SUSTAINABLE WINEGROWING BRITISH COLUMBIA
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VINEYARD ESTABLISHMENT AND MAINTENANCE PRACTICES FOR WATER-USE EFFICIENCY

The information in this fact-sheet has been taken from the BCWGC Best Practices Guide for Grapes for British Columbia Growers and the SWBC Sustainable Practices for BC Vineyards Condensed Guidebook. For further information please see Chapter 3 and 4 to find out more about site selection, vineyard establishment & maintenance through a water-wise lens.

THE BIG PICTURE: Water Cycle and Watersheds

Understanding the water cycle (see Figure 1) and how farm management practices – such as monitoring evapotranspiration, increasing the water holding capacity of your soil, improving soil filtration and managing runoff – fit into the cycle will help you use water efficiently in your vineyard. In addition, your vineyard is part of a watershed, or an area of land where rain and snow drains or seeps into a common water body, and activities in your vineyard (e.g. pesticide application, irrigation) can have downstream impacts.

Design: Keeping Water On-Site

A key strategy in water management is to keep rain and irrigation water on-site as long as possible so it can gradually sink into the ground. All non-irrigation water-use efficiency techniques are aimed at this goal. The following are techniques that will help to prevent excessive water runoff on your site:

- Planting of cover crops,
- Vegetation filter strips separating vineyard from water bodies,
- Conservation tillage,
- Installing subsurface drainage that is built for the specific soil conditions and plant rooting requirements,
- Unpaved roadways,
- Restricting access and use of critical riparian areas, and
- Addressing soil permeability problems.

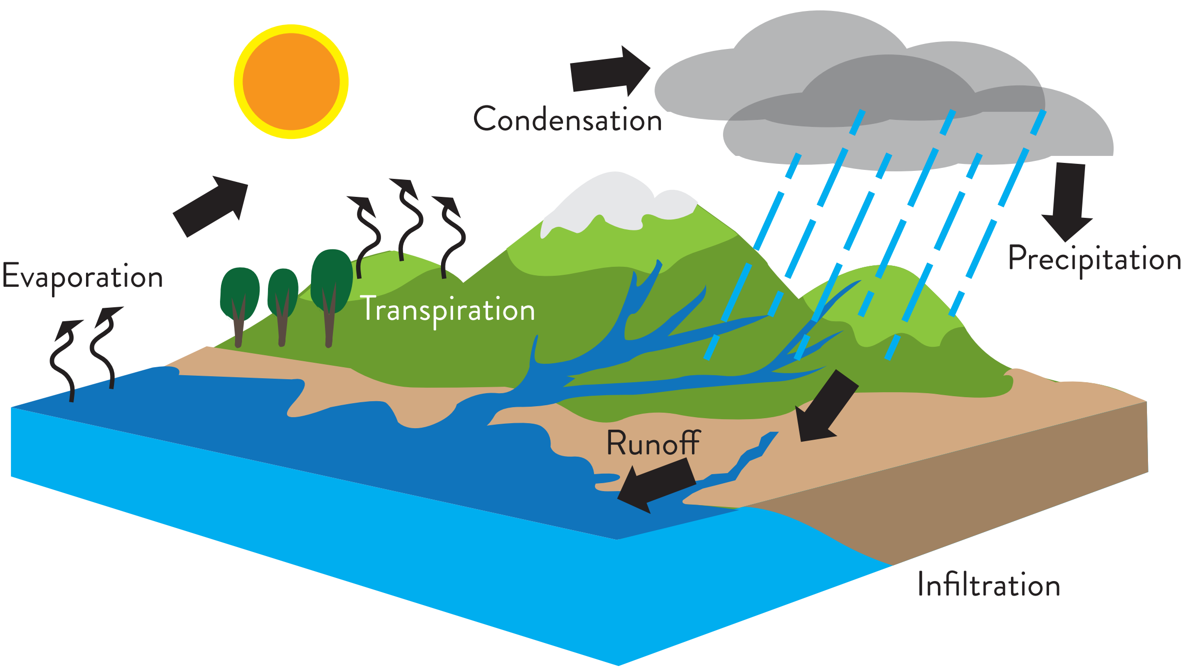

Figure 1 - The Water Cycle (adapted from www.eschooltoday.com)

Establishment and Maintenance: A water-wise vineyard

Good site selection and vineyard establishment practices contribute to long-term water-use efficiency. Careful consideration of soil types, topography, local climate and microclimates, and irrigation water sources will all influence the quality of your wine grapes and minimize soil, drainage, and pest problems.

Looking After Your Soil

Soils can vary widely even within small parcels of land. Ideal soils for grape vines are pH neutral, deep, well-drained and well-aerated, with good organic matter and an adequate supply of nutrients.

Soil should have good infiltration rates and a high water holding capacity to soak up surface water to minimize run off and maximize the amount of water that can be made available to vine root systems. A soil profile is examined to a depth of one to two metres. While your interest is normally concentrated on the topsoil because it lies directly under your control, grapevine roots penetrate into the lower horizons and are affected by the composition of these deeper layers. An accurate account of the soil must include not just the topsoil, but the subsoil as well. The capacity of soil to store water depends on the particle size composition of the soil (texture) and the soil particle arrangement (structure). It also depends on organic matter and content of coarse fragments (see Table 1 on previous page).

Table 1 - A description of important soil parameters and guidelines for interpreting lab results.

Parameter	Description/Importance	Interpreting Lab Results
pH	• Measure of acidity (low pH) or alkalinity (high pH) of the soil • Influences the plant availability of macronutrients and micronutrients	• 6.0 to 7.0 idea because all nutrients available at this pH • Vines can grow in soil that is pH 4.0 to 8.5 • pH greater than 8.0 indicates high calcium carbonate and salts • pH greater than 9.0 indicates high levels of salinity • Low pH can be caused by years of fertilizer and sulphur use and may induce aluminum toxicity • Low pH can also create fungi problems • High pH can be accompanied by iron chlorosis
Cation Exchange Capacity (CEC)	• Also known as the buffer index • Measure of the electrical charge of the soil • Measure is used to calculate the amount of lime needed to raise the pH • CEC can be altered with soil organic matter	• Varies widely with soil type • The more negative the charge of the soil, the greater its ability to attract and hold positively charged nutrient ions (cations) including magnesium (Mg^{++}), calcium (CA^{+}) and potassium (K^{+}) • As the amount of base cations increases, so does the pH
Base Saturation	• Indicates the ratio of base cations in the soil to total cation exchange capacity	• For all alkaline soils, base saturation will typically be greater than 50% and many will approach 100%
Electroconductivity (EC)	• Measure of soil salinity	• Values < 0.7 mmho/cm indicate no salinity present • 0.7 to 2.0 mmho/cm indicate minor salts present, potentially problematic • 2.0 to 4.0 mmho/cm indicate moderate salinity that will affect plant growth and fruit yield • over 4.0 mmho/cm can result in major yield reductions
Chlorides	• A small amount of chlorides are essential for grapevine growth but chlorides can be toxic even at low concentrations	• < 300 ppm are good • 300 to 700 ppm are acceptable • > 700 ppm are problematic

Organic matter is a very small part of soil, but plays a very important role. Proper management of the organic matter influences the vineyard's long-term productivity. Organic matter improves the physical condition of the soil, increases soil moisture-holding capacity, improves aeration and serves as a source of nitrogen and other plant food. It supports bacteria and fungi, which aid in the release of plant nutrients. Most vineyard soils are low in organic matter. The organic matter level can be increased through the addition of green manure crops (cover crops), barnyard manure, grape pomace, grapevine prunings, and hay. Maintaining or improving soil organic matter will benefit the soil and grape plants. Soil sampling should be done every five years to gather information on organic matter content, pH, degree of salinity, and nutrient levels.

A detailed soil survey and analysis should be completed prior to vineyard development to identify where different soil types occur on the site and to characterize the physical properties of each different area. The results of the survey should be used to determine the most appropriate irrigation system, rootstock, variety for each soil type, and possible soil amendments (see Table 2 on previous page).

During site preparation activities, care should be taken to preserve the topsoil as much as possible. The ideal method is to collect and stockpile the topsoil, level the parent material underneath, and then replace the topsoil over the leveled surface to ensure none of the parent material is exposed.

Managing Your Vineyard Floor

Vineyard floor management can impact how abiotic factors (e.g. temperature, wind, precipitation) and biotic factors (e.g. beneficial insects, pests and disease) influence the vineyard environment, especially through microclimate modifications and soil health. Types of floor management systems include resident vegetation, clean cultivation, cover cropping and cultivation. Decisions about what floor management system to use should consider the age of the vines and the overall management goals for the vineyard. While cover crops can provide many benefits in a vineyard (see below), they can also compete with young vines for water and nutrients.

Cover crops can provide many benefits in a vineyard, including:

- **Reduce soil erosion due to wind and water,**
- **Protect the soil surface from high traffic events during the growing season,**
- **Increase water infiltration,**
- **Reduce insect populations (pests),**
- **Increase beneficial insect populations (predators),**
- **Reduce chemical use,**
- **Reduce weeds depending upon the competitive nature of the cover crop,**
- **Reduce vine vigor,**
- **Recycle nutrients within the soil ecosystem,**
- **Prevent nutrient leaching,**
- **Increase organic matter, and**
- **Alter microclimate.**

Table 2 - Important physical properties of vineyard soils.

Property	Description

Texture	• the relative proportions of sand, silt and clay particles found in a soil sample
	• affects nutrient and water holding capacity and aeration of the soil
	• grouped into 12 classes
	  • sandy soils (those dominated by sand sized particles and are referred to as having coarse texture): water enters at a rapid rate, does not retain water and nutrients well, good aeration and easy penetration by plan roots, often low in organic matter and nutrients
	  • silty soils (those dominated by silt-sized particles and referred to as having medium texture): holds more water and nutrients than sand, but less than clay, has less drainage than sandy soils, but more than clayey soils
	  • clayey soils (those dominated by clay-sized particles and referred to as having fine texture): good water and nutrient holding capacity, may have poor drainage and little aeration, compaction may be a problem
	  • loamy soils (those dominated by a mixture of particle sizes): considered best for grape growing because of the desirable properties of a sand, silt, and clay mixture, which allows for ease of cultivation, adequate water-holding capacity and nutrient-storage capacity and good drainage

Structure	• the way soil particles clump together into larger units called soil aggregates
	• naturally occurring soil aggregates are called peds
	• affects the availability of air and water in soil
	• classified according to 3 groups of traits:
	  • type: the shape of the soil peds (granular, blocky, platey or structureless)
	  • class: the size of the peds (very fine, fine, medium, coarse or very coarse)
	  • grade: how distinct and strong the peds are (weak to strong where the peds are easily visible and can be handled without breaking)
	• ideal soil structure for plant growth is well aggregated soil that contains large, continuous pores
	• soil structure takes a very long time to develop naturally but can be damaged very quickly by mechanical operations and compaction

Porosity	• amount of pore space in the soil
	• these pores convey oxygen, water and dissolved nutrients and provide the space in which roots grow
	• nature of the pore space will vary depending on:
	  • texture: sand (relatively large pore spaces, good aeration) and clay (relatively small pore spaces, holds water but can have poor root aeration)
	  • structure: aggregation of particles creates larger pore spaces
	  • mixing of the soil particles: excessibe cultivation, for example, will decrease porosity by destroying natural soil structure, compaction will reduce total pore space due to compression

Organic Matter	• made up of living microorganisms and plant and animal residues in various stages of decomposition
	• plays an important role in many beneficial soil functions, including:
	  • source of nitrogen, sulphur and phosphorus
	  • contains chemical exchange sites and increases the ability of the soil to “hold onto” nutrient compounds
	  • maintains soil structure and stability
	  • increases soil water holding capacity; humic substances can hold up to 5 times their weight in water
	  • provides a major energy source for soil microorganisms
	  • increases soil temperatures due to darker soil, which also promotes biological activity
	• excessive tillage, soil erosion and poor cover crop management will speed the loss of organic matter

Bulk Density	• measures, for a given volume of dry soil, how much is occupied by solids and how much by pore space (i.e. how compact a soil is)

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