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A farm-scale framework for assessing vineyard soil fertility and restoration practices

Emmanuelle Vaudour (1,2), Jean-Marc Gilliot (1,2), Léa Leclercq (1,2)

(1) AgroParisTech, ECOSYS, F-78850 THIVERVAL-GRIGNON, France (emmanuelle.vaudour@agroparistech.fr), (2) INRA, ECOSYS, F-78850 THIVERVAL-GRIGNON

The design of sustainable vineyard management is needed at varied scales and particularly at farm-scale. More and more winegrowers wish to adopt environmental-friendly practices while better controlling harvest composition. This leads to question complex issues with regard to sustainability of winegrowing agroecosystem and the adoption of new soil and vineyard management practices that are likely to favour a long-term preservation of quality production together with soil ecosystem functions. This study aims at elaborating a multivariate approach framework for vineyard soil fertility assessment over a 6 ha-farm planted with rainfed black Grenache and Syrah varieties in the Southern Rhone Valley.

In a previous study carried out at the regional scale, soil landscape and potential terroir units had been characterized. A new field survey comprising ∼20 soil pits, physico-chemical analyses for all soil profile horizons, and a series of additional soil surface samples analyzed for several parameters including soil organic carbon, calcium carbonate, copper and the major mineral nutrients, is here carried out. Along with soil parameters and soil surface condition, vine biological parameters including vigour, presence of diseases, stock-unearthing are collected. Very high resolution multispectral satellite data and resistivity EMI data are acquired and processed in order to characterize spatial variations in both physiological responses, soil surface conditions, soil depth and/or the presence of coarse elements. Multi-temporal historical aerial photographs are used in order to complement farmer's surveys regarding past management practices.

The farm is characterized by a diversity of soils including Red Mediterranean soils (chromic luvisols), colluvic calcisols, arenosols, fluvisols, and regosols, which develop from top to slope then bottom of a Neogene molassic and conglomeratic plateau. Soil management past practices are marked by the absence of chemical/organic manuring in the last decades, resulting in erosional features and weakened vines. Relationships between vine spatial variability, soil spatial variability and the impact of past practices are analyzed and result in formalizing decision rules. Several restoration scenarios are then proposed, that focus either on chemical fertilizer and/or organic amendment and/or interrow cover and/or agroforestry practices.