

Consumer Evaluation of New, Antique, and Little Known Apple Varieties

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Introduction

Massachusetts has had a long history of apple production. Due to its favorable climate, it has been a leading producer in the United State of the variety McIntosh, along with Maine, Vermont, and New York. Over the past few years, the dynamics of apple production has changed dramatically due in large part to the rapid expansion of apple production overseas, especially in the southern hemisphere and a logarithmic increase in production in China. While Massachusetts has a climate that favors the production of high quality apples, return to growers has declined steadily over the past 20 years. Other geographic locations can produce nearly twice as many apples per acre because of high light conditions, a long growing season, and abundant water. Others areas, most notably China, Brazil, and Chile can produce high yields at much reduced cost because of low wages paid to workers. For these reasons, wholesale production of apples in Massachusetts has declined rapidly, and the number of farms growing apples has been significantly reduced. The most profitable growers of apples today are those who sell directly to the public through roadside stands.

Apple production in the United States has been dominated by cultivars such as Delicious, Golden Delicious, and McIntosh for many years. During the past 25 years, there has been a gradual metamorphosis, where new, novel, and different cultivars types are being planted. This change first started first with the successful introduction of Granny Smith from Australia in the early 1980's. The popularity of the apple showed that nontraditional apples could become commercially successful. Significant plantings of Gala, Fuji, and Braeburn soon followed. In the 1980s and early 1990s, many new apple varieties became available. Consumers enjoyed having new and better tasting varieties available, and growers were attracted to these because of the higher price that consumers were willing to pay

for them. Honeycrisp is an example of an apple that not only has become extremely popular, but Massachusetts appears to be a favorable place to grow this apple.

In the past, private breeders, University breeding programs, and nurseries received compensation for patented varieties by receiving royalties from the sale of trees. Because apple breeding programs are very expensive to operate, the royalties received were insufficient to cover the cost to maintain a breeding program. Undoubtedly, new varieties will be released in the future in an entirely different way. Tree sales, production, and marketing of the best and most promising varieties will be under the strict control of patent holders. Trees will be sold only to large growers willing to sign agreements, and they will probably be restricted to growers in large apple-producing states. Most likely, growers in Massachusetts will not be able to plant these new varieties, because they are generally not large apple producers and they are located far away from sales and packaging facilities. Under this scenario, it appears that apple growers in Massachusetts may be restricted to planting old established varieties or newer but available varieties. Examples of the restricted varieties are Ambrosia, Pinata, MN 1914, and NY 674, varieties from Canada, Germany, Minnesota, and New York, respectively. Consequently, Massachusetts growers will not be able to grow and sell the best varieties that will be introduced. These are typically the varieties most in demand and also the ones for which growers receive the highest prices.

The majority of apples sold in Massachusetts are in grocery stores and similar outlets. The variety selection includes many old standard varieties plus a few new varieties such as Jazz, Honeycrisp, Cameo, and the previously mentioned Ambrosia and Pinata. Rarely are locally produced apples sold in such stores, because there are few wholesale growers now, supermarkets are looking for one-source suppliers, and

because of the low profit margins, growers look for other sales outlets. Shelf space is limited, thus there are just a few varieties available. The quality of apples found in large grocery stores is frequently fair at best, due to a number of factors, including long storage, improper handling, the long period of time in transit, and preharvest and postharvest treatments that may suppress ripening and taste development. It is little wonder that the per-capita consumption of apples in the U.S. has remained flat for many years (Desmond O'Rourke, Belrose Inc., Pullman, WA).

Initially, it seemed most unfortunate that Massachusetts growers would be excluded from purchasing trees of the newest and best apple varieties. However, only a very few varieties will possess the characteristics that will make them significant national varieties. Those that are not selected and may be available to growers have flaws, but if recognized, they may not be a serious detriment or even be a serious problem at all. The most notable flaw that many of these varieties have, regardless of season of harvest, is that the postharvest life may be too short to be considered a viable variety to be sold through normal marketing channels. Others may be cosmetically challenged, even though taste is excellent. Some may be small, but otherwise excellent. We suggest that this group of second-tier varieties may provide a unique opportunity for growers, especially those who sell primarily through roadside stands. We believe that customers who shop at roadside stands may be more quality conscious, are interested in purchasing something that is different and good, and are willing to pay a premium for apples that are available only at roadside stands.

Proposed Strategy for Growers Who Want to Take Advantage of the Marketing Potential Offered by Planting New Varieties

We suggest that growers select several new, different, or antique varieties and plant them. These should be planted on precocious and dwarfing rootstocks so that trees can come into production rapidly. We suggest that the number of trees planted and the total volume produced for each variety should be conservative for two reasons. First, this is the safest approach if customers do not like a particular variety. Second, a basic tenet of our proposal is that customers

should have a variety of apples to choose from. As varieties are sold out, they should have other new and different varieties from which to choose. Production of any one variety may be as low as the 50 to 250 bushel range. Apples would be harvested at peak quality and sold over a 3 to 4 week period. Table 1 lists selected time slots and the rationale for having new varieties in each one of these time slots. We suggest having two new varieties in each slot.

Basis and Rationale for this Study

We have been growing and evaluating new apple varieties at the UMass Cold Spring Orchard Research and Education Center (CSOREC) for 25 years. Recently, we have started to sell fruit at the Cold Spring Orchard through a newly-opened farm stand. As part of our fruit-evaluation process, we make new varieties available to customers who frequent our stand. The suggestions made in this report are the result of direct feedback from customers and results from taste evaluations.

Materials & Methods

Many new varieties are grown at the UMass Cold Spring Orchard. Prior to the start of the harvest season we selected 20 varieties that we felt were different, had exceptional quality, fit into one of our marketing periods, and would be available in sufficient quantity for taste evaluation by customers. A fruit evaluation form was developed to quantify respondents' opinions about quality, appearance, and organoleptic (taste) properties of each of the selected apples and the importance of such varieties available to the consuming public (page 4). Questions also were developed to determine the importance to the respondent of having new and different apple varieties available at roadside stands.

Throughout the harvest season, the selected varieties were monitored for maturity so that they could be harvested at the appropriate time. The date of harvest of each variety is listed in Table 2. On each harvest date, a 1- to 3-bushel sample was harvested and placed in regular air storage at 32°F. Samples for evaluation by customers were removed from storage each day for evaluation that day. At the time of harvest, a 10 apple subsample was taken to document fruit

characteristics, quality, and maturity. During this evaluation, the diameter and weight of fruit were first determined, and then, the percent red color of the surface of each apple was estimated to the nearest 10% . Fruit flesh firmness was determined using an Efegi penetrometer. The percent soluble solids was measured in the juice collected while measuring flesh firmness using a hand-held refractometer. Fruit were then cut in half at the equator, dipped in iodine solution, and the starch distribution and intensity were then estimated using the Cornell Generic Starch Chart on a scale of 1 to 8 where 1 was considered immature and 8 was over-mature.

When the retail stand at the CSOREC opened in the morning, a portion of the harvested fruit were placed prominently in the sales area. A sign was placed above the box of apples that informed the customers that we were asking for their help in evaluating new varieties. The results of the responses were to be used as a guide in helping to decide which apples we plant at the CSOREC and which apples we encourage growers in Massachusetts to plant. Additional fruit were brought from the storage area as the box was emptied. Participants were given an apple to taste with the understanding that they would fill out the Variety

Evaluation Form. After variety evaluation was complete, all data were entered into a spreadsheet where they were analyzed and summarized.

Brief Description of Apples Included in the Consumer Taste Evaluations

Akane is a very attractive, medium-sized apple that ripens in early September. It has white flesh, and when ripe, it is one of the most aromatic apples available. It has nearly 100% red color that develops early. Consequently, it is frequently harvested prematurely, before the volatiles and taste components can fully develop. The flavor is mild. It is one of the best pie apples available. When cooked, slices remain intact and unlike many apples, the flavor components of the apple can be detected in the cooked product. Akane displays little preharvest drop, and fruit can be harvested over a 2-week period. It can be stored for 2 to 3 months.

Arlet (Swiss Gourmet) is a red, slightly tart, medium-sized apple that ripens slightly later than Gala. The quality is good. The skin becomes greasy if harvest is delayed. Use of a preharvest-drop-control compound is appropriate, since Arlet is prone to extensive preharvest drop before fruit become fully red. Fruit

Table 1. Marketing periods to target for new varieties.

Time Period	Marketing opportunity
August 15 to August 31	Growers who are producing peaches and other produce. There is a need for good varieties at this time to compliment sale of other fruit.
September 1 to September 15	This is pre McIntosh time when high quality, tree ripened fruit are in short supply. Ethrel is used on McIntosh and this is often to the detriment of fruit quality.
September 16 to September 30	Opportunities are available for providing customers alternatives to McIntosh, Empire and Macoun.
October 1 to October 15	This is a tradition time to visit orchards and roadside stands. It is a prime time to provide customers with some unique choices; something very exciting.
October 16 to later	Many traditional varieties have been harvested by this time. There are a few variety choices so the addition of varieties at this time would be an additional marketing opportunity.

VARIETY EVALUATION FORM

Variety _____

Please sample the apple(s) on display and provide us with an evaluation of the variety filling out this short form. Please circle the appropriate number.

Appearance

Like very much 1 2 3 4 5 6 7 8 9 10 Dislike

Taste

Like very much 1 2 3 4 5 6 7 8 9 10 Dislike

Crispness

Like very much 1 2 3 4 5 6 7 8 9 10 Dislike

Juiciness

Like very much 1 2 3 4 5 6 7 8 9 10 Dislike

Texture

Like very much 1 2 3 4 5 6 7 8 9 10 Dislike

Overall

Like very much 1 2 3 4 5 6 7 8 9 10 Dislike

Additional comments on this variety:

What variety do you usually purchase _____?

Would you purchase this variety? Yes No

Would you purchase this variety in preference to your normal variety? Yes No

How far would you travel to purchase this variety? miles.

What type of apple do you usually like (circle one)

Sweet Sweet/tart Tart/sweet Tart

Would having new or unique apples available at a roadside stand or farmers market be incentive to travel there? Yes No

General comments:

have a tendency to develop russet, especially at the calyx end on as much as 25% of the surface. Red color can mask much of the russet if fruit remain on the tree long enough to develop good red color. It stores quite well if it is harvested at the appropriate time.

Candy Crisp is a newly introduced apple that was discovered as a chance seedling in the Hudson Valley in New York. It is a glossy yellow, and generally russet free apple with an extremely mild, somewhat pear-like flavor. It appears to have low acid content, thus it taste is quite sweet. It is large and very typey with a length/diameter ratio of 1.05 or more, which is higher than most apples in commercial production. In our test trees, there was variability in tree vigor, with some that were quite vigorous while other were somewhat weak.

Chinook is a small to medium sized apple that has an extensive pinkish red blush on 80 to 90% of the surface. It is very firm and somewhat juicy, but the appearance is not distinctive from many other apples. It is a grower-friendly tree with spreading flat branches, spurry, and quite precocious. It has potential for several month in regular air storage.

Creston originated in British Columbia. Frequently Creston is compared with Jonagold, a variety with which it shares many characteristics including large fruit size, only moderately good color, firmness, time of ripening, and fruit quality. Fruit are medium to large, crisp and juicy, pleasant, and refreshing, with a good sugar-to-acid ratio. It lacks good red color and can be stored for 3 to 4 months. It can be considered an alternative to Jonagold with a different and pleasant taste.

Crimson Crisp is a newly named variety that originated from the Purdue-Rutgers-Illinois apple disease-resistance breeding program. It was tested as Coop 39. Color is a very attractive, with bright red blush on over 90% of the surface. Fruit are medium in size and flesh is white and very firm. The flavor is pleasant and mild. It is highly resistant to apple scab.

Daybreak Fuji. This strain of Fuji is a limb sport of Yataka Fuji, and it ripens fully 3 to 4 weeks earlier than the nonmutated Fuji strains. Color is pinkish red and not as intense as later maturing Fuji strains that have been selected for, among other things, red color. Firmness and storage potential are less than for regular Fuji. However, it looks and taste like a Fuji, and this strain provides an opportunity to market Fuji well in advance of the regular Fuji that ripens much later in October.

Hawkeye Delicious. Hawkeye is the name first

given to the original Delicious that was discovered in Iowa in about 1872. It was later named Delicious by Stark Brothers Nursery. It is a somewhat typey apple with a somewhat bleached red color. Flavor is good and fruity. It only slightly resembles in taste and appearance the Delicious grown and sold commercially today. Many mutations have been selected over the years that are cosmetically pleasing, but often times this comes at the expense of taste and eating quality.

Hudson Golden Gem is the largest of the fully russeted apples that are available today. It is conical with a yellow somewhat rough russet skin. The fruit tastes sweet. Its taste is very similar to a pear as is its texture. Some describe the favor as nutty. It is a high-quality apple. It may crack in the spring when fruit are about an inch in diameter, but this is not observed every year. It does display some preharvest fruit drop, thus a drop-control agent may be useful.

Liberty was one of the first disease-resistant apples to be released by Cornell (1978). It is medium to small in size with a striped red color over a yellow background. Flesh is yellowish, fine, crisp, juicy, with a tart/sweet (sprightly) flavor. It is similar in appearance and ripens at about the same time as Empire. While size may be small, it can be improved with aggressive thinning, and quality on the tree can be maintained with the use of ReTain. Liberty is wholly resistant to apple scab.

MN 1914 is a restricted variety from the University of Minnesota that is the result of a cross made between Honeycrisp and Zestar!. It is a nearly full-red, medium-to-large apple that appears to maintain quality on the tree for an extended period of time. It is crisp and juicy, and it has a very complex taste profile. It is unnamed at this time, and the availability is still in question. However, growers in Washington, Minnesota, and Nova Scotia have been licensed to grow this variety. Although apparently well adapted to our growing conditions, it is unclear if Massachusetts growers will be allowed to grow this apple.

NJ 90. A unique taste characterizes this McIntosh-type apple. It is medium sized, extremely attractive apple that has a deep-ebony-red color that may be masked by a very heavy bloom on the surface. The fruit is juicy, and when eating the apple, the juice appears to be quite viscous. It has some preharvest-drop tendencies. The skin is quite thick, and when eaten, it give the impression of being tough. This tough skin is its most serious flaw.

Pinova has been a difficult apple to follow, since it has gone through several name changes in the past several years: Pinova, Corail, and most recently, and perhaps finally, Pinata. It is a medium sized, and somewhat-red apple. It is slightly tart, and the Cox's Orange Pippin in its parentage is quite evident in the taste. It ripens in late September. The taste of Pinova may improve after a period of cold storage. The rights to plant and sell this apple have been purchased. Special permission is necessary to grow and sell Pinova.

Sansa fruit can be harvested starting about 3 weeks before Gala, a variety that Sansa resembles in size, shape, color, and taste. When ripe, it has an aromatic and tropical-fruit taste that is rivaled by few apples. Good light exposure is required to achieve good red color. Fruit will store for up to 2 months. It is moderate-to-weak-growing tree, and the leaves have a mottled appearance that resembles but is not, apple mosaic virus.

Shamrock is a medium to large sized apple that has the potential to be marketed as two different forms of the same apple. When harvested in mid September it is a green apple that has a taste that resembles Granny Smith. It is not ripe at this time, but because it has a low phenol content, it does not taste like a green apple. When allowed to ripen in late September and early October, the color changes to a light green and then it has a taste that is very similar to a very good McIntosh. The flesh is white, and it is slow to brown when cut.

Shizuka and Mutsu have the same parents, Golden Delicious and Indo, and consequently they are very similar apples. Shizuka is an alternative to Mutsu, and under some circumstances, it may be a better choice. Shizuka is smaller, ripens about 5 to 7 days before Mutsu, and it is reported not to be susceptible to infection by the bacterial disease blister spot. Its flesh is a little softer than Mutsu, and it does not store as well. It should be noted that Mutsu is perhaps an under-planted variety, that typically garners strong following when available.

Silken. Ivory to pale yellow skin color and medium to small fruit size characterize this extremely attractive apple recently named by Agriculture and Agri-Food Canada Research Center in Summerland, British Columbia. It ripens during the second week in September, but because of its very light skin color it appears to be ready to harvest earlier. It is firm, extremely crisp and juicy and has a very mild favor. In taste tests it has rated very high in flavor, appearance,

and overall. Silken is a precocious but not very biennial. It has moderate growth, a spreading habit, and is a very grower-friendly tree. It is very susceptible to apple scab.

Topaz is a recently released disease-resistant variety from the Czech Republic. It may be the most widely planted scab-resistant apple in Europe. It is an extremely attractive, red, medium-to-large apple. Fruit are firm and juicy and the taste can be most accurately described as very tart with little perceptible sweetness. Topaz ripens in mid to late October. It is precocious, has moderate vigor, and an upright spreading growth habit.

Zestar!TM is a medium-sized, somewhat attractive apple that was released from the University of Minnesota breeding program. It has pinkish red color on up to 50% of the surface. Zestar!TM ripens with Ginger Gold or perhaps slightly earlier. It has a very unique flavor with an excellent sugar-to-acid ratio. It is one of the few apples where both the sugar and acids are quite evident and yet extremely pleasant. It has a very distinctive and grower-friendly growth habit. The tree is very upright but the branches emanate from the central leader at almost a 90 angle. It lends itself very well to high-density (super-spindle) planting. The tree is precocious and annual.

Results & Discussion

The apples selected to be included in this survey were harvested over an 8-week period starting in late August and extending through late October (Table 2). The diameter of all apples was at least 2.90 inches, and most apples averaged over 3 inches in diameter. The apples less than 3 inches were Early Shamrock, which was harvested about 3 weeks early, and Sansa and Chinook which are considered smaller varieties. Flesh firmness ranged from 19.9 pounds to 13.6 pounds. In this study, we allowed fruit to ripen and develop typical varietal flavor and taste, and consequently some were less firm than might normally be experienced in regular commercial channels. This was not considered a problem, since none were stored long, and we felt that it was most important to present to the consumer an apple with excellent taste. The apples evaluated differed widely in appearance and color. Sugar content, expressed as soluble solids, was generally higher than many mainstream commercial varieties.

Each participant was given the opportunity to rate

Table 2. Harvest date and fruit quality assessment at the time of harvest of variety selected and submitted for consumer evaluation.

Variety	Harvest dates	Diameter (in)	Weight (g)	Flesh firmness (lb)	Red color (%)	Soluble solids (%)	Starch rating (1-8)
Akane	Sept. 7	3.10	182	14.4	81	12.4	7.6
Arlet	Sept. 17	3.04	199	16.1	73	11.8	6.9
Candy Crisp	Oct. 16	3.65	332	14.1	7	13.3	5.8
Chinook	Oct. 9	2.90	176	19.9	75	13.0	4.3
Creston	Oct. 4	3.50	310	13.6	31	13.0	7.2
Crimson Crisp	Sept. 24	3.19	238	19.8	91	12.8	5.7
Daybreak Fuji	Sept. 20	3.11	194	15.5	79	12.2	6.7
Hawkeye Delicious	Oct. 4	3.56	322	14.8	58	13.4	6.1
Hudson Golden Gem	Oct. 9	3.32	271	18.1	0	14.2	4.0
Liberty	Oct. 1	3.17	215	18.2	84	13.0	3.2
MN 1914	Sept. 7	3.31	250	15.5	81	13.7	3.8
NJ 90	Oct. 9	3.49	267	14.8	88	14.2	4.1
Prinova	Sept. 24	3.10	212	17.2	73	13.8	3.6
Sansa	Aug. 30	2.94	166	14.0	68	11.8	6.5
Shamrock early harvest	Sept. 7	2.86	185	16.6	2	11.4	1.2
Shamrock normal harvest	Sept 28	3.29	213	16.1	24	12.3	4.6
Shizuka	Oct 4	3.83	386	14.0	1	12.4	5.6
Silken	Sept. 13	3.03	191	14.2	0	12.2	5.5
Topaz	Oct. 19	3.31	230	16.1	85	14.1	5.8
Zestar!	Aug. 24	3.19	186	14.0	54	12.2	4.8

the apple under evaluation for appearance, taste, crispness, juiciness, texture, and overall desirability on a scale from 1 to 10, where 1 was the best score and 10 was the lowest score (Page 4). Overall, the ratings for all varieties in each category were very high (Table 3). Only Hawkeye Delicious had a majority of responses in the 4 to 5 category. Varieties were categorized into four groups based upon consumer ratings in the taste and overall ranking (Table 4). Varieties that had the highest rating and were given an Excellent (below 2.5) were: Akane, Creston, Hudson Golden Gem, MN 1914, NJ 90, and Shizuka. Only Chinook, Hawkeye Delicious, and Topaz were rated Fair, but even in this group there were many survey participants who expressed high praise for each. The remaining varieties in this evaluation scored between 2.6 and 3.5 and were considered Good or Very Good and represent excellent candidates for future planting.

While the ranking in Table 3 of the apples that were evaluated was based primarily on taste and overall assessment, appearance, crispness, juiciness, and flesh texture are important qualities that influence consumer purchase of apples. While there was some variability in scores, nearly all of these apples ranked high or extremely high (below 3.5). The importance of these attributes in overall quality is illustrated in the comments that the participants had about individual apples.

An excellent way to evaluate a consumers assessment of an apple is to ask if they would purchase it (Table 5). All apples in this survey were well received and well liked by participants. Between 70 and 79% of the participants said that they would purchase Candy Crisp, Liberty, Shamrock, and Zestar!, between 80 to 89% said that they would purchase Akane, Crimson Crisp, Hudson Golden Gem, Sansa, and Silken, while over 90% said that they would purchase Creston, MN

Table 3. Sensory rating on a scale from 1 to 10 of apples evaluated by survey participants at the University of Massachusetts CSOREC. 1 = likes very much; 10 = dislikes.

Variety	Appearance	Taste	Crispness	Juiciness	Texture	Overall
Akane	1.9	2.5	2.3	2.0	2.5	2.3
Arlet	2.9	3.1	3.2	2.7	3.2	3.1
Candy Crisp	3.4	3.3	3.3	3.0	3.3	3.1
Chinook	2.3	3.7	2.3	3.2	3.8	3.2
Creston	3.0	2.1	2.1	1.7	2.0	2.2
Crimson Crisp	2.3	2.8	2.2	2.4	2.6	2.6
Daybreak Fuji	2.9	3.5	3.5	2.0	3.3	3.4
Hawkeye Delicious	3.5	4.4	4.2	3.7	4.4	4.4
Hudson Golden Gem	4.3	2.4	2.3	2.4	2.8	2.5
Liberty	1.8	2.2	1.6	1.6	1.9	1.9
MN 1914	2.1	2.1	1.5	1.4	1.7	2.0
NJ 90	2.3	2.4	1.2	1.5	2.4	2.2
Pinova ¹	1.8	3.2	3.3	3.2	3.8	3.1
Shamrock early	2.4	3.5	3.0	3.3	3.9	3.5
Shamrock normal	3.2	3.4	3.7	3.1	3.0	3.2
Sansa	2.4	2.7	2.5	2.1	2.6	2.6
Shizuka	3.1	2.4	2.3	2.0	2.8	2.2
Silken	2.4	2.8	2.1	2.1	2.2	2.6
Topaz	2.5	3.5	1.8	2.4	3.3	3.6
Zestar!	2.4	2.8	3.0	2.1	2.5	2.6

¹Also known as Corail, Sonata and Pinata.

1914, NJ 90, and Shizuka. Respondents also were asked to indicate if they would purchase this apple in preference to the apple(s) that they normally purchase. The differences among varieties in response to this question were quite large and ranged from 27% for Hawkeye Delicious to 63% for NJ 90. The mean response to this question was 48% which indicates

Table 4. Summary of the taste and overall ratings for varieties.

Excellent 2.5 and below	Very good 2.6-3.0	Good 3.1-3.5	Fair Below 3.5
Akane	Crimson Crisp	Arlet	Chinook
Creston	Sansa	Candy Crisp	Hawkeye Delicious
Hudson	Silken	Daybreak Fuji	Topaz
Liberty	Zestar!	Shamrock	
MN 1914		Pinova	
NJ 90			
Shizuka			

that 48% of the respondents said that they would purchase the varieties under evaluation in preference to the variety that they normally purchase. This is very noteworthy since it is difficult to change consumer purchasing habits, and to have nearly half of the participants express a willingness to do so attests to the attractiveness of these varieties.

Respondents were asked to indicate how far they would drive to purchase this variety. The range is an indication of the degree that a respondent liked the variety. For three quarters of the varieties, some respondents said that they would drive 50 miles or more just to purchase this variety. The mean distance that individuals would drive for all varieties to specifically purchase this variety was 13.3 miles, which is quite a

long distance specifically to purchase apples. A conclusion that we can draw from this result is that individuals like new apples and they are willing to drive some distance to purchase them. These data were taken in the fall of 2007 when gas prices were lower. We suspect that the willingness of consumers to travel to purchase apples will be impacted similarly to other driving-related activities.

Each respondent was asked to indicate the variety or varieties that they normally purchase (Table 6). The varieties most mentioned were McIntosh, Macoun, Honeycrisp, Gala, Cortland, and Fuji, and these varieties accounted for more than two thirds of the total responses. Prominent among this list are the apples that grow very well in New England and achieve their

Table 5. Survey results of consumer taste evaluation of new apple varieties.

Variety	Would you purchase this variety?		Would you purchase this variety in preference to your normal variety?		How far would you travel to purchase this variety?	
	Yes	No	Yes	No	Miles	Range
Akane	84	16	48	52	16.0	0-120
Arlet	67	33	31	69	15.0	0-80
Candy Crisp	78	22	39	61	11.7	0-50
Chinook	65	35	27	73	16.7	0-60
Creston	97	6	57	43	22.5	0-100
Crimson Crisp	85	15	44	56	10.6	0-50
Daybreak Fuji	71	29	44	56	12.8	0-75
Early Shamrock	68	32	38	62	14.4	0-80
Late Shamrock	76	24	54	46	7.2	0-20
Hawkeye Delicious	50	50	27	77	9.9	0-60
Hudson Golden Gem	86	14	60	40	17.4	0-60
Liberty	79	21	33	67	11.0	3-20
MN 1914	92	8	62	38	16.9	2-100
NJ 90	90	10	63	37	13.1	0-20
Pinova	63	37	50	50	9.1	0-50
Sansa	87	13	62	38	11.2	0-75
Shizuka	94	6	53	47	14.5	3-40
Silken	88	12	55	45	14.0	2-50
Topaz	67	33	54	46	13.9	0-30
Zestar!	75	25	42	58	8.5	5-50

highest potential in this region. In contrast to the apples usually purchased by survey participants is the list of the top 10 apple varieties produced in the United States (data provided by US Apple Association). Macoun and Honeycrisp are not listed in the US production but over 25% of the participants list these as the apple that they normally purchase. McIntosh was a favorite of participants yet it only accounts for 4.3% of the national production. One of the most interesting contrasts is with the variety Delicious. More Delicious are produced in the US than any other variety, and it accounts for over 25% of total US production. In the list of customer purchases, Delicious is near the bottom with only 2.1% of the participants indicating that this is the variety that they normally purchase. It is also interesting to note that Hawkeye Delicious was selected as one of the varieties in the heirloom category to test, and it rated near or at the bottom of the varieties evaluated. Our interpretation of this result is that individuals who frequent farmers markets and purchase apples there represent a different group of consumers than those who purchase apples in grocery stores.

Table 6. Summary of the apple varieties that survey participants listed as they normally purchase.

Variety	Percent of total
McIntosh	16.1
Macoun	15.6
Honeycrisp	12.0
Gala	9.1
Cortland	8.9
Fuji	7.7
Golden Delicious	3.9
Granny Smith	3.2
Empire	2.8
Braeburn	2.3
Akane	2.1
Jonagold	2.1
Delicious	2.1
Ginger Gold	1.9
Mutsu	1.8

Table 7. Top 10 apple varieties produced in the United States in 2006. Source US apple.

Variety	Percent of total US production
Delicious	25.8
Gala	12.2
Golden Delicious	12.0
Granny Smith	9.4
Fuji	8.6
McIntosh	4.3
Rome	3.6
Empire	2.8
Idared	2.0
Jonathan	1.8

We asked individuals what taste preference they had for apples. A summary of individual preferences indicated that 48% preferred sweet/tart apples, 30% preferred tart/sweet apples, 16% liked sweet apples, and just 6% preferred tart apples (Table 8.) These results are nearly identical to those published earlier by Bob Stebbins in Oregon and by us in an earlier study. A conclusion that we can draw from this observation is that the individuals who participated in this survey represent a good and accurate cross-section of the apple purchasing public. It also emphasizes that multiple apple varieties should be made available to the public since consumer tastes differ.

A goal of this survey was to gain a sense of the role having new varieties of apples available to consumers may play in attracting consumers to roadside stands. In response to the question “Would having new or unique apples available at a roadside stand or farmers market be incentive to travel there?” Ninety-one% indicated that it would be an incentive (Table 9). This may be interpreted as an overwhelming endorsement and incentive to plant and have available new varieties.

Results presented in Tables 3, 5, and 6 are averages of consumer responses to the questions posed in the survey sheet; however, consumer preferences differ (Table 8). Therefore, we have constructed Table 10

Table 8. Summary of consumer preferences of participants in apple variety evaluation.

Type of apple	Percent of total Respondents
Sweet	16
Sweet/tart	48
Tart/sweet	30
Tart	6

which provides a cross section of positive and critical remarks recorded for each variety evaluated. This is useful for several reasons. First, the positive comments give some insight to the responses consumers have to the various apples. It also conveys the passion some consumers have for some apples. Responses such as “Its perfect! Please sell these” for Akane, “Fabulous” for Hudson Golden Gem, and “Astonishingly great” for MN 1914 attest to strong feeling consumers may have for specific apples. It also illustrates that different individuals can have opposite views of the attributes of the same apple variety.

Mean consumer scores do not provide a profile of preferences. A response of 4.5 on a scale from 1 to 10 could be interpreted to be a mediocre response and the basis for not seriously considering a variety. However, if a variety received a means score of 4.5 where 30% of the responses were 1 (highest score), that would indicate that 30% of the participants thought that this was a great apple and they would most likely be willing to purchase it. The lower scores for Topaz is an excellent illustration of this. Topaz is a very tart apple and consequently, only those individuals who want a tart apple would consider it to be good. As a grower, it would seem prudent to provide some apples for those who have a tart or sweet preference. Although they do not occupy a large percent of the taste profile, they are consumers, and they can be very passionate in their preference for an apple.

The parentage of apples evaluated in this customer survey appear in Table 11. Some are chance seedlings that were discovered growing wild in or near orchards

and their attributes recognized. Others were recognized as the result of bud mutations. By far the majority of these varieties are the product of controlled breeding programs. It is interesting to note that 25% of the varieties have Golden Delicious as one of the parents.

Summary & Conclusions

1. There appears to be strong interest by consumers to have new apple varieties available to purchase. In the survey, over 90% of the participants indicated that they would travel to a roadside stand just to purchase new varieties. On average, participants indicated that they would travel 13.3 miles to purchase new apple varieties. Consumers with a passion for certain apples would travel much longer distances.
2. Consumers have varied tastes. Therefore, having varieties available for all taste profiles is a good strategy for selling new varieties to all customers.
3. The apple purchasing habits of customers who frequent roadside stands appear to be different from those purchasing apples at grocery stores. This was made quite evident in a review of the varieties that survey participants normally purchase. This should be considered an opportunity to expand the sales base.
4. Growers may fear that the purchase of new apple varieties will come at the expense of sale of other varieties. While this may occur to a very limited extent, we feel that the overall result will be a per-capita increase in sales of apples at a roadside

Table 9. Summary of consumer response to the question “Would having new or unique apples available at a roadside stand or farmers market be incentive to travel there?”

Response	Percent of total respondents
Yes, it would be an incentive	91
No, it would not be an incentive	9

Table 10. Selected comments made by individuals participating in the taste evaluation.

Variety	Positive Comments	Critical Comments
Akane	Unique flavor – really like/Yum/ Great apple/It's perfect! Please sell these	Not that flavorful/Plant more Macoun/ A little astringent
Arlet	Like very much/Juicy/Very spicy flavor/Tartness and texture good	Very thick skin/Skin is tough/Too tart/ Taste is ok
Candy Crisp	Juicy/Very good/Very sweet/ Nice and mild	Bland taste/Not enough flavor/ Not much taste
Chinook	Good/I like the color/ Pleasant flavor	Kind of woody/Bland taste/ A bit chalky
Creston	Yummy/Very juicy/Great taste/ Wow, crunchy, juicy	Too big/ Skin a little tough
Crimson Crisp	Super apple/Gorgeous/Very crisp/ Very juicy	Almost too hard/A little too sweet/ Boring
Daybreak Fuji	Excellent apple/Nice apple/ I like these apples/Sweet and light	Not tart enough/Too sweet/Taste not outstanding/Not as good as standard Fuji
Shamrock	Good taste and texture/Good apple/ Nice, tart and crisp/I ate the whole thing	Flavor not strong enough/Poor taste/ Not sweet enough/Thick skin
Hawkeye Delicious	It was good/Great!/Good flavor and balance/Better than Delicious	Too much like Delicious/ Skin tough/Flavor too mild/Too sweet
Hudson Golden Gem	My favorite apple ever/Fabulous/ Sweet, juicy/Loved it	Too bad it's ugly/Like a pear/ Skin is tough
Liberty	Very tasty & crisp/Great apple/ Very good	Not my favorite/ Too tart
MN 1914	Excellent apple/Wonderfully tart/ Astonishingly great/Delicious tart flavor	Too tart/ A bit different
NJ 90	Great apple/Very nice/ Fine apple	Tough skin/ Not very sweet
Pinova	It's really juicy/I love this/ Just the right tartness/Great	Flavor too strong/Tough skin/ Mushy inside
Sansa	Excellent/Very flavorful/Great apple/ Very yummy	A little bland/OK but mealy/ Too bland
Shizuka	Large, pretty apple/Juicy yet crisp/ Really good/Yummy	A bit bland/ Somewhat grainy flesh
Silken	Outstanding/Market it/Super – please plant trees/Very good apple	Odd taste/A little too sweet/ Too pale looking
Topaz	Beautiful/Great, tart, crisp/ I like it/Wow	Too tart/Little mealy/ Most tart apple I have had
Zestar!	Nice balance/It's excellent/ Perfect eating apple/Good tart taste	Too sour/ Pockets of tartness

Table 11. Parentage of varieties evaluated in the survey conducted at the University of Massachusetts CSOREC.

Variety	Parentage
Akane	Jonathan x Worcester Pearmain
Arlet	Golden Delicious x Idared
Candy Crisp	Chance seedling
Chinook	Splendour x Gala
Creston	Golden Delicious x BC 381049
Crimson Crisp	PCFW2-134 x PRI 669-205
Daybreak Fuji	Limb sport of Yataka Fuji
Shamrock	McIntosh x Golden Delicious
Hawkeye Delicious	Chance seedling
Hudson Golden Gem	Chance seedling
Liberty	Purdue 54-12 x Macoun
MN 1914	Honeycrisp x Zestar!
NJ 90	Spartan x 136055
Pinova ¹	[Dutchess of Oldenburg x Cox's Orange Pippin] x Golden Delicious
Sansa	Gala x Akane
Shizuka	Golden Delicious x Indo
Silken	Honeygold x Sunrise
Topaz	Rubin x Vanda
Zestar!	State Fair x MN 1691

¹Also known as Corail, Sonota, and Pinata.

stand. We base this statement upon the enthusiasm of participants who took part in this survey and repeat customers who frequent the UMass CSOREC.

- We feel that the strategy outlined in Table 1 is a good one and provides customers access to new varieties throughout the marketing season and provides the grower with expanded opportunities for sales to enthusiastic customers.
- New varieties should be a sales focus, since many of these varieties equal or surpass the market leaders of Delicious, Gala, etc. and they are not

widely available. It strongly supports a premise of this report that consumers are looking for new things to try.

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An online version of this article, including color photos of the varieties is available at the following web address.

umassfruit.com/variety