



Shiloh Estate

SHILOH VINES & WINES KNOWLEDGE BASE SERIES

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Cover Crops

by

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Coordination Draft
Comments Welcome

Toward Quality Wine

Quality wine is grown in the vineyard. The success of a winegrowing enterprise is dependent on the realization of several interrelated goals:

- Grow quality grapes
- Maintain organic matter and nutrient balance in the soil
- Promote proper soil aggregation
- Prevent soil erosion
- Manage pests, weeds, vigor, and other influences on vineyard health

Ways to help achieve these goals through cover cropping of vineyards were taught in "Cover Crops," a class offered at Napa Valley College under the auspices of Stephen Krebs' Viticulture and Winery Technology Program.

Strategic Imperatives

Thoughtful planning and management of cover crops in vineyard settings not only support the production of superior grapes that can lead to superior wine, but also contribute to the goals of sustainable agriculture (see box). However, cover cropping is still much more of an art than a science. Cover crop strategies should consider:

1. Priority winegrowing (and winemaking) goals and objectives that can be advanced through cover cropping policies and strategies.
2. Site-specific "givens" such as location, climate, soil, and, topology.
3. Viticultural variables (e.g., rootstock) and practices (e.g., vineyard floor management).

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Sustainable Agriculture

Sustainable agriculture integrates three main goals—environmental health, economic profitability, and social and economic equity—and subsumes the following concepts:

Sustainability rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs.

A *systems perspective* is essential to understanding sustainability. The system is envisioned in its broadest sense, from the individual farm, to the local ecosystem, *and* to communities affected by this farming system both locally and globally.

Making the transition to sustainable agriculture is a process. It is important to realize that each small decision can make a difference and contribute to advancing the entire system further on the "sustainable agriculture continuum."

Reaching toward the goal of sustainable agriculture is the responsibility of all participants in the system, including farmers, laborers, policymakers, researchers, retailers, and consumers.

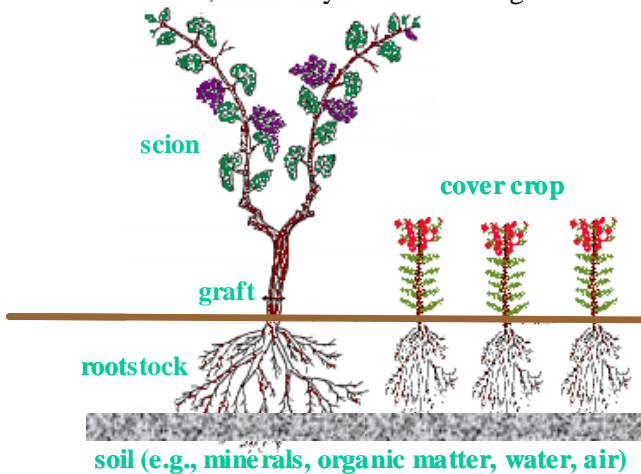
Source: <http://www.sarep.ucdavis.edu/concept.htm>

Several important aspects of cover cropping in vineyards are adumbrated in this paper. Cover cropping represents complex subjects—this paper merely scratches the surface. The benefits of cover cropping in vineyards are not yet fully proven but many trials are underway with advocates of sustainable agriculture, organic farming, and biodynamics leading the way.

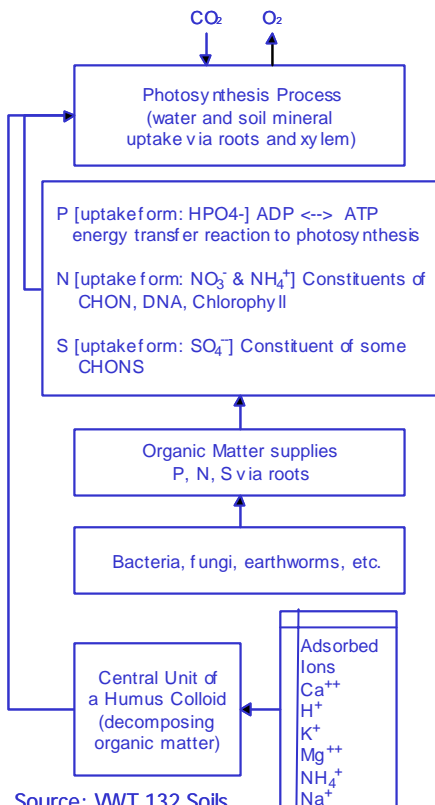
Cited web sites and other references are highly recommended as is the "Cover Crops" course that this paper draws on.

The Systems Perspective

Cover cropping in vineyards can contribute to systems at the micro-, meso-, and macro-levels. At the micro-level, individual vines or groups of vines share a similar climate, soil, and topology. Other major influences on grape and wine quality at the micro-level include intrinsic vineyard vigor and management practices such as irrigation, fertilization, and vineyard floor management.



The highly simplified depiction, above, suggests a micro-system. A different perspective highlights the role of organic matter in supply of nutrients.



Source: WWT 132 Soils, Fertilization, Irrigation NV College

Cover Crop Goalsⁱ

Fruit Quality/Vigor Control—Cover crops, in conjunction with moisture control, can help to bring the fruit "to its best possible quality and maturity."ⁱⁱ Cover crops are used to regulate growth by reducing vine vigor through competition for nutrients that would aid vine growth and therefore delay fruit ripening (stressing the vines through deficit irrigation prior to harvest can achieve similar results). This strategy applies when excessive vigor is promoted by soils, rootstocks, or both. Achievement of optimal fruit quality is the name of the game. See:

<http://www.sarep.ucdavis.edu/ccrop/ccres/>

Erosion Control—Sheet, rill, and gully erosion can be countered to various degrees by use of cover crops. Whether required by laws and regulations or not, erosion control makes sense. Soil erosion is reduced or prevented three ways: (1) top growth protects the soil surface, (2) roots bind the soil and holds it in place, and (3) root penetration increases the level of water penetration vs. flow-off.ⁱⁱⁱ See:

<http://www.nrcs.usda.gov/technical/land/meta/m3711.html>

<http://www.ianr.unl.edu/pubs/fieldcrops/g544.htm>

Soil Nutrients—Cover crops can supply nitrogen (N), carbon (C) and other nutrients to the soil. The cost of seeding needs to be considered as does the timing of rainfall (or irrigation). Winter legumes can add 10 to 35 pounds N per acre.^{iv} A more recent source puts N higher:

Pounds N per Acre		
Cover Crop	Potential	Expected
Red Clover	110	30-50
Crimson Clover	100	30-50
Hairy Vetch	150	50-70
Winter Peas	80	30-50
Arrowleaf Clover	100	30-50

Source: <http://msucare.com/pubs/pub1552.htm>

Phil Coturri, a Sonoma-based vineyard consultant, is more interested in C than N as a nutrient:

Common C:N Ratios	
Organic Material	C:N Ratio
Young Rye Plants	14:1
Rye at Flowering	20:1
Hairy Vetch	10:1 to 15:1
Crimson Clover	15:1

Source: <http://www.attra.org/attra-pub/covercrop.html>

Green Manure—Lush green manures are richer in nitrogen relative to carbon (requires tilling to incorporate cover crop into soil). However, some *do not* favor plowing under a heavy, succulent green-manure crop in early spring as it causes soil N to become low when the vines need it most—just before and during bloom—and N to become high during ripening when supply should be limited to achieve optimal fruit quality.^v See:

<http://www.ia.nrcs.usda.gov/fotg/section4/pstands/340std.pdf>

Soil Aggregation—Ideal soil is composed of 45% minerals, 5% organic matter, and 50% pores filled with air and water. Soil that is compacted and heavy clays lack the pores beneficial to water penetration and aeration. Cover crops improve soil aggregation by putting down roots (like a biological plow) and through decomposition that increases organic matter. Root depth of cover crop plants is usually less than that of vines.

Typical Rooting Depths	
Cover Crop	Depth (Feet)
Red Clover, Lupine, Radish, Turnips	5 - 7
Common Vetch, Mustard, Buck Medic	3 - 5
White Clover, Hairy Vetch	1 - 3

Source: <http://www.attra.org/attra-pub/covercrop.html>

Soil texture is a function of the relative percent of clay, silt, and sand particles in the soil. See:

<http://ucce.ucdavis.edu/files/filelibrary/40/948.pdf>

Weed Suppression—Some cover crops, like subterranean clover, suppress weeds (in the vine row as well between rows). Problem weeds in Napa Valley include bindweed (morning glory), marestail (horseweed), bristly ox tongue, prickly lettuce, and star thistle. See:

http://www.ipm.ucdavis.edu/PMG/weeds_common.html

http://www.ppws.vt.edu/scott/weed_id/cropweeds.htm

Pest Control—Cover crops can become part of an integrated pest management strategy that attracts beneficial insects and lowers pest densities.

However, some cover crops attract pests such as gophers and voles. The idea is to plant cover crops that attract predators that feed on prey as both larvae and adults. The predator community on the vines and cover crop is dominated by various spider species. See:

<http://www.ipm.ucdavis.edu/PMG/selectnewpest.grapes.html>

<http://www.ippc.orst.edu/cicp/org.htm?>

One of the best web sites for cover crops is:

<http://www.sarep.ucdavis.edu/ccrop/>

Step 1

Identify Enterprise Success Factors

Factors important to the success of the winegrowing and winemaking enterprise must be identified, for example:

Cover Crop ESFs Napa Valley Hillside example	Essential	Very Important	Important	Nice to Have	Not important
	Quality/vigor control				✓
Soil erosion	✓				
Soil nutrients			✓		
Green manure				✓	
Soil aggregation		✓			
Weed suppression			✓		
Pest control				✓	

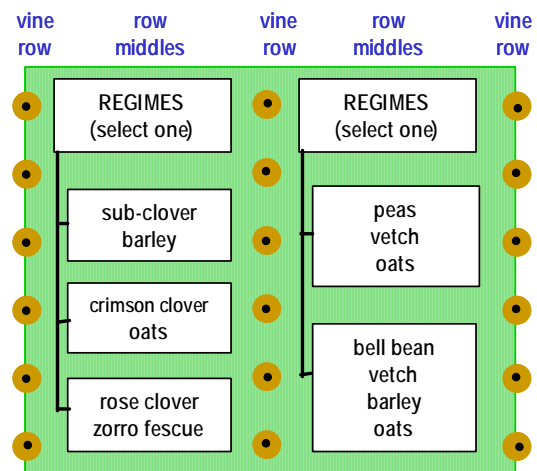
Step 2

Develop Cover Cropping Strategies

Different cover crop mixes in alternate rows is one approach. Options that have worked well in Napa Valley are suggested below:

Workable Cover Crop Strategies

SELECT ONE REGIME FOR EACH ROW



Source: VWT 298 Cover Crops, Napa Valley College (2002)

All are reseeding winter annuals.

Subterranean Clover (especially 'Nungarian', Trikkala', and 'Riverton') is a legume that requires periodic mowing and does well in acid soils. Very good for weed suppression.

Crimson Clover is a mowable legume (so long as it is allowed to grow from mid-March to early April for reseeding purposes).

Rose Clover is similar to crimson clover but branches more and is lower growing.

Field Pea is a legume that produces significant biomass that can be mowed or tilled into soil.

Bell Bean is a legume that offers biomass plus a thick taproot that helps open heavy soils. It does not tolerate close mowing.

Common Vetch is a legume that develops its biomass in March and April and should not be disked or mowed earlier. Has extrafloral nectaries that attract beneficial insects.

Oat is a grass tolerant of wet and heavy acid soils; therefore good for erosion control. Attracts voles.

Barley is a grass producing substantial biomass and is particularly effective for controlling soil erosion in hillside vineyards.

'Zorro' **Fescue** is a quick-growing grass good for erosion control.

The contribution of each plant to goals might be:

Cover Crop Contribution To Goals	Cover Crop Contribution To Goals						
	Quality/vigor control	Soil erosion	Soil nutrients	Green manure	Soil aggregation	Weed suppression	Pest control
Sub-clover	o	+	o	o	o	+	o
Crimson clover	o	+	o	o	o	+	o
Rose clover	o	+	o	o	o	+	o
Field pea	o	+	+	+	+	o	o
Bell bean	o	+	+	+	+	o	o
Common vetch	o	+	o	o	o	o	+
Oat	o	+	o	o	o	o	o
Barley	o	+	o	o	+	o	o
Zorro fescue	o	+	o	o	+	o	o

These are rough estimates for a hillside vineyard with clayey soils.

These cover crops can compete with vines—could use '-' for *Quality/Vigor control*. Most plants attract voles and gophers: so could use '-' for *Pest Control* (except, perhaps, vetch that offers nectar). Also note that 'o' *less impact* is usually somewhat positive vis-à-vis most goals.

Specific strategies must take into account as many important site-specific factors as feasible.

Step 3 Vineyard Floor Management

Cover cropping in vineyards should fully consider the following factors and elements:

Givens—Vineyard location, climate and water availability, soils, and topography.

Decisions taken—Variety, rootstock, vine-row spacing, trellis system, irrigation system, frost protection system, wells and reservoirs.

Tilled vs. no-till—No-till vineyards reduce soil erosion, provide traction during wet season, provide living or dry mulch. Tilling can add more biomass (green manure) and Nitrogen to soil.

Potential Nitrogen (Pounds per Production Acre) ^{vi}			
Annual Winter Cover Crops for Non-Tilled Vineyards			
Sub-clover	Rose Clover	Crimson Clover	Zorro Fescue
30-60	30-60	30-60	0
Annual Winter Cover Crops for Tilled Vineyards			
Common Vetch		Field Peas	
150		120	

Tilled cover crops can be mowed rather than disked.

Diversity & rotation—Different blends in alternate rows with an eclectic mix (10 or more varieties) every 20th row (or so) can be beneficial, especially for pests. Rotate every three years (or so)

New vineyards—In newly planted vineyards, where soils and vines are only moderately vigorous, do not plant the cover crop the first couple of years (except, perhaps, on hillsides).

Seeding—Seed around mid-September (by mid-October at latest), irrigate or pray for early rain, and use high seeding rates (30-40 pounds/acre) for weed suppression.

Vine vigor—Most cover crops compete with vines for water and nutrients; this is minimized by winter crops that die and reseed early.

Innovate and experiment—Keep what works and discard or change what doesn't. Good luck!

ⁱ *Cover Cropping in Vineyards: A Grower's Handbook*, UC Division of Agriculture and Natural Resources, Pub 3338 (1998) <http://anrcatalog.ucdavis.edu/>
ⁱⁱ A.J. Winkler, et al, *General Viticulture*, UC Press (2nd Edition 1974); p. 144.
ⁱⁱⁱ *ibid*; p. 382.
^{iv} *ibid*; p. 414.
^v *ibid*; p. 415.
^{vi} Glenn McGourty, "Cover Crops for North Coast Vineyards," *Practical Winery & Vineyard* (Jul/Aug 1994)