# A COMPARATIVE STUDY ON PHYSIOLOGICAL RESPONSES TO DROUGHT IN WILD VITIS SPECIES

**Authors:** Miriam KALTENBACH[1], Mina MOMAYYEZI[1], Andrew J. MCELRONE[1,2], Elisabeth J FORRESTEL[1]

[1] *Department of Viticulture and Enology, University of California, Davis, CA 95616, USA*
[2] *Crops Pathology and Genetics Research Unit, USDA-ARS, Davis, CA 95616, USA*

*Corresponding author: Miriam Kaltenbach

## Abstract:

**Context and purpose of the study -** The crossings of three wild *Vitis* species are commonly used as rootstocks in wine production worldwide. Factors such as disease resistance and vigor are most important for their selection. With climate change extending drought conditions and water limitations, the selection of rootstocks conferring increased tolerance to drought takes on greater importance. Therefore, identifying Vitis species with improved drought tolerance and incorporating them into breeding programs could contribute to more resilient rootstocks under water limiting conditions. Furthermore, those species serve as a valuable resource to increase genetic variability of rootstocks. We hypothesize that species native to drier habitats will exhibit superior physiological performance under drought stress.

**Materials and methods**
Root and canopy physiological characteristics of 20 North American wild *Vitis* species, across a wide latitudinal range (New England through Mexico and Puerto Rico), under two soil moisture treatments were evaluated using a whole-plant experimental approach. Anatomical and biochemical bases of photosynthetic capacity and response to water stress in wild Vitis accessions originating from habitats with varied climatic conditions were explored. Furthermore, links between leaf structural diversity and physiological features that enhance photosynthetic capacity and, whether genotype differences hold up under water stress conditions was investigated.
Experiments were performed in a greenhouse under ambient atmospheric conditions using clonal and non-grafted saplings of 24 *Vitis* species. The saplings were either subjected to a controlled dry down (target: 20–40% w/w 'drought') or maintained irrigated (70–90% w/w 'control') conditions. Measured physiological parameters included leaf and stem water potential, whole-plant and root system hydraulic conductance, leaf gas exchange and turgor, root and leaf biomass as well as spectra measurements . Additionally, X-ray imaging of plant tissue was performed and manual segmentation was used to prepare X-ray images for auto-segmentation through machine learning algorithms.
Linear regression models were used to describe relationships between anatomical and physiological variables and their associations with biogeoclimate variables.

**Results -** Our data show an impact of the drought treatment and indicate differential responses to drought stress across different species. Furthermore, structural differences that drive photosynthetic responses were found. Elucidating canopy traits associated with improved performance under drought could facilitate a rapid screening of germplasm to develop drought-tolerant rootstocks in the future.

**Keywords**: Grapevine, Hydraulic conductance, Root performance, Water-use efficiency, Water stress, drought tolerance, vitis