Selection and Effects of Cover Cropping in Vineyards and Orchards

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Many growers use or have tried cover crops to obtain economic or environmental benefits. Typical benefits include increased water penetration, reduced soil erosion and water runoff, improved accessibility on wet soils, addition of organic matter and nitrogen, and enhanced wine quality. Of course, there are also drawbacks to using cover crops, and the decision to plant them depends on whether the expected benefits outweigh the drawbacks. The main factors to consider when selecting a species or mix are tillage practices, irrigation method, nitrogen needs, frost concerns, erosion control needs, and costs.

Cover Crop Types

Annual Cover Crops

With tillage. Mixes that produce large amounts of biomass can be used to add organic matter to the soil. Although disking destroys organic matter, the periodic addition of organic matter enhances soil microbes, improving soil structure and nutrient cycling. High biomass mixes contain large seeds and are usually quite easy to grow. In general, they are sown each fall and disked in the spring as a "green manure" cover crop. Where furrow irrigation is used, they are disked before the soil dries excessively to enable the disk to penetrate the soil.

Pure legume blends are used to add a large – and potentially excessive to vineyards – amount of readily available nitrogen to the soil. Solid plantings of grasses, such as barley, oats, triticale, or cereal rye, are used to improve soil tilth and water penetration. Legume/grass blends provide some benefits of both. Typical blends often consist of bell beans, common vetch, peas, and oats or barley. Other common cereals include triticale and cereal rye. Barley/vetch or oat/vetch blends are fairly inexpensive and are frequently used.

Non-tillage. No-till cover crops provide firm footing during wet periods for harvest, spraying, and pruning. Some growers sow winter annual species that reseed and die in the spring and regenerate each fall – usually with rainfall alone. Such species and mixes include annual clovers, bur medic, 'Blando' bromegrass, and 'Zorro' fescue. If not properly managed or if allowed to become too weedy, in time these species will simply become minor components of the ground cover. Periodic replanting every three or four years, if desired, can ensure dominance by these species and build the seed bank.

Bur medic is well adapted to California's climate and grows well in neutral to high-pH soils; it is occasionally a major component of resident vegetation. It effectively reseeds even under fairly close mowing and, because of its high percentage of hard seed, it usually reestablishes well even when tillage is used. Commercial varieties of bur medic are spineless. Subterranean clover, or subclover, usually performs best in acid to neutral soils. Many subclover cultivars are available that have been planted for feed on California rangeland; consult with a local UC rangeland Farm Advisor for those best adapted to your area. Rose clover does well under dry conditions, such as rocky soils and terraces. Crimson clover produces considerable biomass and very attractive red flowers.' 'Blando' brome and 'Zorro' fescue, are popular low-

growing grasses that are often used in monoculture for erosion control. They germinate easily and reseed themselves each year. 'Blando brome' is cheaper than 'Zorro' fescue.

Perennial Cover Crops

Perennial grasses and legumes provide a permanent cover that offers year-round traction. Perennial clovers, such as white and strawberry, are low growing and add nitrogen, but are invasive and can strongly compete with vines for water. Birdsfoot trefoil, a legume, is slow to establish but forms a dense cover. Vigorous, summer-active perennial grasses, such as perennial ryegrass and tall fescue, devigorate vines and should only be planted where vigor is excessive or where soils are deep and fertile.

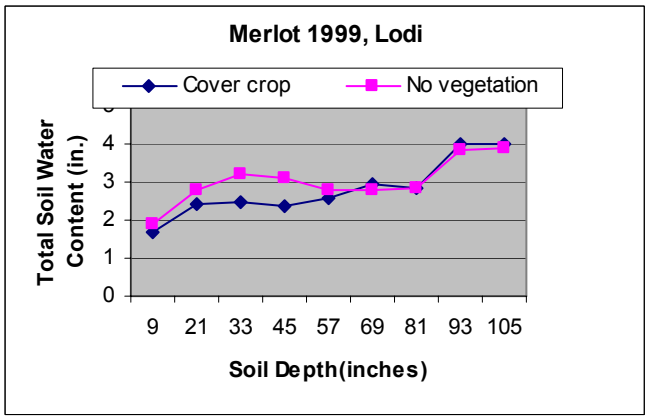
California native perennial grasses are increasing in popularity in some regions. The most popular species are California brome (*Bromus carinatus*), blue wild rye (*Elymus glaucus*), meadow barley (*Hordeum brachyantherum*), and California barley (*Hordeum californicum*), but many other species are being tested and used. Many native grasses are very vigorous and may compete excessively with trees or vines during the spring. In drip-irrigated vineyards in drier regions, these grasses will almost completely shut down growth during the summer, and thus offer little competition with trees or vines. In cooler coastal regions, native grasses can continue to grow and compete with vines through the summer. The seed is quite expensive initially, but is inexpensive over the life of the cover crop.

Recent Research on Cover Crops in Vineyards

Devigoration of Vines

Cover crops, particularly those that grow actively year-round or through late spring, can devigorate vines. Devigoration can be desirable with vigorous vines on rich valley soils, although it can lower yields excessively and damage vines. The use of species that grow actively in late spring, such as native perennial grasses or ryegrass, can potentially reduce shoot growth and improve red wine quality of vigorous vines with little reduction of yield, as long as adequate summer irrigation is provided. However, very little research has been conducted to test the effects of cover crop management practices on wine quality. Some growers have used cover crops in this way and have improved wine quality, only to find that vine vigor and yield declined excessively after two or three years.

Cover Cropping as Component of a Deficit Irrigation Program. Research in a Lodi vineyard has shown that moderate pre-veraison water stress can improve red wine quality (T. Prichard and P Verdegaal, unpublished data). On soils that can hold enough soil moisture to prevent water stress until after veraison, cover crops can help deplete the soil profile by bringing on water stress earlier, thus helping to reduce vegetative growth. In a mature, drip-irrigated Merlot vineyard, a cover crop of annual ryegrass reduced soil moisture at budbreak by nearly 2 in. over the 105-in. soil depth during the third year of the experiment (see figure). Most of the differences occurred within the top 48 in. In 1999 there was about 14 in. of winter rainfall.



In this trial, a comparison was made between cover crop vs. no cover crop in a standard deficit treatment. The irrigation regime for both was non-irrigation until the vines reached -13 bars leaf water potential (stress) then irrigated weekly using 60% of the full vine water requirement. This irrigation regime resulted in about 18 in. of vine water use for both treatments, of which 7 in. was applied as irrigation. Vine shoot growth was significantly reduced in the cover crop treatment, with a maximum shoot length reduction of 15% in June and July.

Harvest dates, sugar content, and juice pH were very similar. The malate (malic acid) content of the juice was significantly reduced in the cover crop (1600 vs. 2125 ppm) owing to less vegetative growth and more light to the fruit. This in turn resulted in a lower titratable acidity (4.8 vs. 8.4 g/L), of which malic acid is a component. Titratable acidity of the wine was much higher in the cover crop than the control due to the fermentation of the higher malic acid in the control. The wine color intensity was significantly higher in the cover crop wine at all measured spectrums. Hue was also improved.

Cover crops grow very actively in the spring, using soil moisture in proportion to their biomass and ambient warmth. Therefore, the larger and later a cover crop grows, the more water it uses, and the rate of water use can be regulated by choosing low biomass species and/or by mowing or tilling in the spring. The annual ryegrass used above is a vigorous, late-maturing cover crop that died out in late spring due to lack of water, before it reseeded. This species would likely resemble several tall-growing perennial grasses in its water use. Another key factor in water use is the width of the herbicide (or cultivated) strip: the closer the cover crop grows to the vine row, the greater the competition with the vines for water and nutrients. Water use (and costs and frost hazard) can also be reduced by sowing alternate rows.

Cover Cropping and Nitrogen Cycling. Annual legume cover crops can be a valuable source of nitrogen for vines. Nitrogen is released rapidly through decomposition of leaf litter from the legume hay after mowing and/or tilling. Over time, soil productivity will also be enhanced. In a vineyard, the use of a cover crop mix that includes legumes could mean that most if not the entire annual grapevine N demand can be met.

The effectiveness of cover crops as a source of nitrogen depends on the timing of nitrogen release from the cover crop, which must coincide with the period of nitrogen uptake and use by the grapevine. One critical period when cover crop N is needed by the vines is during rapid shoot growth and early fruit set. Research in a drip irrigated vineyard in Sacramento County has shown that the N content of vine leaves increased by 15 to 20% in the first 2 to 4 weeks after either mowing or tilling (R. Smith, A. Patrick, and A.M. Berry, unpublished data).

Using natural isotopes of N as tracers, the N derived from the cover crop accounted for 20 to 30% of the leaf N.

Effects on the vineyard ecosystem. In a Sacramento County vineyard study, four cover crop mixes were compared for three years in a drip-irrigated Merlot vineyard with 7 x 11 ft. spacing (C. Ingels, K. Scow, and D. Whisson, unpublished data). The treatments were: 1) California native perennial grass mix, 2) bell bean/ vetch/pea mix, 3) barley/oat mix, 4) reseeding annual clover mix, and 5) disked control. Total soil microbial biomass was greater in the two nontillage treatments (native grass & clover mixes) than in disked cover crop treatments, the disked control, and the non-tilled berm, each of which had similar microbial biomass.

To evaluate gopher activity, each cover crop treatment block in the study was divided into 350 "cells." Each cell comprised the area between vines and rows. In January, February and March 1999, we searched each cell for signs of pocket gophers (fresh mounds and feed holes). The far majority (>85%) of the sign each month was recorded in the clover treatment. With pocket gophers exhibiting such a preference for clover, it was not possible to determine the relative preference of other cover crops to pocket gophers in the absence of clover. It is therefore likely that pocket gophers would switch to a different cover if clover weren't present.

The native grass mix is relatively slow in getting started, so weeds were present in the first year, but far fewer weeds were present in years 2 and 3. On the contrary, the reseeding annual clover mix had the fewest weeds in year 1, but by the third year, this treatment had far more weeds than the other treatments. However, weeds are not a great concern in orchards and vineyards because they can simply be mowed as resident vegetation.

There were no differences in yield or juice quality during the 3 years of the study. To evaluate wine quality, small wine lots were made from 50 lbs. of grapes and the wine was blind-tasted by 11 individuals. Each taster was asked to rank the five wines based on their personal preference. None of the tasters rated the disked control wine first in preference, and this wine was found by some tasters to be noticeably thin and out of balance.

References

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