Sentek sensor technologies

TESTIMONIALS & CASE STUDIES

Measuring Soil Moisture To Improve Yield & Wine Quality

Why do we have to monitor soil moisture?

Why monitor soil moisture? The answer: There are a number of possible goals in vineyard irrigation management: to reduce, maintain or increase vine vigor, to prevent water stress in drought years or during critical vine development stages, to manage soil salinity, to attempt to target a high skin/juice ratio i.e. small berries or to attempt to alter fruit quality by influencing soluble solids, pH, colour etc.

To achieve a particular goal in vineyard management, it is essential to understand plant-water relations at different vine growth stages, effective root zone of the vines, climate, soil type, irrigation system and irrigation system performance and soil water management.

You can't manage what you can't measure and/or you don't understand! Soil moisture monitoring and the knowledge about vine plant-water relationships therefore become essential management tools to achieve these set goals.

Irrigation Management strategies (IMS)

An irrigation management strategy should include the timing and duration of irrigation during the growing season to meet an optimal yield/quality objective for a particular vineyard. Irrigation scheduling is the technique to fulfil the objectives of an irrigation management strategy.

A famous irrigation management strategy known as RDI (regulated deficit irrigation) aims at manipulating vine growth and wine quality. The aim of RDI is to maintain water stress within a desirable range so that the physiological reactions of the vine can be harnessed to the benefit of the vineyard.

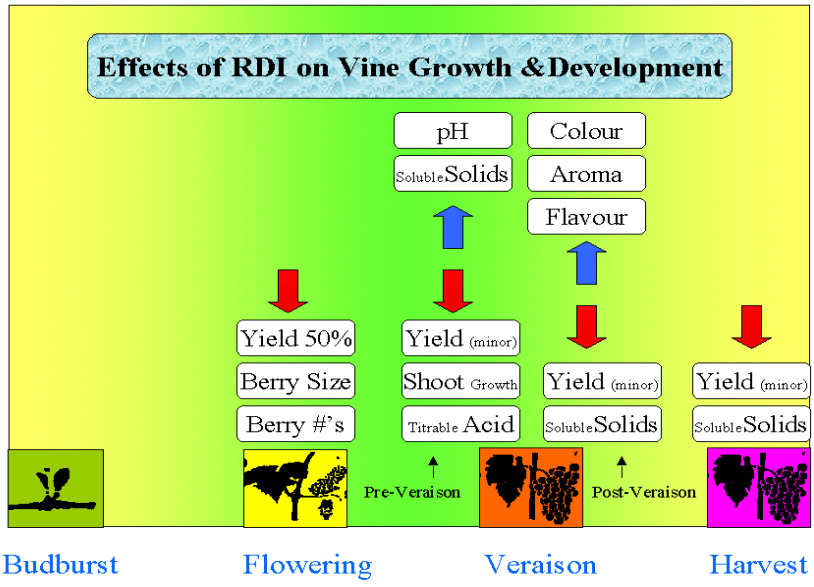

Figure 1:
Summary of the effects of regulated deficit irrigation (RDI) at specific stages of growth and development of a vine. (Drawn using data by Goodwin). A number of different RDI approaches are being used in commercial practice. Figures 2 and 3 show two examples of different RDI in vineyards using real-time soil water content measured with EnviroSCAN ® :

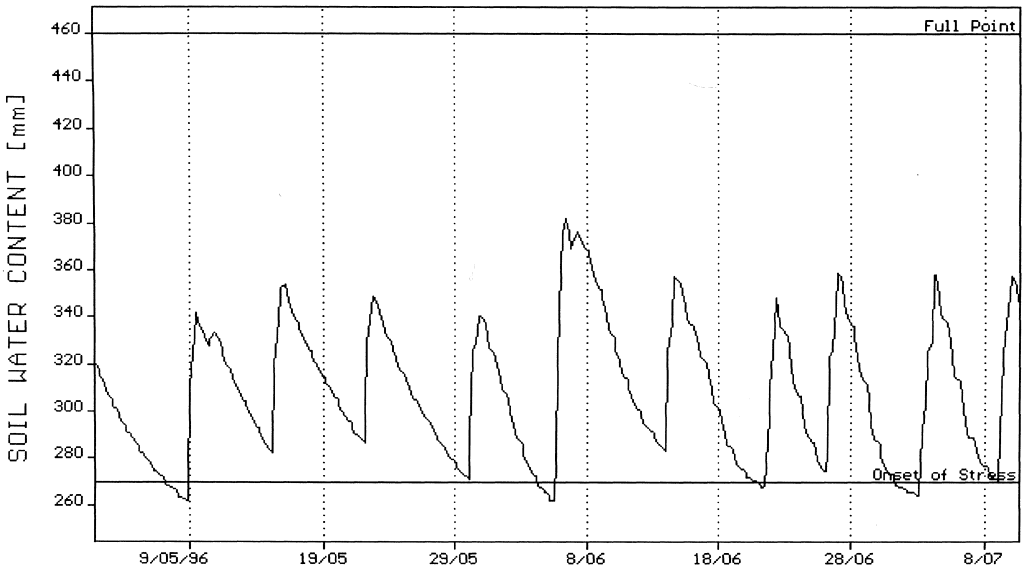

Figure 2:
EnviroSCAN graph of total water content in a 5ft. deep profile under Chardonnay grapes at Monterey Pacific Vineyards in Soledad, California. May 1 – July 10,1996.

Onset of stress is indicated by a flattening out of the graph showing water content. This pattern was maintained for the entire season. Vines were deficit irrigated for a total of 20 days during the season. Six tons/acre of excellent quality Chardonnay were harvested from this block (2).

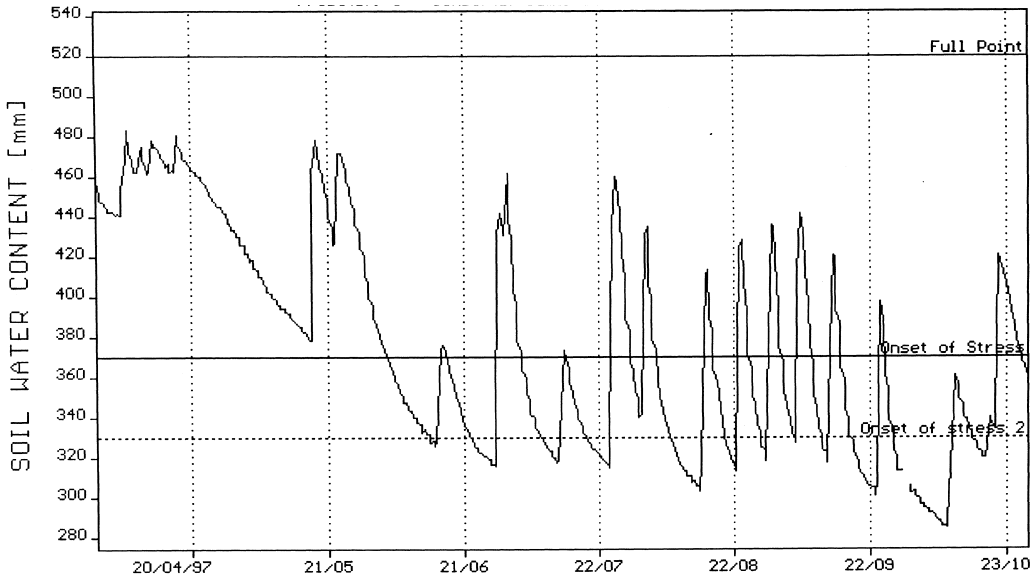

Figure 3:
EnviroSCAN graph of total water content in a 5 ft. deep profile Barbera grapes at Bonny Doon Vineyards in Gonzalez, California. April 6 –Oct26, 1997
The irrigation strategy pursued here was to deplete the profile just after bloom in order to provide some deficit during berry set, with the aim to reduce berry size. From berry sizing through veraison, the goal was to provide moderate water stress, which would taper off after veraison. Prior to harvest irrigations were suspended. Five tons of excellent quality Barbera grapes were harvested from this block. This yield was significantly higher than the previous year, when water deficits were much more severe for the entire season(2).

Soil Water Tension vs. Soil Water content to determine Vine Water Stress

To implement an IMS requires ideally monitoring physiological responses of a vine, such as leaf water potential, stomatal conductance or cell expansion. However, these techniques are not only difficult, expensive and time consuming, but they fail to measure the depth and distribution of vine roots, which are critical for good irrigation management.

Both soil moisture tension and total water content measurement have been used as indicators of plant water stress.

One disadvantage of using soil water tension is that both the non stress and the stress limits of soil water tension **vary with soil type, root-distribution, soil salinity and climatic conditions.** It is stated for example in a hot climate with vines growing in a light textured soil with a root depth of less than 0.5 m, the stress limit is approximately -100kPA suction; whereas in a cool climate with vines growing in a heavier textured clay loam with roots below 1.0 m depth, the stress limit is approximately -400kPA (1). In other words, stress limits are currently approximated. Tensiometers and Watermark ® sensors are only able to monitor soil water tension well below -400 kPa.

The above mentioned factors will limit the vine boundaries between water stress and non-stress. The question is how to identify water stress easier and accurately? Rather than using stand-alone infrequent soil water tension or soil water content data, a very successful approach is to combine real-time soil water content data into a dynamic soil-water trend-line, to reflect the vine's water uptake activity throughout the rootzone.

Real-time monitoring (every 10 minutes) of total soil water content with EnviroSCAN ® is now increasingly used to overcome this problem. The increasing reduction in daily water uptake by vine roots through developing water stress can be accurately traced as dynamic soil water content reductions in **any** soil type, over the **entire** soil water content range and at any potential soil depth. Multiple EnviroSCAN® sensors in a soil profile make it possible to identify a specific stress level, even at different root zone depths. The data can be used to identify the active root zone depth of the vine that is involved in water uptake (in the absence of water tables), a vital prerequisite to implement RDI – IMS.

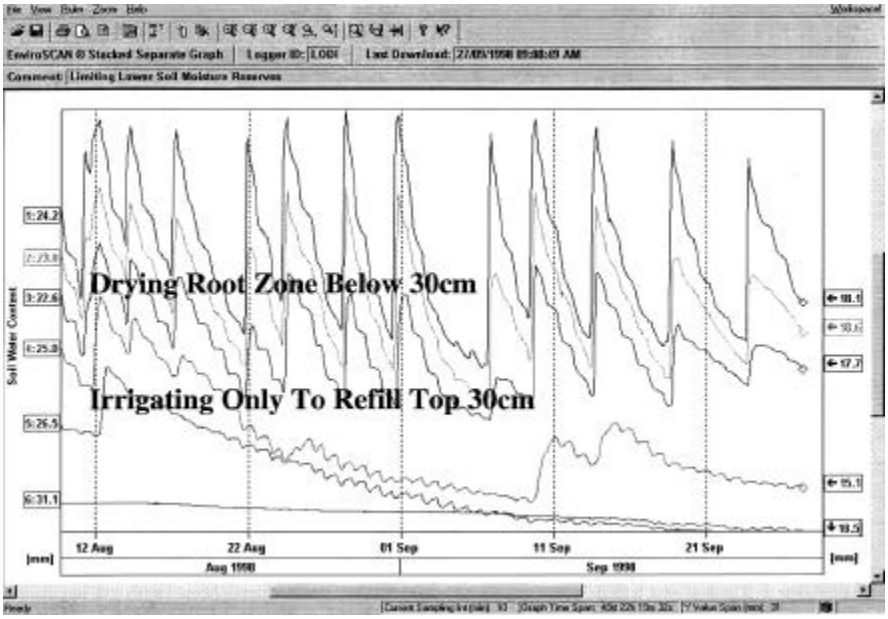

Figure 4:
In this example of RDI, irrigation is aiming at re-filling the top 30cm of the soil profile only, while roots at 50 cm and 80 cm (indicated by the bottom two soil water trend lines) are allowed to dry out after August 20. Water uptake at the 50cm and 80cm root zone depth is significantly reduced. Two irrigation events after September 11 replenish the soil water content at 50cm causing an increase of water uptake by roots at this depth level for a few days (trend within circle). Using real time data, vine water stress is achievable at will targeting not only the degree and the applied duration of vine water stress, but the extent of the root zone involved in water uptake.

Improvements in Sentek's Irrigation Management Tools

EnviroSCAN ® real-time soil moisture data to visualise the dynamic interaction of the soil-water-plant-atmosphere continuum has been used in commercial viticulture for almost 10 years now. Improvements which have been added to the EnviroSCAN ® management tool recently, include:

- Cable-free probes
- a flexible range of communication options for retrieving data remotely or in-field
- integrating soil moisture monitoring with weather data
- integrating soil moisture monitoring with automated irrigation controllers.

Figure 5:
RT6 EnviroSCAN ® with mobile telephone for remote data retrieval. A portable system using the same core technology as EnviroSCAN ® called Diviner 2000 ® has been added to Sentek's irrigation management tools. Diviner 2000® records the volumetric content of water in the soil every 10-cm using automatic depth recognition technology and data are displayed on the unit's LCD screen for instant irrigation management decision making in the field.

Figure 6:
Diviner 2000 ® portable soil water monitoring system

References:

1. Goodwin, I: Irrigation of vineyards. Institute of Sustainable Irrigated Agriculture, Tatura, Victoria, Australia. (1995).

2. Handley, D. : Irrigation Management of Premium Wine grapes with the EnviroSCAN Continuous Soil Moisture Monitoring System. Visalia, California 93292, 16359 Av. 320 USA. (Date of publication unknown).

3. Rosenzweig, B.: RDI- Observations of an irrigation scheduling consulting group. The Australian Grapegrower & Winemaker: (November 1997).

4. Wample,R.I.,Evans,R.G.,Leib,B.G.: Grapevine Irrigation Management- Considerations for Water Usage. Wine Business Monthly: (February 2000).