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Development of in-situ methodologies for the assessment of table grapevine nutritional status

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Determining the concentration of macro- and micro-nutrients in plant tissues is a key step towards assessing the nutritional status of plants. This information, combined with soil chemical analysis, is usually used to define and modulate plant nutrition strategies.

Nowadays, modern agriculture is looking for fast analytical methods allowing in-situ analysis so that timely and precise (i.e., spatially defined) decisions can be made.

Considering the innovations in the field of spectroscopy, portable-X ray Fluorescence (pXRF) and handheld Laser-Induced Breakdown Spectroscopy (hLIBS) emerged as appealing and complementary tools for the determination of nutrient concentrations in plant tissues, being robust, simple, and portable, and thus suitable for the fast analysis of plants tissues directly in the field [1-2].

In this research, we are testing the use of pXRF and hLIBS to investigate the mineral nutrient content in table grapevine tissues (leaves, petioles, and canes) directly in the field.

Five table grape cultivars from Apulia region (Italy) were considered: Autumn Crisp, Carlita, Great Green, Italia, and Timco. Both fresh and dried plant tissues were analyzed using the pXRF and hLIBS. The macro-nutrients detected were Ca and K (by pXRF) and Ca, K, Mg, N, and P (by hLIBS). The micro-nutrients detected were Cu, Mn, Zn, and Fe (by pXRF), and Cu, Mn, B, Fe and Zn (by hLIBS). pXRF and hLIBS spectra of Timco grapevine leaves are reported in Figure 1.

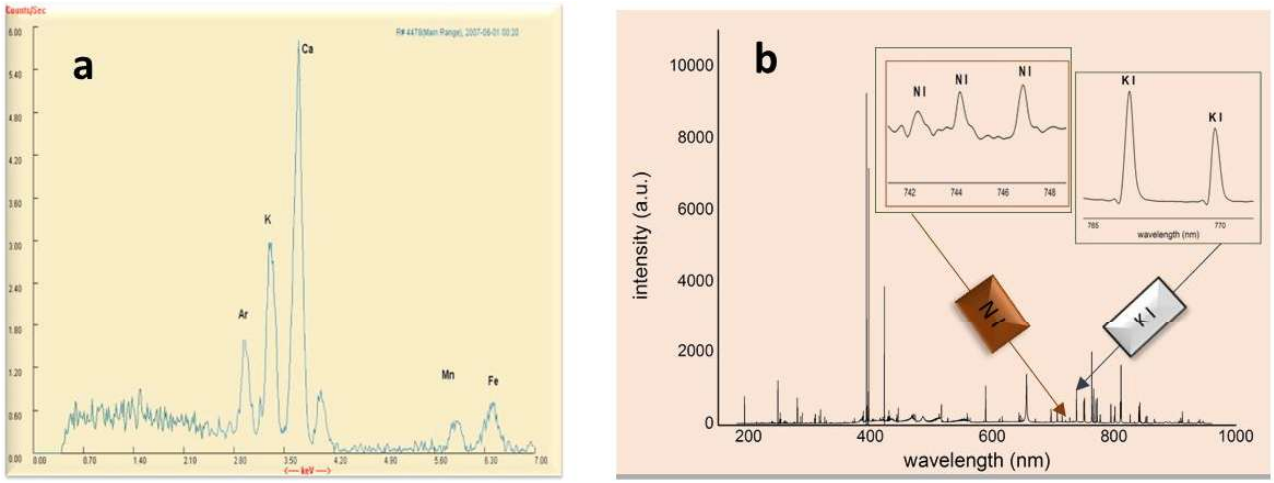

Figure 1: a) pXRF and b) hLIBS spectra of Timco grapevine leaves

The inductively coupled plasma - optical emission spectroscopy (ICP-OES) analysis after sample digestion and CHNS analyses were performed as reference analytical methods. Certified reference

materials were analyzed as well. Besides, micro-XRF analyses were performed in order to check the homogeneity of the spatial distribution of mineral nutrients in the vine tissues to be analysed.
Different simple sample preparation strategies, easily manageable in the field, have been tested, ranging from intact fresh vegetable material to powdered and pelletized dried samples.
The objective of this study is to overcome the many analytical challenges represented by field analyses (especially for fresh samples) in order to develop a method and a protocol allowing the use of pXRF and hLIBS for the rapid in-situ analysis of plant tissues for an efficient plant diagnosis.

Bibliography

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