Horticulture Characteristics of Selected Hard Cider Apple Cultivars

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New England has a long history of production and consumption of fermented apple juice (hard cider, henceforth referred to simply as "cider") dating back to the 1640s and the early English colonists. This cider tradition remained strong until the late 1800s. After a long hiatus of reduced interest due to competition from other alcoholic beverages and Prohibition there has been a resurgence of interest and production of hard cider. This interest in cider production has grown logarithmically in the last 20 years with many new cideries being formed and coming into production across the U.S. Unfortunately, there has been little research information about the horticultural characteristics of some of the traditional English and French hard apple cultivars often favored by craft cider maker. Likewise, nurserymen required some basic information to aid them in making the decisions on what cultivars they would bud and have available to sell to the ever-increasing group of growers interested in hard cider production. This investigation was undertaken to provide some basic information on the growth, flowering, and fruit production characteristics of some popular European cider apple cultivars grown under New England growing conditions.

Materials & Methods

Trees in this trial were planted in a block located at the University of Massachusetts Cold Spring Orchard Research and Extension Center in Belchertown. The soil in the block was primarily a Ridgebury fine sandy loam. Cultivars included in this planting were Binet Rouge, Chisel Jersey, Dabinett, Harry Masters, Major, Medaille D'Or, Brown Snout, Red Streak, Tremlett's Bitter, Ellis Bitter and Gala. All were propagated on M9-337 rootstock. Buckeye Gala was included in this planting to serve as dessert apple check. Since Gala is one of the most heavily planted varieties in the United States, there is abundant information available in the literature for Gala to provide a reference point for cider apple cultivars. The experiment was set up as a random-ized complete block design with 11 treatments and 12 replications. Trees were planted on May 14, 2003 at a spacing of 8 feet between trees in the row and 15 feet between rows. Minimal pruning was done in the year of planting, in subsequent years and that which was done was to help maintain the central leader. All trees were supported with a 10 ft x ½ inch conduit and trees were secured to the conduit at as the trees grew. The conduit was attached to the wire at about 8 feet for additional support. A line was pained on the trunk of each tree at 30 cm above the graft union. After the leaves had fallen from the trees in November, the trunk circumference of each tree was measured with a tape measure on the painted line on the trunk, then recording it.

Bloom and fruit set dates were recorded for each tree starting in 2005. Bloom was taken by first counting all flower cluster located on spurs and then the flower clus-ter on 1-year-old wood and recording them separately. The bloom on a tree was calculated by dividing the number of spur flowers clusters, lateral flower clusters and total flower clusters by the trunk cross-sectional area. In 2007, the date of bloom was recorded over a 2-week period for all trees in the block. The rating scale used was: 1. First king flower open, 2. All king flowers open, 3. 25% king flowers open 4. 75% of king flowers open 5. Full bloom, 6. Petal fall of king flowers 7. Petal fall of all flower clusters. At 2-3 day intervals over the 2-week bloom period the bloom stage was rated on each tree.

In 2005, 2006 and 2007all fruit were harvested from the trees. The time of harvest was estimated by examining the fruit ground color and to a lesser extent the amount of preharvest drop. Harvested fruit were taken to the lab where they where they were counted, weighed and the average weight calculated. At the end of the ex-

periment the yield efficiency was calculated by dividing the total weight of fruit harvested by the tree trunk cross-sectional area.

Results

Vegetative growth, as determined by an increase in trunk cross-sectional area was monitored over a 5-year period. A summary of the cumulative growth of these cultivars is shown in Figure 1. Clearly, Major was the largest and fastest growing cultivar followed in vigor by Ellis Bitter, Binet Rouge and Gala. Tremlett's Bitter was the smallest and slowest growing cultivar while Brown Snout, Dabinett, and Medaille D'Or appear to fall in the moderately small tree size category. The remaining cultivars: Chisel Jersey, Harry Masters and Red Streak can be categorized as showing a moderate growth rate.

Table 1. Total bloom (lateral and spur) on apple cider varieties on M.9 rootstock recorded over the 3-year period of evaluation.

Cultivar	Bloom/cm limb cross-section area[1]		
	2005	2006	2007
Binet Rouge	3.2	34.5	4.5
Chisel Jersey	11.8	7.8	20.3
Dabinett	15.0	3.4	26.4
Harry Masters	18.5	25.4	23.3
Major	24.4	26.6	29.3
Medaille D'Or	8.6	12.9	1.6
Brown Snout	8.2	14.5	20.6
Red Streak	4.7	13.5	6.9
Tremlett's Bitter	18.8	3.9	26.6
Ellis Bitter	2.3	6.8	10.4
Gala	20.0	46.5	35.7

[1]Mean of 12 trees.

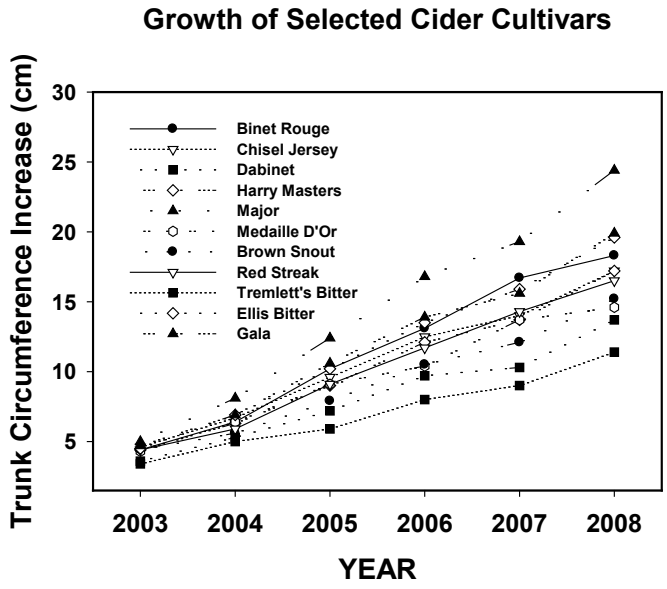

Figure 1. Growth of selected cultivars according to year.

Bloom and Fruit Set. Bloom in the year after planting was minimal. Bloom was quantified starting the second year after planting on the cultivars planted in this trial (Table 1). Harry Masters, Major and Tremlett's Bitter had bloom of over 18 fruit per cm limb cross-sectional area (per cm LCSA) which compares very favorably to Gala with 20. Binet Rouge, Red Streak and Ellis Bitter had the lowest amount of bloom, 3.2, 4.7 and 2.3 per cm LCSA. Bloom recorded over a 3-year period and provided some indication of biennial bearing tendency. The cultivars that displayed the greatest tendency for biennial bearing were Binet Rouge, Dabinett, and Tremlett's Bitter. Major and Brown Snout trees bloom somewhat regularly, similar to Gala.

Most dessert apple cultivars produce the majority of their crop on short shoots (spurs). However, in some years and on some cultivars, flowers may be produced in the axils of leaves on growing shoots. In general, lateral bloom on dessert varieties is considered undesirable because these flowers open later than those produced on spurs and these fruits are generally smaller. Fruit size is less important with cider cultivars, but the time of bloom and the length of the bloom period may be. As shown in Table 2, for each cultivar the date when all king flowers were open to the date when trees were judged to be at petal fall was recorded for 2007. The length of this period is considered the effective bloom period. Clearly, all cider cultivars had a longer bloom period than Gala and most bloomed later than Gala. The bloom period of apple trees in an orchard containing both dessert apples and cider apples may be extended up to a week. Fire blight is a disease that can be devastating and having the bloom period extended over a longer time line makes control of this disease more difficult. Attention of a grower will be diverted away from other important orchard activities occurring at this time such as chemical thinning, apple scab, and early season insect control.

The percent of the total number of flower clusters that were present as lateral bloom was counted for the cultivars in this trial is presented in Table 3. Additionally, the percent of the total fruit set that was attributed to fruit

setting on lateral flowers is presented. Close to 50% of the blossom clusters that set on Binet Rouge, Harry Masters, Major, Brown Snout and Tremlett's Bitter were lateral flower clusters. Therefore. the presence of lateral flower buds on apple cider cultivars may play a very important role in overall production on many cider cultivars as well as the maintenance of other cultivars in the orchard that are not cider cultivars.

Table 2. Bloom period of selected cider apple cultivars late in May 2007.

Cultivar	Full bloom Date	Petal fall Date	Bloom period Days
Binet Rouge	May 17	May 28	11
Chisel Jersey	May 17	May 26	9
Dabinett	May 12	May 26	14
Harry Masters	May 15	May 25	10
Major	May 14	May 27	13
Brown Snout	May 17	May 26	9
Red Streak	May 11	May 25	13
Tremlett's Bitter	May 11	May 25	14
Ellis Bitter	May 14	May 27	13
Gala	May 11	May 18	7

Table 3. Percent of the total bloom and fruit set on apple cider selections that was attributed to lateral bloom over the 3-year period of evaluation.

Cultivar	Percent total bloom represented by lateral bloom[1]	
	Bloom	Fruit set
Binet Rouge	52	62
Chisel Jersey	40	25
Dabinett	27	35
Harry Masters	55	49
Major	55	42
Medaille D'Or	31	39
Brown Snout	49	30
Red Streak	40	61
Tremlett's Bitter	46	71
Ellis Bitter	14	12
Gala	58	19

[1]Mean of 12 trees.

Biennial bearing is displayed by both lateral and spur flowers. The fact that cultivars displaying biennial characteristics have a significant number of lateral flowers raises the question about the dominant role gibberellins emanating from the seeds may have in inhibiting flower bud formation. In spur flowers, fruit with seeds are very close to the bourse bud, where flowers form the crop the following year. Lateral flowers originate from buds that are at the base of leaves where no fruit are present. Therefore, if GAs are involved they must either travel a long distance from a fruiting spur or the GAs may come from the apex of the shoot on which flowers are being formed.

Fruit Characteristics and Productivity. Fruit size is not a major issue with cider cultivars. However, fruit size does play an important role for harvesting the fruit. Fruit size of fruit harvested in this experiment are shown in Table 4. In general, all could be classified as small. As expected, the size was influenced by the crop load. Fruit size varied by year and the crop load on the tree. Fruit size averaged over the 3-years period may provide the best estimate of relative fruit size. Gala was the dessert apple check included in this trial. They were considered very small judged by commercial standards but fruit set on these trees was very high. Among cider cultivars Binet Rouge, Brown Snout and Medaille D'Or were the smallest fruit whereas Ellis Bitter and Major were the largest in the trial. No chemical thinning or hand thinning was done. The long time required to harvest fruit on some of trees because of small fruit size may make it difficult to find pickers in this environ-ment who would be willing to harvest the fruit and hand thinning may be cost prohibitive. Mechanical harvesting or picking dropped fruit under trees may be an alternative to hand harvesting.

Fruit drop under trees varied by cultivar and year (Table 5). This is not unusual. Cultivars displaying the largest drop were Chisel Jersey and Red Streak. Medaille D'Or, Major, Tremlett's bitter and Gala had the least drop. Gala is not known as a cultivar that has elevated preharvest drop. Therefore, the drop under Gala trees may be used as a gauge to judge the propensity for preharvest drop of the cider cultivars under test in this study.

Yield was recorded during the 3 years that the trees fruit were harvested. The highest yield was on Major, especially during the last fruiting year (Table 6). Other productive cultivars included Chisel Jersey, Dabinett, and Brown Snout which were slightly less productive than Gala. Another metric that is frequently used to quantify productivity in apples is yield efficiency. It is calculated by dividing the total yield by the trunk cross-sectional area. Those cultivars that had the highest yield efficiency were

Table 4. Average fruit weight of cider apple selections harvested over the 3-year period when harvest data were taken.

Cultivar	Average fruit weight of harvested fruit (g)			
	2005	2006	2007	Average
Binet Rouge	70	73	45	63
Chisel Jersey	81	106	57	81
Dabinett	65	151	55	90
Harry Masters	99	107	67	91
Major	126	136	77	113
Medaille D'Or	81	46	36	54
Brown Snout	74	80	52	69
Red Streak	112	96	61	90
Tremlett's Bitter	111	96	83	97
Ellis Bitter	137	143	94	125
Gala	134	114	112	120

Table 5. Average fruit drop from cider apple selections during the last two fruiting years, 2006 and 2007.

Cultivar	Average fruit drop (%)		
	2006	2007	Average
Binet Rouge	19	30	25
Chisel Jersey	53	37	45
Dabinett	31	23	27
Harry Masters	---	33	33
Major	22	10	16
Medaille D'Or	23	0	12
Brown Snout	16	24	20
Red Streak	61	57	59
Tremlett's Bitter	0	19	10
Ellis Bitter	0	36	18
Gala	6	21	14

Chisel Jersey, Dabinett, Major, Brown Snout and Gala. The least productive cultivars were Medaille D'Or and Red Streak.

Conclusions

This study provided growth and productivity information on some of the most prominent English and French cider cultivars growing under New England conditions. The results presented will provide guidance to growers in selecting cider cultivars to grow; providing their flowering and fruiting character-istic, biennial bearing tendency, productivity potential and guidance in selecting the spacing to plant these trees.

Table 6. Yield per year, cumulative yield and yield efficiency of selected cider apple cultivars propagated on M.9 337 rootstock growing at the UMass Cold Spring Orchard, Belchertown, MA.

Cultivar	Harvest weight (lb)				Yield
	2005	2006	2007	Total	efficiency
Binet Rouge	1.3	13.4	9.7	24.4	0.67
Chisel Jersey	4.3	9.4	17.4	31.1	1.01
Dabinett	5.7	10.6	17.0	33.3	1.43
Harry Masters	1.1	0.8	26.1	28.0	0.93
Major	1.1	2.5	51.0	54.6	1.28
Medaille D'Or	0.9	11.7	1.8	14.4	0.47
Brown Snout	3.5	5.9	22.4	31.8	1.19
Red Streak	1.6	4.1	8.0	13.7	0.44
Tremlett's Bitter	2.7	4.3	10.7	17.7	0.89
Ellis Bitter	0.7	2.7	22.1	25.5	0.73
Gala	3.1	5.3	32.8	41.2	1.12

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