

# Viticulture - Characteristics of the vine - Underlying principles and practical applications of canopy management

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## DEFINITIONS

- Canopy - that part of the vine above the ground, formed by the leaf and shoot system. It includes the trunk, cordon or canes, shoots, leaves, and fruit.
- Canopy management - a portfolio of vineyard management techniques used to improve vineyard yield and wine quality, and to control vine diseases, especially where vines are of high vigor.
- Canopy microclimate - The third level of climate definition, the climate within and immediately around the grapevine canopy.

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## CANOPY MANAGEMENT

- Techniques aim to produce a desirable canopy microclimate essentially by improving the exposure of leaves and fruit to the sun.
- The phrase became popular in many parts of the New World in the 1980s and early 1990s as part of a growing awareness of the way in which canopy microclimate affects vineyards. This awareness was not restricted to the New World.
- Considerable experimental work was also conducted in Europe, and the effects of canopy microclimate are now recognized as an explanation for the ability of distinguished vineyards to produce great wines.

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## UNDERLYING PRINCIPLES - HISTORY

- Can be traced to early Roman writing. For example, 'Bacchus loves hills' is partly explained by the fact that low-vigor vines growing on shallower soils on hillsides have open canopies with good fruit and leaf exposure.
- In modern times, the principles were best formulated by the experimental work of Professor Nelson Shaulis of Cornell University in New York state. During the 1960s, he showed that increased fruit and leaf exposure to sunlight improved both yield and grape composition and wine quality. These early studies were also much involved with introducing mechanical harvesters and mechanical pruning. Shaulis influenced researchers from other countries, who extended this work to vinifera vine varieties and also considered effects on wine quality.
- Studies in Bordeaux by Dr Alain Carbonneau demonstrated wine quality benefits of canopy manipulation in the mid 1970s.
- Other notable early studies were by Intrieri in Italy, Kliewer in California, Reynolds in Canada, and Smart in Australia and New Zealand.

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## CANOPY MANAGEMENT - UNDERLYING PRINCIPLES

- Essentially aimed at producing an 'open' canopy microclimate which is characterized by good leaf and fruit exposure to the sun and other climate elements, and therefore not much shade.
- The benefits of such a microclimate include improvements to wine quality and yields, and a significant reduction in diseases such as powdery mildew and botrytis bunch rot.
- Interest in overcoming the common problems of excessively vigorous vines caused canopy management techniques to become popular.
- This was particularly marked in the New World, where a lack of experience to quite site selection and management that it affected ripeness and wine quality.
- These problems were exacerbated by the widespread adoption of agrochemicals developed after the Second World War to control pests, diseases, and weeds, which, along with practices such as fertilization and irrigation, stimulated shoot growth, often excessively.
- Canopy management techniques, especially trellis change, can offset the negative effects of vines with excess vigor, but are not always necessary for low-vigor vineyards such as those found in most of the classic fine wines regions of Europe.
- A common feature of vineyards with a reputation for producing high-quality wines is that they are of moderate to low vigor, and that the canopy microclimate is characterized by good exposure of leaves and fruit to the sun, and little shade. Canopy management techniques can emulate this microclimate.
- For example, by altering trellis systems, it is possible to remove the fruit from the deep shade of the depths of the canopy to the outside of the canopy in the sun.

- Canopy management can also increase yield, which is reduced by densely shaded conditions.
- In particular, bud break and fruitfulness are reduced by shade, no doubt an example of adaptive physiology which allowed wild vines to fruit only when they had climbed of the top of forest canopies.
- With increasing global concern about the use of agricultural chemicals, there is a swing towards using canopy management to help control fungal diseases and reduce reliance on sprays. Not only is it difficult and wasteful to force sprays to penetrate to the center of dense canopies, but shaded conditions also encourage diseases such as botrytis bunch rot and powdery mildew.

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#### CANOPY MANAGEMENT - TECHNIQUES

- There is a range of techniques, the applicability of which varies from vineyard to vineyard.
- The simplest of these are:
  - Trimming, which cuts off excessive shoot growth in the summer.
  - Shoot thinning, which removes unwanted shoots early in the season.
  - Leaf removal in the fruit zone, which allows more fruit exposure to sun and wind.
  - Shoot positioning, which makes trimming and leaf removal easy and effective.
- These more simple techniques are traditional in many parts of the Old World and good examples may be seen in the neatly trimmed vineyards in many French regions.
- Pruning also affects canopy density, as well as vine balance.
- These practices may be termed 'Bandaïd viticulture' in the sense that they many overcome the problem only in the season during which they are applied, and need to be reapplied each year.
- More permanent solutions require changes to the trellis system, which affects the canopy size, shape, and density.
- The changing of the trellis usually involve increasing the canopy surface area and decreasing shading. For example, dense canopies in vineyards where rows are as much as 3.5 m / 11.5 ft apart can be converted to a trellis system such as Geneva Double Curtain, which effectively results in a canopy twice as long as the row. This is achieved by dividing the canopy into two curtains, thereby more or less doubling the canopy surface area.
- Other trellis systems such as the Lyre, Scott Henry, and Smart-Dyson are also being widely used commercially, espicawllly in New World vineyards.

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#### CANOPY MICROCLIMATE

- The canopy microclimate at the outside of the canopy is obviously affected by the microclimate and mesclimate, but that within the canopy depends on the way the canopy itself alters the climates.
  - For example, bright sunlight falling on a dense canopy with few gaps in California's Napa Valley may be considered. Suppose a leaf facing the sun at midday receives 100 relative units of sunlight. The second leaf in the canopy will receive less than ten units and the third will receive less than one. So the second leaf in the canopy has a light climate like that of a northern European vineyard on an overcast day. In other words, the number of layers of leaves in the canopy can have even more effect on canopy microclimate than can vineyard location.
  - This drastic reduction in sunlight levels in the canopy is caused by the vine leaves adsorbing and reflecting more than 90% of light falling on the upper surface; less than 10% penetrates through to the lower surface.
- The effects of canopy management can override those of regional climate, clone, rootstock, etc.
- Low vigor vineyards the canopies are not dense or shaded. Leaves and fruit are well exposed to the sun, so the microclimate in the center of the canopy is not too different from that of the outside.
- For vigorous and high-yielding vineyards the canopy interior is a dark, humid, and cool place by day. The processes of fruit ripening slowed, but fungal diseases such as botrytis bunch rot and powdery mildew are encouraged. Techniques can be used to provide high-vigor vineyards with the same canopy microclimate as that of low-vigor vineyards.
- The canopy has the greatest effect on sunlight, wind, and evaporation.
- In a dense canopy the values of these three elements can be less than one-tenth of those above the canopy, while temperature and humidity values are more similar to those outside the canopy.
- The leaves of the vine canopy are responsible for creating the distinctive canopy microclimate. They strongly absorb sunlight and the energy of the wind so that values below just one leaf are very different from those above it.
- Since evaporation depends on sunlight and wind, it is easy to appreciate that these values will also be reduced below the first leaf layer.

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#### CANOPY MANAGEMENT - PRACTICAL APPLICATIONS - NEW WORLD

- There has been resistance to the extension of the ideas of canopy management, however, even within the US, where the technique was effectively born. There was a marked reluctance for academic and commercial acceptance of these ideas in California, and now paradoxically they are being taken up 30 years behind other regions, and seen to be imported from France, Italy, Australia, or New Zealand. This resistance stemmed partly from the fact that Shaulis's initial studies were made with the American grape concord, even though it was proven quickly enough that vinifera varieties responded in the same way.

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#### CANOPY MANAGEMENT - PRACTICAL APPLICATIONS - OLD WORLD

- There is less scope in the Old World for canopy management since row spacing is traditionally less, and trimming and lead removal are used anyways.
- Centuries of trial and error have demonstrated the benefits of open canopies to improve wine quality and reduce vine diseases.
- However, in the Old World the benefits of canopy management are often not recognized as such by traditional viticulturists, many of whom scribe the quality and disease effects solely to the associated lower yield or vigor, and more generally to terroir.
- By the early 1990s, however, there were already examples in Old World commercial viticulture - in France, Italy, and Spain - where trellises had been altered for canopy management reasons.
- Spain's relaxation of laws prohibiting irrigation, together with proven performance of canopy management techniques in La Mancha, may mean that Spain will lead a revolution in use of New World viticultural technology in Europe.
- Contemporary thinking about canopy management suggests the optimal degree of leaf and fruit exposure might vary according to variety and region.
- For example, in association with high temperatures it can lead to loss of color, an effect sometimes called 'berry pinking'; and berries may shrivel if they are exposed to too much heat.
- A practice common in Bordeaux where leaf removal on the eastern side of the canopy in the hottest part of the season and then on the western side only later in the season.
- Positive benefit of sunlight exposure on fruit, but can be negated by high grape temperatures. Research in Washington state by Spayd.