

Executive Summary - Research Progress Report

Site-specific Management Using Remote Sensing for Detection of Abiotic Stress in Grapes

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PROGRESS TO DATE: Ten varieties of wine grapes were propagated as soft wood cuttings during late spring, in the Michigan State University Research Greenhouses. Seven were selected for use in a series of experiments to examine: 1. changes in leaf reflectance due to water deficit stress between different wine grape varieties; 2. threshold of deficit-water stress detected, using changes in leaf reflectance in different wine grape varieties; 3. validity of leaf reflectance as a method for separating water-deficit from other abiotic stresses such as light.

Preliminary assessment of deficit-water stress cycles have been completed so that drying cycles will allow plants to reach only ca. 45% of field capacity. Three cycles of water-deficit will be imposed followed by 2 weeks of maintaining well-watered vine status to enable vine recovery. The first water-deficit cycle was initiated September 10, 2002. Subsequent water-deficit/recovery intervals have followed. In addition to full electromagnetic leaf reflectance measurements, the metabolic impact of water-deficit stress will be quantified by measuring net photosynthesis of the most recently, fully expanded leaves and their respective chlorophyll content. These data should give an indication of both the immediate ramifications of water-deficit conditions (i.e. net photosynthesis) as well as the intermediate influence on chlorophyll concentration and/or turnover (i.e., allocation of reserves to use as metabolic building blocks) and stress conditions that may enhance degradation of essential components in plant metabolism (i.e., chlorophyll). Integration of the impact on whole plant growth responses, internode length, leaf area, and dry weight will be measured after the last water-deficit cycle. Correlation analysis will be completed to examine the relationship between water stress, reduced vine growth and full spectrum leaf reflectance.

Remote sensing technology has the potential of providing real time information for targeting management inputs within the vineyard. Thus, use of these tools can substantially reduce whole vineyard inputs while optimizing fruit yield and quality, thereby providing decreased costs, thereby enhancing quality and profitability for the producer. Research is needed to determine how to optimize the use of the available tools (Geographic Information Systems/GIS, Global Positioning System/GPS, and digital image capture), identify additional tools, and determine the informational inputs which will provide the answers needed to advance SSCM to enable Michigan wine and juice grape growers to manage quality issues, while improving profitability. This work is testing an array of potential monitoring techniques to develop a method of stress response detection that requires minimal technical skill and handling, and is cost effective, particularly across the growing season and within individual vineyards.

PLANNED WORK FOR 2002-2003:

Work will continue to assemble full leaf reflectance curves and digital imagery of the specific grape plant stresses of deficit-water, nutrient availability and temperature under environmentally controlled conditions (greenhouse). Full spectrum leaf reflectance curves and multispectral imagery (digital) of these specific plant stresses will be compared between non-stressed plants (control plants) and plants with imposed stress to identify and quantify spectral differences directly attributable to deficit-water and nutrient stress. Correlate spectral differences with standard methods of measuring the impact of plant stress on growth (shoot dry weight accumulation, leaf number, internode length) and metabolism (photosynthetic rate, water potential, and petiole nutrient analysis) in grape. Leaf reflectance measurements from controlled environment conditions will be compared to in-field leaf reflectance measurements under varying environmental conditions of vineyard production systems in Michigan.