MINIMIZING BRUISING IN APPLES

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Bruising has been a problem since apples were first harvested. In my files I found a report by Dick Bartram, former Chelan County Extension agent, who traveled the country examining Washington apple quality in 1982 in which he recorded the large number of bruised apples on retail shelves. A group of postharvest scientists found that the problem was still dominant just two years ago. Bruising is still the most serious disorder on retail shelves (Figure 1).

This season I have received a number of calls from conscientious packers who are seeing bruising on apples before packing, and even more after packing. There are two factors that influence bruising: impacts and compression. Impact bruising is the most common type, in which fruit are subjected to damage by dropping onto a hard surface. Impact damage is influenced by the surface onto which the fruit fall and the speed of the fruit at time of impact. The other type of damage is compression damage in which fruit are bruised as they are pushed into a bin or bag.

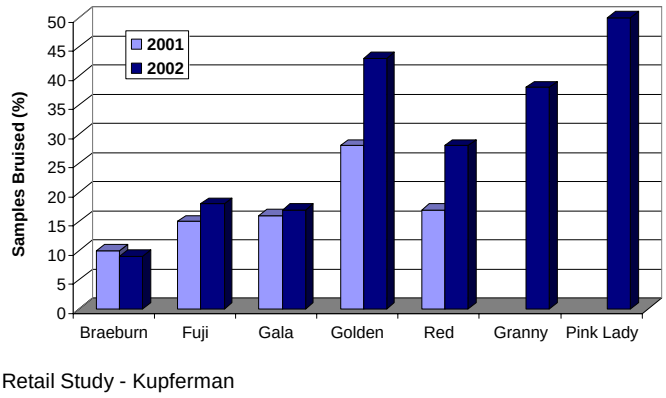

Figure 1. Percentage of bruised apples purchased at 24 markets in 7 states across the United States.

Preharvest factors—some cultivars are more susceptible to bruising than others—no variety is immune. Red Delicious has a reputation that it will resist bruising. This is only partially true as we found out when we peeled several thousand fruit after packing. Numerous small bruises were found in the flesh that could not be seen through the skin. Dr. Gary Hyde (WSU) determined that the bruise susceptibility of Red Delicious was actually greater than that of Golden Delicious. The belief that Golden Delicious is more susceptible stems from the fact that it discolors more easily. A standardized bruise study in the UK ranked Gala and Jonagold more susceptible to bruising than Golden. The portion of the apple with green skin bruised more easily than the portion with red color.

Harvest factors—harvest maturity alone does not influence bruising, but large fruit bruise more easily than smaller fruit. Harvesting activities play a major role in bruise development. Fruit harvested wet will show numerous finger bruises and higher bruising will occur when pickers are wearing gloves. Picking into padded buckets will reduce harvest bruising compared to picking into a soft sided bag or unpadded bucket.

The method of harvest, the dumping of fruit from picking bags and the swamping of the bins in the orchard play huge roles in the amount of bruising. In one study, rough filling of an unpadded bin resulted in 89% bruised fruit; adding a foam pad reduced this to 64%, compared to gentle

filling which bruised 28% of the apples. The pad did not reduce bruising when the bin was filled gently.

Scientists in Michigan demonstrated that bin pads reduced bruising by a ¼ to ½, and most bruising occurred when the bin was carried on the back of the tractor rather than the front. The most serious bruising occurred on fruit at the sides of the bin where the fruit is in contact with the wooden surface. Bruise (impact) damage was most severe in the bin furthest from the tractor. Moving fruit from the orchard to the packinghouse can be another source of bruising. Trucks equipped with air suspension had fewer bruised fruit than those equipped with spring suspension. These studies suggest that 35% of bruising occurs during harvesting and hauling.

Storage factors—a study on Delicious and Granny Smith determined that the longer they are stored, the more susceptible to bruising they become. Packers notice that the fruit from certain rooms are more susceptible to bruising than others. This can be traced back to the humidity within the room. Newer rooms are airtight and are run with a minimum number of defrost cycles to minimize moisture loss as a way to prevent shrivel. Fruit from these rooms develop tremendous internal turgor pressure and are very susceptible to bruising. Packers have developed various methods of 'conditioning' this fruit to allow for a controlled amount of moisture to be lost by the fruit to reduce the susceptibility to bruising.

Some methods of conditioning include increasing the number of defrost cycles, opening the doors and increasing the temperature, or placing the bins in a warm room before packing. It is easy to remove a small amount of moisture, but difficult to ensure that all fruit in a bin are affected equally. It is very difficult to re-hydrate shriveled fruit, even when they are immersed in water (i.e., presize) so caution is advised. There is no uniform method and most packers use a number of techniques.

Temperature and humidity at time of bruising—Dr. Hyde, working with Red and Golden Delicious, found the colder the apple the higher the bruise susceptibility. Manipulating fruit moisture is more powerful than temperature. He determined that by slightly dehydrating the fruit (2-3%) the bruise threshold will double. Firmness is not a good reflection of bruise susceptibility since over 5 weeks in storage fruit had lower firmness levels, but bruise susceptibility did not change. The effect of temperature and fruit turgor was less than the effect of the impact force hitting the fruit; thus it is more important to reduce bruise impact points than to change the fruit.

After injury the bruise will be larger if the fruit remains at a higher temperature; another reason to cool fruit rapidly after packing.

Packingline factors—Simple things like using pads to cushion drops, reduce elevation changes, and minimize turns in the line can help reduce bruising. An instrumented pseudo apple was developed in Michigan that can precisely measure the impact forces on apples. This 'Impact Recording Device' (Instrumented Sphere) is available from Techmark, Inc. (www.techmark-inc.com) and has been used by packers to survey their lines to minimize bruising.

The use of this device enabled Dr. Hyde to survey a number of Washington apple lines. He found that in general damage was less when the equipment was full of fruit. The brush section can cause small bruises and the brush speeds used for Reds provided more impact than the speeds for Goldens. Transfer points can provide impact damage and analysis of every drop is necessary. Drops of 30 cm or greater cause damage to about ¾ of the fruit.

Bagging—has been cited in several reports as the most dangerous packing operation far as bruising is concerned. This is no surprise to anyone who has looked a hand bagging operation. Automatic bagging machines should have a cushion on top of the plate supporting the bag; even a shag rug will help.

Decay development—bruising increases the susceptibility of fruit to blue mold decay, which is found in most packinghouses. Even a bruise not visible to the naked eye can assist the organism in gaining entry into the fruit.

In summary—bruise reduction is everyone's business. Pickers must be carefully supervised. Bins must be transported carefully within the orchard and to the packinghouse. Fruit must be stored carefully to avoid shrivel or excessive turgor. Fruit should be conditioned prior to packing. The packingline must be carefully monitored; transfer points evaluated and drops padded. Equipment must be properly adjusted so that transfers are gentle, especially into the singulator. Fruit acceleration and deceleration must be carefully controlled to avoid impact damage. Modern packing equipment can be superior to that used previously, IF the equipment is adjusted properly and speed is appropriate. There is a balance between through-put and minimization of bruises. What we can do to prevent the retail clerk from bruising fruit as they are building displays, or fruit buyers from handling fruit roughly is another story. I guess we must send them our best fruit and hope that the retailer does their part.

Reprints of a number of studies on bruising can be obtained by contacting me at: Kupfer@wsu.edu. Much of the information cited here comes from studies done at Michigan State University and USDA-ARS, Michigan as well by Dr. Gary Hyde (retired) at WSU.