

Precision Viticulture: The Merging of an old Concept with New Technologies

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The concept of precision viticulture or precision agriculture in viticulture goes back to the late 90's [1]. Its main objective is to maximize the oenological potential of vineyards including: an appropriate management of the inherent variability of crops, an increase in economic benefits and a reduction of environmental impacts.

A high heterogeneity characterizes vineyards due to several factors such as pedo-morphological characteristics, seasonal weather conditions and cropping practices. This spatial variability in the vineyards leads to a variation in grape quality and yields ultimately leading to an overall reduction of wine quality and volume. In order to produce higher-quality products, vineyard management decisions ought to account for spatial variability. These decisions rely on the availability of accurate and reliable data describing spatial variability in relevant vine descriptors. Precision viticulture can offer some answers based on the sampling and the subsequent analysis of within-field variability.

Practical implementation of precision viticulture is linked to the development of certain technologies such as: Global Positioning Systems (GPS), differential GPS, Geographic Information Systems (GIS), crop sensors and yield monitors, local and remote sensors, Variable-Rate Technology (VRT) equipment and machinery and systems for data analysis and interpretation.

Managing the variability can be achieved by two approaches: the map based approach and the sensor-based approach. With available technologies of GPS, remote sensing, yield monitoring and soil sampling, the map-based approach is generally easier to implement which requires grid sampling of a field, performing laboratory analyzes of soil samples, generating a site specific map and using the map to control a variable-rate applicator. On the other hand, the sensor-based approach uses real-time sensors to measure the desired properties, such as soil conditions, water and nutrient availability, plant health and pathogen attacks.

Monitoring technologies for the acquisition of information within the vineyard are divided into 3 parts: the geolocation, the remote sensing, the proximal sensing and the variable-rate technology.

The geolocation or geo-referencing establishes the relationship between spatial information and its geographical position [2]. Nowadays, this process is done with Global Navigation Satellite Systems (GNSS) especially GPS. This type of technology is useful for crop mapping, soil sampling and distribution of fertilizers and pesticides.

Remote sensing techniques such as satellite, aircraft or Unmanned Aerial Vehicle (UAV) are focused mainly on reflectance spectroscopy using different wavelengths (visible region, near infrared and thermal infrared) [3]. They provide a description of the shape, the size and the vigor of grapevine and allow the assessment of variability within the vineyard. The data obtained from these techniques allows a description of the plant physiology by means of vegetation indexes calculation such as Leaf Area Index (LAI), chlorophyll content, photosynthetic active biomass and normalized difference vegetation index. Unfortunately, multispectral applications of the remote sensing technique may not

be affordable for average wine producers, who need to face major technical and economical adversities.

The proximal sensing or ground based monitoring systems have been developed in order to cope with the issues of remote sensing problems caused by vertical trellising. These systems are designed to be mounted on existing machinery allowing the acquisition of spatial information during the daily management of the vineyard.

Variable-Rate Technology (VRT) describes any technology enabling producers to vary the rate of their crop inputs. This technology combines a Variable-Rate (VR) control system with specific application equipment which applies inputs at a precise time and/or location achieving site-specific application rates. Examples of VR applications for viticulture include fertilizer, lime and pesticides.

Due to the great development of the cited technologies, the optimization of decision support systems makes the implantation of rapid intervention strategies possible. Consequently, this leads to a cost reduction in crop management, process traceability and environmental sustainability. However, the study of spatial variability has to be complemented by analysis of seasonal variation.

References

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