# P23 – *Vitis vinifera* phenotyping by NIR spectroscopy and chemometrics

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## Abstract

The phenotype of any plant is an expression of its genotype that is influenced by interactions with the environmental context. Plant phenotyping is conventionally performed with sampling methods that are costly, labor-intensive, time-consuming, and destructive. In modern plant phenotyping, several non-destructive techniques have been developed with numerous advantages over the traditional ones. In this preliminary study, a multivariate analysis combined with near-infrared (NIR) spectroscopy was employed to classify grapevine leaves. We analyzed two commercially important varieties of table grape, namely Red Globe and Sugraone collected from vines of equal age. Both varieties were grown in the same vineyard (Southern Italy) and were subjected to the same field treatments, ensuring identical pedoclimatic conditions. After collection, the samples were left with the stem immersed in water for 1 hour before the NIR spectrometric analysis (wavenumber range of 4000–10,000 $cm^{-1}$). The acclimatization step was performed to compensate for different solar exposure since samples were collected over a large time frame. To achieve a full characterization of the whole leaf, six points on each leaf face (three on each side) were measured. Leaves of various ages (young, intermediate, and mature) from different grapevines were collected for each variety. The analysis showed a difference in the NIR spectra of the two leaves' faces. The spectra of the lower faces were selected to perform a discriminant analysis between the varieties since showed a better discrimination capacity. Several pre-treatment techniques including Standard Normal Variate (SNV) and smoothing were compared, aiming to eliminate unnecessary information in the spectra and amplify relevant variations. The following classification techniques were compared: Linear Discriminant Analysis (LDA), Classification and Regression Trees, k-Nearest Neighbors (K-NN), Support Vector Machines (SNV), and Random Forest. The best fit model on the test data set was obtained with an LDA based on a principal component analysis (PCA) selection of SNV pretreated NIR spectral data. The discrimination ability of the NIR technique could thus be used as a tool for fast variety recognition. In the ongoing analysis of different grape varieties growing in our experimental vineyards, we plan to further verify and improve the discriminating capacity of the technique. In the context of precision agriculture or digital farming, this work shows an example of how the application of chemometric methods could be effectively used tosupport agronomic decision making.

**Keywords:** leaf, *Vitis vinifera*, NIR.