

FINAL PERFORMANCE REPORT

The completed Final Performance Report will be posted to the AMS website.

FINAL PROJECT REPORT TEMPLATE

Final Performance Reports must illustrate the completion of the project within the grant agreement.

PROJECT INFORMATION

Project Title	Development of Red-Juiced Apple Cultivars for Michigan Hard Cider			
Recipient Organization Name:	Michigan State University			
Period of Performance:	Start Date:	4/1/2020	End Date:	7/31/2021
Recipient's Project Contact				
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PERFORMANCE NARRATIVE

PROJECT BACKGROUND

Provide enough information for the reader to understand the importance or context of the project. This section may draw from the background and justification contained in the approved project proposal.

Hard cider is a rapidly growing sector of the Michigan adult beverage industry. As the market begins to saturate, consumers will begin to gravitate towards novelty and specialty ciders. Some non-commercial apple cultivars produce red juice, and our preliminary work has shown that these produce excellent cider and that consumers are likely to be attracted to these. However, none of these red-juiced apple cultivars is perfectly suited to Michigan conditions. MSU has initiated an apple breeding project, called **Michigan PureRed**, designed to produce disease-free, productive cultivars with fruit that has highly intense, red juice with appropriate biochemical properties and taste for hard cider production, and that are optimized for production in Michigan.

ACTIVITIES PERFORMED

Address the below sections as they relate to the entire project's period of performance.

OBJECTIVES

Provide the approved project's objectives from your approved proposal/grant agreement.

#	Objective	Completed?	
		Yes	No*
1	Obtain phenotypic information for populations of apple plants generated in 2016 and 2017 from crossing a variety of red-juiced parents.	X	
2	Make further crosses using the identified superior, elite individuals from this collection as parents, creating new and potentially even better cultivars.	X	
3	Map genetic loci that are important for intense red juice color, and genetic alleles associated with this trait.		X
4			

*If no is selected for any of the listed objectives, you must expand upon this in the challenges and lessons learned sections.

ACCOMPLISHMENTS

List your accomplishments for the project's period of performance, including the impact they had on the project's beneficiaries, and indicate how these accomplishments assist in the fulfillment of your project's objective(s), outcome(s), and/or indicator(s).

#	Accomplishment or Impact	Relevance to Objective, Outcome, and/or Indicator
1	Identified at least 10 selections with optimal combinations of traits enabling production of high-quality, red cider in Michigan. Distributed one of these to grower for field trials.	Objective 1.
2	At least 45 new crosses were carried out in 2020 and 2021. A total of 35 new, potentially superior selections were generated and started for production and evaluation in the field.	Objective 2.
3	Generated a total of 12 mapping populations suitable for further genetic analysis.	Objective 3.
4		

CHALLENGES AND DEVELOPMENTS

Provide any challenges to the completion of your project or any positive developments outside of the project's original intent that you experienced during this project. Also, provide the corrective actions you took to address these issues. If you did not attain an approved objectives, outcome(s), and/or indicator(s), provide an explanation in the Corrective Actions column.

#	Challenge or Development	Corrective Action or Project Change
1	MSU COVID restrictions, which severely hindered all project activities between late-March 2020 and April 2021.	Fewer than projected progeny from previous crosses were able to be transferred to the field in 2020, and so this effort was expanded in the current year (summer 2021).
2	Development of a genetic map for genes influencing juice color was not possible at the seedling stage based on seedling color, because the germination environment influenced this property. Seedling selection would have saved much time and effort.	Accordingly, all progeny (instead of just a subset) were propagated for further study. This increased the effort and cost of the project, as we must wait a few years until fruit is produced in order to do the mapping.
3		
4		

LESSONS LEARNED

Provide recommendations or advice that others may use to improve their performance in implementing similar projects.

We learned it is relatively difficult to propagate and grow apple seedlings/trees in controlled environment with limited or no availability of greenhouse space. We will begin to contract out this work to commercial fruit tree nurseries.

CONTINUATION AND DISSEMINATION OF RESULTS (IF APPLICABLE)

Describe your plans for continuing the project (sustainability; capacity building) and/or disseminating the project results.

In 2020, we distributed the first of several projected high-performing plants to Michigan growers. After a trial period, if performance is verified under commercial production conditions, we will apply for plant patents, providing income to sustain this project into the future. Using the model enabled by funding from MCBC, we will continue to make crosses, evaluate existing lines, and generate mapping populations each year.

BENEFICIARIES

Number of project beneficiaries: ~50 (apple growers for hard cider) Enter Number of Project Beneficiaries

ADDITIONAL INFORMATION

Provide additional information available (i.e., publications, websites, photographs) that is not applicable to any of the prior sections.

- Popular press: “Red-fleshed apples could keep Michigan cider makers in the black” by Kyle Davidson. Great Lakes Echo, March 30, 2021.
- Popular press: “MSU professor changing cider’s taste, breeding red-fleshed apples for juice”. wzzm13.com, March 5, 2021.
- Popular press: “An MSU research wants to get red-fleshed apples to grow”. Lansing State Journal, Feb 24, 2021.
- Distributed scionwood of a PureRed line to Robinette’s Apple Hause and Winery, Grand Rapids MI for field testing.
- Trade article: “Red flesh for red ciders” by Matt Milkovich. Good Fruit Grower, June 24, 2020.

- We assisted Left Foot Charlie Winery in development of red cider from apples grown at MSU ('Otterson'). <https://untappd.com/b/left-foot-charley-otterson/2630597> and provided several hundred pounds of fruit for evaluation in 2019 and 2020.
- Trade article: "Testing cider cultivars" by Stephen Kloosterman. Fruit Grower News, Sparta MI October 2019.
- Presentation: "Red-juiced apple cultivars for hard cider production. Empire State Producers Expo, Syracuse NY, 2019
- Presentation: "Cider Varieties and PureRed Breeding Program". December 2019 GLEXPO, Grand Rapids, MI.
- Presentation: Red-juiced apples and their use in rose cider. CiderCon 2019, Chicago, IL.
- Social Media (YouTube): from MSU Communications: <https://youtu.be/eomIHxaLKdc>
- Collaboration with Robinette's Apple House and Winery, Grand Rapids MI to produce red sweet cider and hard cider
- Presentation to MI apple growers: 'Evaluation and Development of Red-Juiced Apple Cultivars for Michigan Production'. MSU-CRC Field Day, 2019, Clarksville, MI.
- Presentation to Great Lakes-area apple growers: 'Red Fleshed and Other Special Varieties for Sweet Cider'. GLEXPO Sweet Cider session, December 2019.
- Trade article: 'Researcher's quest for a red-juiced apple pays off' by Stephen Kloosterman. Fruit Grower News, Sparta, MI. October 23, 2019. <https://fruitgrowersnews.com/article/researchers-quest-for-a-red-juiced-apple-pays-off/>
- As a result of this work, we have been regularly distributing cuttings from the cultivars Otterson, Cranberry, and Irene for apple growers in Michigan and elsewhere to propagate, in order to establish their own orchards. More than 50 growers have received or inquired about receiving scion wood from us. We have also supplied nurseries with cuttings for propagation. These nurseries included Hostetler in Indiana, Fedco Seeds in Maine, Schlabach's and Cummins in New York, and Adams County in Pennsylvania.

The Authorized Individual must sign this statement after the applicable report form is completed.

I certify that the statements and information contained in these documents are true, accurate, and complete.

Signature of Responsible Official:

Date:

Steve Van Nooher

August 15, 2021