Open Conference on Grapevine Physiology and Biotechnology
LOGROÑO - LA RIOJA
7-11 July 2024

Dry leaf hyperspectral reflectance predicts leaf elemental composition in grafted hybrids

Zachary Harris[1,2*], Danielle Hopkins[2,3], Allison Miller[2,3]

[1] *Taylor Geospatial Institute, Saint Louis University, St. Louis, MO*
[2] *Donald Danforth Plant Science Center, St. Louis, MO*
[3] *Department of Biology, Saint Louis University, St. Louis, MO*

[*]*Corresponding author: zachary.n.harris@taylorgeospatial.org**

Abstract (250 words)

Elemental composition, measured as the concentrations of different elements present in a given tissue at a given time point, is a key indicator of vine health and development. While elemental composition and other high-throughput phenotyping approaches yield tremendous insight into the growth, physiology, and health of vines, costs and labor associated with repeated measures over time can be cost-prohibitive. Recent advances in handheld sensors that measure hyperspectral reflectance patterns of leaf tissue may serve as an affordable proxy for other types of phenotypic data, including elemental composition. Here, we ask if reflectance patterns of dried Chambourcin leaf tissue from an experimental grafting vineyard can predict the known elemental composition of those leaves. Using simple modeling strategies, we show that many elements like potassium and phosphorous can be explained by hyperspectral reflectance patterns (R^2 = 0.50 and 0.62, respectively). In a predictive framework, we show that the predicted concentration of macronutrients like potassium correlate with the true, known value (r = 0.68). We additionally show that even some micronutrients such as nickel can be predicted (r = 0.53) from hyperspectral reflectance. This work offers a promising approach to assess nutrient composition in the field. We next plan to test our models on independent vineyards to see if the predictions are reasonable given leaf age and time of season. Future work will continue to refine these models for higher quality prediction of more elements and extend to other forms of high-dimensional phenotypes.

Keywords: elemental composition, hyperspectral reflectance, statistical modelling, high-throughput phenotyping, Chambourcin.