order to reach the market in good condition.

Production Practices

There are five factors that determine potential cherry quality: 1) crop management factors including variety selection, age and position of bearing wood, tree vigor, crop load and use of growth regulators; 2) proper harvest date; 3) environmental factors such as rain and wind; 4) harvest practices, and 5) post-harvest practices (Facteau, 1988).

Of the crop management factors, one of the most important is proper selection of the variety. As most of you know ‘Bing’ is the number one variety grown in the U.S. for fresh market production. In fact, until just a few years ago, it was nearly the only variety grown for this market. ‘Bing’ is not a particularly large variety and it has a tendency to readily crack in the rain, but it is firm and it does hold up well to our handling and shipping conditions. It works well for us in the Pacific Northwest. However, softer cherries, such as ‘Van’, ‘Sylvia’, ‘Newstar’, ‘Celeste’ and ‘Stella’ are not able to withstand the handling and shipping practices that we subject our cherries to and are, therefore, not grown in the Pacific Northwest for fresh market sales.

Firm cherries better resist impact and compression pressure as compared to soft cherries. Compression damage results from the pressure of fruit by such things as the fingers of pickers, or the weight of cherries in a picking bucket. Compression damage results in bruises and is worse when fruit temperatures are warm. Impact damage results from the dropping of a cherry into a metal bucket or drops of as little as 2.5 cm as the cherry moves through the packing line. Impact damage results in pits on the fruit skin and is worse when fruit temperatures are cold.

‘Bing’ is one of the least sensitive cherries to these types of damage, whereas ‘Van’ is one of the most sensitive (Patten, Patterson and Kupferman, 1983). When ‘Van’ cherries are dropped onto a rough surface from a height of as little as 5 cm, 50 to 80 percent of the cherries will become pitted. An equivalent drop of ‘Bings’ will cause 20 to 40 percent pitting. Besides ‘Bing’, we have found varieties such as ‘Lapins’, ‘Sweetheart’, and ‘Skeena’, from Canada, and ‘Regina’ and ‘Kordia’, from Europe to maintain their quality to our distant markets. Other varieties that have worked well for us include ‘Chelan’ and ‘Tieton’, both early cherries from the breeding program at Washington State University.

Growing a variety that produces firm cherries does not, by itself, guarantee export quality fruit. Poor quality ‘Bings’ will not withstand our handling practices or the journey to our distant markets. Optimizing fruit quality in the growing process is critical to producing a cherry that maintains its quality all the way through to the market.

Most of the other crop management factors named previously, age and position of bearing wood, tree vigor, and crop load, can all be affected by pruning. Good pruning practices help to balance crop load and determines where fruit is borne on the branch. The best quality fruit, in terms of size, sweetness and firmness result when leaf to fruit ratios are 5 to 6 and cherries are borne on axilary buds at the base of one year old shoots and young spurs, as opposed to older spurs (Murphey, 1988). In addition, fruit from over cropped trees tend to have a higher percentage of mechanical injury (Facteau, 1988).

A study conducted a number of years ago well illustrates how crop load, as manipulated by pruning, affects fruit size, soluble solids and predisposition to mechanical injury (Murphey, 1988). Three pruning regimes were compared, heavy, average and minimal. Heavy pruning consisted of saw cuts, removal of some spur-bearing wood and removing very vigorous one-year-old shoots. Average pruning consisted of removing weak, shaded spur-bearing wood over 3 years old, removing 2 and 3 year old fruiting wood, and allowing for good light penetration. Minimal pruning consisted primarily of removing a few branches, but did not alter the status of fruiting spurs or wood to any great extent.

Early in the fruit growth curve (Figure 1), the difference in fruit size was very small, but by the time the fruit turned dark red, fruit from the heavy, average and minimally pruned trees averaged 26.6 mm, 24.2 mm and 21.4 mm, respectively. Most U.S. packing houses sell their fruit based on differences in fruit size. Fruit of different sizes are sorted out and placed into different boxes. Larger fruit sells for a premium. One packinghouse in Oregon simply pays growers an extra 33 cents per kilogram for every size increase of approximately 1.4 mm. This means that fruit from heavy pruned trees would receive an extra $1.32 per kilogram over fruit from the minimally pruned trees, more than enough to make up for the quantity of fruit that is lost in the pruning process.

Larger fruit not only makes a grower more money, it also produces a better tasting product that holds up better in transit. At the mahogany stage, fruit from heavily pruned trees average 5.4 brix higher than those from minimally pruned trees (figure 1). In addition the larger fruit is more resistant to bruising (figure 2). At a given date, damage is greater the darker the cherry. Taking the same color cherry, such as the dark red cherry, we find that damage also increases with delay of harvest. How does this relate to different pruning regimes? We know that fruit borne at the base of one year old shoots ripens earlier than fruit borne on spurs. Also, the older the spur, the later the ripening date. Since heavily pruned trees have the most fruit ripening at the base of one year old shoots it is this fruit that has the most fruit in the early harvest period and would therefore be more resistant to damage.

The other crop management factor that greatly affects cherry quality is the application of gibberellic acid (GA). Most packing houses in the Pacific Northwest require a GA treatment for export cherries. When applied under the right conditions GA treated fruit is consistently firmer, higher in soluble solids and larger compared to untreated fruit at similar color maturities (table 1) (Facteau, 1988).

Table 1. Mean fruit firmness, soluble solids, and weight for paired GA_3 limb study at 10 ppm, over 3 years in 4 orchards with 2 cultivars. Means were compared by student's t test and were significant at 1% (**).

		Firmness (g)		Soluble Solids (%)		Weight (g)	
Year	Cultivar	Control	GA_3	Control	GA_3	Control	GA_3
3 yr mean	Bing	286	347**	16.9	17.8**	8.2	9.0**
3 yr mean	Lambert	245	277**	15.7	16.8**	8.0	8.8**

Besides the previously mentioned attributes, GA treated fruit also resists impact damage better than non-treated fruit. Data in Table 2 shows a significant reduction in pitting, over a 2-year span, looking at dark mahogany fruit and red fruit (Looney and Lidster, 1980).

Table 2. Effect of GA_3 on bruising and surface pitting of 'Van' sweet cherries at red and dark mahogany harvest times.

		Bruised		Pitted	
Year	Harvest	Control	GA_3	Control	GA_3

1 (20 ppm)	Red	13.1	11.4	55.1	38.1
	Dark mahog.	43.1	28.1	11.9	9.6
2 (30 ppm)	Red	6.8	8.5	70.8	28.3
	Dark mahog.	14.0	8.5	27.5	7.5

Growers in the Pacific Northwest apply GA at straw color, as the cherry is turning from green to yellow. Straw color generally occurs about 3 weeks before harvest on ‘Bing’. Typically, 20 ppm of GA is applied in a dilute spray. Coverage is important, as GA is not systemic in the tree. Increasing dose of GA results in a greater response, but at high rates, over 35 ppm, return bloom is affected. This can have detrimental affects on crop quality as flowers borne at the base of one-year wood were reduced to a greater extent than flowers borne on spurs. GA will also affect the time of harvest due to the fact that it delays fruit coloring. Typically, harvest is delayed 3-5 days in treated as opposed to untreated blocks. It is common for growers to use this trait as both a harvest and marketing tool. The three to five day delay in harvest often gives growers the opportunity to finish picking a non-treated block before moving to a treated block. In addition, delaying the harvest by a few days can be a monetary advantage to growers growing a late maturing variety as prices often increase at the end of the season.

Unfortunately, response to GA can be variable. The most important factor affecting the success of GA applications is fruit load. Vigorous, lightly cropped trees treated with GA respond to a greater extent than more heavily cropped trees. In fact, in years when there is a heavy crop, growers will often increase the dose of GA to 30 ppm.

Although there are many positive responses to GA applications, probably the response that concerns growers the most is the response of treated cherries to rain. Although it appears that GA treated cherries are not more sensitive to rain cracking, GA treatments do seem to cause larger cracks. This can be a problem in that small cracks will often heal or will be accepted by inspectors and consumers.

In recent years, growers have begun to apply calcium, in addition to GA, to increase cherry firmness and reduce susceptibility to pitting. Typically, growers will put on multiple applications (3 or 4) of calcium chloride at the rate of 1 kg per hectare in a dilute spray. Multiple applications, compared to a larger single application, have the advantage of greater protection against rain. Calcium chloride sprays will protect cherries, to some extent, against rain cracking, but when applied in high concentrations, fruit size may be detrimentally affected.

Harvest

The final weeks before harvest is a critical period for the development of the fruit. One quarter of the total fruit weight is accumulated during the week immediately preceding harvest (Kupferman). In order for cherries to remain firm they must have adequate water. Out of necessity, nearly all growers in the Pacific Northwest irrigate their cherries. In the final three weeks before harvest growers irrigate more frequently, but applications are of a shorter duration. There must be enough water in the soil to allow the fruit to regain its turgor quickly, especially immediately prior to harvest.

For export markets, it is very important that cherries are harvested at the proper time and that there is uniformity in color. One packinghouse representative stated that uniform color was second only to firmness in its importance for export quality cherries. Cherries that are dark red to light mahogany are more resistant to mechanical damage than at other stages of development (Patten, Patterson, and Kupferman, 1983).

We try to pick our fruit when temperatures are cool. This can be difficult since the cherry production regions of the Pacific Northwest are located in desert climates with temperatures sometimes reaching more than 38º Celsius. On those days we stop picking early in the day since fruit that is picked in the heat of the day is softer than fruit picked in the morning and is therefore more susceptible to bruising.

Full buckets should be kept in the shade. Dark cherries left in the full sun can reach temperatures over 40º C. We then dump our cherries into bins and cover them with wet foam as they are transported to the packinghouse.

Since cherries do not contain stored carbohydrates, firmness, sugars, and acidity are lost very rapidly unless the fruit is cold. Cherry quality begins to deteriorate immediately after it is picked, therefore, the fruit should be cooled rapidly after harvest. One packinghouse in Oregon requires that fruit be delivered to the packinghouse within two hours of harvest so that it can be cooled with a hydrocooler. Since cold fruit is more prone to pitting, packinghouses try to reduce the temperature of the fruit to 5º to 7º C when it is first delivered. If it is too cold when it is run over the packingline it will be more subject to pitting. However, by the time the fruit goes into the box, we want the fruit temperature to be near 1º C in order to maximize its life.

Packaging Cherries

In the United States, large cherry lines are used to pack our fruit. This has the advantage of moving large quantities of fruit to the market in a relatively short period of time, but it has the disadvantage of causing significant damage to the fruit. This is one reason why selecting the right variety and growing the fruit properly is so critical. Once we pick the cherry, we do nothing but damage it, both during harvest and during packing. For this reason, our fruit must start out extremely resistant to damage.

The sorting, sizing and packing process includes emptying the bins, removing leaves, and cutting the fruit stems. Stem cutters cause more damage to the fruit than any other single operation. Once the stems are cut the smallest fruit is sorted out using a roller-sizer. The fruit is then carried to moving belts where workers hand sort damaged and poor color fruit. Cherries are then hydrocooled a second time, sized, boxed, and palletized for final cooling and shipping. This second hydrocooling should bring the temperature of the fruit down to approximately 1º C.

Storing and Shipping Cherries

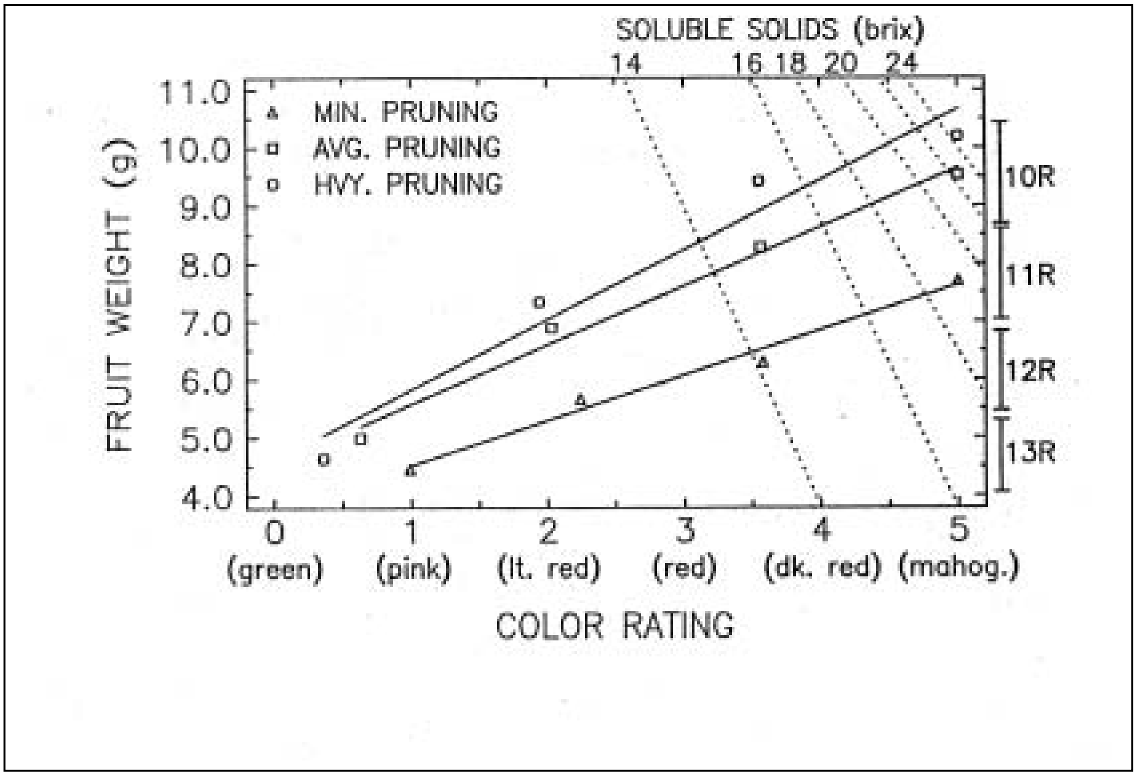
Once the cherries are boxed the fruit is generally placed in a refrigerated room at 1º C. It is important that the fruit be cooled to the shipping temperature prior to boxing as air cooled rooms will not be able to further reduce the temperature of the fruit since cherries are placed in polyliners inside each box thereby restricting airflow around the cherries. The best temperature for shipping cherries is 1º C under high humidity. Studies have shown that refrigerated trucks cannot cool cherries, but merely remove the heat of respiration to maintain a steady temperature.

In the last few years there has been extensive use of modified atmosphere packaging (MAP) for shipping and storing cherries. For the most part, packers use MAP fruit in two situations. The first is to increase the value of the fruit by holding the fruit through an oversupply period. Fruit harvested the first week of July will often receive lower prices due to oversupply situations. By holding the fruit for two or three weeks, it may be possible to receive a better price. The second situation where MAP fruit is utilized is in long distance shipping to export markets. Packers have the option of shipping fruit by air or boat. But since there is a $15 per box savings by boat over air, MAP fruit shipped by boat can save substantial money and still arrive in excellent condition.

Modified Atmosphere (MA) treated fruit have less decay, and greener stems, and the fruit have more luster at the end of 4 weeks than fruit in regular atmosphere (Kupferman). MA fruit is held at 12-14% CO_2 with an O_2 level of about 4% at 0º C.

There are basically two MA systems, one is active the other passive. Initially, MA bags were filled with the proper atmosphere and sealed. More recently, bags such as the Aussie bag allow the fruit to establish the atmosphere naturally. Both systems work well. The critical component of either system is the temperature at which the fruit is stored. It is important that fruit be stored as near 0º C as possible.

Figure 1 Changes in fruit size and soluble solids as related to color. From Murphey, 1988



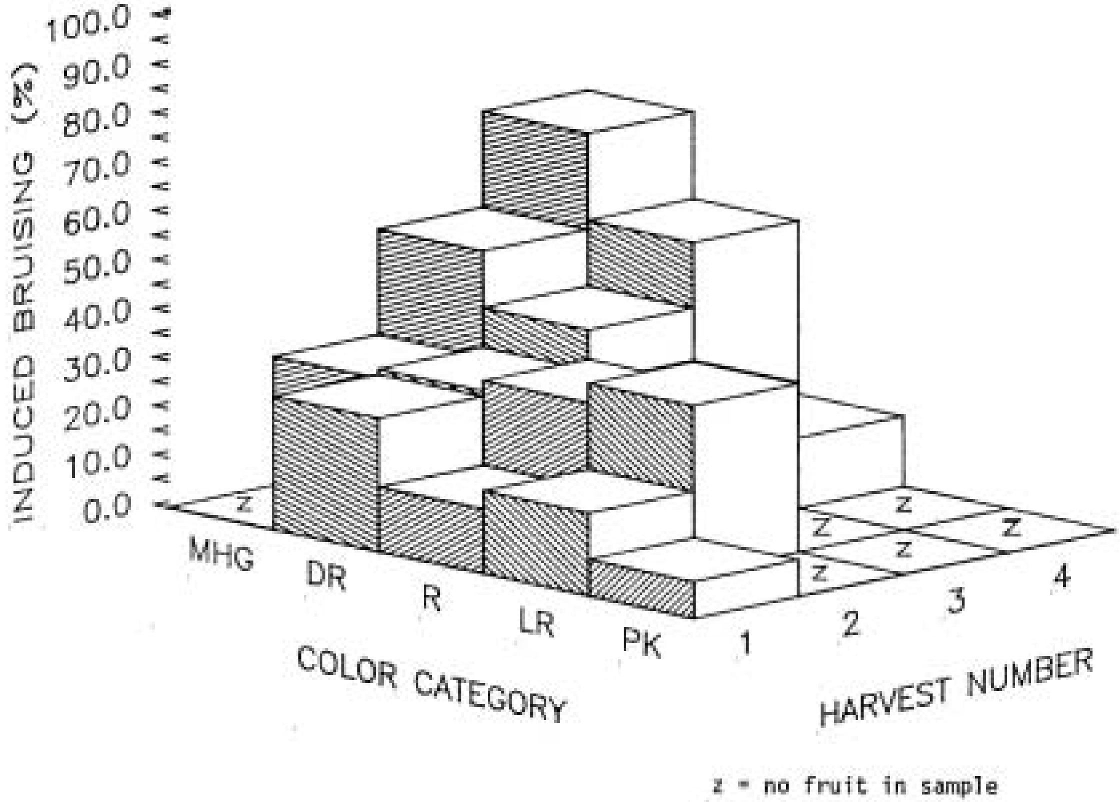


Figure 2. Damage susceptibility as related to fruit color and harvest timing. From Murphey, 1988.

Literature cited

Facteau, T. (1988). Improving Cherry Quality in the Proceedings of the 1988 Pacific Northwest Cherry Production Shortcourse. Washington State University. Pullman, WA. Pp 216-230.

Ing, G. and M. Ing (2000). 2000 Report: Statistical compilation of production, utilization, average prices and imports of sweet cherries. National Cherry Growers and Industries Foundation, Hood River, OR. 25 pp.

Kupferman, E. A Primer for Growing and Handling Fresh Market Quality Cherries. Washington State University Tree Fruit Research and Extension Center, Wenatchee, WA. 30 pp.

Looney, N.E. and P.D. Lidster (1980). Some growth regulator effects on fruit quality, mesocarp composition and susceptibility to postharvest surface marking of sweet cherries. J. Amer. Soc. Hort. Sci. 105:130-134.

Murphey, A. S. (1988). Changes in Cherry Maturation and Quality on the Tree in the Proceedings of the 1988 Pacific Northwest Cherry Production Shortcourse. Washington State University. Pullman, WA. pp 234-239.

Patten, K.D. , M.E. Patterson, E. Kupferman. (1983). Reduction of Surface Pitting in Sweet Cherries in Post Harvest Pomology Newsletter, May 1983. Vol. 1, No. 2. Washington State University Tree Fruit Research and Extension Center, Wenatchee, WA. 6 pp.

Thurlby, B.J. (2001). 2001 Northwest Cherry Promotion Review. Washington State Fruit Commission. Yakima, WA.