Fruit Notes

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Fruit Notes

Editors: Wesley R. Autio & Winfred P. Cowgill, Jr.

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Correspondence should be sent to:

Fruit Notes
Stockbridge School of Agriculture
205 Bowditch Hall
University of Massachusetts Amherst
Amherst, MA 01003

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Cover: Developing nuts on a hazelnut tree in New Jersey. Tom Molnar photo.

Hazelnuts, A Potential New Crop for the Northeast: An Update on the Rutgers University Breeding Program

Megan Muehlbauer and Thomas Molnar
Department of Plant Biology and Pathology, Rutgers University

Rutgers University is committed to developing hazelnuts as a new commercial crop for New Jersey and the northeastern states. Hazelnuts rank fifth in tree nut production worldwide, behind cashews, walnuts, almonds, and chestnuts. We feel confident that new selections of hazelnut will be adapted for commercial production.

Having said that, the Rutgers hazelnut breeding program is still 2-3 years away from releasing our first Eastern Filbert Blight (EFB)-resistant cultivar. We are waiting for results of regional yield trials to make our final decisions. Our ultimate goal is to identify plants that will be consistently productive, disease-resistant, and well-adapted to a multitude of locations across the northeast states.

Turkey is the world's leading hazelnut grower, producing over 70% of the world's crop in some years. Only 4-5% of the world's crop is produced in the United States, 99% of which is grown in the Willamette Valley of Oregon (Figures 1 and 2). Commercial production of hazelnut has been limited in the eastern United States due to the fungal disease eastern filbert blight (EFB), which is endemic to this region. Today, this disease is also present in Oregon and adds significant expense and challenge to hazelnut production. It should be noted that EFB in not present anywhere in the world outside of North America.

The limitation for eastern growers of hazelnuts is

Figure 1. A hazelnut seedling block in the breeding program at Rutgers University. Photo credit: Thomas Molnar.

Table 1. The genetic populations resolved by simple sequence repeat markers when evaluating over 300 hazelnut cultivars and seedlings, and the number of eastern filbert blight-resistant accessions placed in each.

Table 1-Genetic Population/Group	Number of Eastern Filbert Blight resistant trees
Wild population 1	5
Wild Population 2	2
Wild Population 3	11
American x European hybrid group	44
Black Sea group 1	28
Black Sea group 2	25
Gellately hybrid group	15
Wild European species group	26
Spanish-Italian group	9
Moscow group	33
Central European group	25

the disease, Eastern filbert blight, which causes large cankers that girdle stems, which typically kill susceptible trees within a few years of infection. Although expensive fungicides and rigorous pruning regimes can be used to manage the disease, genetic resistance is the most promising and sustainable method of control. See the Hazelnut article in the Spring 2013 Issue of Horticultural News or Fruit Notes.

The Rutgers hazelnut breeding program has numerous promising selections that have resistance to EFB and look promising for adaptation in the Northeast.

History of the Rutgers Breeding Program

The hazelnut breeding program at Rutgers University, in close collaboration with Oregon State University, has made great strides over the past 10 years in identifying sources of resistance to EFB. Many of these resistant plants have come from seed collection trips made across the former Soviet Union, Eastern Europe, and Turkey. In many cases, nuts were simply purchased from local markets in rural areas where the European hazelnut is grown in backyard gardens. The nuts were brought back to Rutgers and germinated Resulting seedlings were grown in fields exposed to high levels of the disease. While most trees died, around 2% were found to be resistant or highly tolerant. The best of these disease-resistant trees are now being used in the Rutgers breeding program to develop cold-hardy, productive plants adapted to the northeastern United States (See Figure 1).

A study published in the July 2014 issue of the Journal of the American Society for Horticultural Science titled "Characterization of Eastern Filbert Blight-resistant Hazelnut Germplasm using Microsatellite Markers" illustrates the latest molecular tools being used at Rutgers University to elucidate the genetic relationships and origins of the new plants. The study included over 100 of the new seedlings as well as a wide representation of the world's hazelnut germplasm (cultivars from Turkey, Italy, Spain, France, Germany, etc.). The goal was to place the origin of the new seedlings and assess how they were related since many of them come from open-pollinated seed and have largely unknown origins.

In summary, the study grouped the collection of over 300 total plants into 11 distinct genetic populations (Table 1). It was found that seedlings from similar origins tended to group together with known cultivars of similar origins, providing support that the new plant material was regionally distinct and representative of local germplasm. Interestingly, each of the 11 "populations" held EFB-resistant seedlings and cultivars, which shows that EFB-resistance is found across a very wide diversity of plant material. This information has significant value for hazelnut breeders, as it suggests that disease resistance can be maintained in breeding efforts without sacrificing genetic diversity. Further, several of the genetic "populations" were comprised largely of the new EFB-resistant seedlings, suggesting that new sources of resistance were identified or, at the very least, resistance was found in plants from distinctly different genetic backgrounds.

In addition, the new genetic information can assist breeders in choosing which plants to keep or cull out of the breeding program to save field space and better manage large collections of trees. For example, Figure 2 shows three promising disease-resistant accessions

Figure 2. New eastern filbert blight-resistant hazelnut accessions from Russia and Crimea in comparison to known cultivars. Top row from left to right : Holmskij Market #1-1 (Holmskij, Russia), Simferopol Market #1B-3 (Simferopol, Crimea), and Nikita Botanical Garden #1-3 (Yalta, Crimea). Bottom row from left to right: 'Santiam', 'Barcelona', and 'Gasaway'. The genetic study showed that the top three accessions, although collected from different regions, were very closely related.

with improved nut quality (top row) in comparison to known cultivars (bottom row). Through the results of this study, it was shown that all three new seedlings are closely related despite being from different collection origins. Thus, only the best one of the three will be used in future breeding efforts, which frees valuable field space and helps concentrates breeding efforts towards using resistant plants from diverse genetic sources.

Female hazelnut flowers

Male hazelnut catkins shed pollen in late winter.

University of Massachusetts Fruit IPM Report 2014

Daniel Cooley, Arthur Tuttle, Jon Clements, Sonia Schloemann, and Elizabeth Garofalo
University of Massachusetts Amherst

Most specific observations made at the UMass Cold Spring Orchard in Belchertown, MA.

Winter harkened back to the winters of the 1970's: long and cold and snowy. Minus 8º F recorded at Belchertown on 4-January, but -10º to -15º F temperatures were likely experienced in many orchards. Some damage to stone fruit buds was anticipated.

Spring lagged compared to average but not too many complained about it. Apple green tip was April 14, full bloom approximately May 13. It was a long time between green tip and bloom, and near-record mid-April cold may have done some damage to buds. McIntosh petals were off by May 19. Pictures of bud stages are archived on the UMass Fruit Advisor (http://www.umassfruit.com). It was becoming apparent at this time that mid-winter and/or early spring bud injury to stone fruit would take a toll, although depending on site and variety, a peach crop was still anticipated.

Summer was seasonal, with abundant sun and near average rainfall. Irrigation was only necessary on an occasional basis. Hail hit a few unfortunate orchards. The maximum temperature was 89ºF on July 23. A coolish and sunny August lead to good, early color development of apples.

The peach crop was down state-wide because of mid-winter or early-spring cold damage to buds. Some peach blocks on colder sites had absolutely no bloom. Some damage (die-back) to scaffold limbs and sometimes whole trees was noted. Peaches were of good quality and sold briskly, which was a change from last year when production was high and the market went flat towards the end of the peach season.

Apple harvest started about right on schedule. Most growers felt production was going to be overall down. McIntosh and Cortland in particular were on the lighter side. Most likely the trees were taking a year "off" after the heavy crop in 2013. But the crop was very orchard-dependent, some growers having a very good crop. Little pre-harvest drop was reported. Before Columbus Day weekend some orchards were already closed to PYO.

Figure 1. Fire blight symptoms in apple observed and the severity of infections realized in very early June, 2014 in Massachusetts.

Depending on interpretation of beginning and end of primary scab season and model used, there were 6-10 primary apple scab infection periods in 2014. Many growers commented it seemed like an "easy" scab management season with clearly defined infection periods and relatively good spraying weather. During the middle of May (around bloom of course) there was a protracted period of wetting which presented

the biggest scab control challenge. A few orchards got into trouble with scab, however, most achieved good control of our most prevalent disease problem in the New England – well, until this year with fire blight!

Fireblight, this was your year. After a mostly no-show in 2013, fire blight (FB) hit many orchards in MA, CT, RI, and NH with a vengeance. There were signs of a problem beginning around May 9-10, and growers who heeded Extension and consultant alerts of a moderate to high FB infection risk and applied streptomycin (two times) got away relatively unscathed. Growers without a history of FB who did not apply antibiotic generally got FB. McIntosh was hit quite hard, as well as Paulared, and most other varieties susceptible to FB had it to varying degrees. Somewhat surprisingly, not much fire blight was observed in Honeycrisp apple or in pears. At the UMass Orchard, whole young Golden Delicious trees were lost to fire blight, and it is suspected that further tree mortality is occurring in M.9 EMLA rootstock infected with fire blight. Growers spent considerable time in June removing fire blight strikes, and there was no doubt a significant economic impact across the board. Hopefully, now that most everyone has experienced fire blight, they will get on an annual fire blight management program (http://bit.ly/1ty4lfq) and pay particular attention to the FB risk level during bloom.

Figure 2. Adult brown marmorated stink bug (BMSB) caught in pheromone trap in central Massachusetts orchard in early September, 2014.

The Massachusetts NEWA network (http://newa.cornell.edu) includes 21 on-site weather station/ orchards (plus 23 airports, total 44 locations) providing fruit and vegetable growers with daily developmental models (including forecasts) to aid in decision-making for management of insect and disease pests. Some of these locations were a centerpiece for providing Extension team-based IPM recommendations on diversified fruit & vegetable farms via the Extension IPM (eIPM) Project, which also provided training in monitoring and management of key pests to nine mentor growers, twelve partner growers, and seven collaborator growers across Massachusetts. Mentor growers worked on 2-3 key IPM issues over the course of 10 farms visits and 5 months and were involved with twilight meetings and project guidance. Partner growers were involved with one research/ extension project over a shorter period of time. Collaborators were part of scouting networks.

Overall insect pressure was average, with nothing particularly noteworthy to report. The University of Massachusetts eIPM team, with the assistance of growers and independent scouts around the state, maintained and monitored nineteen brown marmorated stink bug (BMSB) traps. Two different traps were used. One, the small green plastic rocket was placed either in a fruiting tree and the other a large, free standing, black pyramid was placed at the base of a fruiting tree. Two different pheromones were used, one developed by the USDA meant to attract BMSB specifically and the other a commercially available lure intended for stink bugs in general. Trapping began in early June and ended in early October. The first confirmed sighting was August 12, in Worcester County. While

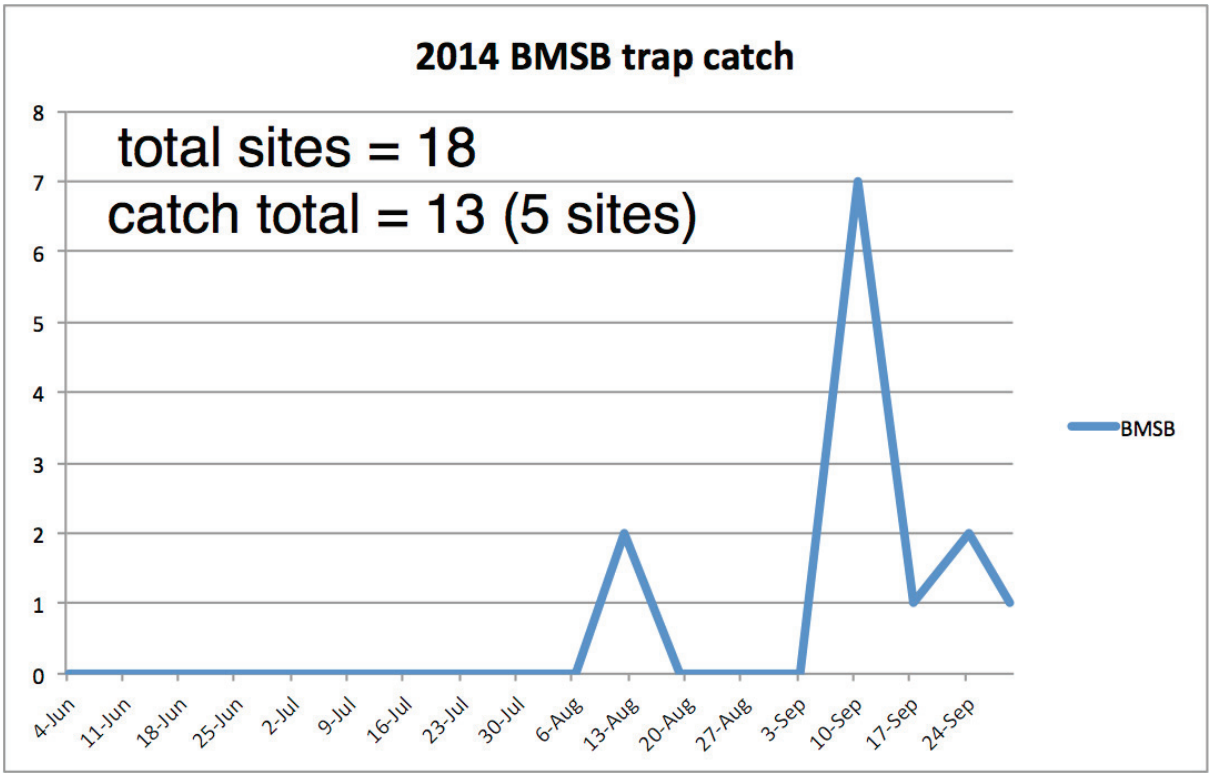


Figure 3. Season-long brown marmorated stink (BMSB) trap catch in Massachusetts in 2014.

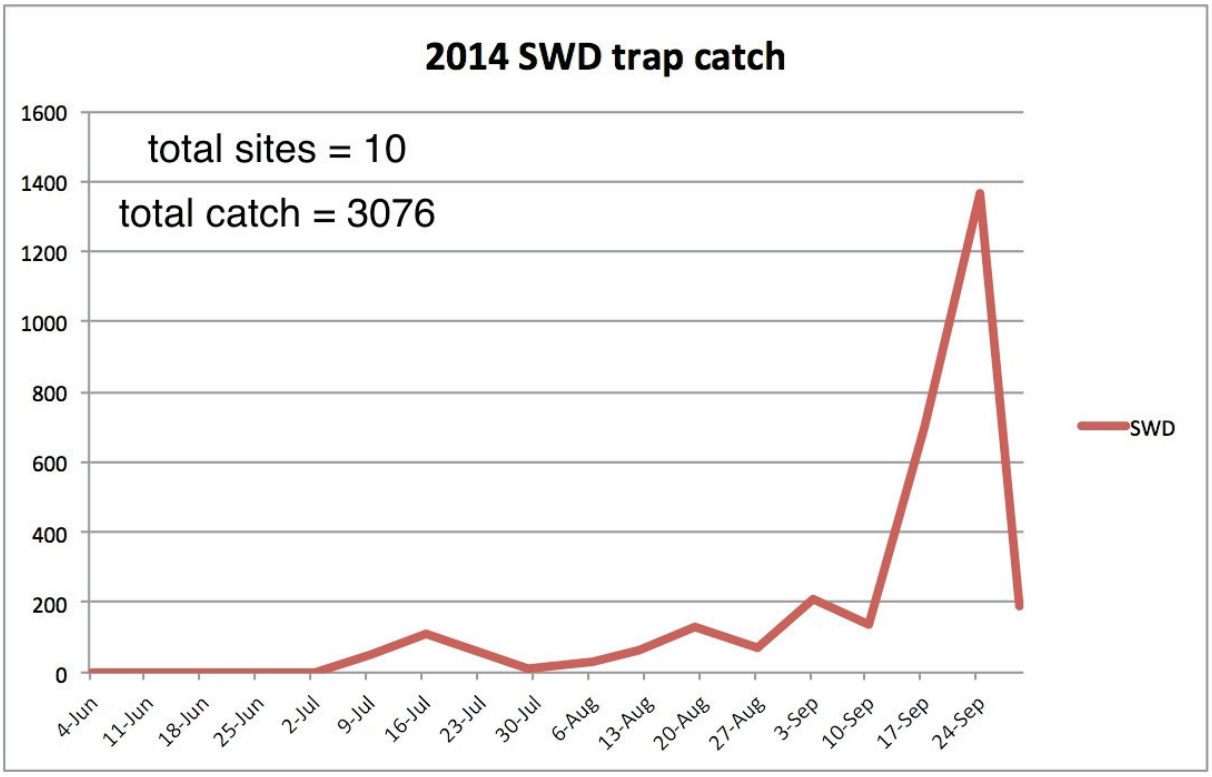


Figure 4. Season-long spotted wing drosophila (SWD) seasonal trap catch in Massachusetts in 2014.

trap captures were not high (13 total from 5 sites), this pest remains of concern to growers in Massachusetts. It is suspected that there are small resident populations developing in orchards (and on farms), and it is just a matter of time before real economic damage occurs. It may already be occurring, either by native stink bugs and/or BMSB, however BMSB has not been observed "loose" in the orchard. One outcome of BMSB trapping/monitoring has been increased awareness of native stink bugs (brown, green, dusky, etc.) and likely damage they are causing in orchards. A dedicated BMSB information page was maintained on the UMass Fruit Advisor.

Spotted Wing Drosophila (SWD) got off to a slow start in 2014, but the numbers ramped up significantly in early September. Again, a statewide trapping and monitoring program was in-place by UMass Extension and partially funded by the Massachusetts Department of Agricultural Resources. Aggressive management of SWD where present using insecticides was commonplace. A dedicated SWD web page was maintained on the UMass Fruit Advisor.

Figure 5. 'Z-Trap' (Spensa Technologies, spensatech.com) automated pheromone traps deployed at UMass Cold Spring to monitor Oriental fruit moth, codling moth, and oblique-banded leafroller. Z-traps were used with Spensa's MyTraps to automatically monitor adult flight of these moths and set biofix.

A Northeast SARE funded study, Towards Sustainable Disease Management in Northeastern Apples using Risk Forecasts and Cultural Controls continued with 19 commercial orchards in New England and University/extension research facilities in MA, NH, and ME. Collaborating scientists are William MacHardy, Cheryl Smith, and George Hamilton of NH and Glen Koehler and Renae Moran of ME. Scab sanitation strategies, advances in the delayed first scab spray strategy (delay until pink), PAD counts, and spring ascospore trapping and maturation were the foci of the study. This was the last field season and results are being summarized and reported.

We also participated in the fifth year of an SCRI (Specialty Crops Research Initiative) study, Manipulating Host- and Mate-finding Behavior of Plum Curculio: Development of a Multi-Life Stage Management Strategy for a Key Fruit Pest. We created a colony of PC from June-dropped apples, performed "trap-tree" experiments for PC management at one orchard in New England, and participated in a nematode bio-control study. Tracy Leskey, USDA-ARS Kearneysville is the project director.

There were approximately 30 research/data-collection/demonstration trials/plots at the UMass Cold Spring Orchard in 2014. Research projects included: the use of plant growth regulators for crop load management, growth control, and stop-drop; using Decision Aid Systems for managing apple scab; apple and peach rootstock plantings; apple, peach, cherry Asian pear, and grape variety and planting system evaluation; improving young apple tree growth and branching with fertigation and hormones; precision apple thinning; Z-Trap demonstration; and Apta (Nichino) new insecticide demonstration.

Five growing season Twilight Meetings for commercial tree fruit growers were held in Massachusetts, Rhode Island (in cooperation with the Rhode Island Fruit Growers' Association), and New Hampshire (in cooperation with the University of New Hampshire) during April, May and June. *Healthy Fruit* was published 19 times from April-September with timely integrated pest management information for pome and stone fruit. The Massachusetts Fruit Growers' Association Summer Meeting was held at the UMass Cold Spring Orchard with USDA's Tracy Leskey the featured speaker on new monitoring and management strategies for plum curculio, brown marmorated stink bug, and spotted wing drosophila.

Controlling Bacterial Canker of Cherry

Winfred P. Cowgill, Jr.
New Jersey Agricultural Experiment Station

Bacterial Canker continues to be a serious bacterial disease of cherry in New Jersey as well as all other regions where the climate is humid. Bacterial canker has been very active this season in both sweet and tart cherry blocks.

Bacterial canker or bacterial gummosis of sweet cherry is caused by several *Pseudomonas* bacteria. This disease infects flower buds and spurs. It can completely kill new spurs and leaves and then move into the trunk on cherry. This is especially problematic with trees on the new Geslia rootstocks, as losing a scaffold or getting infection into the trunk will limit production as the tree rapidly declines. We should avoid large, dormant pruning cuts and use summer pruning to minimize the impact of the disease. For an extensive collection of videos describing how to prune sweet cherry, see http://www.giselacherry.com/

Control with Copper as a Bordeaux Mix is preferred. Cankers get started mainly in the fall after most of the leaves have fallen and the trees are

Bacterial Canker on a 4-year-old sweet cherry tree at the Rutgers Snyder Farm. Note the brown/amber exudate in the trunk at the top of the photo. Photo Credit: Win Cowgill.

beginning to go dormant. The only effective way to control this disease is to reduce the inoculum before the trees enter their susceptible period. The bacteria that start these cankers are found on the surfaces of mature leaves and other green tissues, and do not come from existing cankers.

The only successful control that I have found is repeated applications of the Bordeaux mixture in September, October, and November, repeated again in the spring. Bordeaux Mix consists of hydrated lime (builders lime) and copper sulfate. The rates and methods of mixing are important. We begin our sprays the second week in September.

Note, however, that sprays of Bordeaux applied to green leaves must be saftened with vegetable oil (Canola) to avoid burning the foliage. Four additional sprays 14 days apart will be applied. Bordeaux mix will also be applied in the spring with several applications before bud break.

It is my observation to date that if any bacterial canker is observed in sweet cherry trees, it is best to plan a spray program of Bordeaux Mix.

Mixing Bordeaux. Copper sulfate – Use only powdered copper sulfate (bluestone or blue vitriol), often referred to as copper sulfate "snow," because it is finely ground and dissolves relatively quickly in water. Ordinary lump copper sulfate is not satisfactory. Make sure to store copper sulfate snow in a dry place. Moist snow becomes lumpy and is difficult to work through the screen into the tank. Use copper sulfate registered to make Bordeaux mixture. Lime – To prepare tank-mix Bordeaux, use only good quality *hydrated lime* (calcium hydroxide) also called *builders lime.* The hydrated lime should be fresh, that is, not carbonated by prolonged exposure to air. Hydrated lime is stable and usually is readily available under several trade names. Magnesium lime, a mixture of Ca(OH)2 and Mg(OH)2, may also be used.

Bordeaux formulas are stated as three hyphenated numbers: 8-8-100. The first number refers to the pounds of bluestone (copper sulfate), the second number to the pounds of spray (hydrated) lime, and the last number to the gallons of water to be used. Thus, an 8-8-100 Bordeaux contains 8 pounds of copper sulfate, 8 pounds of spray lime, and 100 gallons water.

Have your tank one half full of water and the agitation turned on, then add the copper sulfate or copper sulfate solution, then the hydrated lime solution, and then add the Canola Oil at 2.8 quarts/100 gallons to saften the mix.

Other Coppers. In a research trial at the Rutgers Snyder Farm, Champ DP copper was also evaluated compared to Bordeaux mix for phytotoxicity on cherry. The oil equally saftened Champ DP as it did Bordeaux. Please note that Champ2 Flowable may not be compatible with the vegetable oils, and all copper mixes should be jar tested before adding to your spray tank. There are numerous other copper formulations. For a complete discussion of copper fungicides, see Dr. Dave Rosenberger's article on the risks and benefits of tree-fruit copper sprays:

http://www.northeastipm.org/neipm/assets/File/TFWG-Rosenberger-3copper.pdf

In our humid climate in New Jersey (and Massachusetts), the cankers can continue to develop in lateral branches and the central leader. In some cases the cankers have grown to girdle and kill 2-year-old wood. I have observed central leader dieback as a result. In older wood, the canker looks very much like a fireblight in apple. In most cases, the canker begins to ooze a brown to amber exudate. It appears that under our humid conditions this disease is very hard to control and can be devastating if control measures and the proper horticultural practices are not followed. This bacterial disease is most troublesome in young plantings where it can cause loses of up to ten percent of the trees. On mature trees, it can reduce yields from 10–50%.

Many growers who did not think they had bacterial canker are beginning to see it on three- and four-year-old trees.

The source of inoculum may come from wild cherry trees in our hedgerows, black cherry; *Prunus serotina,* may be one source of inoculum for *Pseudomonas* during wind and rainstorms in the spring and summer months. Removal may be beneficial.

Preferences for Fresh Apples in El Salvador and Central America

Mildred L. Alvarado, Wesley R. Autio, Richard T. Rogers, and Francis X. Mangan,
University of Massachusetts Amherst

Central America has seen a dramatic increase of more than 100% in apple importation over the last 5 years. According to Foreign Trade Statistics in 2005, Central America imported $14.9 million in apples from the United States, while in 2009, this value grew substantially to $31.5 million. In 2010, 50% of the apples imported by Central America were from the United States, which supplies those countries with apples primarily from September to February. From March to September, most apples come from Chile. From the United States, the primary states which exported apples to these countries were Washington, Pennsylvania, California, Oregon, Michigan, Virginia, and Maryland. Massachusetts is not a primary apple exporter to Central America and may therefore be missing out on a lucrative market. The main goal of this research was to determine Central American apple consumers' preferences in order to assess the best method of introducing apples from Massachusetts into the Central American market.

Several supermarket chains, wholesalers and local markets in El Salvador were visited and assessed as to apple sources, prices, varieties, presentation, and sizes. A survey was also conducted to obtain the primary information with a focus on end-users and distribution channels in El Salvador. Convenience sampling and a

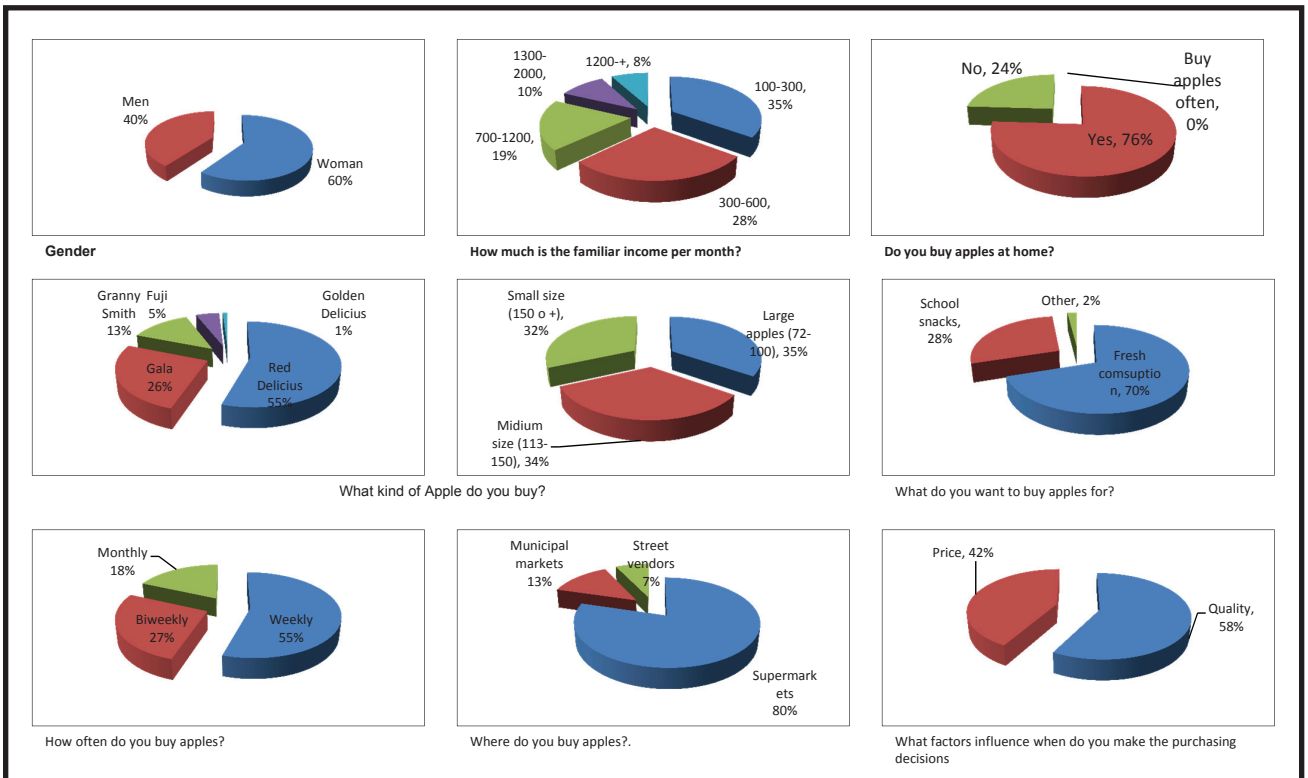


Figure 1. Customer surveys of apple preferences in El Salvador. These results are based on surveys of 165 individuals.

non-probability method were used as an effort to reach a representative target population without prior classification of age, gender, or income level. This survey consisted of fourteen structured questions regarding gender, age range, family size, monthly family income, and the types of fresh apples purchased. It was conducted in a shopping mall in El Salvador during the summer of 2010, and a total of 165 respondents were surveyed.

Of the 165 respondents, 76% buy apples regularly, while 24% do not. Of those who do not buy apples regularly, 33% said that they buy apples only around the Christmas holidays, 21% said that they do not eat apples regularly, 15% said that they do not buy apples because of the high price in marketplaces, and 4% said that they cannot buy apples because of their low income. Of those who buy apples regularly, 35% of respondents prefer large apples, 34% prefer medium apples, and 32% prefer small apples. According to standard variety names, 55% buy Delicious, 26% buy Gala, 13% buy Granny Smith, 5% buy Fuji, and 1% buy Golden Delicious. When asked how often they buy apples, 45% of respondents buy weekly, 22% buy biweekly, 15% buy monthly and 12% buy only for special events. The average amount of apples purchased in one trip is 2.4 pounds. Eighteen percent of respondents said that they prefer to buy apples packaged in bags, and 82% prefer to buy apples in bulk. Of those who regularly purchase apples, 78% buy apples in supermarkets, 13% buy in municipal marketplaces, 5% buy from street vendors, and 2% buy apples on buses. About 70% of the people who took the survey like to buy apples to eat for fresh consumption at home, 28% like to buy apples to give their children (for school snacks, for example), and 2% purchase apples to cook apple pie, make vinegar, or make purée for babies. Fifty-eight percent of respondents reported that the quality of the apple has the greatest influence on their decision to purchase, however 42% of respondents stated that price is the main factor in their decision to purchase. Consumers in El Salvador do not care about the brand of the apple, nor its country or region of origin.

This research reveals that for Salvadorian consumers, the most important attributes when purchasing apples for personal consumption are visual quality, taste, firmness, size, and price. The typical Salvadorian consumer usually buys apples weekly in supermarkets, and most people buy during the Christmas Holidays. Medium and small-sized apples are preferred, as they are thought to be better for sharing with family members. Delicious and Gala are the varieties which are sold most frequently, and these varieties along with Granny Smith and Fuji have a large influence on sizes, prices and consumer preferences for apples in Central America. In terms of apple sources in El Salvador, the statistics show that Washington is the largest exporter of apples in the area, followed by California, Pennsylvania, Oregon, Michigan, and Virginia. Washington State continues to dominate the supply of apples in all of Central America with its most popular variety, Delicious. It could be stated that the Central American market is saturated with Delicious apples and that consumers do not have many other choices when buying apples. This situation gives opportunities to New England apple growers because apple varieties such as McIntosh, Empire, and Macoun have never been sold in Central American markets. Further studies are needed of varieties for Central American consumers.

Evaluating the Acceptance of McIntosh Apples in El Salvador

Mildred L. Alvarado, Wesley R. Autio, Richard T. Rogers, and Francis X. Mangan,
University of Massachusetts Amherst

Since 1970, apple exports from Massachusetts have declined substantially. While Massachusetts' exports are falling, Washington's exports are growing. Meanwhile, over the last five years, Central America has seen a dramatic growth in apple importation; however no apples from Massachusetts have been reported. This could be a result of the lack of information and lack of marketing research due to barriers such as language, culture, costs and others. The goal of the research presented in this was to evaluate the acceptance of McIntosh apples in El Salvador.

In order to determine the consumers' acceptance of McIntosh apples, ten bushels of U.S. Extra Fancy grade, 120-count size McIntosh apples from Carlson's Orchard in Massachusetts were shipped to El Salvador in December of 2010. Walmart of Central America and Mexico collaborated with this study by allowing the use of five stores in different market segments of El Salvador and by lending the services of employees to support the UMass team with the apple evaluation. In addition, a survey was conducted in the apple section of the produce area inside each store. Nine Spanish-speaking Salvadorians were trained to conduct the surveys, which were purposefully administered during Christmas time (December, 22, 23 and 24), since this is the time of greatest apple consumption in the El Salvadorian market. A McIntosh apple was given to each interviewee who was a current consumer of fresh apples. After eating the apple, each consumer completed the survey to assess its appearance, consisting of size, color, and quality, and then its taste, consisting of sweetness, tartness, juiciness, freshness, and texture. Having assessed these organoleptic characteristics, the interviewees were then asked to assess their current apple purchases in relation to the McIntosh apple. Each respondent was then asked if they would purchase McIntosh apples and if so, what size apple he or she preferred and what price they were willing to pay.

Figure 1. Consumers participating in McIntosh taste evaluations in a Walmart in El Salvador.

Of the 729 surveys conducted, all characteristics assessed (using a Likert scale) averaged above a rating of 8.0 (size 8.39, color 8.43, tartness 8.04, crispness 9.12, juiciness 9.45, and texture 9.19) (Figure 2). Consumers enjoyed the juiciness and the texture of the apple, followed by the crispness and its apparent quality. They also were attracted to the red and green colors of the apple, which gave them the sensation of Christmas time. The size and the sweet and tart flavors were also very well received.

In relation to the size that consumers like to buy, 4% preferred small sized (175 to 216 apples per

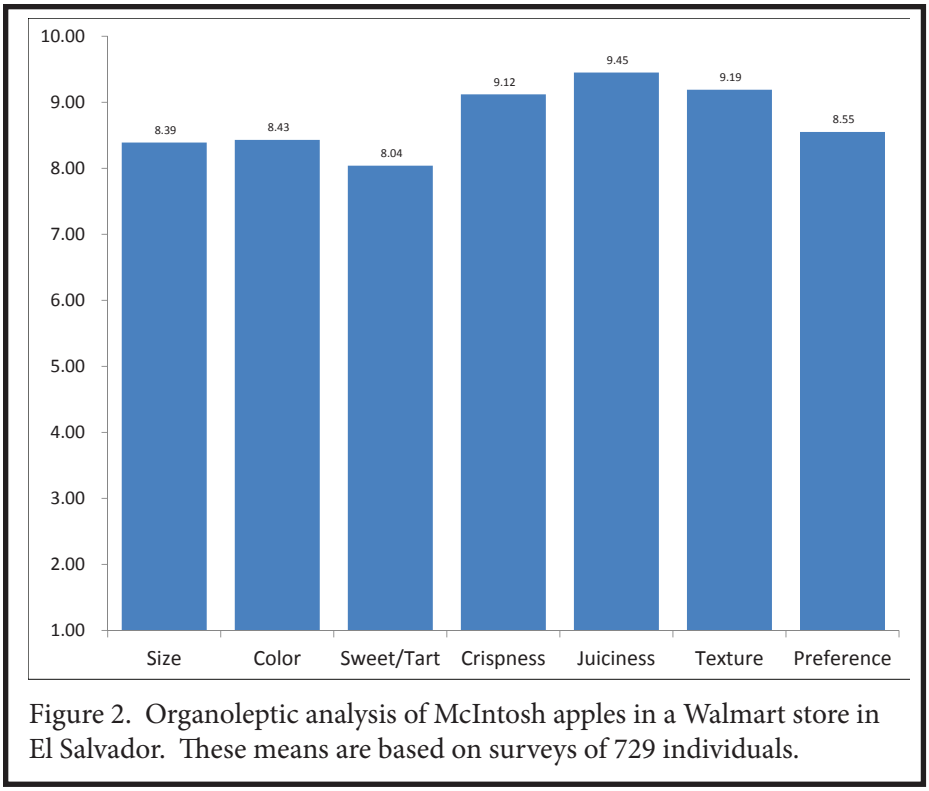


Figure 2. Organoleptic analysis of McIntosh apples in a Walmart store in El Salvador. These means are based on surveys of 729 individuals.

carton/count), 80% said they prefer to buy a mid-sized (120 to 150 apples per carton/count), and 16% reported liking the large sized apples (75 to 113 apples per carton/count). In response to whether or not the consumers preferred McIntosh to their current apple purchases, the mean of 729 surveys on a scale of 1 to 10 was 8.55, indicating a strong preference for this "new" variety. According to these results, preferences for McIntosh apples varied with income class. Almost all apple consumers preferred McIntosh apples, but the highest preference was observed with consumers of middle-income levels who are professionals that work in government or private offices. The apple size that this group of consumers preferred is medium, between 113 – 150 counts, yet color does not influence their apple purchases.

Massachusetts apple growers should try to reach middle-income consumers in El Salvador and Central America, as they have average to above-average income and they represent a large number of people. However, selling apples to middle-income consumers would put Massachusetts' apples in direct competition with several large firms that import apples.

This study revealed that Central American consumers are open to new apple varieties even if they have never seen them before. New England growers can provide considerable amounts of fresh McIntosh apples to the growing Central American apple market with the quality, appearance, flavor, and texture that consumers find desirable, according to this study. McIntosh apples sold to Central America may be preferred in the size categories of lesser demand in the US, specifically those between 113 and 150 count. There are also other Massachusetts and New England varieties that have potential in Central American markets, specifically the Macoun, Cortland, and Empire.

The main threat that Massachusetts growers may face in the Central American market is competition, mostly from apples grown in Washington and Chile. Additional competition is likely from other McIntosh-producing states, therefore the Massachusetts apples must be competitively priced. Relative to other apple-producing regions, Massachusetts orchards have lower yields per acre with higher costs per carton than the US national average. New England producers and wholesalers also lack knowledge of the language and culture of the Central American market, making further studies necessary to acquire information about pricing, competitiveness and exports in this market.

Exporting McIntosh Apples from Massachusetts to Central America

Mildred L. Alvarado, Wesley R. Autio, Richard T. Rogers, and Francis X. Mangan,
University of Massachusetts Amherst

If McIntosh is accepted by Central American consumers, can Massachusetts apple growers export to Central America profitably? In order to answer this question, all procedures were put in place to export approximately 16,000 pounds of McIntosh apples to El Salvador in November of 2012. To export apples from Massachusetts to Central America, wholesalers should have the facilities to pack high quality apples and should also be prepared to manage high-quality fruit for long-distance marketing, including the use of Smartfresh, controlled atmosphere storage, and the other best handling practices and administrative procedures for exporting. In addition, growers should be aware of the varying currencies of Central America, besides El Salvador, whose currency is the US dollar. Despite these factors, many apple wholesalers see opportunities in these markets. These opportunities are notably attractive to the New England region, where there is a surplus of small and medium-sized apples which are the preferred apples of Central American consumers (see previous articles in this issue). The decision to export apples from Massachusetts to Central America becomes increasingly attractive if significant profits are involved.

In order to give growers real information about revenues and prices, this research allocated all costs that were specific to export sale for McIntosh from Massachusetts to Central America, which included tariffs, tax liabilities, transportation costs, warehousing costs, and destination costs. With the current cost structure to export apples to Central America, this study also analyzed which barriers to entry of those markets could affect the apple exportation from Massachusetts to Central America and the price for McIntosh apples in those markets. Regarding what price buyers in Central America are willing to pay, and taking into account that New England apples had not been sold previously in Central America, this research used a pricing approach referred to as pricing at the market, which requires setting the price equal to other sellers. For New England apples, this is a good starting point to understand the apple market structure in these countries, since the Central American market is dominated by two large competitors (WA State and Chile).

Table 1 provides real costs of this shipment es-

Table 1. Costs through exporting one commercial container of McIntosh Apples in 2012 from MA to Central America

	Costs	Costs per lb	% Final Price	Costs	Cost per lb	% Final Price	Costs	Cost per lb	% Final Price
	2012			2011			2010		
Wholesale's FOB price	$ 36,260.00	$ 0.93	69%	$ 25,480.00	0.65	48%	$ 23,520.00	$ 0.60	44%
Sea freight and insurance	$ 5,980.00	$ 0.15		$ 5,980.00	0.15		$ 5,980.00	$ 0.15	
Landed Cost	$ 42,240.00	$ 1.08		$ 31,460.00	0.80		$ 29,500.00	$ 0.75	
Import tariff	$ 402.55	$ 0.01		$ 402.55	0.01		$ 402.55	$ 0.01	
Transportation costs		$ 0.16	12%		0.16	12%		$ 0.16	12%
CIF price plus tariff	$ 42,642.55	$ 1.09		$ 31,862.55	0.81		$ 29,902.55	$ 0.76	
Delays' costs	$ 2,307.35	$ 0.06	4%	$ 2,307.35	0.06	4%	$ 2,307.35	$ 0.06	4%
CIF plus cost for delays	$ 44,949.90	$ 1.15		$ 34,169.90	0.87		$ 32,209.90	$ 0.82	
Distributor purchase price	$ 30,909.20	$ 0.79		$ 30,909.20	0.79		$ 30,909.20	$ 0.79	
Total Incomes / losses	$ (14,040.70)	$ (0.36)	-31%	$ (3,260.70)	$ (0.08)	-10%	$ (1,300.70)	$ (0.03)	-4%
Distributor mark-up	$ 6,330.80	$ 0.16	12%	$ 6,330.80	0.16	12%	$ 6,330.80	$ 0.16	12%
Retailer purchase price	$ 37,240.00	$ 0.95		$ 37,240.00	0.95		$ 37,240.00	$ 0.95	
Retailer margin percent	$ 10,838.80	$ 0.28	20%	$ 10,838.80	0.28	20%	$ 10,838.80	$ 0.28	20%
13% (Domestic taxes)	$ 42,081.20	$ 1.07	13%	$ 42,081.20	1.07	13%	$ 42,081.20	$ 1.07	13%
Consumer purchase price	$ 52,920.00	$ 1.35	99%	$ 52,920.00	1.35	100%	$ 52,920.00	$ 1.35	102%

Source: Personal communication with growers, shippers, marketers and consumers (2011, 2012). Invoices obtained throughout each level of the vertical channel from Massachusetts to El Salvador (Nov, and Dec 2012)

timated for a container (980 cartons) of McIntosh apples to be shipped from Massachusetts to El Salvador. For example, in 2012 the average FOB (Free on Board) price in Massachusetts was $0.93 per pound, or $37.20 per carton. This nominal price was $11.20 more than in 2011. The logistics costs to transport a container (980 cartons) of apples from the eastern US to El Salvador included phytosanitary permits, pallets, temperature record, container, inland freight, ocean freight, and inspection, and were lower than a container shipped from Washington State to El Salvador. The total transportation cost via container shipment was $5,980 from Wilmington Port, Delaware to Port of Castilla, which took 8 days by sea, and then 2 days by land from Honduras to San Salvador without any delays. In El Salvador, local costs included fees for inspection, import license, customs services, and labor costs, for a total about $402.55. The total cost of the container in El Salvador for the importer was about $42,642.55 plus $2,307.35 in delay cost, having a final cost of approximately $45.86 per carton.

The apples comprised 85% of the cost, and logistics and transportation were 15%. Using the strategy of pricing at the market, the discovery price was found to be at a FOB price of $26.40 per 40-pound bushel. This value is close to the higher priced apples in El Salvador; however, McIntosh apples still face barriers while trying to enter Central American markets. Central America is dominated by three firms that account for more than 70% of the region's total apple sales, making the Central American apple market behave like an oligopoly with a monopolistic fringe. This means that importers and distribution firms in Central America compete on more than just price, spending large amounts of money on advertising, packaging, and other marketing strategies. This situation makes the introduction of a new apple variety more difficult when a direct channel is used to export, as there is much competition.

Another barrier to entry is the government's system, which delayed inspection by El Salvador's Customs. This caused the CIF price to increase significantly because of the cost of the container and the need to keep it refrigerated. The supermarket where the apples were sold hired a local distributor that did not use the best handling practices for McIntosh apples, which may or may not have been intentional.

The most important concern regarding exporting apples is how they are handled at their destination, so to avoid potential problems, it is recommended that growers or brokers negotiate a FOB price where the importer takes the risk in Central America. Growers should also work with supermarkets with a good reputation and all the facilities needed to maintain apple quality.
One last barrier to entry is the rising crime rate which affects many businesses in Central America.

Despite these barriers to entry, our results indicate that in the market, most Salvadorian and Central American consumers prefer apples from 113 to 172 count. This preference could be due to the income levels or family sizes, and the variety preference could be due to Washington State apples' influence in the Central American market. However, US consumers prefer bigger apples, which gives an opportunity to New England growers to implement a price discrimination strategy in these separate markets. It is recommended to market apples 113 count and smaller in Central America, but in order to introduce McIntosh, the population should first be educated about McIntosh apples. Other apple varieties that are already known in Central America should also be exported. In addition, it is also suggested to have a sales person in the target market to take care of the consumers and buyers relationships.

While marketing small apples to Central Americans, this study indicates that Massachusetts wholesalers could competitively price small apples, revealing that Massachusetts apple growers could export to Central American markets profitably.

Best Handling Practices to Export McIntosh Apples from Massachusetts to Central America

Mildred L. Alvarado, Wesley R. Autio, Richard T. Rogers, and Francis X. Mangan,
University of Massachusetts Amherst

In the previous articles of this series, we have suggested that there are currently opportunities for apple growers to export McIntosh apples to Central American markets. In this article, we wish to emphasize how best to handle apples from the grower through the Central American consumer such that apple export can be the most profitable.

Best handling practices (BHP) are known as the selection of the best technologies to be applied among a range of available pre-harvest and post-harvest technologies. When choosing technologies, the most significant factors mentioned by many researches are the product characteristics, the market distance and requirements, and the social and economic conditions of the actors involved. This article analyzes BHP for exporting McIntosh apples to Central America and how the actions of participants in the supply chain can affect the quality of McIntosh apples in Central America. In order to conduct this analysis, a commercial container of McIntosh apples was shipped to the primary importers in Central America to assess quality along the supply chain. During this study, it was observed that perceived quality is dependent on experience and knowledge of each actor participating in the whole chain; however there are some unavoidable practices that will affect apple quality in the final markets.

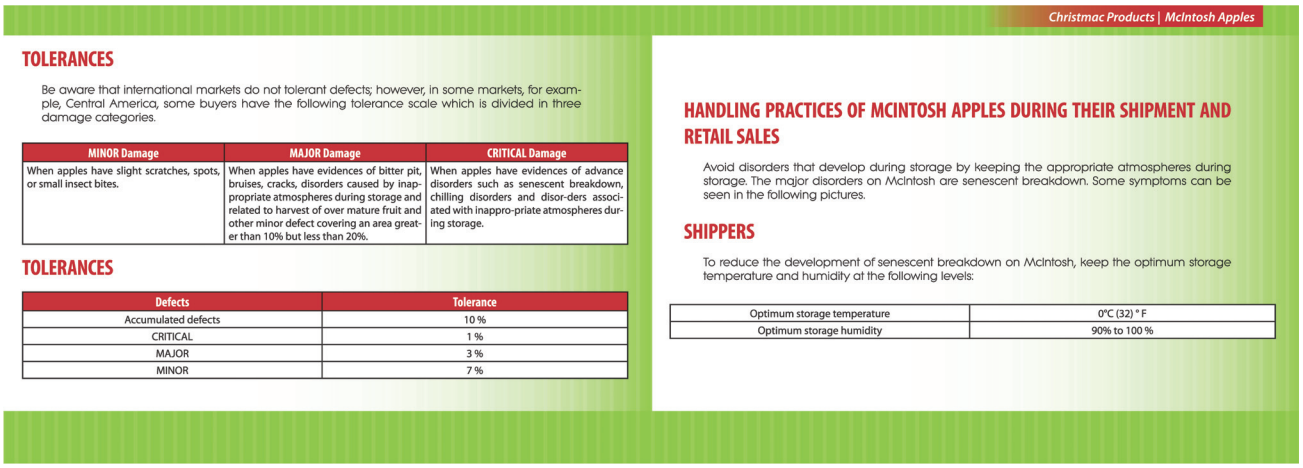
Growers, Packers, and Wholesalers

International shipping of apples is challenging to the quality of the fruit, and our experience with shipping to El Salvador was no exception. Therefore, the apples to be shipped should be optimally treated to assure the best quality in the market. Calcium applications should be a regular part of the growing season activities. Harvest should occur before a significant amount of ripening has occurred. Once harvested fruit should be cooled quickly, treated with SmartFresh™, and kept in controlled atmosphere storage (if at all possible).

Firmness is an extremely important criterion for apple evaluation, as retailers and wholesalers in Central America require apples to have at least 12 pounds of flesh firmness to be

Apples Size

Retailers and wholesalers in Central America require apples to have at least 12 lbs of flesh firmness to be



accepted as high quality. Smaller apples from 125-count had significantly greater firmness than apples from the 80-count fruit. It is strongly recommended to export smaller and firmer apples to Central America markets

Weight per Box of McIntosh Apples

The standard apple box in commerce is considered to be 40 pounds of fruit, and buyers in Central America require 40 pounds per box.

Temperature

The most important technique for controlling the loss of quality along the supply chain is temperature reduction, therefore while exporting McIntosh apples to Central America it is recommended to store at as close to 32°F as possible. Our experience suggested that there is the potential for a great deal of variation imposed during the supply chain in El Salvador. It is extremely important to emphasize to buyers the importance of temperature control throughout the supply chain.

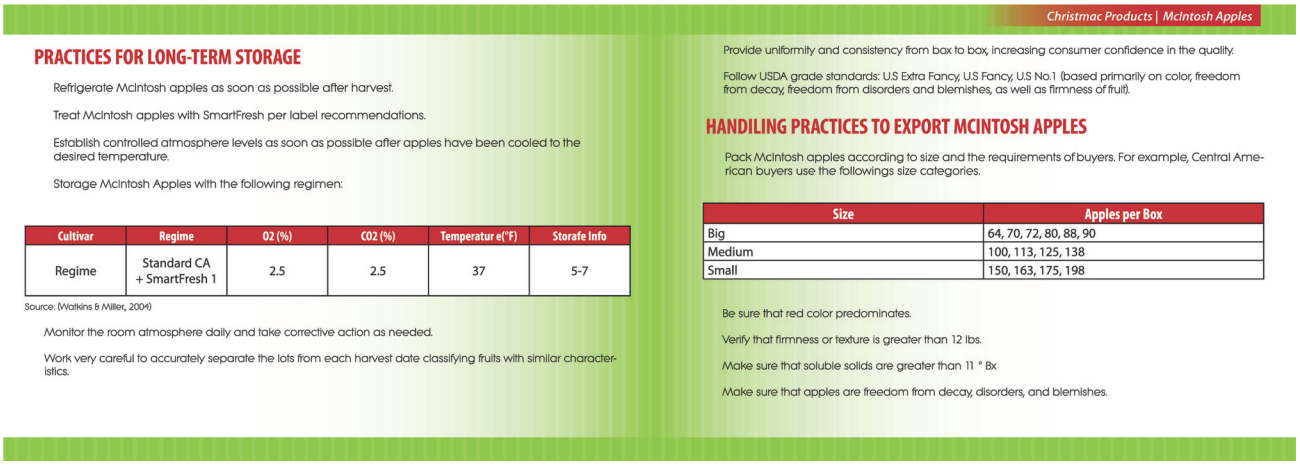
Packing

Furthermore, packing must be carefully planned to provide uniformity and consistency from box to box in order to increase buyer and consumer confidence in the quality. During the packing process, growers must also follow the USDA grade standards: (U.S Extra Fancy, U.S Fancy, and U.S No.1) based firstly upon color, but also on freedom from decay, disorders and blemishes, as well as the firmness of the fruit.

McIntosh apples should also be packed according to the size of the apple, standard industry requirements, and requirements of buyers. Central American buyers use the following size categories: Large = 90-64 count; Medium = 138-100 count; and Small = 198-150 count. We do not recommend exporting large apples since they are more prone to storage deterioration and are not preferred in the Central American markets.

Inspection

During this study, officers from the Massachusetts



Department of Agriculture came to the packinghouse to inspect the apples for the export certificates to Central America. At this point, key factors such as appearance quality were assessed by the inspector. However, firmness and weight were not assessed for the export certificates. Taking into account their importance on the final markets, these factors should be part of the criteria used for determining the suitability of apples for export.

Shippers, Exporters, and Importers

The main goal of shippers, exporters and importers is to avoid losses due to disorders that develop during storage by keeping apples at the lowest possible temperature. The major problem affecting apples during transport is softening, so to reduce the softening of McIntosh apples, keep the storage temperature at 32°F and humidity 90-100%.

During this study, temperature and humidity through the ocean freight were kept at the recommended levels, and there was not any mismanagement observed during the transportation of the apple container from the port of loading to the port of discharge. As a result, this study found that shipping companies understand the handling practices of apples.

Once the apples arrive at customs, they must keep at the right temperature. It is highly recommended to negotiate FOB (Free On Board) price in order to avoid delays and excessive payments in this part of the process.

Distributors

Apples must be kept at the right temperature in the distributor's warehouse. Workers should avoid handling the apples too often, as sometimes workers are unaware of how to handle the apples appropriately.

Retailers

Once the apples are delivered to the supermarket, apples must be kept at as close to 32°F as possible, and workers must be trained in the best handling practices for apples before the McIntosh delivery.

Some other recommendations for retailers and distributors are not to overlap more than 7 boxes of 40 pounds in order to avoid compression bruising, to handle the apples carefully and always arrange them by hand, and to keep damaged or bruised apples off the shelf.

Consumers

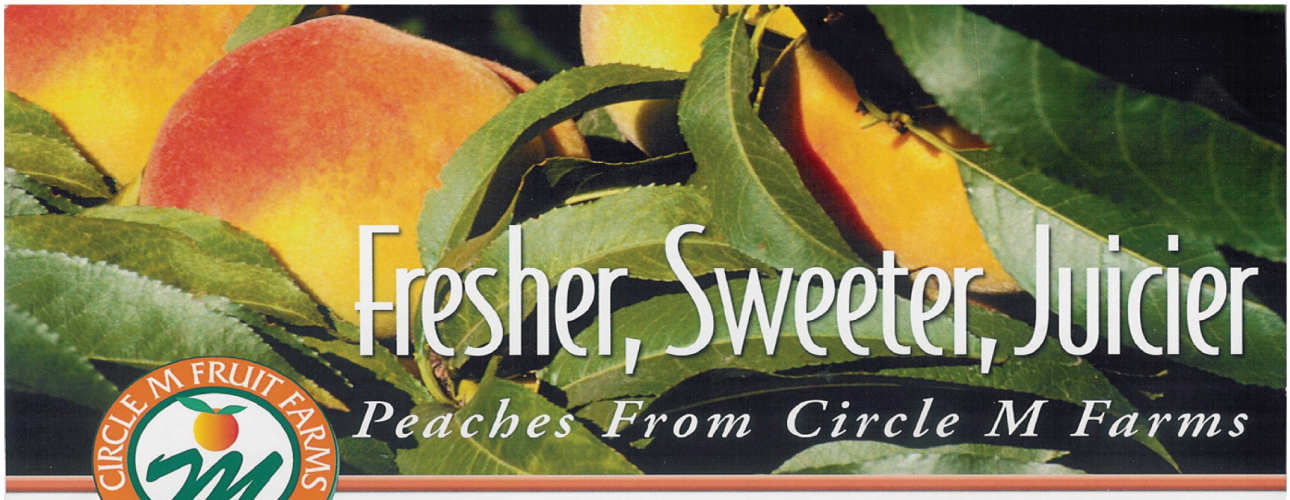
The practices for consumers are very similar to those for retailers; however, it is strongly recommended to store the apples in a refrigerator when possible, and if there is no refrigerator, consumers should place the apples in a cool area.

Conclusions

Throughout the supply chain for McIntosh apples from Massachusetts to Central America, it was determined that each one of the actors forming this supply chain has an important role in maintaining apple quality. Factors of particular importance that affect apple quality include the apple source, fruit size, and proper temperature maintenance.

These results and conclusions are only part of the picture. To make the decision to export McIntosh apples to Central America, there needs to be an economic analysis indicating that it is profitable for growers in Massachusetts.

On June 10, 2014 Rutgers Cooperative Extension held a Horticultural Twilight Meeting at the at Donaldsons Farm, Hackettstown, NJ. Professors Peter Nitzsche and Bill Hulibk presented an Update On The Rutgers NJAES Project To Release New Strawberry Varieties For Eastern US and NJ growers. Farmer Greg Donlandson had extensive plots of our Rutgers strawberry selections on site. He has worked closely with Rutgers for the past 4 years in their testing. "This project is funded by a grant from the Walmart Foundation and administered by the University of Arkansas System Division of Agriculture Center for Agricultural and Rural Sustainability." Forty-two growers were in attendance. Photo credit: Peter Nitzsche.



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