Project recap: Commercial hard cider production had seen growth of over 350% in the U.S. from 2010-2014, and presents a potential high-value processing market for apple growers. Significant expansion of commercial cideries has occurred in Vermont, including investments of several million dollars, supporting over 200 employees statewide. However, cideries in Vermont and nationwide are concerned that continued economic expansion will be limited by their ability to source apples for hard cider making. At the same time, some apple growers have begun to replace or renovate orchards with the intention of growing fruit for the hard cider market, which may be grown with reduced inputs because tolerance for cosmetic defects may be greater. Little research has been conducted in the U.S. on costs of production for apples grown for hard cider production, opportunities to reduce inputs and change management practices in cider apple orchards, or economic impact of cider apple production systems. This project proposed to conduct that research through collaborations with commercial apple growers and cideries in Vermont. Results will be shared with regional and national collaborators and through stakeholder partnerships.

1. MAJOR ACTIVITIES COMPLETED - The objectives of this project and work completed to date include:

1. Evaluate production costs to produce apples grown for processing into hard cider.

Grower cooperators were surveyed in January-March 2015 to develop cost tracking protocols that will be used to quantify production costs for cider apple in Vermont in 2015 and 2016. Growers met with project personnel in winter 2015-2016 to collate and summarize production cost records. Data has been analyzed and publication accepted by *Acta Horticulturae* journal for publication. A separate case study interview was conducted with UK cider industry consultant Neil McDonald which explored the use of contracts to reduce risk in cider apple production. Findings from that interview have been published in a fact sheet: Becot, F., Bradshaw, T., Conner, D. 2016. Fact Sheet: Long-Term Contracts in the UK Cider Industry. http://hortim.ashsmedia.org/items/show/47.

2. Quantify per-acre yield and fruit quality of cider-grown fruit in diverse orchard systems.

Initial crop yield and juice quality characteristics were evaluated in 2014 through work with a complementary but independent project (Bradshaw and Conner, 2013). Fourteen apple cultivars were evaluated from four participating farms. In 2015 data collection was expanded to increase replication of 20 assessed cultivars through this FSMIP project. Additional replicated data including tree phenology and pest incidence was also collected on eight cultivars in 2015. Initial crop yield and juice quality characteristics were evaluated in 2014 through work with a complementary but independent project (Bradshaw and Conner, 2013). Fourteen apple cultivars were evaluated from four participating farms. In
2015 data collection was expanded to increase replication of assessed cultivars through this FSMIP project. However, the diversity of growing systems among cider-specific cultivars has been difficult to study because few trees are presently grown in Vermont and most are young (1-4 years). Data have been collated and analyzed with National Agricultural Statistics Survey and other data to evaluate yield potential for cider cultivars in diverse systems. Results were presented in an industry presentation at U.S. Association of Cider Makers Conference and in the national trade journal Fruit Growers News in 2017, and a supporting academic article is in-press in the journal Acta Horticulturae.

3. Identify orchard management practices that may be modified to enhance profitability of cider apple production systems.

Industry stakeholders were consulted in winter 2014-15 and 2015-16 at industry meetings in Chicago, IL; Burlington, VT; and Middlebury, VT to identify production components for evaluation that may improve cultivar selection and profitability of cider apples. As a result, the project included two subobjectives:

A. Evaluate alternative management strategies to reduce disease incidence on apple scab-resistant cultivars. Scab-resistant cultivars present an opportunity to reduce production costs of cider apple production by reducing fungicide inputs. However, other diseases (cedar apple rust, fruit rots) may impact fruit quality, crop yield, and profitability. Organically-acceptable fungicides were evaluated in a two-way experimental design of fungicide treatment and cultivar with five replications of each combination on four scab-resistant cultivars for effect on crop yield, disease incidence, and juice quality. Data on disease incidence has been published in Plant Disease Management Reports; yield and juice data will be presented in a publication which is presently under development.

B. Evaluate juice quality parameters of apple cultivars potentially suitable for hard cider production. Samples of selected cultivars of traditional dual-purpose cultivars (e.g., Northern Spy, Roxbury Russet), specialty cider cultivars (e.g., Dabinett, Chisel Jersey) and scab-resistant cultivars (e.g., Liberty, Crimson Crisp) were collected from participating orchards including Champlain Orchard (Shoreham) and the UVM Horticulture Research and Education Center (South Burlington). For cultivars with sufficient tree numbers in their respective plantings, five replicates per cultivar were evaluated for juice pH, titratable acidity, soluble solids, total phenolics, and yeast assimilable nitrogen in early winter 2015 from juice samples collected in fall 2014. In 2015, juice was analyzed for over 40 cultivars including several replicated trials at cooperating grower orchards. At least fifteen cultivars were fermented for hedonic evaluation of finished ciders which occurred June 2016. Results from that evaluation have been presented at multiple venues in Vermont, Chicago IL, and at the International Symposium for Beverage Crops in Cairns, Australia. An article from this work is in press with the ISHS journal Acta Horticulturae.

4. Calculate economic impact on the cidery industry using different scenarios based on the results of the above objectives.

Economic evaluation of cider apple production systems has been presented in multiple journals, outreach presentations, and media presentations. Work has focused primarily on cider apple production systems, as opposed to cider production. This is because of the sensitive nature of collecting information from a small number of producers in a competitive market, low incidence of reporting in industry surveys, and a highly bifurcated cider market between one very large, three large, and twelve small producers. That market characteristics was identified in initial work which involved a survey of Vermont apple growers and cider
makers conducted in 2015. In that survey, fair market and desired prices were identified for various types of cider apples, and an imbalance between production of desired specialty cider apple cultivars and demand from cideries. However, multiple production challenges, including a shortage of trees in the nursery pipeline, lack of long-term price guarantees, and lack of horticultural knowledge of the specific cultivars sought has continued to hamper adoption of potentially high-value cider apple cultivars. In later work, long-term net present value analysis was conducted for multiple cider apple production systems in order to evaluate potential profitability of cider apple production. In general, it was determined that any cider apple production systems either a) must operate on a ‘seconds’ market, where high-value, first-quality dessert fruit are harvested and make a substantial proportion of the total harvest so that lower-value, cosmetically-blemished fruit may be sold at a reduced price, or b) yield of specific cider apple cultivars must approach that of commodity dessert cultivars and the price received must be similar to dessert fruit in order to be competitive with dessert fruit production. Results from this work were presented in an industry presentation at U.S. Association of Cider Makers Conference and in the national trade journal Fruit Growers News in 2017, and a supporting academic article is in-press in the journal Acta Horticulturae.

Outreach:

Presentations:


Outreach Meetings Organized and Directed:

• Cider Apple Production in Vermont: Field Research and Cider Quality. 6/28/2016. Middlebury, VT.
• Central Vermont Hard Cider Appreciation Event. 2016. 2/6/2016, Plainfield, VT.
• Hard Cider Session (Five speakers, 2.5 hrs), New England Vegetable and Fruit Meetings. 12/16/2015. Manchester, NH.
• Cider Apple Production in Vermont: Market Opportunities and Technical Challenges. 3/30/2015. Middlebury, VT.

Articles in Industry Trade Journals


Media:


Peer-Reviewed Scientific Publications:

Peer-Reviewed Outreach Publications


Published Non Peer-Reviewed Abstracts