

Hayley Kopelson
CHEM 321 Term Paper

The process of making wine, also known as viticulture, has been practiced for millennia throughout many different cultures and regions. Today, wine is produced in many different countries and through several different methods. However, the production of wine is a subject where sustainability has become rather popular, and the methods currently used in North America have changed, depending on the market the winery is trying to appeal to. Although not all wineries practice sustainable methods, some have made exemplary examples of how wineries can still produce the right quality and quantity of wine with machinery and other practices that reduce their carbon footprint. To do this, a winery must be able to balance three different principles: environmentally sound practices, economic feasibility, and socially equitable qualities (Zucca, 2009).

There are several uses for wine other than for drinking, these range from: fabric dye, a cleaner/disinfectant, insect attractor/trap, a health supplement, and even as a biofuel (Huffington Post). However, the main reason for the production of wine is for drinking. Wineries tend to consume a great amount of energy for the production of their product. For instance: many fertilizers are used for the growth of the grapes, fossil fuels are consumed for heating, grounds care, and production, specific types of trees are used for the large barrels required for aging, and there are many other uses for fossil fuels (and renewables) within the industry.

However, some wineries have shown that not only can they reduce their emissions and carbon footprint, but they can also make it cost effective and marketable in this economy. Several of the methods of green wineries are to reduce their use of fossil fuels/ fossil fuel based resources for maintenance work. One of the methods used is Integrated Pest Management (IPM). IPM is a way to essentially use good bugs against bad bugs to maintain a healthy crop without using pesticides, which are harmful to the environment. By introducing a certain insect, for example, body-snatching wasps that eat aphids, at a particular point in time against one that causes harm to the grape plants, a natural, fuel-free insecticide can successfully protect the plants from harm, while causing no harm to the soil or water. This method is fairly cheap and easy to do in small areas, but it may be more difficult in larger ones and also may be harder to manage. It has proven successful in several wineries, though.

A practice that has a similar goal to IPM is strategically planting summer crops to protect good insects from harm, which allows for a large population to grow. This large

population has a better chance of wiping out insect pests in the long run, and decreases a farmer's need for pesticides. The downside to this is that wineries tend to plant a winter cover crop instead, which doesn't help the beneficial insect population (Gubler, 2008). This practice has proven to be extremely beneficial to wineries of all sizes, especially with a buckwheat seed mix. This mixture dramatically decreased the population of leafhopper nymphs and has proven more effective than organic pesticides (Gubler, 2008).

Another biological method to reduce pesticide use is to select rootstocks that are insect resistant (Gubler, 2008). Many grape plants are susceptible to nematode infestation, which kills the plants and calls for chemical treatment. These rootstocks were released in 2008 and are resistant (through controlled breeding) to dagger, lesion, and root-knot nematodes. These are the major nematodes that wine plants are threatened by, and by using these rootstocks, fumigants and nematicides are no longer needed (Gubler, 2008). This may be a very valuable solution to a pest problem, but since all creatures adapt, these nematodes will eventually be able to overcome this resistance and be able to infest these plants again in the future. This is a classic example of the Red Queen Hypothesis; which means there's a constant arms race between species. We'd have to play constant catch-up with these rootstocks and nematodes, which would be a very costly endeavor.

Through a practice called leaf removal, bunch rot (of grapes) can be eliminated while also improving the overall quality of grapes (improved resource allocation within the plant). Bunch rot is caused by the *Botrytis cinerea*, and it spreads rapidly among grapes once the fungus infects the plant (Gubler, 2008). By removing leaves manually, you cut the expenses of fungicides and the loss of profit due to the fungus. A major issue with this is that it's a very labor-intensive practice; it may cost more money to pay the workers to remove leaves than harbor profits from its benefits. It would work best for a small-scale winery or farm, in general.

Another bio-control method to improve production and eliminate the use of pesticides is to double-prune grape plants to reduce the probability of contracting canker disease (Gubler, 2008). As plants are pruned to eliminate other fungi, the canker disease infects these pruning wounds. By double pruning and timing their pruning to occur in the early spring when these wounds can heal better, farmers can eliminate the risk of this fungal infection. This infection is rather insidious and takes about 8-10 years for all effects to be noticed, so by the time it's noticed, almost nothing can be done. The drawback to this is that it's very labor intensive, like the leaf removal practice. This is highly unpractical for large-scale operations and could only be efficient in small-scale wineries.

To reduce insect population further, a farmer can plant nest boxes to attract bats, owls, and songbirds to the winery. If these various forms of wildlife inhabit the nests, the farmer has another successful bio-control method that takes no maintenance after the nests have been built. This is a beneficial practice because it increases biodiversity, allows for a natural control of the negative insect population, and is pleasing aesthetically for humans. However, birds and bats may not be enough to control the insect population, so other methods mentioned in this paper should be used in combination with this.

Another way to reduce negative environmental impacts is to switch from standard production of grapes to organic farming of grapes. This will instantly cut the use of herbicides and pesticides, which have severe impacts upon the soil and water in the neighboring area. By also cutting out inorganic fertilizers, the issue of phosphorus or nitrogen build-up in the water (which causes toxic algal blooms, among many other unhealthy issues) becomes a null concern. By making these switches, the winery can become more sustainable and less dependent on fossil fuel based resources while appealing to a more affluent market, which allows them to raise the prices of their wine to make a profit. The winery can also make a greater profit because fertilizers, herbicides, and pesticides can be fairly expensive, especially if the winery has a large crop of grapes to tend to. Grapes are also sensitive to chemicals and over-use can damage them, so this could yield a better tasting wine, as well.

Another method of cutting out fossil fuel use in the agricultural sense is to switch to a natural herbicide: sheep. One such winery, Navarro Vineyards, located in Philo, California uses sheep as their lawn-mowing service (Root, 2008). By switching to a natural method (and very efficient) way of lawn maintenance, fossil-fuel use is cut. According to Navarro Vineyards, half of their fuel consumption goes into their tractors to eliminate weeds, so by eliminating the use of tractors, they halved their fossil fuel usage. By also growing native species of plants within the winery, less maintenance is needed on grounds because these plants don't get out of control in their native habitat, so less energy is consumed. By also starting a no till policy, the soil remains intact and doesn't face the issue of erosion.

There are other methods to reduce costs and wastes within the winery itself, though. By re-using wastewater within a winery, the company can save money and also reduce its environmental impact (Muller, 2002). Composting is a popular method to reduce waste within wineries, and the compost goes back into the grounds for the grape plants to grow successfully with a natural fertilizer. Another popular solution in wineries is to recycle many of their materials, such as cork and cardboard. A lot of wood/paper products are used within the winery and recycling not only reduces the amount of trees

cut, it also reduces the costs for the winery. Several wineries have also switched to more green ways of heating their facilities, mostly through geothermal, solar, and wind power. By switching to a more eco-friendly method of heat, a winery can cut its energy usage costs, and put that money into more profitable endeavors. One of the more interesting methods of reducing energy uses is to switch from a conveyor belt system to one that is dependent upon gravity. One winery that has successfully done this is the Stratus Winery located in Ontario, Canada*. From my general understanding, conveyor belts are typically used to process the wine and also to process the grapes. By switching to a system that relies on gravity instead of conveyor belts, the winery is able to reduce its energy costs substantially by switching to a method that requires no additional energy.

As you can see, there are many green practices that can be applied to wineries, both within the facility itself and through agricultural practices outdoors, which can reduce emissions and environmental impact while also saving money. Most of these practices are also socially acceptable because sustainability is now a popular trend in our economics and since this is the case, the more expensive transitions that need to occur to aid the switch from 'dirty' production to 'clean' production can be made affordable and a worthwhile endeavor for the winery. This makes sustainable viticulture, in my opinion, a viable option. There's certainly a market for organic or sustainably produced wine, and the cost difference (in the long run) makes the switch worthwhile. By reducing the use of fossil fuels, and by switching to processes that require almost no energy, wineries can cut their costs and drastically increase their revenue.

Literature Cited

* Although I requested more information from this particular winery, they never got back to me.

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