

Plant scientists investigate genetics, nutritional needs of cold-climate grapes

July 31 2015



Snow covers the Frontec, left, and Kay Gray vines at the Gavins Point Vineyards in Yankton County. Credit: Kim Brannen

The French have spent centuries developing grapes with the unique flavor and character of Burgundy region wines. Cold-climate grape producers are counting on science to help shorten that process.

Plant scientists Anne Fennell and Rhoda Burrows are part of the research team helping cold-climate grape growers carve a niche in the American wine industry through two U.S Department of Agriculture projects.

Fennell works with grape genetics, identifying biomarkers that will help breeders develop better varieties. Burrows, an SDSU Extension horticulture specialist at the West River Agricultural Center, focuses on vine nutrition to help producers properly manage the soil.

Last fall, the Northern Grapes project, which brings together researchers from 10 land-grant institutions, received \$2.6 million for the next two years, putting the 5-year total at nearly \$5 million. VitisGen, which focuses on mapping the genome of cold-hardy grapes, was fully funded for five years for \$5 million. Begun in 2011, both research projects are led by Cornell University and are part of the National Institute of Food and Agriculture Specialty Crop Research Initiative.

Burrows estimated that South Dakota has more than 80 vineyards and about 200 acres of grapevines. Some vineyards have 15 acres or more with roughly 450 to 500 vines per acre.

Developing new cultivars and new flavors

"Cold-hardy cultivars are complex hybrids of *Vitis vinifera* and native American species including *Vitis riparia* which is native to this region," said Fennell, noting that the genomes can contain traits from three to seven species.

"Because the cultivars are new, we're trying to get baseline information," said Fennell. The red Marquette grape, for instance, has only been commercially available for eight years, so the first wines are just becoming available in larger quantities.

"Marquette is about 35 percent wild *Vitis riparia* by pedigree and is a tremendously hardy grapevine," Fennell explained. It tends to break bud and ripen earlier than other varieties.

She collaborates with University of Minnesota and Iowa State University researchers on fruit chemical and aromatic composition and sensory ripening characteristics. Fennell and Burrows provide samples to both universities and will integrate gene expression and chemical information to identify signature characteristics.

The ultimate goal is to help the industry give consumers quality wines that are unique to these regions, according to Fennell.



Anne Fennell explains the challenges that cold-climate grape growers face.
Credit: South Dakota State University

Perfecting fruit quality, harvest time

New cultivars must be tested for sustainability, yield and fruit quality, Fennell explained. Vines take three years to fruit and up to 10 years to reach mature production, so the cultivars that producers choose have long-term impact on their businesses.

Vineyard management is also critical to wine quality. Learning how to balance fruit load to vine size, timing of harvest for full flavor and aroma of the wine for each cultivar takes patience, Fennell explained.

For instance, in another research project, Fennell harvested grapes a week early because she did not like the underlying flavors found at the traditional harvest time. The resulting wine had a more floral aroma.

"We are looking for signature biomarkers related to flavor and ripening," she explained, by genetically tracking both good and bad characteristics. For instance, if the fruit is off flavored, she might detect an associated increase or decrease in specific gene expression.

In addition, cold-climate grapes tend to have more acid when ripe than those grown in California, so the researchers are figuring out how to minimize the acid yet maintain a pH level appropriate for fermentation.

Determining optimum soil nutrients

Burrow uses research from concord-type grapes as a starting point to determine to the nutrients the plants need based on the soil and growing conditions.

"There's a fair amount of debate as to what part of the plant and when to test to monitor nutrient levels," she pointed out.

For instance, potassium levels in northern [grape varieties](#) may fluctuate differently than those in a southern variety that doesn't go through extremely cold winters.

The researchers test plant tissue at various stages beginning when the vines blossom through when the grapes turn color. They compare those results with soil analyses to determine what nutrients are important at each stage of development.

"The aim is to manage the plants to provide optimal berry quality and yield," Burrows said.

Provided by South Dakota State University

Citation: Plant scientists investigate genetics, nutritional needs of cold-climate grapes (2015, July 31) retrieved 27 April 2024 from <https://phys.org/news/2015-07-scientists-genetics-nutritional-cold-climate-grapes.html>

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