CHAPTER 1

Historical and Current Uses

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A cover crop is a noneconomic crop that is grown in vineyard middles and occasionally in vine rows. Most cover crops are classified as winter or summer annuals, which germinate and die in one year or less, or perennials, which live for three or more years. Often, cover crops are also classified based on taxonomy, most being either legumes (Fabaceae family) such as clovers and vetches, or grasses (Poaceae family) such as barley and fescues. Other plant types used as cover crops include brassicas (Brassicaceae family) and phacelia (Hydrophyllaceae family). In addition, weeds are often simply allowed to grow and be managed like a cover crop. This "resident vegetation" offers some of the benefits of a sown cover crop, such as improved water penetration, although the plant species may vary greatly and may include undesirable weeds.

Winter annual cover crops are most often planted in vineyards because they grow during the wet season, thereby aiding in erosion control and reducing competition with the vines for water and nutrients. They are sown or allowed to reseed in the

TRADEOFFS IN COVER CROPPING

Potential Benefits

- Reduced soil erosion
- Addition or conservation of nitrogen
- Addition of organic matter to soil
- Improved soil structure and water penetration
- Improved wheel traction
- Enhanced pest management
- Enhanced aesthetics

Potential Drawbacks

- Increased water use
- Competition with vines for soil moisture and nutrients
- Increased frost hazard
- Increased pests
- Increased costs and management
- Additional equipment required
- Decreased aesthetics

fall and are mowed or disked in the spring. Summer annual cover crops are sown much less frequently; they are usually planted to attract beneficial insects or add organic matter. Most perennial cover crops are sown in the fall, but some can be planted in early spring; they usually do not require replanting for several years. Perennials may grow actively throughout the year or for a portion of the year. For example, turf-type fescues (grasses) may grow year-round, while some California native perennial grasses may grow only during the rainy season and shortly thereafter. The period of active growth is often dictated by water availability and climate.

History

The use of cover crops has a rich heritage. Bell beans were regularly grown in vineyards during early Roman times, and even earlier use occurred in fields in ancient China and India. In northern Europe, lupins were used to improve sandy soils. North American farmers have long used cover crops in rotation with vegetable and field crops in the understories of orchards.

In California, cover crops have been used in vineyards since the early 1900s. They were frequently planted in order to reduce erosion, add nitrogen, and improve soil tilth and water penetration. Winter annual grains or legumes or both were planted in the fall and then mowed and disked in the early spring. Cover cropping was largely abandoned during the late 1940s and early 1950s. During this time, conventional agriculture came to rely more on synthetic fertilizers and less on cover cropping to enhance soil fertility. In the late 1980s and early 1990s, however, cover cropping in vineyards experienced a widespread resurgence as a result of the growing interest in sustainable agriculture. New cover crop species and cultivars, tractor implements, and irrigation methods have allowed many growers to adopt new cover cropping techniques to meet today's needs.

In 1997, there were over 770,000 acres (312,000 ha) of grapes grown in California, and substantial acreage was planted in 1998. An informal survey of UC Cooperative Extension (UCCE) viticulture Farm Advisors indicated that about 16 percent of the vine-

Table 1-1. Approximate proportion and amount of grape acreage in California sown to cover crops

Region and type	Grape acreage (1997)*	% of acreage with sown cover crop†	Acreage with sown cover crop (approx.)
Southern San Joaquin Valley			
Wine	133,752	15	19,985
Table	72,233	17	12,620
Raisin	269,060	11	29,117
Northern San Joaquin Valley			
Wine	95,823	18	17,530
Table	3,843	3	111
Raisin	2,142	5	97
Sacramento Valley	10,934	25	2,549
North Coast (wine)	94,033	26	23,956
Central Coast (wine)	64,451	23	15,179
Southern California			
Wine	3,357	5	168
Table	13,377	10	1,338
Raisin	3,556	5	178
Sierra Foothills (wine)	3,777	36	1,316
Statewide Totals	770,338	16.1	124,144

*Grape acreage obtained from *California Grape Acreage 1997* (Sacramento: California Agricultural Statistics Service, June 1998). Data from counties with very small acreage not included.

†Approximate percentage of grape acreage cover cropped determined from an informal survey of UC Cooperative Extension farm advisors in October 1997.

yard acreage in California was planted to cover crops other than resident vegetation. Table 1-1 shows these results on the basis of region and grape type.

Potential Benefits

The use of cover crops can yield substantial benefits or be the source of unforeseen problems or drawbacks. Both the advantages and disadvantages are described throughout this book, as well as means for improving the chances for success.

The choice of which species to sow, as well as the decision whether or not to plant a cover crop, is based in large part on the benefits desired. The nature and extent of the problems associated with cover crops are often a result of unsuitable species or inappropriate management practices. However, the best choice of species and practices can be highly site-dependent and often evolves through trial and error. Because species or practices may have benefits and drawbacks, the best choice is often a compromise. It is important to remember that if a cover crop sown one year is unsatisfactory, it does not mean that cover crops cannot ever give satisfactory results. Many growers take several years to arrive at suitable cover cropping regimes, and some of the disadvantages can be overcome or reduced by simply changing cover crop species or using different cultural practices.

One of the most important reasons for using cover crops has been to reduce soil erosion. Stands of vegetation such as grasses are the most cost-effective means of controlling rill and sheet erosion, two of the most common types of erosion. Grasses reduce erosion by improving water penetration and by slowing the movement of water down slopes.

Cover cropping with legumes can add nitrogen to the soil. Specialized bacteria fix nitrogen from the atmosphere into nodules created by the bacteria on the roots. Most of the nitrogen is transported to the foliage; a portion of the nitrogen is later made available to vine roots after mowing or incorporation. Cover crops can also prevent the leaching of some soil nitrate to groundwater during wet winters by taking up and storing excess soil nitrogen.

The addition of organic matter is a frequently cited benefit of using cover crops. Soil tilth and water penetration are improved by cover crops for several reasons: glue-like substances produced by roots and associated soil organisms bind soil particles together, improving soil structure; foliage intercepts raindrops, preventing them from striking and dispersing soil particles; and roots add organic matter and create pores in the soil as they die. In many soils, however, it can be very difficult to increase soil organic matter content substantially—the benefit of organic matter additions is more closely related to improved soil tilth and increased soil microbial activity. Wheel traction may also be improved with certain cover crops, especially grasses.

Pest management may also be improved by cover cropping. Some weeds may be suppressed but not eliminated by the use of appropriate species and cultural practices. Some cover crop species have been shown to suppress populations of nematodes. Although cover crops may also attract beneficial arthropods such as spiders, which may reduce insect and mite pests, research on the effects of cover cropping on these pests has shown mixed results.

A well-managed cover crop can also be quite aesthetically pleasing. This aspect can be very important for many coastal and foothill wineries. Attractive species include crimson clover, rose clover, vetch, buckwheat, wildflowers, and many grasses. Unfortunately, cover crops that are allowed to reseed turn brown in late spring and can look weedy. Still, the public is becoming increasingly aware of the environmental benefits of cover cropping, and additional educational activities on the part of wineries can explain the changing look of cover-cropped vineyards.

Potential Drawbacks

One of the biggest drawbacks to using cover crops is their demand for water. Growers in California are under increasing pressure to reduce water use, and cover crops often compete with the vines for soil moisture, potentially reducing production and quality. While some species can be managed to use no more water than clean cultivated soil, some extra water is usually required to maintain optimal vine growth and fruit development.

Cover crops can also compete with the vines for nutrients. For example, winter annual grasses require large quantities of nitrogen and, if allowed to mature, can delay nitrogen availability to the vines and reduce vine vigor. However, this characteristic can be used to advantage in vineyards with excessive vigor. Also, adding legumes to the mix or applying nitrogen fertilizer to the grass can offset

the grasses' demand for nitrogen.

Pest problems may also result from cover cropping. For example, flower thrips may move to vines as cover crops mature in the spring or after they are mowed. Some cover crop species may themselves become weeds if they reseed and grow in an undesirable manner. A notable example is 'Lana' woollypod vetch, which can become a problem weed if it reseeds in the vine row and grows up the grapevines. This problem can be prevented by mowing closely or disking before the vetch reseeds. Another pest problem that may result from cover cropping is the buildup of vertebrate pests, especially pocket gophers and meadow voles. Because these vertebrates can be especially damaging to young vines, growers should consider whether cover cropping in young vineyards is worth the potential risk. Gophers are particularly attracted to perennial clovers and berseem clover, and they may build up wherever vegetation of any kind is pres-ent. Meadow voles eat bark from the lower trunks of grapevines; their damage increases where plants or residues are present next to trunks. Finally, nematode populations may increase in cover-cropped vineyards, although some species may actually suppress nematodes.

Another concern of most growers is the threat of frost in early spring. Cover crops reduce the amount of solar radiation reaching the soil during daylight hours and can reduce air temperatures on cold, clear nights. This phenomenon occurs because bare ground is better than living foliage at storing and radiating solar heat. The duration of lower temperatures may also be longer in cover-cropped vineyards. However, vineyards with closely mowed cover crops and moist soil may be only slightly colder than soil that is bare, firm, and moist. It may therefore be important to avoid species such as bell beans and peas that cannot be mowed closely during periods of frost hazard, or to disk them in before budbreak. Also, planting cover crops in alternate rows leaves a substantial amount of soil exposed, reducing the hazard of frost. Sprinkler irrigation, often used for frost protection, can partially mitigate the cooling effects of cover crops.

Economics

One of the most important drawbacks for many growers is the increased cost usually associated with cover cropping. There is no question that sowing cover crops costs money and requires extra attention, at least initially. Cover crops such as perennials and reseeding winter annuals are sown only once or every few years. For these cover crops, seed and planting costs incurred in one year can be spread out over many years (for specific costs of seed and planting, see table 2-2 and chapter 3).

Cover crops can be included in cropping systems for many different reasons, and the potential benefits impact short-term and long-term farm profitability. Unfortunately, virtually all these benefits are difficult if not impossible to measure in dollar terms. For example, water penetration may improve as a result of cover cropping; this benefit may increase yields over a period of years but may be virtually impossible to accurately quantify. At the very least, the amount of nitrogen produced by the cover crop may not be equivalent to the amount available to the vines. Further, nitrogen produced by this year's cover crop may have a carryover effect in subsequent years. Therefore, a single-season direct comparison of cover crop costs to application of synthetic fertilizers may not be appropriate or plausible. The remainder of this discussion focuses on the annual costs of growing cover crops, with no attempt to measure overall benefits.

A number of factors affect the cost of using a cover crop. The most obvious cost is for the seed itself (see table 2-2). In dry years, fall irrigation may be needed for good stand establishment, and additional water may be needed in the spring. These irrigation costs depend on the cost of water and the type of irrigation system being used. Also, the equipment used for cover crop cultural operations varies among vineyards. For ground preparation, some growers make two passes using a disk with a float attachment before planting. Most growers use a drill for planting, but some use a broadcast seeder. The difference in cost is probably minimal because, although broadcast seeding is faster, a second pass is usually required to incorporate the seed or press it into the soil with a ring roller. Also, some seed is wasted with broadcast planting if there is a herbicide-treated strip. In either case, seeders may be owned or rented. In the spring, growers who plan to disk often mow or flail chop first, but chopping the cane prunings is usually necessary regardless of floor management regime. One or two passes with a disk are then used to incorporate the cover crop. In no-till vineyards, where cover crops are mowed once to several times, depending on the species used and spring rainfall, the cost is similar to no-till management of resident vegetation. A few growers use a power spader, which can cultivate a foot deep or more, to incorporate the cover crop. Although

using a power spader eliminates the need for mowing and a second pass with the disk, the tractor must travel fairly slowly, and power spaders can be prone to mechanical problems.

The total cost of an operation is the sum of the operating costs (fuel, labor, and repairs) and the ownership costs (depreciation, interest, property taxes, insurance, and housing). Therefore, the size and type of equipment used for planting and incorporating the cover crop also impacts the overall cost of the cover crop. Ownership costs vary according to the purchase price, age, and total use of the equipment and can be spread out over total use for the farm. Therefore, increased usage of equipment used for cover cropping decreases the ownership cost per hour by spreading it out over a number of operations.