BREEDING GRAPEVINES FOR DISEASE AND LOW TEMPERATURE TOLERANCE: THE U.S. PERSPECTIVE

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Keywords: Grapevine breeding, Grapevine genetics, Genetic mapping, Disease resistance, Low temperature tolerance

Most grape scion cultivars grown around the world are derived from a single species, *Vitis vinifera*. Yet, the proportion of interspecific hybrids is increasing for a variety of reasons, including resistance to abiotic stresses such as low temperatures; societal, economic and environmental pressures to reduce pesticide usage; and to add a greater range of flavors to new table grape cultivars. New grapevine cultivars, particularly those with improved disease resistance and low temperature tolerance, have helped to extend grape growing beyond the traditional boundaries of *V. vinifera* adaptation. The impact of interspecific cultivars in the United States has been significant, and new cultivars are continuing to be commercialized across the wine, table grape and raisin sectors.

Very active public (Univ. of Minnesota) and private breeding programs in the upper midwestern states have resulted in numerous cultivars able to withstand midwinter temperatures between -25 and -35 °C. These include ‘Frontenac’, ‘La Crescent’, ‘Marquette’, ‘Itasca’ and ‘Clarion’.Many also harbor moderate levels of resistance to a number of pathogens. Significant areas have been planted in colder regions of the midwest, as well as through the colder sites of mid Atlantic and northeastern states. The “Northern Grapes Project” http://www.northerngrapesproject.org addressed the specialized viticulture / enology research and extension issues for those growing these new low temperature tolerant cultivars. This project was funded by the USDA National Institute of Food and Agriculture, Specialty Crops Research Initiative from 2011 to 2016. The project sought to optimize fruit composition and wine quality through the development viticultural and enological practices best suited for cold-hardy grape cultivars. Results were communicated via webinars, publications, newsletters, conference presentations, and via the above website.

The University of California program led by Dr. Andy Walker released five new cultivars of Pierce’s disease resistant wine grapes in 2019. Three are used for red wine production (‘Camminare noir’, ‘Paseante noir’ and ‘Errante noir’) and two for white wine (‘Ambulo blanc’ and ‘Caminante blanc’). All carry a gene for resistance from *V. arizonica*. Rapid cycles of backcrossing were facilitated by aggressive vine training and selection for precocious flowering. The seed to seed cycle was reduced to as little as two years, and was carried out along with greenhouse testing for resistance, and genetic testing for DNA markers for the resistance locus. Four backcross generations with elite *V. vinifera* parents were carried out in a ten-year period. The resulting five cultivars are >90% *V. vinifera* with wine quality similar to *V. vinifera*. https://caes.ucdavis.edu/news/uc-davis-releases-5-new-wine-grape-varieties

Throughout the United States, there are significant plantings of the best of the older “hybrid direct-producers” a/k/a French-American hybrids, such as ‘Chambourcin’, ‘Vidal blanc’, and ‘Seyval blanc’. Cornell’s program in Grapevine Breeding and Genetics has produced a series of successful wine grape cultivars, beginning with Cayuga White in 1972. Other successful white (‘Chardonel’, ‘Traminette’, ‘Valvin Muscat’, and ‘Aromella’) and red wine grape (‘Noiret’, ‘Corot noir’, and ‘Arandell’) releases followed. Traminette (1996) is already responsible for more than $43M worth of wine production annually, and other more recent releases continue to be planted. Award-winning wines of newer Cornell cultivars as well as the Minnesota cold-hardy cultivars are easily found.

The *Vitis*Gen1 and *Vitis*Gen2 https://www.vitisgen2.org projects took place between 2011 and 2022, putting more robust genetic technologies into the hands of breeders. Tools were developed to rapidly phenotype for wine and disease resistance traits, and molecular marker technology allowed breeders to select promising seedlings during their first year of growth. Improved mapping technology (GBS and rhAmpSeq) led to the discovery of new loci for resistance to leaf phylloxera, powdery mildew, downy mildew, and Botrytis bunch rot. Loci affecting aspects of wine quality were identified, as well. Breeding efficiency was greatly improved, and breeding programs in the United States have, as a result, many elite lines undergoing additional testing. It can be expected that improved cultivars will not only expand the range of locations where sustainable grape-growing can be extended beyond the limitations of V. vinifera, but reduced reliance on pesticides will be possible. In time, the development of high quality, disease resistant wine grapes may begin to replace some of the current plantings of *V. vinifera* grapes. It will be important to educate wine consumers about the new cultivars, their value to sustainability, and the unique qualities they can present in the glass.