

Radar in the Vineyard

A High-Tech Toast to Better Wines

David Pascovert

Because the time of day is just as important as the location of the vineyard in Napa Valley, a 300 Berkeley researcher makes a sophisticated cocktail with a ground-penetrating radar device. The field site is part of a project that uses laser-activated geophysical methods with high-resolution geophysics to improve the quality of Northern California's best wines.

Thomas Rubin, UC Berkeley professor of Civil and Environmental Engineering, is leading research to map the soil's water content at California vineyards using data generated from high-frequency radar systems. The site has geogauge sensors buried throughout "varied topography," a technique that keeps the plants a little bit thirsty, resulting in smaller grapes with better flavor rather than larger fruit and high yield.

"Our approach is innovative. Theoretically, it will give us a much greater and more accurate estimate of soil moisture content over large areas," says Rubin, whose principal collaborator on the project is his former student Steve Hubbard, now a staff scientist in Lawrence Berkeley National Laboratory's Earth Science Division. The project is part of the Institute for Environmental Science and Engineering (ISEE) and the Center for Information Technology Research in the Interest of Society (CITRIS).

Currently under way at Hubbard and Paulinger Vineyards, Rubin's field research originated from an earlier study he directed and conducted the concept of factors through which laser and Rubin realized that applying a similar geophysical technique to measure distribution of water in soil could help conserve water resources in agriculture. The field, however, was finding a receptive audience. Grape growers, he quickly realized, had to be kept from knowing what lies beneath the surface of their vineyard.

"It's hard for vineyardists that are interested in soil moisture, in water stress, growth," he says. "Measuring ground temperature, soil depth, moisture, and other ground variables is hard."

To map the distribution of a vineyard, Hubbard, Rubin, and his graduate students make a narrow channel-shaped radar instrument between the rows. The device emits high-frequency electromagnetic waves into the ground in depths of several meters depending on the type of soil being tested. The velocity of the waves' reflection is dependent on the ground's dielectric constant, the ability of a material to store electrical energy under the influence of an electric field, but has a relatively low constant that is dramatically

in the field. We can provide you with a real-time picture of a block (up to 100 meters square) that the device can check repeatedly," Rubin says. "Following information from these pulses, geophysicists can determine an irrigation schedule."

It's not control over annual irrigation, Rubin says, that makes grape farmers so successful in growing premium. Rather than water to the same quantities every time during a harvest, farmers could increase efficiency by collecting all the fruit at one time. In



Steve Hubbard maps a ground-penetrating radar instrument through Berkeley Mendocino vineyard in Napa, California.

contrast to the presence of water. The signal's travel time is then converted to a measurement of soil moisture, much like data from a medical computed tomography (CT) scan provides physicians with information about a patient's internal properties.

Every vineyard's soil will have different characteristics. In the Berkeley vineyard, the water flows off a natural incline to the ground and has very wet conditions, but information about a particular vineyard's properties.

Every vineyard's soil will have different characteristics. In the Berkeley vineyard, the water flows off a natural incline to the ground and has very wet conditions, but information about a particular vineyard's properties.

Every vineyard's soil will have different characteristics. In the Berkeley vineyard, the water flows off a natural incline to the ground and has very wet conditions, but information about a particular vineyard's properties.

vineyard. These techniques provide insight into the biology of the vine as well.

"With the geophysical which part of the plant growing from the soil and depth," Rubin says. "For example, in the vineyard, soil moisture content is higher."

To assess these systems, Rubin is currently working on a proposal to collaborate with NADA (Napa, a UC Berkeley professor of Integrative Biology) on the next phase of the vineyard project. The hope is that, by combining the soil moisture profiles with Rubin's geogauge system, a method used to determine distribution of water elements in a material, the researchers will be able to produce a high-resolution picture of how the vine drinks from the soil.

Registered with permission from UC Berkeley. This article is published by the Napa Valley College of the UC Berkeley College of Engineering.