# BIOLOGY

## Growing Inspired Wines

This workshop is an in-the-vineyard experience of Oregon's cutting edge, cool-climate viticulture practices. You will see firsthand the innovative techniques and technologies coupled with sound farming wisdom learned over generations that modern Oregon winegrowers employ to produce premium Pinot noir. All of our efforts in the vineyard are carried out with the goal of expressing a precise statement, which varies depending on the land in which the grapes are grown to the hands that bring the wine into being. We will discuss clonal selections, trellis systems, rootstocks, spacing decisions, cultural practices and our efforts toward maintaining biodiversity and improving the sustainability of our activity.

### POINTS TO INVESTIGATE

Adapting to the permanent physical environment

- Farming at the margins of acceptable climatic conditions
- Site selection for specificity
- Clonal selections
- Rootstocks
- Density adaptations

Adapting to a year of moments

- Managing for vine balance
    - Canopy management
    - Crop yields
    - Water management
- Managing for pests and disease pressure

Adapting to the uncertain future

- The farm in the landscape

Much is said about Pinot noir's unique propensity for expressing the truth of a place. First and foremost we point to what is typically referred to as terroir, that special combination of the factors of the physical environment: geology, topography, climate and soils. Save for the one-time decision to plant Pinot noir in a certain place, these are the limiting factors. However, terroir does not end there. Beyond these limiting physical realities, the grower and the winemaker impose complex layers of social and cultural institutions relating to viticulture and winemaking that develop in a particular region over time. All of these factors combine to define the character of a region, a vineyard, a block and a vine. That Pinot noir will communicate this all-encompassing sense of place in the end product is not a foregone conclusion, however. It is a study in balance and adaptation.

### ADAPTING TO THE PERMANENT PHYSICAL ENVIRONMENT

Farming at the margins of acceptable climatic conditions

Anywhere Pinot noir is grown you will find that great effort and expense are dedicated to its production. It is very difficult to find the grower who got in the business to produce "mediocre" Pinot noir. But the nature of Pinot noir dictates that the level of finesse will vary greatly depending on the climatic conditions.

Pinot noir, like all varieties, has an inherent climatic threshold for achieving optimum quality. This niche is particularly narrow for Pinot noir, and it is only when grown in these precise conditions that it achieves the best expression of terroir for which it is known. A long, cool growing season ensures a period of flavor development that is perfect for Pinot noir, and we are fortunate to have just those conditions here in the Willamette Valley.

Our vineyards are located along the 45th Parallel North, in the valley formed between the very tall Cascade Mountain Range to the east, and the lower Coast Range to the west, abutting the Pacific Ocean. This reality determines a fairly mild macroclimate, with fair resemblance to a very northern Mediterranean climate, with wet, mild winters and warm and dry summers. While this may sound delightful and not marginal at all, what we lack is the grace of season. In most years, every last moment of sunshine is critical, and when the rains begin in October we can usually assume that our season has come to an end. Therefore, every single decision we make along this path of the vintage has immense implications for the wines.

Beyond the topographical and geographical framework, our year-to-year climatologic realities are heavily influenced by water temperature oscillations in the eastern Pacific. During an El Niño the temperature in the eastern Pacific is higher than normal, whereas in a La Niña the easterly trade winds increase and there is an upwelling of cold ocean temperatures in the tropical Pacific. This El Niño/La Niña occurrence has been both more frequent and intense over the past 20 years, with fewer "Niño neutral" years. For us this means that from one year to the next we can experience vast fluctuations in the timing of and conditions during all the phenological stages, from budbreak to bloom to veraison to harvest. At each stage we make critical decisions as growers in order to achieve the quality and style of the end product. Experience, education and international and local collaboration have all led to this moment, when Oregon is consistently making great wines even in the face of an increasingly unstable climate.

Site selection for specificity

For the reasons already introduced to you in the first chapter, the Willamette Valley provides a unique opportunity for growing premium Pinot noir. While the macroclimate and its influences have been generally described, the mesoclimates within the valley and the soil composition and depth vary greatly with elevation and aspect. Berry development, flavor and composition are heavily affected by site-specific exposure to wind and sun. Furthermore, soil variation (type, depth and water holding capacity) is commonly expressed in vine vigor, canopy density and fruiting habits. Therefore, this one-time decision of site selection is critical to the expression and character of the wine.

The vast majority of the vineyards in the Willamette Valley today have been planted in the low to mid-slope elevation hillsides with southern exposure, between 300'-800'. These rocky hillsides tend to have shallower soils, and to be less vigorous than the deep and rich soils of the valley floor. The hillsides are less prone to frost, but slightly later to ripen than the valley floor. As new categories and styles are explored for Oregon, and as our climate fluctuates, we are seeing more and more exploration with plantings of Pinot noir in both the lower and higher elevations.

Clonal selections and rootstocks

The species Vitis vinifera, responsible for all the commercially important varieties from which we make wine, shares the characteristic of adaptability with those who endeavor to grow it. Its ancient heritage has meant a very long period of evolution, which is responsible for some of its most alluring and frustrating characteristics.

Vinifera can adapt to its growing conditions quite rapidly. It is very heterozygous, meaning that the already complex gene makeup can be combined and recombined easily and exponentially. Furthermore, at some point in its long history, vinifera conveniently became almost exclusively hermaphroditic. Its propensity for vegetative reproduction and bud mutation has been responsible for many of the varieties we know today, and amongst other varieties of vinifera, Pinot noir is particularly mutable.

The process of clonal selection has evolved from simple to complex, with varying results. Essentially, via generations of careful observations (historical) or by complicated measurements (modern), individual vines are selected for a particular trait or traits, such as cluster size, being early or late ripening, growth habit, disease resistance, yield, etc. These vines are then propagated through cuttings (historically) or from tissue cultures (modern) from the base material. The resulting selections, theoretically genetically identical, are often referred to as clones, and are assigned a name or number (113, 114, etc). In the U.S. there are strict protocols of ensuring the sanitation of clonal selections before the plant material can be made commercially available.

Initial plantings of Pinot noir came almost exclusively from the Wädenswil group of clones (UCD1 and UCD2) which came from Switzerland (with perhaps a Burgundy origin,) later joined by the “Pommard clone” (UCD5) originally from Burgundy.

Beginning in 1974, David Adelsheim led an initiative to bring new selections to Oregon directly from research programs around Europe. This culminated in the importation of Pinot noir and Chardonnay clones from the Office National Interprofessionnel des Vins de Table in 1984, the result of years of selection by Dr. Raymond Bernard from various vineyards in Burgundy.

This plant material was finally made available to growers in 1988, after a period of quarantine and evaluation, and has provided growers with many options to enhance diversity and winemakers with different components in the cellar. Today new selections are being tested, indexed and released, expanding the diversity of plant material and therefore our ability to

learn and adapt even further.

Rootstocks

The pioneers of Oregon viticulture put their vineyards down on their own roots, before the discovery of Phylloxera in Oregon in 1990. Since that date, many vineyards have been replanted and almost all new plantings are put on phylloxera-resistant rootstocks. The last remaining own-rooted heritage plantings in the Willamette Valley are tended with great care, and continue to produce beautiful fruit under careful management.

Beyond providing resistance to this tenacious pest, the most profound effect these rootstocks have is on the vigor of the scion. Rootstock selection is a tremendous tool for adapting to site diversity. Where a more vigorous rootstock like 3309 can be useful on a very weak slope with little to no soil, a devigorating rootstock can be critical on deeper soils where excess vigor can be an issue. Rootstock also certainly affects the vegetative cycle of the plant and may advance ripening.

Density and trellising adaptations

Plant density and trellis systems vary greatly throughout the world, but are both critical tools in vineyard design and should not be discounted for their influence on yield and quality.

How many plants an acre of ground can support depends on both water availability (whether by irrigation or just a moist climate) as well as the soil quality. In early Oregon vineyards, much of the trellis and spacing decisions were again borrowed from California and Swiss protocols of the time, around 500-800 vines per acre. Where these early plantings are still in the ground, there was often experimentation in divided canopy trellising to manage vigor where it was an issue. This resourceful management of trellis (Geneva Double Curtain, Lyre and Scott Henry) is more common in older, lower density plantings, whereas vertical trellis, also known as VSP or Vertical Shoot Positioning, is the norm in more recent plantings.

During the years between the first plantings of the late ‘60s (10'x10', 10'x12') and the ‘80s, vine spacing trends in Oregon tightened up, representing a period of “intermediate spacing”. The late ‘80s and early ‘90s saw much more dense, Burgundian style plantings in Oregon, bringing a new generation of equipment as well. Concurrently, of course, was the spread of phylloxera, and thus these plantings were also on rootstock. In high-density plantings vines compete with one another for moisture and nutrition, which in theory hastens ripening and also may affect the size of the clusters.

In the Willamette Valley we have very diverse soils in terms of their strength or weakness, their ability to hold water and their depth. The availability of water is more critical in Oregon than many realize due to the very dry, hot summers we experience. We get plenty of water during the winter, but that water dissipates quickly under dry, hot, sunny conditions and more so in some soils than others. At any rate, Oregon has hugely different soils and growing season conditions than either California or northern Europe. Therefore, spacing decisions must be thoughtfully made and experimentation, when possible, is warranted in order to fine tune.

Capture of light by leaves, managing sun exposure of the fruit, disease pressure and the fruitfulness of a vine: these are all goals of trellis systems. For our climate and growing conditions most growers feel that some form of vertical trellising is the most appropriate for maximizing quality and managing disease.

## ADAPTING TO A YEAR OF MOMENTS: THE QUEST FOR VINE BALANCE

### Winter pruning

Winter pruning is an oft-overlooked art in viticulture. It is our first tangible influence on the next vintage. One cannot stress enough the influence this practice has on a vineyard's productivity. Grapes are only produced on shoots that grow from one-year-old canes, and more so on canes that had good sun exposure. This art is informed by Vitis' unique evolutionary history and its complete dependence on birds for seed dispersal. In the Cambrian period, grapes had to climb trees to get to the sun, as their buds will only express cluster primordia if they have been exposed to sunlight. A bud that did not see sunlight would produce a tendril, to cling to trees to get to the sunlight. Having reached the canopy of the tree, the following season the vine would produce fruit. Therefore, selecting the proper canes to lay down for the following vintage has a tremendous influence on your potential crop even before bloom.

### Canopy management

Canopy management is essentially the series of decisions made by the viticulturist during the growing season to achieve particular goals for leaf volume, leaf area, shoot position/orientation, spray efficiency and fruit exposure to sunlight. Countless research projects have studied the relationship between canopy (health, density, orientation) and resultant corresponding fruit quality. This "balance" is the holy grail of viticulture, and current research is looking at Oregon-specific metrics for balanced canopy/crop ratios.

As photosynthesis is the engine that drives fruit maturity, capturing sunlight is of utmost concern. Too few leaves will not have the energy necessary to ripen fruit. Overly dense canopies do not maximize photosynthetic potential, do not provide proper exposure of the fruit to sunlight and do not allow proper airflow and spray penetration for disease control. Canopy density directly affects the canopy microclimate. Furthermore, current research suggests that many critical stages of berry development and true ripeness may be linked to UV exposure, not necessarily heat.

After budbreak, adjusting the number of buds and shoots via bud and shoot thinning are ways we manipulate canopy density. We remove second and third buds at each node, excess shoots and the suckers at the base of the plant. Once shoots are out, training young shoots between catch wires and actively positioning shoots for sunlight capture and airflow are repeated throughout the growing season. Ideally, vegetative growth would stop around veraison and all the plant's energy would be directed toward fruit ripening. In the absence of the ideal situation, shoots are often hedged once to several times to prevent excess shading by managing excess growth.

Pulling basal leaves is widely practiced to open the fruiting zone for both the exposure to

sunlight as well as for having an efficient spray program, but it can also dramatically affect the retention of acids in the grapes, especially in warmer vintages. A spray program is only effective if the material penetrates the canopy for adequate coverage. Having an open canopy also allows for UV exposure (a natural enemy of many fungal pathogens and good for phenolic development too!) and airflow, as disease pressure increases in moist conditions. Most growers employ some level of leaf pulling, but the amount and timing is a personal decision and depends entirely on the goals for both canopy management and wine style.

Vineyard floor and soil

A vineyard system extends far beyond the vines themselves. What we see above ground of a plant is but a fragment of its total self, and its interaction with the above-ground environment is only the leading edge of the system to which it belongs. Go below and the system literally bursts into a complex web of life, circulating and cycling. And the soil, like us, has a history and a story to tell. Soil, like any natural thing, evolves with the influence of many things and events over time. Our interaction with it, brief as it is, creates impacts down a very long chain.

The makeup of the vineyard floor can have dramatic impacts on the microclimate as well as the biology (beneficial insects, soil flora and fauna, pests, disease, even wildlife) of the whole farm. Vineyard floor manipulation is a very effective tool for managing a host of concerns, but conscientious growers will always consider the impacts on both the vines and the system as a whole.

Having vegetation growing between the vines, whether permanent or seeded annually and at some point tilled into the soil, has numerous benefits, including:

- Minimizing soil erosion during rainy season
- Improving rainfall penetration
- Reducing compaction effects of equipment
- Reducing vine vigor (increasing competition)
- Recycling nutrients
- Preventing leaching
- Increasing soil health and diversity

Furthermore, maintaining some cover and diversity within the vineyard and its borders can provide invaluable continuity for beneficial insect populations, provided there are protected and uncultivated areas nearby. The presence of cover crops may also promote effective colonization by mycorrhizal fungi, symbiotic fungi that can improve nutrient and water intake; research has shown that contact between grapevine roots and cover crop roots is important for efficient colonization. Cover cropping and/or permanent vegetation can also be quite effective tools for managing pests like rust mites and spider mites, which thrive in dusty conditions.

Whether and when to remove or till in a cover crop depends on the goals of the grower and the situation. High cover crops can increase frost pressure during early spring and late autumn. The presence of cover crops can also encourage pesky vertebrates like voles and gophers. Lastly,

depending on the soil, vine age and water status, a cover crop may prove to be too much competition for a vine during critical stages of growth, at which point the viticulturist will remove it by cultivating it into the soil.

Most growers are at least somewhat occupied with the issue of weeds growing under the vines during the growing season. Not only are these weeds sometimes invasive, when they grow very near the plant they can compete for critical water and nutrition. Undervine weeds can be managed either chemically or mechanically, but either way timing is critical for control.

The soil, linking bedrock to the world above, is the very foundation of what we do. How we act upon the soil is perhaps our most significant impact, as winegrowers and as stewards of the land.

Crop yields

Alas, Pinot noir, though referred to as noble, has literally no concern for its role in the magnificent alchemy of winemaking. The prime directive of this excellent specimen of evolution is to reproduce, and grapes are perfectly successful at reproducing prolifically at ripeness levels no winemaker would accept.

Since the beginning of our history, growers have sought to understand the relationship between yield and quality, and we have learned a great deal. In many years, but especially in high crop years, reducing yield, or green thinning, ensures a dedication of the vine's resources to the remaining fruit that can be the difference between good and great, obvious and subtle. In a late vintage, crop thinning is an insurance policy that most winegrowers depend upon.

As with all things Pinot, however, this is about learning to adapt, to find the balance that gets you what you want at the end of vintage. The hand you are dealt is different every year. If a vigorous vine carries too little crop, it can become overly vegetative and this, too will negatively affect quality. Having a higher crop in warmer, longer vintages (provided there is adequate soil moisture) can mitigate some of the effects of very high temperatures, when the accumulation of brix is wont to outpace flavor development, and waiting for proper flavors results in very high sugars.

Water

It has long been observed that in winegrapes, some water deficit is beneficial for fruit quality. In fact, maintaining some level of plant water deficit after an appropriate canopy is established can help regulate vegetative growth, as well as assist in directing carbohydrates toward berry development.

This is not to say, however, that "a stressed plant produces the best fruit". Stressed plants make stressed fruit. Plant water deficit does not equal drought stress. When a plant is under excessive drought stress, photosynthesis is inhibited and the movement of carbohydrates is arrested. The timing and degree of water deficit determine the effect on fruit quality.

In Oregon, with our wet winters and springs, we generally enter the growing season with adequate soil moisture to grow a robust (!) canopy. But even in our "cool" climate, we have hot, dry conditions during the summer months. As the canopy expands, the evaporative demand increases. At this point the plants accelerate their drawing down of soil moisture. Typically, with normal winter/spring precipitation, we approach veraison with adequate soil moisture to maintain very mild plant water deficit.

Post veraison, we often enter the hottest and driest part of our season, and the canopy and climatic conditions push water demand to its highest. Mostly this is still good, as it helps to arrest vegetative growth and assists berry development at a very critical stage. However, very young vineyards, weak rootstocks and shallow, fast-draining soils can all be risk factors at this point of the season. Excessive drought stress can certainly affect fruit quality in the current season. Extended drought post harvest can have grave consequences for shoot and fruit production the following year. Many growers have drip irrigation installed during planting as a valuable insurance policy for hot vintages and young plants.

Generally speaking, the use of irrigation is limited in Oregon and often used for plant establishment and very high drought conditions. This is a critical component of the sustainability of our farming, and we are very fortunate that our crop is so prudent in its water preferences.

Pests and disease

Oregon, and the Willamette Valley especially, enjoy a great diversity of agricultural crops. The landscape is a patchwork of varying crops, orchards, nurseries and forestland. This, coupled with our cold winters, is an important reason why we have heretofore experienced very modest disease and pest pressure. Our main disease challenge is powdery mildew, and botrytis to a lesser extent. Vertebrate pests like gophers, voles and birds can be commercially important in some years, but are generally just an annoying part of doing business. Invertebrate pests are more or less limited to mites, but the appearance of disease-transmitting mealybugs in vineyards in Oregon suggests that we will face more pressure in the future.

Controlling for powdery mildew is the reason for most of our spray activity in the vineyard. The cultural practices of maintaining a healthy, open canopy go a long way in helping control for both powdery mildew and botrytis, but some level of preventative spraying is universally practiced. Most spray programs use low concentrations of organic and soft fungicides, rotated to reduce resistance development. The spray interval varies based on the products used and the amount of pressure, but for most growers between 6 and 10 sprays are done for powdery mildew and botrytis prevention.

All growers want to reduce the number of times they spray, and many of us have been working with researchers at Oregon State to develop new techniques for monitoring sporulation of powdery mildew. The ability to detect outbreaks may enable us to spray only when there is detection of spores. Also, advances in spray technology are making worlds of difference in the amount of material used and even recovered.

## ADAPTING TO THE UNCERTAIN FUTURE

The farm in the landscape

Roughly five percent of our nation's great land base is set aside (for now) to protect what is "natural" and "wild" from industrial influence. Much of this is in Alaska. Twenty percent of the total land base in the U.S. is under cultivation of crops. If you add lands that are public and private but used for grazing livestock, that number grows to well over 50%. While the urban/rural interface grows in importance, it remains true that agriculture, not urbanization, has had, by far, the greatest impact on water resources (especially in the West), habitat and species fragmentation. As land managers in agriculture, we cannot underestimate our potential impacts on the future of the American land base.

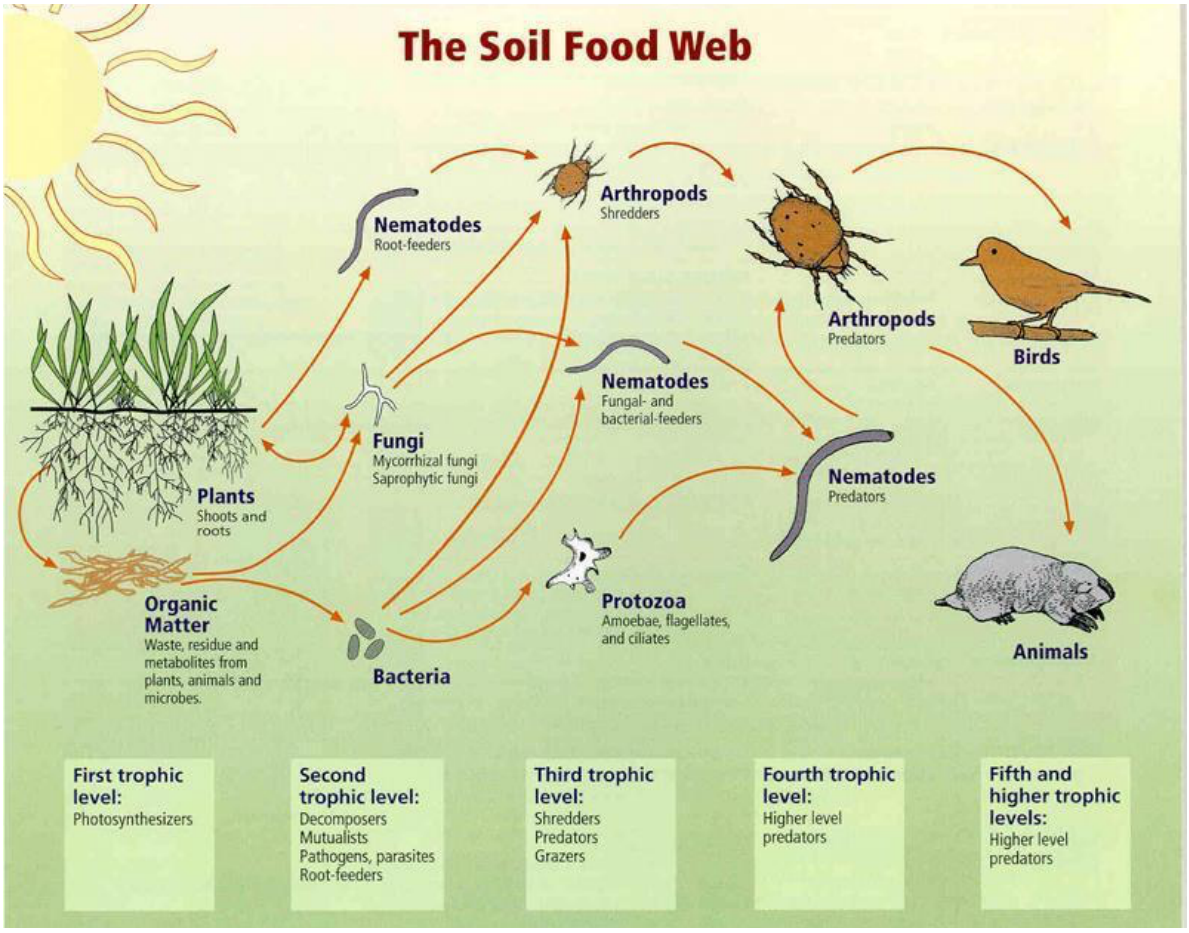
All other idealistic causes aside, we have a tremendous opportunity to affect the health, longevity and continuity of the landscape. Small efforts we make on our farms to promote biodiversity, protect soil, reduce chemical and other inputs (including water) and generally create less of a disturbance can have very positive impacts. As a high-profile agricultural community, we have an opportunity to lead by example. Maintaining uncultivated and continuous areas for wildlife cover and passage, creating insectaries for beneficial insects, efforts to reduce tractor passes, restoring, protecting and maintaining healthy watersheds; these sometimes require sacrificing some plantable area, some effort and dedication of resources, but the benefits far outweigh the output required.

"Stewardship: the careful and responsible management of something entrusted to one's care." Oregon viticulture stands out in the tradition of stewardship. Before it was "en vogue" we scrutinized our practices for gaps in sustainability and continue to demand an ever-higher standard of transparency for our workers, our customers and ourselves. Taking care of the land that we farm and the people who work with us has been part of our identity since the first hippies broke ground for planting vineyards here in the mid-'60s.

Visit almost any vineyard in the Willamette Valley. You may have to ask the question, "what are you doing about sustainability," as we are not known for flaunting or self-promotion, but you will get an answer. Nearly 50% of all vineyard land in Oregon is certified by a third party sustainability program. While we recognize that we cannot do what we do and also preserve a completely natural system, we can continue to ask ourselves what we can do better to make it possible for natural systems to function in the presence of agriculture.

It is not revolutionary to make a connection between having a diversity of life on your farm and the farm's ability to resist pests and disease. In farming, it is easy to focus on all the ways that biodiversity interferes with what we are trying to accomplish: the birds eat your grapes, the weeds compete for nutrition and water, the gophers and voles chew on the trunks and roots, the bugs chew on your leaves and shoots, the deer keep a tidy four-inch canopy on your end rows. All our efforts to maintain a pristine end result seem at odds with nature's endeavors. But remove just one element…

Pinot noir is about balance. When we maintain a diverse landscape, we come a little closer to achieving balance with nature. When our farm supports a diversity of life, our vines thrive and are better able to access the secrets, the truth, of this place, and deliver them in the wine.




## FARMING FOR QUALITY

| vine density | low | medium | high |
|---|---|---|---|
| vine spacing | 6' x 12' | 5' x 7' | 3' x 6' |
| vines per acre | 605 | 1245 | 2420 |
| row feet per acre | 3630 | 6223 | 7260 |
| tons per acre | 2.0 | 2.5 | 2.8 |
| gallons per ton | 150 | 150 | 150 |
| gallons per barrel | 60 | 60 | 60 |
| barrels per ton | 2.5 | 2.5 | 2.5 |
| gallons per case | 2.38 | 2.38 | 2.38 |
| cases per barrel | 25 | 25 | 25 |
| cases per ton | 63 | 63 | 63 |

| | | | |
|---|---|---|---|
| cases per acre | 126 | 158 | 176 |
| bottles per acre | 1513 | 1891 | 2118 |
| bottles per barrel | 300 | 300 | 300 |
| bottles per vine | 2.5 | 1.5 | 0.9 |
| tons per vine | 0.0033 | 0.0020 | 0.0012 |
| pounds per vine | 6.6 | 4.0 | 2.3 |
| pounds per cluster | 0.2 | 0.2 | 0.2 |
| clusters per vine | 33 | 20 | 12 |
| clusters per bottle | 13 | 13 | 13 |