



Red-Juice **Apple Cultivars** **for Hard Cider** **Production**

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Rosé Ciders



Assessing the **red-fleshed** apple diversity



Agriculture and
Agri-Food Canada

- ~8,000 individuals analyzed
- Represent ~3,000 unique genotypes
- Identified >120 different red-fleshed genotypes



Phenotyping

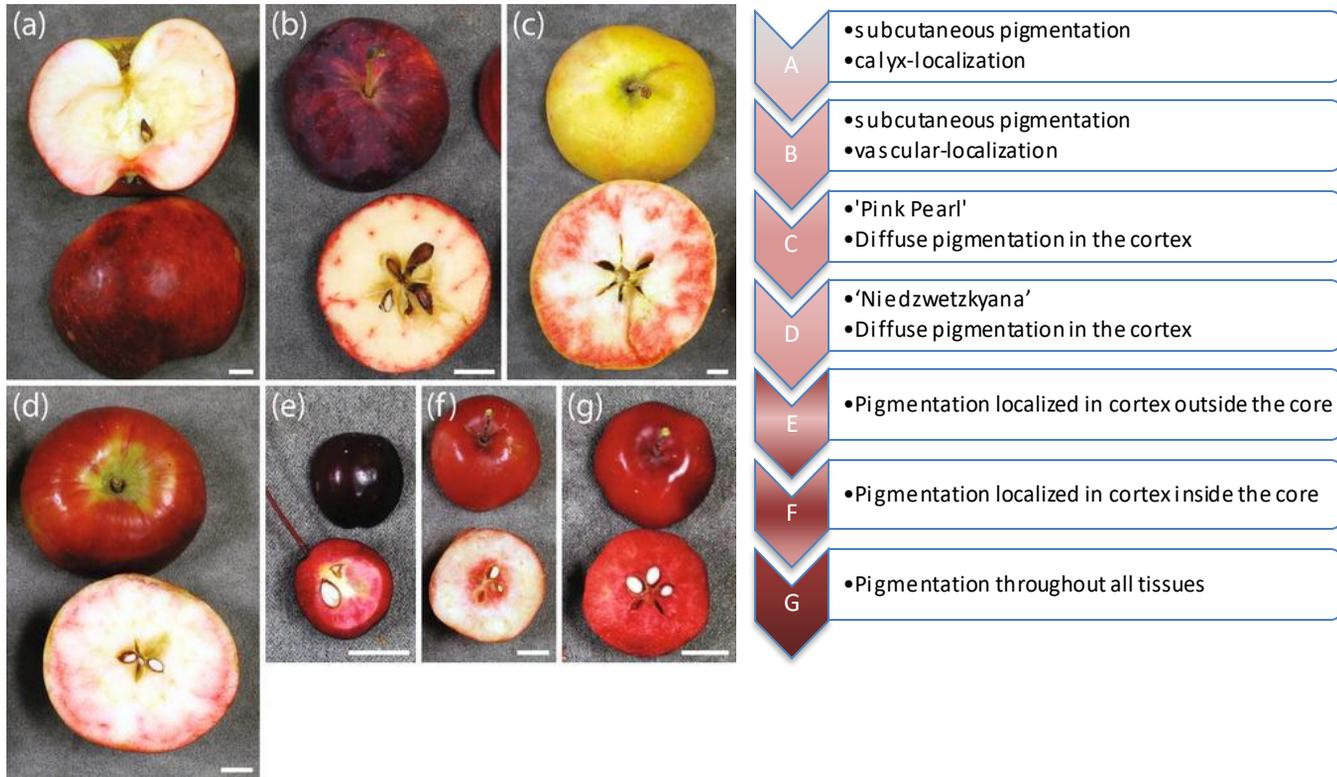


Fig. 1 from van Nocker et al. 2012



Genotyping

t	Classification	Accession	Pattern	Intensity ^a	<i>MdMYB10</i> allele type
1764	<i>x domestica</i>	PI392302	T	3.5	
(not named)	<i>x atrosanguinea</i>	CC2605*01	OC	2	R1/R6
(not named)		90P048*01	T	4	R1/R6
Adams	Hybrid	PI588885	OC	3.5	R1/R6
		MAL0481	OC	3	R1/R6
		90P046-47	OC	3	R1/R6
Alamata	Hybrid	PI588932	CO, OC	2.5	R1/R6
Aldenhamensis	<i>x purpurea</i>	PI589016	CO	1	
		MAL0733	CO, P	1.5	R1/R6
		CC1352*04	CO, P	2	R1/R6
Almey	Hybrid	PI588824	CO	1	R1/R6

Table 2 from van Nocker et al. 2012



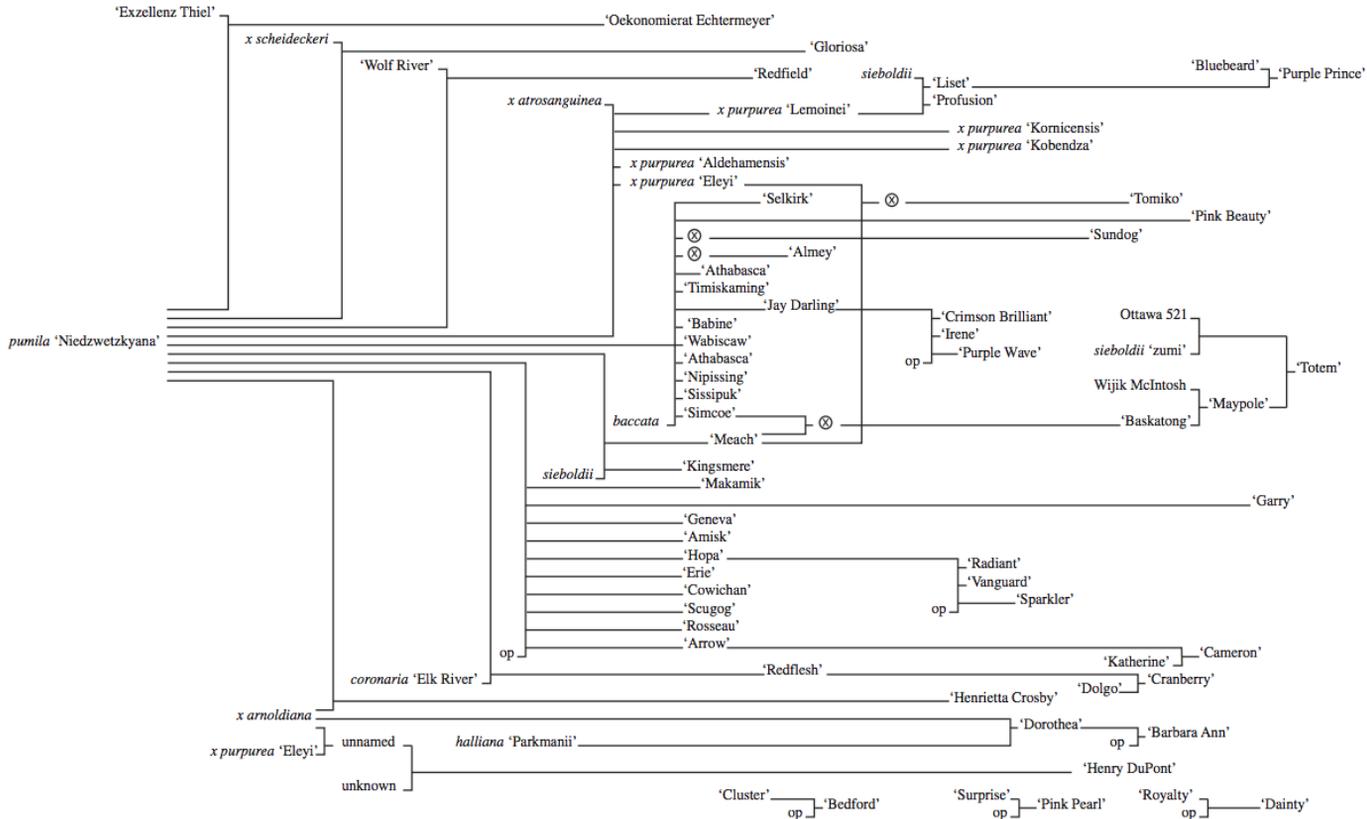


Fig. 2 from van Nocker et al. 2012



Fruit Quarterly

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Cultivar	Disease resistance	Vigor	Estimated yield (tons/acre)	Fruit diameter (cm) and mass (g)	Extractable juice content (ml/g)	Total phenolics	Antioxidant capacity	Extractable anthocyanin content (mg/ml)	Titrateable acidity (g/L)	Extractable juice/acre	Extractable anthocyanins/ acre (kg)
Cowichan	+	+++	12.5±0.8	3.2±0.30 17.1±2.3	0.76	65-73	0.13	0.1	0.095	6,840 l 1,805 gal	0.68
Cranberry	++	++	20.8±1.9	4.2±0.30 51.0±9.0	0.92	83-87	0.14	0.63	0.112	13,778 l 3,635 gal	8.68
Henrietta Crosby	++	++	5.5±0.42	2.8±0.27 10.8±1.1	0.88	56	0.14	0.22	0.278	3,485 l 920 gal	0.77
Irene	+++	+++	24.2±2.8	4.3±0.37 35.6±4.3	0.88	66-70	0.13	0.18	0.197	15,333 l 4,045 gal	2.76
Otterson	+++	++++	21.0±4.3	7.1±0.55 158±12	0.84	46	0.13	0.64	0.092	12,701 l 3,351 gal	8.13
Prairie Fire	++	++	1.6±0.11	1.4±0.22 1.4±.22	0.61	57	0.14	0.55	0.373	703 l 185 gal	0.39
Red Silver	++	+++	1.1±0.17	1.7±0.29 2.3±0.17	0.45	64-77	0.14	0.73	0.19	356 l 94 gal	0.26
Selkirk	++	+++	5.0±0.53	3.0±0.35 12.1±3.2	0.78	86-92	0.13	0.18	0.205	2,808 l 741 gal	0.51
Sissipuk	+	++	1.8±0.09	3.7±0.50 23.4±4.1	0.76	76-79	0.13	0.57	0.205	985 l 260 gal	0.56
Timiskaming	+++	+++	5.8±0.4	5.7±0.76 88.9±10.4	0.88	70-74	0.14	1.29	0.32	3,675 970 gal	4.7

- Winter 2017 Edition
- Cultivar evaluation of 10 dark red-fleshed varieties

Table 1 from van Nocker and Gottschalk (2017)



Recommended Selection – ‘Otterson’

Harvest in late
September / early
October for NY



- Standard sized fruit
- Slightly mealy in texture
- Aroma of overly mature small fruit
- Dark red juice, viable as a single variety cider
- Pedigree history is unknown (Susan Brown collected it)



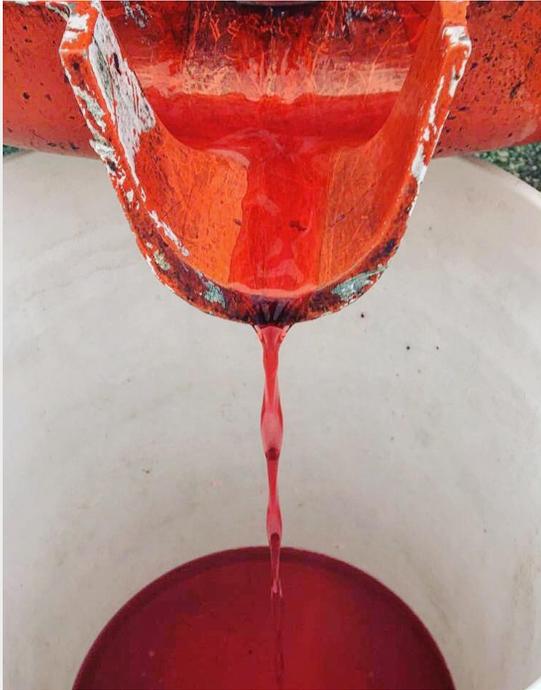
2 bronze in 2018, one
was as a commercial entry



Fruit Yield (tons/acre)	21.0 ± 4.3
Juice Yield (gallons/acre)	3,351
Fruit Diameter (cm)	7.1 ± 0.55
Fruit Mass (g)	158 ± 12
Antioxidant Content (mg/mL)	0.64
Titrateable Acidity (g/L)	0.092
Disease Resistance	Very Resistant
Vigor	Very Vigorous (evaluated on Nic® 29 rootstock)



Ottersen Ciders



Recommended Selection – ‘Cranberry’ Harvest in Early September in MI



- Small sized fruit (half dollar)
- No biennial tendencies observed yet
- Juicy
- Tastes and smells like cranberries
- Dark red, almost purple colored juice
- Recommend blending due to extreme acidity
- Bred by R.L. Wodarz, most likely a cross between cv. 'Dolgo' and 'Redflesh'



Fruit Yield (tons/acre)	20.8 ± 1.9
Juice Yield (gallons/acre)	3,635
Fruit Diameter (cm)	4.2 ± 0.30
Fruit Mass (g)	51 ± 9.0
Antioxidant Content (mg/mL)	0.63
Attractable Acidity (g/L)	0.112
Disease Resistance	Moderate Resistant
Vigor	Moderate Vigor (evaluated on Nic® 29 rootstock)

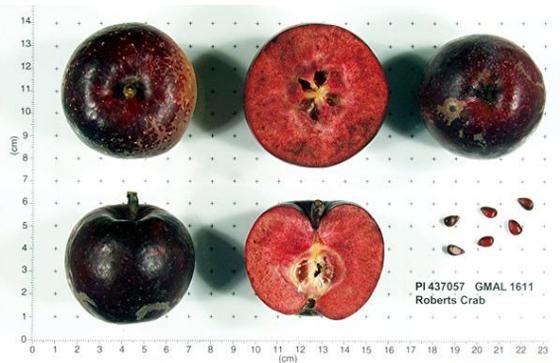


Cranberry Ciders



Recommended Selection – ‘Roberts Crab’

Harvest on or
near September
20 in NY



- Medium sized fruit
- Juicy
- Dark red juice
- Has some astringency

Trait	CRC Value	Geneva, NY Value	Feral Conditions (Geneva, NY) Value
Average Mass (grams)			56.4
Average Length (mm)			46.6
Average Width (mm)			54.6
Penetration Force (Kg)			10.41
Maturity Date			9/21/18
Maturity Date Relative to Jonagold			-38
Starch Index at Maturity			
Juice Yield (mL/lbs)			184.5
Brix			11.1
pH			3.5
TA (g/L)			7.1
Tannic Acid (g/L)			0.847409
Classification			Bittersharp

Future Diversity – Michigan *PureRed* Juice Apples

Great Lakes Cider Apple Collection at Clarksville, MI

2014 Progeny

Fruit evaluations in '19

Ruby Jon x Cranberry

Northern Spy x Kaz

Northern Spy x Irene

Cranberry x Otterson

Otterson x Cranberry

Cranberry x Dolgo

Roberts Crab x OP

Red Silver x OP

Irene x OP

Henrietta Crosby x OP

Timiskaming x OP

Cowichan x OP

Selkirk x OP

Sissipuk x OP

Prairie Fire x OP

Cranberry x OP

Otterson x OP

2018 Progeny

- 68 new populations
- Collected from the USDA *Malus* Germplasm
- Maternal x OP
- Maternal x OP
- Cider-specific maternal selections included



Future Diversity – Michigan *PureRed* Juice Apples

Great Lakes Cider Apple Collection at Clarksville, MI



Variable flesh coloration

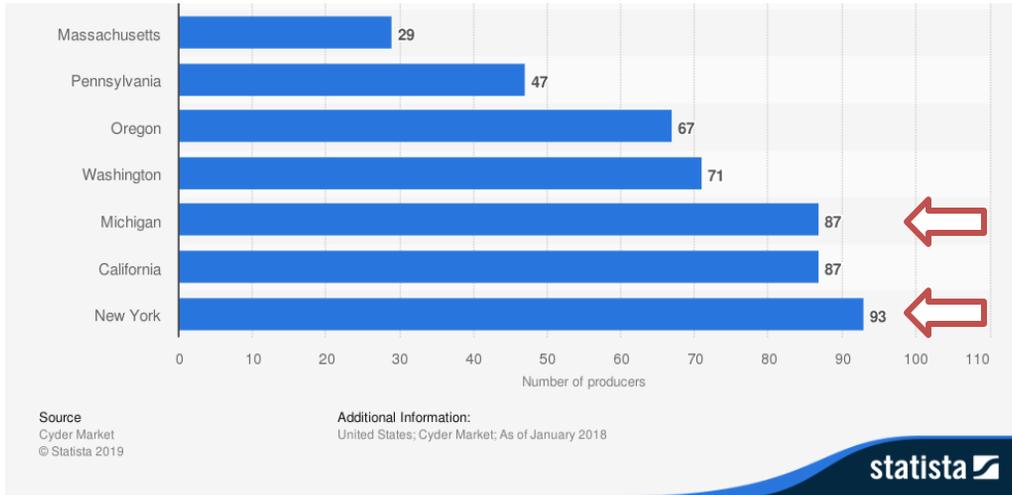
Variable size



Michigan Cider Industry and Cider-related Research at MSU



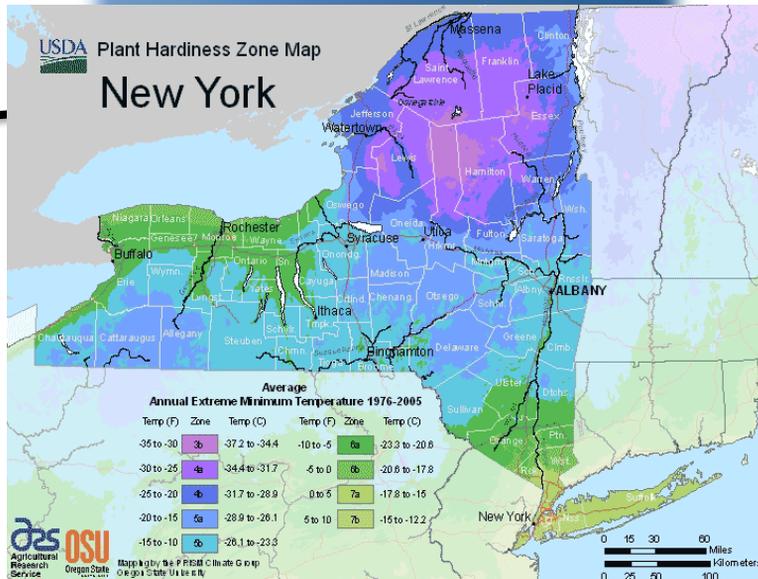
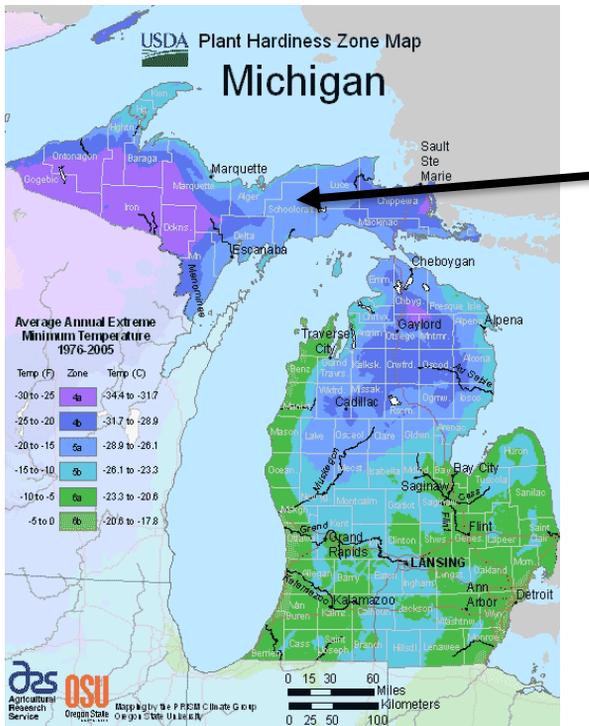
Michigan Cider Industry



MICHIGAN CIDER ASSOCIATION



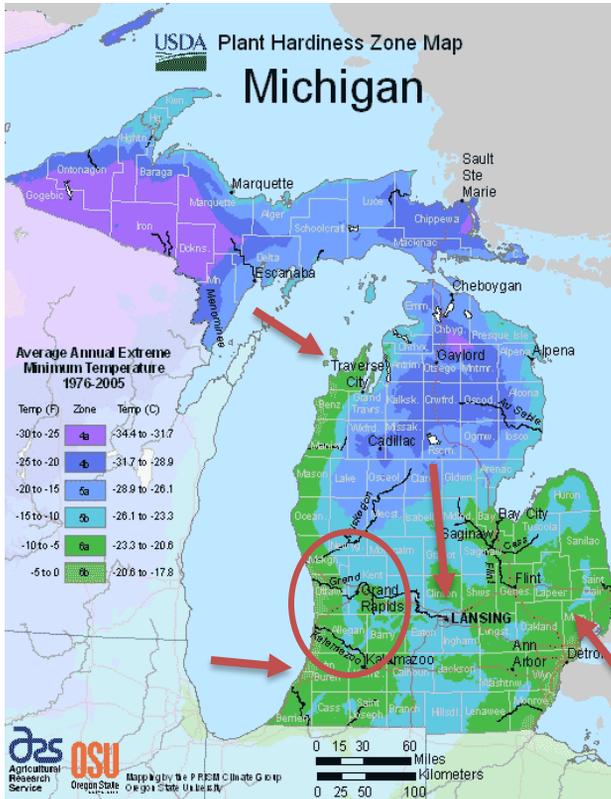
March 23rd, 2019



East Lansing, MI
 Avg Temp: 34° F
 Snow Depth: 0"



Michigan Cider Industry



Primary apple production region



Concentrated area of hard cider producers



Great Lakes Cider Apple Collection

Contains 60+ varieties

- Historic cider varieties
- Scion from USDA *Malus* Germplasm
 - Genetic identity is catalogued



Scion classifications

- Sweets
- Sharps
- Bittersweets
- Bittersharps
- **Red-juice**
 - **Otterson**
 - **Roberts Crab**



Variety Trial Replication

Replicate Trials - 2019

- 4 different rootstocks
 - M106
 - M7
 - Bud9
 - M9 Clones
- Various training systems
 - Free-standing
 - Ultra-high density



Cultivar Evaluations

>150 historic and
prospective cider cultivars

- Great Lakes Cider Apple Collection
- USDA *Malus* Germplasm
- Cornell Pathology Orchard
- MAIA breeding lines
- MSU breeding lines



MSU Cider Apple Trait Database

ciderapples.msu.edu

MICHIGAN STATE UNIVERSITY
Great Lakes Cider Apple Collection

The Collection Previous MSU Research **Trait Database** Red-Juice Varieties Nurseries Resources About

MSU Cider Apple Trait Database

Welcome to the **MSU Cider Apple Trait Database**. Its goal is to provide an internet-based, user-friendly index that will allow anyone (producers, growers, and academics) to submit and review information on cider apple varieties. Just click on the below headers of cider apple classifications to access links to individual "cultivar profile" pages.

Cultivars are assigned to a classification based on our experimental results and could deviate from anecdotal or historical classifications. The classification of any cultivar in this database is subject to change as more data is acquired from our seasonal evaluations. In addition, some cultivars underwent evaluation using feral trees that were cultivated in an "organic" management scheme in a high scab pressure orchard.

Cultivar names with a "*" following the name are included in the Great Lakes Cider Apple Collection.

At the bottom of the page is a submission form for any grower, cider maker, or enthusiast to submit comments, descriptions, and ratings for cider apple varieties. The goal of this is to aggregate user-sourced information to complement our observations.

This information was obtained during the 2018 and 2019 growing seasons.

Sweet +
Sharp +
Bittersweet +
Bittersharp +

USER SUBMITTED INFORMATION
User_Submission

Trait Database / Cultivar Pages /

'Cornish Gilliflower'

Production Traits	+
Fruit and Cider Traits	+
Example Photos	-



Trait Database

- Production traits
 - Bearing patterns
 - Disease
- Cider-specific traits
 - Juice yield
 - Brix
 - pH
 - TA
 - Tannin content

'Winter Banana'

Production Traits		
Fruit and Cider Traits		
Trait	CRC Value	Geneva, NY Value
Average Mass (grams)	245.6	189.6
Average Length (mm)	72.3	63.6
Average Width (mm)	87.0	78.7
Penetration Force (Kg)		7.79
Maturity Date	10/29/18	10/29/18
Maturity Date Relative to Jonagold		Even
Starch Index at Maturity		7.3
Juice Yield (mL/lbs)		212.3
Brix	8.7	7.5
pH	3.3	3.3
TA (g/L)	4.6	3.0
Tannic Acid (g/L)	0.12	0.04
Classification	Sharp	Sweet
Example Photos		



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Greg Peck - Cornell

Clarksville Research Center Staff

Commercial Partners

Mike Beck – Uncle John's Hard Cider
Dan Peat – Peat's Original Hard Cider
Jim and Robin Barker – End of the Road Winery
Kevin VerSnyder – VerSnyder Orchards



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Thank you! Questions?



Fruit Quarterly Article



**Great Lakes Cider
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