

**Demonstration Small Scale Farm Wine, Cider and Juice Production
Facility at UMass Cold Spring Orchard Research and Education Center**

Final Report to the Massachusetts Department of Agricultural Resources
Agricultural Innovations Center
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STATEMENT OF WORK:

A. OUTLINE OF ACTIVITIES

Massachusetts' agriculture increasingly depends on direct sales to local customers, and producing value-added products on farms provides innovative options to Massachusetts' farmers. One promising product for our farms is fermented fruit juices, primarily wine and cider. Farm wineries in Massachusetts were first established in the 1970's following the passage of [Farmer-Winery Legislation](#)¹. Since that time, the Massachusetts farm winery industry has experienced sustained, steady growth in the production of wines made from grapes and other types of fruit. In a report entitled '[An Economic Snapshot of the Massachusetts Winery Industry](#)'², the Massachusetts Dept. of Agricultural Resources (MDAR) documents the industry's growth from 12 Farm Wineries in 1994 to 22 in 2005. The number has increased to 27 in 2007 with an additional 6 in the planning stages. The MDAR report also shows increases in economic impact (total sales; \$6.5 Million in 2005), job creation (a 60% increase from 1998 – 2005) and farmland preservation (1,862 acres in 2005; a Massachusetts winery brochure is available showing established wineries around the state at <http://www.mass.gov/agr/massgrown/wineries.htm>). Wineries are springing up throughout New England with 77 licensed farm-wineries currently in operation in the region. Small-scale farm wineries are becoming a recognized and attractive option for existing and new entry farms.

In addition to giving growers a new product, wines and ciders can augment agrotourism. Other states in the Northeast, notably New York and Connecticut, have shown that consumers enjoy driving to visit wineries bringing visitors not only to the farms themselves, but to rural areas. This can enhance rural economies in general.

Wines and ciders also offer a means to increase sustainable, environmentally sound methods of fruit production. As the saying goes, consumers often shop with their eyes, and fresh fruit is generally most valuable when it is blemish-free. To grow such attractive fruit, growers invest heavily in pesticides and other methods to kill insects and microbial pathogens that attack their crops. Wines and ciders do not need to be picture-perfect as the fruit is mashed in the process, and hence some pesticide applications can be eliminated. Add to that the extra value of the juice product, and both the economic and environmental advantages of making wine and cider are apparent.

Massachusetts leads New England in winery establishment, with more vineyards, wineries and acres in production. This includes the establishment of fruit wineries using fruit other than grapes (e.g., [Nashoba Valley Winery](#) in Bolton using various fruits, [West County Cider Winery](#) in Colrain using apples, [Plymouth Bay Winery](#) in Plymouth using cranberries, and [Chester Hill Winery](#), in Chester using blueberries). UMass has led the region in horticultural research and Extension activities related to wine and cider-making, including IPM initiatives, establishment of research vineyards and cider apple orchards, and the development of the [New England Wine Grape Growers Resource Center](#)³ website. However, no corresponding development of educational or research capacity in enology and winery operations has been established. This is

1 <http://www.mass.gov/legis/laws/mgl/138-19b.htm>

2 <http://www.mass.gov/agr/markets/05%20Wine%20Industry%20Snapshot.pdf>

3 <http://www.newenglandwinegrapes.org/>

an integral part of a wine growing enterprise and should be represented in Extension research and education programming. At UMass close collaborations with faculty in the [Dept. of Plant, Soil & Insect Sciences](#) (PSIS) and in [Food Science Department](#) (FS)⁴ have been established to support work in this area. Future contacts with faculty in [Department of Hospitality & Tourism Management](#) (HTM) as well as with [University Outreach](#) (UO) are planned. These collaborations benefit the initiative both in advising on vineyard/orchard establishment, pest management, post harvest handling, (PSIS) facility design and composition, quality assessment of the end product and potential evaluations for phenolic phytochemicals for functional foods (FS), and marketing and publicity (HTM and UO)

[The UMass Cold Spring Orchard Research and Education Center in Belchertown](#) MA⁵ (CSOREC), evaluates emerging production techniques and develops information for Massachusetts fruit growers. CSOREC grows over 100 varieties of apples, pears, peaches, nectarines, plums, and grapes. Recent plantings include a cold climate wine grape vineyards funded by USDA CSREES and USDA SRAES NE1020, a 12 variety seedless table and juice grape demonstration vineyard, and an 11 variety cider apple production orchard, the latter two funded by the Mass. Fruit Growers Assoc. A winery/cider production facility at CSOREC is critical for a complete research and education program in both fruit production and production of quality fruit beverages.

Therefore, this project seeks to install a small-scale demonstration and research winery at the CSOREC. New vineyards and cider orchards have already received support from the Massachusetts Fruit Growers Association, University Center for Agriculture, and USDA, and both the winery and increased production development will seek support from the Massachusetts Society for Promoting Agriculture⁶. Support from the Massachusetts Agricultural Innovations Center (MAIC) is critical to these efforts and will provide the capital investment necessary to develop this emerging agricultural sector in the Commonwealth.

B. HOW PROJECT ACTIVITIES ACCOMPLISH OBJECTIVES OF MASS. AG. INNOVATIONS CENTER

The establishment of a small-scale demonstration and research winery at the UMass Cold Spring Orchard addresses several key objectives of the Mass. Ag. Innovations Center. First among these is delivering needed technical information for new wineries on **equipment, design, vinification procedures, handling, quality assessment and storage** in order to help secure long term economic viability for these new enterprises. Workshops and demonstrations on these topics have been held in this facility and augmented agricultural business training, and integrated pest management with an emphasis on environmentally friendly production methods. More programs are planned to deliver comprehensive, practical information to prospective growers and recent start-ups to improve their overall economic viability and environmental sustainability. This project funded by the Massachusetts Agricultural Innovations Center has been the catalyst for bringing together existing resources and filling in gaps in needed equipment, facility

⁴ [Dr. Jochen Weis](#) and [Dr. Kalidas Shetty](#)

⁵ <http://www.coldspringorchard.com/>

⁶ See budget for details of matching funds

development and capacity building to position the UMass Cold Spring Orchard for further research and educational programming in this area.

C. PROJECT SPECIFICS - OBJECTIVES AND ACCOMPLISHMENTS

The objectives under this request for funding were to:

1. Demonstrate and teach the principles, methods and materials of small-scale wine and cider production for established and new-entry farm producers in Massachusetts.
2. Evaluate wine production parameters of new and experimental cold climate wine grape varieties and blends in collaboration with the UMass Food Science Department.
3. Evaluate apple varieties and blends for high quality cider production.
4. Evaluate juice grape varieties (and possibly other fruits) and blends for (pasteurized) fresh juice production.
5. Evaluate the influence of production techniques on wine and cider quality.
6. Develop educational programs to educate interested citizens and growers about findings.

Accomplishments under this request for funding were to:

1. Construction of a working small-scale winery and cider production facility used for research and education.
 - renovation of former hydrocooler space at UMass Cold Spring Orchard (involving demolition, new construction, electrical update/repair, plumbing update/repair)
 - purchase and installation of equipment for wine/juice/cider production (detailed list below)
2. Research/develop/demonstrate innovative methods for wine, juice and cider production designed for Massachusetts.
 - Eleven fermentation runs and several subsets of each were processed and evaluated for soundness and quality (see details in Appendices)
 - several tasting/sampling events were held in order to collect feedback on various wines
 - four juice products were also developed and sampled at the UMass Cold Spring Orchard Store
3. Develop and distribute publications for growers based on research carried out at this facility for distribution to interested farms and prospective growers.
 - wine making recommendations for cold climate varieties in development and will be published as online information sheets on UMass Fruit Advisor website and New England Wine Grape Resource Center website as well as for distribution at workshops and at the UMass Cold Spring Store, *(a single year of research/development work as described above is insufficient to support such a publication)*

4. Conduct workshops and demonstrations for established and prospective farm wineries and other farms and stakeholders.
 - four workshops were held at the UMass Cold Spring Orchard for the purpose of providing educational programming on cold climate viticulture and to showcase the small-scale farm winery facility funded through this project, total of 150 in attendance
 - i. 4-5-08, *Cold Climate Viticulture and Pruning Workshop*, Mass Aggie Seminar Series, 15 in attendance
 - ii. 5-20-08, *Cold Climate Viticulture at UMass – Vineyard Walkaround and Wine Tasting*, UMass Fruit Team and Mass Fruit Growers Twilight Meeting, 30 in attendance
 - iii. 6-3-08, *Vineyard Walkaround, Disease Management in Hybrid Varieties for New England, Canopy Management for Hybrids*, UMass Fruit Team and Mass Farm Wineries & Growers Association Twilight Meeting, 25 in attendance
 - iv. 7-17-08, *Vineyard Walkaround and Wine Tasting*, UMass Fruit Team and Mass Fruit Growers Association Summer Meeting, 80 in attendance
 - five additional meetings were held at other locations to disseminate viticultural information to current and prospective wine growers in Massachusetts; while not funded directly from this project, information derived from the project was included in these meetings. (approx 250 in attendance)
 - individual consultation with 15 new start-up vineyard/wineries across Massachusetts and several from neighboring states

5. Collaborate with the [Massachusetts Farm Winery and Growers Association](http://www.masswinery.com/)⁷, [Massachusetts Fruit Growers](http://www.massfruitgrowers.org/)⁸, and other grower or commodity associations to disseminate information gained from the operation of this facility.
 - viticultural information derived from research planting disseminated via electronic newsletter New England Grape Notes, archived on UMass Fruit Advisor Website and New England Wine Grape Growers website
 - close collaboration with MFWGA on co-sponsorship of educational meetings (see above) and dissemination of timely information for vineyard managers via New England Grape Notes and Mass Farm Winery website

⁷ <http://www.masswinery.com/>

⁸ <http://www.massfruitgrowers.org/>

Facility renovation and construction in former hydrocooler space:



Cider/Juice/Winery Facility Layout at UMass Cold Spring Orchard
Research and Education Center
Belchertown, MA

Equipment, Materials and Supplies Purchases:

Equipment, materials, and supplies purchases are outlined in Figures 1 and 2 and Table 1 below. Included are items purchases w/ matching funds and categorized according to the source of those funds. Labor expenditures are shown in Table 2 and also show matching contributions.



1) 'Frontenac' harvest underway Sept. 27, 2007; 2) 'Chardonnay' bunch ripening in early Oct. 2007; 3) Pony Destemmer Crusher in operation processing 'Chardonnay' grapes for test wine batch #1; 4) Rossi 50 Idopress pressing 'Frontenac' juice for test wine batch #3; 5) Stainless steel variable capacity floating lid fermentation tank ready to fill; 6) CiderSure UV juice processing unit for processing grape juice and/or apple cider; 7) donated 4-spout stainless steel gravity feed bottle filler donated from Chicama Vineyards in Martha's Vineyard, MA.



1) Filled bottles of apple wine, 2) Enomatic single bottle filter and filler; 3) custom apple grinder for tree fruit; 4) Ferari manual bottle corker; 5) Tio-50-Manual 35 Gallon Hydraulic plate press for pome fruit and Ice Wine, harvest lugs, macrobin and bottle washer; 6) Frontenac wine in corked bottles; 7) Rossi Idopress, Lachman bladder press and 40 gallon pump-over sump on second platform; 8) air conditioning unit and shelving w/ multiple fermentation batches in locked fermentation room.

Table 1. Equipment, materials and supplies purchased for the establishment of the Demonstration Small Scale Farm Wine, Cider and Juice Production Facility at the UMass Cold Spring Orchard Research and Education Center.

Items Purchased on MDAR AIC Funds		
Quantity	Item	total price (including shipping)
Equipment		
1	CiderSure UV juice processor	\$15,700.00
1	Tio-50-Manual 35 Gallon Hydraulic plate press for pome fruit and Ice Wine	\$ 2,786.00
1	Apple Crusher - for grinding of pome fruit (split funded)	\$ 435.41
1	40 gallon Pump over Sump	\$ 1,476.00
1	Lanchman VSP-A-120 Tilting Bladder Press	\$ 2,025.00
1	Portable AC 10,000 BTU	\$399.00
1	Ph meter	\$354.00
1	Horizontal Capsule Heat Shrinker	\$289.80
	Harvest tools	\$260.13
1	Enolmatic Wine Bottle Filler (1 Head) for small batches	\$461.75
2	Metal Storage Racks (48x24x72 plus 4 additional shelves)	\$435.47
26	Harvest Lugs	\$355.60
1	Half Ton Macro Bin for bulk harvest	\$259.00
1	Ferari Italian Floor Bottle Corker	\$131.00
3	22 gallon storage/fermentation vessels	\$231.00
Total Equipment		\$25,599.16
Materials and Supplies		
	Winemaking/bottling supplies	\$2,035.84
	Construction/renovation supplies	\$1,651.27
Total Materials and Supplies		\$3,574.40
Total Equipment, Materials and Supplies		\$29,173.56
Items Purchased on USDA/Hatch Funds - Match		
Quantity	Item	total price (including shipping)
Equipment		
1	Ponyl Destemmer Crusher	\$2,945
1	Rossi 50 Idopress-S/S 120 liter bladder press	\$3,300
1	BP160 replacement bladder	\$175
4	20 gallon food grade primary fermentation vessels w/ lids	\$124
2	55 gallon food grade drums w/ removable head	\$239
50	30# harvest lugs	\$527
3	SU 150L variable capacity floating lid fermentation tanks	\$1,275
1	related valves, clamps & gaskets	\$333
1	wine pump, hoses, clamps & gaskets for destemmer and press	\$966
2	predrilled tank lids	\$100
2	cooling plates for tank lids	\$575
1	3bay stainless steel commercial sink	\$596
3	bottle rinsing rack	\$75

1	bottle rinsing base	\$17
Total Equipment		\$11,247.00
Materials and Supplies		
Total Materials and Supplies (Construction/renovation)		\$2,386.44
Total		\$13,633.44
<u>Additional Matching Support</u>		
Support Funds from Massachusetts Fruit Growers Assn.		
Quantity	Item	total cost
1	Secure Overhead Door for access to winery space with equipment (incl installation)	\$2,700.00
	Framing lumber etc. for overhead door installation	\$181.34
	labor for renovation/construction	\$1,000
	labor for door installation framing preparations	\$520.25
Total		\$4,401.59
Items Donated by Massachusetts Wineries		
Quantity	Item	total value
1	3 Spout Stainless Steel Bottle Filler (Chicama Vineyards, Vineyard Haven, MA)	\$300
40 cases	Green & flint glass wine bottles, 750ml and 375 ml (Nashoba Valley Winery, Bolton MA)	\$400
71 cases	Flint glass wine bottles, 750ml (Neponset Winery, Needham MA)	\$700
	Cash donation in support of winery development - labor (Cherewatti Farm Winery)	\$1,000
Total		\$2,400.00

Labor:

Work performed included cleaning out space which had been used for storage for many years, removing some wooden platform lumber and old conveyor system, washing walls and prepping for concrete sealer, applying skim-coat to walls to eliminate non-HACCP compliant rough concrete surface, apply vinyl surface to wood walls and linoleum flooring to wood floors. In addition a platform system was constructed to improve product flow and efficiency in the facility. Labor costs are outlined below.

Table 2. Labor expenditures from grant and matching sources for the establishment of the Demonstration Small Scale Farm Wine, Cider and Juice Production Facility at the UMass Cold Spring Orchard Research and Education Center.

Labor costs to date				
Labor Category	MDAR AIC	MFG	Hatch	Total
Classified Labor	\$14,491.41	\$0	\$30,910	\$45,401.41
Hourly Labor	\$6,067.67	\$1,000	\$9,500	\$16,567.67
Total	\$20,559.08	\$1,000.00	\$40,410.00	\$61,969.08

Juice, Cider and Vinification:

Harvest 2007 yielded approximately 1.5 tons each of ‘Frontenac’ and ‘Chardonel’ grapes. Some was sold fresh to various wholesale or retail accounts, some made into fresh pasteurized juice. From the remaining yield, 4 test fermentation batches of ‘Frontenac’ wine (using *Montrachet* yeast) and 3 test fermentation batches of ‘Chardonel’ wine (using *Côte des Blanc*, *Pasteur Champagne* yeast, or both) were initiated. One batch of ‘Chardonel’ ice wine (*Champagne* yeast) was also initiated. And, one batch each of hard cider and apple wine were also initiated. These are being followed and data on wine quality parameters (phenolic composition, acidity, aroma components, etc.) are being tracked and cross-referenced with fermentation procedures (skin time, yeast used, initial brix, etc.) to help identify successful methods for these varieties.



UMass Cold Spring Orchard

*Cold Pressed
Wine Grape Juice*

‘CHARDONEL’

16 oz

UMass Cold Spring Orchard, 391 Sabin St., Belchertown MA 01007



UMass Cold Spring Orchard

*Cold Pressed
Wine Grape Juice*

‘FRONTENAC’

16 oz

UMass Cold Spring Orchard, 391 Sabin St., Belchertown MA 01007



UMass Cold Spring Orchard
*Cold Pressed
Wine Grape Juice*
**‘CHARDONEL’/‘FRONTENAC’
BLEND**

16 oz

UMass Cold Spring Orchard, 391 Sabin St., Belchertown MA 01007



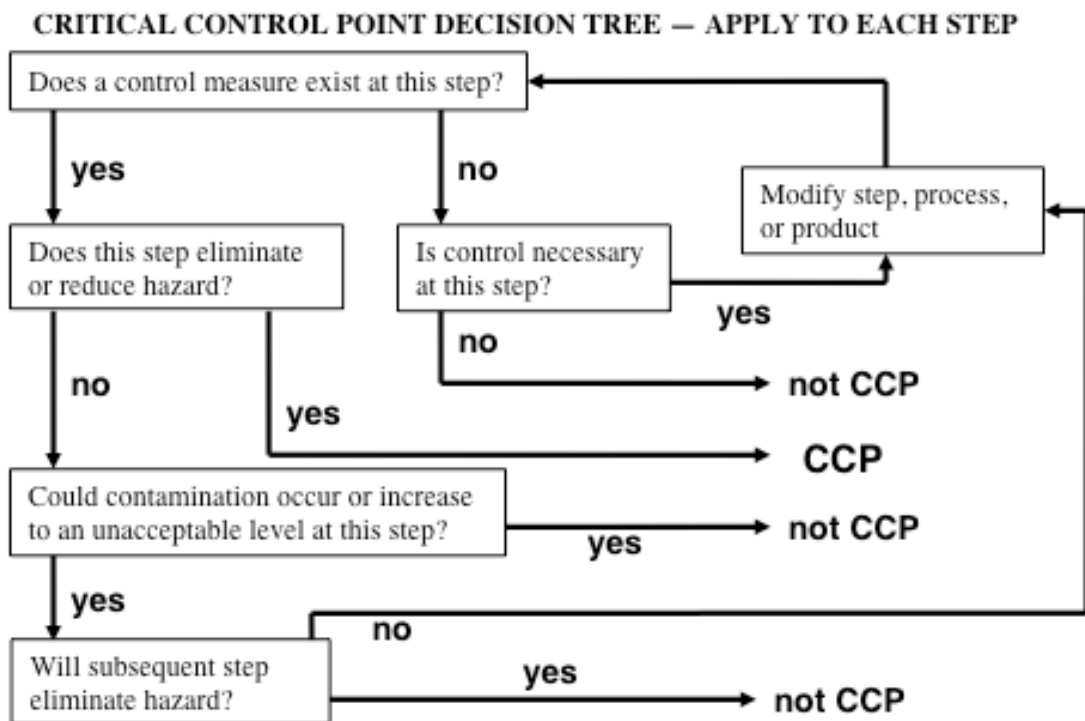
Educational Meetings



1) UMass Cold Spring Vineyard tour for Mass Fruit Growers Summer Meeting July 2008, 2) Dr. Justine Vanden Heuvel (Cornell Univ.) discussing canopy management for cold climate hybrids; 3) wine sampling at twilight meeting w/ Mass Farm Winery Assoc. June 3008; 4) UMass Cold Spring Vineyard tour for Mass Fruit Growers Summer Meeting July 2008; 5) Dr. Dan Cooley (UMass) discussing disease management for cold climate hybrids.

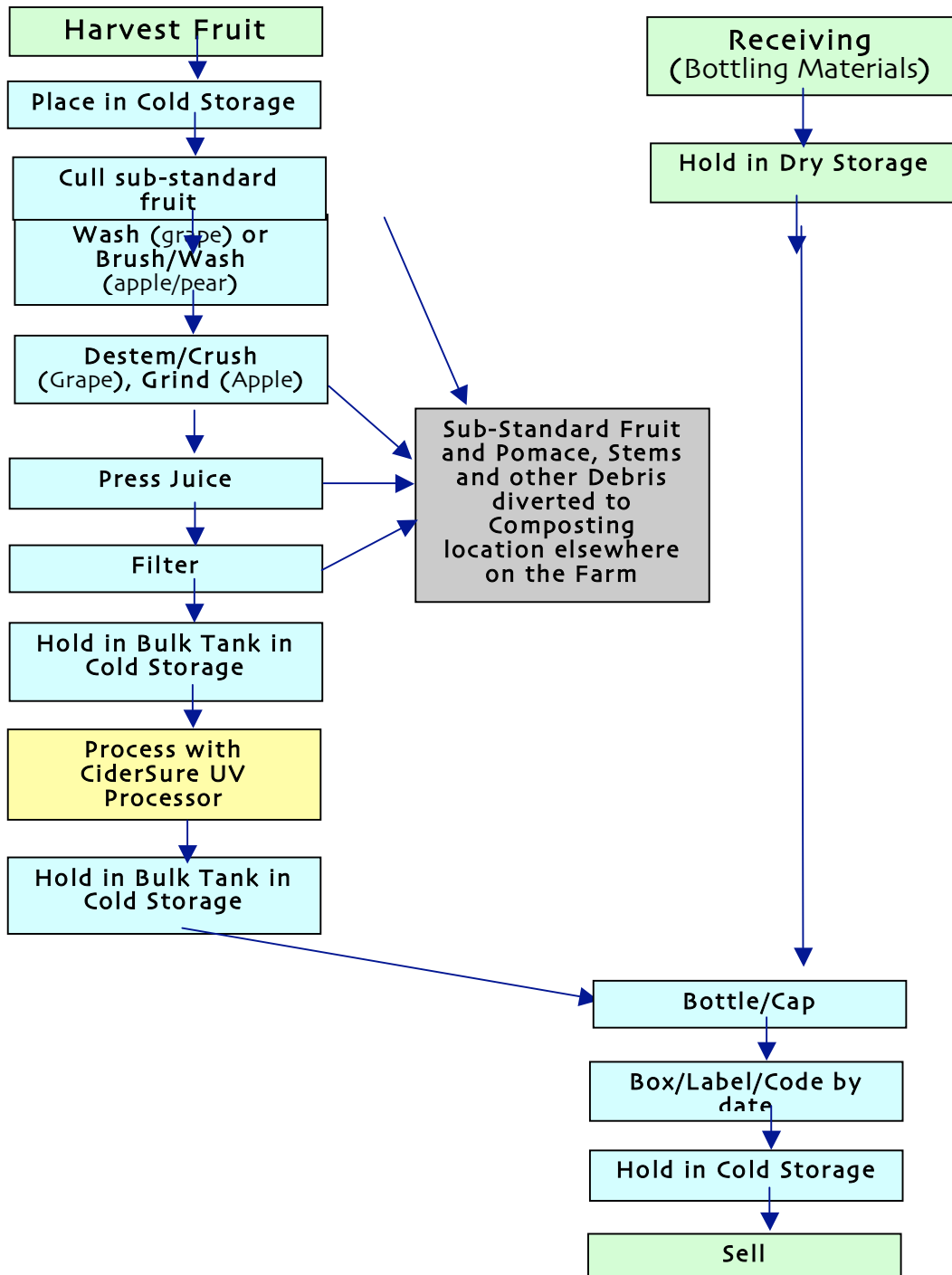
HACCP Plan Development:

Arthur Tuttle and Sonia Schloemann met with UMass Nutrition Professor Dr. David Nyachuba on July 26th and again on August 6th, 2007 to discuss plans for cider/juice production as part of the facility development at the UMass CSOREC. These meetings resulted in a more complete knowledge of the process for developing a HACCP plan and understanding of the USDA requirements for retail juice/cider production (<http://vm.cfsan.fda.gov/~comm/juiceqa.html>), The FDA/CFSAN “Good Manufacturing Practices (GMPs)” (<http://www.cfsan.fda.gov/~dms/gmp-toc.html>), and the related USDA GAPs information.



While determining that the facility will not be required to develop a HACCP plan unless/until product is sold off site, it was decided that such a plan would still be beneficial to the operation. Subsequently we met with MA Dept. of Public Health inspector “” who inspected the proposed facility, provided sample record keeping forms and documentation including “Guidelines for the Sanitary Operation of Massachusetts Cider Mills” also found at <http://www.mass.gov/Eeohhs2/docs/dph/environmental/foodsafety/cider.pdf>. The following flow chart was established for the juice processing facility:

Flow Chart for Juice/Cider Production for Commercial Sale



Capacity Building into the Future:

Grant Funded Research/Education Activities:

One of the hopes in establishing this demonstration small scale farm wine, cider and juice production



NE1020 planting in June 2008 showing vines in grow tubes

facility is to provide relevant and needed information to a growing industry. Toward that end, having this facility has enabled us to participate in larger initiatives, such as the USDA/CSREES funded NE1020 project entitled “[Multi-state evaluation of wine grape varieties and clones](#)”. The intent of this project is to provide a coordinated approach to the evaluation, and dissemination of knowledge gained by cooperator evaluation of existing and newly released wine grape varieties in the eastern USA. This is a subset of a national project for grape variety and clone evaluation, the goals of which are recognized as a high priority with the National Grape and Wine initiative (<http://www.ngwi.org/>).

In Massachusetts 8 varieties will be evaluated for their wine making potential according to project protocols. Varieties to be evaluated are [Chambourcin](#), [St Croix](#), [Frontenac](#), [Corot Noir](#), [Noiret](#), [Marquette](#), [La Crescent](#), [Reisling](#), and [Vidal](#). These varieties represent some traditional hybrids and the most promising new cutting edge varieties coming out of breeding programs at Cornell and University of Minnesota plus one hardy *V. vinifera* variety for comparison. The winery project allows us to participate in this larger project by providing the capacity to do the complex wine evaluations required in the NE1020 protocol. Additional such grant funded activities are being pursued for 2009 and thereafter.

Table 3. Randomized layout of NE1020 variety trial at UMass Cold Spring Orchard Research & Educ. Center, 2008.

Chambourcin	Reisling	Vidal	St Croix	Frontenac	<i>Corot Noir</i>	La Crescent	Noiret	Marquette
La Crescent	Chambourcin	Reisling	Marquette	<i>Corot Noir</i>	Noiret	St Croix	Frontenac	Vidal
Vidal	Marquette	La Crescent	Reisling	St Croix	Chambourcin	Noiret	<i>Corot Noir</i>	Frontenac
Frontenac	<i>Corot Noir</i>	Noiret	Marquette	Reisling	La Crescent	Vidal	St Croix	Chambourcin
Noiret	Frontenac	<i>Corot Noir</i>	La Crescent	Marquette	Reisling	Chambourcin	Vidal	St Croix
<i>Corot Noir</i>	St Croix	Chambourcin	Vidal	Frontenac	Marquette	Reisling	La Crescent	Noiret
Marquette	Noiret	Frontenac	St Croix	Vidal	<i>Corot Noir</i>	Chambourcin	Reisling	La Crescent
St Croix	La Crescent	Vidal	Chambourcin	Noiret	Frontenac	Marquette	<i>Corot Noir</i>	Reisling
Table Grapes								
Table Grapes								
Table Grapes								

Proposals under development include:

Eco-Grape and Eco-Wine Pilot Study:

The project's goal is to support the growth of Massachusetts' nascent viticulture and wine-making industry by developing methods for biointensive pest management, primarily focusing on diseases and weeds consistent with New York's [VineBalance](#) protocol, and linking this effort to an eco-labeling program to be developed with Red Tomato ([Eco-Apple](#) Program), the [IPM Institute](#) and [Whole Foods Local Products – North Atlantic Region](#). Our initial objectives include the following:

- Identify existing biointensive disease management approaches for grapes in the Northeast, for management of powdery mildew, downy mildew, phomopsis and black rot, and test promising new methods, particularly biofungicides, at UMass Cold Spring Orchard;
- Identify existing non-herbicidal alternatives for weed management in grapes, and test promising methods at UMass Cold Spring Orchard;
- Evaluate the most promising disease and weed management alternatives at grower sites under commercial conditions;
- Work with 3 to 6 grape growers, Red Tomato and the IPM Institute in the development of a production protocol for grapes to be used in a certification and eco-label program for vineyards;
- Work with Red Tomato develop eco-label marketing materials and systems (will require additional funding through other sources, primarily for Red Tomato);
- Develop a prototype protocol for ecological wine production that would be available to MA wine-makers.

Trellis Mounted Fixed Spray System for Grapes:

Based on work done by Drs. Art Agnello and Andrew Landers at Cornell University (described in article in [NY Fruit Quarterly](#), winter 2006), using micro-sprinkler technology for spray delivery of organic or conventional pesticides and foliar application of micronutrients in a trellised crop, this system will allow growers to deliver spray material rapidly (estimated at 5-10 minutes per acre) and frequently. This is especially valuable for organic production where growers rely on materials (such as sulfur, copper, neem oil or bicarbonates) that require short intervals between applications in order to be effective. But it is also valuable for non-organic growers who want to limit the compaction caused by tractor operations in the vineyard and/or wish to plant a high density vineyard with row spacing closer than allowed for most tractor operations.

One of the limitations identified by the original investigators for apple orchards is that the system loses efficacy in large plantings (over 2 acres) because of the inability to maintain consistent spray pressure in the delivery lines over long distances. Engineers are working on ways to overcome this limitation, but Massachusetts' vineyards are often planted in small block of less than 2 acres so may not



require sophisticated engineering fixes for this problem.

Our objectives for this project are to:

- Set up a demonstration fixed spray system at the UMass Cold Spring Orchard vineyard block and one commercial vineyard
- Test several spray programs using this system at both location and evaluate the results
- Hold twilight meetings to demonstrate the system for interested vineyard growers
- Present results at educational grower meetings and in newsletters

These and other initiatives are being pursued through federal, state and private grant programs.

Acknowledgements

In addition to the Mass Dept of Agricultural Resources, we gratefully acknowledge the support and collaboration on this project of the *Massachusetts Agricultural Experiment Station*, the *Massachusetts Fruit Growers Association*, the *Massachusetts Farm Wineries and Growers Association* and private donations made by *Chicama Vineyards* of West Tisbury MA, *Nashoba Valley Winery* of Bolton MA, *Neponset Winery* of Needham MA and the *Cherewatti Foundation*, and technical support and encouragement by many, especially Kip Kumler of *Turtle Creek Winery* and Joe Sullivan of *Chester Winery* who let us pick their brains a lot about equipment and winery design. Without all this input and support, we would not be as far along as we are. We encourage visits and inquiries about this project by contacting Sonia Schloemann at 413-545-4347 or sgs@umext.umass.edu or other investigators listed on the cover page of this report.