Environmentally-friendly practices, high elevation, and favorable climate reduce pest pressures

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There are many noteworthy efforts to improve sustainability and environmental stewardship among different California winegrowing regions. Located in the mountains north of Napa County, Lake County winegrowers use fewer pesticides and more low-risk crop protectants than other winegrowing regions in the North Coast and California.

The climate of Lake County is very favorable for wine grape production but not for diseases and pests. The region has many new vineyards that are designed and managed by experienced growers. There are also well-educated crop consultants knowledgeable in environmentally-friendly integrated pest management (IPM) practices to assist growers in pest management decisions. There are many activities in the region to educate growers on sustainable practices:

1. Under the leadership of the Lake County Winegrape Commission

Zinfandel vines in the Madder Lake Vineyard above the east end of Clear Lake (1300 foot elevation), spaced 7 x 5. Tractor rows are mowed once a year in the NO-till vineyard. A Landini or Yanmar crawler tractor with minimal compaction is used in the hillside vineyard and a weed whacker is used to knock down weeds in vine rows.

Common annual grasses and forbes in the Beckstoffer Amber Knolls Vineyard of Cabernet Sauvignon include Soft chess (*Bromus hordeaceus*), Common vetch (*Vicia sativa*), Crimson clover (*Trifolium incarnatum*), and Rose clover (*Trifolium hirtum*).

(LCWC), over 75% of Lake County growers have completed the Code of Sustainable Winegrowing Practices Self-Assessment Workbook.

2. During the rapid expansion of the vineyard business in the 1990s, an Erosion Prevention Education Committee was formed as part of a permitting process that required all new vineyard developments to submit plans for a no-fee county permit that included consultation with the committee composed of: two LCWC growers with large acreage, two LCWC growers with small vineyards, an at-large community member interested in environmental conservation, the UC Winegrowing Farm Advisor, and the NRCS Soil Conservationist. The purpose of the consultation was to encourage the use of Best Management Practices (BMP's) to prevent soil erosion, and conserve native vegetation and habitat.

3. Improving water quality by funding cover crop research with UC Cooperative Extension (see "Performance of 18 Cover Crop Species in New High Elevation North Coast Vineyard," ***PWV*** Sept/Oct 2006); holding well-attended tailgate meetings on Best Management Practices to prevent soil erosion; and conducting a Vineyard Water Quality Planning Short Course (a joint effort between UC Cooperative Extension, Mendocino College-Lakeport Center, and the Lake County Farm Bureau) on water quality issues and help growers prepare water quality plans for their vineyards. Forty producers participated in the effort.

4. From 2002 to 2007, the LCWC organized and funded a sustainable winegrowing education program with five to ten meetings each year that covered irrigation, soil fertility, canopy management, and many aspects of pest management.

5. Funding of ongoing research with UC Cooperative Extension to develop "Soft, Safe, and Sound" integrated pest management practices that reduce pesticide use by creating in-vineyard habitat while protecting soil from erosion, reducing dust, choosing "least toxic" materials if spraying is needed, and augmenting predatory mite populations.

6. Working with the Lake County Air Quality Management District to help the region maintain its position as having the cleanest air in California by reducing dust (cover cropping and minimizing sulfur dust applications) and minimizing agricultural burning (chipping and shredding vineyard waste).

7. Lake County growers have a commitment to alternative farming practices. There is more than 500 acres of certified organic and biodynamic vineyards in the region. The LCWC has also conducted tailgate meeting and seminars on organic winegrowing, partnering with the California Certified Organic Farming "Going Organic" program and UC Cooperative Extension.

More than 100 growers in the Lake County region are taking a very proactive approach to sustainable and environmentally-friendly farming practices. A recent review of pesticide use reports and testimonies from individual Lake County wine grape growers help explain how Lake County growers keep pesticide use low.

Climate

During the growing season, Lake County's elevation (mostly above 1,300 feet) and crystal clear and dry air lead to diurnal temperature swings in most locations (between 40 to 50°F most days). This temperature pattern is less favorable to development of powdery mildew as measured by the UC Davis Gubler-Thomas powdery mildew risk assessment index.

Winters are cold and relatively wet (averaging 35 inches of rain around Clear Lake and up to 70 inches in higher elevation areas). Problem pests and diseases that plague adjoining winegrowing regions have not been detected in Lake County, including Pierce's disease, glassy winged sharp shooter, light brown apple moth, and vine mealy bug (males have been detected in traps but no females have ever been found).

There are other Lake County factors that reduce pest incidence and pest management costs. "Cold winters knock out some pests, and budbreak is later, leading to a shorter growing season," explains Peter Molnar (Obsidian Ridge Vineyard).

Integrated Production

Lake County growers have the goal of farming balanced vines that are not excessively vigorous (which predisposes the fruit to vegetative flavors, the canopy to leaf hopper damage and fungal diseases) or stressed (causing unbalanced ripening, shriveled fruit, and mite attacks on vines) as the foundation of their pest management program.

Cultural practices to dissuade disease include trunk- and cordon-suckering, shoot-positioning, and leaf-

pulling. Self-reseeding annual cover crops are widely planted to prevent soil erosion and reduce dust in the summer, and provide habitat and biodiversity for predators and parasitoids.

Growers work closely with crop consultants to avoid spraying insecticides or any other materials that will actively disrupt predator/prey relationships. Many growers are trying to remove sulfur products from their disease control program to encourage predatory mites and reduce any off-aromas during fermentation.

Fungal disease control

The annual average applications of sulfur in Lake County is 35 to 40 lbs per acre (Figure I). Lake County growers take an IPM approach to disease management. Many growers use the UC Davis Gubler-Thomas powdery mildew risk assessment index to schedule powdery mildew control. Dr. Doug Gubler, UC Extension Plant Pathologist, has worked closely with Lake County growers to educate them on how to use the powdery mildew risk index, and suggest the use of new materials to reduce sulfur use.

Lake County growers have access to local powdery mildew indices and weather information through a publicly-available Lake County Pear and Grape Network of weather stations. (This network is a cooperative effort between UC IPM, UC Cooperative Extension, Lake County Air Quality Management District, the Lake County Department of Agriculture, and three growers who own five weather stations.)

Information is available to growers for disease forecasting, air dispersion, fire hazard, fruit frost hazard, and general weather data. Any grower can access the web-based network at no cost. The LCWC pays for year-round weather forecasts and growing season ET (evapotranspiration) forecasts available on the website.

Several growers emphasize the importance of vine balance and maintaining an open canopy for disease management. Walt Lyon (longtime winegrape grower in Big Valley) has 45 acres of Syrah and Sauvignon Blanc on a lyre trellis that allows the shoots to grow out at an angle rather than positioning them vertically. This promotes air circulation and requires little or no leaf removal. If grape clusters are piled on top of each other, the fruit is thinned so that no clusters touch each other to prevent botrytis.

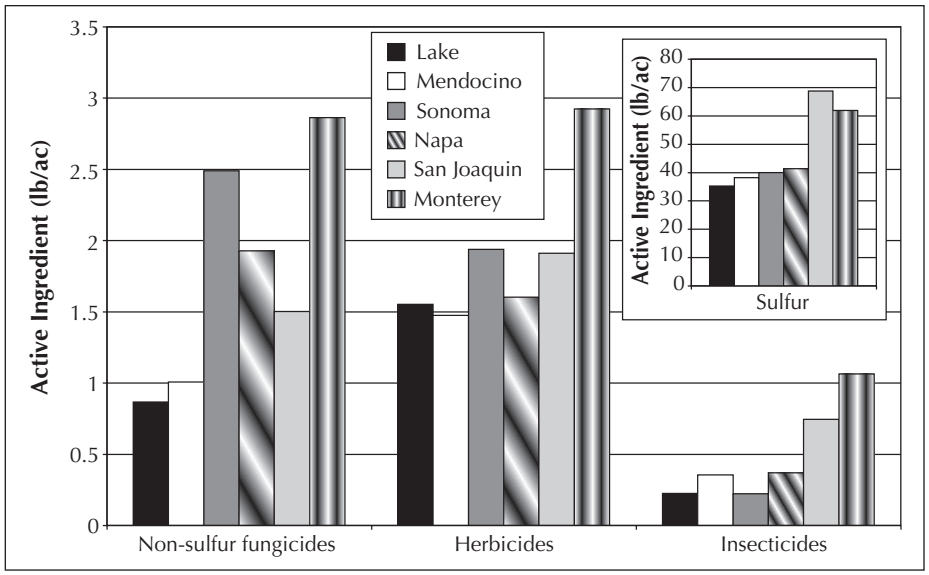

Figure I. Average winegrape pesticide use for 2002–2004 in several pesticide categories for Lake, Mendocino, Napa, Sonoma, San Joaquin and Monterey Counties.

Peter Molnar has experience with a high elevation Lake County vineyard and a cool, coastal vineyard. His 105-acre Obsidian Ridge Vineyard is at an elevation of 2,350 to 2,640 feet in Red Hills, and his family also has a vineyard in Carneros along the Napa River. The varieties grown are suited to the two locations: Cabernet Sauvignon, Syrah, Cabernet Franc, and Petite Verdot in Red Hills; Chardonnay and Pinot Noir in Carneros.

For powdery mildew control in Red Hills, Lake County, Molnar avoids sulfur dust to prevent spider mite outbreaks and applys JMS Stylet-Oil early in the season and wettable sulfur for powdery mildew control pre-bloom.

"We make two to three fewer powdery mildew applications per season in Red Hills compared to Carneros," reports Molnar. With a hillside vineyard location, canopy growth is limited by gravelly soil conditions, permitting better air circulation and reducing costs for leaf removal compared to Carneros.

The Carneros vineyard has substantial Pierce's disease pressure. Molnar has made efforts, at great cost, to limit Pierce's disease damage. Lake County, on the other hand, has never demonstrated a conclusive Pierce's disease find. With a few vineyards at 900 feet elevation and most winegrape growing above Clear Lake at 1,300 feet, winter in Lake County is colder than in many grape growing regions, possibly preventing the Pierce's disease causal agent *Xylella fastidiosa* from establishing a foothold.

Balanced nutrition for healthy vines

David Weiss (owner of Bella Vista Farming Company), emphasizes balanced vine nutrition to avoid pest and disease pressure. His own vineyards and those he manages total 300 acres of Sauvignon Blanc, Gewurtztraminer, Reisling, Zinfandel, Petite Sirah, Cabernet Sauvignon, Cabernet Franc, Syrah, Merlot, Petite Verdot, and Tempranillo.

Mike Boer, of Ag Unlimited, helped Weiss develop a vine nutrition program. Boer's approach is to ensure plenty of plant-available potassium, calcium, and phosphorus that will minimize leafhopper and mite pressure. At the same time, this program maintains better vine health in the presence of phytophagous nematodes and oak root fungus, according to Boer. Weiss credits the fertility program and canopy management with eliminating the need for Botrytis sprays since 1999.

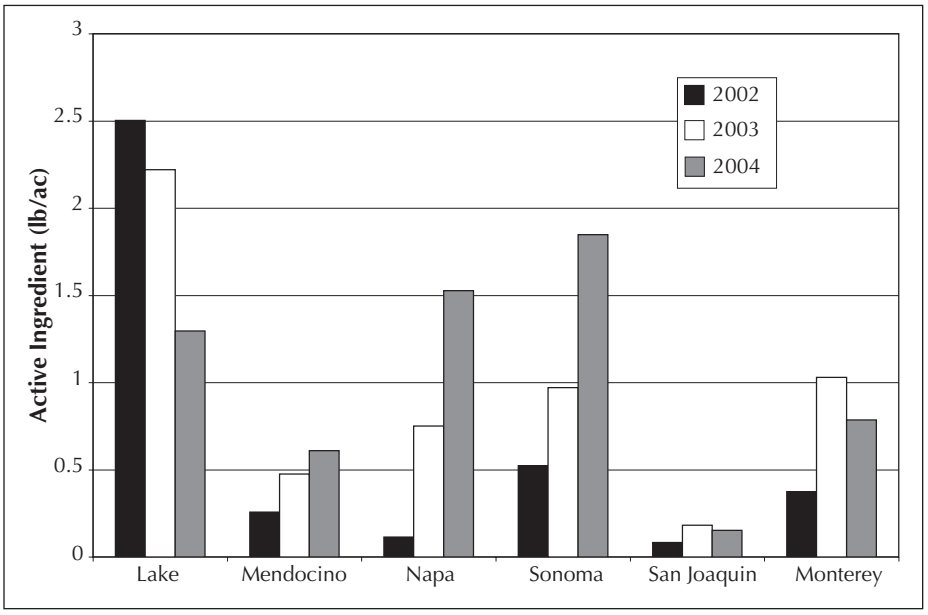

Figure II. Application of horticutural oil for the years 2002, 2003 and 2004 in Lake, Mendocino, Napa, Sonoma, San Joaquin, and Monterey Counties.

Soil tests help Boer to adjust the fertility program for each block. His recommendations depend on the soil. Lake County soils range from high magnesium/low potassium soils in locations influenced by serpentine minerals to high potassium soils in volcanic areas.

Soil amendments are an important part of a sustainable farming approach to improve soil physical qualities and soil fertility.

A typical amendment program will include fall application of four tons per acre of compost (50% winegrape and pear pomace and 50% animal manure), and one ton per acre of lime or gypsum by broadcast-application to the vineyard floor. When needed, micro-nutrients, including zinc, boron, iron, manganese, and copper are applied in early season fungicide sprays.

While compost application might seem expensive, "Where multiple nutrients are needed, it becomes cost-competitive," explains Boer. The compost builds long-term soil nutrient availability, eventually eliminating the need for most drip-applied nutrients.

Boer emphasizes the need to track changes using soil tests: "Eventually compost and amendment rates will be reduced, eliminated, or applied infrequently as needed." Compost also benefits cover crops which can make small contributions of nitrogen to the vineyard soil.

Weed control

When looking at total herbicide use, Lake, Mendocino, and Napa Counties apply very low annual rates (Figure I). This may be due to organic growers and an increasing number of conventional growers who use mechanical weed control. Lake County growers confirm that many herbicide programs are based primarily on Roundup. Pre-emergent herbicides with high-leaching potential are avoided.

With 115 acres of vineyard in Big Valley, 58 of which are in transition or certified organic, Steve Devoto relies primarily on cultivation for weed control. Devoto uses a Pellenc Sunflower in-row cultivator, and if the soil has dried and become too hard, he uses a Bianco cultivator. He has found that the cultivators are hard on vines under two-years-old. In newly planted blocks, sturdy stakes are used to allow cultivation without damaging vines. In some conventional blocks, glyphosate is sprayed for weed control.

Weiss farms both conventional and organic vineyards. For organic weed management, a combination of hoe-plowing under the vine row and disking in the tractor-row is done. In the spring, a hoe plow moves soil out of the vine row. After several weeks, the tractor rows are disked, and, at the same time, soil is thrown back into the vine row to cover weeds that have emerged since the hoe plow pass.

After harvest, soil amendments are applied, and disking throws more soil into the vine row.

Conventional blocks are managed the same way, or vine rows are sprayed with glyphosate supplemented with a low rate of Goal or Chateau for improved control. Weiss has been able to reduce weed sprays to one per year in some conventional blocks.

Insect / Mite control

The experience of Lake County winegrowers confirms relatively little need for pesticides to control leafhoppers and mites (Figure I). Only the grape leaf hopper *Erythroneura elegantula* is found. The parasitic wasp of the leafhopper *Anagrus epos* is widely distributed. Since growers try to keep the canopies in balance, this helps in their integrated approach to managing leafhoppers and often there is no need to spray to control this pest.

Many growers, in valley locations where vines are more vigorous, treat for leafhoppers or mites only every second or third year, and even then, only on 5% to 20% of their vineyard acreage. In upland vineyards, many growers have never sprayed for leafhoppers. Machine-harvesting has enabled many growers to avoid spraying for leafhoppers that would be a nuisance to pickers.

In hillside locations, spider mite infestations are more common than in valleys. Taking an IPM-approach, growers focus on reducing dust by planting self re-seeding cover crops in a no-till management system, and applying dust suppressants to roadways. Some growers have had good success releasing *Galendromus occidentalis* predatory mites.

North Coast counties are fortunate to suffer little damage from *Lepidopteran* (moth) pests such as omnivorous leafroller and orange tortrix, which are more serious problems in warmer regions.

Promoting biological control

The IPM program at Beckstoffer Vineyards (500 planted acres of red wine grapes, primarily Cabernet Sauvignon, planted on rolling, volcanic

terrain of the Red Hills Lake County AVA) is to avoid chemicals that disrupt natural pest control or practices that promote a flare up of pests, including control of powdery mildew and spider mites.

Randy Krag (Beckstoffer vineyard operations manager), credits Frank Anderson (recently retired general manager), with a philosophy of minimizing pesticide application. The slope of the hillside vineyards has dictated a no-till vineyard floor management approach to prevent soil erosion which also reduces dust. Main avenues within the vineyard are graveled and/or treated with dust suppressants.

To avoid a potential increase in spider mite populations, Krag makes no more than two sulfur dust applications per season for powdery mildew control in any block. Powdery mildew control starts with one application of JMS Stylet-Oil, which controls both powdery mildew and mites. This spray is combined with a sterol inhibitor or DMI-fungicide, and is followed by a rotation of fungicide chemistries throughout the season. Products include Flint, Elite, and Quintec.

Since planting of Cabernet Sauvignon in 1999, Beckstoffer Vineyards (Red Hills) has applied no chemical miticide beyond one early season Stylet-Oil application, instead augmenting natural control with predatory mites, *Galendromus occidentalis.* In June (post-bloom), mites are released at a rate of 2,000 per acre. Krag takes delivery of bean plants in small lots, so that the mites can be applied between 6 and 9 AM, before the bean plants (containing the mites) dry out.

Working with UC Cooperative Extension on an experimental basis, Krag has eliminated sulfur completely from the powdery mildew control program, released predatory mites, and applied only 22 ounces of fungicide for the entire growing season with no mite problems or detectable powdery mildew. No insecticides or miticides are used in the trial blocks.

While field-monitoring has not convinced Krag that innoculative predatory mite releases are necessary, it appears to confirm that avoiding disruption of natural control is important. "I see some blocks with lots of predatory mites and no spider mites, so perhaps there is an alternate food source for the predatory mites. I have also seen predation by six-spotted thrips."

Several years ago, the grape leafhopper arrived at Beckstoffer-Red Hills. Lucia Varela (UC North Coast IPM Advisor), encouraged Krag to hold off on chemical control. She advised Krag to be on the lookout for a *Brachonid* wasp parasite. "2007 was the first year that we saw widespread parasitism by a *Brachonid* wasp" reports Krag.

Horticultural Oil application

Stylet-Oil is another tool in Lake County's sustainable winegrape pest management strategy that can be applied for mildew and mite control. Stylet-Oil is typically applied early in the season to control both powdery mildew and spider mites, beginning shortly after the leaves are open (Figure II.).

In hillside vineyards, both Beckstoffer Vineyards and Obsidian Ridge Vineyard apply oil in early season sprays, however in valley locations, where mite outbreaks are less frequent, oil is seldom applied.

Cover Crops

All surveyed growers have cover crop strategies. Besides protecting soil from erosion and suppressing dust, cover crops increase habitat diversity and food sources for biological control agents and their alternate prey.

In Big Valley, Walt Lyon encourages natural predators with a legume-grass cover crop in alternate tractor-rows. The cover crop is mowed in the late spring (May) to maintain habitat for beneficial insects.

In valley locations, David Weiss has seeded a legume-grain mix to add nitrogen and build soil organic matter in developing vineyards. In established vineyards, a *Brassica* mix cover crop is seeded in alternate tractor-rows to repel phytophagous nematodes. All cover crops are disked early in the growing season (April or May).

Steve Devoto seeds a *Brassica* cover crop mix in blocks where he suspects nematodes could be a problem. In other blocks, cover crops are mowed in tractor-rows, only tilling in the vine row.

Almost all hillside Lake County vineyards are managed no-till with a cover crop in the tractor-rows to prevent soil erosion and strip sprayed in vine rows to prevent erosion and control weeds.

At Beckstoffer-Red Hills, the no-till annual cover crop is fertilized in the fall with a balanced fertilizer to promote biomass production and enhance erosion control. After it is mowed in April, the annuals dry out in the well-drained soil. Since seeding during vineyard development, the cover crop composition has self-selected to include rose clover, crimson clover in wet years, and annual grasses such as soft chess, ripgut brome, and Italian ryegrass.

Conclusion

Lake County's sustainable pest management can be credited to two factors: the favorable mountain climate, and grower commitment to sustainable pest management.

The PUR data and interviews show that Lake County winegrowers use a very low amount of pesticides among California wine growing regions. Use of cultural practices including canopy management and cover crops to reduce pest incidence is nearly universal. Increasingly, growers are adopting approaches such as tillage for weed control and promotion of natural pest control to eliminate or greatly reduce chemical use. ■

Pesticide Use Report (PUR) Data Base

In 1990, California's pesticide use reporting program was developed to insure that pesticide use can be easily tracked by commodity, product, and county. It is the most comprehensive in the world. Under the program, all agricultural pesticide use must be reported monthly to the county agricultural commissioner, who in turn, reports the data to the California Department of Pesticide Regulation (DPR). The data is then tabulated, summarized, and made public. The data base can be accessed by anyone with web access and fairly complex reports can be generated. The data base was used to generate the information used in the graphs in this article. For more information, go to this web address: www.cdpr.ca.gov/docs/pur/purmain.htm.