UNIVERSITY OF CALIFORNIA

Santa Barbara

# California Winemaking Impact Assessment

A Thesis submitted in partial satisfaction

of the requirements for the degree of

## Master of Environmental Science and Management

by

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May 2000

We would like to thank our advisors,

Professor Arturo Keller and Professor Magali Delmas,

for their time, patience, and guidance.

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**ABSTRACT**

In 1998, winegrapes were cultivated on more than 400,000 acres in California, a 10 year increase of more than 30%. The pace of wine industry expansion is causing growing concern. This report explores the environmental impacts and socioeconomic benefits of winemaking and examines differences between organic and traditional viticulture. Data were derived from direct mail surveys of wineries and vineyards in Napa, Sonoma, and Santa Barbara counties, and from a survey of wine consumers.

*Significant Results*

- The economic impact of wine on the state economy totaled $33 billion in 1998, representing 3% of California's gross state product.
- In 1998, 34 million pounds of pesticides were applied to winegrapes, however 86% of this mass was sulfur, which has a low toxicity (CDPR, 1999). Other agricultural commodities use greater quantities of toxic pesticides per acre.
- Organic vineyards use less pesticide and synthetic fertilizer. Organic and conventional vineyards, however, reported applying the same mass of fertilizer, on average. Since organic fertilizers are less nutrient dense than synthetic, organic vineyards may have lower nutrient requirements.
- Average production costs for organic viticulture are on the high end of the range of viticulture costs. No significant difference was observed in the average size of organic and traditional vineyards.
- The majority of surveyed consumers had never tried wine from organically grown grapes (WOGG) and do not consider the environment very important in their wine purchasing decisions. However, those who tried WOGG rated it favorably; a significant percentage of this group reported purchasing it regularly.

*Recommendations*

- To capitalize upon a potential marketing benefit, WOGG should be labeled as "wine made from organically grown grapes."
- To reduce costs and minimize environmental risks, vineyard managers should increase the application of Integrated Pest Management.
- The California legislature should regulate vineyard development on steep slopes statewide, or winemakers should voluntarily cease steep slope development.
- A "Sustainable" wine label should be developed; requirements would include standards for minimal fertilizer and pesticide application, erosion management, and water use.

# *Contents*

# Acronyms

| | |
|---|---|
| AOC | Appellation d'origine controlee |
| ARB | Air Resources Board |
| AVA | American Viticultural Areas |
| BATF | "Bureau of Alcohol, Tobacco and Firearms" |
| BIFS | Biologically Integrated Farming System |
| CASS | California Agricultural Statistics Service |
| CCOF | California Certified Organic Farmers |
| CCVT | Central Coast Vineyard Team |
| CDFA | California Department of Food and Agriculture |
| COFA | California Organic Foods Act |
| CWIA | California Winemaking Impact Assessment |
| DPR | Department of Pesticide Reform |
| E3 | "Economics, Equity, and Environment" |
| EDD | Employment Development Department |
| EPA | Environmental Protection Agency |
| ERI | Eco-Rating International |
| ETU | Ethylenethiorea |
| IPM | Integrated Pest Management |
| LWWC | Lodi-Woodbridge Winegrape Commission |
| NASS | National Agricultural Statistics Service |
| NGO | Non Governmental Organizations |
| NOSB | National Organic Standards Board |
| OC | Organochlorine |
| OFPA | Organic Foods Production Act |
| OGWA | Organic Grapes into Wine Alliance |
| PCA | Pest Control Advisors |
| PPS | Positive Points System |
| PUR | Pesticide Use Reporting |
| RUP | Restricted Use Pesticide |
| RWQCB | Regional Water Quality Control Board |
| SAREP | Sustainable Agriculture Research and Education Program |
| SI/NI | Somewhat Important / Not Important |
| TAC | Toxic Air Contaminants |
| UCCE | University of California Cooperative Extension |
| USDA | United States Department of Agriculture |
| VI/I | Very Important / Important |
| WOGG | Wine from Organically Grown Grapes |
| WRAP | Waste Reduction Awards Program |

# 1. Introduction

The wine industry is a large and influential sector of the California economy. By virtue of sheer size, the industry substantially influences California's environment. In 1998, wine generated $33 billion in economic activity within California, and $48 billion nationwide. To generate these economic benefits, wine grapes were cultivated on over 400,000 acres. Presently, the wine industry is in a state of dramatic flux. Acreage under wine grape cultivation has grown by more than 30% over the last 10 years.

The state is home to thousands of individual wine grape growers and more than 800 independent wineries (Wine Institute, 2000). These wineries vary in size with annual production ranging from tens to millions of cases. Within this diverse group, techniques of viticulture and winemaking vary considerably, as does the perceived environmental impact of production and cultivation processes.

This report explores the extent of the environmental and socioeconomic effects winemaking has upon the state of California. The industry has the potential for impacts on several fronts. Wine-related jobs and tax revenues enhance the state economy and help shape the social fabric of the state. Vineyards use land, water, pesticides, and fertilizers to produce wine grapes, affecting the state's environment. In an effort to both minimize the environmental burden of viticulture and continue to provide wine-related jobs, some California wineries are choosing to market wines that are made from "organic grapes". However, few comparative studies have been undertaken to date which detail differences in both costs and environmental impacts of "organic" and traditional viticulture.

This report addresses four key questions:

- What does the California economy gain from vineyards and winemaking?
- What is the effect of the wine industry on the state's environment?
- What are the significant differences between organic and traditional viticulture, if any?
- Do consumers care about environmental impacts related to wine, and would their choices be affected by additional information?

These four questions are examined through a quantitative analysis of the environmental and socioeconomic effects of wine grape cultivation and wine production. Three counties are singled out for intensive study: Napa, Sonoma, and Santa Barbara. These counties represent three of California's prime wine production districts, dominated by small-scale growers and winemakers who predominantly produce premium wines.

This California Wine Impact Assessment (CWIA) fills a gap in the body of publicly available literature, between isolated analyses of individual aspects of the life cycle of wine and broadly focused but unpublished or entirely qualitative works. Previous research programs with similar goals include a semi-quantitative assessment system developed by the Swiss consulting company, Eco-Rating International (ERI) in 1995. ERI's system involves compilation of a set of "ecologically relevant" statistics for individual California wineries into a single rating scale (Baum, 1997). Unfortunately, ERI has published few of its results; publications derived from the study are limited to conference poster abstracts, and an aggregated qualitative summary available on their corporate website. The usefulness of their rating system is limited because it is proprietary, preventing critical analysis of the weighting factors they employ to integrate a host of environmentally related information into a single number. The Central Coast Vineyard Team (CCVT), a non-profit consortium of local wine grape growers and technical advisors from the University of California Sustainable Agriculture Research and Education Program, has also developed a rating system for vineyard management (CCVT, 1999). The CCVT Positive Points System (PPS) is a qualitative self-assessment which allows vintners to determine for themselves how far they have gone in implementing reduced risk vineyard management practices. Though the organization collects PPS data from CCVT members, the results are not available to individuals outside the Central Coast Vineyard Team.

The CWIA approach uses a set of indicators of environmental and socioeconomic conditions to analyze the differences in impacts of three classes of wine grape cultivation: organic viticulture, viticulture which relies upon Integrated Pest Management Technology, and traditional viticulture.

This report is organized in the following manner. Chapter 2 provides an introduction to the history of winemaking in California and the processes of grape cultivation and winemaking. Understanding these processes is useful in comparing variations on basic techniques. Comparison of organic and traditional vineyard management techniques requires a clear definition of what it means to be "organic". Organic standards are still under debate at the federal level. It was therefore necessary to review current standards of organic agriculture proposed by California, the USDA, and non-governmental organizations. Questions of state and federal enforcement are addressed. From this review, a working definition of what it means to be organic is chosen for the remainder of the project.

The socioeconomic effect of the winemaking industry on the state of California is examined in Chapter 3. This examination of the contribution of the wine industry to the state's economy includes a thorough review of the direct and indirect employment resulting from the sale of wine, the value of wine as a commodity, and the contribution of the wine industry to state, local, and federal tax revenues. Since images of gently rolling hills covered by vineyards and elegant wineries attract many visitors to the state, the contribution of the wine industry to California's tourism industry is also considered.

Chapter 4 explains the CWIA research approach in detail, revealing what the current available literature is able to supply. It goes on to explain why a significant portion of the information required to address our research questions had to be gathered through surveys. Three questionnaires were developed in the process of compiling this report, targeting both people employed by the wine industry and wine consumers. Industry practices were examined by a survey of vineyard managers and a survey of winery managers, referred to as the Vineyard Survey and the Winery Survey, respectively. The market survey is referred to as the Consumer Survey.

The results of the questionnaires are presented in Chapter 5. To address the question of differences between organic and traditional vineyards, Vineyard Survey respondents are divided between certified practitioners of organic viticulture, and vineyards managed with standard industry practices. The Winery Survey examines the role of environmental concerns in winery management. Consumer Survey results are examined to determine whether wine buyers incorporate environmental concerns into their wine purchase decisions.

In isolation, the question of whether organic or traditional viticulture is environmentally preferable does yield a comprehensive picture of the environmental impact of wine in California. In order to assess the impacts of the winemaking industry, grape cultivation and wine production are analyzed separately.

Chapter 6 explores the environmental impacts of wine grape cultivation. Impacts addressed in Chapter 6 include conversion of land to vineyards, material inputs such as pesticides and fertilizers, and the demands irrigation places upon state water supplies. Through examination of these factors, risks to air, soil, and water quality are addressed. Though the focus of the analysis is the industry as a whole, differences between organic and traditional agriculture are examined to gauge the effect of management practices on relevant impacts. Production costs for organic methods are compared with more traditional approaches. Recognizing the fact that vintners employ a wide spectrum of cultivation practices, the chapter concludes with a discussion of Integrated Pest Management (IPM). In the debate over the sustainability of organic and traditional agriculture, IPM has been proposed as a middle ground. Discussion of IPM focuses on the activities of the Lodi-Woodbridge Wine Grape Commission, a group currently promoting intensive application of IPM techniques in San Joaquin County.

Wine production and marketing is explored in Chapter 7. The primary impact of wine production addressed by this report is wastewater generation and treatment. Our analysis further addresses the implications of the current debate regarding internet-based wine sales for both traditional and organic wine producers. The chapter concludes with a discussion of consumer interest in wines marketed as environmentally preferable.

To complete our examination of organic viticulture, a case study of a large scale wine company that has gone organic is included in Chapter 8. The CWIA project was fortunate to gain the cooperation of Fetzer Winery in Hopland, California for this case study. Fetzer was an ideal choice because they own vineyards that are being cultivated using both organic and traditional methods. The case study examines what practices are being employed, whether or not they see themselves as successful, how they integrate environmental concerns into all of their operations, and whether the Fetzer approach can be applied to other wineries.

The concluding chapter, Chapter 9, is a presentation of the overall impacts identified in this research. A summary of environmental and socioeconomic indicators is included; these indicators could be used by future researchers, winemakers, or governments to track changes in the industry's impact over time.

# 2. Background

The winemaking industry has a rich history in California; it has been integral to the development and character of the state. California continues to be a leader in the United States wine industry as well as having a reputation that holds its own next to the highest quality wines of Europe. Identifying the impacts of winemaking requires a general knowledge of the procedure of cultivating the grapes and fermentation process that converts grape juice into wine. Following this, a review of the current industry standards of what it means to produce organic grapes and wine is discussed. From this review, a working definition of what it means to be organic is chosen for the remainder of this report.

## History of California Wine

No one knows how far back winemaking goes; wine was mentioned in many texts from ancient Mesopotamia, Egypt and Gaul. The Epic of Gilgamesh has many stanzas singing the praises of wine, as does the Song of Solomon. After the collapse of the Roman Empire, the craft of winemaking was preseved by the Christians who needed it for mass. Monastic Christian orders were among the first to set out vineyards in what are now some of the most highly regarded wine-growing regions (Balzer, 1984).

The history of wine in California began in 1697 when Father Juan Ugarte planted vines at Mission San Francisco Xavier in Baja California. Then in 1769, Spanish missionaries introduced the art of viticulture to California. In keeping with the Christian tradition of using wine in religious ceremonies, Padre Junipero Serra planted the first vineyards at Mission San Diego and missionaries continued to cultivate grapes at most of the twenty-one missions that were established. California's first vintage is believed to have been produced in 1782; the wine was made from a variety of the European *Vitis vinifera* now called the Mission grape (Winkler 1974).

The first American viticulturalist in California was Joseph Chapman, who planted a 4,000-acre vineyard of Mission grapevines in Los Angeles in 1824. In 1833, Jean Louis Vignes recognized the inferiority of the Mission grapes and planted 35 acres of unknown varieties of *Vitis vinifera*, establishing the El Aliso Vineyard in Los Angeles. Vignes is often considered the father of the California wine industry (Pinney, 1989).

In the late 1800's, California wines began to rival East Coast wines in quality. The competition between the two coasts became fierce and petty rivalries began to spring up. Eastern vintners began to accuse California wineries of selling their wines under counterfeit French and German labels, and started putting California labels on inferior wines

(Geraci, 1997). During and after the gold rush, immigrants from Germany, France, and Italy made a fortune in winemaking instead of gold. From 1861 to 1919 winemakers such as Jacob Schram, Charles Krug, Joseph Korbel, and Georges de Latour all planted their first vines here. California led the nation in wine production when it became a state in 1850, ousting Ohio as the leading producer (Pinney, 1989).

In 1880 the Los Angeles wine industry was infected by insect-borne bacteria nicknamed "Anaheim disease." The Mission grapes that dominated the area were especially vulnerable to this disease, and as a result the vineyards were decimated. In 1891 there were fourteen acres of grapes left in the Anaheim region. Premium grape varieties which are more resistant to this disease flourish in cooler climes; consequently the wine industry moved northward. With the success of the new wineries, California legislature did not want to hinder the industry and exempted vineyards from taxation in 1859 (Geraci, 1997).

Funding for the development of agricultural experiment stations was provided by the Hatch Act of 1887. Taking advantage of this, the University of California at Berkeley planted vineyards and established an enology and viticulture program. The program moved to its present location at the University of California at Davis in 1938.

In 1873 grape agriculture was again victim to an infestation, this time by the phylloxera insect. This insect was first discovered in Sonoma and observed to be slowly spreading. Growers ignored its presence until it became apparent that the problem was not going to disappear. The University of California offered a solution: the use of native rootstocks, which are not affected by phylloxera. Unfortunately, vineyardists were slow to heed the University's advice and by 1888 only 2,000 acres had been replanted with native rootstock. About 10,000 acres were destroyed between 1889 and 1892, and by 1900 there were only 2,000 bearing acres remaining in Napa (Pinney, 1989).

The industry was then dealt another blow in 1919 with the passing of Prohibition. The purchase of distilled liquors, including wine, was banned. Unable to purchase wine, consumers had to make it themselves. Home wine production went from 50 million gallons a year to 76.5 million gallons during Prohibition. Home winemakers were permitted to make 200 gallons per year for family use. Nationwide, per capita wine consumption was at 0.47 gallons before Prohibition, and 0.64 gallons during Prohibition.

"When Prohibition ended, most of the American industry had been shut down for twenty years, and to a certain extent, they had forgotten how to make wine. The University of California at Davis was instrumental in encouraging the industry to make sound, safe wines through the meticulous application of the scientific method-primary chemistry, tightly controlled fermentation, meticulous sanitation, and heavy filtration," claims Josh Jensen of the Calera Winery (DeVilliers, 1994). After Prohibition was repealed, the wine industry faced 48 different sets of regulations for sale, transport, taxation and distribution of their products. Despite heavy regulation, over 380 wineries reopened after Prohibition across the United States. The California Wine Institute was founded in 1935 to cope with the different regulations (Pinney, 1989). The years following the repeal of Prohibition produced little wine of interest, though UC Davis was quietly continuing its research. The Gallo brothers were laying the foundation for their extraordinary dominance of American winemaking. It was not until the 1970's that California noticed that it was producing wines of great character and complexity in numerous small pockets around the state. In the late 1970's the famous Paris Tasting pitted the best American wine against the finest European vintages; to Europe's chagrin America triumphed, and the enological world was at last forced to accept California as one of the premier wine regions (Balzer, 1984).

In the 1960's and 70's winemaking became a popular corporate investment and wineries were purchased by companies with little or no experience in the wine business. There were several companies that bought into the industrry, for example Nestle of Switzerland invested $6 million dollars into Beringer, Coca-Cola bottling of New York bought Franzia, and Pillsbury invested in Napa and Sonoma. This period of investment was followed by drought, recession, and competition from imported wines in the 1980's. In the 1950's imports only accounted for 5% of the American wine market, but by 1984 they had claimed a 25%  market share. Today, imports account for 75% of the total U.S. wine market (WIne Institute, 2000).

## The Grape Cultivation Process

Growing wine grapes is a complicated process. There are many factors to consider when initially planting vines such as vine density, type of irrigation, and which grape type(s) is best suited to the soil and climate. Once the vine is established then there are decisions to be made about the level of pruning, trellis type use of fertilizers and/or pesticides and vineyard water use.

Grapes need to be planted in soil that is favorable to root growth including good aeration and good internal and surface drainage. Soil conditions can affect the quality of wine and are often considered the most important factor in planting a vineyard. The French word, *terroir*, is used to describe all the ecological factors that make a particular type of wine special to the region of its origin. For many French winemakers the soil is considered the "soul" of a vineyard. French officials used terroir to justify the "appellation d'origine controlee" system (AOC) to protect French regional wines in 1911 (Sawyer,1998). In the United States, American Viticultural Areas (AVAs) are designations that try to protect particular growing regions and link flavor differences among fine wines to biogeography instead of winemaking.

In addition to soil, rainfall and temperature also need to be considered when initially planting a vineyard. Wine grapes are best grown in regions that have few or no summer rains. Grapes need to be planted where the winters are mild, there is freedom from frost, and there is full sun exposure. Dormant bare-root grapevines should be planted in the spring after the last hard freeze. Vines start producing grapes about three years after planting and a useable crop after five years. Although grapes can grow for hundreds of years, they reach their prime in terms of crop yield between ages ten and thirty. Production is reduced as the vines get older.

Even though there may be sufficient rainfall, growers use irrigation to control plant growth more efficiently. Many vineyards use drip irrigation to minimize excessive water use, and as competition for water in California increases, it is even more important. Agriculture will be under increasing pressure to reduce water consumption. Irrigation can be used to maintain or increase vine vigor (rate of growth), prevent occasional water stress throughout the season or during drought years, attempt to stimulate fruit development (berry size), or attempting to alter fruit quality by influencing soluble solids, pH or titratable acidity. To irrigate properly factors such as soil type, depth, water-holding capacity and infiltration rate, and the effective rooting zone of the vines must be taken into consideration. Soils with low infiltration rates and with a significant slope also present runoff problems for overhead sprinkler systems with high delivery rates. Drip irrigation can accommodate all of these situations but has a higher initial capital-investment cost and is generally considered to require a higher level of management (Wine Business Monthly, 2000).

Vines are pruned to a desired form to facilitate vineyard operations and to save labor. Pruning, which consists of removing living canes, shoot, leaves and other vegetative parts of the vine, distributes the bearing wood over the vine to decrease the need for thinning as a means of controlling crops. Pruning determines the number and position of the buds that develop.

Grapes cannot be grown successfully without structural support. The trellis system can greatly affect the amount of yield of the vines and the amount of vegetative growth. Trellises can also impact the microclimate within the vine's canopy by changing the distribution of leaves. The type of trellis is chosen by the climatic conditions of the area, pruning and harvesting methods, and soil characteristics. Trellises also must be designed to accommodate harvesting machinery if it is going to be used.

The density of the vines within and between rows affects growth of individual vines and can affect the productivity of vineyard. In general, as vine density increases, yield per vine decreases, but yield per acre increases. Most vines are planted with nine to ten feet between rows and the spacing between vines is usually eight feet. However, if the grapes are going to be mechanically harvested, then the grapes have to be spaced to accommodate the machinery.

## The Winemaking Process

In order to fully appreciate how wine is made, a detailed description of the entire process is needed. The technique of winemaking is complicated, yet delicate. There is a general methodology that is followed by most wineries, although each vintner may fine tune the procedure to achieve a desired quality in the wine.

The winemaking process consists of four phases: grape cultivation and harvest, fermentation, clarification, and aging. Jackish (1985) characterizes the phases of wine production according to the process which dominates each segment of the operation; cultivation is macrobiological, fermentation is microbiological, clarification is largely physical, and successful aging is a chemical process. There is a degree of overlap between the processes.

### Harvest

Wine grapes are considered ripe when there is an optimal balance between sugar content and acidity. The optimal balance is selected by individual growers and will vary across vineyards, and varieties. Ripe grapes are harvested either by hand or by mechanical harvesters. While grapes that are harvested by hand are typically shipped whole to wineries, mechanically harvested grapes may be crushed in the field or shipped whole, depending upon the equipment employed. Immediate crushing is sometimes employed by high-volume operations to reduce the potential for oxidization of grape tissues damaged by the harvester (Skofis, 1981).

Within a few hours of harvest, all grapes are delivered to the winery, whether it is onsite or the grower is selling the grapes to another vintner. Harvested grapes are inspected for soluble solids, defects, and non-grape materials such as leaves (Skofis, 1981). In commercial winemaking, incoming grapes are weighed, inspected, and unloaded into a stainless steel hopper, a conveyor carries the grapes to the crusher. The crusher separates the berries from the stems and pumps the juice, skins, pulp, and seeds into a fermenting tank. Stems are discarded or retained for the vineyard soil, except in the case of a few grape varieties, such as Pinot noir, where some of the stems are retained to enhance the flavor of the wine by increasing extraction of tannins during fermentation. The slurry of crushed grapes is called “must”, though the term can also be applied to the juice or “meat” of the berry prior to crushing.

Sulfur dioxide ($SO_2$) is added immediately after crushing, primarily to control enzymatic oxidation of the juice. $SO_2$ is a gas; it’s partial pressure within the must is generally augmented by addition of potassium metabisulfite or (in large operations) it may be bubbled into the must as gaseous $SO_2$. The amount of $SO_2$ required is a function of the variety of grapes employed and their condition at harvest. Grapes which are bruised, broken, moldy, hot, low in titrable acid, or possess excessively high pH require more $SO_2$. Grapes from California's North Coast are generally treated with 70-100 mg/L $SO_2$ (Long,1981; Martini, 1981).

## Fermentation

Ethanol fermentation is the process by which sugars in the must are respired anaerobically, producing ethanol. The process commences as soon as the grapes are crushed; grape skins naturally harbor wild yeasts capable of producing ethanol. The enologist may allow the natural yeast to ferment the wine, or add a specific yeast culture, generally a strain of Saccharomyces cerevisiae. Wineries applying a specific strain in fermentation may wash the uncrushed grapes with a $SO_2$ enriched solution prior to crushing and addition of the yeast culture.

This is the point where red, white, and rose wine production diverge. The following description will apply to red wines. Red wines are fermented with the skins for 3-7 days; this process gives the wine its color as pigments and tannins are extracted from the grape skins. During fermentation on the skins, the skins float to the top and form a cap at the top of the fermenting chamber. The cap must be periodically submerged, or "punched down" into the juice in order to keep the it from overheating, which can result in spoilage or bad flavor. In large scale fermentations, physically pushing the cap into the juice is too labor intensive; the vintner must instead pump juice from the bottom of the fermenter to wash over the cap. A key step in making a red wine is fermentation of the must with the skins; this period largely determines the ultimate color, flavor, astringency, texture, and longevity of the wine (Martini, 1981). The juice is then drawn from the skins and may be transferred to a vented chamber for continued fermentation. Pomace, the material remaining after draining the original fermenter, is pressed to extract any additional must held within the skins and seeds. The product of this pressing is typically very astringent; it may either be blended into the free run juice or it may be vinified separately and mixed at a later stage.

By contrast, the free run, or unpressed juice, from a white wine is drawn off through a screen either immediately after pressing or within about two hours.

Malolactic fermentation is a process whereby bacteria convert malic acid to lactic acid, which begins while yeasts are still fermenting sugars in the must to ethanol. Since lactic acid has fewer carboxyl groups than malic acid, this process reduces total acidity and raises pH. The process may occur without manipulation by the winemaker if the fermenting tanks harbor natural flora capable of such a decomposition. Some winemakers choose to inhibit malolactic fermentation by adding $SO_2$ (Martini,1981). This is not entirely uncommon in California, because increased pH can reduce stability in the wine. As a result of the state's climatic stability, California's grapes are typically higher in sugar and lower in acidity than grapes cultivated in the East or in Europe.

### Clarification

Once fermentation is complete, the bulk of suspended solids is removed from wine through either racking, centrifugation, or filtration. Racking is the slowest process, working best in small containers such as barrels and potentially requiring several months. After solids naturally settle out of the wine, the wine is siphoned off the lees (settled solids) and stored in a new container. This process is generally repeated several times.

Centrifugation and filtration are considerably faster and often used in combination; centrifugation is employed first to remove the bulk of solids which might otherwise clog a filter, while a diatomaceous earth filter does a better job removing low density solids. Using filtration alone, the wine may be excessively exposed to oxygen, reducing quality (Amerine, 1981).

### Stabilization

To be classified as stable, a wine must not develop a haze or precipitate when exposed to normal shelf conditions. When a wine is heated, protein precipitation may cause the wine to become cloudy, while cold conditions can induce the precipitation of potassium bitartrate crystals. To reduce the protein content of the wine, one of several flocculants can be added: bentonite clay, milk powder, egg whites, or even blood. Excess bitartrate is removed from white wines by chilling to induce precipitation. These materials are removed by further racking, centrifugation, or filtration (Amerine, 1981).

### Aging

During the aging process, wine quality is generally improved through slow oxidation. The optimal conditions for aging occur in barrels; barrels as small as 50-60 gal. are optimal (but expensive) in producing a full bodied wine (red and white) because of their high surface area to volume ratio. The duration of aging varies considerably with grape variety and the goal of the enologist.

## Current Industry Standards of Organic Agriculture

In order to assess the environmental impact of organic and conventional methods of wine grape growing and winemaking, we must first define what the term "organic" means. The pertinent regulations with respect to organic agriculture are the federal Organic Foods Production Act of 1990 (OFPA) and the California Organic Foods Act of 1990 (COFA). These regulations are explained in greater detail in Appendix E. These acts encompass all organic crop, livestock, and dairy production. Currently, these standards for organic farming and food processing are still undergoing revision and review as regulators, farmers, and the public debate about what should become law (See Appendix E for latest developments). The most active debates concern the inclusion or exclusion of genetically modified foods, certain ingredients in processed foods, and bovine growth hormone usage.

There are also definitions from third-party certifiers such as the California Certified Organic Farmers (CCOF) that seek to codify the various definitions of organic into one certifiable meaning. The 120-page CCOF list of standards provides detailed restrictions, which include prohibiting any synthetic additions to plants or soil. In addition, all fertilization and pest management agents must originate from 100% naturally occurring substances that can break down organically in the vineyard. CCOF requires that the COFA standards be met and will certify all, crop and livestock-based farms that meet the CCOF standards on an annual basis. When the CCOF standards are applied to vineyards, "organic" means that there has been *no application of synthetic pesticides, herbicides, and fungicides to the plants for at least three years prior to harvesting*. Since the CCOF is the largest third-party certifier in California and most farmers agree to its definition of organic, the CWIA has chosen to use the CCOF terminology when referring to organically grown grapes.

Organic, as it applies to wine, is much more difficult to determine. The main controversy surrounding organic wine is the inclusion of sulfites in the winemaking process as a preservative. In France, Italy, and Germany, an organic wine must first come from organic grapes and be made according to regulations governing filtering and fining, but *can* contain up to 100 parts per million of sulfur dioxide and still receive an organic distinction. In the United States, this is not the case and is the focus of an ongoing debate. The current National Organic Standards Board (NOSB) proposed rule allows processed foods, including wine, to be labeled as organically grown and processed if permitted inorganic substances comprise no more than 5% of the product by weight (excluding salt and water from the weight limit). If the current proposed rule went into effect, wines that are 95% organic by weight and use only sulfur dioxide gas (not potassium metabisulfite) bubbled through the wine as a sulfite stabilizing agent would be given an organic distinction.

Producers of wine made with no added sulfites argue that the proposed standards are too lax and that wine with a total sulfur content of 10ppm or less should be granted organic wine status. The reason for allowing the 10ppm is because sulfites do occur naturally in wine grapes. There are still others that argue wine should not be labeled organic if *any* inorganic substances are added to the wine. Currently, the Bureau of Alcohol, Tobacco and Firearms (BATF) requires that all wine containing more than 10ppm sulfites be labeled with "Contains Sulfites." Since the definition of organic wine is still under contention and consequently 'Organic Wine' does not exist under US law, the CWIA has chosen to refer to it as 'Wine from Organically Grown Grapes' or WOGG.

# 3. State of the Industry

Though grown in over 40 states, California produces almost 90% of the nation's grapes. In the last decade the U.S. grape crop has more than doubled from $1.35 billion in 1987 to $3.1 billion in 1997. In addition, the crop yield has increased almost ten fold, and it is the highest value fruit crop in the nation and the sixth most valuable crop overall. Grapes processed for wine and juice now make up 67% of the entire national crop compared with about 30% in 1969 (American Vintner's Association, 1999). Profitability and increased demand for wine grapes has driven the rapid expansion of the wine industry (MKF, 2000). California continues to be a leader in both grape cultivation and wine production. The coupled industries have significant impacts on the state economy, as shown in Table 3.1.

Table 3.1 Major economic impacts of the California wine industry in 1998 (MKF, 2000).

| | |
|---|---|
| Number of grape growers | 4,400 |
| Full-time equivalent jobs | 145,000 |
| Wages paid | $4.3 billion |
| Retail value of all wine produced | $12.3 billion |
| Tourism expenditures | $1.2 billion |
| Taxes paid in California | $1 billion |
| Taxes paid nationwide | $3.1 billion |

## Employment

The California wine industry currently provides 145,000 full-time jobs to Californians, and an additional 40,000 to 50,000 jobs during the fall harvest (MKF, 2000). In Santa Barbara County, 600 people work full-time in the wine industry and more than 2,600 are employed part-time or seasonally. The county's total wine-related payroll exceeds $30 million per year (Gomberg, 1999). Studies conducted by Wine Business Monthly in 1997 and 1999 of 300 wineries show significant salary increases for wine workers in the last two years. California is at the top of the pay scale for winery employment.

Employees of larger vineyards are typically paid much more than their counterparts at smaller vineyards. In 1997, vineyard managers made an average of $33,300 per year; by 1999 the mean salary of vineyard managers had increased to $41,572, a gain of nearly 25 percent. Vineyards over 200 acres offer the highest income for most positions; vice presidents of vineyard operations and directors of vineyard operations hold

Table 3.2 Mean 1998 salaries for selected vineyard and winery positions (Wine Business Monthly, 1999).

| Position | Vineyard size | Mean salary |
|---|---|---|
| Directors of vineyard operations | >200 acres | $78,385 |
| | 40-200 acres | $40,000 |
| Viticulturalist | >200 acres | $56,398 |
| | 40-200 acres | $33,000 |
| Average of all full time workers | >200 acres | $21,705 |
| | 40-200 acres | $18,310 |

the highly remunerated vineyard management positions, earning nearly twice as much as their counterparts at smaller vineyards, as shown in Table 3.2. A breakdown of industry aggregate wages is shown in Table 3.3.

Though they are generally not as well paid as their counterparts at large wineries, small winery employees are responsible for a wider array of duties, saving the winery or vineyard the cost of hiring additional personnel. With growth in vineyard production and California's wine industry, the rise in vineyard employee salaries may continue as long as the economy is booming. Since the practice of making wine begins in the vineyard, filling these positions with quality employees is vital to a winery's success (Wine Business Monthly, 1999).

Table 3.3 Sum of wages earned by California winery employees in 1998, in millions of dollars (MKF, 2000).

| On-site labor | Total wages |
|---|---|
| Winery employees | $641 |
| Vineyard employees | $597 |
| Vineyard development, contracted services | $397 |
| Vineyard development, vineyard employees | $283 |
| **Off-site/indirect labor** | |
| Tourism employees | $218 |
| Distributor employees (wine only) | $100 |
| Glass manufacturing | $70 |
| Label design and printing | $56 |
| Box and bag-in-a-box production | $46 |
| Grapevine nurseries | $27 |
| Trucking | $26 |
| Liquor store (wine specific estimate) | $20 |
| Cooperage | $12 |
| Corks, capsules, and screwtops | $7 |
| Stainless steel tank manufacture and installation | $5 |
| Education | $4 |
| Wine analysis laboratories | $2 |

## Sales

The California wine industry has a total economic impact of $48 billion nationwide. Although the actual volume of wine sold has not significantly grown in recent years, California wineries have been seeing a definite increase in their profits. This is due to the fact that American consumers have shifted towards higher quality wines. Table wines account for 88% of total wine volume in the U.S., with the remaining 12% divided roughly equally between dessert and sparkling wines. Over the past year, the segment that showed the largest percentage increase was the “super-premium” wines in the $7-$14 range (Wine Institute, 1999). California wines account for roughly three out of every four bottles sold in the U.S. The demand for U.S. wines abroad is steadily increasing, with California wines contributing 98% of U.S. wine exports. In 1998 wine exports grew to $506 million. From 1989 to 1998, wine exports grew at of 20% per annum. The largest export markets for U.S. wine are the United Kingdom, Japan and Canada. In 1998, California wine industry sales were $13 billion. To put that into perspective, Hewlett-Packard had a net revenue of $47 billion (Rachman, 1999) In Table 3.4 the total sales of the largest wine producing companies are presented.

In June of 1999, Gomberg, Fredrickson & Associates a winery consulting firm published the results of a survey of Santa Barbara County growers, vintners, and professional vineyard managers. Eighty-one percent of the wineries participated in the sur-

Table 3.4 Wine related revenue for California in 1998 (in millions of dollars).

| | |
|---|---|
| Total winery sales revenue | $7,900 |
| Retail and restaurant wine sales in California | $4,425 |
| Distributors sales in California | $3,000 |
| Wine grapes | $1,600 |
| Tourism | $1,200 |
| Glass | $1,150 |
| Tax revenues | $1,002 |
| Financing revenues–Debt | $886 |
| Vineyard development | $643 |
| Vineyard development materials, excluding vines | $373 |
| Corks, capsules, and screwtops | $175 |
| Box and bag-in-a-box sales | $170 |
| Wine labels | $106 |
| Grapevines | $81 |
| Trucking | $63 |
| Charitable contributions | $62 |
| Cooperage | $56 |
| Financing revenues–Equity | $20 |
| Stainless steel tanks | $11 |
| Wine analysis laboratories | $4 |
| Grapevine assessments | $2 |
| Research | $2 |

vey, and 58% of the growers participated. This survey demonstrated that the wine industry in Santa Barbara County has become the largest and most important agricultural business. The value of the grapes alone is $59 million, the third highest value crop after broccoli ($74 million) and strawberries ($71 million). Since 1996, planted grape acreage has increased by 5,500 acres to 16,500 acres, and it is estimated that county vineyards will exceed 20,000 acres by the year 2000. Santa Barbara County wine industry's direct revenues increased by 35% to $136 million. In 1992 there were 34 wineries, while today there are over 56. The number of cases of wine has doubled since 1992 surpassing one million cases. Santa Barbara County grapes are the third highest in price just behind Napa and Sonoma. The ten largest wineries in Santa Barbara County produce 80% of the county's total wine volume (Gomberg, 1999). In California the ten largest wineries produce approximately 70 million cases while the majority of the wineries produce less than 25 thousand cases which can be seen in Figure 3.1.

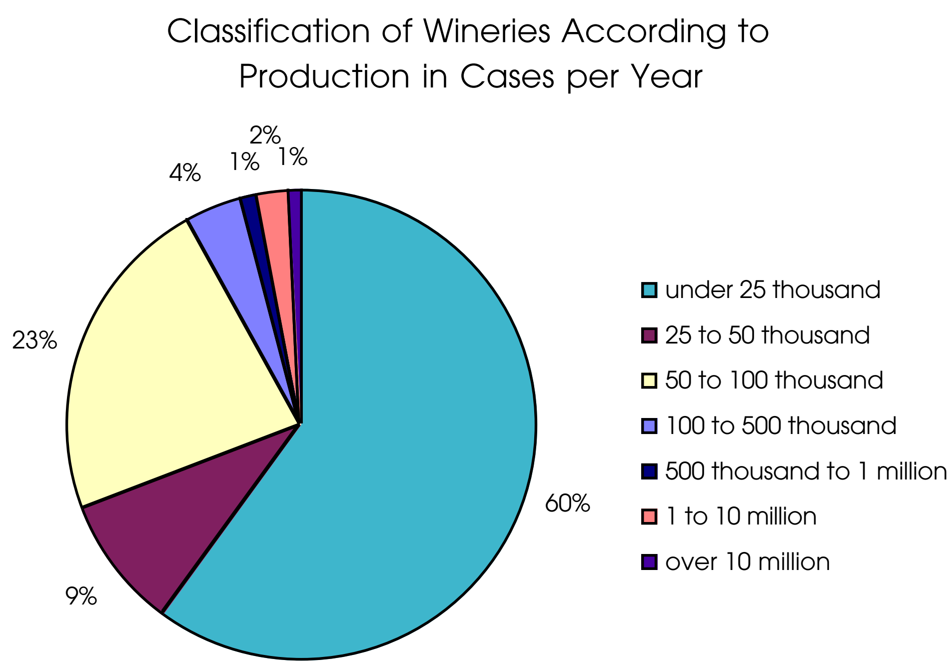



*Figure 3.1 Number of wineries producing different volumes of wine. Total number of wineries equals 850 (MKF, 2000).*

## Tax Revenue

State and local governments receive more than $1 billion annually from wine-related sales, excise, income and property tax revenues. The federal government and other states collect an additional $2.1 billion in taxes. In Santa Barbara, the economic contribution of the wine industry is important, contributing $1.1 million per year in California sales taxes and about $3.9 million in county property taxes (Gomberg, 1999). Since 1977, the annual revenues from wine taxes in California have increased 244.2% (MKF, 2000).

## Tourism

Almost 11 million people visit California's vineyard areas annually, generating more than $1.2 billion in tourism dollars. Tourism is the third largest employer in the state(California Tourism Research, 2000). Napa County alone has nearly 5 million tourists visiting each year (MKF, 2000). In 1997, winery tourists spent an estimated $25,300,000 within Santa Barbara County (Gomberg, 1999).

In summary, the California wine industry has a significant impact on the State's economy. Grapes are the second most valuable commodity in California, behind milk and cream (NASS, 1999). In 1998 wine grapes had a value of approximately $1.8 billion, far surpassing the value of other crops as seen in Table 3.5. The California wine industry provides jobs, tax revenue, and is a major tourist attraction. With the rapid growth of the industry it is likely that its economic contribution will continue to grow.

Table 3.5 Total Value of California agricultural commodities (County Agricultural Commissioners Data, 1998).

| | |
|---|---|
| Wine Grapes | $1,848,398,600.00 |
| Table & Raisin Grapes | $1,299,324,400.00 |
| Oranges | $980,582,100.00 |
| Almonds | $912,983,900.00 |
| Cotton Lint | $627,105,300.00 |
| Lettuce(head) | $601,544,200.00 |
| Rice | $409,499,300.00 |
| Strawberries | $368,605,400.00 |
| Lemons | $333,616,000.00 |
| Broccoli | $326,805,800.00 |
| Walnuts | $288,616,800.00 |
| Tomatoes | $269,781,000.00 |
| Garlic | $120,257,600.00 |
| Carrots | $55,604,300.00 |

# 4. Methods

Analysis of the impacts of the California wine industry began with the assembly of a representative suite of categories of the environmental and socioeconomic effects of wine grape cultivation, wine production, and distribution. The final list, shown in Table 4.1, was designed to enable CWIA to answer four key questions:

A. What does the California economy gain from vineyards and winemaking?

B. What is the effect of the wine industry on the state's environment?

C. What are the significant differences between organic and conventional viticulture, if any?

D. Do consumers care about environmental impacts related to wine, and would their choices be affected by additional information?

For each category, we sought information necessary to address the four questions of interest. The California wine industry is large, complex, and diverse. A comprehensive study of all information relevant to each category of environmental and socioeconomic impacts listed in Table 4.1 would arguably be impossible, and certainly was beyond the manpower and budgetary resources at our disposal. In an effort to develop a rea-

Table 4.1 Impact Criteria.

**Winegrape Cultivation**
Land use conversion
Alteration of air, soil and water quality
Health impacts
Differences in water/nutrient demand
Grape yield and quality

**Wine Production**
Differences in fermentation techniques
Material inputs
Wastewater treatment

**Socioeconomic Factors**
Employment
Production cost
Tourism
Sales
Marketing
Distribution channels

soned assessment of the industry as a whole, key criteria were selected as indicators and used to evaluate selected impacts relevant to the four questions of interest. For each indicator, information was collected through at least one of five avenues:

- *Source Review:* Assembly of available data, including information collected by state and local government agencies, university extension services, wine industry groups, and literature of the sciences and social sciences.
- *Vineyard Survey:* A direct mail Vineyard Survey targeting vineyard managers in Santa Barbara, Napa, and Sonoma counties and all vineyards certified organic by the California Certified Organic Farmers.
- *Winery Survey:* A direct mail Winery Survey targeting winemakers in Santa Barbara, Napa, and Sonoma counties and all wineries operating vineyards certified organic by the California Certified Organic Farmers.
- *Consumer Survey:* A survey of consumer opinions about conventional wines and wines from organically grown grapes.

## Source Review

The first step in information assembly was the identification of stakeholders and agencies likely to possess data about the wine industry's performance for each category listed in Table 4.1. Targeted groups included state and local governmental agencies, non-governmental organic certification agencies, the University of California Agricultural Extension Service, the University of California Sustainable Agriculture Research and Education Program, academic researchers, industry associations, and chambers of commerce. Through an extensive literature search, relevant publicly available information was gathered. Significant sources of data included the California Department of Pesticide Regulation (DPR) (PUR, 1998; Ross and Kaplan, 1998), the Wine Institute (Wine Institute, 1999), University of California Cooperative Extension Service (UCCE, 1992a and b; UCCE, 1994; UCCE 1996a,b, and c; UCCE 1997; UCCE 1998), wine industry consultants (Gomberg et al., 1998), the California Employment Development Department, and primary research literature (Huske & Levson, 1997, etc.).

It was confirmed that comprehensive analysis of differences in impact between segments of the wine industry cannot be accomplished solely on the basis of published literature. Published sources provide extensive context for the results of the project's questionnaires and experiments. However, in many cases the data of interest are not collected on a regular basis, limiting potential for comparisons of factors of interests, or are not available in a format that differentiates between the management practices of interest. We therefore found it necessary to develop surveys that filled gaps in extant literature regarding current industry practices and consumer preferences.

## Industry Surveys

It was determined that two types of survey were required to obtain information beyond the materials currently collected and published regarding the wine industry. These questionnaires include a survey of viticultural practices (Vineyard Survey), and a survey of winery management practices (Winery Survey).

The methodology employed for each survey varies with the scale of the population sampled. Questionnaires for the Vineyard Survey and the Winery Survey were designed for direct mailings targeting every winery and/or vineyard that could be identified in Napa, Sonoma, and Santa Barbara counties, along with all vineyards certified by the California Certified Organic Farmers (CCOF) statewide.

Contact information for certified organic farmers was provided by CCOF. Compiling a comprehensive list of California vineyards was problematic; agricultural agencies do not maintain a complete list of vineyards in the state. In addition, requests for membership listings were denied as a matter of policy by the California Association of Winegrape Growers and the Wine Institute. The mailing list for vineyards not certified as organic was therefore compiled from the next best available source: advertising. An extensive list of wineries in Napa, Sonoma, and Santa Barbara counties was assembled through an internet-based search. Numerous lists of wineries, regional advertising websites, and individual winery home pages were compiled into a single database.

Surveys were addressed to winemakers whenever possible; names of survey recipients for each operation were compiled from individual winery home pages, which yielded a contact name for approximately 90% of wineries. The final database included 73 certified organic vineyards and 470 non-certified vineyards and/or wineries in three key wine producing counties: Napa, Sonoma, and Santa Barbara. The Vineyard and Winery questionnaires were distributed via U.S. post in November 1999. Companies that did not respond to the surveys within six weeks were contacted by telephone and provided with an additional copy of the questionnaires, if necessary.

A sampling methodology based upon advertising is not comprehensive, even in the targeted counties. This approach works best with companies that have a retail product that needs to be brought to the general public's attention, i.e. wineries. As a result, the list of wineries surveyed is more likely to be exhaustive than for vineyards that sell their grapes directly to wineries or to wholesale wine grape buyers ("growers"). Growers have little incentive to advertise to the public; as a result, only 16 growers completed the Vineyard Survey. It is uncertain what proportion of the total grower population in the surveyed counties is represented.

## Vineyard Survey

The Vineyard Survey questionnaire was designed both to gauge general industry trends and to illuminate differences between certified organic and conventional vineyards. The questionnaire was limited to factors that are too site-specific to be determined by examination of aggregated data in published literature. To maximize survey response rate, the questionnaire was brief rather than comprehensive, probing for key indicators which were selected to illuminate the effect of viticulture on the environment, the distribution of wage rates among vineyards, and the significant differences between organic and conventional viticulture, if any.

The survey, included in Appendix B, consisted of five types of questions:

- *Productivity:* Four questions determined cultivated acreage, grape yield, and the selling price for grapes sold.
- *Material inputs and outputs:* Seven questions determined quantity and types of fertilizer applied; sulfur application rate; non-sulfur pesticide cost; and the quantity of water required, its source, and irrigation methodology.
- *Integrated Pest Management:* One question quantified the degree of implementation of five common IPM techniques for vineyards, identified by the Central Coast Vineyard Team (CCVT, 1999).
- *Organic certification:* Three questions identified total certified organic acreage, organic but non-certified acreage, and reason for not obtaining organic certification, if applicable.
- *Labor input:* Two questions determined the labor intensity of harvesting and the number of temporary and permanent personnel employed at low, modest, and professional wage rates.

## Winery Survey

Like the Vineyard Survey, the Winery Survey questionnaire was designed to examine industry trends; its further intent was to determine the fate of organically grown grapes from the point of view of the winery. The questionnaire was brief; its scope was limited to factors that are too site-specific to be determined by examination of aggregated data in published literature. The survey, included in Appendix B, consisted of five types of questions:

- *Productivity:* Five questions determined winery age, average annual production, production during the previous year, projected output for the current year, and percentage of wines produced from organically grown grapes.

- *Material inputs and outputs:* Six questions identified water source and usage rate; wastewater flows and treatment; percentage of grapes purchased rather than grown on winery-owned vineyards and percentage of purchased grapes grown organically.
- *Grape purchase criteria:* One question probed the criteria for grape purchase decision making.
- *Labor input:* One question addressed the number of temporary and permanent personnel employed at low, modest, and professional wage rates.
- *Distribution and marketing:* Four questions determined retail price of wines produced, distribution channels employed by the winery, whether wines from organically grown grapes require alternative distribution channels and whether wines made from organically grown grapes are labeled as such.

In contrast to the Vineyard Survey, analysis of the Winery Survey did not focus upon organic certification. Though the California Organic Foods Act prescribes standards for the processing of organic foods, “organic wine” was not a term with an approved regulatory definition at the time the survey was conducted. Additionally, processing standards for organic products do not appear to impose any substantive limitations on organic winemakers that would significantly alter winery environmental impacts, as discussed in Chapter 2.

## Consumer Survey

The Consumer Survey, included as Appendix C, was designed to determine whether consumers take environmental impact into consideration when deciding which bottle of wine to buy, and whether the importance of environmental impacts in wine purchase decisions would be affected if a greater quantity of relevant information was available.

Consumers were interviewed by project team members at a variety of locations in Santa Barbara, including a local wine specialty shop, two grocery stores known for their wine selection, a local graphic design firm, and at a University of California Santa Barbara class. At each sampling point, interviewees consisted of all individuals entering or exiting the study site who agreed to participate in the study. In order to exclude persons who are not part of the current wine market, individuals who purchased wine infrequently (less than once per month) were asked no further questions and were not included in the analysis. Eighty-four wine consumers participated in the survey.

# 5. Survey Results

## Response Rate

A total of 107 companies responded to the industry surveys, representing 91 wineries and 86 vineyards, as shown in Table 5.1. More than one quarter of completed surveys were received from certified organic vineyards – 24 of the 84 surveys returned. The cumulative response rate for the surveys was 20%. Though it would be preferable to calculate response rates for each survey individually, it is not possible to use advertising information alone to reliably differentiate between wineries, vineyards, and combined operations. However, a response rate for the Vineyard Survey (for example) can be estimated by normalizing the total list of companies by the ratio of Vineyard Survey respondents to all respondents [(Vineyard Survey / Total Responses) * Total Companies Identified]. Normalized estimated response rates for both surveys do not deviate significantly from the cumulative response rate.

Table 5.1 Survey response rates, by county.

| County | Surveys Distributed | Vineyard Survey Respondents | Winery Survey Respondents | Total Responses* | Response Rate* |
|---|---|---|---|---|---|
| Napa | 211 | 33 | 38 | 41 | 19% |
| Sonoma | 183 | 33 | 33 | 37 | 20% |
| Santa Barbara | 59 | 10 | 15 | 17 | 29% |
| Other | 90 | 10 | 5 | 12 | 13% |
| **Total** | **543** | **86** | **91** | **107** | **20%** |

** Total Responses is less than the sum of Vineyard and Winery Survey respondents because the majority of facilities surveyed perform both operations*

## Vineyard Survey Results

Vineyard Survey data was divided into two sets: vineyards which were certified organic by CCOF on all or a portion of their acreage ("Organic") and vineyards with no certified organic acreage ("Traditional"). It is not uncommon for a company to operate both Traditional and Organic vineyards. Seven of the 24 Organic vineyard respondents employ this mixture of management strategies. As a result, 57% of the acreage managed by vineyards termed "Organic" in this study is CCOF certified, as shown in Figure 5.1. An additional 34% of surveyed acreage receives no synthetic pesticide or fertilizer inputs (labeled "Non-certified 'Organic' Acreage" in Figure 5.1. It is unclear from survey results why the additional acreage is not certified. Survey results indicate only a

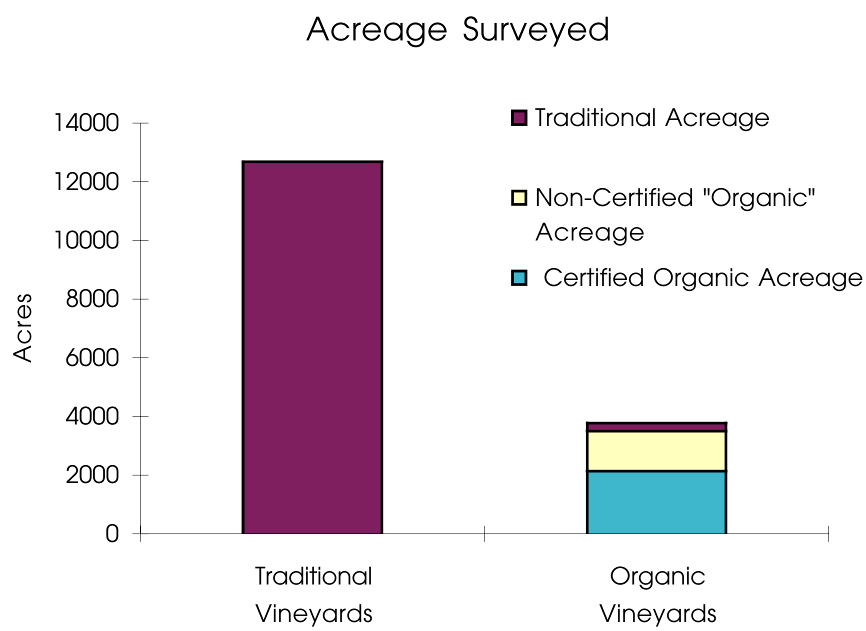



*Figure 5.1 Total Surveyed Acreage for Organic and Traditional Vineyards*

small fraction of the uncertified acreage is undergoing the waiting period prior to certification. However, the survey design did not allow complete segregation of data to reflect differences in management techniques applied by individual companies managing more than one vineyard. The mixture of management strategies among the set of Organic vineyards surveyed is therefore likely to result in somewhat conservative estimates of differences between Organic and Traditional vineyards.

The rate of use of pesticides and synthetic fertilizers is of course the most substantial difference between Organic and Traditional vineyards. Organic vineyards must abide by strict limitations on the type and quantity of pesticides they apply, and sulfur is their primary chemical tool for pest control. Sulfur is the most commonly applied pesticide on all vineyards, accounting for 86.5% of the mass of pesticide applied to wine grapes statewide in 1998 (PUR, 1999). Pesticide data was therefore broken into two categories: sulfur and pesticides other than sulfur.

Respondents could reasonably be expected to be reticent to detail the mass of non-sulfur pesticides they apply, so the survey was designed to gauge the impact of these pesticides on vineyard finances by asking for an estimate of annual non-sulfur pesticide expenditures. Traditional vineyards reported spending $55.12 per acre per year on non-sulfur pesticides. Not surprisingly, Organic vineyards spent far less, an average of $1.70. The estimate is slightly inflated by two vineyards with a mixture of organic and traditional management strategies, presumably indicating pesticide use on their non-certified acreage. Excluding these two mixed farms, the remaining Organic vineyards spent less than $0.25 per acre per year on non-sulfur pesticides. The fact that Organic vineyard non-sulfur pesticide expenditures were greater than zero does not necessarily indicate a violation of organic cultivation standards. CCOF standards allow organic growers to use a number of products on their vineyards for pest control purposes – acetic acid, ascorbic acid, and certain plant-derived oils, for example.

The distinction between sulfur application rates for Organic and Traditional vineyards is not as clear cut. Survey results appear to indicate that Organic vineyards use less sulfur per acre than Traditional Vineyards, as shown in Table 5.2, a counterintuitive result. Since the set of chemical pest control tools at the disposal of Organic vineyards is limited, one would expect they would compensate somewhat by using sulfur more heavily than Traditional vineyards. Unfortunately, the logarithmic binning applied to the question could conceivably mask differences in mean sulfur usage.[1] Table 5.2 should therefore be conservatively interpreted to indicate the distribution of sulfur application rates is similar for both vineyard types within the sensitivity of the test.

Table 5.2 Comparison of annual sulfur application rates. Values are percentages of total respondents.

| | Pounds of Sulfur per Acre | | |
|---|---|---|---|
| | **0-10** | **10-100** | **>100** |
| Traditional | 24% | 70% | 6% |
| Organic | 39% | 57% | 4% |

When asked about the source of fertilizer for their vineyard, Traditional Vineyards reported that the bulk of their fertilizer needs are met with synthetic fertilizers, followed by compost, and other materials such as grape pomace and bone meal, as shown in Figure 5.2. As one would expect, Organic vineyards reported that they did not use synthetic fertilizers, with one exception. One of the companies that manages both a certified Organic vineyard and a Traditional vineyard uses synthetic fertilizers to meet 80% of its fertilizer needs.

The two key differences between synthetic fertilizer products and compost are energy use and the potential for water quality impacts. As discussed in Chapter 6, synthetic fertilizers require substantial energy to produce, and the chemical species of essential nutrients can be more mobile, increasing the likelihood of nitrate leaching into ground or surface waters. However, farmers are rational business people; synthetic fertilizers

[1] Future researchers applying the indicator list contained in this report are encouraged to avoid this problem by discarding the binning approach in favor of direct answers when collecting non-ordinal numerical data. This limitation was unique to the sulfur question.

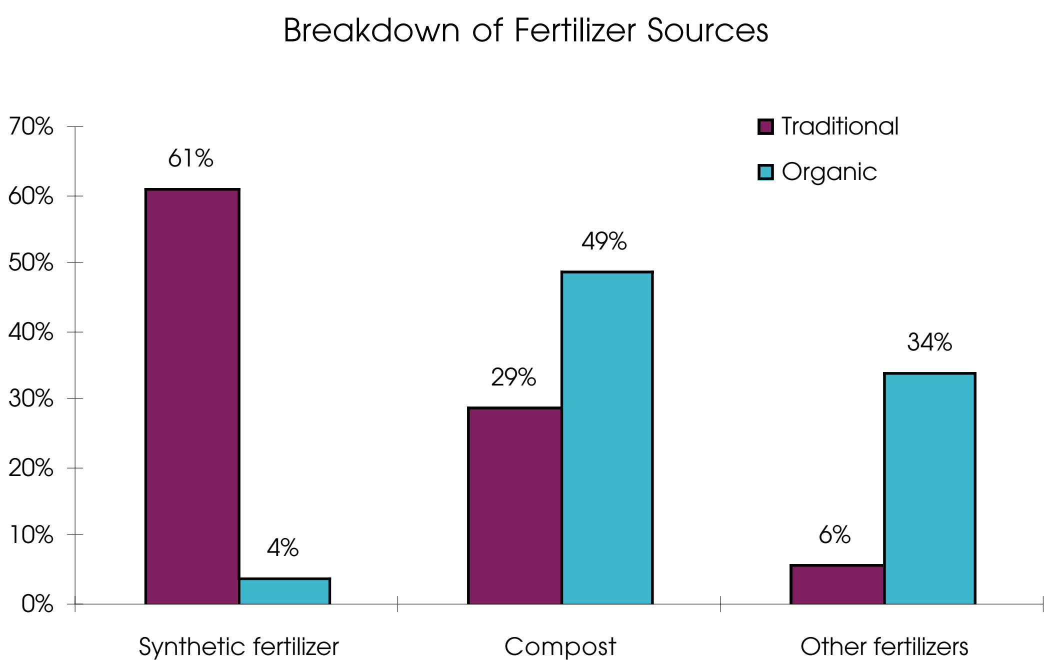



*Figure 5.2 Breakdown of Fertilizer Sources. Percentages shown illustrate the proportion of each group's fertilizer needs met by the indicated fertilizer type.*

have their advantages. Nutrients in compost are entrained in a matrix of organic matter, meaning that compost has a significantly greater mass and volume than synthetic fertilizer per unit of nitrogen, phosphorous, and potassium applied. Looking at the farm system in isolation, application of synthetic fertilizer is therefore presumably less labor intensive, and requires less on-farm fuel use per unit of nutrient applied. However, though the average mass of fertilizer applied per acre per year to Organic vineyards was larger than the mass applied to Traditional vineyards, the difference was not significant, implying that the difference in fuel use for fertilizer application is probably also not significant. It should be remembered that vineyards take pains not to over-fertilize, which can result in reduced grape quality and can even damage the roots of young vines. Large applications of synthetic fertilizer are therefore unlikely to be beneficial, and are probably quite rare for both vineyard types.

Integrated Pest Management (IPM) has been proposed as a "third way" (after traditional and organic techniques) of reducing vineyard fertilizer and pesticide inputs. IPM is the practice of using an intensive pest monitoring program in conjunction with biological and cultural manipulation of the vineyard ecosystem to reduce pest populations. The use of pesticides in IPM is not entirely abrogated, as in organic viticulture, but IPM practitioners attempt to limit pesticide use to applications which are economically rational. Pre-emptive applications of broad-spectrum pesticides throughout the entire vineyard are discouraged in favor of targeted and carefully timed pesticide use whenever possible. A key characteristic of integrated pest management strategies is habitat manipulation. Vegetation is cultivated to minimize habitat for problematic insects that would otherwise need to be chemically controlled, to maximizing available habitat for species that prey upon pests, and to exclude weeds from the vineyard. Multiple strategies are often employed simultaneously. Such vegetation, grown between the rows of vines, is termed cover crops. IPM is discussed in greater detail in Chapter 6.

To gauge the prevalence of Integrated Pest Management in vineyards, surveyed vineyards were asked to estimate the percentage of their acreage on which they employed five common IPM management practices. None of the techniques are exclusive; ambitious IPM adherents could apply all five techniques to the same plot. As shown in Figure 5.3, the rates of application for four of the five IPM techniques included in the survey are very similar for Organic and Traditional vineyards. However, the one clear difference is telling: Organic vineyards use cover crops to provide habitat for beneficial insects on nearly twice as much of their acreage as Traditional vineyards, on average. This phenomenon emphasizes the limitations imposed on Organic vineyards by

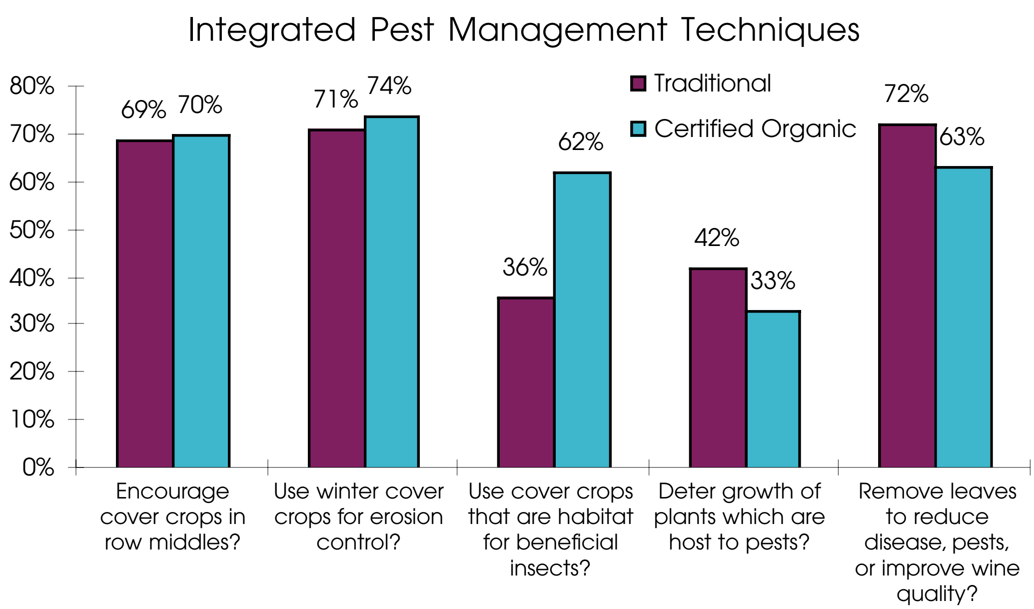



*Figure 5.3 Mean Percentage of Vineyard Area Managed with Selected Integrated Pest Management Techniques*

organic standards; lacking the ability to use pesticides to control problem insect, Organic vineyards must rely more heavily upon beneficial insects to control their pest problems.

Increased usage of IPM techniques by Organic vineyards is to be expected; many IPM techniques are adaptations of the biological control techniques that had to be developed for Organic vineyards to be successful. In fact, the observation that Organic and Traditional vineyards differed little in their application of 4 out of 5 selected IPM techniques is evidence of widespread adoption of Integrated Pest Management principles by vineyards with little or no interest in "going organic". Though the survey results cannot be construed to indicate the relative importance of reducing environmental impacts versus the possible financial benefit of reduced reliance upon pesticides, the difference is moot. IPM techniques have clearly become a part of mainstream wine grape viticulture.

One must ask whether Organic vineyards have a financial incentive to adhere to the strict standards of organic agriculture. At first glance, the survey results indicate that there is no premium for organic grapes. In fact, Traditional vineyards were able to charge a slightly higher price per ton of grapes ($2,056), than Organic vineyards ($1,868). Detailed cost analyses performed by the University of California Cooperative Extension Service (discussed in greater detail in Chapter 8), indicate that the production cost of organic grapes fits within the range of prices for traditional grape cultivation, though organic grapes tend to fall on the high end of the spectrum. If the average selling price of organic grapes is lower than the price of traditional grapes and the production cost of organic grapes is higher, the implication is that Organic vineyards' choice of management strategy may be based on preference for pesticide and fertilizer minimization, or other non-financial factors.

However, location is widely recognized as a significant factor in grape pricing, and vineyards in premium wine producing regions fetch a higher price. Surveyed Traditional vineyards are all located in one of three premium wine grape growing counties. Napa and Sonoma counties were the number one and number two highest priced wine grape growing districts in 1999. District 7, which includes Santa Barbara county, fifth in this classification (CASS, 2000). Though the majority of CCOF certified vineyards are located in Napa, Sonoma, and Santa Barbara counties, organic growers are distributed throughout the state, as shown in Figure 5.4. The average price per ton of grapes for the thirteen Organic vineyard survey respondents located in the 3 test counties was $2,205, greater than the Traditional vineyard average. On the other hand, the eleven Organic vineyards located outside the premium region indicated an average price of $1,493 per ton.

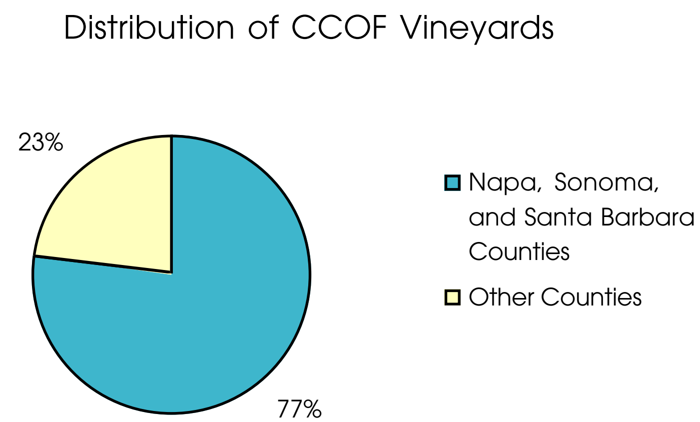



*Figure 5.4 Distribution of All CCOF Certified Vineyards in California. Source: CWIA Vineyard Survey. Total number equals 70 vineyards.*

These results underline the importance of location in grape pricing, and suggest that Organic Vineyards located in premium wine producing regions may enjoy the highest overall prices. The reader is cautioned to remember that grape variety is also a significant factor that is not accounted for in this analysis. For example, the average selling price of Cabernet Sauvignon grapes grown in the three Districts is $2,029, while Zinfandel grapes yield average returns of $1,341 per ton (CASS, 2000). In the absence of information about the mixture of grape varieties grown by surveyed vineyards, the survey results may be conservatively interpreted to indicate grape prices for Organic growers are in line with those earned by Traditional vineyards, and may actually be higher.

If the material costs are similar for traditional and organic wine grapes, but outlays for pesticide and fertilizer inputs are less for Organic vineyards, other factors contributing to production costs must be more expensive. One possible factor is labor cost; several aspects of organic viticulture appear likely to result in a greater need for laborers relative to traditional techniques. Examples include intensive monitoring of pests, climate, and invasive weeds, along with mechanical weed management techniques. To examine potential differences in labor costs, vineyards were queried regarding the number and pay rate of their employees. As shown in Table 5.3, the total number of seasonal employees per 100 planted acres of Organic and Traditional vineyard is very similar, implying that there is actually no significant increase in the on-farm labor pool of Organic vineyards. If one assumes that the annual employment period for seasonal employees is similar for Organic and Traditional vineyards, the cost of seasonal labor may

Table 5.3 Vineyard employees per 100 planted acres.

| Employee class | Traditional | | Organic | |
|---|---|---|---|---|
| | **Mean** | **S.E.** | **Mean** | **S.E.** |
| **Seasonal** | | | | |
| $5-10 per hour | 14.3 | 2.9 | 25 | 7.5 |
| $11-20 per hour | 11.9 | 5.4 | 2.5 | 1 |
| More than $20 per hour | 0 | - | 0.5 | 0.5 |
| **Total Seasonal** | **26.0** | **5.8** | **28.0** | **7.1** |
| **Permanent** | | | | |
| Les than $30,000 per year | 5.4 | 0.8 | 2.3 | 1.1 |
| $31-50,00 per year | 1.6 | 0.4 | 0.6 | 0.2 |
| More than $51,000 per year | 0.1 | 0.1 | 0.03 | 0.02 |
| **Total Permanent** | **7.0** | **0.9** | **3.0** | **1.1** |

*S.E. = Standard Error*

actually be smaller for Organic farms than for Traditional. Organic vineyards employed more low-wage seasonal laborers ($5-10 per hour), while Traditional vineyards tend to have more seasonal employees earning between $11-20 per hour.

Seasonal employees can reasonably be expected to be primarily responsible for manual labor. It appears that Organic management practices are either not more labor intensive than Traditional practices, or seasonal workers are employed on Organic vineyards for a greater percentage of the year. It is possible that hiring people at a lower wage for longer periods allows organic vineyards to obtain more man-hours of labor without increasing vineyard expenses.

Organic vineyards tend to hire fewer permanent employees per 100 planted acres across all wage classes, as shown in Table 5.3. One might wonder if this is a function of vineyard size; if Organic vineyards are primarily small owner-operated farms, family members might be partially paid in non-monetary goods, such as room and board, while larger operations would be forced to pay employees at market rates. This hypothesis cannot be directly refuted by survey results, but surveyed Organic vineyards were typically larger than Traditional vineyards, contrary to popular wisdom (Table 5.4).

Table 5.4 Vineyard planted acreage.

| Group | Mean | Standard Error |
|---|---|---|
| Traditional Vineyards | 133.0 | 29.0 |
| Organic Vineyards | 160.3 | 57.3 |
| Certified Acreage | 92.1 | 33.7 |

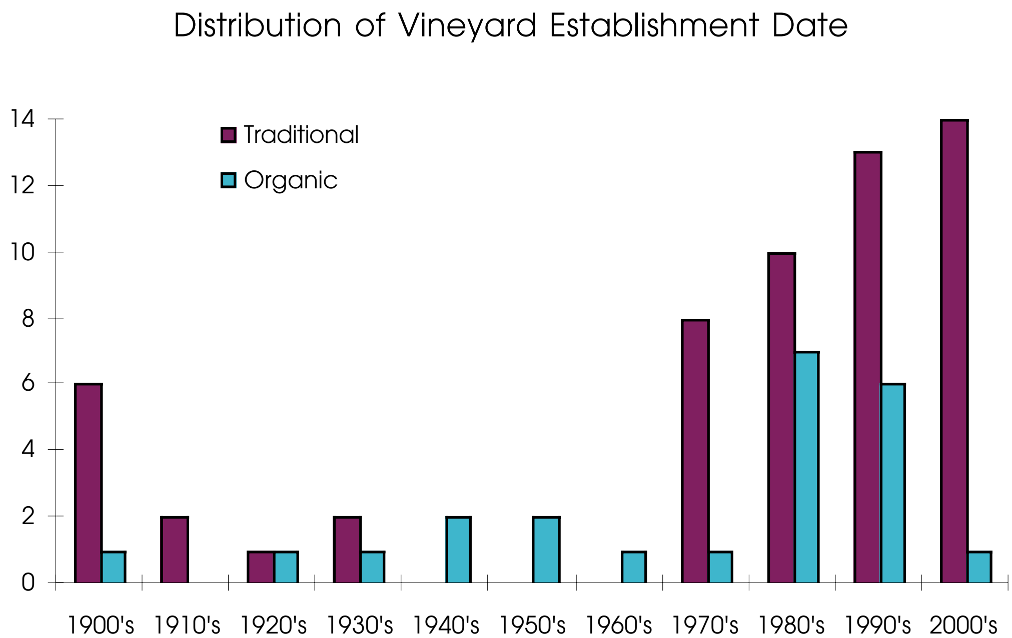



*Figure 5.5 Distribution of Vineyard Establishment Dates.*

Vineyard age is another possible explanation; older vineyards with mature vines could conceivably require less active management. However, the average year of first commercial grape production was not different for Organic and Traditional vineyards, though Figure 5.5 suggests that Traditional vineyards were established in a bimodal pattern. Most Traditional vineyards were developed during or after the 1970's, though several were established before 1930. Vineyards that are now Organic were established at a fairly constant rate prior to a spike in the 1980's, but Organic vineyards comprise a declining share of vineyards established in the 1990's. Establishment dates only reflect the initial development of the vineyard; the questionnaire did not address the date when organic management practices were first implemented or the expansion of existing vineyards. Interestingly, the year of first commercial grape production ranged from a venerable plot first planted in 1870, to a winery that intends to harvest its first crop of grapes in 2001.

Though CCOF standards place stringent limitations on chemical inputs to the vineyard, adherence to organic standards is not necessarily indicative of overall sustainability. Water use is a key environmental concern in agriculture that is not covered by organic standards. As shown in Table 5.5, on average, Organic vineyards indicated they use less water per acre then Traditional Vineyards, but the difference is not statistically significant. Drip irrigation is by far the dominant water delivery system. It is applied by both types of vineyard in nearly equal proportion, and is the dominant water delivery method for more than 80% of surveyed vineyards.

The substantial variance in reported water use rates may be partially attributable to the widespread adoption of IPM techniques, discussed above. Targeted, water efficient irrigation management is frequently used to control vineyard pests, particularly mites (SAREP, 1999), and can reduce nitrogen requirements by 50% (SAREP, 2000). Limiting water use therefore reduces the burden of agriculture on California's water supplies, curbs on-farm water costs, and may reduce pesticide and fertilizer requirements in some situations. Drip irrigation is the primary irrigation methodology for more than 85% of survey respondents; such widespread use of this technique is an encouraging sign of increasing environmental and fiscal prudence in the California wine industry.

Table 5.5 Annual water requirements for irrigation, in acre-feet per 100 acres.

| | Mean | Standard Error |
|---|---|---|
| Traditional | 59.2 | 35.3 |
| Organic | 29.5 | 15.5 |

In summary, the Vineyard Survey confirmed Organic vineyards use less synthetic fertilizer and non-sulfur pesticide, but did not demonstrate a difference in sulfur application. Integrated Pest Management techniques and drip irrigation are widely used by Organic and Traditional vineyards alike. Despite nearly equivalent drip irrigation usage, Traditional vineyards may use more water than their Organic counterparts, though the distributions of water usage for the two groups overlap. Contrary to expectations, organic wine grapes may earn a premium, and there is little difference in the size of Organic and Traditional vineyards. Total seasonal employment per unit of vineyard is similar for both groups, but Traditional vineyards tend to pay more, and Traditional vineyards hire more permanent employees at all wage scales. Complete results for the Vineyard Survey are included in Appendix D.

## Winery Survey Results

In contrast to the Vineyard Survey, Winery Survey results cannot be used for comparison of organic and traditional wineries because there were no organic certification standards for winemaking at the time the Winery Survey was developed (as noted in Chapter 2). As a result, there is no certification program winemakers can use to differentiate their product from other wines. There is no clear, consistent criterion wineries can use in an attempt to convince consumers their wines may be environmentally preferable. However, surveyed wineries buy more than half of their grapes from other farmers, and all 92 wineries surveyed purchase grapes, either to augment the products of their

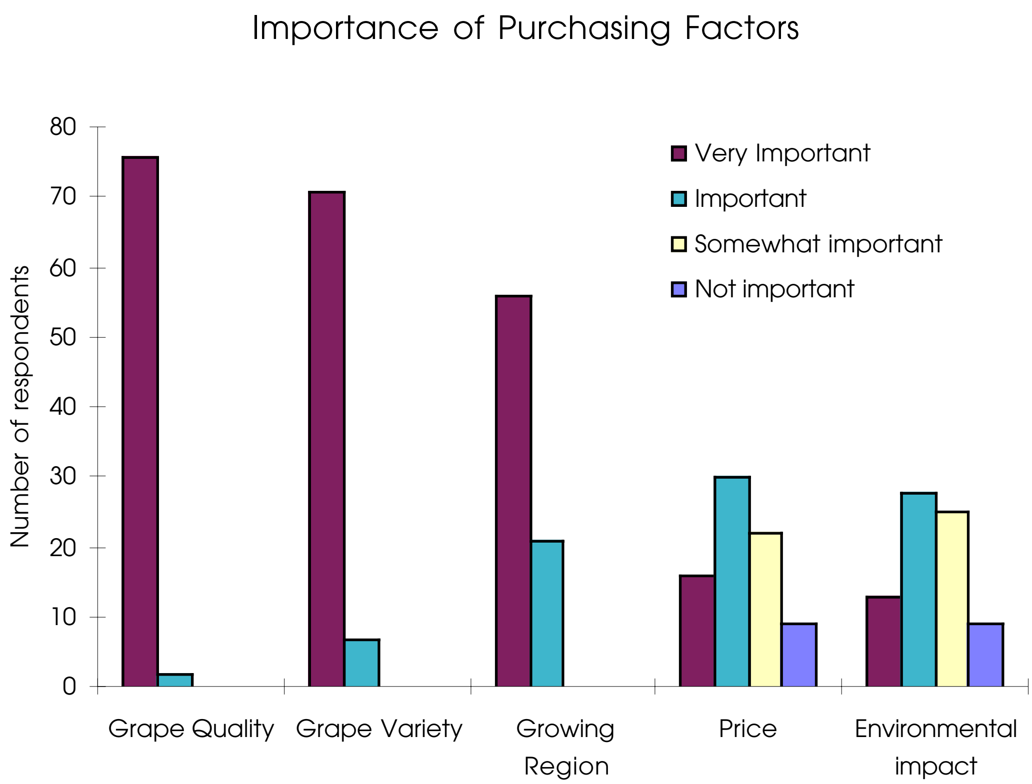



*Figure 5.6  Importance of selected factors in wine grape purchasing decisions.*

own vineyards, or because they do not operate a vineyard at all. Consideration of environmental impacts in the grape supply chain was therefore used as a criterion for analysis.

Grape quality and variety, followed by growing region, were clearly shown by the survey to be the most important factors in grape purchasing, as shown in Figure 5.6. However, the influence of environmental impacts on grape buying varied considerably. Of the 78 wineries who completed the purchase decision question, 53% (including all 10 CCOF certified Vineyard Survey respondents that operate wineries) rated environmental impact in grape cultivation "Very Important" or "Important", while 47% rated environmental concerns "Somewhat Important" or "Not Important".

Based on this result, two approaches were used to analyze the Winery Survey dataset. First, aggregate survey responses were used to examine the entire group of winemakers. Second, two groups of wineries were compared: one included all wineries who rated environmental impacts "Very Important" or "Important", while the second group was comprised of wineries who rated environmental impacts "Somewhat Important", or "Not Important". The groups are referred to as "More Sensitive" (MS), and "Less Sensitive" (LS). The reader is cautioned to avoid value judgements based upon the term "More Sensitive". In practice, the winery management strategies employed by MS winemakers may not necessarily be environmentally preferable to those used by their "Less Sensitive" counterparts.

Table 5.6 Wine grape purchase rate, and proportion of grapes bought from organic growers.

| **Percentage** | **More Sensitive** | | **Less Sensitive** | |
|---|---|---|---|---|
| | **Mean** | **S.E.** | **Mean** | **S.E.** |
| Grapes bought from other growers | 69% | 5% | 59% | 6% |
| Grapes purchased that are organic | 14% | 4% | 1% | 1% |

*S.E. = Standard Error*

Though survey respondents in both groups bought grapes from other growers in roughly equal proportion, MS wineries bought significantly more organic grapes, as shown in Table 5.6. This result confirmed that environmental concerns strongly influence grape purchasing for MS winemakers. MS wineries further reported they produce 12.6% of their wines exclusively from organically grown grapes, while 0.3% of LS winemaker output is WOGG. It is therefore clear that organic grapes are frequently segregated from other grapes, and used to produce WOGG.

However, only 31% of wineries who produce WOGG choose to note the organic origin of the grapes on their wine labels. This result is surprising. With the exception of premium "Estate Bottled" vintages, wines are generally produced from blends of more than one grape variety, often coming from several different vineyards. If wine processors are in fact paying a premium for organic grapes (as discussed in the previous section), and they are maintaining separate fermentations for organic grapes, there would appear to be some value added to the grapes because of their organic origin. It is therefore curious that only a third of WOGG producing winemakers would attempt to use the organic origin of their wine grapes as a selling point.

Compounding this apparent oddity, 60% of wines sold by MS wineries have retail prices over $20 per bottle, compared with less than fifty percent of LS wines. In fact, MS wineries appear to be sold for significantly greater retail prices overall; as shown in Figure 5.7, wines priced in the $7-14 range account for an average of 20% of LS wine sales, while they only represent 9% of sales for surveyed MS wineries. This difference was observed despite the effect of location; the MS group included all of the surveyed wineries outside the premium wine grape growing counties. The implication is that MS


*Figure 5.7  Breakdown of Retail Price Per Bottle of Wine*

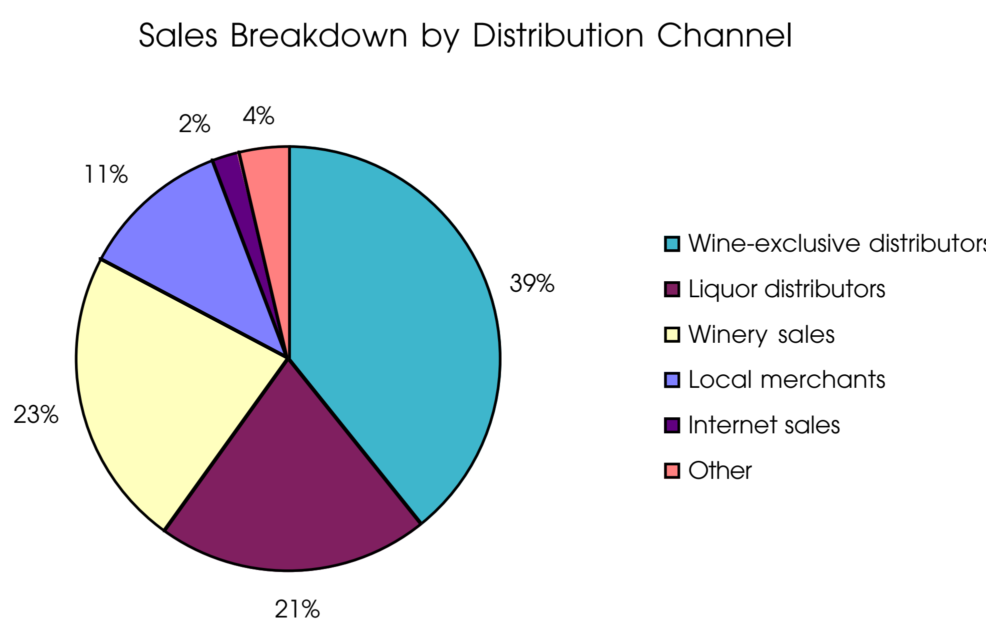



*Figure 5.8  Sales Breakdown by Distribution Channel*

wineries may be paying a small premium for organic grapes and charging their consumers higher prices, but they are successfully charging consumers more for their wines solely on the basis of quality, or *a priori* knowledge of the environmental sensitivity of individual brands. A specific price breakdown for wines from organically grown grapes cannot be extracted from the Winery Survey dataset, so this inference cannot be tested directly.

Surveyed wineries generally do not inform consumers via labeling or advertising when a given wine is made from organically grown grapes, yet 82% of WOGG producers reported their wines from organic grapes require different distribution channels than their other wines. It is unclear why alternative distribution channels would be necessary if the wines do not advertise the organic origin of their grapes. Additionally, there was no significant difference between the percentage of sales MS and LS wineries attributed to each distribution channel. Values for MS wineries are shown in Figure 5.8. In the absence of a visible difference across major categories of distribution channels, one must conclude WOGG is primarily distributed by different *distributors* (i.e. specialty wine and/or liquor dealers), rather than different distribution channels.

Table 5.7. Number of employees per 10,000 cases produced.

| **Employee class** | **More Sensitive** | | **Less Sensitive** | |
|---|---|---|---|---|
| | **Mean** | **S.E.** | **Mean** | **S.E.** |
| **Seasonal** | | | | |
| $5-10 per hour | 2.6 | 1.5 | 4.9 | 2.5 |
| $11-20 per hour | 1.5 | 1.5 | 4.5 | 0.9 |
| More than $20 per hour | 0.005 | - | 0.02 | 0.1 |
| **Total Seasonal** | **4.2** | **1.3** | **9.4** | **4.2** |
| **Permanent** | | | | |
| Less than $30,000 per year | 1.2 | 1.1 | 2.6 | 1.5 |
| $31-50,000 per year | 1.7 | 1.1 | 1.3 | 3.3 |
| More than $51,000 per year | 1 | 0.5 | 0.7 | 2.5 |
| **Total Permanent** | **3.9** | **0.9** | **4.5** | **1.0** |

*S.E. = standard error*

Since MS wineries tend to earn more per bottle of wine than surveyed LS wineries, it is interesting to note that they may actually have fewer employees for a given level of production. When winery employees are broken down into the six classifications listed in Table 5.7, LS wineries appear to hire more seasonal workers at both the $5-10 per hour and $11-20 per hour wage classes. However, since the difference is mostly found in the employment of seasonal workers, the total contribution of winery employees from the two groups to local employment is probably similar.

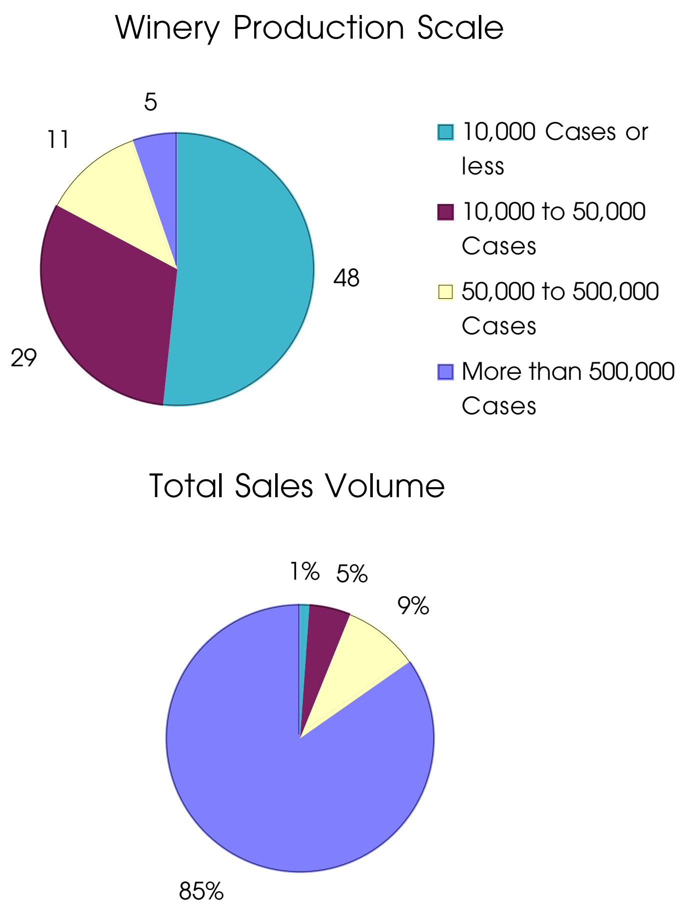



*Figure 5.9 a) Distribution of winery production scale, and b) Sum of each wine produced by each winery size class for survey respondents.*

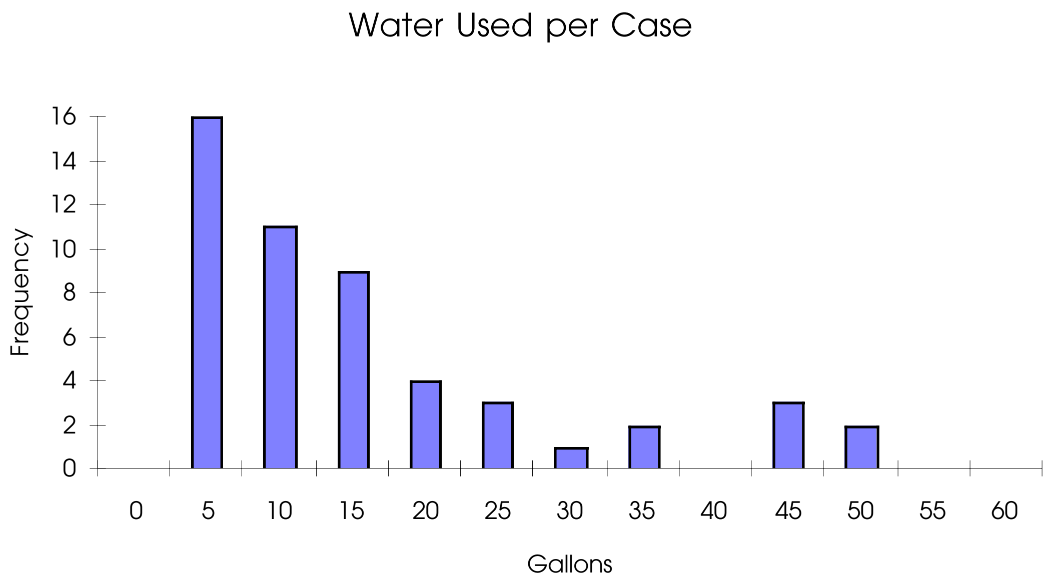
A more important variable for local economies is winery size. Average annual wine production for surveyed wineries varied over four orders of magnitude. Four surveyed wineries produce less than a thousand cases per year, while at the other end of the spectrum there were four wineries which each produce more than one million cases of wine per year. The wide distribution of winery sizes indicates the industry is diverse, and competitive pressure may be intense. However, total wine production is dominated by just a few large wineries, as shown in Figure 5.9 (b).

Regardless of annual case production, water is a key input for all wineries. All of the materials wine is exposed to, from grape to bottle, must be meticulously kept clean to avoid contamination and spoilage. Though sulfite additions do inhibit the growth of undesirable bacteria, molds, and fungi, every tank, pipe, hose, and barrel must be thoroughly cleaned after use, and often cleaned again before re-use. Not only is water essential to the production process, it is a key input for landscaping and sanitation. The Winery Survey attempted to gauge the source of water used in winery operations and the fate of wastewater generated.

Approximately 70% of surveyed wineries obtain their water from the same source, private wells. This result is probably indicative of the distribution of wineries within the three counties, rather than a statewide trend. All the three counties surveyed are outside of the range of the bulk of state water projects, and wineries that also manage vineyards are typically located close to some section of their vineyards, resulting in a diffuse distribution which would generally make municipal water delivery difficult and expensive. The distribution of winery wastewater treatment mechanisms supports this hypothesis. MS and LS wineries overwhelmingly rely upon on-site treatment techniques. Taken together, only 13% of MS and LS wineries send their wastewater to a municipal treatment plant. There was no appreciable difference between the two groups in terms of water source or treatment technology.

Rates of water usage and wastewater generation per case of wine produced are the two factors that characterize winery water use. Since the size of surveyed wineries varies over a wide range, and total water use is largely a function of scale, reported values for total annual fresh water influx and for annualized wastewater efflux cannot be meaningfully compared. By normalizing total flows by the number of cases each winery produces per year, variance attributable to differences in winery size was removed from the distribution, yielding a statistic that was expected to be reasonably comparable across most wineries.

However, the calculated quantity of water required to produce a single case of wine varied over three orders of magnitude; the values for both variables ranged from less than 1/10 of a gallon per case to more than 50 gallons per case. As shown in Figure 5.10 (a) and (b), there are no clear outliers within the distributions of either water use per case or wastewater production per case. Wineries who make more than 250,000 cases per year did appear to use somewhat less water per case than smaller wineries, presumably due to economies of scale inherent in larger scale production processes, but no further conclusions can be drawn from the aggregate distribution. Distributions of each variable for MS and LS wineries were similar to the aggregate distribution (not shown).



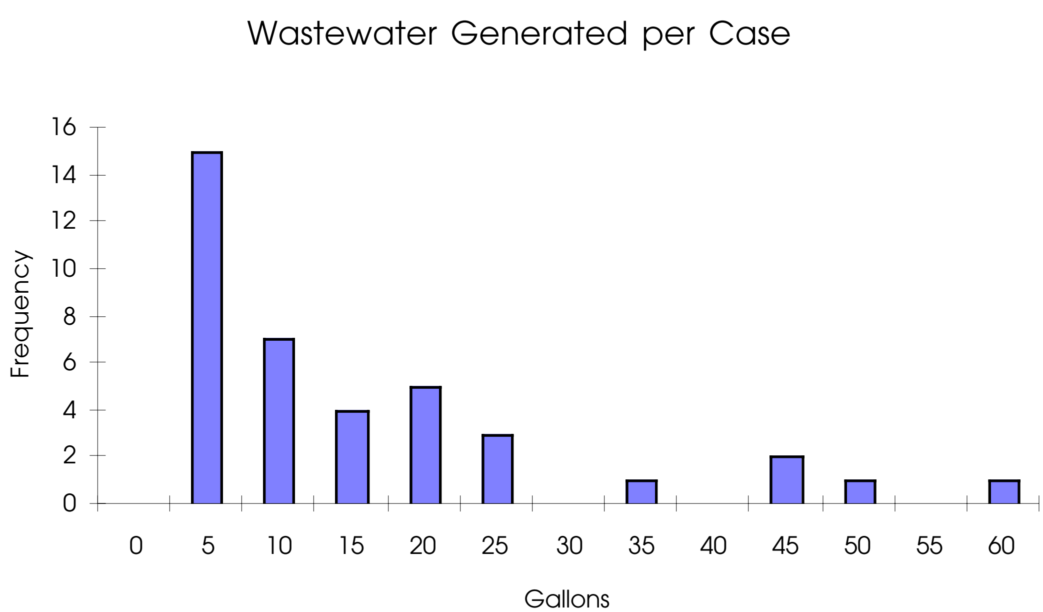




*Figure 5.10 Histograms depict the distribution of a) water used per case, and b) wastewater produced per case of wine produced. Calculated values incorporate all applications, including cleaning, landscaping, and sanitation.*

The wide range of reported water usage rates may be partly attributable to the reliance of wineries upon private wells for their water supply, and upon on-site wastewater treatment technologies. Wineries that get their water from private wells are more likely to be aware of the electricity cost associated with operating their wells than the total water influx to the winery. Likewise, though all wineries are presumably aware of the capacity of their wastewater treatment facilities, septic tank users do not necessarily have gauges to monitor the flux of effluent to their tanks and leach fields. Fifty-five percent of surveyed wineries rely upon septic systems, 12% send their effluent to municipal treatment plants, and the remaining 33% employ other treatment technologies such as evaporation ponds, aerated ponds, activated carbon, or a combination of treatments.

Users of municipal water supplies and wastewater treatment plants must pay for these services by volume of water disposed of or consumed. They can therefore be reasonably expected to have a better idea than private well or septic tank users about how much water they take in and send out. Table 5.8 shows the results of analysis of the few surveyed wineries that rely solely upon public water supplies and municipal wastewater treatment plants. Though the sample size is small, 3 to 7 gallons probably represents a reasonable range for the water required per case of wine.

Table 5.8 Water used and wastewater generated per case of wine produced.

| | Water use per case | Wastewater per case |
|---|---|---|
| Number of respondents | 6 | 5 |
| Mean | 4.78 | 7.12 |
| Standard Deviation | 1.55 | 6.13 |
| Minimum | 3.21 | 1.18 |
| Maximum | 7.14 | 14 |

Inflow of water should be nearly equivalent to water outflow, since no water is actually incorporated into the product. Some winery water is presumably lost to diffusive uses, such as landscape irrigation, so one would expect wastewater flows to be consistently less than fresh water inflows, implying values in Table 5.8 should be considered rough estimates only. The primary message to be gained from the water use estimates provided by survey respondents is that many wineries simply do not know how much water they use or how much wastewater they generate.

In summary, the survey results indicate MS wineries buy significantly more organic grapes, and make more of their wines exclusively from organically grown grapes. Though the majority of MS wineries do not note that their wine is WOGG on their labels, MS wines generally earned higher retail prices, perhaps implying greater overall grape quality. MS wineries report that their wines from organic grapes require different distribution channels than other wines, but there is no apparent difference in distribution channels employed by MS and LS wineries. Total wine production is dominated by a few wineries, but the vast majority of wineries are relatively small. Most wineries obtain their water from private wells and dispose of their wastewater in septic tanks. Neither MS nor LS wineries consistently reported realistic estimates for total water use or wastewater flow, implying that they may rely on outdated or erroneous estimates of parameters in their production processes.

Summary tables of Winery Survey results are included in Appendix D.

## Consumer Survey Results

Eighty-four wine consumers participated in the survey. Non-numerical responses are reported as relative frequencies, but due to the relatively small number of consumers interviewed, absolute counts of responses are included in Appendix D. To minimize survey duration and intrusiveness, simplified demographic information was collected. As shown in Table 5.9, the group of respondents had an approximately even sex ratio, and were fairly evenly divided between persons estimated to be over or under 40 years of age.

Table 5.9 Demographics of consumers surveyed.

| | | |
|---|---|---|
| **Sex** | Male | 46% |
| | Female | 54% |
| **Estimated age** | 39 or under | 56% |
| | 40 or over | 43% |

Table 5.10 Rate of wine purchase for consumers surveyed.

| **Bottles purchased per month** | **Wine (in general)** | | **Organic wine*** | |
|---|---|---|---|---|
| | **Percent** | **Frequency** | **Percent** | **Frequency** |
| 1-2 per month | 36% | 30 | 7% | 6 |
| 3-4 per month | 31% | 26 | 4% | 3 |
| 5-9 per month | 20% | 17 | | |
| 10-15 per month | 11% | 9 | | |
| More than 15 per month | 1% | 1 | | |
| **Total** | **100%** | **84** | **11%** | **9** |

** Organic wine and wine from organically grown grapes, combined.*

Sixty-seven percent of survey respondents reported purchasing less than 5 bottles of wine per month, as shown in Table 5.10. Eleven percent of interviewees purchase "organic wine"[2] at least once per month. The implication is that wines from organic grapes represent a small portion of the wine market in the Santa Barbara. The "organic wine" purchasing rate is similar to the overall rate of WOGG production reported by Winery Survey respondents at 12% of total production, implying that the group of surveyed consumers may be fairly representative of wine consumers in general, despite the small sample size.

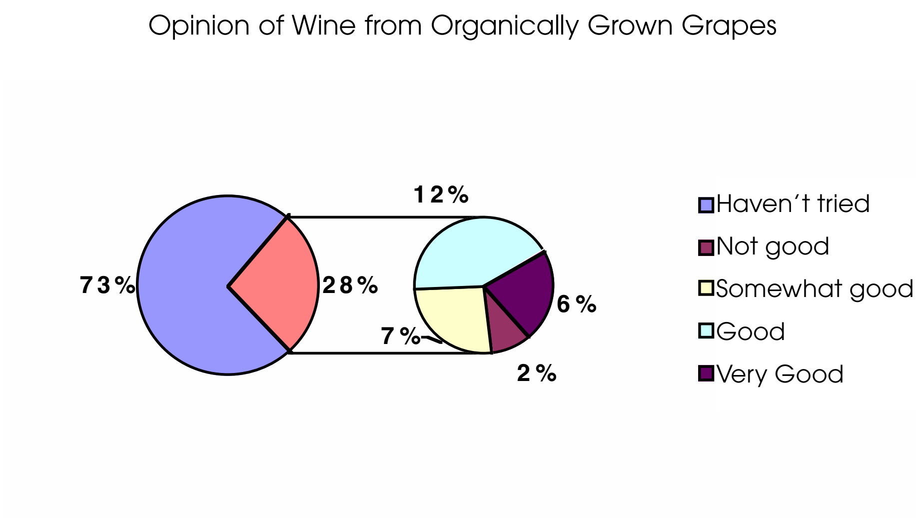



*Figure 5.11 Breakdown of consumer opinion of wines from organically grown grapes*

When consumers were asked their general opinion about the quality of wines made from organically grown grapes, only 28% had ever tasted it. Recalling that only one third of surveyed WOGG making wineries are attempting to communicate that their wines are made from organically grown grapes, it is likely that many consumers have unknowingly tried WOGG. As shown in Figure 5.11, fifteen of the 23 respondents who have tried WOGG considered it to generally be "Very Good" or "Good". Twenty percent of survey respondents had bought WOGG at least once solely because it was

[2] To minimize confusion, consumers were not expected to differentiate between wine from organically grown grapes and wine produced in accordance with organic standards set forth by non-governmental groups such as the Organic Grapes into Wine Alliance; reported values represent the combination of the two.

made from organic grapes. Sulfite-free wines yielded similar results (Not shown). The similarity in the size of the groups of consumers who have tried WOGG and those who have bought it appears to imply that the organic label has significant potential as a selling point.

Consider: nearly one third of the consumers who have tried WOGG reported that they buy at least one bottle of it per month. It appears that WOGG makers who decide not to advertise that their wines are "made from 100% organically grown grapes" may be

Table 5.11 Importance of selected factors in wine purchase decisions.

| Factors affecting purchase | Very Important | Important | Somewhat Important | Not Important |
|---|---|---|---|---|
| Tasting before buying | 42 | 26 | 4 | 11 |
| Grape variety | 41 | 30 | 9 | 3 |
| More information | 20 | 22 | 19 | 19 |
| Price | 18 | 33 | 24 | 9 |
| Name brand | 13 | 20 | 19 | 31 |
| Environmental sensitivity | 11 | 13 | 13 | 46 |
| Wine critic ratings | 5 | 14 | 21 | 43 |
| Label design | 4 | 19 | 19 | 42 |

missing a chance to lock-in repeat customers. When asked to indicate the single most important factor in their wine purchasing decisions, surveyed consumers indicated satisfaction in tasting prior to purchase by a clear majority, as shown in Table 5.11. Wine tasting rooms are not uncommon in the Santa Barbara area, allowing easy sampling of local wines. However, repeat purchases of a given vintage represent another way consumers can demonstrate their preference for wines they have previously enjoyed. Factors that give a winery an edge in getting its product to the consumer may amount to a significant competitive advantage.

Though a minority of consumers surveyed did buy WOGG, the "environmental sensitivity" of wineries was not a particularly important consideration in wine purchases, as shown in Table 5.11. Additionally, only four consumers surveyed indicated label design was a "Very Important" factor. The issue could be semantic; the label design is not necessarily the same thing as label content. However, it is quite possible that the consumers who were interested in WOGG did not try it solely because of a perception that it was environmentally benign; their interest may have sprung from the popular perception that organic products are in some way healthier.

Consumer Survey results offer additional context for the distribution of retail wine prices reported by Winery Survey respondents. A total of 69% of Consumer Survey respondents reported that they most frequently buy wines with retail prices less than $14 per bottle, as shown in Table 5.12. However, 84% of the wines produced by surveyed wineries retail for $14 per bottle or more. The retailers who hosted the winery survey cater to upper-middle class wine and grocery customers, yet survey respondents typically reported that they most frequently drink moderately priced wines. Consumers surveyed may not represent the market targeted by winemakers in California's premium wine producing counties.

Table 5.12 Retail price of wines purchased by surveyed consumers.

| Price | Percentage | Respondents |
|---|---|---|
| 0 – $7 per bottle | 23% | 19 |
| $8 – 13 per bottle | 46% | 38 |
| $14 – 20 per bottle | 17% | 14 |
| More than $20 per bottle | 14% | 12 |

In summary, the results of the Consumer Survey show that WOGG may be a small part of the Santa Barbara wine market, but the rate of WOGG purchase among surveyed consumers is similar to the rate of WOGG production for surveyed wineries. Additionally, tasting was most frequently cited as the most important factor in wine buying, and the majority of wine consumers who have tried WOGG rated it favorably. Nearly one third of the people surveyed who have tried WOGG buy it regularly, so WOGG producers who do not label their wine as "wine from organically grown grapes" may be failing to capitalize on an opportunity to expand their sales and lock-in repeat customers. However, the cohort of respondents was quite small, and the retail price of wines bought by surveyed consumers does not overlap well with the price range at which winery survey respondents sell their wines. Survey results must therefore be viewed with caution.

# 6. Wine Grape Cultivation

Winegrape cultivation is an integrated process involving numerous inputs of land, labor and capital. The input of land, or conversion of property from either a pristine state or traditional agriculture to vineyards and is an issue that has particular importance in the Santa Barbara area. In recent years, both the pace and pattern of vineyard land use conversion has sparked an outpouring of public concern.

Material inputs and their impact to air, soil and water quality plays an important role in the integrated impact evaluation. Generally, inputs to the winemaking process can be classified as either pesticides, fertilizers or irrigation. While pesticide use has incited the greatest public concern, the use of water and fertilizers can play an important role in healthy ecosystem processes. The use of pesticides, however, generates the largest source of acrimony and legislation, ultimately spelling the difference between organic and traditional cultivation practices.

Finally, there is an examination of the spectrum of cultivation practices that are included in growing wine grapes. In general, the section will outline a comparison of the overall differences in traditional cultivation, organic farming and sustainable agricultural practices. As a viable alternative to the strict requirements of organic farming an approach known as Integrated Pest Management will be explored and included in the cultivation spectrum analysis.

## Land use conversion

How Californians uses their land is an issue of growing significance. With statewide population forecasted to grow to more than 58 million by the year 2040 (County Population Projections with Age, Sex and Race-Ethnic Detail-California, 2000), land allocation will be increasingly important. Presently, along the Central Coast this issue is particularly sensitive. The conversion of land from traditional agriculture uses, such as cattle grazing, to vineyards, is a topic that the community, regional leaders, and the media have all recently investigated. In fact, Santa Barbara County Planning and Development office is currently drafting regulations regarding vineyard land use conversion and its impacts on the environment. Throughout the state, and particularly on the Central Coast, the acreage of winegrape cultivation has increased rapidly in the last ten years (Table 6.1). For example, in San Luis Obispo County vineyard acreage more than doubled between 1988 and 1998.

Table 6.1 California Grape Acreage per County (total cultivated acreage). Counties with no acreage devoted to wine grape cultivation have been omitted (MKF, 2000).

| **County** | **1978 Acreage** | **1988 Acreage** | **1998 Acreage** |
|---|---|---|---|
| Alameda | 1,916 | 1,795 | 1,605 |
| Amador | 929 | 1,631 | 2,502 |
| Butte | 547 | 139 | 122 |
| Calaveras | 63 | 176 | 500 |
| Colusa | 69 | 547 | 1,339 |
| Contra Costa | 952 | 735 | 1,059 |
| El Dorado | 190 | 496 | 1,011 |
| Fresno | 37,007 | 35,175 | 45,529 |
| Glenn | 685 | 1,258 | 1,433 |
| Humboldt | - | 4 | 10 |
| Kern | 37,217 | 29,481 | 31,910 |
| King | 1,135 | 1,238 | 2,418 |
| Lake | 2,449 | 2,644 | 4,723 |
| Los Angeles | - | 1 | 32 |
| Madera | 27,975 | 38,085 | 43,413 |
| Marin | 13 | 11 | 94 |
| Mariposa | - | 42 | 61 |
| Menocino | 9,984 | 11,829 | 14,263 |
| Merced | 12,774 | 14,472 | 15,494 |
| Monterey | 33,442 | 27,863 | 36,378 |
| Napa | 24,460 | 32,165 | 37,486 |
| Nevada | 60 | 180 | 187 |
| Orange | 86 | - | - |
| Placer | 295 | 109 | 94 |
| Riverside | 2,633 | 2,650 | 2,229 |
| Sacramento | 3,168 | 3,385 | 13,177 |
| San Benito | 4,582 | 1,591 | 3,262 |
| San Bernadino | 8,140 | 1,642 | 1,126 |
| San Diego | 223 | 108 | 91 |
| San Joaquin | 35,214 | 34,661 | 57,430 |
| San Luis Obispo | 4,551 | 7,280 | 14,846 |
| San Mateo | 4 | 53 | 52 |
| Santa Barbara | 5,836 | 9,289 | 11,800 |
| Santa Clara | 1,729 | 1,088 | 1,245 |
| Santa Cruz | 94 | 145 | 233 |
| Shasta | 36 | 36 | 36 |
| Solano | 1,307 | 1,221 | 2,096 |
| Sonoma | 26,581 | 31,555 | 43,314 |
| Stanislaus | 20,489 | 15,117 | 14,217 |
| Sutter | 362 | - | 80 |
| Tehama | 269 | 142 | 130 |
| Trinity | - | 5 | 44 |
| Tulare | 18,261 | 11,999 | 13,255 |
| Ventura | 21 | 1 | 10 |
| Yolo | 688 | 1,658 | 6,635 |
| Yuba | 697 | 352 | 312 |
| **Total Acreage** | **327,133** | **324,054** | **427,283** |
| **Percent Change** | | **-1%** | **31%** |

On the Central Coast, most land suitable for vineyards has historically been Valley Oak habitat. The Valley Oak Restoration Suitability Assessment study performed by a previous group project at the Bren School suggested that the extent of the California's oak woodlands has decreased in both viability and area. (Oaks Group Project, 1999). Specifically, they indicate that the State's original 10-12 million acres of oak woodland has today been reduced to less than 7 million acres. The Oaks project indicates that this decline continues a pattern that began with the arrival of immigrants. Moreover, the Oaks Project suggests that land use decisions such as agricultural conversion and ever expanding suburban development are directly responsible for the continued degradation of the Valley Oak Habitat. The group pointed out that here in Santa Barbara the conversion of oak woodland to commercial vineyards creates additional urgency for quantitative resource inventories and effective mitigation of losses.

Compounding the already dramatic effect of land-use conversion, new vineyards are increasingly being constructed on steeper slopes and further up the watershed. In September 1999, the University of California Davis released the Sonoma County GIS Development Model. Among other things, the model attempted to quantify the spatial extent of vineyard expansion. The figures and graphics that we will present in this chapter indicate that vineyards constructed during the 1990's in Sonoma County were built both topographically higher and on steeper slopes than vineyards constructed prior to 1990.

In general, soil can be eroded by wind or water. In California, water erosion plays a more important role in net soil loss. The rate of sediment transport in sheetwash depends on the discharge per unit width to the power of roughly 2 and the slope to the power of between 1.2 and 1.9 (Dunne, 2000). Consequently, as slope increases, sheetwash sediment transport can be expected to rise to a power of something between 1.2 and 1.9 depending on surface soil conditions.

Table 6.2 Comparison of pre-1990 and post-1990 vineyard development in Sonoma County.

| **Vineyard Factor** | **Pre–1990** | **Post–1990** |
|---|---|---|
| Slopes steeper than 10% | 6% | 25% |
| Above 100 m in elevation | 18% | 42% |

*Source: Merenlender, 1999*

Data from the California Winemaking Impact Assessment (CWIA) Vineyard Survey were analyzed and compared to vineyards established before and after 1990. The following discussion summarizes the results of the Pre / Post 1990 Vineyard Survey analysis.

## Differences Between New and Old Vineyards

Results from the Vineyard survey suggested that vineyards entering production in the 1990's differ from older vineyards in several ways. Specifically, the Vineyard Survey suggested that Older Vineyards (pre–1990) are more likely to be certified as organic by the California Foods Act.

Table 6.3 Comparison of vineyards that are either certified or not certified by the California Foods Act.

| Vineyard Factor | Pre–1990 | Post–1990 |
|---|---|---|
| Certified | 36% | 8% |
| Not certified | 64% | 92% |

*Approximate significance, 0.046. Source: CWIA Vineyard Survey*

Several possible explanations exist. The certification process could be sufficiently time consuming as to limit certification to pre-1990 vineyards. Further, it is plausible, that older vineyards, less concerned with recent financing costs, could risk additional capital for the certification process. Finally, the limited sample of recent vineyards could have altered the results.

An additional statistically significant difference suggests that pre-1990 vineyards generally produced more grapes than vineyards entering production in the 1990's. Based on the Survey, pre-1990 vineyards produced, on average, slightly less than 400 tons of grapes in 1999, while vineyards established in the 1990's produced an average of 54 tons of grapes in 1999. While it is possible that the smaller sample size of post-1990 vineyards (Post-1990 vineyards, N=10; Pre-1990 vineyards, N=65) could explain some of the variation, it is also plausible that recently developed vineyards have not yet reached maximum capacity. Alternatively, it is possible that newer vineyards are being developed in less prime grape production regions. In fact, a study at the University of California Davis, as seen in Table 6.2 also observed that vineyards in Sonoma County developed after 1990 were located on steeper slopes and higher elevation than older vineyards (Merenlender, 1999). Theoretically, it could be proposed that vineyards on steeper slopes are declining in yield because they are occupying increasingly marginal regions.

While it is compelling to propose that newer vineyards are occupying more marginal land, the results from the CWIA Vineyard Survey nor UC Davis studies conclusively prove this. Evidence would have to be compiled that examined yield per acre based on vineyard age class and topography.

### Further Results

The following results were not statistically significant (P values were less then 0.05); however, the data do suggest several possible trends.

1. New vineyards may be more likely to grow winter cover crops to prevent erosion control

Table 6.4 Percentage of vineyards that use cover crops to prevent erosion.

| Vineyard Factor | Pre–1990 | Post–1990 |
|---|---|---|
| Use cover crops | 82% | 92% |
| Do not use cover crops | 18% | 8% |

*Approximate significance, 0.367. Source: CWIA Vineyard Survey.*

It is possible that recent water quality standard requirements implemented by the State and the individual counties could influence recently established vineyards, encouraging them to utilize cover crops. Alternatively it is possible, as the UC Davis study by Merelender suggests, that new vineyards built on steeper slopes require greater erosion control efforts.

2. Older vineyards may be more likely to be third party organic certified.

Table 6.5 Percentage of vineyards that are certified organic by non-governmental organizations.

| Vineyard Factor | Pre–1990 | Post–1990 |
|---|---|---|
| Third party organic certified | 55% | 25% |
| Not certified | 45% | 75% |

*Approximate significance, 0. 262. Source: CWIA Vineyard Survey.*

The results could be attributed to the time and effort required for certification or a simply a difference in vineyard managing policies.

### Existing Regulations Regarding Vineyard Expansion

The Press Democrat, an online newspaper from Santa Rosa, California, has recently published several articles regarding land use conversion. In the autumn of 1999 the Press Democrat published a four part series that examined the environmental and socioeconomic aspects of vineyard growth. The study included a summary of current government vineyard regulations, a survey of public perception about vineyards, and other pertinent data about vineyard practices (Press Democrat, 1999). The following are a few highlights from these articles on how different counties are trying to minimize environmental impacts of vineyards.

Sonoma County

- Vineyards prohibited on slopes greater than 50 percent.
- Erosion control plans required for slopes greater than 10 percent.
- All new vineyards must be registered with agricultural commissioner.
- No vines within 50 feet of streams.

Napa County

- Vineyards prohibited on slopes greater than 50 percent.
- Erosion control plans required for slopes greater than 5 percent.
- Planning Department has regulatory oversight.
- Well drilling regulated in some water-scarce areas.

Santa Barbara County (proposed)

- Growers must submit plans before removing oaks.
- Full-scale environmental analysis for large projects.

*Source: The Press Democrat "Spreading Vines - A Changing Landscape," (10/99).*

### Public Opinions of Vineyards and Vineyard Expansion

The Press Democrat conducted a survey of general community opinions regarding the wine industry. The poll was conducted by Richard Hertz Consulting among 700 registered voters Sept. 7-16, 1999.

In general, the survey focused on Sonoma County resident's opinion of the benefits and costs of the wine industry. Overall the respondents suggested they had a positive opinion of the wine industry, with some concern for the environmental impacts. For example, people indicated that wine industry was, good for the economy (18.7%), created jobs (18.2%), and brought tourists to the region (17.5%). Future land conversion, however, was a source of concern. When asked about the amount of land in Sonoma County currently in grape production 54% indicated they felt the amount of land was 'just right' while 35% suggested it was 'too much'. On the other had, 54% indicated that they felt that there could be too much land planted with grapes in the future, while 42% did not think that would be a problem. This suggests possible concern about the rate and sheer quantity of land in winegrape production in the three counties examined in this report.

The plans and policies governing how we use our land shape the future of California. Today, issues of urban sprawl and vineyard expansion rank high among resident concerns along the Central Coast. The above examination of vineyards suggest that, to some degree, these concerns could be warranted. In Sonoma County, new vineyards are built on steeper slopes than older vineyards. Also, throughout California newer vineyards are less likely to be certified organic. These facts do not suggest a trend toward more sustainable agriculture practices. The rate of vineyard expansion, however, has triggered civic concern, and today, local leaders seem to be attempting to address these issues through law. Sonoma, Napa, and Santa Barbara County regulations seek to minimize new vineyard development on steep slopes.

Increased public scrutiny and progressive development regulations could lead to a sustainable future for wine production. The results, however, would be contingent upon receptive involvement from business leaders. Should wine-growing regions continue to use unsustainable agricultural practices and expand at the present rampant rate, the industry is certain to face severe public reprisal.

## Material Inputs

When considering synthetic inputs that are often applied during the winegrape cultivation process, three factors deserve attention: pesticides, fertilizers and irrigation. This section of the report discusses the need for these inputs and highlights the differences between traditional methods of cultivation and organically grown grapes. The information for this section is derived from an extensive source review of government agencies as well as the results of the CWIA industry survey. The most significant difference between organic and traditional grape cultivation is the application of pesticides; this aspect is addressed first. Following this discussion is an analysis of the differences in fertilizer application and irrigation practices.

### Pesticides

To fully appreciate the difference between traditionally cultivated grapes and grapes grown using other methods, the magnitude of pesticide use needs to be examined. This requires an understanding of the impacts on the environment of agricultural pesticides. The following is a brief overview of pesticide toxicity, categories and potential effects. The specific pesticides that are most commonly used on wine grapes are identified, and the most abundant or harmful chemicals are described. Finally, the environmental impacts these pesticides have on the environment are investigated.

Pesticides can have a range of adverse effects. Some of these effects are immediate; for example, contact with a particular chemical can result in immediate death. Other effects are more subtle; damage can occur from long term exposure to small doses of a chemical. Therefore pesticides are classified in terms of the severity and type of adverse effect that it has on a particular species. The following terminology is used to describe the effects:

*Acute toxicity* refers to the short-term exposure to a chemical. The LD50, or dose of the pesticide that is lethal to 50% of a set of test organisms, is most often used to quantify toxicity.

*Chronic toxicity* results from long-term or repeated exposure to a chemical. This type of poisoning is of particular concern for pesticides that are applied frequently or break down very slowly in the environment.

*Endocrine disruption* refers to the hormone-altering effects of certain chemical substances on animal endocrine systems that impair reproduction or development. Endocrine-disrupting chemicals alter the messages sent through hormones, impair reproduction and can increase susceptibility to cancer in adult animals. Many commonly used pesticides are suspected endocrine disrupters (Kegley et al., 1999).

The term "pesticide" is used as a general term to represent any chemical substance used to control pests. The major classes of pesticides include: insecticides, used to kill insects; herbicides, used to kill plants; and fungicides, used to prevent molds and mildews. The properties of these major classes of pesticides are discussed briefly.

One of the most potentially harmful class of pesticides are the chemicals used to destroy insects. Insecticides constitute nearly 25% of the total reported pesticide use in California (Pesticide Use Report, 1998). There are three major categories of insecticides that have detrimental effects in the environment: organochlorines, organophosphates and carbamates, and synthetic pyrethoids.

Organochlorine (OC) pesticides such as DDT, dieldrin, chlordane, and others were widely used in the 1960s and 1970s. They were not only highly toxic, but they were especially slow to break down chemically and therefore had significant chronic effects. These insecticides work by acting as contact and stomach poisons to insects. Although most of the more persistent OC pesticides were banned from use in the U.S. in the 1970s, the effects of these substances are still being experienced today (Kegley et al., 1999).

In response to the outlawing of many organochlorine pesticides, the agrochemical industry turned to the less persistent, but more acutely toxic organophosphate (OP) and carbamate compounds to control insects. OPs are very similar to the chemical warfare agents originally produced during World War II (Kegley et al., 1999). They work by interfering with the nervous system of insects, as well as mammals, birds, and fish. Organophosphates and carbamates block production of an enzyme called cholinesterase (ChE), which ensures that the chemical signal that causes a nerve impulse is halted at the appropriate time. Birds and mammals that have been poisoned by these pesticides respond with uncontrolled nerve impulses. The OPs and carbamates are among the most acutely toxic pesticides, with most formulations classified by the U.S. Environmental Protection Agency as toxicity class I (highly toxic) or II (moderately toxic). A common organophosphate insecticide is the widely used product Diazinon.

Pyrethins are a type of pesticide that can be naturally occurring in chrysanthemum flowers. Synthetic pyrethins, called pyrethroids, mimic the effects of this compound. They are very similar to organochlorine insecticides in their effects on insects. While these compounds may have only moderate acute toxicity to mammals and birds, they can decimate populations of beneficial insects and aquatic organisms (Kegley et al., 1999).

Another important class of pesticides are chemicals that are used to destroy unwanted plants, or "weeds." These chemicals are collectively known as herbicides. There are several major types of herbicides used in California. Glyphosate, the active ingredient in Monsanto's Roundup®, is unique in its structure and mode of action. As it is applied to the leaves of emergent plants, glyphosate inhibits an enzyme essential for plant survival, causing the death of the plant (Kegley et al., 1999). Glyphosate has the highest reported use of any herbicide in California.

Other classes of herbicides include triazines and acetanilides. Some of these herbicides work by inhibiting photosynthesis in the plant, others by inhibiting protein synthesis and therefore affect plant growth. While not as acutely toxic to animals as the insecticides, the primary environmental impact of widespread herbicide use is the destruction of habitat for beneficial insects, birds and aquatic life.

The last group of pesticides, fungicides, are those used to control molds and mildews on crops and in the soil. Fungicides of particular concern for the environment include copper salts and synthetic compounds with high toxicity to some species. Many fungicides are highly toxic to aquatic life, including copper salts, ziram, maneb, chlorothanlonil, captan and mancozeb (Kegley et al., 1999). There is very little data on the effects of fungicides; the extent of their potential effects is not fully known.

## Pesticides Used on Wine Grapes

All pesticides that are used in agriculture in California must be reported to the State Environmental Protection Agency, Department of Pesticide Regulation.

Under full use reporting, which began in 1990, California became the first state to require reporting of agricultural pesticide use, including amounts applied and types of crops or places treated (Pesticide Use Report, 1998).

Table 6.6 Top ten pesticides used on wine grapes in California in 1998 (Pesticide Use Report, 1998). The total amount includes all pesticides used on wine grapes in that year.

| | Pounds | Lb/Acre |
|---|---|---|
| 1. Sulfur | 29,781,899 | 69.7 |
| 2. Cryolite | 579,667 | 1.36 |
| 3. Sodium Tetrathiocarbonate | 546,592 | 1.28 |
| 4. Methyl Bromide | 477,976 | 1.12 |
| 5. Glyphosate | 355,070 | 0.83 |
| 6. Copper Hydroxide | 253,658 | 0.59 |
| 7. Oryzalin | 156,535 | 0.37 |
| 8. 1,3-Dichloropropene | 149,359 | 0.35 |
| 9. Simazine | 133,356 | 0.31 |
| 10. Mancozeb | 120,196 | 0.28 |
| **Total** | **34,436,026** | **80.6** |

According to the 1998 Annual Pesticide Use Report, there were over 34 million pounds of pesticides applied to wine grapes, using 298 different chemicals. These chemicals include insecticides, herbicides and fungicides. By far the most abundant of these chemicals is sulfur, which accounts for 86.5% of the total (by weight). Table 6.6 contains the ten most abundant pesticides used on wine grapes in the state of California. However, not all pesticides are applied in all vineyards. Data is presented in terms of total pounds applied and total pounds applied per acre of wine grape cultivated (source for acreage data is Table 6.1).

Although pesticide loading (pounds/acre) is an important consideration, a pesticide's toxicity must also be examined; small loading of highly toxic chemicals can have greater detrimental effects than large loading of a mostly benign product. Table 6.7 contains

Table 6.7 Toxicity ratings for top ten pesticides in California in 1998 (EPA, 2000).

| Chemical | Toxicity Category | LD50 | Primary Use |
|---|---|---|---|
| 1. Sulfur | 4 | >5000mg/kg | Fungicide |
| 2. Cryolite | 3 | 2100mg/kg | Insecticide |
| 3. Sodium Tetrathiocarbonate* | N/A | N/A | Nematicide |
| 4. Methyl Bromide | 1 | 214mg/kg | Nematicide |
| 5. Glyphosate | 2 | 5600mg/kg | Herbicide |
| 6. Copper Hydroxide* | N/A | N/A | Fungicide |
| 7. Oryzalin | 4 | >5000mg/kg | Herbicide |
| 8. 1,3-Dichloropropene* | 2 | N/A | Nematicide |
| 9. Simazine | 4 | >5000mg/kg | Herbicide |
| 10. Mancozeb | 4 | >5000mg/kg | Fungicide |

** Currently under review by the EPA.*

toxicity information for the most abundant pesticides. The source for this information comes from the U.S. Environmental Protection Agency's Pesticide Fact Sheets (EPA,2000). The EPA Toxicity Category is given, which ranges from I (highly toxic) to IV (least toxic). The toxicity rating is quantified using the LD50 value for rats and mice. Also included is the use for which the chemical is generally applied to wine grapes. The majority of pesticides used on wine grapes are considered benign by human standards, although the highly toxic methyl bromide is still widely employed as a fumigant. In addition, there are other chemicals that did not appear on the top ten list in terms of abundance, which are even more toxic than methyl bromide. For example, the chemical fenamiphos, of which "only" 35,000 pounds were applied in 1998, is extremely toxic. Fenamiphos has an EPA Toxicity Class I, and an LD50 range of 2 to 19 mg/kg!

The data in Table 6.8 contains the pesticides most used on wine grapes in Sonoma, Napa and Santa Barbara Counties in 1998. Not surprisingly, sulfur is at the top of the list, representing over 80% of all chemicals used in each county. Other chemicals that are commonly used in these counties include methyl bromide and glyphosate. It is

Table 6.8 Top five pesticides used in Sonoma, Napa and Santa Barbara in 1998 (PUR, 1998).

| **Sonoma** | **Pounds** | **Lb/Acre** |
|---|---|---|
| 1. Sulfur | 3,031,285 | 70.0 |
| 2. Methyl bromide | 193,667 | 4.47 |
| 3. Mancozeb | 41,019 | 0.95 |
| 4. Glyphosate, isopoylamine salt | 36,686 | 0.85 |
| 5. Copper hydroxide | 24,038 | 0.55 |
| All other | 186,227 | 4.30 |
| **Total** | **3,512,922** | **81.10** |
| | | |
| **Napa** | **Pounds** | **Lb/Acre** |
| 1. Sulfur | 2,361,987 | 63.0 |
| 2. Glyphosate, iso. salt | 57,814 | 1.54 |
| 3. Methyl bromide | 19,702 | 0.53 |
| 4. Mancozeb | 14,714 | 0.39 |
| 5. Simazine | 12,719 | 0.34 |
| All other | 113,406 | 3.03 |
| **Total** | **2,580,341** | **68.83** |
| | | |
| **Santa Barbara** | **Pounds** | **Lb/Acre** |
| 1. Sulfur | 910,776 | 77.2 |
| 2. Sodium Tetrathiocarbonate | 44,878 | 3.80 |
| 3. Glyphosate | 19,176 | 1.63 |
| 4. Copper Oxychloride Sulfate | 17,092 | 1.45 |
| 5. Methyl Bromide | 12,283 | 1.04 |
| All other | 107,884 | 9.14 |
| **Total** | **1,112,090** | **94.24** |

interesting to note that the second most abundantly used pesticide in California, the insecticide cryolite, does not appear to be used very widely in these counties. Sonoma County has by far the most concentrated use of methyl bromide, with a value of 4.47 pounds per acre.

A brief description of some of the most abundant or harmful chemicals used on winegrapes follows. All information is from the Extension Toxicology Network's Pesticide Information Profiles (PIP, 2000) unless otherwise noted.

**Sulfur** is a naturally occurring element widely used as a fungicide in both conventional and organic farming. It is most often used to control brown rot on grapes and other fruits. Sulfur controls powdery mildew on wine, raisin and table grapes (Kidd et al., 1991). Sulfur is a general use pesticide; it has been placed in Toxicity Category IV, the least toxic category. Sulfur has been known and used as a pesticide for many years and has been registered for pesticidal use since the 1920s. Currently, sulfur is registered in the U.S. by EPA for use as an insecticide, fungicide and rodenticide. It is applied in dust, granular or liquid form, and is an active ingredient in nearly 300 registered pesticide products.

*Toxicity*. Sulfur is known to be of low acute toxicity, and poses very little if any risk to human and animal health. Short-term studies show that sulfur is of very low acute oral toxicity and does not irritate the skin (EPA, 1991). However, some studies have shown that it can act as a skin and eye irritant (EPA, 1991). Acute exposure inhalation of large amounts of sulfur dust may cause atarrhal inflammation of the nasal mucosa which may lead to hyperplasia with abundant nasal secretions (Meister, 1994). Chronic exposure to elemental sulfur at low levels is generally regarded as safe. There are no known risks of reproductive, teragenic, mutagenic or carcinogenic hazards.

*Environmental Fate*. Sulfur is a component of the environment, and there is a natural cycle of biotic and abiotic oxidation and reduction reactions which transforms sulfur into both organic and inorganic products. The half-life of elemental sulfur depends on soil and meteorological conditions.

The California Winemaking Impact Assessment (CWIA) Vineyard survey conducted in the fall of 1999, asked managers to report their approximate use of elemental sulfur. The three ranges were less than 10 pounds per acre, 10-100 pounds per acre, and more than 100 pounds per acre. It is interesting to compare the results from the CWIA survey to the amount of sulfur that was reported to the California Department of Pesticide Regulation(DPR). Figure 6.1 displays the range of surveyed use of sulfur on vineyards compared to the amount of sulfur that was reported by each county in California in 1998. The results were similar, although the DPR results show that there is a greater occurrence of application of over 100 pounds of sulfur applied per acre than was reported in the survey. Also, more survey respondents claimed to have applied less than

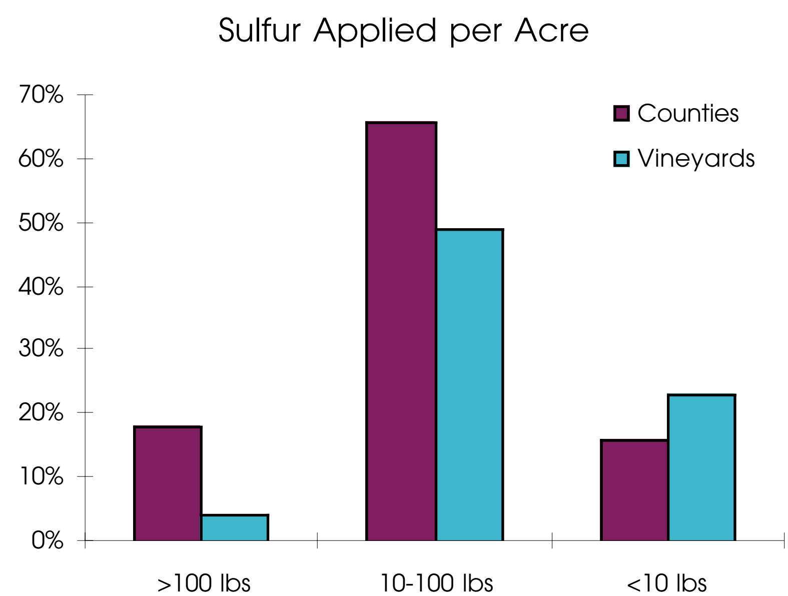



*Figure 6.1 Pounds of Sulfur applied per acre. Vineyard data comes from CWIA Vineyard Survey, 2000. County data comes from 1998 Pesticide Use Report (DPR). Percentage of vineyards reported, 75%. Percentage of counties reported, 84%.*

10 pounds per acre than was reported to the DPR. One aspect to keep in mind, however, is that surveyed respondents originated for the most part in Sonoma, Napa and Santa Barbara counties, whereas the DPR data encompasses the entire state of California.

**Methyl bromide** is chiefly used as a soil and structural fumigant against insects, termites, rodents, weeds, nematodes, and soil-borne diseases. About 70% of methyl bromide produced in the U.S. goes into pesticidal formulations (PIP, 2000). The chemical is a colorless, odorless gas at room temperature. Methyl bromide is a Restricted Use Pesticide (RUP); it may be purchased and used only by certified applicators.

Grape growers routinely fumigate soil with methyl bromide before planting to improve plant growth in the early years. Soil fumigation with methyl bromide at replanting commonly returns the cost of the treatment, usually with 10 to 50 percent greater initial plant growth, leading to larger, more productive plants when they begin to bear three to seven years after planting (Wilhoit et al., 1998).

Methyl bromide has the potential for depleting stratospheric ozone. It has been estimated that Methyl bromide is responsible for 5-10% of worldwide stratospheric ozone depletion (Ross, Zev and J. Kaplan, 1998).

*Toxicity*. Methyl bromide is a highly toxic compound; it is classified in EPA Toxicity Class I (most toxic). The most significant route of exposure is inhalation. Inhalation of 6 mg/L for 10 to 20 hours, or 30 mg/L for 1.5 hours is lethal to humans. Methyl bromide can be highly irritating to the mucous membranes of the eyes, airways, and skin with contact. Chronic exposure to methyl bromide can cause extensive damage to neurons in involved in cognitive processes and physical coordination or muscular control. There are no known reproductive or teratogenic hazards. Methyl bromide is considered to be weakly mutagenic. Data on carcinogenic effects are inconclusive (Wauchope et al., 1992).

*Environmental Fate*. Methyl bromide quickly evaporates at temperatures ordinarily encountered in fumigating, some product may be trapped in soil micropores following application. Methyl bromide is moderately persistent in the environment, it has a field half-life of about 55 days (Wauchope et al., 1992).

Under new federal regulations, methyl bromide will be phased out of use by 2005 (Santa Rosa Press Democrat, 1999). The University of California Sustainable Agriculture Research and Education Program (SAREP) is sponsoring several new studies that are researching the use of alternatives to methyl bromide (SAREP, 1999). One of these studies, a three year study titled "Development of Grape Rootstocks with Multiple Nematode Resistance," is specifically targeted for California grape growers. This research will accelerate the development of grape rootstocks with resistance to a broad range of nematode species (SAREP, 1999).

**Simazine** is a selective triazine herbicide. It is used to control broad-leaved weeds and annual grasses in field, berry fruit, nuts, orchards and vineyards. Simizine is available in wettable powder, water dispersible granule, liquid and granular formulations. It is a General Use Pesticide (PIP, 2000).

Plants absorb simazine mainly through the roots, with little or no foliar penetration. From the roots, it is translocated upward to the stems, leaves and growing shoots of the plant. It acts to inhibit photosynthesis (Kidd et al,, 1991).

*Toxicity*. Simazine is slightly to practically non-toxic. It is in EPA toxicity class IV. The reported LD50 in rats and mice is >5000 mg/kg. Tests on humans have shown that simazine is not a skin irritant, fatiguing agent or sensitizer. However, rashes and dermatitis from occupational exposure to simazine have occurred. There are no known reproductive, teratogenic or mutagenic hazards. Carcinogenic effects are undetermined (Kidd et al,, 1991).

*Environmental Fate*. Simazine is moderately persistent with an average field half-life of 60 days. It has low water solubility and loss from volatilization is insignificant. Simazine is moderately to poorly bound to soils.

**Mancozeb** is used to protect many crops against fungal diseases. It is of the chemical class dithiocarbamate and is in the EPA toxicity class IV. It is registered as a general use pesticide. Mancozeb is available as dusts, liquids, water dispersible granules, and as wettable powders. It is commonly found in combination with zineb and maneb (PIP, 2000).

*Toxicity*. Mancozeb is practically non-toxic to mammals. It is a mild skin irritant and sensitizer, and a mild to moderate eye irritant. A major toxicological concern in situations of chronic exposure is the generation of ethylenethiorea (ETU) in the course of mancozeb metabolism, which can affect thyroid function. Reproductive effects in humans are unlikely. Teratogenicity  and carcinogenic effects are unknown. Data regarding the mutagenicity are inconclusive (Edwards et al., 1991).

Mancozeb is highly toxic to birds, and moderately to highly toxic to fish and aquatic organisms. It is not poisonous to plants.

*Environmental fate*. Mancozeb degrades to ETU within 1 to 7 days. It is practically insoluble in water. Studies indicate that ETU has the potential to be mobile in soils (Edwards et al., 1991).

The chemicals that vineyards use to control pests have been identified, and the following section examines the potential impacts that these chemicals may have on air, water and soil quality. Once a pesticide is released into the environment, it can be transported to different environmental media through various processes. Droplets of pesticide sprays and small particles from pesticide dusts rarely stay within the confines of the field on which they are applied. There is always potential for contamination of air, water and soil.

## Air quality

Ambient air quality can be affected by pesticide use in different ways. The amount of damage to the atmosphere can depend on the type of chemical used as well as the method of application. For example, methyl bromide is used to fumigate the soil before vineyards are planted, usually under highly controlled conditions. Exposure is limited to the amount of volatilized methyl bromide that may leak to the atmosphere at the time of application. Alternatively, the widely used sulfur is usually applied as a powder, and although it is a benign product, it may affect air quality by increasing particulate matter into the air. Workers that directly handle the vines are usually directly exposed to the sulfur, and may be experience minor dermatitis and bronchial irritation.

Pesticides can become airborne in several ways; on droplets of water, as volatilized vapors, adhered to dust particles or some combination of the three. Once airborne, these toxic chemicals can travel great distances. Many pesticides commonly used in California have been detected far from the site of application, some as far as 25 to 50 miles, and at high elevations in the Sierra Nevada Mountains (Zabik and Seiber, 1993).

Often, the majority of the applied pesticides do not even reach the target pest. A recent review of studies on spray drift from aerial and ground applications indicates that an average of 50% of the applied pesticide typically does not hit the target application site, and as much as 80% drifts away from the site (Stein and White, 1993).

Spray drift is not the only source of pollutant release into the air; contamination can continue to occur even after the chemical has been applied. Many pesticides evaporate readily, particularly at warmer temperatures. In some cases as much as 90% of a pesticide can volatilize from soil surfaces or plants within days of an application (Huskes and Levson, 1997).

California passed the Toxic Air Contaminant Act in 1983, which created the framework for the evaluation and control of chemicals as toxic air contaminants (TACs). The statute defines TACs as air pollutants that "may cause or contribute to increases in serious illness or death, or that may pose a present or potential hazard to human health." These bills require that the California Department of Pesticide Regulation (DPR) and California Air Resources Board (ARB) work together towards the evaluation and control of pollutants in the air. In general, the law requires DPR to follow a process to list a pesticide as a TAC. First, DPR must rank each chemical for its potential to contaminate the air and its risk to human health. DPR is then required to create a public health effects report for each high priority pesticide based on extensive air monitoring and literature review. Based on the results of the evaluation of this report, DPR determines whether the candidate pesticide is a TAC. Finally, the agency is required to officially list and stringently regulate those pesticides found to pose significant risk.

The success of this program has been limited. A critical aspect of the program requires air monitoring to determine the extent of a pesticide's presence in the atmosphere. However, only 16 of California's 58 counties have ever been monitored as part of the TAC program (Ross and Kaplan, 1998).

The overall hazard that the wine grape industry poses for the entire state of California can be demonstrated by inspecting which wine grape pesticides are also included in the DPR's list of Toxic Air Contaminants. The list, seen in Table 6.9, was created by cross-checking the pesticides that are listed as being used on wine grapes from the Pesticide Use Report (1998) with the substances identified as Toxic Air Contaminants by the Air Resources Board from 1996. The list of TACs was reviewed again in 1998-1999, but the final results have not yet been released. There are a total of nine chemicals that are listed as known air contaminants.

Table 6.9 List of pesticides designated as California Toxic Air Contaminants.

| |
|---|
| Captan |
| Carbaryl |
| Chlorine |
| 1,3-Dichloropropene (trade name Telone) |
| Mancozeb |
| Methoxychlor |
| Methyl bromide |
| Trifluralin |
| Xylene |

Three of these pesticides, 1,3-dichloropropene (1,3-D), mancozeb, and methyl bromide, are listed in the top ten most abundantly used pesticides on wine grapes (Table 6.4). Methyl bromide ranked fourth, 1,3-D was eighth and mancozeb was tenth. As methyl bromide is phased out, the use of 1,3-D is expected to increase as it is often used as an alternative for controlling nematodes. Methyl bromide and mancozeb are also listed in the most abundant pesticides used in Sonoma, Napa and Santa Barbara counties (Table 6.8). In addition, one of the breakdown products of the herbicide glyphosate is formaldehyde, which is a highly toxic air contaminant (Lund, 1986). Clearly, the cultivation of wine grapes can have a significant impact on local ambient air quality.

## Soil and Water Quality

Pesticides may contaminate water by leaching through the soil profile or by running off the field surface into nearby water bodies. Many of the same factors affect leaching and runoff potential, and some areas have high potential for both pathways. But distinctions are also apparent. In rainy months, storms wash pesticides off fields and into nearby surface waters. The amount of pesticides that washes into the receiving water depends on a number of factors, including the amount and identity of pesticide applied, water solubility of the pesticide, and type of soil and vegetation present in the application area. While some pesticides bind tightly to soils and are transported only via sediments, others dissolve readily in water and travel with the overland flow into streams, agricultural drains and rivers (Kegley et al., 1999). Of the pesticides used on wine grapes, the chemicals that have a high potential for contaminating water quality are simazine, oryzalin, oxyfluorfen, demethoate, benomyl and glyphosate (CAT Report, 1998). Damage to soil quality can result from repeated applications of soil fumigants such as methyl bromide that can destroy many beneficial organisms as well as harmful ones.

Table 6.10 Pesticide use and acreage of major agricultural commodities in California in 1998. Source data for acreage originates from the County Agricultural Commissioner and pesticide data is from the DPR.

| | Total Acres | Total Pesticides | Per Acre | Sulfur Not included | Per Acre |
|---|---|---|---|---|---|
| 1. Strawberries | 23,158 | 7,234,565 | 312.4 | 6,973,234 | 301.1 |
| 2. Carrots | 34,343 | 7,690,466 | 223.9 | 7,368,748 | 214.6 |
| 3. Lemons | 50,466 | 3,997,388 | 79.2 | 3,776,306 | 74.8 |
| 4. Oranges | 202,315 | 10,226,523 | 50.5 | 10,134,808 | 50.0 |
| 5. Almonds | 477,567 | 16,045,079 | 33.6 | 15,606,432 | 32.7 |
| 6. Tomatoes | 41,610 | 1,627,096 | 39.1 | 939,821 | 22.6 |
| 7. Walnuts | 207,126 | 3,915,289 | 18.9 | 3,909,249 | 18.9 |
| 8. Lettuce(head) | 130,329 | 1,937,169 | 14.9 | 1,929,793 | 14.8 |
| 9. Table Grapes | 278,490 | 35,011,973 | 70.5 | 6,053,096 | 12.2 |
| 10. Cotton Lint | 837,269 | 9,537,317 | 11.4 | 9,360,171 | 11.2 |
| ***11. Wine Grapes*** | ***427,283*** | ***34,436,026*** | ***80.6*** | ***4,654,127*** | ***10.9*** |
| 12. Rice | 505,609 | 4,979,981 | 9.8 | 4,979,632 | 9.8 |
| 13. Garlic | 37,412 | 472,423 | 12.6 | 256,891 | 6.9 |
| 14. Broccoli | 117,219 | 767,728 | 6.5 | 767,032 | 6.5 |

How does wine grape cultivation compare to other agricultural products in its use of pesticides? This is an important question to ask as it puts the impact of wine grapes in perspective to other commodities. Table 6.10 (following page) lists fourteen important agricultural commodities to California. Wine grapes, as well as table grapes, are compared to other products in harvested acreage, pounds of pesticides applied in total amounts and as pounds per acre. Amounts of pesticides are given with and without sulfur included. As can be seen in Table 6.10, even when sulfur is included, wine grapes are not ranked as high as some other products, notably strawberries, carrots and oranges in terms of their environmental impact. Strawberries use by far more pesticides per acre than any other product.

In summary, pesticides have a significant impact on air, water and soil quality. Wine grapes used over 34 million pounds of pesticides in 1998. Sulfur is the most used chemical, comprising 86% of the total. Sulfur is used a fungicide and is generally considered an environmentally benign product. Smaller percentages of highly toxic chemicals, including methyl bromide, are still widely used in the industry. These toxic chemicals have the most severe health and environmental impacts. Although the pesticides used in the wine industry pose a serious risk to the environment, other agricultural commodities, such as strawberries, use considerably more pesticides per acre and may present a greater overall hazard.

## Fertilizer

The two primary areas of fertilizer environmental impact are water quality and energy use. Fertilizers are commonly used in agriculture to promote plant growth by providing nutrients that may be of limited availability in the soil. Nitrogen, phosphorous and potassium are the main nutrients applied. These nutrients can be supplemented in the soil by the addition of organic fertilizers, such as compost and pomace from wine production, or in the more concentrated form of synthetic fertilizers.

In conventional viticulture, synthetic fertilizers are commonly applied through irrigation systems to supplement soil nitrogen, phosphorous, and potassium (Mayse and Striegler, 1997). As noted in chapters 2 and 5, one of the primary distinctions between conventional viticulture and organic methods is synthetic fertilizer application. Wine grapes, unlike many other perennial crops, do not require large amounts of nutrient inputs. In fact, over-fertilization can lead to excessive vine productivity, ultimately reducing wine grape quality. It is for this reason that many vineyards grow vines under nutrient and water deficit conditions. However, Vineyard Survey results in Chapter 5 clearly indicated that many vineyards, both traditional and organic, apply significant quantities of fertilizer to enhance soil conditions.

Applied inappropriately or in excessive amounts, these otherwise beneficial materials can threaten nearby water resources. The potential for these and other chemicals to move from land to water is governed by a variety of factors, such as soil type, climate, and tillage practices. Fixed inorganic nitrogen, particularly in the form of nitrate, is highly mobile. Nitrate has a high potential to leach below the root zone into groundwater or be carried overland to nearby surface waters, while excess ammonia can volatize into the atmosphere. Phosphate is not as mobile as nitrate, and tends to be carried on soil particles that move off the field due to erosion. Compost represents an organic nitrogen source; its nitrogen must ultimately be mineralized prior to plant uptake, but the proportion of nitrogen lost to surrounding water resources is generally greater from synthetic (primarily inorganic) nitrogen than compost.

Perhaps the largest difference between the environmental impact of fertilizer inputs to organic and conventional agriculture is energy use. Synthetic nitrogen fertilizer, the most common agricultural input by mass, is fixed through the Haber-Bosch process, where hydrogen and nitrogen are reacted at high temperature and pressure in the presence of iron catalysts to produce ammonia. Approximately 60 gigajoules are required for each ton of ammonia produced, along with substantial quantities of hydrogen (Fluck, 1992). Ammonia is then converted to a variety of forms of nitrogen, including urea, ammonium nitrate, ammonium phosphates, and ammonium sulfate, and combined with other materials to create a complete N:P:K fertilizer product (Lauriente, 1998).

Fluck (1992) estimated that the energy required to produce one pound of synthetic nitrogen fertilizer to be on the order of 34,000 BTU, while the energy required to produce an equivalent quantity of nitrogen in compost derived from crop residue is less than 500 BTU. Both estimates are exclusive of the energy requirements in handling, transportation, and application and should therefore be only taken as rough estimates of total energy use for each fertilizer type. However, surveyed Organic and Traditional vineyards applied approximately the same mass of fertilizer per acre, as noted in Chapter 5. The nutrients provided by synthetic fertilizer are at much higher concentrations than compost. Synthetic fertilizers often contain around 15% Nitrogen by mass whereas compost contains 0.9% Nitrogen by mass. Organic vineyards have to spend significantly more time and money to ensure that the vines are receiving sufficient nutrients. It should also be noted that soil nitrogen levels can be augmented in many viticultural systems by cultivation of leguminous cover crops. However, cover crops can increase vineyard water demand (Miller et al., 1989), and no estimates of the energy input required for mowing and/or tillage were found.

## Comparison of Production Costs

Comparing the costs of producing organic and traditional wine grapes is not easily done. The price of growing wine grapes is a function of a myriad of factors that vary with location. At a minimum, the vintner must consider grape variety, production scale, fertilizer and water requirements, land value, vine density (per acre), the historical intensity of pests in the area, and the price of labor. Though a definitive analysis would be cost-prohibitive, requiring a controlled study over a long period in several regions, some general conclusions can be drawn from a collection of cost comparison studies performed by the University of California Cooperative Extension Service (UCCE) over the past decade examining the cost of establishing a vineyard and producing wine grapes.

The UCCE studies offer snapshots of the cost of growing different grape varieties in different regions in different years; they are most valuable in demonstrating how the price of growing wine grapes can vary profoundly. For example, estimated development costs ranged from $10,000 to $80,000 per acre (Klonsky, 1999). The studies indicate that the cost of establishing a traditional vineyard is comparable to that of establishing an organic vineyard. Initial costs include purchasing vineyard site, land preparation (including vine layout, planting, and trellising), purchase of common vineyard management equipment, irrigation of crops, utilities, property taxes, administrative overhead, and vineyard employment.

The major cost differences occur once a vineyard is established. The labor and materials input are the biggest differences between organic and traditional agriculture, along with the cost of registration and certification as an organic vineyard. The registration cost includes an initial $500 non-refundable fee, fees-for-service, travel charges, and per diem charges. CCOF certification costs a $200 membership fee, the cost of an inspector's time, and an assessment on organic sales. Yields of organically grown and traditional wine grapes are similar and usually range from three to nine tons per acre. Yields depend on grape variety, vineyard age, county of production, yearly growing conditions, and vineyard design. While the organic vineyards spent significantly less on fungicides, herbicides, and insecticides, they had much more substantial costs to provide nutrients to the soil. Organic vineyards add soil amendments including mined limestone, sulfate of potash, and compost, and their costs of material inputs are much higher than conventional practices.

Table 6.11 Comparison of wine grape production costs in organic and conventional vineyards in 1998-adjusted dollars (U.C. Cooperative Extension, 1992-98).

| Location | Grape Variety | Yield | Total Cost per acre | Total Cost per ton |
|---|---|---|---|---|
| **Conventional viticulture** | | | | |
| 1997 San Joaquin Valley | N/A | 7 | $2,503 | $358 |
| 1994 Lodi | Cabernet sauvignon | N/A | $2,447 | $408 |
| 1996 Santa Maria Valley | Chardonnay | 6 | $4,661 | $777 |
| 1998 Lake County | Sauvignon blanc | 6 | $4,536 | $756 |
| 1996 Sierra Foothills | N/A | 5.5 | $5,302 | $964 |
| 1996 Paso Robles | Cabernet sauvignon | 6 | $4,860 | $810 |
| 1996 Sierra Foothills | N/A | N/A | $4,253 | $709 |
| **Average cost of wine grape production** | | | **$3,919** | **$647** |
| | | | | |
| **Organic viticulture** | | | | |
| 1992 Resident Vegetation | N/A | 6.25 | $5,178 | $828 |
| 1992 Annually Sown Cover crop | N/A | 6.25 | $5,262 | $842 |
| **Average cost of organic wine grape production** | | **$5,220** | **$835** | |

Table 6.12 Average cost per acre in 1998, given in dollars (U.C. Cooperative Extension, 1992-98).

| | Conventional | Organic |
|---|---|---|
| Fungicide | 64.83 | 7.49 |
| Fertilizer | 31.62 | 353.95 |
| Insecticide | 30.80 | 12.86 |
| Herbicide | 26.12 | 0.00 |
| **Average Total Cost per Acre** | **153.37** | **374.30** |

Cover crops represent another substantial difference in startup costs between organic and traditional vineyards. Annually sown cover crops require seed, labor, additional farm machinery, and may increase a vineyard's total water demand. By having cover crops, the need for insecticides may diminish as cover crops often provide habitat for beneficial insects. In 1992, UCCE performed two studies that specifically examined the costs of producing organic wine grapes; one study assumed an annually sown cover crop and the other factored in the cost of nurturing resident vegetation between vine rows (Klonsky, 1999). The studies implied that it is more expensive to grow wine grapes with annual cover crops at $725 per ton than resident vegetation, which cost $713 per ton.

Comparison of the two organic cost studies with seven available traditional viticulture studies indicates that production costs for organic grapes may tend to fall on the high end of the range, after adjusting for inflation. However, organic grape production costs do not appear to be substantially higher than traditional grape cultivation, as shown in Table 6.11 and Table 6.12. Organic vineyards may have higher costs by maintaining cover crops and having more expensive fertilizers, but the entire costs of grape cultivation needs to be looked at to reach an accurate comparison.

## Integrated Pest Management

Conventional vineyard management often relies upon the use of sulfur along with synthetic insecticides, fungicides, and herbicides to control pests, while organic growers depend on the use of sulfur and biologically intensive methods. Integrated Pest Management (IPM) has been developed as a compromise. Farmers practicing IPM use both the biologically intensive methods of organic farmers and pesticides, using whichever method they see as the most effective or profitable to deal with a given pest outbreak, or to reduce the risk of an outbreak occurring. Integrated pest management is a long-term approach to managing pests by combining biological, cultural, and chemical tools in a way that minimizes economic, health and environmental risks (Lodi-Woodbridge Winegrape Commission, 1998).

IPM is generally implemented using "volunteer" plants in the vineyards, grown between the rows of vines, to suppress the growth of undesirable "weeds", which may compete with the vines for water, nutrients, and sunlight. The volunteer plant is also chosen to act as a host for predators of potential insect pests. The volunteer plants are chosen depending on location, soil type, and other variables. If chosen properly the volunteer plants, with a little maintenance, will decrease pests and help retain moisture and nutrients in the soil. The result can be not only reduced pesticide application, but also reduced water and fertilizer application.

The following is a description of the ways in which both conventional and IPM methods handle the most common pests found in a vineyard. It should be noted that pests and the mechanism of treatment varies greatly with location, soil type, climate, and preference of the farmer. The two recommended treatments for each pest are taken from the UC Pest Management Guidelines (UC IPM Project, 2000).

### Insects

The list of potential insect pests in a vineyard is extensive. However there one species is particularly common in California vineyards. This insect, the leafhopper, feeds on the nutrient rich juices in the leaves of the vine. Symptoms of leafhopper predation include damaged, white-spotted leaves, resulting in reduced photosynthetic capacity and an overall weakening of the vine.

Leafhoppers are commonly controlled through the application of the pesticides Endosulfan, Sevin, or Guthion. These pesticides are generally quite effective, significantly reducing leafhopper populations, though Endosulfan-resistant leafhoppers are found in some areas. Pesticide use is generally not recommended until after a season in which damage is noticed as the vines can tolerate fairly high populations without harm.

Integrated Pest Management techniques attempt to use biological and cultural control before resorting to pesticide use. Biological controls consist predominantly of planting hosts to natural leafhopper predators, such as blackberry bushes, between rows and around vineyards. Unfortunately, these plants can in some cases be an alternate host to leafhoppers as well.

Cultural techniques remove weeds in vineyards and surrounding areas before vines start to grow in spring can reduce leafhopper populations that might disperse to new grape foliage. The use of a flail mower before budbreak can be particularly effective in controlling overwintering adults if mowing occurs during early morning hours before temperatures warm up to above the flight threshold. Removing basal leaves during berry set and the 2-week period following (before adult leafhoppers emerge) can reduce peak leafhopper populations during the season by 30 to 50%. Maintaining a low growing, summer cover crop to encourage populations of beneficial insects can also help reduce leafhopper populations. Preventing overly vigorous vine growth can also help suppress leafhoppers (UC IPM Project, 2000).

As a last resort, organic farmers can use insecticidal soaps on the underside of the affected leaves. This must be done at a particularly small window of time during larval development.

### Diseases

A major fungal disease problem in grape growing is powdery mildew. The disease appears as a sticky, greyish-white, spore material. The fungus can attack both the vine and the fruit. If fully developed bunches are attacked, they will fail to ripen properly, and the fungus will inevitably end up in the wine, where it creates "off" flavors (Hainle Vineyards, 1995).

The disease can be controlled by canopy management. Bright sunlight and good air circulation prevent spores from spreading, while shade pockets provide a favorable environment for the fungus. By controlling nutrition and irrigation, as well as trimming dense areas, powdery mildew is less likely to become a problem.

Another option, which is approved for use in organic vineyards, is the spraying of sulfur and water. Sulfur is sprayed at budbreak to 2-inch shoot growth. Conventional growers use either sulfur or a synthetic equivalent to deal with powdery mildew. Synthetic equivalents include Rally, Rubigan, Bayleton, and Procure.

### Weeds

Weed management practices vary considerably. Location in the state, climatic conditions, grape varieties, soils, irrigation practices, topography, and grower preferences significantly influence vineyard floor management decisions and the tools used. Weeds are commonly controlled either mechanically or chemically in a 2- to 5-foot-wide strip in the vine row. The area between vine rows can be mechanically mowed, tilled, or sometimes, chemically treated.

IPM is generally implemented using "volunteer" plants in the vineyards, between the rows of vines, to suppress the growth of undesirable weeds which may compete with the vines for water, nutrients, and sunlight. Examples of volunteer plants in California include cereals, such as oat and barley, or subterranean clovers. Alternatively, weeds can be removed physically, though this is labor intensive and must be frequently repeated.

Herbicides can also be used to control most weed species. In most conventional vineyards, combinations and/or sequential applications of herbicides are required to provide effective, economical control.

### Nutrition

As an alternative to synthetic fertilizer application, IPM techniques call for the tilling of volunteer plants into the soil prior to bud break. The plants can be tilled prior to growth in the spring. This not only provides nutrients to the soil, but controls the volunteer plant (which can compete with the vine) and leafhopper populations as well. Conventional vineyards might apply nitrogen fertilizers as necessary.

It should be noted that "organic" does not imply the use of a single set of viticulture methods, just as there is no single "conventional" grape-growing method. The range of practices could be described as more of a continuum than a set of contrasting methods. For instance, a certified organic viticulturalist may not utilize all methods that could be included in the term "organic," while conventional growers can apply biologically intensive methods. Although organic methods may be assumed by many to embrace all environmental "best management practices," this is not necessarily the case. Similarly, conventional vineyards may, or may not, utilize IPM techniques minimize pesticide use.

## Biologically Integrated Farming System: Lodi-Woodbridge Winegrape Commission

In 1994, Governor Wilson signed into law AB 3383, which mandated increased research and implementation of Integrated Pest Management. This assembly bill requested that the Regents of the University of California establish a pilot demonstration program for farmers who want to voluntarily reduce their use of agricultural chemicals. The goal of AB 3383 was "…to expand the use of integrated farming systems that have been proven to decrease the use of farm chemicals," by integrating these elements (Section 591):

- Relying on biological and cultural control to protect crops from pest outbreaks.
- Creating on-farm habitats that harbor populations of beneficial insects and mites.
- Using cover crops to provide some or all of the nitrogen needed by the crop plants.
- Directing overall attention to soil building practices.
- Reducing reliance upon chemicals.

The resulting program became known as the Biologically Integrated Farming System (BIFS) under the direction of the University of California Sustainable Agriculture Research and Education Program (UC SAREP). In 1995 the Lodi-Woodbridge Winegrape Commission received a grant for three years of funding to help transform the IPM program which began in 1992 into an integrated farming program (IFP).

LWWC's definition of BIFS is: "BIFS (of wine grapes) is a long term approach to managing wine grapes using a combination of farming techniques (biological, cultural and chemical) that optimizes the production of quality wine grapes and minimizes economic, environmental, and health risks" (SAREP, 1999).

In 1996, the Lodi-Woodbridge BIFS program began with 30 BIFS grower cooperators and 37 vineyards. By 1998, the third year of the program 43 BIFS growers were working with 60 demonstration vineyards totaling 2370 acres. The LWWC's BIFS program consists of three components: grower outreach, field implementation, and evaluation.

### Grower Outreach

Grower outreach addresses the entire membership of 650 growers in the LWWC district. It involves providing information on integrated farming strategies to growers, pest control advisors (PCA's), and winery personnel. Grower outreach was accomplished through breakfast meetings, workshops/field days, an IPM newsletter, half-day research seminars, and neighborhood grower meetings.

### Field Implementation

The field implementation component requires working with individual LWWC growers and PCA's in a one-on-one situation. This work occurs in specific vineyards to implement one or more of the integrated farming strategies. Types of strategies to be implemented include: weekly monitoring for pests, establishment of economic thresholds, use of cover crops, and the spraying of contact herbicides instead of pre-emergent herbicides. BIFS encourages the weekly monitoring of vineyards in order to familiarize the grower with the vineyard pest situation. This results in the vineyard only being treated during actual pest encroachments (not perceived threats), and only treating the affected sections. In addition, it is possible to establish economic thresholds, which are the levels at which the concentrations of pests will result in economic damage. It is important to recognize that the mere presence of pests is not always cause for concern. LWWC recognizes that "…individual vineyards will periodically suffer pest problems requiring control actions to avoid significant economic losses. It is important for everyone to realize that BIFS (and other sustainable agricultural systems) do not eliminate pest problems" (LWWC, 1998).

Table 6.13 presents some of the BIFS techniques used and their frequency in the LWWC program. From this data, some initial trends can be seen. The cover crop numbers are skewed due to the addition of 13 vineyards to the program that did not have cover crops. However, 100% of the vineyards conducted weekly vineyard monitoring in all three years, reflecting the emphasis on this monitoring by the LWWC BIFS. Also, the spraying of pre-emergent herbicides decreased from 54% in 1996 to 28% in 1998, while the spraying of contact herbicides (preferred by the LWWC BIFS) increased from 19% to 39% during that same period. In addition, those vineyards spraying for mites or leafhoppers decreased from 54% in 1996 to 28% in 1998.

Table 6.13 LWWC techniques and frequency.

| BIFS Management Practice | % of vineyards using practice | | |
|---|---|---|---|
| | 1996 | 1997 | 1998 |
| Weekly Monitoring | 100% | 100% | 100% |
| Cover Crops: Annual | 38% | 34% | 28% |
| Cover Crops: Perennial | 53% | 46% | 44% |
| Strip sprays: Pre-emergent herbicides | 70% | 57% | 59% |
| Strip sprays: Contact herbicides | 19% | 35% | 39% |
| Mechanical weed control under vine | 10% | 8% | 7% |
| Not sprayed for mites or leafhoppers | 46% | 50% | 72% |
| Leaf Pulling | 51% | 55% | 50% |
| Manure Addition | 17% | 14% | 13% |
| Compost Addition | 31% | 26% | 25% |
| Drip Irrigation | 57% | 60% | 73% |
| Owl Boxes | 0% | 24% | 24% |

### Evaluation

What are the benefits of using IPM and/or the BIFS? Does this technique of farming results in the use of smaller amounts of synthetic pesticides and fertilizers? The Lodi-Woodbridge Winegrape Commission's Biologically Integrated Farming System for Winegrapes Final Report dated December 31, 1998 presented the results from the three years worth of implementation (SAREP, 1999). The participating growers were surveyed to determine the levels of BIFS implementation in the vineyards, however the term IPM was used to reduce confusion. The use of various BIFS/IPM strategies increased overall. Of the survey respondents, 76% reduced the per acre load of insecticides, 66% use lower herbicide load, and 58% use lower miticide load. Ninety percent of the respondents "somewhat agreed to strongly agreed that IPM is effective, minimizes environmental risks, reduces use of broad –spectrum chemicals, reduces health risks, and reduces pesticide use" (SAREP, 1999).

The LWWC BIFS project has been successful in the following ways:

- 70% of the BIFS vineyards use cover crops.
- 100% of the BIFS vineyards monitor intensively for in-season pest and beneficial.
- A computer database was developed to manage all grower, crop, pest and pesticide information.
- 28% of the BIFS vineyards sprayed for mites or leafhoppers in 1998 down from 54 percent in 1996.

- 73% of the BIFS acreage has been converted to drip irrigation, up from 57 percent in the first year of the program. This technology can reduce nitrogen use by 50 percent.

"In 1998, a comprehensive grower survey was sent to more than 600 LWWC growers, managers and PCAs. Among other things, survey results show that 94 percent of the growers have read the BIFS newsletter, 65 percent had attended a BIFS neighborhood grower meeting, and 66 percent reported monitoring their vineyards more frequently since 1992. This suggests that the Lodi-Woodbridge BIFS program has had a significant impact on the entire districts' implementation of biologically integrated farming practices". (SAREP, 2000)

The LWWC believes that the use of many kinds of pesticides is "gradually declining over time in LWWC vineyards due to better monitoring and development of realistic economic thresholds by individual growers" (LWWC 1998). The results of the LWWC's efforts could be an overall indication of the usefulness of IPM as an environmentally sensitive tool in farming. Evaluation of the program is ongoing, and IFP program development is continuing. The LWWC Integrated Farming Program is planning to expand to the entire district, which includes 650 growers and about 70,000 acres. Since IPM is already used extensively, it is likely that if LWWC is successful, many other growers throughout the state will begin to adopt integrated farming practices as well.

# 7. Wine Production and Marketing

As with all commercial production activities, wineries affect the social and environmental landscapes in which they are located. Wine is, however, a simple product. Grapes are crushed and given time and care, they are fermented. A few materials, such as fining and stabilizing agents, may be added during processing, but they are not used in large quantities or present in the finished product. After grapes, sulfites are the primary material added, albeit in trace quantities; they inhibit oxidation and stem the proliferation of undesirable microbes. In general, wineries are faced with limited options for minimizing their environmental impact: reduce water usage, improve water treatment, minimize wastewater, improve energy efficiency, or increase the use of recycled materials. This study was primarily concerned with impacts to water supplies.

Despite the apparent simplicity of the winemaker's ingredient list, organic wine is surprisingly an undefined quantity in the United States. Processing standards for organic wine are well established in France and Germany. The United States Department of Agriculture has yet to approve regulatory standards for organic wine processing. Lacking processing standards from the USDA, the Bureau of Alcohol Tobacco and Firearms (BATF) does not recognize any wine as organic. Wine therefore cannot be labeled "organic wine", regardless of the processing standards employed. In effect, there is no such thing as American organic wine.

Clearly there is no domestic consensus regarding organic wine production. A few wineries, such as Frey Vineyards, process their wine completely without the use of sulfites, yeasts other than those present on the grape skins at harvest, gases such as carbon dioxide or nitrogen, stabilizing agents, or fining agents derived from animal products. Such strict limitations constrain the winemaker, limiting flexibility to take corrective action when a batch begins to go awry. On the other hand, the standards set by the Organic Grapes into Wine Alliance (OGWA), for members of the organization include limited sulfite addition, provided that the sulfite is not added as potassium metabisulfite, and most practices associated with high quality wine production are either allowed or "tolerated". The reason for the distinction between potassium metabisulfite and other sulfite compounds is unclear; OGWA standards do not offer a rationale for the division.

In the absence of accepted organic wine processing standards, there is little with which conventional wine processing may be compared. Chapter 5 examined wine production volume, winery water source, winery wastewater treatment technology, employment and distribution for wineries that indicated that they consider environmental impacts when they buy grapes and those that do not.

This chapter examines some of the water sources available to wineries, and explores wastewater flow rates. In the following section, current wastewater treatment standards are evaluated and standard winery self-monitoring reports are studied. Winery distribution options are then evaluated, including differences between distribution options for traditional wine and wine from organic grapes. Finally, consumer preferences and environmental sensitivity are examined.

## Wastewater Disposal

Wineries are faced with several options to treat their wastewater. Unless the winery is located within the public infrastructure network and they are given the option of using a municipal treatment plant, wineries generally use treatment ponds or a septic systems. Of the 83 wineries that answered the question, 46 used septic systems and leach fields. This represents 55% of all wineries, as shown in Figure 7.1.

Septic systems are a sewage treatment and disposal system buried in the ground. Generally a septic system is composed of a septic tank and a leach field or trench. Wastewater is gravity fed, from the disposal site to the septic tank where heavier particles settle out. Bacteria in the tanks break down some of the solids. While the sludge and scum remain in the tank, the effluent flows out of the tank into the leach field, where it is distributed over crushed gravel or absorbent soil.

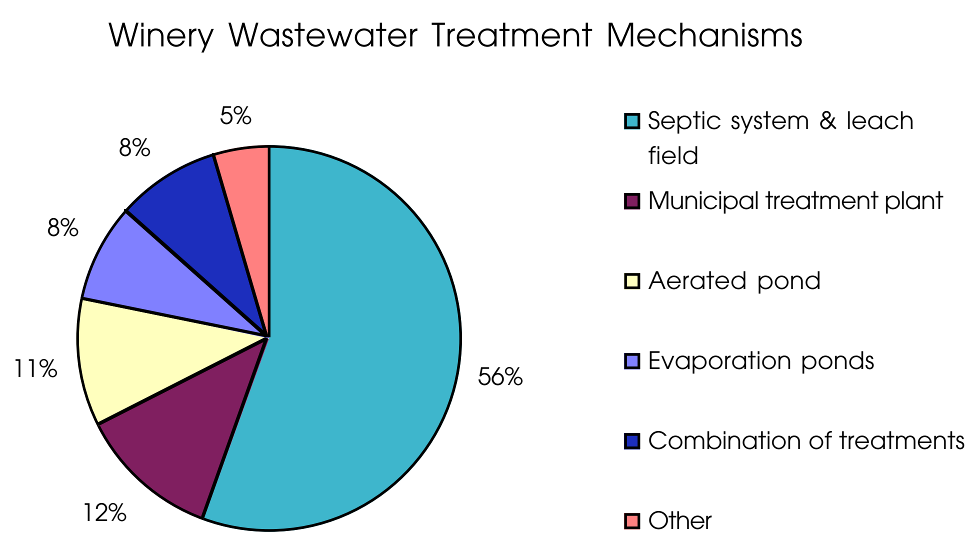



*Figure 7.1 Winery Wastewater Treatment Mechanisms.*

The effluent typically includes organic matter, nitrates, and phosphorus. The septic tank and leach field provide minimal treatment for these contaminants. Generally phosphorus and dissolved metals are bound by the soil - although sandy and gravelly soil may not remove these compounds. Nitrate, however, is much more mobile and usually travels with the groundwater. Biological Oxygen Demand (BOD) is also an issue with nutrient loading. BOD is the amount of oxygen consumed if bacteria and protozoa oxidized all the organics in one liter of water.

The State Coastal Commission is the only agency to implement septic tank regulations state-wide. According to the Coastal Commission, new septic tanks, referred to as on-site disposal systems (OSDS), should not be place in 'unsuitable areas'. Unsuitable sites include:

(a) with poorly or excessively drained soils;

(b) with shallow water tables or high seasonal water tables;

(c) within floodplains; or

(d) where nutrient and/or pathogen concentrations in the effluent cannot be sufficiently treated or reduced before the effluent reaches sensitive water bodies.

Further, the Coastal Commission prohibits the installation of OSDS where conditions indicate that surface waters may be adversely affected by excess nitrogen from ground water, or require the installation of OSDS that reduce total nitrogen loadings to meet water quality objectives (California Coastal Commission–Urban Management Measures. 2000). These requirements point to the impact of septic systems on the environment. As a result, it appears that many wineries are loading nitrogen, phosphorus and pathogens into the environment.

## Winery Waste Discharge Requirements

The State of California through the Regional Water Quality Control Boards (RWQCB) regulates the discharge of wastewater into the environment. Locally, the Central California RWQCB issues Waste Discharge Permits and the County of Santa Barbara share waste permitting responsibilities. Staff with the Central California RWQCB indicated that their requirements and practices closely match those of the RWQCBs in the Napa/Sonoma and Central Valley winemaking regions. Wastewater from wineries usually comes in two forms, domestic wastewater from employee activities and wastewater from the winemaking process.

Domestic wastewater is either input to a local sewer system or it is treated on-site using a septic system. A cursory review of Waste Discharge permits, and initial research efforts, suggests that most wineries are located outside of public utility sewer service. Consequently, most wineries in the Santa Barbara Region use septic systems to treat domestic wastewater.

Septic systems for disposal of domestic wastewater most often consist of underground septic tanks that discharge to subsurface leachfield systems. In some cases, permits requirements indicated that the winery must construct dual leachfields–with capacity for 200% of the calculated disposal flow-with diversion valves to allow wastewater to be periodically allocated to separate leachfields. Septic systems can be permitted either locally–through county or city governments–or through the State of California RWQCB.

Wastewater from wineries is usually either added to the domestic sewer system or treated through a series of wastewater treatment ponds. Winery wastewater is most often generated during the crush period, August through October. When designing wastewater treatment options for winemaking operations, most wineries chose from a limited set of options. Essentially, wineries decide if they should use lined or unlined ponds and whether they should aerated or not aerated those ponds. Further, they must decide if they will employ mechanical or other pretreatment options such as screening devises or pH adjustments and acquire a permit from the RWQCB.

According to the Central Coast RWQCB, larger winemakers frequently employ aerated ponds, while smaller wineries rely on non-aerated evaporation ponds (Higgens, 1999). Winery survey results agree with RWQCB experience for large wineries, as shown in Figure 7.2. However, survey results indicate small wineries use septic systems far more often than evaporation ponds.

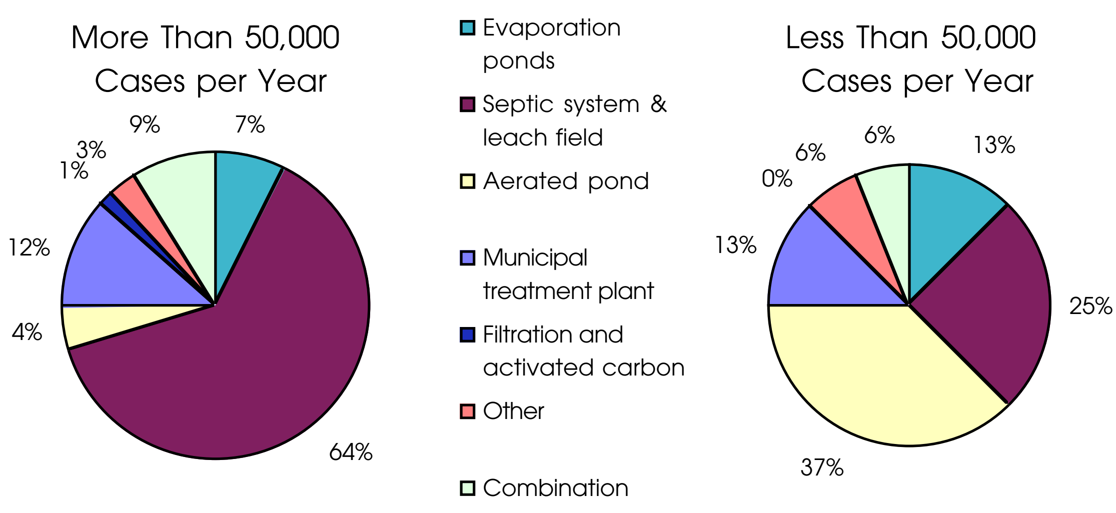



*Figure 7.2 Wastewater treatment technologies applied by small and large wineries.*

The additional oxygen input in aerated ponds allows for the more complete and faster removal of BOD and other components, reducing the area required to treat a given flow rate. Wineries are usually directed to line or not line the ponds by the RWQCB and consulting engineers based on local conditions such as depth to ground water and soil permeability.

After the water has passed through the treatment ponds it is usually used for vineyard irrigation. Reviewed permits contained conditions limiting wastewater to pH between 6.5 and 8.4 for disposal to either the leachfield or as irrigation. Permits also require minimal impact to groundwater nitrate concentrations, usually not to exceed 10 mg/l as N in discharge. Further, permits require that wineries demonstrate water balance calculations that provide adequate disposal/irrigation capacity for the peak crush flow so as to eliminate ponding or surface runoff.

Solid waste from the winemaking process includes pomace and stems. Stems can be used as a farm animal feed supplement, and both pomace and stems can be disced back into a vineyard as a fertilizer.

Waste discharge permits usually contain monitoring and reporting requirements. Monitoring and reporting requirements can include weekly measurements of flow and pond freeboard and annual measurements of total dissolved solids, dissolved oxygen, chemical oxygen demand, and pH. Finally an annual summary of volumes and disposal/use locations of stems, pomace, and sludge must be reported. Table 7.1 displays the results from a sample winery monitoring report.

Table 7.1 Results from a sample winery monitoring report.

| Date | Pond | Analyte | Result | Units | Det. Limit | Method |
|---|---|---|---|---|---|---|
| 11/25/97 | Upper | COD | 4900 | mg/l | 5 | EPA 410.4 |
| 11/25/97 | Upper | DO | 1.2 | mg/l | 1 | SM 4500-OG |
| 11/25/97 | Upper | TDS | 3900 | mg/l | 10 | EPA 160.1 |
| 11/25/97 | Upper | pH | 6.1 | Units | 0.1 | EPA 160.1 |
| 11/25/97 | Middle | COD | 4,500 | mg/l | 5 | EPA 410.4 |
| 11/25/97 | Middle | DO | 1.1 | mg/l | 1 | SM 4500O–OG |
| 11/25/97 | Middle | TDS | 2,400 | mg/l | 10 | EPA 160.1 |
| 11/25/97 | Middle | pH | 6.6 | Units | 0.1 | EPA 150.1 |
| 10/01/98 | Upper | COD | 2,200 | mg/l | 5 | EPA 410.4 |
| 10/01/98 | Upper | DO | ND | mg/l | 1 | SM 4500–OG |
| 10/01/98 | Upper | TDS | 1,400 | mg/l | 10 | EPA 160.1 |
| 10/01/98 | Upper | pH | 6.6 | Units | 0.1 | EPA 160.1 |
| 10/01/98 | Middle | COD | 780 | mg/l | 6 | EPA 410.4 |
| 10/01/98 | Middle | DO | >10 | mg/l | 1 | SM 4500–OG |
| 10/01/98 | Middle | TDS | 960 | mg/l | 10 | EPA 160.1 |
| 10/01/98 | Middle | pH | 9.2 | Units | 0.1 | EPA 150.1 |

*COD=Chemical Oxygen Demand, DO= Dissolved Oxygen , TDS=Total Dissolved Solids*

## Distribution

One of the most contentious issues the California wine industry faces is the distribution of wine. The issue is more socioeconomic than environmental, but the implications for the structure of the wine industry are significant. The 21st Amendment to the U.S. Constitution gives each state the right to regulate, control, and tax the sale of alcoholic beverages. Under California law, wineries can sell wine to consumers directly from the winery, via mailing lists, and through distributors.

Since the major distributors of wine are privately held, available information about their sales is somewhat limited. There are ten major wine distributors in California; it is estimated that they directly employ 2,200 people with total wages of $100 million and total revenues of $3 billion (MKF, 2000). According to Hoovers Business Profiles, the two main distributors in California are Southern Wine and Spirits and Young's Market, who collectively employ 1,600 people to support their wine sales and generate annual revenues on the order of $2.2 billion (Hoovers, 1999).

As discussed in Chapter 5, wine sold to distributors is clearly the dominant distribution channel for Winery Survey respondents, accounting for nearly 60% of total sales. Wineries reported that direct sales through winery web sites comprised only 2% of total volume. Recent independent estimates suggest direct phone and internet sales combined account for approximately 3% of industry sales, a comparable figure (Couzin, 2000). Though they represent a small portion of total sales, direct sales through the internet are a major point of contention between small winemakers and wine distributors. Small winemakers believe they stand to benefit greatly from unfettered direct sales through the open medium of the internet, while it is in the interest of wine distributors to maintain their position as a conduit for the bulk of wine sales to retailers.

The substance of wine distributors' case for federal legislation limiting interstate wine sales through the internet is not couched purely in terms of self-interest. Distributors suggest that their mastery of extant state and local alcohol shipping regulations is essential for compliance with the Byzantine array of laws surviving from the Prohibition era. Individual wineries shipping small amounts directly may neglect to pay the appropriate state-mandated excise and sales taxes. Conflict between the two groups is sufficiently venomous to engender direct accusations of winery malfeasance by their distributor lobbyist groups. For example, Barry McCahill, executive director of Americans for Responsible Alcohol Access accused California wineries of "shipping with impunity." He went on to state, "We advocate felony laws because it's the only thing that will stop these California wineries." (Woody, 1999).

The August 3, 1999 passage of the 21$^{st}$ Amendment Enforcement Act marked a significant victory for the distributor lobby and groups concerned about the possibility of illegal wine purchasing by minors. With the passage of the 21$^{st}$ Amendment, the U. S.

Congress delegated to the states a portion of its constitutional authority to regulate interstate commerce. The amendment specifically allows states to regulate interstate shipments of alcohol; many states have exercised this right by imposing excise taxes on alcohol shipments. However, the 21st Amendment did not specifically delegate to the states the right to enforce state alcohol regulations on companies in other states. Until the passage of the 21st Amendment Enforcement Act, only the federal government was empowered to engage in interstate enforcement of alcohol regulations, and state excise tax fraud generally did not command significant attention from federal prosecutors.

Though it's an open question whether or not children were really buying significant quantities of ultra-premium wine (i.e. wines costing more than $14/bottle) over the internet, the 21st Amendment Enforcement Act may have a substantial impact on how the internet distribution channel develops. Interstate alcohol shipments are regulated by 30 states, limiting the legal market for direct sales by California wineries. When an estimated 80% of wine drinkers have internet access , limitations on direct sales may favor the growth of online alcohol clearinghouses modeled after Amazon.com who will work through arrangements with local distributors to comply with the maze of local regulations (Woody, 1999).

It is unclear whether regulation of internet wine sales, or the rise of web-based wine clearinghouses will affect WOGG producers differently than Traditional winemakers. Of the 91 responses received for the Winery Survey, 12 wineries surveyed produce at least 5% of their wines exclusively from organically grown grapes. It is not possible to determine whether there is a statistical difference between these 12 and the remaining 79 in terms of distribution channels employed. However, it is interesting to note that 10 of the 12 wineries reported that their wines from organically grown grapes require different distribution channels from their wines from conventionally grown grapes, and the company with the single highest rate of internet sales (45%) is among the ten. Wines from organically grown grapes make up a small section of the total wine market, and the Consumer Survey results indicate that people who have bought wines from organically grown grapes because the grapes are organically grown represent a minority of wine consumers (20%).

Since there are on the order of 4,000 individual wine labels currently on the market, physical wine retailers can only display a limited number of wines, and they presumably base their stocking rates in large part upon sales patterns, it's probably difficult for interested consumers to find wine from organically grown grapes. The lack of an industry accepted labeling scheme to communicate to consumers that the wines are in fact made from organic grapes is also likely to limit the ability of organic wine producers to expand their market with retail buyers. It may therefore be exceptionally beneficial for small labels and WOGG producers to advertise and sell over the internet, where they can more readily differentiate their products. On the other hand, the total size of the potential market for WOGG is dependent upon consumer interest.

## The Wine Consumer

When asked to indicate the most important factor in deciding which bottle of wine to buy, people interviewed for the Consumer Survey overwhelmingly cited satisfaction in tasting wine before it is purchased, as shown in Figure 7.3. Grape variety was the next most frequently cited factor, and the variable of primary interest to this report, winery environmental sensitivity, was a distant third.

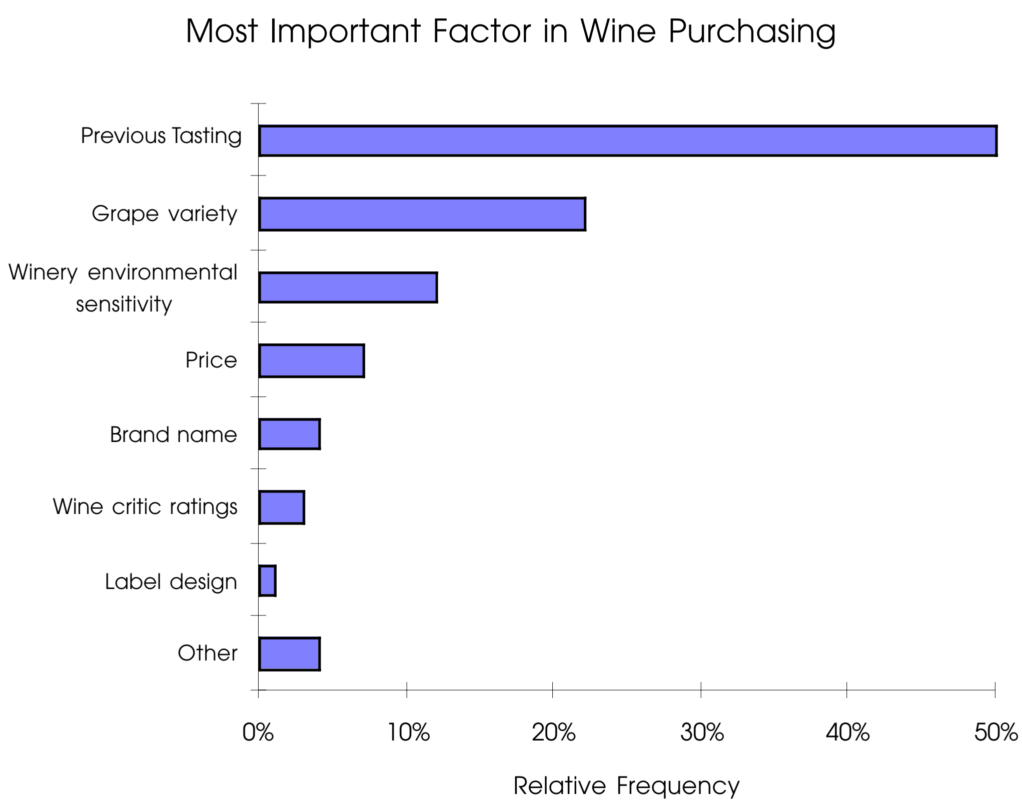



*Figure 7.3 Most important factor in retail wine purchase decisions. Numbers represent the proportion of consumers surveyed who selected the variable as the most important.*

Surveyed consumers were polarized on the issue of winery environmental sensitivity. More than 50% of the group indicated the factor was "Not Important," and an additional 20% rated it only "Somewhat Important." However, winery environmental sensitivity was rated most important more often than price, brand, label design, or wine critic ratings. Taken together, the results indicate that there is a group of concerned consumers that places considerable importance upon environmental issues, but many consumers may not consider a winery's environmental reputation at all when buying a bottle of wine.

Twenty-seven percent of the people surveyed had tasted wine that was either organically grown and produced or made from organically grown grapes, and 20% had bought a bottle of wine specifically because it was organic. Of the 23 respondents who had

Table 7.2 Consumer Survey respondent rate of wine purchase.

| **Bottles/month** | **Wine** | | **WOGG** | |
|---|---|---|---|---|
| | **Yes** | **No** | **Yes** | **No** |
| 1-2 | 36% | 30 | 7% | 6 |
| 3-4 | 31% | 26 | 4% | 3 |
| 5-9 | 20% | 17 | | |
| 10-15 | 11% | 9 | | |
| >15 | 1% | 1 | | |
| **Total** | **100%** | **84** | **11%** | **9** |

*WOGG=Wine from organically grown grapes.*

tasted wine that was "organic" in some sense, fifteen thought favorably of its quality in general (i.e. rated it as "good" or "very good".) However, only nine people, or 11% of the people surveyed, bought wine made from organically grown grapes regularly, as shown in Table 7.2.

Consumers were also asked if they have or have not bought wine because it was organic or made from organically grown grapes. A substantial difference is evident in the potential importance in purchase decisions of more information about winery environmental sensitivity. It must be noted that the precise meaning of the terms "more information" and "environmental sensitivity" was left to the consumer. It is also unlikely that a significant proportion of wine consumers have detailed knowledge of the environmental impacts of winemaking; the absence of comprehensive analyses like this report is evidence for this conclusion.

Nonetheless, a difference was observed between the two groups, as shown below in Figure 7.4. Consumers who have already shown interest in wines from organically grown grapes clearly indicate that they would respond to additional information about differences in environmental impact between wineries. Though Figure 7.3 indicates that this would not be the absolute criterion upon which purchasing decisions are based. However, the results do indicate that vintners stand to gain by exploiting the preference for products perceived as having a lesser environmental impact.

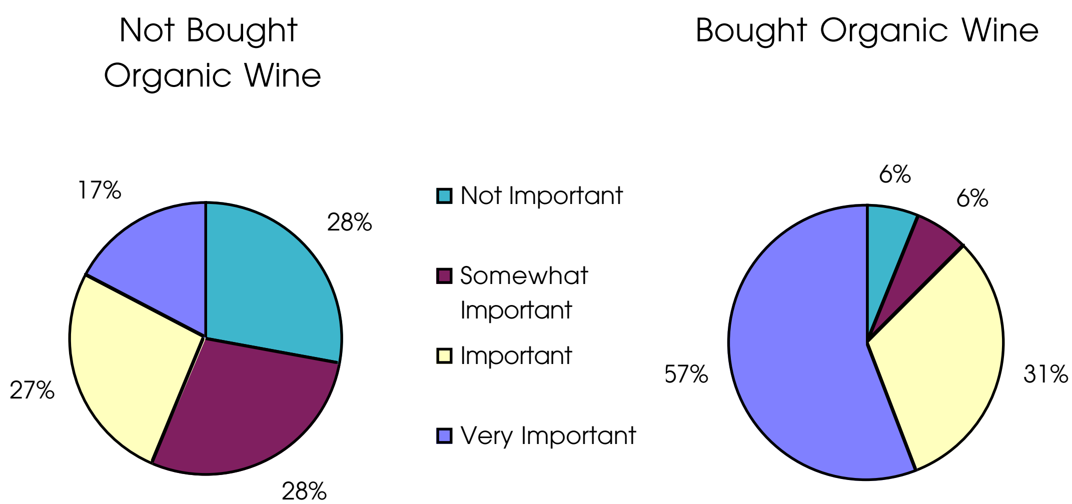



*Figure 7.4 Potential importance of more environmental impact information. Surveyed consumers were asked how important additional information about winery environmental sensitivity could be in their purchase decisions.*

# 8. Fetzer Winery

Fetzer Vineyards and Winery of Hopland, California was selected as a case study for several reasons. First, Fetzer vineyards were initially established using traditional techniques; about ten years ago they converted to organic production. Second, they are a medium sized operation allowing for a more representative study of a typical vineyard and winery. Third, the management team is willing to share information and actually consider it part of their job to offer information to those interested in their company. Fourth, Fetzer is well established in the industry. Finally, Fetzer is leading the development of "sustainable business" practices, and is regarded as a leader among environmentally sensitive companies.

Information for this study was gathered both from the literature concerning Fetzer as well as person-to-person interviews with company management. More specifically, Managing Director Paul Dolan, Director of Vineyard Operations Tom Piper, E3 team leader Jill Jepson, and Environmental Issues Director Patrick Healy offered several hours of their time on February 1, 2000 to answer our questions.

## History

In 1958, the lumber merchant Barney Fetzer and his family purchased a run-down ranch in rural Mendocino along with a 100-year-old vineyard. Ten years later, Jim and John, the eldest Fetzer brothers converted an old barn into a small winery and produced their first 2,500 cases of wines. Since then, Fetzer has continuously marketed their modestly priced wine throughout the state, nation, and today, the entire world. In 1976, sales at Fetzer were booming, allowing Barney to retire from the lumber business and a year later, hire Paul Dolan as head winemaker.

In 1981, just before Barney's death, the family purchased the 1130-acre Sundial Ranch near Hopland, 25 miles south of Redwood Valley, mainly to produce its white wine varietals. In 1984, the family purchased the Valley Oaks ranch near the Sundial ranch and began production at a new winery.

Fetzer's Sundial Chardonnay and Eagle Peak Merlot are America's best sellers in their categories. Today, the company is the sixth largest premium wine producer in the United States. In 1992 Fetzer was sold to the Brown-Forman Corporation of Louisville, Kentucky and Paul Dolan was named president. Since the acquisition Fetzer has earned numerous awards, including Wine and Spirits Magazine's prestigious "Winery of the Year" award nine out of the past twelve years. Through its organic viticultural practices, Fetzer has also developed a reputation as an environmental leader in the wine industry. In the words of Fetzer's president Paul Dolan: "Fetzer will continue to be recognized as the environmentally and socially conscious winery, committed to making the highest quality, best valued wines in the world." This environmentally conscious approach is apparent in many aspects of Fetzer as a vineyard, winery, and a business. Today, Fetzer maintains roughly 770 acres of vineyards, all CCOF certified organic, near the Russian River in the southern end of Mendocino County.

## Organic Viticulture Program

Fetzer's suggests their main reasons for adhering to the California Organic Foods Act of 1990 are as follows:

- Improve soil health and fertility to achieve improved tilth, water retention, nutrient availability and ultimately a stronger vine.
- Minimize the impact on the surrounding environment to foster a diverse community of plants, insects, and animals.
- Reduce the use of fuel and of farm inputs.
- Reduce tractor trips through the vineyard.

The Director of Vineyard Operations, Tom Piper, has chosen to focus on four key areas of essential farming practices in pursuit of the goals listed above. These areas are Soil Building, Insect Control, Weed Control, and Disease Control.

### Soil Building

Fetzer employs the techniques of cover cropping, composting and appropriate tillage to enhance the vitality and sustainability of the vineyard soils. They report that their soils are characterized by sufficient amounts of micronutrients, varying amounts of organic matter, and slightly acidic pH levels. The belief is that, by increasing the soil organic content and the number of soil microorganisms, they will improve soil health and grow a stronger vine with a longer economical life span. Fetzer performs a soil analysis every 2-3 years to monitor these changes (See Table 8.1).

#### Composting and Cover Crops

Approximately 1 ton of compost per acre is applied to 100 acres of the vineyard each year that they are able to produce mostly from vineyard clippings and winery pomace. They primarily target replacement of nutrients that grapes remove and the addition of microorganisms. The use of cover crops helps Fetzer to build up the soil organic matter. They predominantly use three types of cover crop mixes: a rapid-growth mix, a sub-clover mix, and a grass mix. The rapid-growth mix is a mixture of 50% Cayuse Oat, 20% Bell Bean, 20% Austrian Winter Pea and 10% Daikon Radish that is cultivated into the soil in the spring to substantially add to the amount of soil organic

Table 8.1 Soil analysis of Fetzer organic vineyards.

| **Location: Sundial** | | | | | |
|---|---|---|---|---|---|
| **Date** | **1991** | **1992** | **1993** | **1994** | **1997** |
| % Organic Matter | 1.6 | 1.5 | 2.1 | 2.2 | 2.9 |
| Phosphorus | | | | | |
| P1 | 30 | 32 | 24.2 | 32.2 | N/A |
| P2 | 98 | 32 | 18.6 | 17.2 | 32.6 |
| Potassium | 148 | 146 | 147 | 186 | 273 |
| Magnesium | 646 | 519 | 663 | 597 | 571 |
| Calcium | 1630 | 1490 | 2193 | 2270 | 2015 |
| pH | 6.3 | 6.6 | 6.5 | 6.4 | 6.3 |
| C.E.C. (meq/100g) | 15.7 | 13 | 16.5 | 16.9 | 16.1 |
| Nitrate | 12 | 12 | 0.8 | 7.7 | 4.6 |
| Zinc | 1.2 | 1.3 | 1.62 | 0.96 | 1.92 |
| Boron | 0.8 | 1 | 0.8 | 0.9 | 0.49 |
| Sulfur | 12 | 6 | N/A | N/A | N/A |

| **Location: Valley Oaks** | | | | | |
|---|---|---|---|---|---|
| **Date** | **1991** | **1992** | **1993** | **1994** | **1996** |
| % Organic Matter | 1.9 | 1.1 | 1.2 | 1.3 | 1.2 |
| Phosphorus | | | | | |
| P1 | 77 | 7 | 8.1 | 9.7 | N/A |
| P2 | 121 | 6 | 1.1 | 3.3 | N/A |
| Potassium | 123 | 33 | 47 | 63 | *191 |
| Magnesium | 313 | 197 | 178 | 194 | *739 |
| Calcium | 1090 | 620 | 765 | 780 | *2615 |
| pH | 6 | 5.7 | 5.7 | 5.8 | 6.4 |
| C.E.C. (meq/100g) | 10 | 6.3 | 6.8 | 6.8 | N/A |
| Nitrate | 14 | 3 | 1 | 3.7 | N/A |
| Zinc | 4 | 0.2 | 0.82 | 0.6 | 4.3 |
| Boron | 0.8 | 0.6 | 0.6 | 0.6 | 1.16 |
| Sulfur | 11 | 6 | N/A | N/A | N/A |

*Source: Tom Piper, Director of Vineyard Operations, Fetzer Vineyards. February 2000.*

***Note & Assumptions***

*All values are expressed as parts per million unless otherwise noted.*
** = lbs./acre*
*C.E.C. = cation exchange capacity*
*N/A = not available*
*The Sundial tests are from the same location.*
*The Valley Oaks test location changed in 1992.*
*The 1996 results from Valley Oaks were an analysis from a different lab than the others.*

matter. Typically, they plant every other row with a permanent mixture of sub-clover comprised of 25% Koala, 25% Karridale, 25% Mt. Barker and 25% Trikala. They may also plant a permanent grass mix comprised of roughly 27% Delaware Dwarf Rye, 27% Chewings Fescue and 27% Creeping Red Fescue along with a 19% mixture of New Zealand White Clover and Broadleaf Trefoil. This grass mix is used for locations where they need increased competition to help control vine vigor. The cover crops are selected for their rapid growth, ability to choke out weeds, and their ability to tolerate wet winters. The temporary cover crops are periodically tilled back into the soil to serve as organic matter for the vines. About every 3 years, the row middles are ripped to break up the compacted solids.

The cover crops are selected for their rapid growth, ability to choke out weeds, and their ability to tolerate wet winters. The temporary cover crops are periodically tilled back into the soil to serve as organic matter for the vines. About every 3 years, the row middles are ripped to break up the compacted solids.

The soil analysis presented in Table 8.1 suggests some interesting results. The Sundial location is considered by Piper to be a very good soil - as far as grapes are concerned - while the Valley Oaks soil is not as good. In both soils, there seems to be a trend toward greater potassium, calcium, boron, and zinc concentrations. At the same time, there is a downward trend in nitrate levels, at least since the first samples in 1991. Piper notes that these nitrate figures illuminate the problem that can be found in standard soil analysis; many times, the lab values do not make sense. He explains that from year to year, lab values will fluctuate in anomalous ways that avoid interpretation.

The key for Fetzer is to look at the larger view and observe identifiable trends, both in the vineyard and in the analysis. This particular soil analysis shows a steady increase in the critical nutrients - calcium, phosphorous, potassium, as well as total organic matter and Cation Exchange Capacity. Piper states that they literally pay no attention to the nitrate levels because grapevines have a very low nitrogen requirement and that nitrogen only manifests itself when it is in excess. If that is the case, they will try to consume the surplus nitrogen by cropping more heavily in that area or by planting a cover crop that will effectively consume the nitrogen. It is with these reservations that Piper presents his soil analysis results to others in the industry as an example of how organic practices may help improve soil health.

## Insect control

As any organic vineyard, Fetzer seeks to maintain populations of pests through the development of a strong vine and a balancing of the predators within the vineyard.

### Cover Crops and Native Vegetation

Fetzer has chosen cover crops that provide an alternative food source for pests while encouraging the propagation of beneficial, predator insects - primarily spiders, lacewings, and ladybugs. They also seek to maintain the natural balance of insect life by preserving the native vegetation outside the vineyard. Blackberries, native bunch grasses and flowering weed species all provide beneficial predator habitat.

### Cultural Practices

Dust mites have a potentially large negative impact on Fetzer's grapevines. Steps have been taken in the vineyard to minimize dust using river gravel as the main control measure on vineyard roads. They have also purchased a liquid timber industry by-product to spray on the roads; however, this method is expensive and rarely used. Fetzer has also experimented with re-using their own by-products, mainly, stems from grapes and wood chips that were initially used to add oak character to tank wines. The stems and chips are applied using a compost spreader on the dirt roads around and near the vineyard. Within the vineyard itself, the permanent cover crops do an excellent job of controlling dust.

Leaf removal helps to reduce young pest populations while maintaining the vigor of the vine and discourages leafhoppers. Ultimately, Piper feels that unnatural techniques, such as spraying pesticide, lead to greater problems in years to come (e.g., pesticides kill all things, including beneficial predators which could lead to infestations of pests in future years.)

## Weed Control

Since Fetzer uses no synthetic herbicides, physical removal techniques are employed to control weed populations. Techniques include:

- Use of a Clemens under-the-vine cultivator that covers two rows at once and can clear 25 acres a day.
- Use of a Kimco machine, mounted on the side of a tractor which covers one row at a time and can clear 10 acres a day. This machine is typically used in heavy soils and dense weeds.
- Hand hoeing in younger fields to maintain the vines that are not well established.
- Ridging up the dirt - essentially discing the dirt and smothering the weeds.

In addition to the machinery, the Clemens weeder requires a tractor operator and an assistant to remove the accumulations of weeds when used in heavy weeds such as bur clover or vetch. A Kimco machine, on the other hand, only requires one operator. In terms of hand hoeing, a good rule of thumb is that one worker can hoe one half acre a day.

## Disease Control

The techniques listed below are used primarily to address Powdery Mildew and Botrytis. Other fungal manifestations such as Eutypa and Measles are difficult to remedy. To control Mildew and Botrytis, Fetzer:

- Reduces the humidity at bud break by low mowing and cultivation.
- Increases air circulation through trellising and leaf removal in the fruit zone.
- Uses drip irrigation as opposed to sprinklers.
- Applies sulfur at regular intervals.

## Wastewater Outputs from Winery

Fetzer produces 3.8 million cases of wine annually from 50,000 tons of grapes. This production requires 28 million gallons per year of water input to the winery alone and produces approximately 18 million gallons of wastewater that must be treated. This effluent is split between their traditional method of evaporation ponds and newly constructed reed-bed ponds.

The reed-bed ponds were built in 1998 as the result of a three-year study by a UC Davis doctoral candidate. The reed beds are a natural filtration technique for dealing with wastewater effluent from winery facilities. This technique includes diverting the wastewater from the winery into a series of three ponds covering two acres. These ponds include different biological and mechanical components such as reed beds, gravel and sand filters to purify the waste. In fact, the systems is effective enough to return recycled water to the vineyards as a water source. Also, low energy aeration takes place with sprinklers instead of more energy-intensive equipment.

## Input Costs/Yields of Organic Vineyards

Tom Piper believes that the total cost to maintain and operate an organic vineyard is roughly the same as that of a conventional vineyard; it is just the cost allocations that differ. For example, Fetzer's only fungicide cost is sulfur. Sulfur is inexpensive but Fetzer must purchase more of it than a vineyard that uses other fungicides. Fetzer applies up to 100 lbs. of sulfur per acre annually. Additionally, they must dust with the sulfur on a 10-day cycle while other vineyards can go for 14 days or more between dustings of synthetic fungicides. Compost is another input that is greater on an organic farm. Ultimately, Piper believes that these costs are offset by the costs incurred by other vineyards for synthetic herbicides, pesticides, and fertilizers. Our vineyard survey of approximately 107 vineyards in the Napa, Sonoma, and Santa Barbara wine grape-growing regions yielded an average annual budget of non-sulfur pesticides to be about $4000. This translates roughly into $36 an acre for the average-size vineyard in these wine grape-growing regions. Also, the survey noted an average annual pounds per acre use of fertilizer is 350 for these same vineyards. These are costs that a purely organic farm does not incur.

An additional example is the case of John Williams, part owner of Frog's Leap Winery in Napa Valley, who admits that there are drawbacks to organic farming but believes in the long run they are outweighed by the benefits. First there is the so-called "ramp-up" period of three to five years before a farmer gains the full benefit of organic farming. During that period, the farmer must recognize the particular needs of the vineyard and quickly adapt, initially, the costs may be greater. After two or three years of higher costs, maintenance drops, and the lack of any need for chemicals (some of which are expensive) keeps costs low.

There are other costs associated with Organic Certification. A farm seeking to convert from conventional methods to organic methods must consider the cost of farm equipment acquisition, fees for certification, and the added costs of self-monitoring. Piper suggests that when compared to conventional methods, organic farmers must spend much more time in the vineyard, looking for potential problems. Most farmers will have to purchase machinery such as a compost spreader that can be expensive but costs will vary widely depending on the size of the machinery. Additionally, the farmer must pay fees for certification by a third-party certifier such as the California Certified Organic Farmers (CCOF). Fetzer pays approximately $2,500 to certify its 770 acres annually. Piper argues that this cost is probably offset by the cost a conventional farmer must pay for chemical certification, training, and disposal.

Fetzer is in a somewhat unique position because they do not sell their grapes but use them all for wine production. They also buy additional grapes if necessary so any loss from their respective vineyard is more easily absorbed than if they relied solely on the sale of their grapes as some vineyards do. However, Fetzer has not experienced a loss of grape yield as a result of becoming organic.

## Challenges of Cultivating an Organic Vineyard

The greatest challenges about being organic for Fetzer are control of Spider Mites, Pierce's Disease, and Powdery Mildew. Piper says that Spider Mites tend to be attracted to vines that are under stress, such as in exceedingly hot summers. Spider Mites are very small insects that attack the leaves of the vine. Pierce's Disease is a bacterium that affects the whole vine and the fruit, usually killing the plant one year after symptoms can be observed. The disease can be spread via xylem feeding insects such as leafhoppers and spittlebugs. Powdery Mildew attacks the leaf surface, absorbing nutrients. Wind, leaf-wetness, relative humidity, light, and temperature all affect the mildew's ability to destroy the plant.

Fetzer has not had a devastating infestation of any of the pests mentioned above since converting to organic practices over ten years ago. Their organic techniques have been successful at combating these and other problems in the vineyard. Fetzer's management does not feel they have suffered a greater loss of fruit than a conventionally farmed vineyard in the region. It is worth noting that these problems are very location specific and differ from vineyard to vineyard.

A final challenge that plagues the organic farmer is control of under-the-vine weeds. Since they do not use herbicides and mechanical weed abatement is dangerous to the vines, organic farmers must often manually hoe the weeds nearest the roots and base of the vine. Piper estimates that this costs Fetzer about $150/acre added to a $15-20/acre under vine cultivation cost (tilling the rows between vines).

## Lifespan of Organic Vineyards

One of the physical benefits of an organic vineyard that farmers, including Tom Piper, tout is an extended lifespan of the vines. While there are no definitive studies to support it, most organic farmers agree that vines treated with chemicals are weakened and don't build up their internal defense mechanisms to fight pests and viruses. Piper suggests that 25 years is a very good economic lifespan for a vine. After the lifespan has run out, vineyards must be replanted with new, certified virus-free vines, from the traditional varieties developed in Europe.

Both Fetzer president Paul Dolan and Frog's Leap owner John Williams say that organic farming may lengthen the life of vineyards infected with the tiny root louse phylloxera, which is destroying thousands of acres of northern California vineyard[3]. There appears to be some validity to this theory as evidenced by Williams' purchase of a 30-acre block of land that had phylloxera and is now doing very well.

A study conducted by Don Lotter and his colleagues, Professor Jeffrey Granett and Dr. Amir Omer in the Department of Entomology at UC Davis, have found that organic farming techniques might actually protect vineyards against phylloxera and eventual root-rot (Lotter et al. 1998).

[3] In 1996, about 10 percent of Napa Valley's 36,000 acres of vines were torn out and replaced because of the tiny root louse.

Lotter and his colleagues studied several organic and conventionally farmed, phylloxera-infested vineyards in the California wine country for two years. The scientists compared the two farming practices for various measures such as amounts of organic matter and nitrogen in the soil, presence and extent of root-rot, and levels of phylloxera infestation in the roots. Earlier experiments in controlled vineyards demonstrated that roots grown in soils of organically managed vineyards have significantly less root rot (30.3%) than that of conventionally managed soils (54.5%). Although phylloxera populations in organic soils tended to be greater, they were inversely correlated with root rot.

Field experiments sampled phylloxera-resistant roots in nine conventional and four organic vineyards to assess phylloxera populations and root damage. The study showed similar trends, root-rot in organically managed vineyards was 9.0% compared to 30.1% for the conventionally managed vineyards. But unlike the greenhouse experiment, phylloxera numbers were similar in the soil of the organically managed vineyards. Pest populations did not differ between the vineyards and there were no striking or consistent differences in soil quality, organic content, or levels of fungi, harmful or beneficial. All of the vineyards showing favorable results were using compost in combination with winter cover crops. This could suggest that organic methods somehow alleviate the side effects of phylloxera feeding and subsequent root-rot. Lotter and his colleagues also suggest that organic methods might trigger in the vines a sort of immunity to infection known as "induced resistance". In other plants, such as cucumbers, compost can have this effect. Conversely, the herbicide, Roundup, commonly used in conventional farming, has been shown to suppress induced resistance.

### Organic Perception

When asked about the perception of Fetzer's organic conversion among other vineyards, Piper confessed that early in the 1990's there was a belief in the industry that Fetzer was being critical of other vineyards. That is generally not the case today. This sentiment could resurface, however, if Fetzer begins to aggressively market the organic aspect of their wines. Perhaps more importantly, marketing some of their wines as made from organically grown grapes may raise an issue with wine products that are not organic.

## Environmental Business Practices

In 1992, Fetzer created the Bonterra wine label for their wine produced from 100% organically grown grapes. In 1997, Bonterra accounted for 4% of Fetzer's wine sales with 120,000 cases. Managing Director Paul Dolan states that Fetzer is not an organic company. They engage in these sustainable business practices because they simply feel that it is "the right thing to do". They do not actively market their organic aspect because they believe that there is little market incentive to do so. Dolan notes that

Bonterra wines are made from 100% certified organically grown grapes. These wines have seen a 25% increase domestically and 100% increase in export sales in the last year, despite the fact that the better-known Fetzer name does not appear on its label. Dolan attributes this increase specifically to the quality of the Bonterra wines and not so much to the environmental sensitivity of the wine. Dolan also says that the product awareness of Fetzer wines among the general public is only about 30%. Ultimately, Dolan feels that the organic side of their wines is not a beneficial point of differentiation. He does believe, however, that there is a trend in the industry toward organic or at least "sustainable" types of farming.

## Recycling

Environmental sensitivity extends beyond the vineyards at Fetzer and into virtually every aspect of the company. They have established a company-wide recycling center that recycles bottles, plastic, aluminum, fax and computer paper, antifreeze, 70 tons of cardboard, 740 gallons of waste oil, 392 cubic yards of wooden pallets, and 10,000 cases of glass per year. These items are then sold to local recyclers. By doing so, they have been able to save thousands of dollars in disposal fees and have reduced the amount of material hauled to landfills by 93% since 1991 eliminating the dumping of 1,580 cubic yards of landfill.

## Wine Barrels

Fetzer has engaged in a rigorous maintenance program for its wine barrels and has become the first winery in the United States to operate an in-house barrel restoration program. This helps extend the life of their wine barrels resulting in decreased costs to replace barrels, minimizing the impact of barrel making on oak forests in America and France, and reducing the amount of landfill waste from worn-out wine barrels.

## Energy Consumption

Working with Pacific Gas & Electric, Fetzer has designed and built a simple, insulated concrete wall to separate cold stabilizing wine from warm-fermenting wine resulting in an electric bill reduction of $5,000 per month. Additionally, the barrel room, which stores 47,000 wine barrels, was built into a hillside and the walls were covered with a dirt berm. This keeps the room at a constant 65° F without the use of air conditioners. Fetzer is also a member of the ClimateWise program under the US Environmental Protection Agency. This program, similar to the EPA's WasteWise program, is a collaboration between the federal government and industry to turn energy efficiency and increased environmental performance into a company asset. This is done by establishing energy-reduction goals in the form of an "Action Plan" developed in conjunction with the technical assistance from the ClimateWise program. The program does offer some financial assistance to meet goals, tracking software for monitoring environmental performance, as well as case studies of companies who have successfully reduced their energy consumption.

## Club Bonterra

Fetzer also began a program called Club Bonterra designed to show other interested vineyards how to become organic; but, the program became too burdensome on the company. The original intent of the club was to serve as an example or a template of how Fetzer became organic; however, it became too proprietary for Fetzer and was cancelled.

## Administration Building

In 1996, Fetzer built a 10,000-$ft^2$ administration building on the grounds at Hopland. The innovative building design incorporates 18" thick walls constructed out of rammed earth mined from the building site. The roof is made from recycled steel and wood and the interior doors and wooden beams are from a recycled 1920's PG&E building formerly located in San Francisco. The building is cooled not by a conventional air conditioning unit but by water-cooled air from the winery. When this is not sufficient, the system is backed up by a glycol-cooled system from the winery. Additionally, a computer automatically controls vents in the roof that open at night to allow cool, fresh air in, while motion sensors in the rooms turn lights on and off. The Green Building Council concluded that the new building is up to 46% more energy efficient than a comparably sized building. This is based on the percentage the new building exceeds current building codes for energy consumption. The building cost approximately \$148/$ft^2$, which falls within the range of \$110-250/$ft^2$ that a comparably sized building with conventional materials might cost.

## Business Program - E3 Team

In 1998, Fetzer initiated a company-wide business program that established a triple bottom line for all projects and processes at Fetzer. Known as the E3 program, this analysis technique requires that the Economic, Equity, and Environmental impact of existing and future programs and proposals be evaluated and included in final business decisions. To do this, Fetzer has established an E3 Team with subcommittees appointed to assess various aspects of the company such as energy consumption, water usage, and waste reduction with respect to the 3 E's. After their evaluation, the committees make recommendations concerning what courses of action should be pursued.

## Future Efforts

Fetzer is currently undertaking tests in conjunction with researchers from the University of California to evaluate mowing, mulching, organic herbicides, and other techniques to control under-the-vine weed control. They are also attempting different cultural practices and alternative insecticide materials to control mite populations, especially in the hot, dry years. Finally, alternatives to elemental sulfur application in the vineyard are sought in an attempt to establish a better rapport with Fetzer's non-farm oriented neighbors.

In other areas of the company, Fetzer is actively looking to reduce its energy consumption, water usage, and waste production. Through the E3 Team, they hope to achieve a 25% reduction in energy usage, a 30% reduction in water usage, and zero waste production by 2009. Patrick Healy, responsible for Fetzer's recycling, packaging, and other environmental programs, believes that this last goal of zero waste might be overly ambitious as it has become more difficult to achieve reductions in waste production in the past few years. Additionally, the company is currently pursuing ISO 14001 certification, the environmental component of the ISO standards.

### Conclusion

Fetzer has been able to successfully employ organic techniques in its vineyards and winery. They have been maintained as organic for more than ten years and have posted profits every year. They believe that Fetzer serves as an example of a profitable, mid-sized business that has converted from conventional farming methods to organic methods and been just as competitive in the wine industry as conventional vineyards.

President Paul Dolan explains that Fetzer has had some support from their parent corporation, Brown-Forman. Ultimately, however, Dolan feels that if he was not able to make Fetzer profitable during their conversion and adoption of organic practices, the parent company may not have been as supportive.

Fetzer has gone beyond organic practices in its attempt to become more environmentally sensitive. It has invested time and capital into other areas of its business, such as solar-energy cells, the company-wide recycling program, and the wastewater effluent reed-bed technology, in order to enhance Fetzer's environmental aspects. At the same time, they have not actively market their environmental sensitivity because they do not believe that it is beneficial to do so in the wine industry. Moreover, Fetzer feels there might be a negative backlash from other, conventional vineyards if they were to differentiate themselves within the industry in this manner. It is for this reason that Fetzer created the Bonterra label to produce its wine from organically grown grapes and does not place the Fetzer name on its label.

It should be noted that Fetzer's corporate culture is very conducive to the implementation of environmentally sensitive business practices. Essentially, the environmental push is from "top-down" within the company and is spearheaded by individuals with a strong influence such as Fetzer's president, Paul Dolan. While it is not impossible to alter a company's environmental aspect from a "bottom-up" perspective, Paul Dolan, Tom Piper, Jill Jepson and Patrick Healy all agree that it is significantly more difficult and would definitely influence the degree of success in achieving environmental goals.

The Fetzer Case Study is just one example of a vineyard and winery that has been able to convert from conventional practices to organic practices while maintaining market share and profits. There are other success stories (such as Frog's Leap Winery, Butow Vineyards, and Hainle Vineyards) that have also been profitable as organic vineyards and wineries. They all share a common ideal that companies in the wine industry can be prosperous while minimizing their impact on the environment and creating a more sustainable business.

# 9. Conclusion

This California Winemaking Impact Assessment explored the environmental and socioeconomic effects of winemaking in California. Winemakers and vineyard managers were surveyed in three counties: Napa, Sonoma, and Santa Barbara; these three counties represent a significant portion of California's prime wine production districts. Previously published literature and data from these test counties was compiled and analyzed in order to determine the effect of the wine industry on the state's economy and environment, to detail differences between organic and traditional viticulture, and to assess the effect of information about environmental impacts upon consumers' wine purchasing decisions. These assessments were made through the use of indicators of socioeconomic and environmental impact, which are summarized in Table 9.1. To summarize the results of this Assessment, the questions this project addressed are discussed as follows.

*A) What does the California economy gain from vineyards and winemaking?*

The wine industry is an important contributor to the state's economy, and it is an integral piece of California's agriculture industry. Grapes are the second most valuable commodity in California, and in 1998 wine grapes had a value of approximately $1.8 billion dollars (NASS 1999). The full economic impact of wine on the state economy totaled $33 billion in 1998 (MKF, 2000) representing about 3% of California's gross state product (EDD, 1999). Wine grapes are now cultivated on more than 400,000 acres and employ more than 145,000 people. In the last ten years, the number of acres under wine grape cultivation has grown by more than 30%. In light of the rapid growth of the industry, it is likely that its contribution to the state economy will continue to increase.

*B) What is the effect of the wine industry on the state's environment?*

While residents around the state clearly recognize benefits the wine industry brings to their communities, there is growing concern regarding the environmental impacts of the industry. As the number and area of vineyards continues to expand, communities, agency staff, and elected officials have increasingly expressed concern regarding the use of agricultural pesticides. The overuse of agricultural pesticides impacts air, water and soil quality. The wine grape cultivation industry used over 34 million pounds of pesticides in 1998. Sulfur was the most widely used chemical, comprising 86% of total pesticide use. Sulfur is utilized as a fungicide, and its use in 1998 was 69.7 pounds per acre (CDPR, NASS). However, sulfur is generally considered a low impact chemical. However, highly toxic materials, including methyl bromide, are still widely used by

Table 9.1. Summary table of indicator statistics.

| FACTOR | 1999 | Source |
|---|---|---|
| **Land use** | | |
| Acres under winegrape cultivation | 427,282* | Wine Institute |
| Acres certified organic | 5,139 | CCOF 2000 |
| Total Acres using at least one IPM technique | 83% | CWIA |
| **Water Quality** | | |
| Percentage of vineyards using cover crops for erosion control | 73% | CWIA |
| Percent of vineyards on >10% slopes (Sonoma County) | 25% | Merenlender |
| Percent of vineyards using drip irrigation | 81% | CWIA |
| **Air Quality** | | |
| Number of pesticides listed as TACs | 9* | DPR |
| **Inputs** | | |
| Gross pesticide application rate without Sulfur | 10.9 lbs/A* | CDPR, NASS |
| Sulfur per acre | 69.7 lbs/A* | CDPR, NASS |
| **Socioeconomic** | | |
| Total industry employment | 145,000* | MKF 2000 |
| Tourist visits | 11million * | |
| **Marketing/Consumer perception** | | |
| Consumers who have bought organic wine | 20% | CWIA |
| Consumers vineyard's environmental record would influence purchasing decision | 53% | CWIA |
| **Wine production** | | |
| Number of wineries | 847* | MKF 2000 |
| Wine distributed on the internet | 2% | CWIA |
| Wine distributed through liquor distributors | 22% | CWIA |
| Wine distributed through direct winery sales | 24% | CWIA |
| Wineries that purchase at least 5% organic grapes | 12% | CWIA |
| Bonded Wineries | 1,185* | Wine Institute |

**1998*

the industry. These toxic chemicals have been shown to have severe health and environmental impacts. Although pesticides used on wine grapes pose serious environmental risks, other agricultural commodities, such as strawberries, use greater quantities of toxic pesticides per acre and likely present a greater environmental and human health hazard.

Fertilizer inputs are another aspect of grape cultivation that may affect environmental quality. Numerous studies have shown that the heavy use of inorganic fertilizers can lead to surface and groundwater contamination. However, fertilizer is generally not overused in premium wine grape cultivation, as there is an inverse relationship between yield and grape quality. In actuality, most vineyards grow wine grapes under water and nutrient deficient conditions.

Organic agriculture relies on nutrients applied through use of non-synthetic fertilizers such as compost or pomace, while non-organic farmers have the additional option of utilizing synthetic fertilizers. Production of synthetic nitrogen fertilizer is a very energy-intensive process, but it is a relatively inexpensive input since it is produced in massive quantities. Conversely, compost prepared locally or on-site uses less energy and more labor per unit of nitrogen delivered to the plant. However, survey results indicate that CCOF certified and traditional vineyards use about the same mass of fertilizer per year, implying organic vineyards receive less nutrient input than their traditional counterparts. Survey results further revealed that 61% of non-organically certified vineyards' fertilizer needs come from synthetic fertilizers, while only 4% of the vineyards with certified organic acreage use synthetic fertilizers. Alternatively, 83% of the organically certified vineyards' fertilizer needs come from compost or other organic fertilizers, while only 29% of the conventional vineyards' fertilizer budget is supplied by compost. However, the impact of fertilizers used by the wine industry upon water resources is a topic in need of further study.

In some counties, such as Sonoma, new vineyards are being built on steeper slopes than they were in the past. Cultivating grapes on steeper slopes is likely to increase soil erosion. Recently, several counties have established regulations regarding future vineyard development. Sonoma, Napa, and Santa Barbara County regulations seek to restrict new vineyard development on steep slopes to diminish these impacts. It is likely that more regulations regarding vineyard development will be enacted due to increased public awareness of this issue.

*C) What are the significant differences between organic and conventional viticulture, if any?*

While in 1988 there were no certified organic vineyards in California, today there are more than 5,000 acres of certified organic vineyards (CCOF 2000). As this trend suggests, growing concern with pesticide usage has produced an expanding market for organic products. The exact definition of organic wine is, however, complicated. On a federal level, the term “organic” refers to food produced according to the Federal Organic Foods Production Act of 1990 (OFPA), while California has the California Organic Foods Act of 1990 (COFA). Since federal standards for organic farming and food processing are currently undergoing revision and review, COFA remains the applicable legislation in California.

COFA delegates the power of organic certification to third parties, who often have their own regulations in addition to the COFA and OFPA. The state’s largest third-party organic certification organization, California Certified Organic Farmers (CCOF), provides a series of detailed restrictions for organic growers, which include prohibition of any synthetic additions to plants or soil. In addition, all fertilization and pest management agents must originate from 100% naturally occurring substances. When the CCOF standards are applied to vineyards, “organic” means that there has been no application of synthetic pesticides, herbicides, and fungicides to the plants for at least three years prior to harvesting. Since CCOF is the primary third party certification organization for wine grapes in California, the CWIA has chosen to use CCOF terminology when referring to organically grown grapes.

To evaluate the differences between the Organic and Traditional Vineyards the CWIA developed a Vineyard Survey. The Survey targeted vineyard managers in Santa Barbara, Napa, and Sonoma counties and all vineyards certified organic by the California Certified Organic Farmers. The Vineyard Survey confirmed Organic vineyards use less synthetic fertilizer and non-sulfur pesticide, but did not demonstrate a difference in sulfur application. Despite nearly equivalent drip irrigation usage, Traditional vineyards may use more water than their Organic counterparts, though the distributions of water usage for the two groups overlap. Contrary to expectations, organic wine grapes may fetch a small premium, and there is little difference in the size of Organic and Traditional vineyards. Total seasonal employment per unit of vineyard is similar for both groups, but Traditional vineyards tend to pay more, and Traditional vineyards hire more permanent employees at all wage scales.

An alternative to organic growing methods is integrated pest management (IPM). IPM is an agricultural pest management system that encourages the monitoring and control of pests – weeds, fungi, and insects – with minimal use of pesticides. Examples of specific techniques employed by IPM practitioners include removal of vine leaves to reduce disease, and the use of cover crops that are hosts to beneficial insects. Many growers around the state use IPM techniques; in fact, more than 83% of surveyed vineyards used one or more IPM techniques. Integrated Pest Management techniques and drip irrigation are widely used by Organic and Traditional vineyards alike. IPM does not abrogate the use of pesticides, but the goal is minimization of its use through targeted application. Organic growers, on the other hand, depend almost entirely upon careful monitoring, sulfur application, and IPM techniques to control pests, though there are a small number of "organic" pesticides allowed by CCOF/COFA standards. While strict definitions exist for organic grape cultivation, there is currently no certification system for IPM implementation and there are no caps on the quantity of non-sulfur pesticide that an IPM adherent can apply.

The Lodi-Woodbridge Winegrape Commission (LWWC) is a large scale example of IPM implementation. In conjunction with the University of California Sustainable Agriculture Research and Education Program, LWWC growers are encouraged to implement not only IPM practices, but a more complete management system known as the Biologically Integrated Farming System (BIFS). The LWWC's BIFS program consists of three components: grower outreach, field implementation, and evaluation. The LWWC Integrated Farming Program is planning to expand to the entire district, which includes 650 growers and about 70,000 acres. If successful, the BIFS program could ultimately impact the entire industry. As IPM techniques are already extensively employed, it is likely that many other growers throughout the state will begin to adopt integrated farming practices as well.

Though the term organic has a strict regulatory definition, the meaning of the term "organic wine" is more difficult to determine. Current National Organic Standards Board (NOSB) rules state that organic products can contain no added sulfites. As the winemaking process is very difficult in the absence of sulfite additions, very little wine meets proposed NOSB standards for organic production. Currently, the NOSB is considering modification to its rules, which would allow winemakers to use some forms of sulfites in the bottling process. However, as the definition of organic wine is still under contention and "Organic Wine" per se does not exist under U.S. law, we chose to limit our examination to wine made entirely from grapes that are organically grown or "Wine from Organically Grown Grapes" (WOGG).

To evaluate industry trends in employment, water use, and wastewater generation, and to follow organically grown grapes to the next stage in the life cycle of wine, the CWIA developed the Winery Survey. The Survey was a direct mail survey sent to winemakers in Santa Barbara, Napa, and Sonoma counties and all wineries operating vineyards certified organic by the California Certified Organic Farmers. The results from the Winery Survey were divided into two groups: one included all wineries who rated environmental impacts "Very Important" or "Important", while the second group was comprised of wineries who rated environmental impacts "Somewhat Important", or "Not Important". The groups were referred to as "More Sensitive", and "Less Sensitive".

The Survey indicated most wineries obtain their water from private wells and dispose of their wastewater in septic tanks. Neither More Sensitive nor Less Sensitive wineries consistently reported realistic estimates for total water use or wastewater flow, implying that they may rely on outdated estimates of these parameters in their production processes.

The Survey further suggested that More Sensitive wineries buy significantly more organic grapes, and they also make more of their wines exclusively from organically grown grapes. However, the majority of More Sensitive wineries who make WOGG do not highlight the use of organic grapes on their labels. Wines produced by More Sensitive wineries generally earned higher retail prices, perhaps implying greater overall grape quality. Though the survey data do not indicate any overall difference in the distribution channels employed by More Sensitive and Less Sensitive wineries, More Sensitive wineries did report that their WOGG requires different distribution channels than other wines. Total wine production is dominated by a few wineries, but the majority of wineries are relatively small, suggesting the market has room for many niche wine makers.

Fetzer Vineyard is an example of a business that utilizes both traditional and organic techniques. It grows certified organic grapes, and produces several varietals of wine made exclusively from organic grapes. As an example of a business that utilizes both traditional and organic techniques, Fetzer demonstrates that organic viticulture can be successfully practiced at a large scale. The company has managed organic vineyards successfully for more than 10 years. Although their management is committed to environmental sensitivity, if Fetzer had not been profitable during their conversion and adoption of organic practices, their corporate parent probably would not have allowed them to continue cultivating the majority of their vineyards organically.

Fetzer is one example of a vineyard and winery that has converted from traditional to organic practices while maintaining market share and profits. There are other success stories of profitable organic vineyards and wineries. Their success proves that wineries can be profitable while actively striving to minimize their impact on the environment and attempting to create a sustainable business.

*D) Do consumers care about environmental impacts related to wine, and would their choices be affected by additional information?*

As part of the consumer analysis, the CWIA undertook a survey of consumer opinions. The Consumer Survey was designed to determine whether consumers take environmental impact into consideration when deciding which bottle of wine to buy, and whether the importance of environmental impacts in wine purchase decisions would be affected if a greater quantity of relevant information was available. Consumers were interviewed at a variety of locations in Santa Barbara County.

The results of the Consumer Survey show that WOGG probably represents a small part of the Santa Barbara wine market. The rate of WOGG purchase among surveyed consumers is however, similar to the rate of WOGG production among surveyed wineries. Previous tasting of a wine was most frequently cited as the most important factor in wine buying. Moreover, the majority of wine consumers who have tried WOGG rated it favorably, and nearly one third of the people surveyed who have tried WOGG buy it regularly. Consequently, WOGG producers who do not label their wine as "wine from organically grown grapes" may be failing to capitalize on an opportunity to expand their sales and lock-in repeat customers.

## Recommendations

This section details specific recommendations for research and action, to better develop our understanding of the impacts identified in the previous section, and, in some cases, to attempt to mitigate them.

### Industry

- To facilitate conscientious resource use, wineries should initiate a voluntary program of monitoring water use and wastewater generation. Quantification of water flows is the first step in developing effective water conservation strategies and a set of Best Management Practices for management of winery water requirements.
- In order to both reduce costs associated with non-sulfur pesticides and minimize environmental risks associated with handling and application of toxic materials, vineyard managers should increase the application of Integrated Pest Management techniques. Intensification of monitoring of pest and beneficial insect populations is desirable, along with monitoring for conditions favorable to undesirable biota. Monitoring is the cornerstone of adaptive management, allowing targeted application of pesticides and appropriate manipulation of cover crops and the physical environment to enhance habitat for desired biota and diminish pest habitat.
- Winemakers who produce wines from organically grown grapes should inform customers that they are selling WOGG, preferably by including the information on wine labels. Survey results indicate that clearly identifying wine made from organic grapes as WOGG would confer an advantage in marketing wines to environmentally conscious consumers.

### Consumers

- At present, concerned consumers should examine wine labels for one or more of three indicators of environmental sensitivity: the term "wine made from organically grown grapes", direct claims of environmental awareness, and the California Certified Organic Farmers symbol. However, consumers should also be aware that these indicators are far from perfect. Many wines made from organic grapes do not include the CCOF logo or other indications they are organic on their labels. Further, though adherence to organic standards does provide some assurance of reduced impacts due to pesticide and fertilizer use, organic standards do not mandate minimization of other inputs such as water, energy, and land use, which also affect the environment. Thus, organic certification is not necessarily an indicator of overall sustainability, since organic standards only affect a limited set of winery environmental impacts. Lastly, consumers should be aware that labels claiming environmental awareness do not necessarily have a significant connection to actual vineyard and winery management practices.

**Regulators**

- The USDA should finalize and implement federal organic standards authorized under the Federal Organic Foods Act of 1990. Interested vineyard managers may not pursue organic certification due to uncertainty about the details of federal organic standards or their implementation.
- Congress and the USDA should work together to send consumers a simple, clear message about whether wine is "organic" or not. There are currently two terms which apply to wine, "wine from organic grapes", and "organic wine", which have slightly different meanings. For the sake of clarity, a single term should be selected. Since the process of wine production, from fermentation to bottling, involves very few inputs other than grapes, the term "organic wine" is essentially equivalent to "wine from organic grapes, with minimal added sulfites." Since the use of sulfur as a fungicide is unrestricted in organic viticulture, and sulfur applied prior to harvest is one of the sources of "natural" sulfites in wine, there is no clear rationale for imposing restrictions on sulfite additions in organic winemaking (Grapes are not washed prior to crushing).

Sulfite allergies do pose a health risk for some consumers, but organic standards are an attempt to minimize the use of "synthetic" materials, and they do not purport to completely address health risks. If organic standards were in fact based upon health risks, it would be arguable whether a product whose active ingredient is ethyl alcohol should be considered "organic." Rather than incorporating the sulfite issue into organic production standards for wine, Congress and the USDA should address sulfite content separately. One relatively simple solution would be to mandate the inclusion of sulfite content on wine labels. Since consumers are unlikely to know the precise relationship between sulfite content and health risk, labels should include a simplified scale based upon assessments of sulfite risk. Rather than including potentially misleading quantitative data (such as "This wine contains 32 ppm sulfites"), a simple, qualitative message should be developed. Much as other food products denote their fat content with terms such as "lowfat", and "nonfat", sulfite contents below the threshold for allergic reaction in sensitive individuals should be labeled "Low sulfite wine". Wines with sulfite levels at or near the limits of inexpensive analytical techniques could be labeled "sulfite free". Wines with sulfite contents that fall within the range of negligible risk to individuals who are do not have sulfite allergies should be labeled “Moderate sulfite wine”. This information could be included in an unobtrusive space on wine labels, replacing the nearly meaningless phrase, “contains sulfites”.

In the absence of the sulfite issue, it would be relatively easy to select a single term for wine that is organic. Since the term “organic wine” currently implies low sulfite content to many consumers, we suggest the adoption of the label “wine from organic grapes”. This single term should minimize confusion on the part of the consumer while distancing wines from organic grapes from the question of sulfite content. USDA should therefore approve the continued use of the term “wine from organic grapes”.

- The California legislature should consider regulating vineyard development on steep slopes statewide, using Sonoma County as a model. New vineyards placed on a slope greater than a specific threshold, such as 10%, should require erosion management plans, protecting topsoil and reducing stress on California’s waterways caused by heavy sediment loading due to soil erosion. To avoid such regulation, the wine industry could and should discontinue the practice of planting vineyards on steep slopes.
- The California Air Resources Board should increase its efforts to monitor air quality impacts due to application of pesticides that are known to be toxic. Air quality monitoring data is crucial to determining whether a given pesticide should be listed as a Toxic Air Contaminant and identifying whether steps must be taken to minimize its impacts. However, as of 1998, only 16 of California’s 58 counties had initiated monitoring programs (Ross and Kaplan, 1998.)
- The state legislature, in partnership with concerned winemakers and University of California enologists and agricultural extension researchers, should develop an “Environmentally Sensitive” or “Sustainable” label for wine by creating a certification program that includes requirements for grape growing and wine processing which encompass a wider array of factors than current organic standards, while simultaneously setting more readily achievable certification standards for fertilizer and pesticide use. Reductions in application of synthetic fertilizer and non-sulfur pesticides should be encouraged, particularly through the promotion of Biologically Integrated Farming Systems. However, the per-acre use of these materials on wine grapes is relatively modest in comparison with other crops, implying that reduction of other impacts may yield greater environmental benefits, at the margin. The Environmentally Sensitive label could based upon Biologically Intensive Farming System vineyard management techniques, with standards for agrochemical usage that could be attained by a wider array of vineyards than current organic standards. Envi-

ronmentally Preferable standards should include monitoring of a wide variety of factors, including pests, beneficial insect populations, soil water and nutrient levels, and vineyard and winery water use. Such standards should further include erosion management by excluding vineyards developed on steep slopes and requiring the use of cover crops and they should place reasonable, achievable caps on application of non-sulfur pesticides and synthetic fertilizers.

## Recommendations for Future Research

- Methyl bromide is currently being phased out, forcing growers are switching to alternative chemicals for their nematacide requirements. Some of these alternatives may be as harmful as methyl bromide (Telone, for example). Additional research should be initiated immediately to ensure that the environmental impacts of these substitutes are actually less than the impact of methyl bromide itself.

- Quantify the difference in nutrient input between traditional and organic vineyards. Determine whether the difference is a result of nitrogen input from leguminous cover crops, loss due to phenomena such as denitrification and sorption onto clays or organic matter, or due to undesirable processes such as erosion and groundwater leeching.

- Develop a comprehensive set of Life-Cycle Assessments to quantitatively compare the difference between traditional methods and other management practices such as organic viticulture and Biologically Integrated Farming.

- Our Consumer Survey yielded a number of interesting results which could potentially be valuable to winemakers. However, the number of people surveyed was relatively small, limiting the assurance we can have that our results are in fact representative of consumers in general. Our Consumer Survey could be used by other researchers as a pilot study. Additional surveys are necessary to definitively prove that people who have tasted wines made from organic grapes generally like them and many of them purchase it regularly, or that most consumers do not consider environmental impacts very important when they buy a bottle of wine, but the majority would place greater emphasis on environmental considerations if more information was readily available. Further research examining how consumers value the “wine made from organic grapes” label in other states and in international markets could also be beneficial.

- Further research should determine whether long term application of elemental sulfur to vineyards has any significant environmental effects (other than reductions in pest populations.)

- A key limitation of this study was that available data did not provide sufficient evidence for the endorsement of a management strategy as both environmentally preferable and cost-effective. Perhaps the most valuable research that could be done would be a long-term controlled study of the differences in cost and environmental impact of organic, traditional, and IPM vineyard management strategies. In fact, researchers from Fresno State University are currently conducting just such a study (Mayse and Striegler, 1997). Conventional, biologically-intensive, and organic vineyard practices have been applied to carefully monitored plots for the past three years. This research team seeks to comparatively evaluate the relative strengths and limitations of these three systems of viticulture. Though the study has been underway for several years, no results have been released to date.

# Appendix A. References


*American Journal of Enology and Viticulture* (1997), Vol 48, No. 2., 1997.

American Vintners Association, The National Association of American Wineries, www.americanwineries.org.

Ash, John (1999), "Some thoughts about organic farming," *The Washington Times*, June 9, 1999.

Associated Press (2000), "Winery sues New York over ban on Internet wine sales," www.cnn.com/2000/food/news/02/04/internet.wine.ap/index.html, 2000.

Balzer, Lawrence (1984), The Los Angeles Times Book of California Wines, New York: Harry N. Abrams, Inc. 1984.

Baum, M. M. a. M. C. C.-V. (1997), "Developing and testing an international environmental rating system for vineyards and wineries," *American Journal of Enology and Viticulture*, 48(2): 249, 1997.

Bay Area First! (2000), Tourism and Wineries Page, www.bayareafirst.org/infra/tourism.cfm last visited 2/25/2000.

Benitez, J. F., J. Beltran-Heredia, J. L. Acero, and M. L. Pinilla (1997), "Simultaneous photodegradation and ozonation plus UV radiation of phenolic acids — Major pollutants in agro-industrial wastewaters," *Journal of Chemical Technology and Biotechnology*, 70: 253-260, 1997.

Berger, Dan (1996), "Wineries turn to growing techniques that allow them to reduce use of chemicals," *Minneapolis Star Tribune*, July 24, 1996.

Bertani, Elizabeth (1996), "California leads in organic wines," *Natural Food Merchandiser Online*, www.nfm-online.com/nfm_backs/Apr_96/food_focus.html, last visited 2/23/2000, April 1996.

Bugg, R. L., G. McGourty, M. Sarrantonio, W. T. Lanini, and R. Bartolucci (1996), "Comparison of 32 cover crops in an organic vineyard on the north coast of California," *Biological Agriculture and Horticulture,* 13: 63-81, 1996.

Butzke, C. (1999), University of California Extension Enologist, UC Davis, personal communication, November 8, 1999.

Cabras, P., A. Angioni, V. L. Garau, E. V. Minelli, M. Melis, and F. M. Pirisi (1997), "Pesticides in the distilled spirits of wine and its byproducts," *Journal of Agricultural Food Chemicals*, 45: 2248-2251, 1997.

California Air Toxics Program (1999), www.arb.ca.gov/toxics/toxics.htm, last visited 12/8/1999.

California Air Toxics Program (1999), www.arb.ca.gov/toxics/id.htm, last visited 12/8/1999.

California Coastal Commission (2000), "Urban Management Measures" ceres.ca.gov/coastalcomm/nps/npsmmr/cammprur.pdf. 2000.

California Department of Pesticide Regulation Home Page (1999), www.cdpr.ca.gov/ last visited 12/8/1999.

California Tourism Research, California Division of Tourism, www.gocalif.ca.gov/research/tlkngpts.html.

Californians for Alternatives to Toxics (2000), "Wine Grape Report," www.reninet.com, last visited 02/21/2000.

Californians for Pesticide Reform (CPR) (1999), www.igc.org/cpr/ last visited 12/6/1999.

CDFA (1999), "California grape acreage increases to highest level since 1984," California Department of Agriculture, 1999.

CASS (2000), "Final Grape Crush Report 1999 Crop," California Agricultural Statistics Service, 105 pages, 2000.

Climate Wise Homepage (2000), United States Environmental Protection Agency, www.epa.gov/climatewise last visited 3/7/2000.

Community Indicators Handbook (1997), Tyler Norris Associates, Redefining Progress, Sustainable Seattle, 1997.

"County Population Projections with Age, Sex and Race-Ethnic Detail, California" (2000), California Department of Finance Homepage, www.dof.ca.gov/html/Demograp/projca.pdf last visited 2/28/2000.

Couzin, J. (2000), "Uncorking the electronic wine business," *Cable News Network,* www.cnn.com/2000/TECH/computing/03/03/electronic.wines.idg/index.html March 3, 2000.

Cox, Billy, and Susan McAvoy (2000), "Glickman announces new proposal for national organic standards," *National Organic Standards Board Online*, News Release No. 0074.00, Mar 7, 2000 www.usda.gov/news/releases/2000/03/0074.

*Davis Enterprise, The*, February 14, 1999.

Department of Pesticide Regulation, "Pesticide use report, annual 1998, indexed by commodity (preliminary data)" (1999), State of California Environmental Protection Agency, 1999.

De Villers, Marc (1994), “The heartbreak grape: a California winemakers search for the perfect pinot noir,” HarperCollins West, 1994.

Dolan, Paul (2000), Managing Director, Fetzer Vineyards, personal interview, February 1, 2000.

Dunne, Thomas (2000), Professor of Geomorphology & Hydrology, University of California, Santa Barbara, personal communication, March 2000.

Edwards, I. R., Ferry, D. G. and Temple, W. A. (1991), “Fungicides & related compounds,” Handbook of Pesticide Toxicology, Hayes, W. J. and Laws, E. R., Eds. Academic Press, New York, NY, 1991.

Employment Development Department, www.edd.cahwnet.gov.

Figiel, Richard (1994), “Vintners take the pledge,” *Sierra*, November 1, 1994.

Fluck, R.C. (1992), “Energy in Farm Production,” *Energy in World Agriculture*, Elsevier, New York, Vol. 6, pp.177-201. 1992.

Frey Vineyards (1999), Frey Vineyards Home Page, Frey Vineyards, www.freywine.com, last visited 11/8/1999.

Fried, Rona (1999), “Fetzer does it all,” *Sustainable Business Online*, December 1999. www.sustainablebusiness.com/html/insider/dec99/fetzer.cfm, last visited 2/28/2000.

Fulmer, M. (2000), “USDA sets new rules for organic foods,” *Los Angeles Times*, p. C1, March 8, 2000.

Geraci, Victor (1997), “Grape Growing to Vintibusiness: A History of the Santa Barbara, California, Regional Wine Industry 1965 to 1995,” Dissertation at UCSB, 1997.

Gomberg, Fredrickson & Associates (1999), “The Wine Industry’s Economic Contribution to Santa Barbara County: 1998 Survey Update,” June 1999.

Hainle Vineyards(1995), “Organic Viticulture,” www.hainle.com/soft.html, last visited 1/12/00.

Healy, Patrick (2000), Environmental Issues, Fetzer Vineyards, personal interview, February 1, 2000.

Higgens, Michael (1999), Central Coast Regional Water Quality Control Board, State of California personal communication, December 5, 1999.

Hill, Nathon; DiDomenico, Nicole (1998), “Fruit of the vine, a surging organic industry delivers natural wine,” *Organic Wine E.*, V9 a5, 1998.

Hirschfelt, D., W. Peacock, and P. Christensen (1992), “The effects of cover crops on grapevine nutrition and growth,” www.sarep.ucdavis.edu/ccrop/ccres/22.HTM, last modified, 12/28/1998.

Hofmann, U. J. (1997), "Comparative studies on organic and conventional/integrated cropping systems," *American Journal of Enology and Viticulture*, 48(2): 249, 1997.

Hoover's Online (1999) "The Business Network, Beverages - Bottlers & Wholesale Distributors," 1999, www.hoovers.com/industry/description/0,2205,3375,00.html.

Huskes, R. and K. Levson (1997), "Pesticides in rain," *Chemosphere* 35(12): 3013-3024, 1997.

Jackish, P. (1985), Modern Winemaking, Cornell University Press, 1985.

Jackson, D. I., and P. B. Lombard (1993), "Environmental and management practices affecting grape composition and wine quality — A review." *American Journal of Enology and Viticulture*, 44(4): 409-430, 1993.

Jepson, Jill (2000), E3 Team Director, Fetzer Vineyards, personal interview, February 1, 2000.

Kegley, Susan, L. Neumeister, and T. Martin (1999), "Disrupting the Balance: Ecological Impacts of Pesticides in California," Californians for Pesticide Reform, Pesticide Action Network, 1999.

Kidd, H. and James, D. R., Eds (1991), The Agrochemicals Handbook, Third Edition. Royal Society of Chemistry Information Services, Cambridge, UK, 1991.

Klonsky, K., L. Tourte, et al. (1999), "Sample costs to produce organic wine grapes in the north coast with resident vegetation," Davis, CA, University of California Sustainable Agriculture Research and Education Program: 21 pp. 1999.

Lauriente, D.H. (1998), Nitrogen Industry Overview, SRI Consulting, Inc. 353 pages.

Long, Z. R. (1981), "White table wine production in California's North Coast Region," 1981.

Lotter, Don, Granett, J., A. D. Omer, P. Pesserau, and M. A. Walker (1998), "Fungal infections of grapevine roots in phylloxera-infested vineyards," UC Davis Dept. of Entomology, 1998. www.dcn.davis.ca.us:/~dwlotter/research.html, last visited 2/10/2000, entomology.ucdavis.edu/faculty/granett/lotter.htm, last visited 2/10/ 2000.

Lund-Hoie,K., and H.O. Friestad. (1986), "Photodegradation of the herbicide glyphosate in water," *Bulletin of Environmental Contaminants and Toxicology*, 36:723-729, 1986.

Martini, L. P. (1981), "Red Wine Production the Coastal Counties of California 1960-1980, Wine Production Technology in the United States," a symposium sponsored by the Division of Industrial and Engineering Chemistry at the Second Chemical Congress of the North American Continent, 180th ACS National Meeting, Las Vegas, Nevada, August 26, 1980, Maynard A. Amerine, editor, Washington, D.C., American Chemical Society, 145: 59-84, 1981.

May, Thomas Garvey (1999), "Time is ripe for organic wine," *Natural Foods Merchandiser Online*, October 1999.

Mayse, M.A., and R. K. Striegler (1997), "Optimal viticulture systems comparison," *Viticulture and Enology Research Center Research Note*, www.atinet.org/cati/verc/rese/97/970402/, March 14, 2000.

Meister, R.T. (1994), Farm Chemicals Handbook 1994. Meister Publishing Company. Willoughby, OH.

Merenlender, Adina (1999), "A spatially explicit vineyard expansion model: addressing crop production, public policy, and environmental concerns," University of California Sustainable Agriculture Research and Education Program, Final Report, September 1999. www.sarep.ucdavis.edu/grants/Reports/Merenlender/merenlender96-47.htm.

Merrick, Jennifer, Joshua Phillips, and Cathryn Wild (1999), Valley Oak Restoration Site Suitability in the Los Alamos Valley, Santa Barbara County, California, Donald Bren School of Environmental Science and Management, Unpublished, June, 1999.

Miller, P.R., Graves, W.L., Williams, W.A., and Madson, B.A. (1989), "Covercrops for California Agriculture," University of California Division of Agriculture and Natural Resources, Oakland, California, Leaflet 21471, 24 pp. 1989.

Motto, Kryla & Fisher (2000), "Economic Impact of California Wine," St. Helena, CA, January 2000.

Mullins, Michael (1992), Biology of the Grapevine, Cambridge University Press, Cambridge, 1992.

National Agricultural Statistics Service (1998), County Agricultural Commissioner's Data, 1998. www.nass.usda.gov/ca/bul/agcom/indexcm.htm.

Natural Resources Conservation Service Home Page, United States Department of Agriculture, www.nhq.nrcs.usda.gov last visited 2/2/2000.

Newlands, B. (2000), "Internet may turn wine stores into Web masters," *Cable News Network*, 2000.

Norberg, Bob (1999), "Fetzer goes solar: winery unveils largest solar-electric system on the north coast," The Press Democrat, June 25, 1999.

OGWA (1999), "Standards for wines produced from organically grown grapes," www.isgnet.com/ogwa/standards.htm, last visited 10/5/1999.

Organic Wine Company Home Page (2000), ecowine.com/organic.htm last visited 1/20/2000.

Pesticide Action Network North America (PANNA) (1999), www.panna.org/ last visited 12/2/1999.

Pesticide Information Profiles (1999), ace.ace.orst.edu/info/extoxnet/pips/ghindex.html last visited 12/3/1999.

"Pesticide Use Report, Annual 1998" (1999), www.cdpr.ca.gov/docs/pur/pur98rep/98_pur.htm last visited 12/5/1999.

Pinney, Thomas (1989), A History of Wine in America: From the Beginnings to Prohibition, Los Angeles: University of California Press, 1989.

Piper, Tom (2000), Director of Vineyard Operations, Fetzer Vineyards, personal interview, February 1, 2000.

Porter, Christy (1999), "California wineries take major steps to improve vineyards" *BioCycle*, January 1999.

Press Democrat (1999), *Spreading Vines, - A Changing Landscape*, "Growers, regulators say chemical risks low," www.pressdemo.com/vineyards/2chemicals.html, last visited 12/1/1999.

—. (1999), *Spreading Vines, - A Changing Landscape*, "Staking Out Regulations," www.pressdemo.com/vineyards/3laws.html, last visited 12/10/1999.

—. (1999), *Spreading Vines, - A Changing Landscape*, 'The Press Democrat Poll on the Wine Industry," www.pressdemo.com/vineyards/poll/poll.html, last visited 12/10/1999.

Programs, U. O. O. P. (1999), "Assessing health risks from pesticides," US EPA, 1999.

Proposed Update to the Toxic Air Contaminant List (1999), www.arb.ca.gov/toxics/tac/update98/update98.htm, last visited 12/8/1999.

Rachman, Gideon (1999), "The Globe in a Glass," *The Economist*, Dec. 18, 1999.

Reuters (2000), "Internet may turn wine stores into Web masters," *Cable News Network*, 2000.

Reregistration Eligibility Decision (RED) document (1998), "1,3-Dichloropropene," Environmental Protection Agency, Fact Sheet #EPA-738-F-98-014, December, 1998.

Reregistration Eligibility Decision (RED) document (1996), "Cryolite," Environmental Protection Agency, Fact Sheet #EPA-738-F-96-016, August, 1996.

Revised Proposed Rule (2000), National Organic Standards Board, National Organic Standards Revised Proposed Rule, Mar 7, 2000. www.ams.usda.gov/nop/.

Ross, Zev and J. Kaplan (1998), "Poisoning the Air: Airborne Pesticides in California," Californians for Pesticide Reform, Pesticide Action Network, 1998.

*Santa Barbara News Press, The*, May 19, 1999.

SAREP (2000), Highlights of BIFS Projects: Lodi-Woodbridge Winegrape Commission's "Winegrape BIFS," Sustainable Agriculture Research and Education Program, 2000. www.sarep.ucdavis.edu/bifs/highlights.htm.

SAREP (1999), "Progress Report on the Biologically Integrated Farming System (BIFS) Program: January 1997 - December 1998," Sustainable Agriculture Research and Education Program, Division of Agriculture and Natural Resources, University of California. January 1999.

Sawyer, Abby (1997), "Whether red, white or rose, wine is going green," *Wine Business Monthly*, October 1997.

Sawyer, Abby, and Jim Hammett (1998), "American Appellations Earn Distinction as a Marketing Tool: Growers and Vintners Weigh Merits of Tying Appellation to Varietal," *Wine Business Monthly*, June 1998. www.smartwine.com.

Skofis, E. (1981), "Production of Table Wines in the Interior Valley. Wine Production Technology in the United States," a symposium sponsored by the Division of Industrial and Engineering Chemistry at the Second Chemical Congress of the North American Continent, 180th ACS National Meeting, Las Vegas, Nevada, August 26, 1980, Maynard A. Amerine, editor, Washington, D.C, American Chemical Society, 145: 123-142, 1981.

SPSS for Windows 9.0 (1998), "Online Help Reference: Definition of Standard Error of the Mean," Statistical Package for Social Sciences, Inc. 1998.

Stein, R.G. and J.H. White (1993), "Aerial movement and deposition of diazinon, chlorpyrifos and ethyl parathion," Department of Pesticide Regulation, Sacramento, CA, 1993.

Steindorf, Sara (1999), "Leaders in ethical business" *The Christian Science Monitor*, November 29, 1999.

Sustainable Agriculture Research and Education Program (SAREP), University of California, www.sarep.ucdavis.edu, last visited 03/05/2000.

Toxic Air Contaminant Evaluations (1999), www.cdpr.ca.gov/docs/empm/pubs/tacmenu.htm, last visited 12/8/1999.

U.C. Cooperative Extension (1992), "Sample Costs to Produce Organic Wine Grapes in the North Coast with Annually Sown Cover Crops," 1992. www.sarep.ucdavis.edu/pubs/costs/92/grape1.htm.

—. (1992), "Sample Costs to Produce Organic Wine Grapes in the North Coast with Resident Vegetation," 1992. www.sarep.ucdavis.edu/pubs/costs/92/grape2.htm.

—. (1994), "Sample Costs to Establish a Vineyard and Produce Wine Grapes: Cabernet Sauvignon Variety and Drip Irrigated in the Lodi Appellation of Sacramento and San Joaquin Counties," 1994.

—. (1996), "Sample Costs to Establish a Vineyard and Produce Wine Grapes: Zinfandel Variety on a 5 acre planting in the Sierra Nevada Foothills," 1996.

—. (1996), “Sample Costs to Establish a Vineyard and Produce Wine Grapes: Zinfandel Variety on a 28 acre planting in the Sierra Nevada Foothills,” 1996.

—. (1996), “Sample Costs to Establish a Vineyard and Produce Wine Grapes: Drip Irrigated Chardonnay Variety Santa Maria Valley, Santa Barbara County,” 1996.

—. (1996), “Sample Costs to Establish a Vineyard and Produce Wine Grapes: Drip Irrigated Cabernet Sauvignon Variety Paso Robles Region San Luis Obispo County,” 1996.

—. (1997), “Sample Costs to Establish a Vineyard and Produce Wine Grapes: San Joaquin Valley,” 1997.

—. (1998), “Sample Costs to Establish a Vineyard and Produce Wine Grapes: Sauvignon Blanc: Lake County,” 1998.

University of California, Davis, Pest Managements Guidelines, IPM Online Page (2000), www.ipm.ucdavis.edu.

Unknown (1999), “Grapes Aren’t the Only Thing Growing in the Vineyard: Salaries on the Rise,” *Wine Business Monthly*, October 1999, www.smartwine.com.

—. (1999), “Green Harvest: Fetzer vineyards becomes world’s first wine producer to purchase 100% renewable-source power mix,” *Business Wire*, September 13, 1999.

—. (1991), “Harvest of Change,” *National Geographic*. NA: 52-73, 1999.

USDA (1999), “National Organic Program proposed rule,” United States Department of Agriculture, 1999.

USDA (1997), *California Agricultural Statistic Service, California Grape Acreage Report*, 1997.

USDA (1998), *California Agricultural Statistic Service, Final Crush Report,* 1998.

“USDA plans organic food standards”(2000), The Associated Press, *New York Times AP Online*, March 8, 2000. www.nytimes.com/aponline/w/AP-Organic-Food.html.

U.S. Environmental Protection Agency (1991), “Reregistration Eligibility Document Facts: Sulfur,” US EPA, Pesticides and Toxic Substances, Washington, DC. May 1991.

U.S. Environmental Protection Agency (2000), Pesticide Fact Sheets, www.epa.gov/pesticides/factsheets, last updated 2/15/2000.

Vergari, D., and R. B. Boulton (1993), “A survey and analysis of the factors affecting production costs, pricing, and sales in small California wineries,” *American Journal of Enology and Viticulture,* 44(3): 342, 1998.

Wagner, P. M. (1976), Grapes into Wine, New York, Alfred Knopf, 1976.

Wahl, K. a. K. P. H. (1997), "Effects of different pruning lengths, fruit-thinning, and soil management on the vegetative and generative production as well as on wine quality," *American Journal of Enology and Viticulture,* 48(2): 254, 1997.

Wample, Robert et al. (2000), "Grapevine Irrigation Management: Considerations for Water Usage" *Wine Business Monthly*, February 2000, www.smartwine.com.

Wauchope, R. D., Buttler, T. M., Hornsby, A. G., Augustijn Beckers, P. W. M. and Burt, J. P., (1992), SCS/ARS/CES Pesticide properties database for environmental decisionmaking. Rev. Environ. Contam. Toxicol. 123: 1-157, 1992.

Wert, Mark (1994), "Organic Wines" Gannett News Service. June 7, 1994.

Wilhoit, Larry, D. Supkoff, J. Steggall, A. Braun, C. Goodman, B. Hobza, B. Todd, M. Lee (1998), "An Analysis of Pesticide Use in California, 1991 - 1995," Department of Pesticide Regulation and California Department of Food and Agriculture, Sacramento, California, 1998. www.cdpr.ca.gov/docs/dprdocs/puranal.htm, last visited 11/23/1999.

Wine Institute (1999), "U. S. House passes 21st Amendment Enforcement Act:

Federal action does not deter Wine Institute work at state level," August 5, 1999, www.wineinstitute.org/shipwine/current_events/hr2031_update.htm.

"Wine Production Technology in the United States," a symposium sponsored by the Division of Industrial and Engineering Chemistry at the Second Chemical Congress of the North American Continent, 180th ACS National Meeting, Las Vegas, Nevada, August 26, 1980, Maynard A. Amerine, editor, Washington, D.C., American Chemical Society, 145: 29-58.

Winkler, A.J. (1974), <u>General Viticulture,</u> University of California Press, Berkeley, CA, 1974.

Woese, K., D. Lange, C. Boess, and K. W. Bogl (1997), "A comparison of organically and conventionally grown foods — Results of a review of the relevant literature," *Journal of Science, Food, and Agriculture*, 74: 281-293, 1997.

Woody, T. (1999), Online Wine Sales Turn to Grapes of Wrath. Industry Standard http://www.idg.net. April 9, 1999.

Zabik, J.M. and J.N. Seiber (1993), "Atmospheric transport of organophosphate pesticides from California's Central Valley to the Sierra Valley to the Sierra Nevada Mountains," *Journal of Environmental Quality*, 22: 80-90, 1993.

# Appendix B. Industry Surveys

## Cover Letter

Dear X:

You are invited to participate in a study examining the innovative methods of viticulture and winemaking practiced by California vintners. This research is being conducted by the California Wine Project (CWP) team from the Donald Bren School of Environmental Science & Management at the University of California, Santa Barbara. Please complete the enclosed survey; the most valuable information we gather will come directly from experienced members of the wine community.

The CWP survey is designed to collect information relating to traditional and organic grape growing and winemaking practices in California. The survey is divided into two separate questionnaires: a Vineyard Survey, which applies to grape cultivation, and a Winemaking Survey, which is directed at the wine production process. Please fill out both sections of the survey if your operation includes both a vineyard and a winery.

The information you provide is confidential; the results of the survey will be reported only as aggregate statistics. While it may not be necessary to answer all of the questions within a section, please provide as much information as possible and return the survey using the enclosed self-addressed, stamped envelope by December 10, 1999.

We appreciate your participation. Your responses will ensure that the winemaking community is accurately represented in our report, which will be completed in April, 2000. If your winery is interested in further information about our research and its results, please contact Adam Baughman at (805) 983-7198 or via email, abaughman@bren.ucsb.edu. We would be delighted to provide you with a copy of our report; if you are interested, please check the box at the end of the survey. Thank you for your time and expertise.

Sincerely,

Adam Baughman

Survey Coordinator

California Wine Project

## Vineyard Survey

*(If your company does not manage a vineyard, please skip this section.)*

Company: ____________________________County:

Name:________________________________Title:

1) What is the total planted acreage of the vineyards you manage?

____________________________ acres

2) When did the vineyard first commercially produce grapes?

____________________________

3) How many tons of grapes did the vineyard yield for 1998?

____________________________ tons

4) How many tons of grapes did the vineyard yield for 1999?

____________________________ tons

5) What is your average selling price per ton of grapes?

____________________________ $/ton (If you do not sell any grapes, please skip)

6) On what percentage of the vineyard do you use the following integrated pest management techniques?

_______ % Cover crop encouraged or planted in vine row middles

_______ % Winter cover crop maintained for erosion control

_______ % Cover crop chosen as an effective habitat for beneficial insects

_______ % Deterring growth of plants which are host to problematic insects

_______ % Removing leaves in the fruit zone to reduce disease, pests, or improve wine quality

7) On average, how many pounds of sulfur do you annually apply per acre?

_______ 0-10 lbs/acre _______ 10-100 lbs/acre _______ >100 lbs/acre

8) Approximately how much fertilizer is applied annually?

____________________________ lbs/acre

9) What is your annual budget for pesticides other than sulfur?

____________________________ $/year

10) What percentage of the vineyard's fertilizer needs come from each of the sources listed at the right?
______ % Synthetic fertilizer
______ % Compost or direct application of winery waste (leaves, pomace, etc.)
______ % Other(Please specify)

11) What methods do you employ to harvest your grapes?
______ % Harvested by hand
______ % By mechanical harvester

12) How many acres of your vineyards are organic, as specified by the 1990 California Organic Foods Act?
______ acres (If the answer is zero, skip to Question 15)

13) How many acres of the vineyards you manage have been certified organic by an independent certification agency, such as the California Certified Organic Farmers?

_________acres (If the answer is not zero, skip to Question 15)

14) If you use organic viticultural practices, but have not been certified by an independent certification agency such as California Certified Organic Farmers, please rate the following criteria in terms of their importance in the decision *not* to pursue certification. For each factor, place a check in the box which best signifies its importance in making the decision.

**Deciding factors against certification**

| | Very important | Important | Somewhat important | Not important |
|---|---|---|---|---|
| Restrictions are too tight | | | | |
| Expense of certification | | | | |
| Little financial benefit | | | | |
| Local conditions require pesticide use | | | | |
| Slow certification process | | | | |
| Other: (Please specify) | | | | |

15) What is the source of water for the vineyard?
______ Private well ______ Private reservoir ______ Municipal water supply
______ State water project

16) How much water is required annually for irrigation? _______ acre-feet

17) What type of irrigation system do you use?

______ Sprinklers ______ Drip Irrigation ______ Other

18) How many people does the vineyard employ in each of the following categories?
Seasonal:
______ $5-10/hour ______ $11-20/hour ______ More than $20/hr.
Permanent:
______ Less than $30 k/year ______ $31-$50 k/year ______ More than $51k/year

If you are interested in receiving a copy of the project results, please note your email address (or fax/phone number if you do not have email):

____________________________________________

If you are interested in further contact or participation in the study, please check here:

## Winery Survey

*(If your company does not operate a winery, please skip this section.)*

Company:____________________County: ______________________
Name: ____________________Title: ______________________

1) When did your winery first commercially produce wine?
___________________________

2) What is the average annual case production of the winery?
___________________________ cases

3) What was the winery's case production for 1998?
___________________________ cases

How many tons of grapes did this require?
___________________________ tons

4) What is your projected output, in cases, for 1999?
___________________________ cases

5) What percentage of your wines fall into each of the following retail price ranges?
______ % Less than $3 per bottle
______ % $3-$7 per bottle
______ % $7-$14 per bottle

______ % $14-20 per bottle
______ % More than $20 per bottle

6) What percentage of the grapes used in 1998 did you purchase from offsite growers? __________________________ %

7) What percentage of the grapes purchased in 1998 were organically grown?
__________________________ %

8) Please rate the importance of the following factors in your grape purchasing decisions. For each factor, place a check in the box which best signifies its importance in making the decision.

| | Very important | Important | Somewhat important | Not important |
|---|---|---|---|---|
| Grape quality | | | | |
| Price | | | | |
| Growing region | | | | |
| Variety | | | | |
| Environmental impact | | | | |
| Other: (Please specify) | | | | |

10) What is the source of water for the winery?
________ Private well ________ Private reservoir ________ Municipal water supply
________ California Water Project

11) Approximately how much water do you require per year to operate the winery? (Please include all uses.) ______________________ gallons/year

12) What is your average wastewater flow (in gallons) per month?
_______ Avg. gal./month

What is your peak flow (in gallons per day)?
________ Peak gallons/day

13) How is your winery wastewater treated?
________ Evaporation ponds ________ Septic system & leach field
________ Aerated pond ________ Municipal treatment plant
________ Filtration and activated carbon
________ Other: ____________________

14) How many people does the winery employ in each of the following categories?
Seasonal:
______ $5-10/hour ______ $11-20/hour ______ More than $20/hr.

Permanent:
______ Less than $30 k/year ______ $31-$50 k/year ______ More than $51 k/year

15) What percentage of your wine is distributed through each of the following channels?

______ % Wine-exclusive distributors
______ % Liquor distributors
______ % Direct sales at winery
______ % Direct sales to local merchants
______ % Internet sales
______ % Other (Please specify)

16) What percentage of your wines are produced exclusively from organically grown grapes? ________________________ % (If zero, please skip the next two questions)

17) Do your wines from organically grown grapes require different distribution channels than other wines? ________ Yes ________ No

18) Are your wines from organically grown grapes labeled as wine crafted from organically grown grapes? If not, why?________ Yes ________ No Why?

If you are interested in receiving a copy of the project results, please note your email address (or fax/phone number if you do not have email):
________________________________________________________________

If you are interested in further contact or participation in the study, please check here:

# Appendix C. Consumer Survey

**How many bottles of wine do you buy in an average month?**

1 – 2 3 – 5 5 – 10 10-15 >15

**How much, on average, do you usually spend on a bottle of wine?**

0 - $7 $8 – 13 $14 – 20 >$20

**How important are the following factors in your decision to purchase a bottle of wine?**

| Factors affecting purchase | Very important | Important | Somewhat important | Not important |
|---|---|---|---|---|
| Price | | | | |
| Satisfaction in tasting(s) prior to purchase | | | | |
| Rating by wine critics | | | | |
| Varietal (Merlot, Cabernet, Zinfandel) | | | | |
| Name brand | | | | |
| Label design | | | | |
| Environmental sensitivity of the winery | | | | |

**If more information easily available about the environmental sensitivity of winemakers, how important would that be in your purchasing decision?**

More information, easily available:

**Which of these factors is most important in your purchasing decision?**

**Please rate your opinion of the quality following types of wine, if you have tried them:**

| | Very good | Good | Somewhat good | Not good | Haven't tried |
|---|---|---|---|---|---|
| Sulfite-free wine | | | | | |
| Wine from organically grown grapes | | | | | |
| Biodynamic wine | | | | | |

**Have you ever bought a bottle of wine because it was organic?** Yes No

**(If yes) How many bottles of organic wine do you buy per month?**

0 1 – 2 3 – 5 5 – 10 10-15 >15

**Is the respondent Male or Female?** (Circle) **Estimated age:** <39 >40

# Appendix D. Survey Responses

## Vineyard Survey

Vineyard Planted Acreage

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | 141.7 | 24.8 |
| Vineyards without CCOF certified organic acreage | 133.0 | 29.0 |
| Vineyards with some CCOF certified organic acreage | 160.3 | 57.3 |
| Certified Acreage | 92.1 | 33.7 |

First Year of Commercial Production

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | 1965 | 3.5 |
| Vineyards without CCOF certified organic acreage | 1966 | 4.6 |
| Vineyards with some CCOF certified organic acreage | 1962 | 6.2 |

Yield Per Acre, 1998

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | 2.5 | 0.2 |
| Vineyards without CCOF certified organic acreage | 2.4 | 0.2 |
| Vineyards with some CCOF certified organic acreage | 2.9 | 0.5 |

Yield Per Acre, 1999

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | 2.4 | 0.1 |
| Vineyards without CCOF certified organic acreage | 2.4 | 0.2 |
| Vineyards with some CCOF certified organic acreage | 2.4 | 0.3 |

Average Selling Price Per Ton of Wine Grapes

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | $1,975 | $85 |
| Vineyards without CCOF certified organic acreage | $2,056 | $112 |
| Vineyards with some CCOF certified organic acreage | $1,868 | $136 |

Cover Crops: Vine Row Middles

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | 69% | 4% |
| Vineyards without CCOF certified organic acreage | 69% | 5% |
| Vineyards with some CCOF certified organic acreage | 70% | 9% |

Cover Crops: Winter Erosion Control

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | 73% | 4% |
| Vineyards without CCOF certified organic acreage | 71% | 6% |
| Vineyards with some CCOF certified organic acreage | 74% | 9% |

Cover Crops: Promoting Beneficial Insects

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | 44% | 5% |
| Vineyards without CCOF certified organic acreage | 36% | 6% |
| Vineyards with some CCOF certified organic acreage | 62% | 10% |

Deterrence of Problematic Insect Hosting Plants

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | 38% | 5% |
| Vineyards without CCOF certified organic acreage | 42% | 6% |
| Vineyards with some CCOF certified organic acreage | 33% | 9% |

Leaf Removal

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | 69% | 4% |
| Vineyards without CCOF certified organic acreage | 72% | 5% |
| Vineyards with some CCOF certified organic acreage | 63% | 9% |

Mass of Sulfur Applied Per Acre Per Year, in Pounds

The number of vineyards in each group whose annual sulfur application rate fits into the indicated categories.

| | 0-10 lbs | 10-100 lbs | >100 lbs |
|---|---|---|---|
| All Vineyards | 22 | 51 | 4 |
| No CCOF certified acreage | 13 | 38 | 3 |
| Some CCOF certified acreage | 9 | 13 | 1 |

Annual Non-Sulfur Pesticide Budget (per acre)

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | $36 | $9.7 |
| Vineyards without CCOF certified organic acreage | $55.1 | $14.5 |
| Vineyards with some CCOF certified organic acreage | $1.7 | $1.5 |

Mass of Fertilizer Applied Per Acre Per Year, in Pounds

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | 350 | 120 |
| Vineyards without CCOF certified organic acreage | 337 | 155 |
| Vineyards with some CCOF certified organic acreage | 399 | 215 |

Percentage of Fertilizer Needs Met by Synthetic Fertilizer

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | 43% | 5% |
| Vineyards without CCOF certified organic acreage | 61% | 6% |
| Vineyards with some CCOF certified organic acreage | 4% | 4% |

Percentage of Fertilizer Needs Met by Compost

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | 36% | 4% |
| Vineyards without CCOF certified organic acreage | 29% | 5% |
| Vineyards with some CCOF certified organic acreage | 49% | 9% |

Percentage of Fertilizer Needs Met by Other Fertilizers

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | 14% | 3% |
| Vineyards without CCOF certified organic acreage | 6% | 2% |
| Vineyards with some CCOF certified organic acreage | 34% | 8% |

Prevalence of Manual Grape Harvesting

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | 96% | 1% |
| Vineyards without CCOF certified organic acreage | 95% | 2% |
| Vineyards with some CCOF certified organic acreage | 97% | 3% |

Prevalence of Mechanical Grape Harvesting

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | 4% | 1% |
| Vineyards without CCOF certified organic acreage | 5% | 2% |
| Vineyards with some CCOF certified organic acreage | 3% | 3% |

Mean Acreage Cultivated in Accord with 1990 California Organic Foods Act.

| Group | Mean | Standard Error |
|---|---|---|
| Vineyards without CCOF certified organic acreage | 1 | - |
| Vineyards with some CCOF certified organic acreage | 101 | 34 |

Acres Certified Organic By California Certified Organic Farmers

| Group | Mean | Standard Error |
|---|---|---|
| Vineyards without CCOF certified organic acreage | 0 | - |
| Vineyards with some CCOF certified organic acreage | 92 | 34 |

Frequency of Use of Selected Water Sources

| Group | Private Well | Private Reservoir | Municipal Water Supply | Other, or combination |
|---|---|---|---|---|
| All Vineyards | 53 | 3 | 5 | 23 |
| No CCOF certified acres | 39 | 1 | 2 | 15 |
| Some CCOF cert. acres | 10 | 2 | 3 | 6 |

Annual water requirements for irrigation, in acre-feet per acre

| Group | Mean | Standard Error |
|---|---|---|
| All Vineyards | 0.5 | 0.2 |
| Vineyards without CCOF certified organic acreage | 0.6 | 0.4 |
| Vineyards with some CCOF certified organic acreage | 0.3 | 0.2 |

Frequency of Use of Selected Irrigation Systems

| Group | Sprinklers | Drip Irrigation | Combination |
|---|---|---|---|
| All Vineyards | 1 | 62 | 12 |
| No CCOF certified acreage | 0 | 47 | 9 |
| Some CCOF certified acreage | 1 | 15 | 3 |

Vineyard Employees Per 100 Acres of Planted Acreage

| Employee class | Traditional | | Organic | |
|---|---|---|---|---|
| | Mean | Standard Error | Mean | Standard Error |
| **Seasonal** | | | | |
| $5-10/hour | 14.3 | 2.9 | 25.0 | 7.5 |
| $11-20/hour | 11.9 | 5.4 | 2.5 | 1.0 |
| >$20/hour | 0 | - | 0.5 | 0.5 |
| **Permanent** | | | | |
| <$30 k/year | 5.4 | 0.8 | 2.3 | 1.1 |
| $31-50 k/year | 1.6 | 0.4 | 0.6 | 0.2 |
| >$51k/year | 0.1 | 0.1 | 0.03 | 0.02 |

## Winery Survey

Survey Response Rates, by County

| County | Surveys Distributed | Vineyard Survey Respondents | Winery Survey Respondents | Total Respondents | Response Rate |
|---|---|---|---|---|---|
| Napa | 211 | 33 | 38 | 41 | 19% |
| Sonoma | 183 | 33 | 33 | 37 | 20% |
| Santa Barbara | 59 | 10 | 15 | 17 | 29% |
| Other | 90 | 10 | 5 | 12 | 13% |
| Total | 543 | 86 | 91 | 107 | 20% |

Wine production volume, in thousands of cases

| Group | Average | | 1999 (Projected) | | 1998 | |
|---|---|---|---|---|---|---|
| | Mean | S.E. | Mean | S.E. | Mean | S.E. |
| All wineries | 165 | 79 | 184 | 89 | 182 | 95 |
| More Sensitive | 137 | 94 | 147 | 99 | 138 | 93 |
| Less Sensitive | 280 | 183 | 321 | 211 | 313 | 225 |

First year of commercial production

| Group | Mean | Standard Error |
|---|---|---|
| All wineries | 1977 | 3 |
| Very important/ Important | 1983 | 3 |
| Somewhat important/ Not important | 1967 | 7 |

Cases per ton of grapes fermented, 1998

| Group | Mean | Standard Error |
|---|---|---|
| All wineries | 62.6 | 1.2 |
| Very important/ Important | 63.6 | 2.4 |
| Somewhat important/ Not important | 63.0 | 1.2 |

Breakdown of retail price of wine produced (All wineries)

| Retail Price | All Wineries | | Very Important Important | | Somewhat or Not important | |
|---|---|---|---|---|---|---|
| | Mean | S.E. | Mean | S.E. | Mean | S.E. |
| $3-7/bottle | 2% | 1% | 3% | 2% | 2% | 2% |
| $7-14/bottle | 14% | 3% | 9% | 3% | 20% | 5% |
| $14-20/bottle | 30% | 3% | 29% | 5% | 30% | 6% |
| >$20 | 55% | 4% | 61% | 6% | 48% | 7% |

Rated importance grape purchasing factors

| Factor | Very Important | Important | Somewhat Important | Not Important |
|---|---|---|---|---|
| Grape quality | 76 | 2 | | |
| Variety of grape | 71 | 7 | | |
| Growing region | 56 | 21 | | |
| Price | 16 | 30 | 22 | 9 |
| Environmental impact | 13 | 28 | 25 | 9 |

Wine grape purchase rate, and percentage of bought from organic growers

| | All Wineries | | Very Important/ Important | | Somewhat/ Not Important | |
|---|---|---|---|---|---|---|
| | **Mean** | **S.E.** | **Mean** | **S.E.** | **Mean** | **S.E.** |
| Grapes bought from other growers | 53% | 4% | 69% | 5% | 59% | 6% |
| Grapes purchased that are organic | 10% | 3% | 14% | 4% | 1% | 1% |

Winery water sources

| Source of water | All Wineries | Very Important/ Important | Somewhat/ Not Important |
|---|---|---|---|
| Private Well | 67 | 28 | 24 |
| Municipal Water Supply | 13 | 8 | 4 |
| Combination | 6 | 2 | 4 |
| Private Reservoir | 2 | 0 | 2 |
| CA Water Project | 1 | 1 | 0 |

Winery wastewater treatment mechanism

| | All Wineries | Very Important/ Important | Somewhat/ Not Important |
|---|---|---|---|
| Septic system & leach field | 46 | 17 | 18 |
| Municipal treatment plant | 10 | 6 | 3 |
| Aerated pond | 9 | 4 | 5 |
| Evaporation ponds | 7 | 2 | 3 |
| Filtration and activated carbon | 1 | 1 | |
| Combination of treatments | 7 | 5 | 2 |
| Other | 3 | 2 | 1 |

Number of employees per 10,000 cases produced

| | All Wineries | | Very Important/ Important | | Somewhat/ Not Important | |
|---|---|---|---|---|---|---|
| | **Mean** | **S.E.** | **Mean** | **S.E.** | **Mean** | **S.E.** |
| **Seasonal** | | | | | | |
| $5-10/hour | 3.4 | 1.2 | 2.6 | 1.5 | 4.9 | 2.5 |
| $11-20/hour | 3.1 | 0.7 | 1.5 | 1.5 | 4.5 | 0.9 |
| >$20/hour | 0.01 | - | 0.005 | - | 0.02 | 0.1 |
| **Permanent** | | | | | | |
| <$30 k/year | 1.9 | 0.8 | 1.2 | 1.1 | 2.6 | 1.5 |
| $31-50 k/year | 1.5 | 1.4 | 1.7 | 1.1 | 1.3 | 3.3 |
| >$51k/year | 0.8 | 1 | 1.0 | 0.5 | 0.7 | 2.5 |

Breakdown of distribution channels

| | All Wineries | | Very Important/ Important | | Somewhat/ Not Important | |
|---|---|---|---|---|---|---|
| | **Mean** | **S.E.** | **Mean** | **S.E.** | **Mean** | **S.E.** |
| **Wine-exclusive distributors** | 41% | 4% | 45% | 6% | 41% | 6% |
| **Liquor distributors** | 22% | 4% | 20% | 5% | 24% | 7% |
| **Winery sales** | 24% | 3% | 22% | 4% | 21% | 5% |
| **Local merchants** | 12% | 5% | 19% | 11% | 6% | 2% |
| **Internet sales** | 2% | 1% | 2% | 1% | 1% | 1% |
| **Other** | 4% | 2% | 2% | 1% | 8% | 4% |

Do your wines from organically grown grapes require different distribution channels?

| **Response** | **Frequency** |
|---|---|
| Yes | 14 |
| No | 3 |

When you make wine exclusively from organically grown grapes, do you note it on the label?

| **Response** | **Frequency** |
|---|---|
| Yes | 11 |
| No | 5 |

Percentage of wine produced solely from organically grown grapes

| **Group** | **Mean** | **Standard Error** |
|---|---|---|
| Total | 12.6% | 3.5% |
| Very Important/ Important | 12.2% | 4.6% |
| Somewhat or Not Important | 0.3% | 0.2% |

# Appendix E. Current Organic Standards

## Summary of the federal Organic Foods Production Act of 1990

To be sold and labeled as a organically produced agricultural product, the Act

- prohibits the use of synthetic chemicals in the production and handling of the agricultural product.
- requires that the land on which it is produced has had no application of prohibited substances including synthetic chemicals during the three years prior to the harvest of the product.
- requires that the product be handled in compliance with an organic plan agreed upon by the producer, handler and the certifying body.
- requires that all organic agricultural product be produced on certified organic farms using organically certified handling techniques.
- these farms must be certified annually with an on-site inspection.

Farms must meet both the Federal Act criteria as well as the California Organic Food Act of 1990 criteria. Compliance with the following criteria, in addition to the requirements set forth in the Federal and State organic acts, allows the producer to utilize the CCOF seal for advertisement of their product.

## California Certified Organic Farmers

Organic Production:

The CCOF requires a long-term program of ecological soil management that includes:

- a goal of healthy, fertile, biologically active soil.
- special attention to reaching optimum levels of organic matter and cation exchange capacity for the particular soil type in order to minimize the use of soluble nutrients.
- that the land be certified under the California Department of Food and Agriculture.

- a minimum buffer zone of 25 feet is required from the dripline of the crop in the program to potentially contaminated adjacent area.

The CCOF recommends:

- agricultural practices include the incorporation of composted organic materials, mineral powders, microorganisms, green manures (especially legumes) and crop residues.
- crop rotation and the use of cover crops.
- soil building programs must make a reasonable effort to control soil erosion.

Processing, Handling, and Storage

The CCOF requires:

- all product labeled as "Made with Organic" must contain at least 50% organic ingredients, by weight, excluding water and salt.
- processing and handling lines used for both organic and non-organic product must be thoroughly cleaned immediately before organic product is processed or handled.
- there must be no mixing of organic and non-organic product between containers, and no addition or removal of product from containers.

The CCOF also has specific recommendations regarding nitrogen, phosphorous, disease management, insect management, micronutrients, etc. The CCOF bases criteria for generic materials designations on the California Organic Foods Act of 1990, and the California Department of Food and Agriculture Preliminary Materials List. CCOF maintains its own lists of allowed, regulated, and prohibited substances in a comprehensive array of categories: crop materials, additives, ingredients, processing aids, cleansers, disinfectants, sanitizers, and pest controllers.

## Organic Grapes into Wine Alliance

The Organic Grapes into Wine Alliance presents its standards more succinctly than the three above mentioned standards. The OGWA standards outline 14 sections; within these sections are practices that are listed as recommended, tolerated, and prohibited. Unlike the three other standards, the OGWA standard is specifically designed for wine production. Membership in OGWA requires compliance with the federal Organic Foods Production Act and additionally in California, the California Organic Food Act.

The OGWA standards are comprised of 14 sections. They include grape origin, harvest crushing, yeasts, sulfur treatment, stabilizing agents, clarification/fining, coloring/decoloring, volatile acidity, acidification/deacidification, storage vessels, transportation of bulk juice in wine, bottling/packaging, corking, and cleaning agents. The following includes sections that can be compared directly with the federal and state legislation.

### Grape Origin

The Standard:

- recommends third-party certification.
- tolerates wine grapes grown according to COFA, but not third party certified.
- prohibits the use of synthetic herbicides, pesticides, fungicides, or fertilizers.

Sulfur Treatments:

The Federal and State Acts require that there be no added sulfites. Incidentally, the California legislation requires levels of no more than 10ppm but the COFA does not contain similar language. Nonetheless, the BATF requires that wines containing more than 10ppm be labeled with "Contains Sulfites." The OGWA standards recommend:

- sulfite levels shall be no more than 100ppm and 30ppm free sulfite at the time the wine is released.
- Solutions of greater than 5% sulfite, up to saturation, prepared on-premise by bubbling gas through water.

The use of sulfur dioxide as a preservative is one of the most controversial points in determining a definition of organic. Most of the literature concerning organic wine has been opposed to the introduction of any sulfites into the winemaking process (excepting for sulfur applied to the grapes on the vine to prevent mold). The Federal and State Acts also support this sentiment. This is definitely an area that deserves more research.

## The Status of the Organic Foods Production Act

The National Organic Standards Board has been given the responsibility of designing a national organic program that may be used to comply with the Federal Act. In April 1995, NOSB at their meeting in Orlando, Florida gave a general definition of what they mean by organic agriculture. It states that, "Organic agriculture is an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony" (NOSB News Release).

All processors, growers and handlers of products that are labeled as organic must be registered with the state of California under the 1990 California Organic Foods Act (COFA). Processors register with the Department of Health Services while growers and handlers register with the California Department of Food and Agriculture. Registration is mandatory and regulated by state law unlike certification, which is voluntary and controlled through private organizations. Since 1990, the federal Organic Foods Production Act (OFPA) has been "in process" which when finalized will change the certification requirements. In December of 1997, the United States Department of Agriculture developed a proposed rule of the National Organic Program, which would set national standards and regulations for organically produced agricultural products. The proposed rule states annual sales of $5,000 or more must be certified by and accredited certification agency. In a survey of growers in 1994 and 1995, all organic growers who grossed above $500,000 were certified whereas half of the growers with sales of $25,000 or less were certified. Only one-fifth of the growers with sales of $10,000 or less were certified. The new federal requirements under the proposed rule could be a significant deterrent (Statistical Review of California's Organic Agriculture: 1992-1995, UC Agricultural Issues Center, July 1998).

As mentioned above, the Federal Organic Foods Production Act (OFPA) is currently in review at the Office of Budget and Management (OMB). The OBM reviews all proposed Federal rules, evaluating compliance with the existing administration's goals, the Paperwork Reduction Act, and relevant Executive Orders.

It is expected that the OFPA will be released by the OMB in the near future. It is, however, unclear just how great the impact of the revised federal rule will be on California organic agriculture. Keith Jones, the director of the National Organic Program, for example, at an Ecological Farming Conference in January discussed the proposed rule and its status in the approval process. Jones suggested that the proposed rule is nearing approval and has cleared USDA requirements. The rule was scheduled for publication in the Federal Register on February 8th, clearly it has been delayed. It should be noted that, the proposed rule is not just a revision of the original rule. The OFPA was drafted from as a new rule, not a revision to existing Federal regulations.

In January 2000, Ray Green the Organic Program Manager at California Department of Food and Agriculture elaborated on why the current California law does not function as intended. The 1990 California Organic Act identifies chemicals that cannot be used in organic farming, but in no way does it ensure that a farm is employing sustainable farming practices. Green suggested that farmers can be "organic by neglect"; that is, a farmer could find himself in compliance with the 1990 California Organic act simply by not applying chemicals. Moreover, there is no requirement that the farmers utilize sustainable practices. Farmers are only required to have a certification plan, which the CDFA has no legal ability to deny.

Further, the California law does not mandate any type of training for an organic inspector. In fact, according to Green, the legal framework for the certification plan lacks explicit data requirements. The materials list in California is ten years old and may require updating.

Finally, enforcement of the 1990 California Organic Act currently only utilizes random spot inspections by local county agriculture offices. According to Mark Lipson of the Organic Farming Research Foundation, these spot checks have demonstrated more noncompliance among certified organic farmers than among farmers who are merely registered organic. The combination of the above factors, a lack of a sustainable agriculture focus, limited inspector requirements, outdated pesticide lists, and poor enforcement reflect a clear need for changes to the California organic certification process.

The latest development in the formulation of national organic standards comes from the US Secretary of Agriculture, Dan Glickman. On March 7, 2000, Glickman presented a new proposal for a uniform and consistent national standard for all organic food. It essentially offers a national definition for the term "organic" and delineates methods, practices, and substances that can be used in the production and handling of organic crops, livestock and processed foods. The most notable aspects of the proposal are the prohibition of genetic engineering, sewage sludge, irradiation and antibiotics in organic livestock. This proposal comes in response to the more than 275,000 comments the NOSB received to its December 1997 organic proposal. The proposal states that products containing at least 95% organic ingredients will be allowed to carry the seal of "USDA Certified Organic." Foods that are comprised of at least 50% organic ingredients can be labeled "made with" organic ingredients. As it applies to wine grape growing, the proposal mimics the CCOF standard of no application of prohibited materials for three years prior to certification. It does state that some synthetic materials may be allowed in fertilizers and pesticides in certain instances. The USDA will take public comment on the rules from March 13 through June 14 before putting them into effect. Farmers and processors will then be given 18 months to get into compliance.

# Appendix F. Fetzer's Recent Environmental Achievements

*June 24, 1999*. Fetzer unveils the largest solar-electric system on the North Coast. The $250,000 photovoltaic system, built by Real Goods Trading Co., Fetzer's neighbor in Hopland, provides up to 32 kilowatts of electricity, enough to provide 80 percent of the power for Fetzer's administration building. Photovoltaic systems use rooftop panels that turn sunlight into direct electric current, which flows to transformers and is transformed into alternating current, powering electric lights, fans and computers. At Fetzer, there are 360 photovoltaic panels covering the south, east and west roof of the administration building, which houses the business functions of the sprawling winery, where the bulk of Fetzer's wine is made, stored and bottled. The 360 panels together produce 500 kilowatt hours of power a day. In contrast, a typical home would need 16 panels.

*Sept 14, 1999 - Clean Choice 100*. Fetzer announced that it has become the first wine producer in the world to purchase, for all its operations, a power generation supply portfolio comprised of 100% renewable resources. The power mix Fetzer is buying - also known as PG&E Energy Services' Clean Choice 100™ - is a supply portfolio comprised entirely of renewable energy sources, including wind, biomass, hydro and geothermal plants. A portion of the negotiated purchase price also supports the completion of "new renewable" sources - wind, biomass, geothermal and other renewable generation plants scheduled to be built in the future - thereby helping to expand the development of environmentally-preferred energy sources. None of the Clean Choice 100™ portfolio includes plants fueled by coal, oil, natural gas, nuclear resources, wood or wood waste from old growth forests, tire-burning or solid municipal waste. PG&E Energy Services' contract with Fetzer is its first green power agreement with a major commercial business.

*Nov 2, 1999 - Climate Wise Partner Achievement Award*. Given to Fetzer for "significant accomplishments in improving energy efficiency and reducing pollution" given by the US Environmental Protection Agency. Fetzer has made a serious commitment to harvest and produce wine in an environmentally responsible way. With over 700 acres farmed organically, Fetzer is one of the largest growers of organic wine grapes in the world. Each year the winery recycles tons of waste paper, surplus cardboard, cans, glassware, wooden pallets and metals, and composts 10,000 tons of grape pomace. As a result, it has cut its trash by 93% between 1990 and 1998, eliminating the dumping of 1,580 cubic yards of landfill.

*Nov 12, 1999 - ISO 9000 certification.* First North American Winery to receive certification. Received certification that their Quality Management System meets the Quality Management System Standards of ISO 9001:1994. The certification was granted by Lloyd's Register Quality Assurance Limited of Houston, Texas for the Fetzer, Bonterra, Mariah, and Bel Arbor wines in North America, Japan and the United Kingdom.

*Nov 16, 1999 - 1999 Business Ethics Award for Environmental Excellence.* Honors corporate responsibility in a wide range of areas including stakeholder relations, employee ownership, and environmental concerns. Business Ethics magazine commended Fetzer for its "broad-based approach to environmental sustainability, combined with financial excellence." Judges for the awards included Jonathan Hickman, co-author of Corporate Report Card and research associate at the Council on Economic Priorities; Marjorie Kelly, co-founder and editor of Business Ethics; Steven Lydenberg, principal with Kinder, Lydenberg and Domini social research firm in Cambridge, MA; Joel Makower, Editor, The GreenBusiness Letter in Oakland, CA; and Sally Power, Professor of business ethics at the University of St. Thomas in Minneapolis.

*1997.* Named one of the Top Ten Recycling Companies in the state by the State of California Waste Reduction Awards Program (WRAP). This program is run under the auspices of the California Integrated Waste Management Board.