Background

HEALTHY SOIL is the foundation of a sustainable vineyard. A third of the grapevine lives underground in the form of roots. Leaves feed the vines sugar, but the roots feed everything else. The soil provides the roots with three vital resources: water, nutrients and air. These resources are best provided by soil with good structure and a vibrant population of microbes and worms that help form important soil aggregates by slowly decomposing organic matter. While no product or technique has been developed that can mimic or accelerate this soil-building process by microbes and worms, there are a number of ways that soil can be damaged in a short period of time. Improper or excessive tillage, compaction and lack of organic matter turnover all reduce the quality of the soil and the ability of the roots to get the air, water and nutrients needed to fight diseases, cope with soil pests and overcome other stresses.

Growers can take advantage of natural soil processes to improve vine health while allowing roots better access to nutrients. This translates into a reduced need for increasingly expensive fertilizers in the field. One way to utilize nature is through the use of cover crops, which, among other benefits, increases the turnover of organic matter, can add important nutrients, and generally enhances the health of the soil. Awareness of this soil-enrichment cycle helps growers make better-informed decisions about fertilizers and soil amendments. Because cover crops can compete with vine growth, it is important to determine that the cover crop or cover crop mix is appropriate for the region and is likely to produce the desired effects according to individual vineyard characteristics.

The same proactive approach is needed when considering soil quality. Since the cycle time for soil testing is so long, a method of recording test results is important for tracking the historic soil quality of the vineyard. 76% of the growers sample on 5-year cycles if under-going a soil amendment program. 14% also record the results using GIS/GPS technology. Another 14% sample their soil every 7 years, while 21% sample at some point. 3% replied N/A, not applicable or information not available.

Ensuring proper nutrients are available to the roots and vines begins in the soil. 34% of the growers use leaf petiole analysis, vine vigor, fruit quality, leaf symptoms and the history of the vineyard to make informed decisions. An additional 49% of the growers use this information with water quality test results to make site-specific nutrient applications. 8% of the growers are basing nutrient applications on broad deficiencies, and 7% make decisions based on time of year or other type of established program that is not based on site-specific information. 2% replied N/A, not applicable or information not available.

CHAPTER 4. SOIL MANAGEMENT BENCHMARK DATA

4-1. PETIOLE ANALYSIS Growers make their living from the quantity and quality of the fruit they produce. As a result, most check the vine’s nutrient status through petiole (stem) analysis to insure that nutrients are available in the plant to produce the desired crop. 61% of the growers are proactive and send samples to a lab for analysis every year, with another 24% adhering to a two-year or three-year cycle for lab results. Of the remaining 15%, 5% sample petioles in response to problems, 8% never sample and 2% replied N/A, not applicable or information not available.

4-2. SOIL ANALYSIS The same proactive approach is needed when considering soil quality. Since the cycle time for soil testing is so long, a method of recording test results is important for tracking the historic soil quality of the vineyard. 76% of the growers sample on 5-year cycles if under-going a soil amendment program. 14% also record the results using GIS/GPS technology. Another 14% sample their soil every 7 years, while 21% sample at some point. 3% replied N/A, not applicable or information not available.

4-3. INTERPRETING RESULTS Getting the results of soil tests are not enough to improve soil quality. Interpreting the results and using that information in management decisions improves soil quality. 47% use expert help to interpret the results, using the results in their vineyard management decisions. 39% can interpret the results for themselves. 5% of the growers accept the vineyard nutritional recommendations as given, 7% don’t take samples, and 2% replied N/A, not applicable or information not available.

4-4. NUTRIENT MANAGEMENT Ensuring proper nutrients are available to the roots and vines begins in the soil. 34% of the growers use leaf petiole analysis, vine vigor, fruit quality, leaf symptoms and the history of the vineyard to make informed decisions. An additional 49% of the growers use this information with water quality test results to make site-specific nutrient applications. 8% of the growers are basing nutrient applications on broad deficiencies, and 7% make decisions based on time of year or other type of established program that is not based on site-specific information. 2% replied N/A, not applicable or information not available.
**CHAPTER 4  SOIL MANAGEMENT**

**4-5. NITROGEN MANAGEMENT**

An important element in the nutrient mix is nitrogen. 51% take local conditions and water into consideration and apply nitrogen in at least two separate applications (never when the vine is dormant), and another 24% never add nitrogen because it is provided by cover crops. 17% of growers use the petiole analysis and vine vigor when deciding to add nitrogen. 4% apply nitrogen every year even though vine vigor is more than adequate. 4% replied N/A, not applicable or information not available.

**4-6. AMENDMENTS FOR WATER PENETRATION**

The health of the vine is dependant on water availability. 34% of the growers replied N/A, which most likely means they have no problem with water penetration in the soil. When growers do notice a problem, 26% have a long-term plan that includes increasing the organic content of the soil through cover crops or manure and do annual water quality testing, 24% add manure or establish cover crops, 12% add gypsum, and 4% take no action.

**4-7. AMENDMENTS FOR PH**

Sometimes stomachs can get out of balance and not process food correctly. This can also happen to the soil. If the soil pH is too high or low, it impacts the vine’s ability to obtain nutrients present in the soil. 27% of the growers do not have a pH problem in their vineyards or answered N/A. 11% don’t know if they do or not. Of those who have a problem, 38% also build up the organic matter with compost and cover crops, 20% add more than half the recommended levels of amendments to correct it, and 4% don’t do anything about it.

**4-8. ORGANIC MATTER**

Organic matter is critical to the health of the soil. 38% add a combination of organic matter such as cover crops and compost, and reduce tillage to lower the rate of organic matter breakdown. Another 35% add organic matter to the soil annually through compost, manure or cover crops without changing their tillage rate. 20% don’t add any organic matter or simply let the resident vegetation grow through the winter, and 4% of growers also use clean-tilling in the vineyard. 3% replied N/A, not applicable or information not available.

**4-9. SOIL COMPACTION**

Soil compaction can affect the ability of the vine roots to access nutrients, oxygen, and water. 91% choose or modify equipment that minimize compaction of the soil. Of these growers, 46% have an annual cover crop and minimize field activity during wet weather, while 25% maintain a non-tilled or reseeded cover crop and never go into wet fields. 7% don’t take soil compaction into consideration when choosing equipment or working in the vineyards during wet conditions. Nearly 2% replied N/A, not applicable or information not available.

**4-10. KNOWLEDGE OF SOIL SERIES, WATER-HOLDING CAPACITY & EROSION POTENTIAL**

Like the wine it will produce, the soil in a vineyard has its own unique characteristics. Awareness of these characteristics can allow a grower to make smart choices for amendments, additives and pH balance. 60% of growers know the soil properties (erosion hazards, soil water holding capacity, wilting point and infiltration rate), and 26% have also consulted with a qualified soil specialist if erosion is a potential problem. 36% know the type of soil but not its properties. 4% do not know what kind of soil they have, and less than 1% replied N/A, not applicable or information not available.

**4-11. SURFACE WATER DIVERGENS**

Erosion is not a problem for growers in flat valley lands, and 16% of growers replied N/A, not applicable or information not available. 70% have permanent or engineered drainage systems and minimal erosion issues, with 20% responding that they have no impacts from erosion. Just over 2% have erosion problems they do nothing about, while 12% use annual drainage structures and have moderate erosion issues in the vineyard and along roads.

**4-12. NON-POINT SOURCE POLLUTION PREVENTION**

Non-point source (NPS) pollution is an environmental issue of growing concern and a large number of growers are taking proactive steps to address the issue. 17% maintain a permanent cover crop, practice no-till vineyard floor management, use permeability and runoff rates in their irrigation planning, and have adopted a local soil erosion program that includes working with community groups interested in erosion control measures. Another 36% of growers have implemented water diversions and a NPS monitoring plan. 35% maintain a winter cover crop, have a tillage plan and are researching and planning to have a NPS monitoring program. 10% of the growers have no cover crop present and don’t monitor for non-point source pollution. 2% replied N/A, not applicable or information not available.
4-13. AIR QUALITY  Air quality continues to be an area of increasing concern for all of California agriculture and the regulatory pressures are increasing for growers in the state, especially in the Central Valley. Particulate matter 10 (PM10) is of increasing concern. Soil blown by the wind can be a source of PM10. 15% of growers water their roads to minimize dust in the dry months, while another 56% also maintain an annual cover crop and only burn vineyard residues. 15% maintain a permanent cover crop, practice no-till farming and do not do any burning. 12% of the growers have not implemented any actions to minimize soil loss through wind action. 2% replied N/A, not applicable or information not available. See Chapter 16 for additional Air Quality criteria.

4-14. COVER CROPS & SOIL QUALITY  Cover crops provide many benefits for vineyards and growers. 93% of growers invest management time in cover crops, with 29% also managing a seeded annual cover crop in the winter, and 44% maintain a permanent cover crop in vine row middles. Another 20% allow an annual resident vegetation (non-seeded) to be there in the winter. Only 6% do not grow cover crops in the vineyards. 1% replied N/A, not applicable or information not available.

4-15. CHOICE OF COVER CROP  Of the high percentage of growers using cover crops, 75% of growers select cover crops based on vigor of the site or erosion conditions, while 26% also track the interaction between cover crops and vines to ensure no undesirable outcomes. 5% base cover crop selection strictly on the cost of seed. 10% don’t know the interaction of the cover crop with their vines, and another 10% replied N/A, not applicable or information not available.

4-16. SOIL EROSION FROM ROADS DITCHES AND CULVERTS  Erosion along roads, ditches or culverts can occur even in relatively flat landscapes if the vineyard floor is not properly managed. 14% of growers replied N/A because they do not have erosion or the information was not available. 27% of growers have implemented a comprehensive erosion control plan and regularly maintain roads, ditches and culverts. 25% of growers have developed a plan but have not fully implemented it. 31% of growers fix problems as they arise, but do not have a plan, and 3% have erosion problems and take no action.

BEN DRAKE, President of Drake Enterprises in Riverside County, farms on the rolling hills of Temecula. Soil in Temecula is granitic so there is very little top soil. Ben incorporates mulch and compost to improve soil structure and help with erosion control. Cover crops are also used to control erosion and retain soil moisture. The use of cover crops, compost and mulch all help the farm run efficiently and decreases water use and associated energy costs through less water pumping. Drake Enterprises also uses deficit irrigation to save water resources.

Ben participates in the SWP to evaluate his practices on an annual basis. “The Sustainable Winegrowing Program helps me take time out of my busy schedule to review my entire operation and enables me to take a fresh look at my practices each year.” Increasing soil organic matter for clients of Drake Enterprises is important to Ben. Accordingly, he helped convert a former citrus orchard into a vineyard by chipping the removed citrus trees for use as mulch. The mulch was put directly back into the property that it came from to enhance the soil. Although newly planted, the vineyard is expected to have a saleable crop after only two years, since the benefits provided by the mulch help the vines grow faster. Therefore, as a result of using sustainable practices during vineyard establishment, the owner will benefit financially by depreciating the vineyard and collecting a return on investment sooner.

Best Practices
Comparative Results & Next Steps

THE FOLLOWING shows average scores from the 2004 Sustainability Report and the change in those scores since 2004. A total of 15 out of 15 Soil Management criteria increased, with a maximum increase of 13% for criterion 4-2 Soil Analysis. Despite this result of generally improved performance, growers should continue to assess their operations and implement site-specific plans to continuously improve the sustainability of their soil management practices. Please note: criterion 4-16 was added in the second edition of the Code workbook in 2006 so there is no data from the 2004 report for comparison.

To drive additional improvements in soil management, CSWA needs partners. If you are interested in improving soil management practices, please email info@sustainablewinegrowing.org.

CHAPTER 4. SOIL MANAGEMENT COMPARATIVE DATA

![Bar Chart showing 2004 Sector Avg and Change Since 2004 for various soil management criteria]