Cider Apple Research at UVM
(and other U.S. Land Grant Institutions)

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UVM TREE FRUIT & VITICULTURE SPECIALIST

CIDER APPLE PRODUCTION IN VERMONT: MARKET OPPORTUNITIES AND TECHNICAL CHALLENGES
WOODCHUCK CIDERY, MIDDLEBURY, VT

MARCH 30, 2015
Why cider? Why now?

• Personal interest in cider
• New faculty role at UVM to direct research
• Rapidly expanding cider industry in Vermont & the U.S.
• Critical mass of producers, growers, enthusiasts, and researchers
Cider research programs at UVM: Now & later

Long-term research & outreach program

• Baseline data
• Horticultural research
• Pest management
• Economic evaluation
• ...cidermaking...
Two worlds of cider apple production

• Dessert fruit from existing/future plantings
  • Vast majority of apples used for cider
  • Lower-valued from (compared to fresh market)
  • What are the qualities of dessert fruit from a cidermaking perspective?
  • What strategies can be adopted to reduce costs of production/increase supply/improve cider quality?

• Specialty cider cultivars
  • Unique flavor profile
  • Heirloom
    • Ashmead’s Kernel, Golden Russet, Esopus Spitzenburg
  • Low-input scab-resistant cultivars
    • Liberty, Topaz, Winecrisp, etc.
  • Regionally-unique cultivars
  • Bittersweet cultivars
    • Often European origin
  • How do these cultivars perform in Vermont orchards?
  • What management strategies can increase supply/profitability/cider quality?
Vermont Working Lands Enterprise Initiative
Apple Market Optimization and Expansion through Value-Added Hard Cider Production

• Quantify production costs for apples managed specifically for hard cider production

• Identify fruit quality and yield characteristics of apple cultivars suited for hard cider production

• Coordinate fermentation trials and evaluate finished ciders made from Vermont apple cultivars

Dan Rowell, CEO VT Hard Cider Company (left) and Dr. David Conner, UVM CDAE Dept. Photo: VT Working Lands Enterprise Initiative
2014 WLEF

Orchard and cultivar data
• Production by cultivar & orchard system

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Bushels / acre</th>
<th>Firmness (psi)</th>
<th>Starch index</th>
<th>Soluble solids (°brix)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cortland</td>
<td>672</td>
<td>15.9</td>
<td>3.7</td>
<td>10.3</td>
</tr>
<tr>
<td>Empire</td>
<td>932</td>
<td>18.8</td>
<td>5.0</td>
<td>12.8</td>
</tr>
<tr>
<td>Idared</td>
<td>1221</td>
<td>17.4</td>
<td>4.0</td>
<td>10.6</td>
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<tr>
<td>Jonagold</td>
<td>338</td>
<td>16.0</td>
<td>7.4</td>
<td>12.6</td>
</tr>
<tr>
<td>Liberty</td>
<td>282</td>
<td>17.5</td>
<td>6.0</td>
<td>11.0</td>
</tr>
<tr>
<td>Macoun</td>
<td>705</td>
<td>15.4</td>
<td>5.0</td>
<td>10.9</td>
</tr>
<tr>
<td>McIntosh</td>
<td>1134</td>
<td>15.2</td>
<td>4.6</td>
<td>11.6</td>
</tr>
<tr>
<td>Paula Red</td>
<td>435</td>
<td>17.1</td>
<td>3.4</td>
<td>11.3</td>
</tr>
</tbody>
</table>
Cider apple classifications

Barker's Classification of Cider Apples (LARS 1903)

<table>
<thead>
<tr>
<th>Classification</th>
<th>Acid (%)</th>
<th>Tannin (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharp</td>
<td>&gt; 0.45</td>
<td>&lt; 0.2</td>
</tr>
<tr>
<td>Bittersharpe</td>
<td>&gt; 0.45</td>
<td>&gt; 0.2</td>
</tr>
<tr>
<td>Bittersweet</td>
<td>&lt; 0.45</td>
<td>&gt; 0.2</td>
</tr>
<tr>
<td>Sweet</td>
<td>&lt; 0.45</td>
<td>&lt; 0.2</td>
</tr>
</tbody>
</table>
### 2014 WLEF

**Orchard and cultivar data**

**• Cultivar juice characteristics**
  - *Single year, single orchard dataset*

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Soluble solids (°brix)</th>
<th>pH</th>
<th>Malic acid (mg/l)</th>
<th>Total polyphenols (%)</th>
<th>YAN (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashmead’s Kernel</td>
<td>17.6</td>
<td>3.25</td>
<td>10.40</td>
<td>0.075</td>
<td>262.4</td>
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<tr>
<td>Commercial blend</td>
<td>12.2</td>
<td>3.40</td>
<td>5.91</td>
<td>0.037</td>
<td>58.5</td>
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<tr>
<td>Cortland</td>
<td>11.2</td>
<td>3.43</td>
<td>4.74</td>
<td>0.047</td>
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<tr>
<td>Dabinet</td>
<td>13.1</td>
<td>4.13</td>
<td>1.88</td>
<td>0.109</td>
<td>60.6</td>
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<tr>
<td>Esopus Spitzenburg</td>
<td>15.3</td>
<td>3.48</td>
<td>7.10</td>
<td>0.035</td>
<td>113.4</td>
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<tr>
<td>Honeycrisp</td>
<td>12.6</td>
<td>3.52</td>
<td>4.97</td>
<td>0.027</td>
<td>85.0</td>
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<tr>
<td>Idared</td>
<td>10.8</td>
<td>3.29</td>
<td>5.98</td>
<td>0.017</td>
<td>15.5</td>
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<tr>
<td>Jonagold</td>
<td>12.3</td>
<td>3.40</td>
<td>5.12</td>
<td>0.021</td>
<td>38.6</td>
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<tr>
<td>Liberty</td>
<td>11.5</td>
<td>3.45</td>
<td>5.72</td>
<td>0.018</td>
<td>56.7</td>
</tr>
<tr>
<td>Macoun</td>
<td>11.7</td>
<td>3.47</td>
<td>4.17</td>
<td>0.021</td>
<td>65.1</td>
</tr>
<tr>
<td>McIntosh</td>
<td>11.7</td>
<td>3.25</td>
<td>5.48</td>
<td>0.036</td>
<td>30.1</td>
</tr>
<tr>
<td>PaulaRed</td>
<td>11.0</td>
<td>3.40</td>
<td>4.45</td>
<td>0.050</td>
<td>30.4</td>
</tr>
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<td>Topaz</td>
<td>12.4</td>
<td>3.35</td>
<td>9.86</td>
<td>0.056</td>
<td>16.1</td>
</tr>
<tr>
<td>Wickson</td>
<td>13.9</td>
<td>3.40</td>
<td>11.94</td>
<td>0.018</td>
<td>53.3</td>
</tr>
</tbody>
</table>
2014 WLEF

Working Lands Enterprise Fund

Fermentation characteristics

- Ciders fermented at three commercial cideries
- *Today*: evaluation of finished ciders to characterize cider quality
USDA Federal State Marketing Improvement Program

Orchard Economic Assessment to Support Vermont Hard Cider Production

- Assist in the development of more efficient marketing methods, practices and facilities to bring about more efficient and orderly marketing of cider apples, and reduce the price spread between growers and cideries.

- Quantify the economic impact of hard cider and cider apple production on rural Vermont economies.

*Terence Bradshaw collects orchard yield data at Sunrise Orchards, Cornwall, VT. Photo: T. Bradshaw*
Other topics of research interest

- Cultivar evaluation
  - Unique, cider-specific cultivars *presently planted*
  - Regionally-developed cultivars

- Systems
  - Long-term evaluation of planting systems
  - 2015-2017 plantings? Call me!

- Pest management
  - Low-input production systems for cider apples, including dessert cultivars

- Research requires grower & researcher cooperation, plan ahead
Washington State University

Carol Miles, Suzette Galinato, Peter Tozer

• Cider cultivar trials
• Mechanical cider apple harvest
• Enterprise budgets & economic analysis of cider apple production
Michigan State University

Nikki Rothwell

• Cider cultivar evaluation
• Integrated pest management systems for cider apple production
Cornell University

Olga Padilla-Zakour, Chris Gerling

• Extensive enology program and winemaking facilities
Virginia Tech

Greg Peck, Gustavo Ferreira, Andrew Neilsen, Amanda Stewart

• Cider orchard economic feasibility
• Cidermaking Extension workshops
• Orchard management for cider apples
• Cropload effects on juice quality
• Fermentation trials
• Characterization of phenolics in cider apples
USDA Specialty Crops Research Initiative
CIDER: Redeveloping the North American Hard Cider Industry

• Coordinate a stakeholder-driven national research & outreach agenda to support cideries and cider apple producers in the U.S.

• Planning grant awarded & project initiated to develop & submit $5 million+ project to USDA Specialty Crops Research Initiative, July 2015

• 3-5 year coordinated research & outreach program
USDA CIDER SCRI Proposal: Fruit Production

1. Determine impact of horticultural practices on juice quality.
   a) Crop load, light interception, cultivar evaluation

2. Initiate trials to determine disease and insect susceptibility and management of cider varieties
   a) In-vitro & field-based trials

3. Test and develop mechanized pruning and harvesting for cider apples

4. Identify cultivars and genetic markers in the USDA Malus collection that interest cider producers and apple breeders.
USDA CIDER SCRI Proposal: Cider Production

1. Assess processing techniques to optimize tannin extraction from apples and retention in cider
   a) Compare existing technologies for maceration, pressing, and extraction for their ability to increase and retain tannin content of cider juice

2. Develop cider production lab manual using research-based analytical techniques validated specifically for cideries

3. Characterize cider quality based on apple cultivar and blending strategies.
USDA CIDER SCRI Proposal: Economics & Marketing

1. Determine scale of U.S. cider market and impact on the apple industry

2. Increase profit for cider apple growers by modeling cost-benefit scenarios.
   a) Compare production systems and harvest methods from existing budget models in key apple production regions

3. Determine consumers’ preference for key cider profiles
   a) Conduct sensory evaluation panels and consumer surveys
USDA CIDER SCRI Proposal: Transdisciplinary activities

1. Assess the U.S. cider industry through online surveys
   a) Survey nurseries, apple growers, and cider producers for current and projected cider production

2. Coordinate case studies of key apple growers and cideries

3. Develop online database of apple cultivar information for growers and cidermakers
   a) Replicated field trials, research observations, grower experiences
   b) Regionally and systems-sortable
PSS 209 Sustainable (Vegetable) Farm Practicum

• Instructors: Susie Walsh Daloz and Terry Bradshaw

• Dates: May 18-August 5, 2015 (On-line coursework is from May 18-27 and August 3 - 5; On-farm practicum is MW from June 1-July 29)

PSS 195 Sustainable Orchard and Vineyard Management

• Instructor: Terry Bradshaw

• Dates: TR, June 15 - July 10, 2015