Soil and Site Selection Considerations for Wine Grape Vineyards

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Terroir is a fuzzy French word that, despite its lack of a clear definition, finds itself at the center of any effort to define wine quality. As defined by French geologist Yves Herody, terroir refers to those elements that interact to produce the liquid that ends up in your glass. The elements include soil, climate, plant and man. Each has its own particular influence on wine quality, and the relative significance may vary from one vintage to the next. Finding the right balance of each one of these important terroir components is the ultimate achievement in wine growing. That perfect balance can be recognized and understood in some very familiar names, such as Romanee-Conti, Lafite-Rothschild, Wehlener Sonnenuhr, Tignanello, To-Kalon and other prized vineyards around the world. Here, an ethereal balance of nature and man result in sublime wines that capture the imaginations of wine lovers everywhere and set standards that all wine growers seek to achieve.

Outside of France, and particularly in the New World, the contribution of soil to wine character has been largely ignored prior to the 1990s. Climate was thought to be of overriding importance in determining wine quality. Even the French, with their illustrious viniculture history, have had to reevaluate the importance of its soils to the uniqueness of her wines, having stripped away much of its character through the overuse of chemical fertilizers and pesticides after WWII. Now, soil quality is consider paramount in the production of fine wines.

When we think of ideal vineyard soils, we must analyze them in their full context – physical, chemical and biological properties. Again, the correct balance of these constituent parts is sought to best accommodate the plant and climate as well as the applied viticulture. Other considerations, such as slope, aspect, and elevation have indirect effects on soil relative to its impact on vine physiology. What is underfoot is an incredibly complex system that we sense is critical to wine quality, yet we don't fully understand how or why.

Site selection is the single most crucial decision to you will make as a wine grower - odd, perhaps, since you have not yet planted a vine or squished a single berry. Once this decision is made, terroir realities can be determined through years, if not decades, of winemaking, and only then can excellent terroir be proclaimed. The best vineyard site is not necessarily the place with the best view, or the most expensive land, or the one closest to the local tavern. It's the one that has the best combination of an infinite set of variables that intertwine to produce a great bottle of wine. Site selection is a process, not a "this is the place" moment. It involves careful study of records, discussion with neighbors, digging holes, soil tests, conversations with consultants and a lot of walking around and scratching your head. The final act of committing to a site is an act of faith.

For many years, soil chemistry was considered the most important part of the soil portfolio. Mainly, growers were trying to maximize yields so nitrogen content was very essential to productivity. For growing fine wine, however, the formula has changed. Now, wine growers look for moderately fertile soils that do not promote an overly vigorous vine. Its no surprise that grapevines can often be found on ground that farmers deemed unsuitable for any other crop. Vines are tenacious plants and their roots will spread far and deep in search for water and nutrients. For this reason, they often do not require very much in the way of additional nutrients, except on the most inhospitable sites. The addition of inorganic chemicals has been the primary postwar method of ameliorating the soil. Essential macronutrients include nitrogen, phosphorus, potassium, calcium, magnesium and sulfur. Micronutrients include iron, zinc, manganese, copper, boron, molybdenum and chlorine. Of these, N, P, K, Ca, Mg, Fe, Zn, and B are most often implicated in nutrient imbalance situations. All of these elements have important roles in vine metabolic functions and need to have minimum levels maintained. Some, such as boron and nitrogen, can also cause toxicity problems for vines. Too much N, in non-toxic amounts, can exacerbate canopy management problems. A soil test by a reputable lab is part of the standard site evaluation protocol. Remember, a test is only a set of numbers. The true value is in the proper interpretation of these results. For this, it is suggested that a vineyard soils expert be consulted. Amendments to the soil should be made prior to planting. Other soil variables include soil pH and cation exchange capacity. These have an influence on nutrient availability to the roots. Recently, composting, compost teas, biodynamic preparations and other organic materials have been used to improve soil chemistry.

The soil food web is relatively new to the viticulture lexicon. It refers to the great diversity of biological life that exists in the soil medium. This myriad of organisms are often present in astonishing numbers (one shovel full of soil may contain as many microorganisms as there are people on earth), and range in size from the tiniest single celled bacteria to small vertebrates (gophers, etc.) and everything in between such as algae, fungi, protozoa, arthropods, nematodes, earthworms, insects and more. Each of these organisms has its own important function in the web and all are food for each other. Actinomycetes help to decompose organic matter. Fungi and bacteria create compounds that help to bind soil particles. Nematodes are involved in nutrient cycling. Soil arthropods help to shred dead plant materials, greatly enhancing decomposition. Earthworms mix and aggregate soil particles and stimulate microbial activity. We are only now beginning to understand how this complex world impacts plant life and how it might influence wine quality. There are laboratories that will analyze you soil for types and amounts of key organisms and make recommendations for treatment. Most of the evidence for any benefit from applying food web products is anecdotal. Grape growers should be attentive to this underground world and employ practices that enhance and preserve the food web. Reducing chemical inputs, aerating soils, reducing soil compaction, improving soil drainage, adding compost when needed are all practices that can contribute to the sustainability of the subterranean life. Some of the organisms that live in the soil, such as nematodes, grape phylloxera, grape rootborer and various bacteria and fungi, maybe harmful to vines. These should all be evaluated and treated before planting.

Soil physical properties are important to wine quality. However, as with chemistry and the food web, these attributes can vary dramatically, yet still contribute to fine wine production. Consider the wines in Napa Valley, where great Cabernet Sauvignon is grown both on the deep bale loams of the valley floor and the shallow, rocky soils on the hills above the valley. Even soils as varied as these have common features that make them suitable for making great wine. The common

denominator among all great vineyard sites is that they are well drained. They strike a balance between adequate depth, good drainage and water holding capacity so the vine will not suffer too much in summer, yet the soils will drain amply if late season rains afflict the ripening period. Soil types that provide these features are all over the map – literally and figuratively – from the clays of Pomerol to the calcareous soils of Burgundy and schists of the Mosel. Soil texture and structure, while closely related, describe different physical properties. Texture is the way a soil feels in your hands – like fine, gritty or coarse. Structure is the way particles are stuck together, described as platy, blocky or granular. The space between these particles is also important. Adequate aeration is vital to the food web and root function. In evaluating a potential vineyard soil, soil pits are necessary to determine the physical nature of the soil at effective rooting depth – texture, structure, as well as chemistry and biology should be analyzed. Again, there is no substitute for an experienced eye and hand to complement the lab results.

Soil surface characteristics are also an important consideration. The reflective and re-radiation effects of the soil is an important part of the quality equation, especially in cooler growing regions where every heat unity is needed to fully ripen the grapes. Cover crops will also have an effect on soils, both their drainage capacity as well as fertility. The use of herbicides and other chemicals will affect soils, especially over long periods as they build up. A soil should be analyzed with its history in mind as well. If it was a pasture, years of manure have added to its fertility. If it was a reputable peach orchard, perhaps it is particularly well suited to be a vineyard.

So what is the ideal vineyard soil? The only sure way to truly find out is to plant vines and make wine. Short of that, use every tool at your disposal to predict the performance of your soil. You should first determine your wine making goals. If the best possible wine is the main objective, then you are looking for a well drained soil of moderate fertility, adequate depth that will grow a small to medium size vine. While a balanced vine is always the viticultural goal, it is commonly recognized that smaller vines on higher density spacing tend to produce the best wines. If the goal is high production and moderate quality, then deep, rich, fertile soils are appropriate. Soil vigor will impact many other pre-plant decisions such as variety, clone and rootstock selection, vine spacing, trellis system, irrigation and more and all of these will determine the costs of vineyard development.

You have one shot at the right soil. If you are in Napa or Bordeaux, you can look over the fence or across the road and see what your neighbor's vines are doing. If you are in New England, you have to use a crystal ball and any information you can develop on your own to make the best educated decision possible to validate a site for wine grapes. As part of this process, you may wish to include the following resources, which I referenced for this presentation:

1. Terroir. James E. Wilson. 1998. The University of California Press.
2. Viticulture and Environment. John Gladstones. 1992. Winetitles.
3. Viticulture: Vol 2. Practices. B.G Coombes and P.R. Dry. Winetitles
4. Soil Biology Primer. Soil and Water Conservation Society. 2000. NRCS.

Consultants

1. Todd Mason. Soil and Viticulture Consultant. Ontario, CAN. 905 332-8480
2. Lucie Morton. Viticulture Consultant. Virginia. 540.347.5262

3. Alex Blacburn. Soil Scientist. Loudon County, VA. 540 955-2687
4. Paul Skinner. Terra Spase. Napa Valley. 707-967-8323 x12
5. Kinsey Agricultural Services - http://www.kinseyag.com/

Soil Analysis Labs

1. Penn State Agricultural Analysis Services Lab - http://www.aasl.psu.edu/
2. Brookside Laboratories, Inc. - http://www.blinc.com/
3. A and L Eastern Laboratories, Inc. - http://www.al-labs-eastern.com/

Web Sites

1. BBC Laboratories, Inc. - http://www.bbclabs.com/
2. Soil Food Web Inc. - http://www.soilfoodweb.com/sfi_html/index.html