

## CRITICAL ASPECTS OF HARVEST AND QUALITY MANAGEMENT

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In the critical economic times when a modern grower considers when to harvest, the grower should take into account who buys the fruit, what it is that they want, and the quality they require. If these end-user components are not carefully considered the consumer is likely to be dissatisfied and unlikely to purchase again.

This way of thinking about harvest is different than in the past. Formerly, growers were told that fruit harvested early will have a longer storage life than fruit harvested more mature. This is still true. Growers were also told that the return on this fruit would be higher than fruit marketed earlier in the season. This may not be true in the current economic model (e.g., Gala), since an increasingly large amount of fruit is being brought in from the southern hemisphere. The apple world is changing (too fast some might say), and fruit marketed late in the season may not bring the best return—especially when that fruit is lower in color, sugars and size. We may even find that a 12-month-marketing season cannot be profitably sustained.

The modern approach to determining harvest maturity depends upon what is known about the likes and dislikes of apple consumers. This information is coming in from several sources, but I would like to focus on information gathered for our industry as reported by two groups of researchers, Dr. Roger Harker from New Zealand; and Drs. Paul Patterson and Tim Richards of Arizona State University.

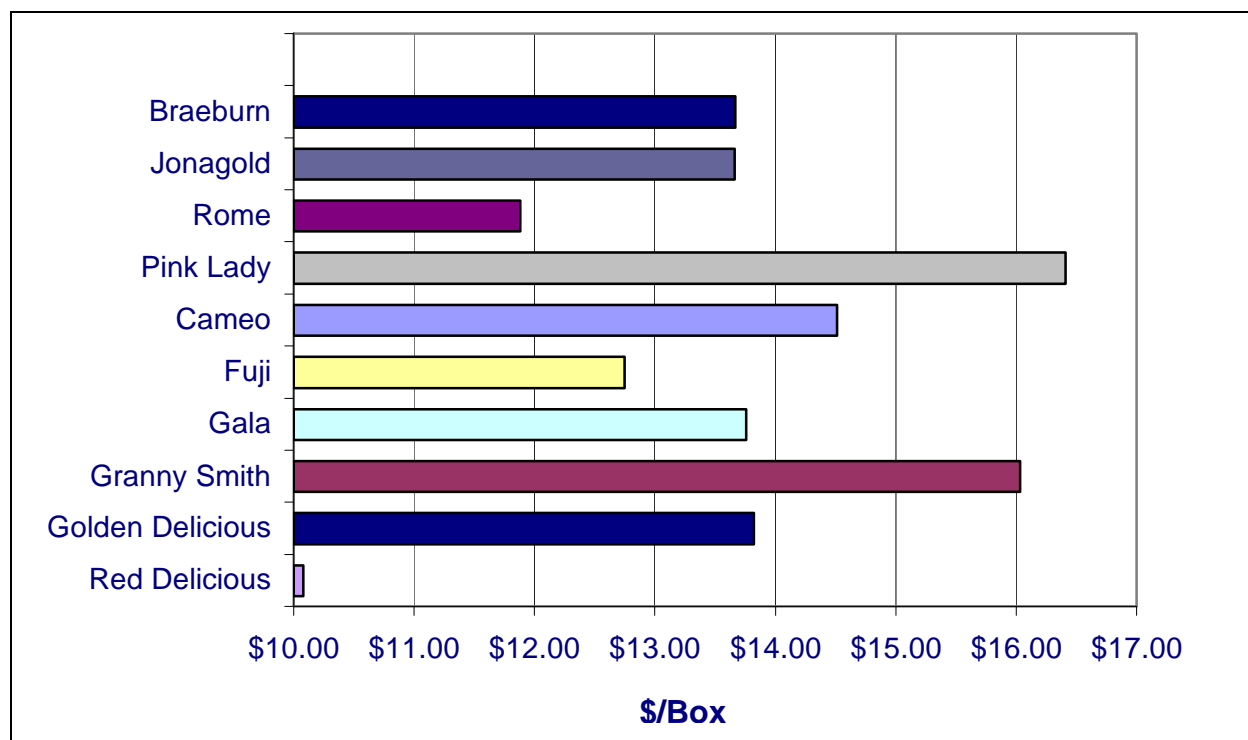
In a survey of almost 2,000 consumers Drs. Patterson and Richards (TRD Frameworks, 2001) reported that there are basically five types of apple consumers, ranging from the “Hard Cores” who eat apples regularly, are older, and like Red Delicious, to the “Experimenters” who eat many varieties of apples and like any variety so long as it is not Red. The bottom line is the expectations consumers fall into different categories and a successful marketer must learn which group they are dealing with.

Dr. Harker runs the sensory program of HortResearch in New Zealand, and was funded by the Washington Tree Fruit Research Commission to bring us up to date on what the world knows about apple consumers. As a result of his study of this information, he has suggested minimum standards for apples at time of consumption. These standards move beyond just firmness (Washington Grade Standards) and appearance to include firmness, soluble solids and starch. At time of consumption most consumers would be accepting of apples when the firmness is above 14 lbf, the soluble solids is above 12% and starch is below 4 on a 0 to 6 scale. Note that these are the levels at which most consumers would accept apples, not necessarily enjoy or like the apples.

An alternative definition of ‘quality’ is the right variety, the right size, the right color, sold into the right market at the right time. Let’s examine this definition by looking at information provided by the Growers Clearinghouse from last year’s (2000) marketing season.

**The right variety:** the return to a grower for Pink Lady® brand apples and Granny Smith dwarfed that of Red Delicious, Fuji or Rome on a per box basis (Figure 1). This does not speak to yield and can be misleading since it is far more difficult to obtain a high yield from Pink Lady® brand apples than from Granny Smith. It is obvious that Red Delicious cannot be grown profitably even when yields are up if it is not the correct strain.

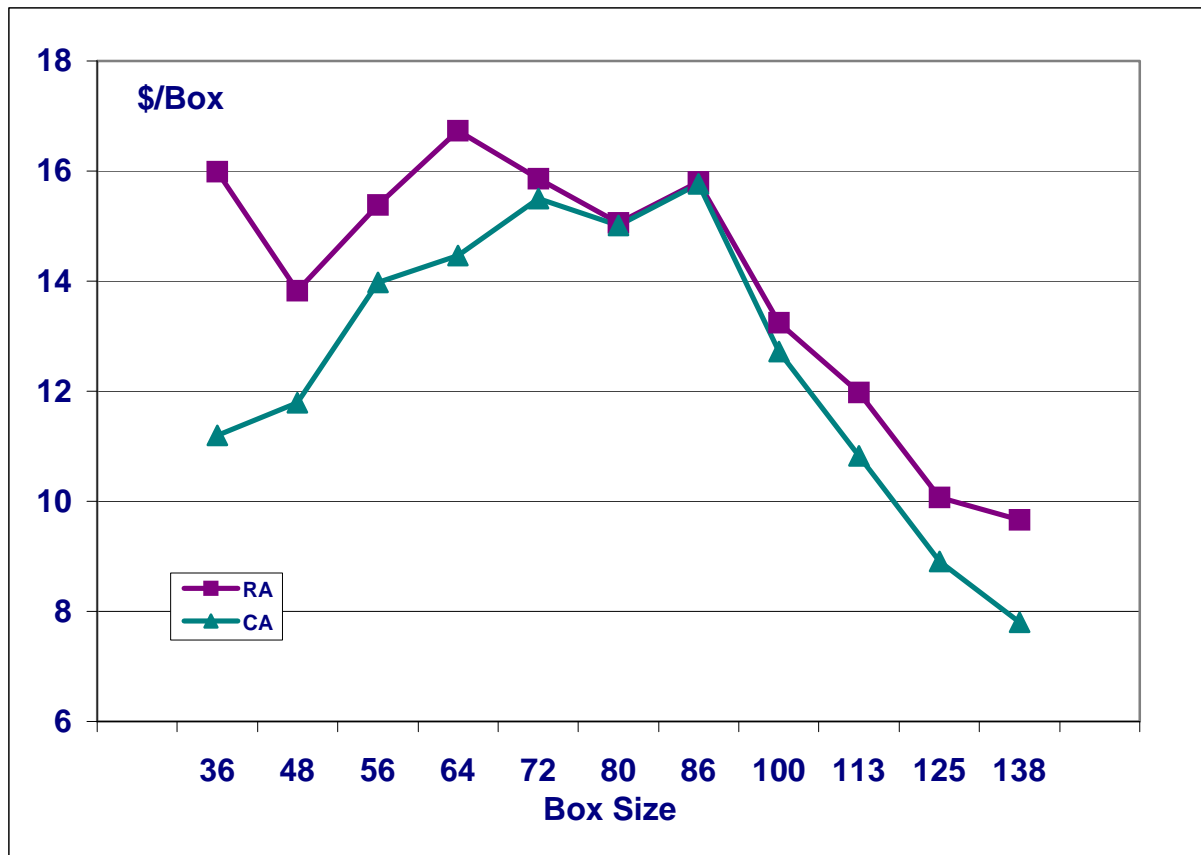
**Figure 1.** Returns based on variety for the 2000 crop (Growers Clearinghouse, 2000).



**The right size:** larger size fruit returns more than small fruit (Figure 2). Returns for Galas from the 2000 harvest size 110 and above were greater than \$14/box while smaller fruit returned as low as \$8/box. A similar situation existed with Fujis. Why harvest small fruit? It certainly is not profitable.

**The right color:** color paid a premium—even in 2000 (Figure 3). While the difference between WAXF and USXF in Red Delicious was less than \$2/box, the same difference in Fujis was almost \$5/box more and Gala was just under \$6/box additional. Growers must optimize the development of color to be profitable.

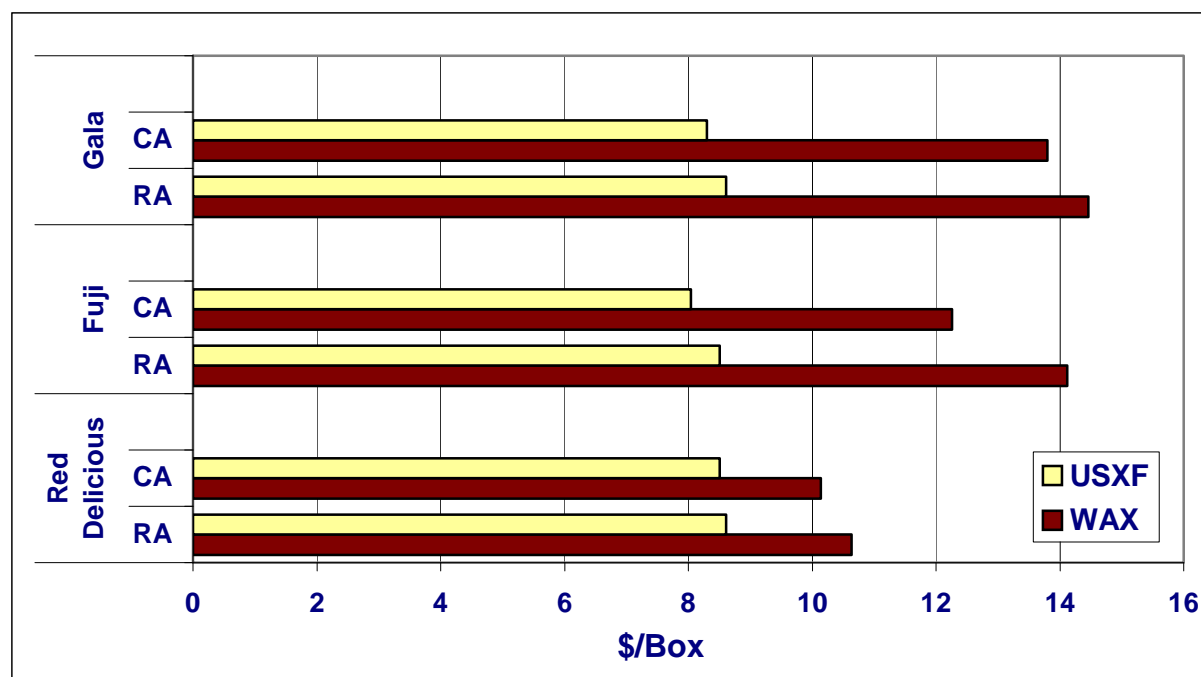
**The right time:** Per box returns for the very early marketed fruit is higher than that of fruit sold from Oct to May. This is very dramatic with Gala and Fuji and much less so with Red Delicious. There appears to be a dampening of profitability from very long term CA of Red Delicious. Much can be learned from the information available from the Grower’s Clearing House. I urge you to review their data.

**Figure 2.** Returns based on fruit size for the 2000 crop (Growers Clearinghouse, 2000).

So if the argument is made that consumers prefer apples with certain firmness, soluble solids and acid levels why doesn't the market reward growers for providing this type of fruit? The reason lies in the inability of the packing process to distinguish between fruit of low and high firmness or solids levels. It is easy to sort and sell on color and size. It is much more difficult to sort on the basis of firmness and sugar levels—until now. Recent developments in packing technology will provide the industry with the ability to first sort for soluble solids content and soon will allow for the sorting of fruit on the basis of firmness—all done nondestructively. Growers will now need to know how to grow firm fruit with high sugar content to obtain the highest returns.

Scientists, economists and consumers tell of the importance of 'edibility' to apple sales. Consumer studies are showing that unless an apple is firm enough it will not be satisfactory. An apple that is not firm will be dismissed immediately. Once the firmness of the apple is acceptable it is then evaluated on the basis of sugar and acidity. How firm is firm enough is under investigation.

To optimize edible as well as visual quality the grower must optimize variety/strain, fruit size, color, firmness and sugars.

**Figure 3.** Returns based on color for the 2000 crop (Growers Clearinghouse, 2000).

Variety selection must be based on site suitability. A variety is adapted to a site when the apples have excellent appearance (including color and finish), at the same time in the season that internal quality is optimum. Two growers of the same cultivar will end up with very different fruit in appearance and edible quality due in a large part to the influence of site. Site includes soil, slope and temperature profile (both early season and late season).

Fruit size is affected by competition between fruits. Action taken or not taken in pruning and thinning can seriously affect fruit size.

Red color is based on the amount of a plant pigment called anthocyanin. “Good” red color depends on the degradation of chlorophyll and an increase in anthocyanins. This occurs as fruit mature (5-fold increase), with light (both amount and wavelength) and temperatures (below 60 °F and negated by temperatures above 90 °F). Nitrogen can reduce red color, especially when it is applied late in the growing season. Potassium can promote red color in some orchards, possibly only on deficient trees, and may increase bitterpit.

Some growers have been applying very low levels of Ethephon to trees within the last 6 weeks of the growing season to stimulate the degradation of chlorophyll. The application may shorten storage life. Other growers are bagging every apple on the tree or using reflective cloth, both very expensive methods. Evaporative cooling is also a method of reducing tree stress and increasing color. The worst method of increasing red color is to delay harvest beyond the fruit’s internal quality resulting in a red apple not worth eating.

Apple firmness is affected by fruit size and the amount of nitrogen applied. Large fruit are softer than smaller fruit and are made even softer by high nitrogen levels in the fruit. Leaf analysis is an excellent method of determining the nitrogen level in the tree. Firmness can also be affected

by irrigation management. Consulting information provided by WSU Extension can be one way of determining how much water should be given and at which parts of the season extra water should be applied. Excessive water at the end of the season can reduce fruit firmness. Again, evaluating the firmness of the fruit at harvest against color development may help pinpoint the fact that strain may not be suited to the site.

Sugars depend upon the leaf to fruit ratio. Fruit that is grown on a tree with mineral balance and adequate exposure to light will be sweeter. Sugars depend upon the leaf to fruit ratio. Photosynthesis is the process of making sugars and is done most efficiently by leaf tissue. Sugars are then moved to the fruit. Every fruit must have its complement of leaves within a short distance to accumulate sugars. Sunlight is obviously essential to this process and light penetration throughout the canopy will optimize photosynthesis. Mineral (fertilizer) balance determines leaf size and small leaves do not make a lot of sugar.

Harvest maturity should be judged by considering both the internal quality of the apple and the external appearance. Growers of high quality fruit rely upon multiple factors including starch clearing, firmness, skin color and background color to determine when to harvest. They look at the rate of change as well as the absolute values. They harvest only saleable fruit leaving the rest of the fruit in the orchard or picked later for processing.

Again, a variety is adapted to a site when the internal and external maturity factors converge. If you have trouble maturity a high quality product at a specific site consider changing cultivars. In the future competition will increase, not decrease as fruit is evaluated for firmness, soluble solids as well as appearance.