Fruit Notes

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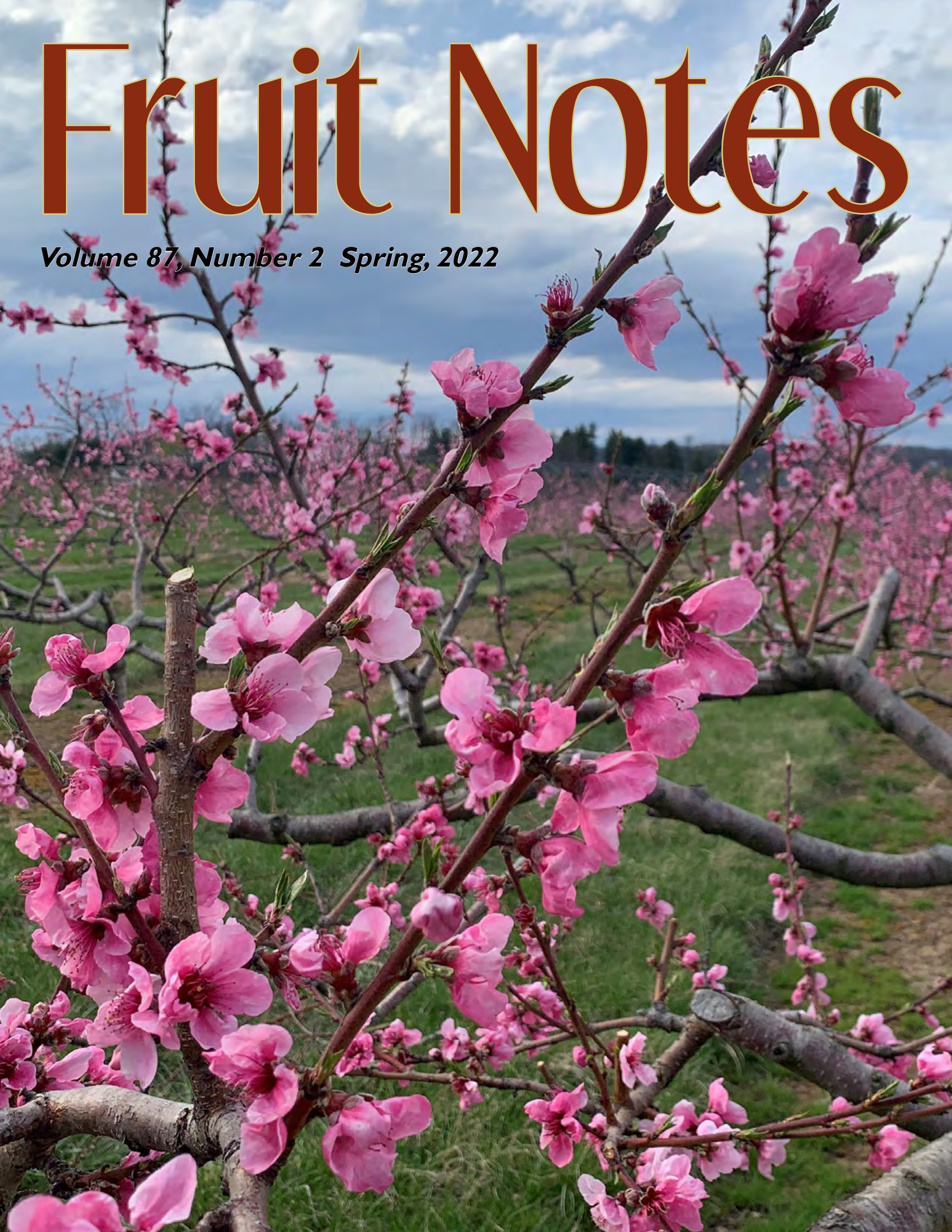

Fruit Notes

Editors: Jaime C. Piñero & Winfred P. Cowgill, Jr.

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Cover: White Lady Peach in bloom, Melick Town Farm, Oldwick, NJ location.
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Thanks to the generous sponsors of the UMass Fruit Program:

What was Old is New Again: A Survey of "New" Heritage Cool Climate Grape Varieties for the Northeast

J. Stephen Casscles
Director, Milea Estate Vineyards Heritage Grape/Wine Project, Staatsburg, NY and owner of Cedar Cliff Vineyards, Athens, New York.

All photos taken by Steve Casscles. Photo Credits: to J. Stephen Casscles, Cedar Cliff Vineyards, Athens, NY.

This article details Heritage and French-American grape varieties that I have grown and evaluated for the past twenty years or more. The grape varieties covered in this article are different from the grape varieties covered in our earlier articles published in *Fruit Notes and Horticultural News.* My farm, Cedar Cliff , is located in Athens, NY, which is on the west bank of the Hudson River about fifty miles north of Newburgh, NY. These quality heritage and French-American varieties were bred in eastern Massachusetts or in the Hudson Valley between 1840 and 1880. Many also came to the Hudson Valley from France before World War II via the grape pioneer Philip Wagner of Boordy Vineyards of Maryland.

These varieties are suitable for most of New England and the Middle Atlantic States except for its coldest regions. Some of these varieties can be used for both wine production and as table grapes. They are all productive, winter hardy, and fungus disease resistant. Because of their resilience, they need less labor, spray material, and other cultivation practices than most of today's commercial varieties. Consequently, they can be grown profitably in the Northeast. Further, since many are locally developed heritage grape varieties, they should command heightened interest and demand from wineries and the wine consuming public

White Grape Varieties

BACO BLANC (Baco 22-A) – Created in 1898 by François Baco (1865-1947) who lived south of Bordeaux, France. It is a hybrid of Folle Blanche x Noah. It is still recommended in France to make brandy in Armagnac. This variety is highly productive, very fungus disease resistant, and winter hardy. The white/green cluster is long and cylindrical (Picture 1). Its bud break is fairly early, and it ripens late in the season to attain proper sugar levels. While recommended to be distilled in France, in the Northeast, it makes clean and fresh white wines that are high in acid. Its flavor profile includes green apples, pink grapefruit, lemons, and flint that melds with softer flavors of melons. While overall it is a neutral wine, it is a good blender that adds substance to the middle of a white wine blend. In addition, its skins can be used to make superior brandy as is done in Armagnac.

Picture 1. BACO BLANC (Baco 22-A)

BOORDY WHITE ROGUE – A superior white grape variety that was sold by Philip Wagner (1904-1996) of the former Boordy Nursery, Riderwood, Maryland. Unfortunately, the name tag of this variety was lost, but since it was such a superior grape variety, Philip continued to grow it and sell it in his nursery catalog as Boordy "White Rogue". Wagner said it was "one of the earliest, extremely vigorous and productive, winter-hardy, disease resistant, [and of] good wine quality." This variety (Picture 2) was a keeper for Wagner especially in places that have a short growing season and harsh winters. I agree on both counts. Wagner suspected that this was a François Baco white hybrid.

Picture 2. BOORDY WHITE ROGUE

BURDIN 4672 – A hybrid of S. 5455 (Plantet) and an unknown white *vinifera.* The cluster is of medium size, compact and winged, fungus disease resistant, productive, and cold hardy (Picture 3). The wines are soft, with elements of pears, pink grapefruit, and slight peach and banana flavors, with a firm acid profile. These fragrant wines are bright with a clean finish. This variety ripens by mid-season and is suitable for the cooler, but not coldest areas of New England.

J.S. 12.428 – Bred by Joannes Seyve (1900-1966) of the Rhône-Alpes region of France, that is of unknown parentage. The white/pink cluster (Picture 4) is large and compact, with solid fungus disease resistance, which is moderately winter hardy and productive. The wine quality is very good either on its own or in a blend. When blended with Valerien, listed below, it makes a brilliant, complex, and very-French white wine, reminiscent of a Sancerre, with integrated flavors of green apple, lemons, pink grapefruit, white peaches, and melons, that is overlaid with soft vanilla elements. It is aromatic wine that has interesting layers. As this wine ages, it become more Alsace-like, with a delightful weighty viscosity, with flavors of melons, older pineapple, white peaches, and lots of vanilla.

Picture 3. BURDIN 4672

Picture 4. J.S. 12.428

SIEBEL 13.047 – A white Seibel hybrid (S. 5658 x S. 4995) that was bred by Dr. Albert Seibel (1844-1936) in an area south of Lyon, France. It is moderately winter hardy with moderately tight clusters of white/pink berries (Picture 5) that are of medium size. It ripens early, but can stay on the vine in cooler locations to attain very high sugar levels. It needs a solid spray program for fungus disease protection. It is best suited to cooler, but not coldest parts of the Hudson Valley, Mohawk Valley, New Jersey, and New England. The wines are exceptional that is "very French" in its flavor profile with elements of white peaches, pears, melons, and light bananas. It has substantial body for a white that conveys a soft, creamy, and velvet finish.

Picture 5. SIEBEL 13.047

VALERIEN (S.V. 23-410) – Bred by Bertille Seyve, Jr. (1895-1959), who lived south of Lyon, France. The white/pink cluster (Picture 6) of unknown heritage is medium-large and loose, with moderate winter hardiness. It is fungus disease resistant with a good spray program and productive. It is a vigorous variety of unknown genetic heritage that tends to bud out late and ripens by mid-season or earlier. The wines are very good that are well balanced, fruity, with good mouth feel. Valerien is good alone and compliments most white blends, especially J.S. 12.428, which is listed above.

Picture 6. Valerien S.V. 23-410

Pink/Red Grape Varieties

CAPTIVATOR – A hybrid developed by T. V. Munson (1843-1913) of Denison, Texas, that is a hybrid of various E. S. Rogers varieties. (Herbert x Meladel (Delago (Delaware x Goethe) x Brilliant (Lindley x Delaware)). This variety is productive, winter hardy, and fungus disease resistant. It has a medium small bunch of large pink colored berries (Picture 7). This is a dual-purpose grape that is good for the table and for wine production. The white wines are bright, very fruit forward, and aromatic with a soft and approachable muscat flavor. It is good either on its own or when used in blends to brighten them up. It reminds me of Lindley in many ways (see Lindley entry).

Picture 7. CAPTIVATOR

LINDLEY – A high quality dual-purpose red/pink grape (Picture 8) bred in 1851 by E. S. Rogers (1826-1899) of Salem, MA. Lindley is a hybrid of Carter x White Chasselas. It is a physically attractive table/wine variety that is vigorous, fungus disease resistant, moderately winter hardy, and a healthy grower that produces a quality white wine. Its flower is somewhat self-infertile, but it can be fully fertilized by Baco Blanc, Concord, Delaware, and Corot Noir. The fruity wines are of at least the quality of Delaware, with more bright Muscat overtones that complement its guava and mixed tropical fruits of mangoes and pineapple. It is a quality grape that was used extensively by the grape breeder T. V. Munson to bred Brilliant, Captivator, Hidalgo, and others.

Picture 8. LINDLEY

Blue/Black Grape Varieties

ANNIE NOIR – A chance seedling found in the Hudson Valley around the year 2000. In the field, it is productive, fungus disease resistant, and winter hardy. Its canopy has open growth, the canes grow laterally, and before its fruit ripens, its canes harden off so that it is winter hardy. Annie Noir clusters are large, open, with large blue-black berries and clusters (Picture 9). The berries start to fall off as it ripens, so it is best to harvest when it is at or before maturity. The wines are clean and pleasant with lots of berry fruits and soft tannins. It has slightly cooked blueberry, blackberry, and strawberry jam notes, with some elements of black cherry, raisins, and anise in its nose and flavor profile, that is grounded with burnt toast and wet bricks. While it is a relatively soft wine, it has darker notes of light chocolate, cooked plums, and light black pepper. Its fruit/acid profile is balanced with an under pinning of charcoal, light tobacco, and tannin to support its fruit.

Picture 9. ANNIE NOIR

B.S. 3408 – It is a hybrid bred by Bertille Seyve, Sr. (1864-1939) who lived in the Rhône-Alps region of France. A blue-black grape of great promise in the field and cellar whose heritage is B.S. 872 x S.5410. It is very productive in the field, moderately winter hardy, with good fungus disease resistance. The cluster is medium-large (Picture 10) and loose that readily accept a spray application. This light ruby red wine is bright and aromatic with flavors of cranberry juice, red and black raspberries, and slight strawberry jam, with a soft, but substantial flinty tannin structure.

Picture 10. BS 3408

HUMBERT # 3 – Developed around 1912 by Monsieur Humbert of the Jura, France. One of its grand-parents is the Hudson Valley Heritage variety Eumelan. It is a hybrid of Roi des Blancs (Gaillard 157) x Gaillard 2. The cluster is medium in size and loose, with medium sized blue-black berries (Picture 11). The variety is productive to very productive and of medium winter hardiness. It has good fungus disease resistance, except for powdery mildew. It ripens early-late to late season. Its wine is of a crimson color and is balanced for acids with a great tannin structure. It is integrated with a burnt raspberry nose, and cranberry/cherry flavors, black olives, cedar, and smoke that has some herbaceous overtones. This wine can age, with a medium-bodied flint middle and finish. Because of its tannin structure, it is a good blender to beef up lighter red wines.

Picture 11. HUMBERT # 3

LE COLONEL (B.S. 2667) – Bred by Bertille Seyve, Sr. It is Couderc Noir x B.S. 872 hybrid. While not commonly grown in the Northeast, it shows much promise at our farm at Cedar Cliff, Athens, NY. It is moderately winter hardy, with solid fungus disease resistance. The vine is of standard size, is a vigorous grower, with moderately high yields. The variety buds out late to avoid late spring frosts and has an airy growth habit (Picture 12) to help minimize fungus disease pressure. It is in the cellar where Le Colonel shines, with complicated flavors of cherry, cranberry juice, raspberries, and beach plums that combines with tobacco box and cedar flavors. The body of the wine is serious, which is steely and flinty, with great tannin structure. The wine is big, aromatic, and approachable, with complex layered fruit. Le Colonel is good on its own or when used in blends to lend its hefty tannins to such a blend.

Picture 12. LE COLONEL (B.S. 2667)

MARION – Either purposely bred or found by Dr. Charles Grant (1810-1881) who established a vineyard and breeding program on Iona Island, near Bear Mountain State Park, New York before 1860. It is a *riparia/labrusca* hybrid which is evidenced by its taste. The must produces a dark juice, with high acids and soft labrusca flavor. The wine has overtones of fresh and cooked strawberries, a soft slightly labrusca middle, that is bright and integrated with a long clean finish. The cluster is medium sized and compact (Picture 13). It is a very vigorous vine that blooms early, but ripens early-late in the season. It is very fungus disease resistant, winter hardy, very productive, has high sugar levels, and does well on many different soil types. This grape is good for wine either on its own or in red blends to brighten them up and to elongate its finish.

Picture 13. MARION

PINARD AND MARECHAL JOFFRE – These two sister varieties have the same genetic make-up as Marechal Foch and Leon Millot (Foster's clone). Like the former, Pinard and Marechal Joffre are hybrids of Millardet 101-14 x Goldriesling. All four are hybrids bred by Eugène Kuhlmann (1858-1932) of Colmar,

Alsace around 1911. Both Pinard and Marechal Joffre (Picture 14) are red varieties that are winter hardy, fungus disease resistant, vigorous, and very productive. Both Pinard and Marechal Joffre should be considered along with their sister varieties Marechal Foch and Leon Millot when planting suitable red varieties for cool and even cold sites in New England and Upstate New York. Of the two, Marechal Joffre ripens about one week to ten days before Pinard, which ripens about the same time as Marechal Foch. Both have good tannin structure that can beef up thinner red wines. The fruit flavors are similar to Marechal Foch and Leon Millot that include blackberry jam, cooked mulberries, black cherry, and soft cooked prunes, with some chocolate, mahogany, and earth elements. These grapes can be used to make bright fruity red wines or to add complexity to other red wines.

Picture 14. PINARD

PALLMER – A chance seedling of unknown parentage found in the Hudson Valley around the year 2000. It has an upright growth habit on a vine of average to above average vigorousness and is moderately productive. Its smallish black berries (Picture 15) are on medium to large sized loose clusters. The variety is hardy to very winter hardy with solid resistance to all fungus diseases. In the cellar, Pallmer shines. It has deep and dark crimson red colors, with aromas and fruit flavors of integrated light cooked prunes, black cherry, black raspberry, cooked mulberries, with a mahogany wood finish. This very aromatic wine has lots of the above cited fruits that integrates well with its big, but soft and meaty tannin structure, and has elements of violets, lavender, black pepper, and raspberry jam. It is a complex wine, which while bright, has the substance and flavor profile of a Malbec. It is good on its own or in red blends to give such blends some heft.

Picture 15. PALLMER

S.V. 18-307 – Bred by Bertille Seyve, Jr., which may be a hybrid of Chancellor x Villard Blanc or Subereux bred after 1935. It is a parent of the Cornell hybrid Corot Noir. This vigorous vine has a thick canopy and is good in the field with modest fungus disease resistance, is very winter hardy, and productive. Its semi-loose clusters help to reduce fungus disease pressure. This small-berried black grape (Picture 16) ripens by mid-season and is a very reliable producer. The wines are deeply colored to inky, with a full rich body, great balance, and tannin structure. While a good blender to add substance to a lighter red blend, it has interesting and integrated flavors of cooked mulberries, blackberries, heavy plums, mint, coffee, and black pepper.

Picture 16. S.V. 18-307

WILDER – A Rogers hybrid bred in 1851 that crossed Carter x Black Hamburg. It is named in honor of Marshall P. Wilder, one of the founders of the Massachusetts Horticultural Society and the American Pomological Society. 'Wilder' (Picture 17) is vigorous to very vigorous and winter hardy. It is somewhat susceptible to fungus diseases, but is productive. Its flower is self-infertile, but it can be pollinated by the same varieties that pollinate Goethe (see 'Pink and Light Red Heirloom Grape Varieties for the Northeast', in *Fruit Notes,* vol. 83, no. 4 (2018) and *Horticultural News,* vol. 98, no. 4 (2018). It ripens by mid-season at about the same time as Concord. It is a reliable producer of relatively non-*labrusca* tasting wines. It is a great great-grandparent of the cool climate grape variety Marquette.

Picture 17. WILDER

Conclusion

It is my hope that those in the Northeast who are looking for "new" grape varieties to cultivate and wines to produce from them will consider these "old" grape varieties that had not been closely evaluated in the past. Further, that those interested in low spray programs will consider these grape varieties when developing their own sustainable vineyard programs and practices.

This article is based on the author's over forty years of experience growing cool climate grapes in Athens and Middle Hope, NY and making wine from them; and *Grapes of the Hudson Valley and Other Cool Climate Regions of the United States and Canada*, by J. Stephen Casscles (Coxsackie, N.Y.: Flint Mine Press, 2015), which is going to a new and expanded second edition. This book has more information on some of the grapes covered by this article. The author's email address is cassclesjs@yahoo.com. Heritage Vines of the Hudson Valley.

From Left to Right: Win Cowgill, Trevor Hardy, Megan Haynes, Jacob Wafler, Cristian Ferrari, Alessandro Valente, Kyle Wafler, Susan Wafler, Paul Wafler.

Aslendro Valente and Trevor Hardy discuss converting to a cement trellis post system at Wafler Ochards with Paul and and Kyle Wafler.

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Horticulture Characteristics of Selected Hard Cider Apple Cultivars

Duane W. Greene, Maureen Vezina and James Krupa.
Stockbridge School of Agriculture, University of Massachusetts

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 randomized 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 cluster 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.

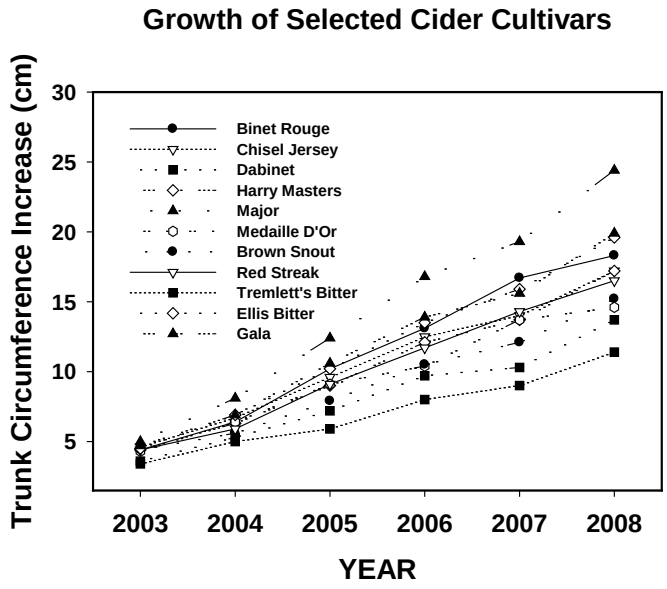

Figure 1. Growth of selected cultivars according to year.

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 culti-vars 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 Chisel Jersey, Dabinett,

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

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 characteristic, 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

Evaluation of American Hybrid Winegrape Cultivars in a National Trial Vineyard in Massachusetts

Elsie Murphy[1], Sonia Schloemann[2], Lyndsey Ware[2], Elsa Petit[1]

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[2]***UMass Extension***

Selecting the right wine grape cultivar for the right location is the first key decision when establishing a new vineyard. Choosing wine grape cultivars that are both cold hardy, disease resistant and produces well are essential if a grower is to be successful in New England.

Prior to the turn of the 21st century, most U.S. states produced few to no winegrapes, primarily because of limitation in cold hardiness and disease resistance of the *Vitis vinifera*, the European winegrape species that comprises most commercial cultivars grown in the U.S. in traditional production regions[1].

While *Vitis vinifera* cultivars had been used for centuries throughout Europe they ran into trouble in the 1800's[2]. "The creation of interspecific hybrid grapes primarily came about because of problems encountered in France in the 1860s. A devastating phylloxera outbreak began there around 1860 and lasted for the next 20 years. During that time, about 90 percent of French vineyards were destroyed. To combat this epidemic, cultivars derived from phylloxera-resistant American species were planted. At one time, more than 25,000 acres of the American grape 'Noah' were planted in France, as were other American grapes such as 'Clinton,' 'Othello,' 'Lenoir,' 'Isabella,' and 'Herbemont.' 'Concord,' 'Catawba,' and 'Delaware' were tried but had low resistance to phylloxera. The importation of these varieties also brought with them new disease problems like downy mildew and black rot. In 1876, it was found that *V. vinifera* cultivars could be grafted onto American grapes successfully. The discovery helped transition back to *V. vinifera* grapes, but diseases were also a problem according to Stafne.

The introduction of interspecific Hybrid grape varieties in the USA commonly called French- American Hybrids[2]. French hybrids originally were developed from breeding efforts for rootstocks on which to place *V. vinifera* grapes. Amateur grape breeders pushed the breeding process forward to look for vines with roots resistant to phylloxera, foliage resistant to fungal pathogens, and fruit that could produce wines more similar to *V. vinifera* types. This stage of breeding produced some cultivars such as 'Baco noir' and 'Baco blanc.'

The second wave of breeding for interspecific hybrids used crosses between hybrids gained from the first stage[2]. Some of the influential breeders of this time period were Seibel, Bertille Seyve, Joannes Seyve, Galibert, and Landot. The third stage of hybrid breeding led to the modern hybrid grapes commonly grown today. These were usually crosses of hybrids from the second stage with *V. vinifera* grapes to gain superior wine quality. However, with the elevation of wine quality came the dilution of pest resistance. There are several breeding programs around the world now involved in creating high quality hybrid grapes. Some of the programs in the United States are in Arkansas, California, Florida, Georgia, Minnesota, Mississippi, New York, and North Carolina.

The introduction of new, interspecific hybrid cultivars has allowed for the development of grape industries in regions not previously considered possible[1]. As the wine grape industry continues to expand into the colder New England states it became important to evaluate potentially cold hard cultivars from multiple sources for adaptabilty for commercial production.

To this end a team of UMASS scientists participated in the "NE1720: Multi-state Coordinated Evaluation of Winegrape Cultivars and Clones: trial established

in 2005. The purpose was to evaluate the horticultural characteristics of each cultivar, the national project "NE1720: Multi-state Coordinated Evaluation of Winegrape Cultivars and Clones" has been developed. As part of that national project, the University of Massachusetts vineyard at the Cold Spring Orchard, Belchertown, has a variety trial with nine winegrape cultivars planted in 2005. Here we report results concerning survivability, timing of key phenological stages, Brix, and natural disease resistance to downy mildew. Part of NE1720 is to obtain consistent responses from stakeholders including support not only for continued cultivar development and evaluation, but also for developing best management practices to improve consistency, quantity, and quality of crops from evaluated winegrape cultivars and clones.

This report will cover results concerning survivability, timing of key phenological stages, Brix, and natural disease resistance to downy mildew.

Materials & Methods

Location, plant material, and management. The vineyard is located at the Cold Spring Orchard in Belchertown MA (42.2, -72.36). In 2005, Chambourcin, Corot Noir, Frontenac, La Crescent, Marquette, Noiret, Riesling, St. Croix, and Vidal (Table 1) were planted in a randomized complete block with three plants per block replicated in four rows (Figure 1). Riesling is a vinifera cultivar that was used as a comparison. Grapevines were trained in high wire with a cordon-spur pruning system for hybrids and a low wire with a cordon-spur pruning system with vertical shoot positioning (VSP) for *vinifera*.

In spring, shoots are thinned annually to 4 shoots per foot. Early in the summer, shoots are combed for the high wire training system or positioned vertically

Table 1. The nine winegrape cultivars evaluated at the vineyard at the University of Massachusetts Cold Spring Orchard, in Belchertown.

Cultivar	Wine color	Year released	Breeding program or breeder
Chambourcin	Red	1963	Seyve
Corot Noir	Red	2006	Cornell
Frontenac	Red	1996	UMN
La Crescent	White	2002	UMN
Marquette	Red	2006	UMN
Noiret	Red	2006	Cornell
Riesling	White	NA	NA
St. Croix	Red	1981	Swenson
Vidal	White	1930	Vidal

Row 4		Row 3		Row 2		Row 1	
Variety	Plant number	Variety	Plant number	Variety	Plant number	Variety	Plant number
St. Croix	1	Noiret	1	La Crescent	1	Riesling	1
St. Croix	2	Noiret	2	La Crescent	2	Riesling	2
St. Croix	3	Noiret	3	La Crescent	3	Riesling	3
Vidal	1	La Crescent	1	Riesling	1	Corot Noir	1
Vidal	2	La Crescent	2	Riesling	2	Corot Noir	2
Vidal	3	La Crescent	3	Riesling	3	Corot Noir	3
Chambourcin	1	Riesling	1	Chambourcin	1	Marquette	1
Chambourcin	2	Riesling	2	Chambourcin	2	Marquette	2
Chambourcin	3	Riesling	3	Chambourcin	3	Marquette	3
Riesling	1	Marquette	1	Corot Noir	1	Frontenac	1
Riesling	2	Marquette	2	Corot Noir	2	Frontenac	2
Riesling	3	Marquette	3	Corot Noir	3	Frontenac	3
Marquette	1	Frontenac	1	Vidal	1	Noiret	1
Marquette	2	Frontenac	2	Vidal	2	Noiret	2
Marquette	3	Frontenac	3	Vidal	3	Noiret	3
La Crescent	1	Vidal	1	St. Croix	1	Chambourcin	1
La Crescent	2	Vidal	2	St. Croix	2	Chambourcin	2
La Crescent	3	Vidal	3	St. Croix	3	Chambourcin	3
Corot Noir	1	Chambourcin	1	Frontenac	1	Vidal	1
Corot Noir	2	Chambourcin	2	Frontenac	2	Vidal	2
Corot Noir	3	Chambourcin	3	Frontenac	3	Vidal	3
Frontenac	1	St. Croix	1	Noiret	1	La Crescent	1
Frontenac	2	St. Croix	2	Noiret	2	La Crescent	2
Frontenac	3	St. Croix	3	Noiret	3	La Crescent	3
Noiret	1	Corot Noir	1	Marquette	1	St. Croix	1
Noiret	2	Corot Noir	2	Marquette	2	St. Croix	2
Noiret	3	Corot Noir	3	Marquette	3	St. Croix	3

Figure 1. Experimental design used in the winegrape cultivars trial at the University of Massachusetts vineyard at Cold Spring Orchard in Belchertown, MA.

for the VSP training system. Mid-summer, leaves are pulled to expose the fruits to sun. Pests are managed using a regular conventional pesticide program.

Soil. According to the USDA National Cooperative Soil Survey, the soil is classified as 315B (Scituate fine sandy loam), which is a moderately well-drained fine sandy loam with 3 to 8 percent slopes.

Data collection. In 2021, survivability of each cultivar (number of alive plants out of all original plants for a given cultivar) after 16 years was computed. For key phenology, we evaluated bud burst (stage 4, Figure 2), flowering (stage 26, Figure 2), and veraison (stage 35, Figure 2). We also quantified juice soluble solids (Brix). For disease, we focused on downy mildew, one of the most economically important diseases, in MA.

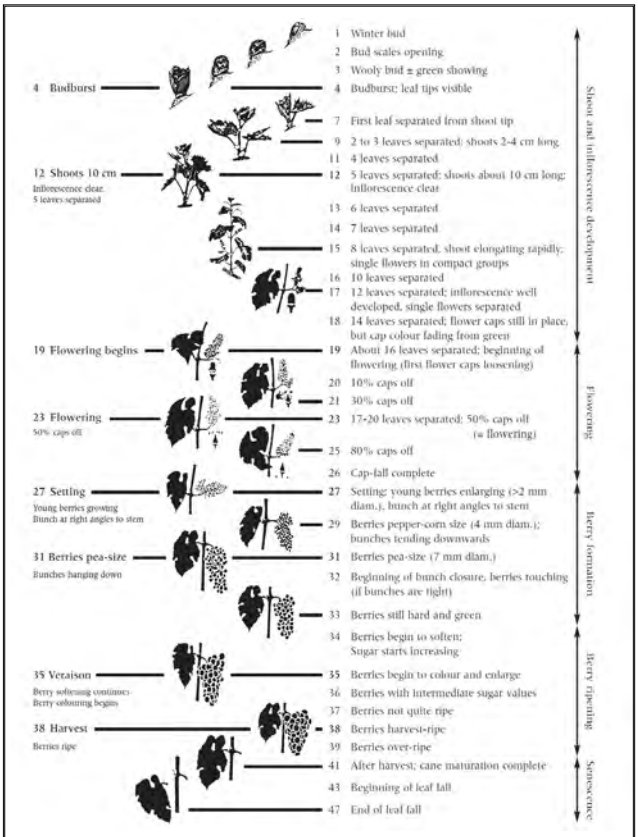

Figure 2. Modified E-L system for identifying major and intermediate grapevine growth stages from Dry and Coombe 2004.

Results

Survivability. In 2021, the levels of survivability were the lowest for Riesling (42%) and Chambourcin (50%), followed by Noiret and Vidal (both 75%), Marquette (83%) and Corot Noir (92%) (Figure 3). Frontenac, La Crescent and St. Croix did the best and all survived (Figure 3).

Key phenology and total soluble solids (Brix). Bud break in 2019 occurred around 15 May (day of year 135) (Table 2). The nine winegrape cultivars had bud break on different days, from early to late bud break as follows: La Crescent, Marquette, Frontenac, St. Croix, Vidal, Chambourcin, Noiret, Corot Noir, and Riesling (Table 2). Bloom occurred around 24 June (day of the year 175) in 2019 and around 16 June (day of the year 167) in 2021 (Table 2). For both years, cultivars that bloomed the earliest were La Crescent, Marquette and Frontenac and the latest were Corot Noir and Riesling. Veraison occurred around 28 August (day of the year 240) in 2019 and 23 August (day of the year 235) in 2021 (Table 2).

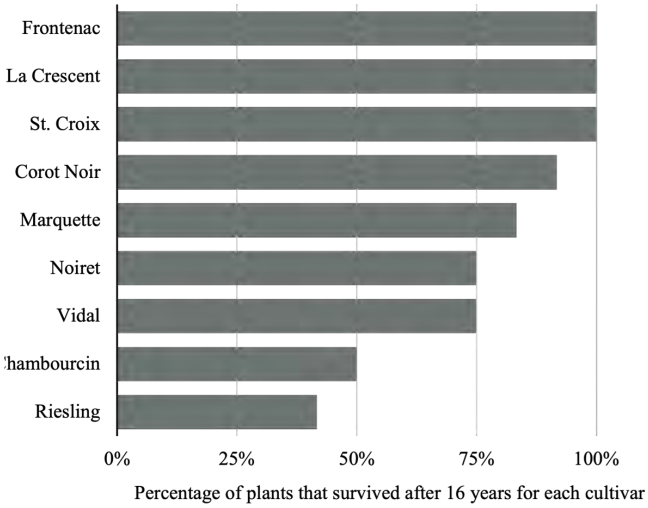

Figure 3. Survivability of each of nine winegrape cultivars at the University of Massachusetts vineyard at Cold Spring Orchard in Belchertown, MA.

Marquette was the first cultivar to go through veraison and Riesling the last (Table 2). Brix was measured for all winegrape cultivars the same day, 20 September 2021. Marquette had the highest Brix and Riesling the lowest (Table 2).

Natural resistance to downy mildew. In 2021, among the nine cultivars tested, Vidal, Riesling, La Crescent, had the least natural resistance to downy mildew while St. Croix showed average symptom level and Chambourcin, Noiret, Frontenac and Marquette showed the most resistance (Figure 4).

Variety	Bud break 2019 (DOY)*	Full bloom 2019 (DOY)	Full bloom 2021 (DOY)	Veraison 2019 (DOY)	Veraison 2021 (DOY)	Brix on Sept 20, 2021
La Crescent	133	172	163	243	234	18.2
Marquette	133	172	163	232	221	25.1
Frontenac	134	172	163	233	224	19.9
St Croix	135	172	165	235	230	20.8
Vidal	135	177	168	255	239	17.2
Chambourcin	136	177	170	245	242	17.1
Noiret	136	175	167	236	240	17.0
Corot Noir	137	178	172	245	242	16.9
Riesling	138	180	175	257	247	16.5

Table 2. Key phenology and total soluble solids (Brix) measured in 2019 and 2021 for nine winegrape cultivars at the University of Massachusetts vineyard at Cold Spring Orchard, Belchertown. Bud break data were not available for 2021 and Brix was not available for 2019. *DOY: Day of Year.

Conclusions

At the University of Massachusetts vineyard at Cold Spring Orchard, cultivars that were the most suitable based on survivability, level of sugar and downy mildew resistance are Frontenac, Marquette and St Croix. Cultivars that are the least adapted are Vidal and Riesling.

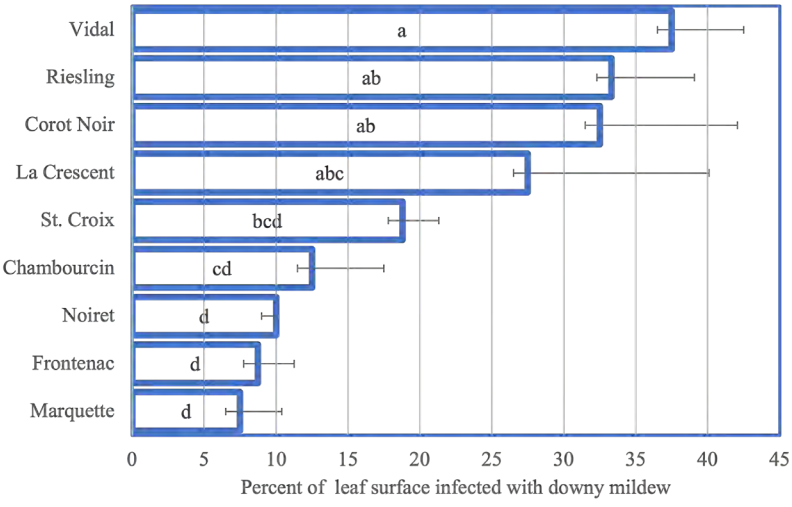

Figure 4. Level of susceptibility to downy mildew according to winegrape cultivar. Bars with the same letter are not different at odds of 19:1.

Acknowledgements

This project was made possible thanks to the support of the NIFA Multistate project NE1720 for the MA Experiment Station Project #MAS00516: "Multistate Coordinated Evaluation of Winegrape Cultivars and Clones".

Citations

[1]NE1720: Multi-state Coordinated Evaluation of Winegrape Cultivars and Clones
https://www.nimss.org/projects/view/mrp/outline/18405
[2]Interspecific Hybrid (French-American) Wine Grapes, 2019. Eric Stafne
https://grapes.extension.org/interspecific-hybrid-french-american-wine-grapes

Table salt added to diluted Concord grape juice prior to fermentation results in a highly attractive bait for spotted-wing drosophila

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Pest monitoring is a cornerstone of IPM. In order to effectively time insecticide sprays to mitigate damage by spotted-wing drosophila (SWD), growers need to monitor SWD populations. Commercial food-based lures are available for monitoring purposes. However, those lures are based on fermentation materials and consequently they also attract a comparatively high number of other fly species that belong to the same family (Drosophilidae) as SWD, as well as other non-target insects. Captures of unwanted insects hinders trap performance and increases sorting time. Thus, bait selectivity, cost, and accessibility are important factors influencing growers' decision to adopt monitoring systems

Diluted Concord grape juice (DGJ) was previously reported to be highly attractive to male and female SWD. Our interest in DGJ stemmed from its local availability and low cost. Results from fermentation studies (see fall 2020 issue of *Fruit Notes*) revealed that female SWD captures can be increased if traps are left for up two weeks in the field (we did not evaluate longer intervals). However, the fermentation process will also attract more non-target insects. It is known that preservatives such as borax and table salt influence microbial fermentation. The presence of and choice of preservative may alter bait effectiveness either directly by adding additional volatile attractants, or indirectly by affecting rate and amount of fermentation.

Here, we report the results of cage and field studies that sought to assess whether the response of adult SWD and of other drosophilids could be manipulated by the addition of varying amounts of table salt to DGJ prior to fermentation. More specifically, we attempted to make fermented DGJ less attractive to non-target insects without affecting SWD captures.

Materials & Methods

Cage studies. This study was conducted from 3 June to 20 July 2021 using experimental cages (2 x 2 x 2 ft) made of nylon woven mesh. Four wires (6 inches in length) were suspended equidistantly at each of the four corners of the cages. The following four materials were evaluated: (1) fresh DGJ, (2) 1-week old DGJ with no table salt added, (3) 1-week old DGJ with 2% table salt (roughly between 1/16 and 1/8 teaspoon for 6 oz. of DGJ), and (4) 1-week old DGJ with 4% table salt. All materials were evaluated using 2 ml polypropylene microcentrifuge tubes. Prior to treatment application, the lids of the microcentrifuge tubes were removed, a 3 cm wire was wrapped around their neck, and a thin coating of Tangletrap insect coating was applied to the outer surface of the tubes to capture alighting flies. On each observation day, 15 males and 15 females were released inside each cage between 0815 and 0830 hours. Observations were initiated immediately after introducing the Tangletrap-coated centrifuge tubes with the odor treatments. One person quantified the number of males and females that were captured at 4, 8, and 24 hours after starting the experiment. Results show the percentages of males and females that were captured by traps over a 24-hour period. Each trial was replicated 12 times.

Field studies. We conducted two field experiments. The first experiment compared the attractiveness of (1) fresh DGJ, (2) DGJ aged for one week in the absence of table salt, (3) DGJ aged for one week with 2% table salt (Figure 1), and (4) Scentry® SWD lure, to male and female SWD, and to non-target insects using 1-quart platic traps (Figure 1). This study was conducted in a commercial cherry block at the University of Massachusetts Cold Spring Orchard (Belchertown, MA) from 1 June to 17 July 2021. Five cherry trees were used for this evaluation, and each tree served as a replicate. Traps were inspected twice a week.

Figure 1. Trap baited with diluted Concord grape juice aged for 7 days in the presence of 2% of table salt.

Results

Cage studies. DGJ aged for one week in the presence of 2% table salt was much more attractive to males and females than any other treatment (Figure 2). Increasing the concentration of table salt to 4% resulted in decreased attraction, which was comparable to that recorded for the no-salt treatment. Each of the aged materials was significantly more attractive to males and females than fresh DGJ. This is interesting because we know that fresh DGJ is about 3 times more attractive to SWD than some commercial lures.

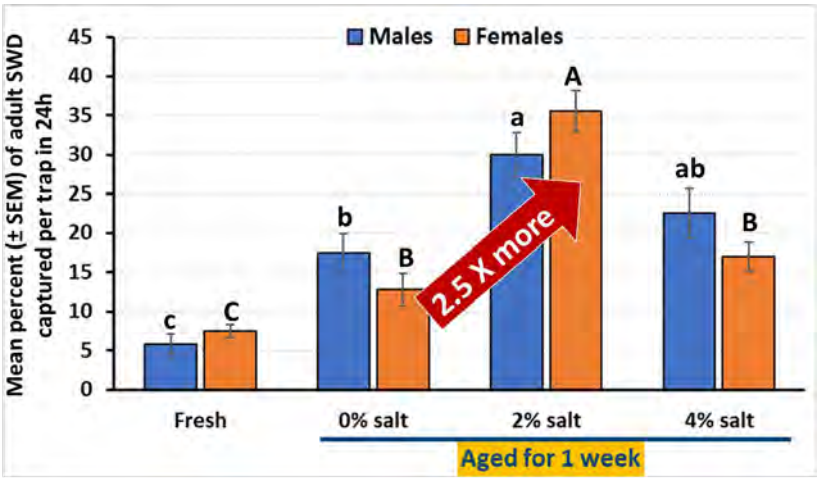

Figure 2. Response, expressed as the percentage of male and female SWD captured over a 24-hour period in cages, to fresh diluted grape juice either, fresh or aged for 7 days with 0, 2, and 4% of table salt added prior to fermentation. For each fly gender, bars superscribed by the same letter are not significantly different at odds of 19:1.

Field studies. Figure 3 presents the results of the comparison of fresh DGJ, DGJ aged for 1 week in the absence and presence of 2% table salt, and the Scentry® SWD lure. For both males and females, 1-week old DGJ that was aged in the presence of 2% table salt attracted significantly more SWD than any other treatment. For males, the response to 1-week old DGJ with no table salt added was intermediate, and fresh DGJ was not attractive when compared to water control. For females, the response to DGJ that was aged for 1 week in the absence of table salt did not differ statistically from that recorded to fresh DGJ, and both materials were significantly more attractive than water control. Captures of non-target insects were significantly greater in Scentry® SWD lure-baited traps than in traps containing other treatments, which were statistically similar.

The second field experiment was conducted in a commercial raspberry orchard in Whately, MA, from 26 July to 12 August 2021. The five olfactory treatments evaluated here were: (1) fresh DGJ, (2) DGJ aged for one week with 2% table salt, (3) Scentry® SWD lure, (4) Trécé broad spectrum PEEL-PAK® multi-component lure, and (5) Trécé high selectivity 3-component lure. Each treatment was replicated six times. Traps were hung from the upper wire of the trellis system, along the perimeter of the block. Trap-capture data were collected twice a week.

In the second field study, DGJ that included table salt at 2% concentration and aged for 1 week outperformed the fresh DGJ and the three commercial lures. Fresh

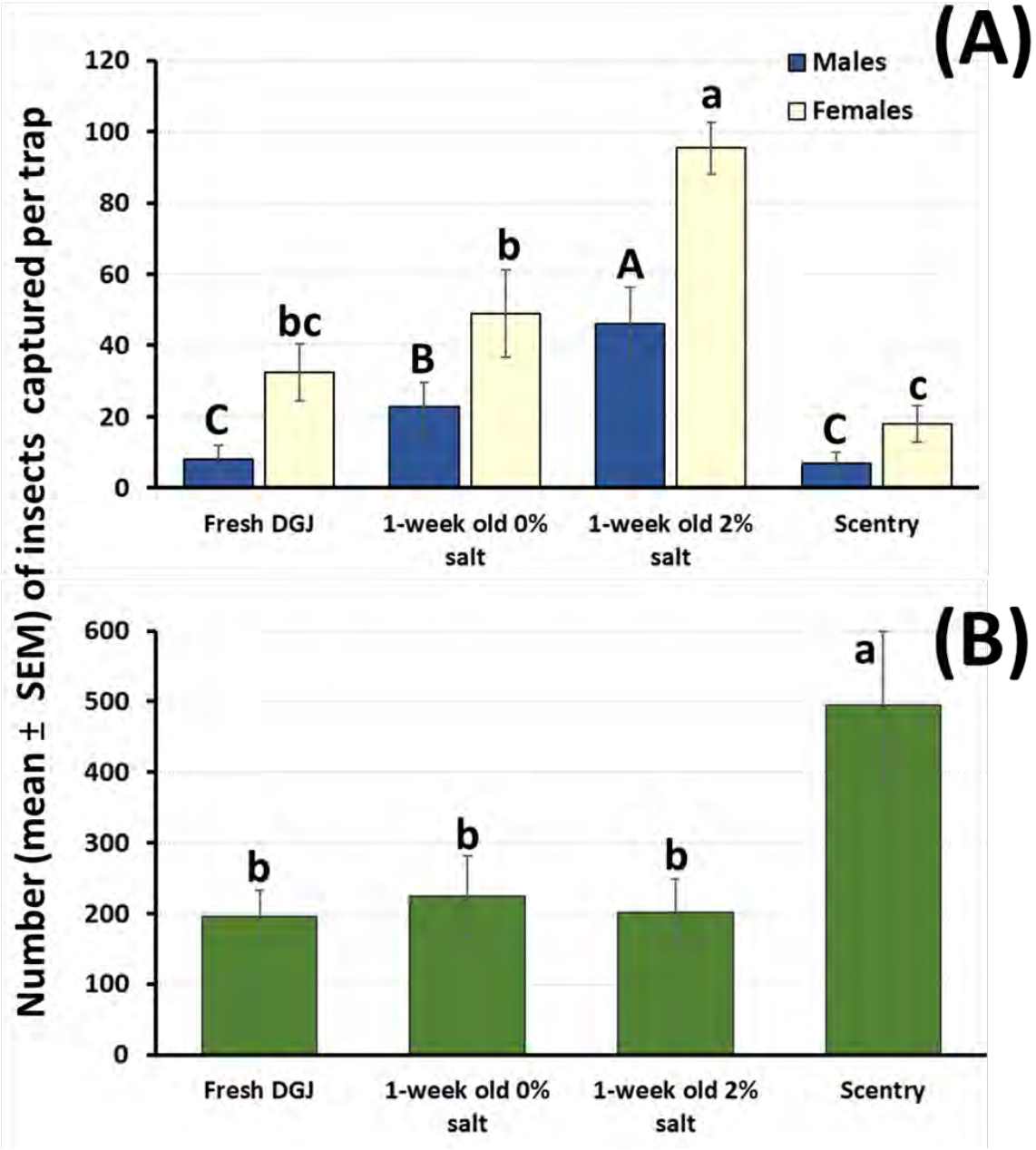

Figure 3. Captures of (A) male and female SWD and (B) non-target insects in traps baited with diluted Concord grape juice (DGJ) either, fresh or aged for 7 days with 0 and 2% of table salt added prior to fermentation versus Scentry SWD lures. For each sex of SWD, bars superscribed by the same letter are not significantly different at odds of 19:1.

DGJ was as attractive to males as the Trécé selective and the Scentry® SWD lures. Fresh DGJ was significantly more attractive than the Trécé broad spectrum lure. The response of females to fresh DGJ was comparable to that shown to the Trécé selective and Scentry® SWD lures, but greater than that recorded to the Trécé broad spectrum lure (Figure 4A). In terms of captures of non-target insects, the Trécé selective lure attracted the fewest number of non-target insects whereas the Scentry® SWD lure attracted significantly more insects than any other treatment except for the Trécé broad spectrum lure (Figure 4B).

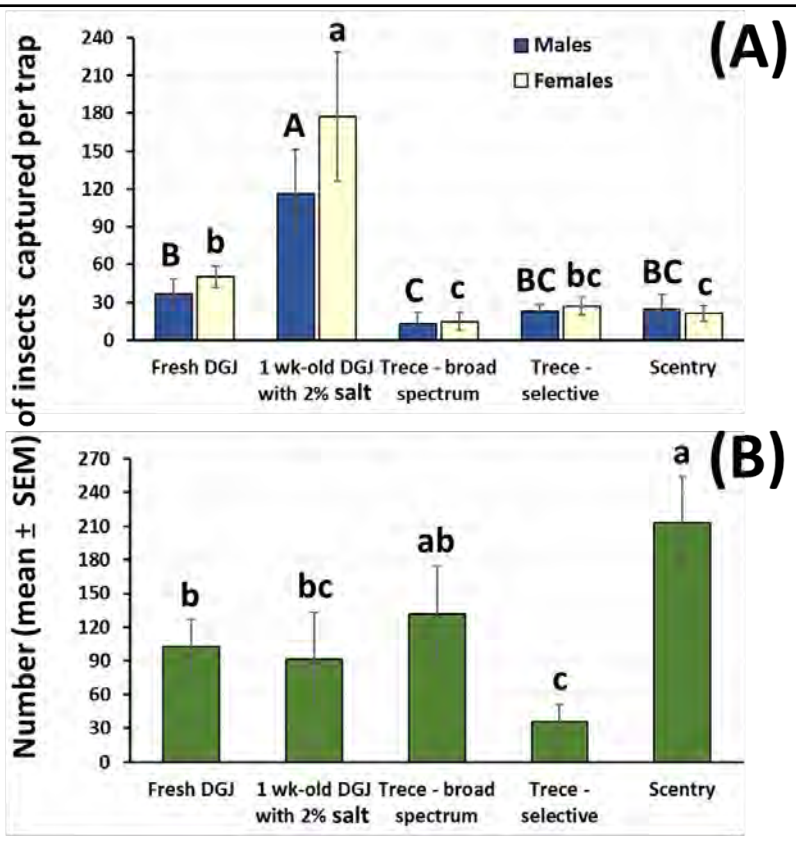

Figure 4. Captures of **(A)** male and female SWD and **(B)** non-target insects in traps baited with diluted Concord grape juice (DGJ) either, fresh or aged for 7 days with 2% table salt added prior to fermentation versus three commercial lures. Bars superscribed by the same letter are not significantly different at odds of 19:1.

Conclusions

When table salt is added to DGJ the resulting material outcompetes the performance of commercial lures and greatly reduces captures of non-target insects, thereby increasing bait selectivity. Taken together, these results when combined with its low cost and accessibility make DGJ a feasible monitoring option for small-scale growers who are not able to monitor or manage SWD populations because commercially available baits are too expensive or inaccessible.

RECIPE for making the UMass diluted Concord grape juice (materials for 5 traps):

- 25 oz. of tap water
- 9 oz. of Concord grape juice
- 1 tablespoon of table salt

Mix all ingredients, divide in equal parts, bait, and hang traps.

Acknowledgments

We thank Tim Nourse, Al Rose, and Tom and Ben Clark for allowing us to work on their orchards. We also thank Emily Begonis for assistance. Funding for this research was provided by the UMass Center for Agriculture, Food and the Environment (CAFE) and the Stockbridge School of Agriculture at University of Massachusetts Amherst, under Hatch project number MAS 00522.

Ernie's Influence on a Pomological Career

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Department of Plant Science, Penn State University

Presented as the Ernie Christ Memorial Lecture at the 2022 Tri-State Horticultural Meeting, Hershey, PA, February 2, 2022

I had the honor of presenting the first Ernie Christ Memorial Lecture and now that I will be retiring soon, I volunteered to make a second presentation to remind us of Ernie's contributions to the mid-Atlantic peach industry. I was the last pomologist on the Rutgers campus to work with Ernie and I shared an office with him for about 2 years before he retired in 1982. Although we were of different generations, we hit it off because we both loved pomology and I was lucky to have him as a mentor. During our time together, I travelled around the state with Ernie and he taught me about the history of the New Jersey fruit industry and about the changes he had seen during his career.

Photo 1. Ernie inspects apples with Bob Best, Sr. at Best Fruit Farm Hackettstown, NJ. https://www.facebook.com/profile.php?id=100057655419884 Photo: Credit Win Cowgill.

After visiting growers with Ernie, I was able to identify some of the problems facing the industry, most of which Ernie had been working on, and I continued to work on some of his favorite projects. Below is a discussion of some of the research projects that he helped me identify and how this has improved our understanding of peach tree physiology which has led to modifications in orchard practices.

Peach Variety Evaluations

Ernie was interested in evaluating new varieties and had a planting with more than 40 varieties from New Jersey, Maryland, Michigan, California, North Carolina, and Vineland and Harrow, Ontario. When I taught the tree fruit course at Rutgers in 1981, the 3 leading varieties were 'Redhaven', 'Loring' and 'Rio-Oso-Gem' and at

the Research Center at Cream Ridge we had research plantings of 'Redhaven', 'Cresthaven', 'Sunhigh', 'Blake', 'Sunqueen', and 'Jersey Queen'. However, due to cold winters, only 'Redhaven' and 'Cresthaven' cropped consistently. After a very cold winter in 1983, the only peach tree with a crop at Cream Ridge was the original 'Encore' tree and it quickly replaced 'Rio-Oso-Gem' as the leading late-season variety. The variety picture has changed quite a bit over the years and now the top 3 varieties being planted in the mid-Atlantic region include 'Redhaven', Glenglo' and 'John Boy'.

Photo 2. Ernie accepts an award from Bob Best and the NJ State Horticulture Society for his years of service to the NJ fruit industry.

In 1982 I wanted to establish a new planting for pruning experiments and Ernie recommended NJ244 that was recently named 'Jerseyglo'. The first year that the trees had fruit buds, they were killed by low winter temperatures and since the trees seemed to lack hardiness, I asked Ernie why he recommended it. He said that the trees had been observed in 10 locations around the state for 10 years, but they never experienced a cold winter. He said, "*It takes a long time to evaluate varieties*". In Virginia I evaluated more than 90 varieties and I think there is no minimum number of years required to evaluate a variety, but to identify its weaknesses of a variety must be exposed to different conditions, such as cold winters, spring frost, drought, hot summers, and wet summers.

Peach Rootstocks

Ernie was very interested in finding peach rootstocks that provided a range of vigor, were cold tolerant, and were disease resistant. He was also a skilled grafter and tried a number of grafting techniques to propagate peaches on peach (*Prunus persica*) and nonpeach rootstocks. He had several rootstock trials at Cream Ridge and Les Miller, Camden County agent, had trials in south Jersey. After several trials, Les preferred Halford and Ernie liked Lovell, but when I analyzed their data the two rootstocks performed similarly. Ernie like Lovell so much that he planted about an acre of Lovell to provide seed for the nursery at the Research Center. During my four years at Rutgers, I established 4 peach rootstock trials with every rootstock I could find in commercial nurseries, plus Citation from Floyd Zaiger, plus 3 harrow selections and some peach x almond hybrids that our peach breeder Shawn Mehlenbacher produced. The trees were still young when I left, but I learned that 'Redhaven', but not 'Cresthaven' or 'Loring' were incompatible with Citation.

Over the past 40 years many new peach varieties and rootstocks have been released. The 1980 Adams County nursery catalogue listed only 26 peach and 4 nectarine varieties, but today they offer 94 peach and nectarine varieties. All these varieties greatly extend the growing season, and most are higher quality and more attractive than varieties developed during the first half of the

20th century. However, we still need varieties with better cold hardiness and disease resistance, and bloom later in the north and have lower chilling requirements for the south. We have made less progress on peach rootstocks, and the leading rootstocks in the northeast are Bailey, Lovell and Guardian. West coast nurseries offer several others and some are interspecific hybrids. The Controller series from UC Dais shows promise for vigor control, however they need further testing in the east. It seems that the mechanism for dwarfing is reduced xylem hydraulic conductance. Now that we know the dwarfing mechanism, breeders may be able to select for vigor control, but we need a stone fruit breeding program in the U.S. similar to our apple rootstock program at USDA/Cornell.

Photo 3. The Rutgers University Fruit Team from the early 1980's that Rich Marini worked with.

Own rooted trees

In the early 1980s some nurseries mixed up varieties and rootstocks. As a result, growers were frustrated and were asking about growing their own trees. Ernie and I both discouraged on-farm nurseries because it is difficult to grow quality trees. One day in the office Ernie commented that it was too bad that we could not root peach cuttings and grow trees on the own roots. I told him about a recent publication where D.C. Coston and Armon Erez, at Clemson University, were able to root semi-hardwood cuttings. So, we tried rooting 6 varieties. The process involved cutting one-year-old shoots into 8"-long pieces, removing all but the 3 terminal leaves and cutting those leaves in half to reduce water usage. Strips of bark were removed from each side of the base of the cutting and the cutting was dipped into a solution of IBA. The cuttings were then stuck in flats and placed under intermittent mist for about 6 weeks. About 70% of the cuttings rooted. Later I learned that there was about a 2-week window from about August 8 to August 22 where we got the best rooting. Thick cuttings rooted better than thin cuttings and peach x almond hybrids did not root as well as peach. We compared own-rooted trees with trees on Lovell and Halford at several locations in New Jersey and own-rooted trees performed similar to trees on Lovell and Halford. The reason that own-rooted trees never became commercially important is because nurseries were not really set up to produce trees in this manner

Pruning and Tree Training

The first time I saw Ernie prune peaches was a demonstration for Neil Vincent's Pomology class from Delaware Valley College. He explained that he like the low open center tree and stressed the importance of balancing vegetative and reproductive growth. He said "*when you finish pruning you should be able to throw a cat through the tree without catching a branch*." He was also a promoter of mowing tree tops about a month before harvest. He said there were many benefits of mowing including, setting the tree height, increased light into the tree resulted in better fruit quality and flower bud formation, and some growers felt there was a reduction in cytospora canker. How-

ever there were no data to support these claims.

Summer Pruning Peach

During my doctoral research at Virginia Tech, I was not able to verify similar claims for summer pruning apples. So, I performed 3 summer pruning experiments and found that peach trees responded to summer pruning in a similar manner as apples. Summer pruning and summer mowing did not suppress tree vigor. Although summer mowing improved light penetration into the canopy, fruit color was improved slightly in the tops of the tree and fruit size and soluble solids were reduced. Summer mowing also delayed leaf drop and cold acclimation and cold hardiness in the early winter. A partial economic analysis showed that summer mowing reduced net profits by more than $350 per acre per year.

Importance of light

The fact that summer mowing improved light levels in the tree, but had little effect on fruit quality made me wonder how much light is needed to produce high quality fruit. When I went to Virginia, I covered 'Redhaven' trees with shade cloth at different times to determine the effect on fruit and fruit bud development. I found that at least 45% full sun is needed during the final two weeks before harvest to develop highly colored fruit. At least 25% full sun is needed for flower bud development and the most critical time is mid-June to early July. Late season light is not important for flower bud formation because covering trees with 90% shade cloth from July 31 to September 30 had no effect on flower bud development or fruit set the following year. These results made me rethink the potential benefits of summer pruning. I found that especially for young trees, I could maintain high quality fruiting shoots throughout the tree canopy with summer pruning. As trees age, the fruiting zone tends to move further from the ground because the lower canopy is shaded out. Removing upright shoots that shaded the tree center about 40 to 60 days after bloom had little effect on the fruit, but trees fruited throughout the entire tree. With annual early-season summer pruning, trees can be maintained at 7 to 8' and the fruiting zone remains low.

Tree form

Ernie and I both recognized the benefits of central leader training for apple trees and we discussed the possibility of growing peaches as central leaders. He showed me some trees that he trained as central leaders, but they were actually open centers with a vertical scaffold branch in the middle. It seemed to me that the open center was important to let light into the tree, but a high percentage of the canopy volume was devoid of fruit and it seemed that central leader trees used land area more efficiently. So, I established a planting to evaluate different canopy shapes and different methods of tree training and pruning. I quickly learned that it is challenging to reorient peach limbs. Every place I used a spreader, the wound was infected with canker. If I tied twine around a limb to pull it down, I had to remove it within a couple of weeks because peach branches grow in diameter so quickly the branches are girdled. As much as I disliked bench cuts, they were the best way to obtain a spreading branch. But when the lower branches were oriented fairly horizontal like apple limbs to allow light into the tree, water sprouts developed along the branches and shaded the tree interior. So, summer pruning was required to remove most of the upright shoots. I also learned that central leader trees should be planted closer together than open center trees because long scaffold branches produce too many suckers. I conducted an experiment *where central leader and open center trees were spaced 16 or 8 feet in the row established. A third* treatment had temporary or filler trees at 8' apart, but trees were pruned to reduce competition with adjacent tree and were removed after 3 fruiting years. After 8 years, the lower density plantings were least profitable, the higher density planting was most profitable and open center trees were more profitable than central leader trees.

Peach orchard systems in the future will likely evolve to facilitate mechanization. As with apple, the optimum canopy is probably a narrow hedgerow about 3 to 4' wide. This narrow canopy allows adequate light into the tree for high production of high-quality fruit and vision-sensing devices can detect fruit throughout the canopy. Narrow canopies also facilitate the use of string thinners and platforms, and someday robots may do much of the work. Such systems will likely require summer pruning and possibly trellises. About 20 years ago Dr. Ralph Scorza, at the USDA, release a pillar peach tree that has very upright growth habit. He also had trees that were less upright, but more upright than commercial peach varieties. These types of tree form may be easily adapted to a narrow hedgerow.

Peach thinning

Ernie was a proponent of early thinning to optimize fruit size. Growers sometimes asked if fruit should be preferentially retained at the basal or terminal end of a shoot, and he recommended spacing fruit uniformly along a shoot. Recent publications had me confused. Researchers in Georgia published a paper where fruit on the terminal end of a shoot were larger than fruits at the basal end, but Luca Corelli-Grappadelli, a grad student at Clemson, found the opposite was true. So, I performed a few experiments to learn why their results conflicted. I learned that position along a shoot did not influence fruit size. The number of fruits per shoot, not the spacing influenced fruit size. Also, fruits developing on shoots with leafy axillary shoots produced the largest fruit. So large fruits developed at nodes with axillary shoots. Luca later told me he came across an old Italian report from the 1920s that supported my results. So, while thinning, one should retain the largest fruits, especially if they develop at nodes with leafy shoots. Also, fruit size was positively related to shoot length. Shoots less than 6" long produced small fruit and shoots 18 to 24' long produced the largest fruit because they were more likely to have axillary shoots.

While pruning, Ernie did not like to head the fruiting shoots because it removed flowers and potential fruit. While demonstrating pruning to a group of Master Gardeners in eastern Virginia, I was told that less fruit thinning was needed when some of the shoots were head by half. A few weeks later during a peach pruning demonstration with some visiting Egyptian fruit growers, a grower told me that heading shoots increased fruit size. These comments made me reconsider Ernie's approach and I performed an experiment to compare heading vs. no heading. Heading all the one-year-old shoots by 50% while dormant pruning did increase fruit size. So, I performed another experiment to determine the optimum severity of heading and headed shoots to retain about 75, 50, 25, 12.5 or 6% of each shoot and then I thinned the trees to retain the same number of fruits per tree. I found that the optimum length of shoot to retain was 50% and heading more severely reduced fruit size. Heading all the shoots on a tree was time consuming, so I thought maybe I could achieve the same results by reducing the number of shoots per tree by 50% rather than heading the shoots. Over three years, I pruned trees to retain varying numbers of shoots and then thinned the trees to retain the same number of fruits per tree. The time to thin trees was positively related to the number of shoots per tree and fruit size was negatively related to the number of shoots per tree. These relationships were even apparent in a year when frost reduced the crop to less than a full crop. A partial economic analysis showed that retaining only 70 shoots per tree and then thinning to retain 7 or 8 fruits per shoot was more profitable than pruning to retain 170 shoots and thinning to retain 3 or 4 fruits per shoot. The number of fruits per tree or per acre is important, not the spacing of fruits on a shoot. The appropriate number of shoots and fruits to retain per tree will vary with variety and tree spacing.

Climate change

One aspect of my research in graduate school and at Rutgers was measuring photosynthesis, and while calibrating my equipment I measured ambi-

ent carbon dioxide levels. In 1981 the CO_2 concentration in Blacksburg, VA was about 300 ppm, but in New Brunswick, NJ it was about 330ppm due to the more urban environment. When I returned to Virginia in 1985, the ambient CO_2 concentrations had increased to about 315 ppm. In the early 1980s the influence of rising CO_2 levels still had little effect on temperatures, but by the early 2000s fruit trees were blooming earlier than in the 1980s. Reports from California showed that early-season temperatures were increasing, resulting in early harvest dates and reduced fruit size. Eight members of the NC-140 regional project had a planting of 'Chresthaven' and we decided to learn if the effect of temperature on fruit size was influenced by crop load. We thinned trees to various crop densities and recorded growing degree days during the first 30 days after bloom and found that high early season temperatures did result in smaller fruit regardless of crop load. For example, average fruit weight for trees with a crop density of 3 fruit/cm^2 trunk cross-sectional area was 180, 170 and 145g, respectively when cumulative growing degree days was 220, 300, and 400. As our climate continues to warm, growers will likely have to thin more aggressively to produce large fruit.

Photo 4. Adam Costello, President NJSHS presents Dr. Rich Marini a Certificate and Honarium for presenting the Ernie Christ Memorial Lecture at Hershey PA in 2022.

Final comments about Ernie

Early in my career, I was fortunate to work closely with several experienced pomologists, such as Ross Byers, Jack Rollins, George Mattus, and John Barden at Virginia Tech, but Professor Ernie Christ had the greatest influence on my understanding of peach culture and his ideas greatly influenced my peach research program. I know that Ernie also had an impact on many students, fruit growers, and extension workers. I think my friend Dr. Mark Robinson, who shared the office with Ernie before I started at Rutgers, described Ernie Christ perfectly. As Mark was preparing to give the Gorenstein Lecture in October he said "I wanted to specifically mention people that have had a profound impact on me and were my best teachers, my list, like your list, included Ernie. He was such a kind, humble and decent person, and as I got older, I realized how very kind and humble and decent he actually was, I really wish he was here today.

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