Grape-HAND: a smart optical prototype for measuring grapes’ qualitative parameters

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**Abstract.** The possibility to control the ripening stage of the grapes directly in the field has become increasingly important, both to ensure high-quality raw materials and to assist winemakers in their decisions. Sustainability is another crucial factor to consider. Chemical analyzes, which are used in laboratories to evaluate qualitative parameters of grapes, require chemical reagents, as well as a significant amount of time and trained personnel. Optical analyzes, on the other hand, constitute a valid alternative. Nowadays, the majority of commercially available spectrophotometers are extremely expensive bench instruments that cannot be utilized for in-field measurements. For these reasons, research is focusing on ensuring that this type of optical analysis maintains its high performance using simplified, portable and easy-to-use tools.

Grape-HAND is a cost-effective visible/near-infrared prototype tested to quantify qualitative attributes of Chardonnay grapes using a combination of spectroscopic data and the building of predictive models. The optical acquisitions were acquired directly in the field using 12 wavelengths in the visible/NIR range: 450, 500, 550, 570, 600, 610, 650, 680, 730, 760, 810, and 860 nanometers. The qualitative parameters were predicted using a multivariate model through the Partial Least Square regression technique, which was developed using the real values of the parameters (total soluble solids, titratable acidity, and pH) as determined by the reference laboratory analyzes. Two harvest years were included in the sampling. The results showed that the optical prototype is capable of providing relevant information in order to support operators in rapid and objective decision making promoting a sustainable approach and viticulture 4.0.