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Managing Grape Variability in Ohio

Ohio's state viticulturist who is based in Wooster, Imed Dami is an assistant professor in Horticulture & Crop Science.

The wine and grape juice industry are growing in the state of Ohio and are currently valued at more than $70 million and $10 million, respectively. Grape growers, like producers of any horticultural crop, are faced with challenges as they attempt to maximize production and thus profitability while producing a uniform product. Growers have long realized that even identical biological factors such as variety, clone, and rootstock in a vineyard produce grapes of varying maturity and wine quality.

Due to the lack of methods and tools that aid in identifying and quantifying variability, uniform management practices continue. However, information technologies and tools - such as global positioning systems (GPS), geographical information systems (GIS), remote sensing, and proximal soil sensing, having proved successful in managing variability in field crops - offer opportunities to acquire detailed geo-referenced information about vineyard performance to identify site-specific management strategies to optimize productivity in terms of both yield and quality.

Ohio grows more than 3,000 acres of grapes and boasts over 80 wineries.

OSU faculty **Imed Dami** (Horticulture & Crop Science), **Mohammad Ehsani** and **Barry Allred** (Food, Agricultural, and Biological Engineering) have teamed up to develop cost-effective data collection techniques for characterizing and managing variability in quality and yield of grapes in Ohio.

Assessment of yield variability is usually a first step in precision agriculture studies before contemplating further management action. Therefore, this project was initiated to address three objectives:

1. To quantify variability within vineyards.
2. To understand underlying causes by analyzing topography, soil, and plant parameters.
3. To explore the utility of airborne and proximal (groundbased) remote sensing as means of monitoring variability in vine canopies, both for quantifying variations in yield and quality attributes and for making segregated harvesting decisions.

A collaborator's vineyard was divided into a grid, and yield was collected for each grid section and mapped to have a quantitative assessment of yield variability. In order to understand the cause of yield variability, topographic, soil, and plant data were collected. Soil samples on a fine-scale grid were taken and analyzed along with moisture and electrical conductivity data. Remote sensing data was acquired through aerial imagery. In addition, data from GreenSeeker sensor, which is a proximal sensing device, was collected.

All of the data then was analyzed to find relationships between yield and quality. Decisions to divide the fields into two zones based on differences in grape-quality parameters were made and used to implement segregated harvesting with a view to harvesting uniform quality grapes.

A three-fold variation in grape yield in the study area of approximately 1.25 acres was observed, which was surprising for the grower. In general, an inverse relationship was observed between yield and grape quality, measured in terms of parameters such as sugar, pH, and acid content.

The field topography and major and minor nutrients were not found to be yield-limiting factors. Based on statistical regression analysis, clay content, organic matter, and pH were found to be strongly correlated with soil electrical conductivity values. Thus, electrical conductivity of soil can be described to be valuable in delineating within-field variable zones.

Aerial imagery and the GreenSeeker sensor provided useful information about crop canopy status and helped explain yield and quality variability without obtaining information on vine parameters across the whole vineyard. The grape quality map created by picking grapes from locations guided by remote sensor information led to the division of fields into high- and low-quality zones. The grapes from the low-quality zone were harvested a week later than the high-quality zone to ensure similar quality.

As the study field was divided into grids, a pattern of yield variation was observed. The high-yielding grids in the study field during the first year returned lower yields in the following year, helping the grower understand the importance of maintaining optimum fruit load on vines. Armed with the quantitative yield data, the grower had more confidence in making management decisions about replacing those vines that performed below expectations.

Continuing the study for a longer duration will help in establishing relationships between grape canopy vigor, yield, and quality parameters. This will enable scientists to study the impact of variable application of inputs (e.g., fertilizer, water, canopy management techniques, canopy training techniques, etc.) on outputs (i.e., grapes and wine) and provide growers with the confidence needed to make changes in their management decisions.

Photos by Ken Chamberlain. Web publishing by Victor van Buchem.
Published May 07 2007 - http://HCS.OSU.EDU