Honeycrisp Maturity Guidelines for Western NY

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This work was funded in part by the New York Apple Research and Development Program

Harvest date of Honeycrisp has a large influence on fruit storage quality and the susceptibly to various postharvest disorders such as off-flavor development, the chilling disorder soft scald, superficial scald, and soggy breakdown. This project was done to establish harvest maturity guidelines to minimize the postharvest problems and maintain fruit quality.

Honeycrisp has been widely planted by growers in New York because of the potential for premium pricing. However, problems with bitter pit, both pre- and-post harvest, off-flavor development, and development of the chilling disorder soft scald, superficial scald and soggy breakdown during storage, have been of concern to growers and packers. In addition, packouts have been reduced due to susceptibility of the fruit to skin cracking, stem punctures and cuts, which occur at various stages of the handling process. However, because Honeycrisp is such a new variety, relatively little is known about proper harvest timing and maturity and quality indices that may be useful to determine the optimal harvest window, and how these relate especially to skin-related problems. In 2001, a two-year trial was initiated to provide guidelines for Honeycrisp harvest windows using Honeycrisp in Western New York. Factors that are associated with soft scald, soggy breakdown and bitter pit risk in Honeycrisp, and methods that can control these disorders, are discussed in associated articles.

Methods and Materials

Fruit samples from five Honeycrisp blocks in the Western NY area were harvested every three to four days over a three-week period in 2001 and 2002. Trees in the five blocks ranged in age from 4 to 9 years, and the same orchards were used in both years of the trial. Five trees in each orchard block were flagged off and left unharvested by the growers. Sample collection started when the fruit were at early stages of maturity and ended when fruit were over-mature. Only fruit with the most red color were selected at each sampling. On each sample date, 12 fruit were assessed for maturity by measuring internal ethylene concentration (IEC), starch index using the Cornell starch chart, firmness and soluble solids content (SSC). An additional 30-35 apples were collected and placed in regular air storage at 35°F-36°F in the first month in storage, and then 33°F-34°F for the remainder of the storage period. On Dec 5 in 2001, and January 10 in 2002, fruit were removed from storage

Honeycrisp apples on display for the taste panel evaluations in December 2001. Samples show ideal blush and background color at the time of optimal harvest. Culls appear on the table next to each sample date.

Stem punctures and cracks at harvest caused invasion by *Penicillium expansum* (Blue mold) during cold storage. Punctures and cracks can result in a high percentage of unmarketable fruit if Honeycrisp is harvested late or handled roughly.

September 2001						
						1
2	3	4	5	6	7	8
9	10	11	12 BHD	13	14	15 BHD
16	17	18 BHD	19	20	21	22
23	24	25	26	27	28	29
30	1	2	3	4	5	6

Figure 1. The acceptable harvest period for five Honeycrisp blocks in Western NY in 2001 ranged from Sept. 8 to Sept 20. The single best harvest dates (BHD) occurred on Sept. 12 (one block), Sept. 15 (two blocks), and Sept. 18 (two blocks). Individual blocks remained in acceptable condition for an average of 11 days. Acceptability was determined by a 16-member taste panel based on appearance and eating quality after fruit was stored until December 2, 2001 and held at room temperature for three days.

September 2002						
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24 BHD	25	26	27	28 BHD
29	30	1	2	3	4	5

Figure 2. The acceptable harvest period for five Honeycrisp blocks in Western NY in 2002 ranged from Sept. 14 to Oct. 1. The single best harvest dates (BHD) occurred on Sept. 24 for two blocks, and Sept. 28 for three blocks. Individual blocks remained in acceptable condition for an average of 13 days. Acceptability was determined by a 16-member taste panel based on appearance and eating quality after fruit was stored until January 6, 2003 and held at room temperature for three days.

and assessed for the occurrence of disorders and defects. A 16- to 18-member panel comprised of storage operators, packers, growers, extension faculty and agents evaluated the samples for appearance and eating quality after keeping the fruit for three days at 70°F. The panelists judged each sample as acceptable or not acceptable, and then rated the top three samples for each individual orchard block. The information from the panelists allowed us to determine the ideal harvest window in each year, and to relate post storage eating quality to maturity factors at harvest. The remaining samples were then tested for firmness and SSC on the day of the panelist evaluations.

Best Harvest Date

Best harvest date: In 2001, the best harvest dates for the five orchard blocks were between Sept. 12 and Sept. 18 (Fig. 1). The acceptable harvest period ranged from Sept. 8 to 20, but only lasted for a period of 11 days on average for individual blocks. Fruit harvested before the first acceptable harvest date lacked flavor development and were too green. Fruit harvested after the last acceptable harvest date were over mature and typically had off flavors or poor texture. Based on taste panel evaluations, Sept. 12 to 20 appeared to be the ideal harvest window for Honeycrisp in 2001.

In 2002, fruit matured 7 to 10 days later compared with 2001, and the best harvest dates ranged from Sept. 24 to Sept. 28 (Fig. 2). The acceptable harvest period fell between Sept. 14 and Oct. 1, considerably longer than the previous year, and averaged 13 days for individual blocks. Even though the single best harvest dates occurred in late September in 2002, fruit was acceptable for harvest much earlier than those dates. The ideal harvest window for the five blocks occurred between Sept. 17 and Sept. 28 based on taste panel assessments.

Honeycrisp is an apple that must be spot picked for best quality, and our results indicate that growers have about two weeks to harvest fruit of acceptable condition. In any given year, growers should expect to spot pick Honeycrisp three or more times between the second and fourth week of September, but maturity testing must be incorporated to more clearly define the harvest window. In 2001, fruit harvested in the fourth week of September were overmature and at higher risk of developing disorders.

Harvest Indices

Starch Index: In 2001, the average starch index moved from 7.0 to 7.7 during the period of best harvest dates, Sept. 12 – 18 (Figure. 3). Fruit became acceptable for harvest when the average starch index reached 6.9 for the five blocks.

In 2002, the average starch index moved from 7.5 and 7.8 during the period of best harvest dates (Sept. 24 – 28). Blocks were judged acceptable for harvest once the average starch index reached 6.7 units, a similar value that of the previous year.

Starch index changes were similar in both years, but overall index values were high, indicating that starch hydrolysis was well advanced at the time of optimal harvest. Therefore, it is difficult to determine a lower and upper starch range for identifying the harvest window of Honeycrisp, and the starch index is less useful for this variety than for others. Nevertheless, the data from this trial suggest growers in Western New York should not begin harvesting Honeycrisp until the reddest colored fruit have reached a starch index of 7. After that point, growers can choose to spot pick once a certain percentage of the crop has obtained acceptable color. Although in some cases the amount of fruit judged acceptable for

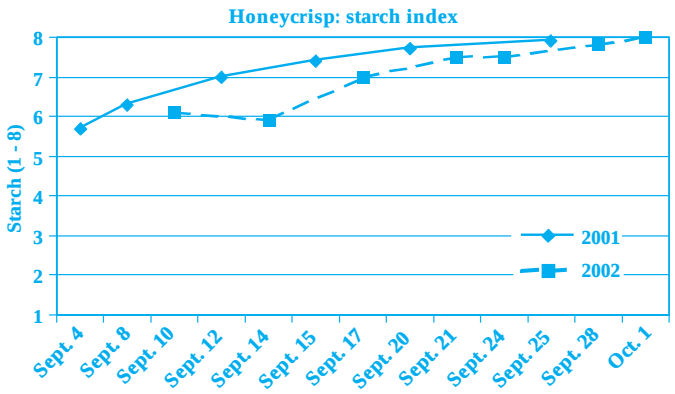

Figure 3. Average starch index of five Honeycrisp blocks in 2001 and 2002. Red colored fruit became acceptable for harvest once the starch index approached 7.0 and remained in acceptable condition even after the starch reserve was depleted. Average of five orchard blocks.

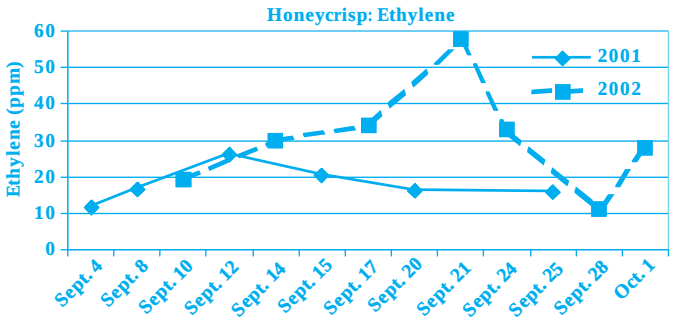

Figure 4. Internal ethylene production of four Honeycrisp blocks at harvest. Best harvest dates occurred on or after peak ethylene production in both years.

harvest may be less than 25% at the time of the first spot pick, it should be harvested.

Some orchards may have fruit in optimal condition even after the starch reserve has been totally depleted (starch index = 8), so one cannot use the upper range of the starch index to assume over maturity. It is important to remember that only the red colored fruit should be sampled for starch testing since red fruit are typically more mature than green fruit on the same tree.

Ethylene: In 2001, internal ethylene steadily increased to a high of 27 ppm on Sept. 12, and then decreased and leveled off after Sept. 20 (Fig. 4). In 2002, ethylene increased continually until reaching a peak of 59 ppm on Sept. 21, and then dropped off sharply after that date. The ethylene peak was 9 days later in 2002, again providing evidence that maturity was delayed compared with 2001.

Ethylene production in Honeycrisp is different from many other varieties because it does not increase autocatalytically. In both years, ethylene reached a peak and then decreased over time which is unusual since most apple varieties continue to produce higher amounts of ethylene as maturity advances. Interestingly enough, best harvest dates in both years occurred on, or within seven days following, the peak of ethylene production. It is generally assumed apples should be picked prior to the onset of ethylene production for best storage quality. Honeycrisp, however, does not seem to follow this trend, and storage quality appears unaffected by ethylene at harvest. Furthermore, ethylene induced fruit drop was not a problem in either year of the experiment even in orchards that produced over 60 ppm ethylene. This suggests that Honeycrisp is inherently resistant to preharvest fruit drop under Western NY conditions, even when ethylene levels are high.

Firmness: Fruit firmness decreased 2.5 lbs. over the three-week harvest period in both years (Fig. 5). This decline in firmness occurred at a much slower rate compared with other varieties that tend to soften rapidly near harvest. During the period of acceptable harvest dates, fruit firmness typically ranged from 13.5 to 15.0 lbs. at harvest.

Honeycrisp is unique in its ability to maintain firmness in regular storage conditions. Firmness loss in storage was negligible in 2001, while fruit lost only about 0.5 lbs. during storage in 2002 (Fig. 5). This may have been because of the additional month of storage in 2002.

The pressure test does not always reflect acceptability of this variety accurately, probably because of the unique texture characteristics of Honeycrisp. Nevertheless, acceptance ratings declined once firmness levels dropped below 13.0 lbs. Therefore, growers should attempt to harvest Honeycrisp above 13.5 lbs. allowing for some firmness loss in storage. Meeting this threshold should be relatively easy for most blocks, except possibly where excessive fruit size is a problem. Since harvesting fruit at high firmness is not a critical factor for Honeycrisp, growers will have greater flexibility to make harvest decisions based on other factors.

Soluble Solids: There was little gain in soluble solids content (SSC) over the three-week harvest period in either year. SSC varied in individual blocks from 12 to 14%, and this appeared to be related to

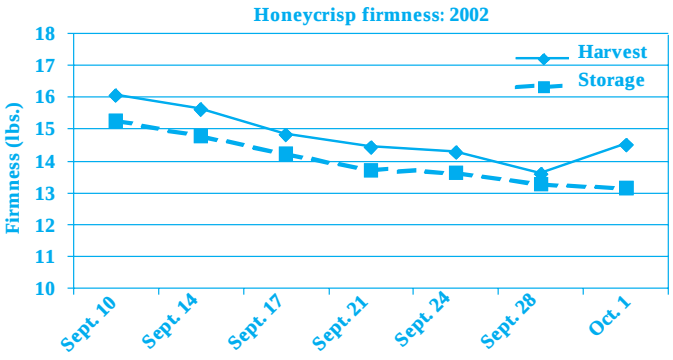

Figure 5. Honeycrisp firmness at harvest and after removal from storage in January 2003. Firmness dropped slowly over the harvest period, and declined only 0.5 lbs. in cold storage. Average of five orchard blocks.

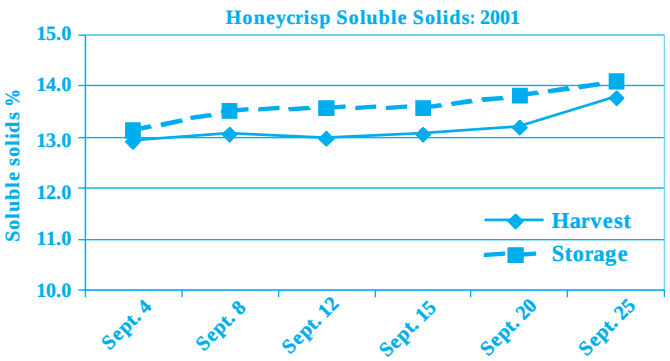

Figure 6. Soluble solids at harvest and after removal from storage in December 2001. Soluble solids did not increase much over the harvest period and increased by 0.5% in storage. No increase was found after storage in the 2002 trial. Average of five orchard blocks.

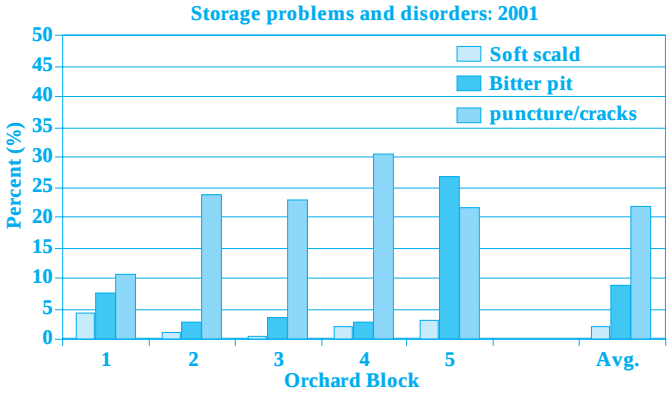

Figure 7. Percent soft scald, bitter pit, stem punctures/cracks for each of the individual orchard blocks after storage until December 2001. There was wide variation in occurrence between orchards for each disorder. Punctures/cracks were the most serious problem. A similar trend was found in 2002.

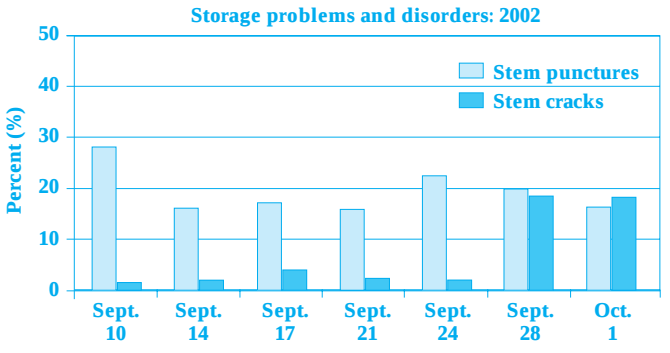

Figure 8. Honeycrisp stem punctures and stem cracks over the harvest period in 2002. Stem punctures were unaffected by harvest date, but stem cracks increased with later harvests. A similar trend was found in 2001. Average of five orchard blocks.

crop load more than any other factor. It would be reasonable to expect little increase in SSC by delaying harvest in a typical year.

SSC increased about 0.5% during storage in 2001 (Fig. 6), but not in 2002 (data not shown), and during the period of acceptable harvest dates, SSC ranged from 13.to 14% after storage in both years. The blocks that were rated highest for eating quality had SSC above 13%, while blocks that rated lowest typically had contents below 13%. Since SSC does not increase much as the fruit mature, harvest should not be delayed in anticipation of greater SSC accumulation. Achieving higher SSC can probably be best achieved by regulating crop load early in the season.

Storage and Condition Problems

The most common problems of Honeycrisp apples after storage were stem cracks and stem punctures (Fig. 7). Depending on the orchard, the combination of stem cracks and punctures ranged from 10 to 30% in each year. Stem punctures were not related to harvest timing, but stem cracks became worse with later harvest dates (Fig. 8). Stem cracks occurred while the fruit was on the tree, and were particularly noticeable on late harvested fruit after a heavy rain. Cracking may occur because the cuticle cannot keep up with the rate of expansion while fruits continue to grow.

Stem punctures appeared to occur for two primary reasons: 1) Honeycrisp stems are very rigid and thick. Some apples produce long stems that puncture other fruit when dropped in to the picking basket or bin. 2) Some fruit have very short stems that detach from the spur deep down inside the stem bowl of the apple. The sharp pointed bud located on the spur for next year's crop can puncture the skin in the stem bowl or shoulder when the apple is twisted from the spur at harvest. This type of puncture often goes undetected at harvest, or when the fruit is packed soon after harvest, but the wound ultimately becomes infected by fungi causing a visible black mark during storage. With this type of defect, the apple is usually culled out during packing.

Bitter pit was a problem in some blocks and ranged from 2 to 28% (Fig. 7). Harvest date did not affect bitter pit development. A wide variation in bitter pit occurrence among orchard blocks is quite common and typically depends on several factors such as crop load, soil water status, soil fertility and calcium availability, and the use of foliar calcium sprays. The incidence of bitter pit was greatly reduced in blocks where foliar calcium sprays were applied.

Soft scald was not severe in either year of this trial and typically averaged 2% or less (Figure. 7). This disorder is a form of chilling injury that is caused by storing fruit at too low a temperature, and can be minimized by harvesting fruit at the correct maturity and storage at elevated temperatures (36°F to 38°F). In general, we find less soft scald development in Honeycrisp from Western New York than in fruit from the Champlain at similar maturities, but the elevated storage temperature used for this trial also could explain the relative absence of this disorder. We encourage use of warmer storage temperatures for the Honeycrisp variety.

Rot was not a major problem in this trial and typically ranged from 0 to 3% for individual blocks. Rot caused by *Penicillium expansum* (Blue mold), appeared to occur in fruit that had cracks or stem punctures. Since stem cracking was more severe on later harvested fruit, rot tended to increase with later harvests as well. Storing fruit with considerable amounts of cracks and punctures is likely to result in a higher incidence of rot in storage and lower packouts.

Conclusions

1. The optimum harvest period for Western New York Honeycrisp is the second to the fourth week of September, but the optimum period within this harvest window can vary according to growing season. Honeycrisp maturity can fluctuate considerably from year to year due to seasonal variation. The precise harvest windows for each orchard block must be identified using a combination of harvest index testing and visual observations.

2. Honeycrisp must be spot-picked, at least three to four times during the harvest window. The need for multiple spot picks will require flexibility in harvest management since Honeycrisp maturity overlaps that of McIntosh. Moreover, earlier spot picks may overlap with Gala, while later ones may overlap with Cortland and Aceymac.

3. Our results suggest that Western New York-grown Honeycrisp should be harvested when the reddest colored fruit have reached a starch index of 7 (Cornell starch chart). For best post-storage eating quality, fruit should be harvested with a minimum firmness of 13.5 lbs and at least 13% soluble solids. Other factors that should be considered are the presence of varietal flavor and change in background color from green to cream yellow. Flesh texture also takes on a buttery color when the fruit are ripe.

4. Special care is needed when harvesting and handling this variety to minimize damage due to skin punctures. There is no easy solution to this problem, but growers should supervise pickers closely to avoid unacceptable amounts of punctures. If pickers are paid hourly, they should be allowed to harvest fruit at a pace that will minimize rough handling. Honeycrisp should be handled more like a McIntosh than a Rome, and while this may slow harvest, the result will be greater pack-out percentages and thus profitability.

5. Skin cracking is mostly a problem of late harvested fruit and can be reduced by harvesting at the proper maturity. If the fruit are ripe and rain is in the forecast, it will be well worth the effort to harvest before the wetting event.

6. Honeycrisp maintains acceptable texture and eating quality for a relatively long time on the tree, and preharvest fruit drop is only a minor concern in Western NY. However, harvest should not be delayed beyond optimal maturity for better color development. The greater risks associated with late harvest such as development of alcoholic flavors, increased susceptibility to stem end cracking, soft scald development in storage, degradation of the cuticle layer, and higher rot potential, resulting in reduced pack out and lower returns to the grower.

Acknowledgements

Special thanks to Dave Kast, Lamont Fruit Farms, and Peter Russell for their collaboration and donation of fruit, and to Bill Gerling for storing the samples and hosting the panel evaluations. We also thank Terence Robinson for participating in this trial and collecting samples from the Geneva station orchard.

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