Evaluation of Hard Cider Apple Varieties to Promote Hard Cider Industry Growth in New Jersey

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Hard cider is one of the most recent alcoholic beverages to gain popularity in the USA. Despite being considered a niche product, sales reached $428.2 million in 2019. (Jacobsen, J. 2020) These figures indicate there is a significant amount of profit to be realized from growing and pressing apples into hard cider in the United States. In fact, a number of case studies have shown this to be true. Budget spreadsheets developed by Farris, J et al. illustrate the economic feasibility of hard cider production, and despite often requiring significant inputs, profits can still be realized.

Currently New Jersey orchardists already making sweet cider are looking to produce an additional value-added product. NJ farm wineries seeking to diversity their product line have also considered producing hard cider and are looking to learn how to grow 'hard cider varieties' to blend with sweet cider. The common question is which variety or varieties are best suited for New Jersey growing conditions.

Apple varieties have historically been chosen for use in hard cider based upon flavor characteristics. Most notably, high sugar, high acid, and complex tannin profiles. Most hard cider producers in New York and Pennsylvania are blending approximately 75% sweet cider with some more traditional hard cider cultivars from England or France to increase the tannin content and acidity and improve flavor profiles. A hard cider variety trial by Duane Green at UMASS showed that some traditional eating apples make very good hard cider as well i.e. Goldrush, Liberty, Golden Russet, Baldwin, Roxbury Russet, Rhode Island Greening and Esopus Spitzenburg, a favorite of Thomas Jefferson's.

Many of the older eating varieties and the European hard cider varieties that are of interest for their use in cider often lack disease and pest resistance, vigor and high yields. In fact, many bloom late and are severely susceptible to fire blight. Field trials, to determine how best to manage these varieties in modern orchards. A number of these trials have been established and are ongoing at Universities including Cornell University, The University of Vermont and Washington State University. Despite these efforts, studies have shown there is a continued need for an increased number of variety trials across diverse climate conditions.

A study by Alexander et al. (2016), illustrated that

Figure 1. Successful cleft grafts of cider apple scions in Aztec Fuji Interstem/M.9 NAKBT337, August 2018.

Table 1. Cultivars included in the trial, and their use in ciders. All varieties included in this study are best used for blending with varieties that have complimentary characteristics.

Variety	Description
Calville Blanc	**Sharp** Noteworthy aroma, can be used as a single varietal cider.
Collaos	**Bittersharp** Ripens very late in season.
Dabinett	**Bittersweet** A well-balanced variety, commonly used for cider.
Ellis Bitter	**Bittersweet** Noteworthy for being a tip-bearer.
Golden Russet	**Sharp** High acidity, sugar and aroma, a highly recommended cider variety.
Harrison	**Sharp** Noted for excellent, well balanced juice quality.
Kingston Black	**Sharp** A well-balanced stand-alone variety.
Margil	**Sharp** A variety with nuance, rich, intense and aromatic.
Rein Des Reinettes	**Sharp** Vigorous with a high sugar content.
Roxbury Russet	**Sharp** Notable for holding well in storage.
Stoke Red	**Bittersharp** It is used in cider blends and as a single varietal.
Wickson	**Sharp** Commonly grown by cider makers, notable for high sugar content.

four widely utilized hard cider cultivars grown over the course of several years at different locations resulted in significantly different sugar content and tannin profiles in the pressed juice.

As a result, a hard cider variety trial was established in New Jersey, as a means to provide New Jersey apple growers a local resource for yield, vigor and fruit size of locally grown hard cider apples, in addition to other management decisions for establishing a hard cider apple orchard in New Jersey.

Experimental Design

This trial was established in 2018 at the Rutgers Snyder Research and Extension Farm in Pittstown, New Jersey. A block of 80, 5-year-old Daybreak Fuji trees on M.9 NAKBT337 top worked to create the trial. Scion wood was obtained from the USDA Germplasm Repository (Geneva, NY). Twelve hard cider varieties were chosen, which represent the major hard cider apple types (bittersweet, bittersharp, and sharp) Table 1. A total of 2 scions per tree and two trees per variety were grafted (top-worked). Figure 1. In 2019 and 2020 yield and fruit count totals for each tree were tabulated. Tree vigor was recorded by measuring scion wood diameter 12 inches above the graft union of the most vigorous graft per tree, and total height of that same scion was recorded at the end of the growing season.

Results

Measurements of diameter illustrated Dabinett had the largest diameter in 2018 (0.57 in), however in 2019 Stoke Red was shown to have the largest diameter (1.5 in). In contrast Margil had the smallest diameter in both 2018 and 2019, 0.22 (in) and 0.55 (in) respectively.

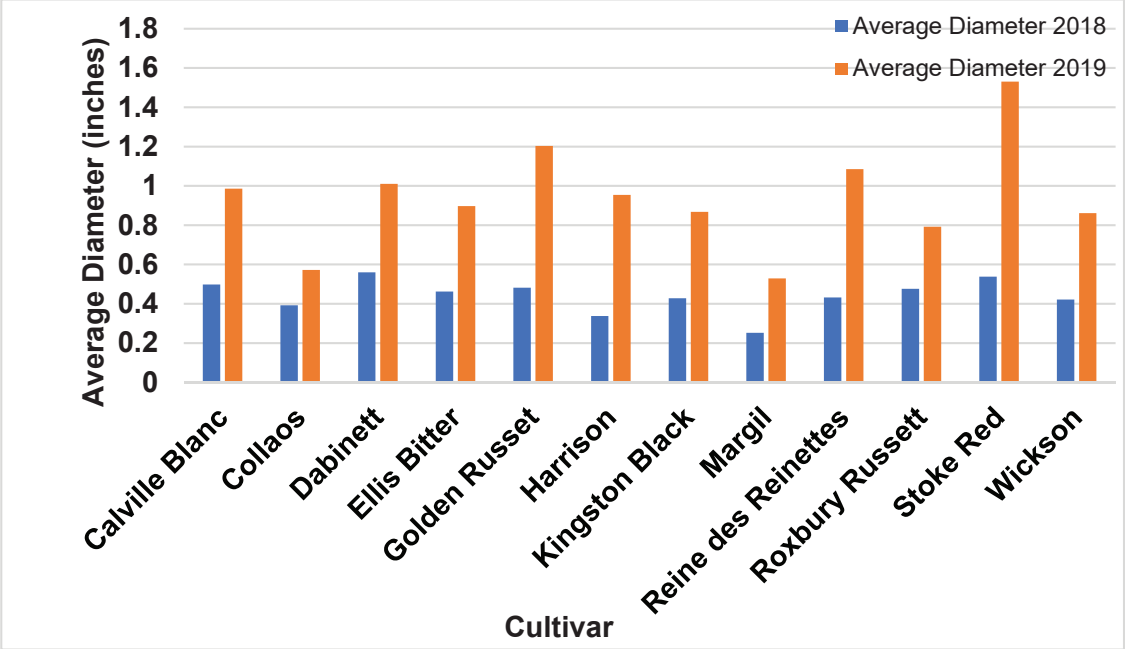

Figure 2. Illustrates the differences in vigor across all varieties as measured by diameters measured 12 inches above the graft union of the tallest scion per tree.

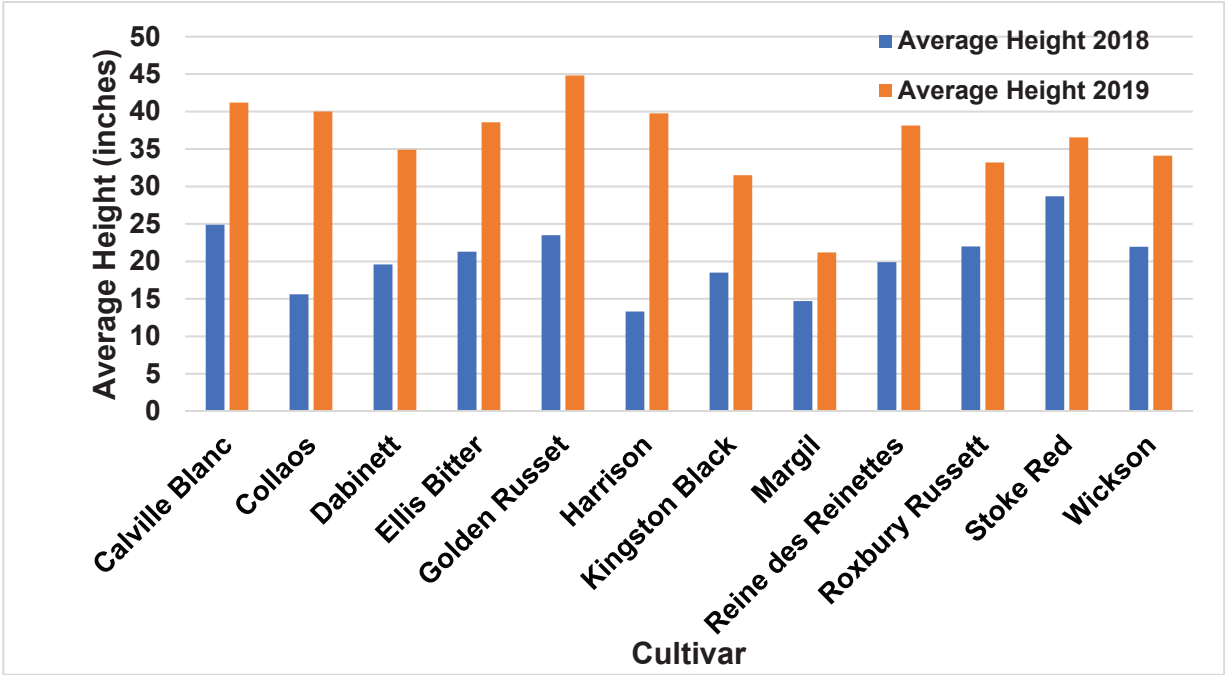

Figure 3. Illustrates the differences in vigor across all varieties as measured by height from the graft union to the top of the leader of the tallest scion per tree at the Rutgers Snyder Research and Extension Farm, Pittstown, NJ.

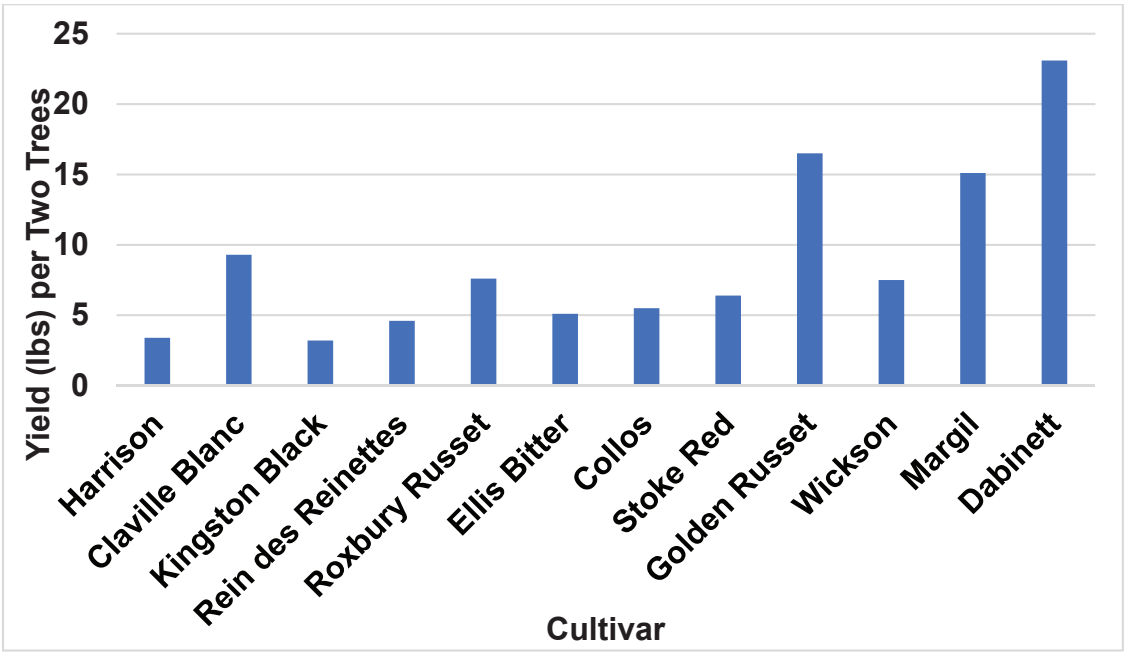

Figure 4. Total yield sampled in 2019 from two trees per variety at the Rutgers Snyder Research and Extension Farm, Pittstown, NJ.

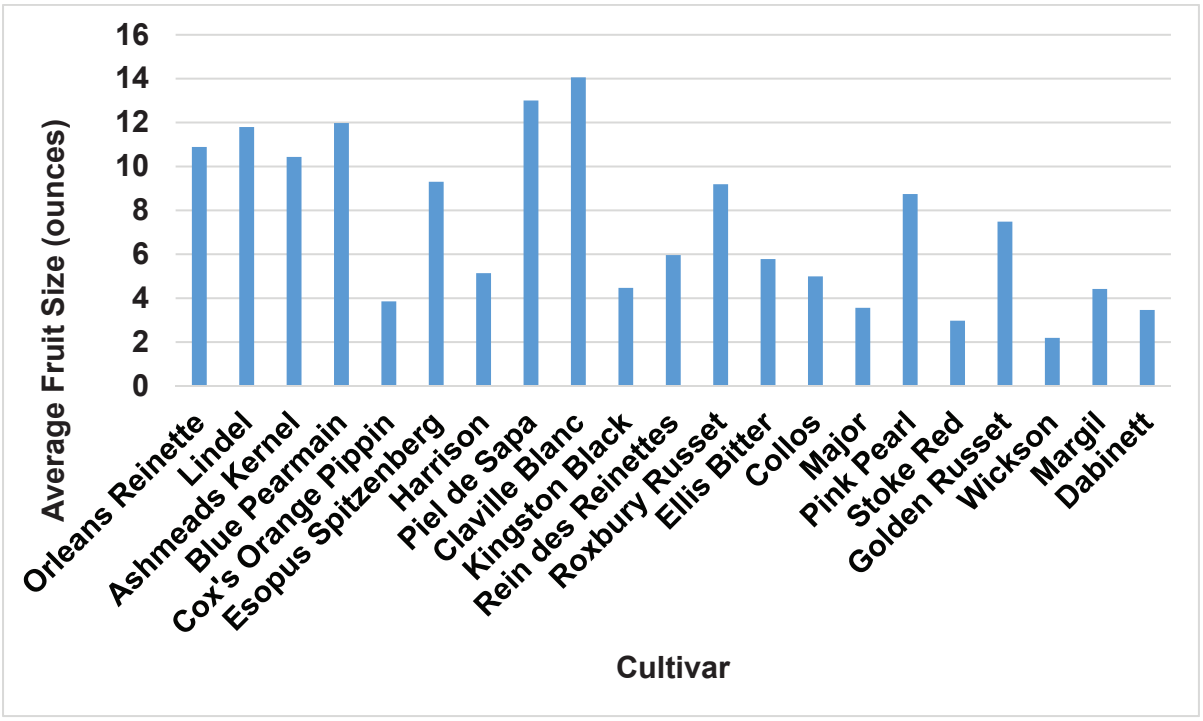

Figure 5. Average fruit size in 2019 was collected by obtaining the total yield per two trees divided by the total number of apples collected at the Rutgers Snyder Research and Extension Farm, Pittstown, NJ.

Figure 6. Mature Stoke Red apples at the Rutgers Snyder Research and Extension Farm, Pittstown, NJ.

Figure 2 The tallest main leader was observed for Stoke Red in 2018 (28 inches) and Golden Russet in 2019 (45 inches). The smallest main leader was observed for Harrison in 2018 (14 inches) and Mivity argil in 2019 (21 inches). Figure 3

Measurements of yield and fruit size showed the highest yielding cultivar was Dabinett (23 lbs./2 trees) and the lowest yielding cultivar was Kingston Black (3 lbs./2 trees).Figure 4 Average fruit size was observed to be the greatest for Claville Blanc (14 ounces) and

Figure 7. Mature Claville Blanc apples at the Rutgers Snyder Research and Extension Farm, Pittstown, NJ.

Figure 8. Mature Golden Russet apples at the Rutgers Snyder Research and Extension Farm, Pittstown, NJ.

Figure 9. Mature Margil apples at the Rutgers Snyder Research and Extension Farm, Pittstown, NJ.

Figure 10. Mature Dabinett apples. Photo Credit: Raintree Nursery.

the smallest for Wickson (2 oz). Figure 5.

Conclusions

The measurements of tree vigor (Figure 2 and 3) indicated that Stoke Red (Figure 6), Claville Blanc (Figure 7), and Golden Russet (Figure 8) thus far, thrive under New Jersey growing conditions.
Yield data indicated Margil (Figure 9), Dabinett (Figure 10) and Golden Russet (Figure 8) show promising fruit yields (Figure 4).

Fruit size measurements (Figure 5), showed about 75% of the varieties tested would likely be most efficiently harvested if swept off the ground (<150 g), and the other 25% would most likely be best harvested by hand (>150g).

Of the biochemical measurements taken, the pH showed levels comparable with those found in previous studies, while Brix, TA, and Tannins were much more variable (data not shown).

This project will be continued, and data collected (yield, vigor and biochemical analysis) for several more years to corroborate the project findings.

Best practices for pruning and training of these trees will be investigated, along with PGR's (plant growth regulators) to minimize blind wood and enhance productivity and optimize crop load management.

In addition, this research demonstration plot will also serve as a field lab for showcasing the top working of existing orchard trees, which has garnered interest with NJ growers.

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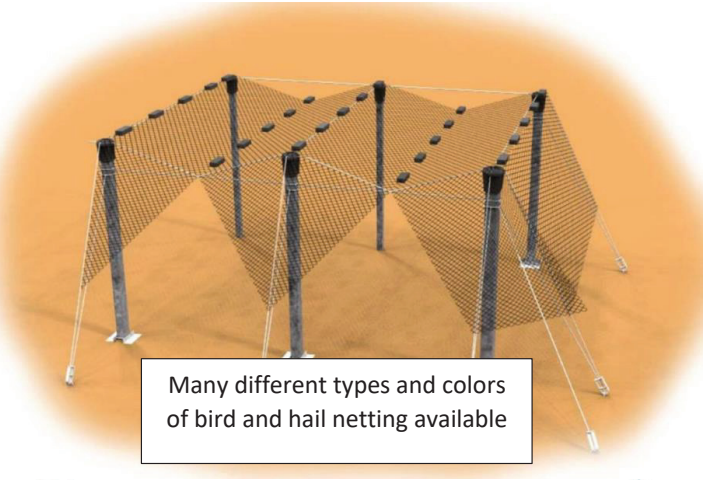

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