

True Precision Farming

Through a unique array of GIS solutions and spatial information products, Terra Spase's Paul Skinner shows clients how to better integrate and understand their vineyard variables.

Paul Franson

THOUGH HE IS little known to wine buyers and consumers, **Paul Skinner** is one of the most influential presences in Napa Valley and indeed in the world of wine. The president of **Terra Spase** has helped innumerable growers and wineries decide what vines to plant where. In the process, he has also become a virtual one-person research department, collecting, compiling and publishing diverse data to make it accessible and useful to the industry.

Skinner's most recent contribution is *Weather and Wine Grapes in the Napa Valley AVA*, the first comprehensive report on the weather of the Napa Valley and its influence on wine grape production (see "Weather and Wine Grapes in the Napa Valley AVA," p. 68).

This report follows his *Soils and Wine Grapes in the Napa Valley AVA* published in 2003. Together, the two reports provide the most detailed information on growing conditions in Napa Valley, a compact viticultural region that has some of the most diverse weather and soil conditions of any comparable area in the world.

"Napa Valley is extremely diverse for a small area," said Skinner. "It has six of the 12 orders of soil found worldwide, for example."

He admitted, however, that he is not interested in publishing the next logical report telling growers what to plant and where. "We stop at the appellation level," he said. "The bread and butter of our business is helping growers choose the right rootstocks and vines for their area."

A GROWING DEMAND

Skinner, a soil scientist with a Ph.D. from University of California, Davis, noted that growing grapes today is more challenging than it has ever been.

"Today's grape varieties and rootstocks demand more intensive management of irrigation and canopies than the forgiving AxR and St. George of the past," he said. "You can make high-quality wines from a variety of sites, but it's important to get the rootstock, the clone, the trellising and the irrigation right."

He also noted that growers are planting varieties in places once considered unsuitable, and this complicates their lives. "Many growers are pushing the envelope of where grapes thrive. That makes vintages more important," he said. But, he warned, "It's also risky behavior."

Skinner formed Terra Spase in 1994 to offer GIS consulting services to vineyard owners and wineries. His spatial information products include in-house tools and services that combine soil, weather, vine and wine data with statistical analysis, forecasting and mapping tools.

He grew into the business naturally. Skinner grew up in rural Southern Ohio, where he recalls swinging on the native riparian grapevines now used as components of rootstocks. Originally going to college on a football scholarship, he transferred to the University of Wisconsin, where he earned his bachelor's degree in soils and subsequently worked in agriculture.

He had a stint in the Peace Corps in Nicaragua, then returned to the U.S. as a soil consultant with the USDA in Wisconsin. He then joined the Forest Service, mapping soils north of Green Bay where he was forced to learn the art of navigation. "It was a strange, random topology, the result of glaciers. We used to carry around aerial maps so we wouldn't get lost."

Skinner then got his master's in agronomy from Colorado State and worked in Wyoming mapping weed distribution across the Great Plains. In the process, he used a lot of remote sensing, including satellite imaging.

Moving to Davis, California, he enrolled at UC Davis, where Professor **Jim Cook** was looking for a Ph.D. candidate to study phosphorus distribution in vineyards. It was a subject that had not previously received much attention, though now it is recognized

as critical to grape growing. Skinner's studies focused on phosphorus, including publishing four papers on the subject.

While at Davis, he met many veterans of World War II who had received their Ph.D.s, then went out into the field. "They spent a lot of time with wineries and tried to solve their problems," said Skinner. "I received a lot of insight into how they worked with industry. They were doing applied



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research, not the basic research UC Davis focuses on now.”

Based on his experience, Skinner formed **Vineyard Investigations** and became an independent consultant in 1987. “I saw what the data indicated and how it affected crops. I was more interested in that than academia.”

He used the next six years to build a business and become established, and in 1994 he saw the opportunity to create a business that involved more than just selling his time. He founded Terra Spase and started hiring people, initially creating a weather network in Napa and Sonoma counties.

Using that as a base, he then began intense soil studies, in the process developing Geographic Information Systems (GIS) software that could put data into easily understood maps rather than tables of numbers. “We could use this GIS to develop soil maps and tie them to a place with GPS (Global Positioning Satellites).”

He rolled this out in 1994 then participated in CRUSH, a **NASA** project that uses aerial imagery taken from an airplane to map vineyards. He still par-

ticipates in the program every year. “We’ve even started to use satellite imagery in the Central Valley where things are bigger,” he noted.

More recently, he has used his weather-monitoring infrastructure to help growers manage irrigation. Beyond soil moisture and leaf water status, he is experimenting with real-time sensing of water in a vine. “It may seem far out, but 18 years ago, pressure bombs were only used in the university,” he said. “Now they’re used in production vineyards.”

Skinner is also working with **John Deere** on a new method of soil sampling using core sampling that wouldn’t require digging trenches. “A corer produces different measurements, so we have to correlate it with our present knowledge.”

Currently, Skinner spends much of his time looking at vineyards, including telling growers what they should be doing in the next few weeks. His staff handles the weather network and soil and moisture readings. Not surprisingly for a pioneer in this area, he has filed patents on some of his developments and one has been approved.

A VARIED LOOK AT GROWING

Skinner finds some of his consulting in the Central Valley especially challenging but rewarding.

“People in Napa Valley rarely set foot outside the valley,” he noted, “but they’d be surprised at what growers in other regions are doing. Working with others really broadens my understanding.”

He noted that **E&J Gallo**, with 12,000 acres of vines, is making great strides toward improving its viticulture. “They process 1,000 tons per night, and everything has to be top-notch,” he said. “Some of these Central Valley growers farm large acreages and do it very well.”

Still, Skinner feels his biggest challenge is to help small wineries consistently produce high-end wines. Clients include **Pride**, **Pahlmeyer**, **Hanzell** and **Chimney Rock**, all noted for excellent wines.

“Soil conditions differ, but we have to balance the vines so they’re not too vegetative.” This is especially related to the trellis systems used. “Small trellises and vertical positioning are more vegetative,” he noted. But he contends that if a grower puts all the pieces together properly, they can produce high-

quality wines from closely spaced vineyards. He believes there is an optimum production for a given acre, whether the vines are closely spaced or farther apart.

Skinner noted, however, that big vines are more appropriate for rich soils, not the stylish small vines copied from Bordeaux, with its completely different conditions. “With Bordeaux varieties planted in Napa, it is important to match the rootstocks then carefully manage growth.”

Fortunately, local growers have done a lot of research, especially since **Phylloxera** mandated replanting. “There’s a willingness of growers to do research on their own. That’s why there’s so much diversity here. It’s not what you typically find overseas.”

He feels that the ultimate solutions for producing quality grapes in Napa Valley haven’t emerged yet. “We don’t know what is best,” he said.

What he has found, however, is that choosing rootstocks and scions based on data, not just a feeling, works.

WHAT TERRA SPASE OFFERS

Terra Spase offers a variety of services related to soil and weather, including soil analysis and mapping.

As is well known to any grower, surface and subsurface soils are very diverse, particularly in hilly coastal areas such as the Napa Valley. Terra Spase combines its experience mapping soils with its proprietary soil mapping program, **Terroir**, to clarify this variability.

The company’s staff of soil scientists sample and map soil variability in specific vineyards and can link them to weather, remote sensing and wine analytical data.

Terra Spase also specializes in local weather. It is the sole authorized **Adcon Telemetry** representative in Napa and Sonoma counties, and offers a wide range of weather monitoring services, including sales, installation, support and network administration.

Remote, wireless weather stations collect temperature, relative humidity, precipitation, leaf moisture and solar radiation data at specific sites and transmit this information via radio to a central base station and computer every 15 minutes. Users can download this data over the Internet using **Adcon’s** software, which summarizes the data and allows it to be viewed and manipulated by the end-user.

One feature is its ability to forecast risk for vine diseases such as powdery mildew, **Botrytis** and downy mildew.

In addition, Terra Spase sells the **Vincula** winery spatial information system, which extends graphical data management systems from the vineyard into the winery. It integrates winery spatial data management, statistical analysis and communication software tools to provide global tracking of wine characteristics from the vineyard to the bottle. The data can be analyzed statistically to determine the factors that are correlated with specific wine characteristics (i.e., pH, color, phenolics, N status). **Vincula** was developed with **ETS Laboratories** of St. Helena.

Finally, Terra Spase can help users obtain and combine aerial photography and remotely sensed imagery with GIS data of a vineyard site. This photography and imagery can help record vine-growth conditions, soil moisture status and stress levels for any period of time during the growing season.

The company’s archives include color infrared, radar and thermal imagery, and the complete set of three-meter-resolution **ADAR** images collected in the **NASA GRAPES** project in 1995.

MAKING WINE

With his knowledge of viticulture, it’s not surprising that Skinner has taken the plunge into making wine. He has been making wine since 1998, currently at **Pride Mountain Vineyards**. This fall he is releasing the first commercial production, a 2001 Zinfandel from two acres on **Kidd Ranch** in St. Helena.

He calls his wine “**Sequum**,” a geological term for a vertical sequence of soil layers that define the hydric regime and nutrient status of the grapevine. He will ultimately have a variety of wines, each with their soil profile pictured on the label. In 2003 Skinner made a Dry Creek Zinfandel and a Cabernet Sauvignon from four different vineyards. “It’s a soil mélange,” he said.

The wines will undoubtedly be in demand from the knowledgeable, if for no other reason than to see if “**Doctor Dirt**” can produce what he promises. Few would expect them to be anything but superb. **wbm**

Paul Franson writes from St. Helena, California, about wine and business.

Weather and Wine Grapes in the Napa Valley AVA: An Excerpt

Weather and Wine Grapes in the Napa Valley AVA provides a detailed description of the area's 14 different appellations and the weather that has occurred within the Napa Valley AVA from 1996 to 2002. The report includes individual color maps of maximum and minimum temperature, precipitation, growing degree-days and disease risk for the entire Napa Valley AVA. It also includes growing degree-day maps for each appellation.

The study combines weather data on the growing, harvest and dormant seasons, with information on grapevine growth and production for different wine grape varieties grown in Napa Valley. The report will help readers (1) understand vineyard sites, varietal potential and vintage variations, (2) adjust vineyard production, irrigation and pest management programs to achieve goals, and (3) evaluate harvest scheduling plans and vineyard quality potential for winegrape pricing and purchasing agreements. Overall, it's designed to help vintners market wines produced from the unique terroirs of the Napa Valley AVA.

This excerpt details the meso-climate of Oak Knoll District, one of the 14 appellations within the Napa Valley AVA.

OAK KNOLL DISTRICT

Situated at the southern end of the Napa Valley and influenced by the proximity of the San Pablo Bay's cooling fog and afternoon breezes, the Oak Knoll District contains vineyards of both early and late ripening varieties. Early ripening Chardonnay and Pinot Noir vineyards are consistently of high quality while the quality of the later ripening Merlot and Cabernet Sauvignon vineyards is more dependent on the growing season weather from season to season. As shown in the data, the weather can vary considerably from year to year within the Napa Valley AVA's Oak Knoll District.

RAINFALL

In the Oak Knoll District, annual rainfall ranged from as low as 15 inches in 2000-2001, to 65 inches in 1997-1998.

Average seasonal rainfall was approximately 36 inches. Average seasonal variability within the region was approximately 11 inches.

MEAN SPRINGTIME MIN/MAX TEMPERATURES

Oak Knoll temperatures in the early growing season are within a range that usually supports healthy shoot and leaf growth prior to flowering or bloom time in most seasons. Mean springtime minimum temperatures ranged from 40°F in 1999 and 2002 to 47°F in 1997, with variability within the region averaging approximately 3°F. Extended periods of time with temperatures below 50°F in the spring can have a negative impact on both growth and flowering, especially in the early-season varieties.

Mean springtime maximum temperatures ranged from 67°F in 1998 to 80°F in 1997, with variability within the region averaging approximately 4°F. Mean maximum temperatures above 70°F are least likely to have an effect on early-season vine growth and flowering. Four out of seven years in the time period studied had mean springtime temperatures above 70°F.

FROST

The Oak Knoll District is subject to damaging, early-season frost events, requiring growers to use frost-control measures, particularly in low-lying areas at the base of the western hill slopes and along the streams and drainage ways leading to the Napa River.

MEAN SPRINGTIME RELATIVE HUMIDITY

Springtime relative humidity ranged from an average of 62 percent in 1997 to an average of 82 percent in 1998, with variability within the region averaging approximately 7 percent. The cooler seasons of 1998 and 2002 appear to be associated with higher springtime relative humidity than do the warmer seasons

of 1997 and 2001. Higher relative humidity may be associated with lower water use and increased disease risk during springtime growing conditions.

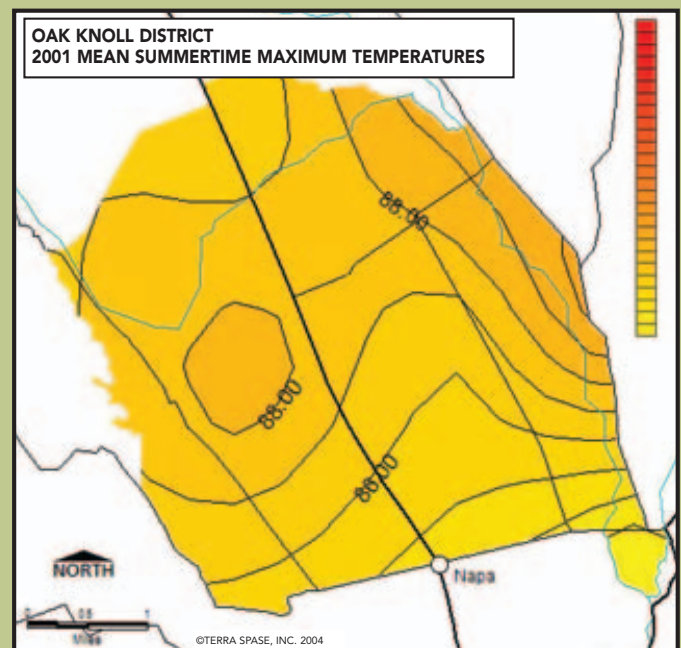
SPRINGTIME DISEASE RISK—POWDERY MILDEW AND BOTRYTIS

The Oak Knoll District normally experiences moderate to high powdery mildew pressure in the spring due to its average temperature profile, higher relative humidity and the varieties that are being grown.

However, springtime powdery mildew pressure can be considerably reduced in cooler years, such as in 1998, when the average springtime mildew index was only 10-20.

MEAN SUMMERTIME MIN/MAX TEMPERATURES

The mean maximum and minimum summertime temperatures in the Oak Knoll District are very important to determining when the vines will ripen their crop. Lower than average temperatures at this time could delay harvest of the early-ripening varieties into mid- to late-September, while later-ripening Cabernet and Merlot could be pushed into mid- to late-October. Depending on other weather factors, particularly precipitation, a longer, slower ripening could produce exceptional quality grapes in the major varieties grown in Oak Knoll.



Mean summertime minimum temperatures ranged from 48°F in 1996, 2000 and 2001 to 54°F in 1997, with variability within the region averaging approximately 4°F. Mean summertime maximum temperatures ranged from 82°F in 2000 to 92°F in 1996 and 1999, with variability within the region averaging approximately 5°F.

MEAN SUMMERTIME RELATIVE HUMIDITY

Summertime relative humidity in the Oak Knoll District is influenced by the depth and extent of the marine layer from the San Pablo Bay and can have important effects on vine irrigation requirements as well as disease risk within the appellation. A prolonged increase in relative humidity could reduce vine water requirements on some rootstocks, and may increase the disease risk in varieties with tight clusters and dense canopies, such as Chardonnay.

The average summertime relative humidity ranged from 62 percent in 2001 and 2002 to 76 percent in 1998, with variability within the region averaging approximately 8 percent.

MARINE LAYER AND WIND

Vineyards within the appellation are influenced by the marine layer on almost a daily basis in the summer months.

SUMMERTIME DISEASE RISK—POWDERY MILDEW

Summertime powdery mildew pressure is generally high in the Oak Knoll District, with the powdery mildew risk index ranging from 60-90 in 1997 to 60-70 in 1998. This can be particularly significant for vineyards of susceptible varieties that have dense and sprawling canopies.

The district can also, however, experience periods of low powdery mildew pressure brought on by very high (>95°F) summertime temperatures.

DEGREE DAYS/HEAT SUMMATIONS

Growing degree day accumulations ranged from 3100 in 1998 and 1999 to 4000 in 1997.

According to Winkler's research, the Oak Knoll District falls largely within Region 3, rising as high as Region 4 in the warmest years.

MEAN JULY TEMPERATURES

The average July temperatures ranged from 65°F in 2001 and 2002 to 70°F in 1997, 1998 and 2002. Variability within the region averaged approximately 3°F.

MEAN RIPENING (SEPT. & OCT.) TEMPERATURES

Mean September temperatures ranged from 62°F in 2001 to 70°F in 1997. Average variability within the region was approximately 3°F. In most years, the mean temperature in September is slightly lower but close to the 68-70°F that Gladstones reports as being optimum for ripening most grape varieties.

Mean October temperatures ranged from 57°F in 1998 and 2002, to 63°F in 2001. Average variability within the region was approximately 3°F. The difference between September and October indicates how quickly the southern end of the Napa Valley cools off in the fall and how important this can be to the finished ripening of the grapes grown within the appellation. Later ripening varieties may require considerable hang-time in order to achieve maximum desirable ripeness levels.

For more information about Terra Spase reports (*Weather and Wine Grapes in the Napa Valley AVA*, 183 pages, 93 original color weather maps and images, \$295, or *Soils and Wine Grapes in the Napa Valley AVA*, 233 pages, 137 original color soil maps and images, \$495), contact Terra Spase at 707-967-8325 or email terraSpase@earthlink.net (www.terraspace.com). **wbm**