Management of Vigour and Canopies in Different Environments

RICHARD E. SMART
Smart Viticultural Services, Port Macquarie NSW

Introduction
I have been asked to discuss the adoption of canopy management practices worldwide. In my work as a consultant specialising in canopy management I am involved in such developments on a daily basis, and the latter part of this paper describes one such example from Argentina. However, it is appropriate to commence this paper with a review of principles of canopy management, to see how these might guide applications in different situations.

At the outset it is interesting to put canopy management in some historical/literary context. Canopy management can be defined as a suite of viticultural practices aiming to modify canopy microclimate. Reading the canopy management literature will reinforce the central importance of leaf and fruit exposure to sunlight.

From this point of view, we might pose the following question: 'What do Galileo, Louis Pasteur, Thomas Peacock, André Simon, John Mortimer and Richard Smart all have in common?' The answer is that they have all written about sunlight and wine. To wit:

Wine is sunlight, held together by water.
Galileo (1564–1642)

A meal without wine is like a day without sunshine.
Louis Pasteur (1822–1895)

The juice of the grape is the liquid quintessence of concentrated sunbeams.
Thomas Peacock (1785–1866)

Wine is a friend, wine is a joy; and, like sunshine, wine is the birthright of all.
André Simon (1877–1970)

The point of drinking wine is... to taste sunlight trapped in a bottle.
John Mortimer (1923– )

Sunlight into wine.
Richard Smart (1945– )

Why use canopy management?
Research and commercial experience has shown canopy management to have the following benefits:

• improvement of yield, especially for high vigour, shaded canopies;
• improvement of quality, in particular the reduction of pH, K⁺ and malic acid, and herbaceous characters, and the increase in colour, phenols and varietal character;
• reduction in disease incidence, especially of powdery mildew and botrytis bunch rot;
• facilitation of mechanisation, especially leaf removal, shoot topping and trimming, and harvesting and pruning.

These benefits are well recorded in the scientific and trade literature, and recent accounts of the principles and summaries of my commercial experience may be found in the book Sunlight into Wine (Smart and Robinson 1991) and trade journal articles (Smart 1991, Smart 1992 a,b, Smart 1993 a,b,c,d,e, Smart 1994 a,b,c).

The dilemma of current Australian viticulture: is cheapest best?
Following the successful and widespread adoption of mechanical harvesting and mechanical pruning, an Australian viticulture is now among the most cost efficient in the world. Many of my overseas clients are incredulous when I tell them it is possible to grow good yields of high quality grapes using 50 hours labour per hectare or less. Such values have been reported for example in large vineyards in South Australia. For some other countries the labour input is several hundred hours per hectare, more than ten times higher than Australia.

There is no doubt that minimizing labour costs has allowed large scale and profitable viticulture to develop in Australia, but I wonder whether this cost minimisation approach has now run its useful course. Cost minimisation does not always lead...
to profit maximisation. This is particularly the case with pruning mechanisation. I believe that because of intentions to reduce pruning cost (either by use of mechanical or minimal pruning) many vineyards in the country are performing at less than their yield and quality potential. In other words, the vineyards might return a greater profit if the pruning costs were not minimised. From a community viewpoint I question the wisdom of importing machines which will make Australian labour redundant.

Consider the following simple examples. A prune a moderate vigour vineyard producing at 15 tonne/ha. Hand pruning might take about 100 hr/ha, and for labour at $15/hr (including all 'add-ons'), the cost will be around $1,500 per ha, or $100 per tonne.

At the other cost extreme is minimal pruning, which we will assume requires 5 hr/ha of labour, or $75/ha and $5/tonne, for similar yield. A non-intermediate approach is to do mechanical pruning requiring about 5 hr/ha machine time ($25/hr) and hand follow up of say 30 hr/ha, giving a total cost of $575/ha, or around $38/tonne. Such an approach would produce vines which are indistinguishable from those which are hand spur pruned, and yet the correct spur spacing, as will be detailed later, can be maintained. I suggest that this intermediate approach should be used more frequently; for the sake of saving $33 per tonne ($38 minus $5) we lose the ability to exercise one of the most important vineyard manipulations, that is, to control bud number and position at winter pruning.

By abandoning control of bud number and location, as is more or less a consequence of full pruning mechanisation without hand clean up, the vigneron loses control of crop level, vine vigour and canopy density, the ability to easily perform leaf removal, trimming, desuckering and crop thinning, and the flexibility to readily change training system without crop loss. Is the relatively small increase in fruit cost adequate compensation for these disadvantages? I would say not, from both yield and quality point of view. I believe that vineyard and winery profitability is being compromised by pruning cost cutting, and that such an approach may in the long term affect Australia's international competitiveness.

Introducing the Three Golden Rules of Viticulture: keys to successful canopy and vigour management

The principles and practice of canopy management can be distilled into a few simple guidelines, which I call The Golden Rules of Viticulture. They are of course only guidelines, but in my work I find them applicable to a wide range of environments and varieties. This is how they work in summary; a fuller account may be found in Smart (1993 e).

Smart's Golden Rule Number One (for the control of vigour)

Prune to about 30-40 buds per kilogram of pruning weight.

Vine balance between fruit and shoot production is all important for high yields and also wine quality. This can be assessed in two ways; the ratio of yield to pruning weight and the mean cane weight. A chieving vine balance requires that the number of shoot tips growing in spring is in proportion to the size and activity of the root system, affecting as it does both carbohydrate and hormone supply. So the number of buds retained at winter pruning should be proportional to vines' capacity for growth, in turn related to the root system. Many studies have indicated that the amount of vegetative growth measured as pruning weight is a useful indication of the vine's capacity to support growth.

Leaving too few buds at winter pruning will result in exces-

sively vigorous shoot growth, with rapid growth rate, large leaves, large internode length and diameter, and a propensity to regrow after trimming. Leaving too many buds will result in shoots which are too short, with small leaves and often determine growth habit.

Smart's Golden Rule Number Two (for the control of canopy density)

An ideal canopy has about 15 shoots per metre.

This rule helps to create an ideal canopy microclimate, which is another way of saying that there is sufficient leaf and fruit exposure. Such a canopy will help ensure sufficient fruitfulness for high yields and also fruit composition suitable for high wine quality. A open canopy also helps avoid some diseases.

The value of 15 shoots per metre applies actually to medium vigour shoots, and to vertically positioned canopies. Where shoots are of high vigour and/or the canopy is not vertical, then the ideal shoot spacing will be less than 15 shoots per metre.

Smart's Golden Rule Number Three (to avoid cross-canopy shading)

Vertical canopies should be no higher than they are close together.

It is tempting to make row spacing very narrow, so as to maximise the amount of exposed canopy surface area per hectare. However, the closer together are vertical walls of foliage, obviously the less sunlight will penetrate to the bottom of the canopy, even though the top (and sides near the top) receive plenty of sunlight. Low sunlight levels leads to loss of yield and also fruit quality. Therefore it is critically important not to have the vine fruiting zone at the base the canopy when rows are very close, especially if spur pruning. Measurements of light and vine response have indicated that when the ratio of canopy height to distance apart exceeds about 1:1 then cross-row shading is excessive.

Applying the Golden Rules

The rules must be simultaneously applied.

While it is not necessarily self apparent, the three rules should be applied together so that all goals can be achieved simultaneously. There are approaches for their adoption when they seem irreconcilable, which can involve all or some of the following: canopy division, vine removal, desuckering and altered pruning level. The proper sequence of their adoption is another story which will be told elsewhere.

Methods of canopy management

Canopy management techniques can be divided into two categories, the cheap and easy and the permanent. Typically those of the first category have to be repeated each year, and those of the second require capital expenditure and involve trellis conversion. These are detailed in Sunlight into Wine.

Cheap and easy techniques

Soon after budbreak it is possible to carry out shoot thinning, sometimes called desuckering. Typically this involves removal of shoots from all but 'count' nodes; this practice is widespread in California. The canopy may be thinned, for example, to 15 shoots per metre. Trimming is normally first done after fruit set, and depending on the vine balance it may need to be repeated several times. Leaf removal is normally done for a few leaves around the bunch zone, and is carried out just prior to veraison.
A dense Parral system in Mendoza as seen at winter pruning.

Parral system converted to GDC at winter pruning, July 1993. Mendoza, Argentina.

The first Scott Henry conversions in Argentina, winter 1993.

The appearance of the GDC conversion the following January. Note the excellent leaf, fruit, people and book exposure.

Richard Smart (right) and Santiago Mayorga beside the first vines converted to the Smart Mayorga system.

The appearance of the Smart Mayorga trellis the following winter. Note the horizontal shoots.

A tasting of experimental wines in July 1994 in Mendoza which showed the benefit of the conversions to Scott Henry, GDC and Smart Mayorga the previous vintage.
In essence we have established a Ing. Santiago Mayorga of the Penaflor company at Mendoza, Argentina of a modification to this system. My collaborator is below the canopy in the shade. The shoots cannot be trimmed easily and the fruit hangs vertically on the trellis, called the Smart Mayorga System. An example of application of canopy management principles: are definitely improved by increased leaf and fruit exposure. (high pH, low colour and phenols, low varietal character) improve wine quality in such areas, as has been known for 14 years. There is certainly no doubt that canopy management will answer to this question, but in 1994 the MIA Wine Grape Marketing Board commenced experiments to find the answer. The principal decision about when to apply canopy management: the two ‘V’s’ depends on the two ‘V’s’, that is vineyard vigour and product value. The guidelines are quite clear; canopy management is a strategy best suited for high vigour vineyards of moderate to high value. Recently I was asked in the San Joaquin Valley of California about canopy management for Chenin Blanc which was selling for $200 a tonne; I replied that the grower had a marketing problem which could not be solved by canopy management.

In Australia an interesting question arises as to whether vineyards in the hot irrigated vineyards will respond economically to canopy management. I do not know the answer to this question, but in 1994 the MIA Wine Grape Marketing Board commenced experiments to find the answer. There is certainly no doubt that canopy management will improve wine quality in such areas, as has been known for 14 years (see Smart 1982). The principal red wine problems of hot irrigated vineyards (high pH, low colour and phenols, low varietal character) are definitely improved by increased leaf and fruit exposure.

An example of application of canopy management principles: the Smart Mayorga System

In both Chile and Argentina there are large areas of overhead trellis, called the Parral or Parronales. W hile these vineyards can be very productive, producing more than 50 tonne/ha, they are very susceptible to shade-induced problems when vigorous. For example, the wine quality can be poor and the fruit susceptible to botrytis. The canopies are about 1.8 m above the ground and the vineyards of a typical low density, often 3 × 3m. The shoots cannot be trimmed easily and the fruit hangs below the canopy in the shade.

Over the 1993/94 season I have performed evaluations in Argentina of a modification to this system. My collaborator is Ing. Santiago Mayorga of the Penafior company at Mendoza. In essence we have established a Te Kauwhata Three Tier on the overhead supporting wires. Here the shoots are trained horizontally using moveable wires and are trimmed to about 90 cm long. Currently we are pruning to about 15 buds per metre crown length, although this density may need to be decreased. Early responses with Cabernet Sauvignon have been favourable, with yields of around 30 t/ha and substantially improved vine balance and wine quality.

Conclusion

The author’s experience has been that canopy management has wide application in modern viticulture. It is of particular and proven value to higher vigour vineyards with medium to high value fruit. Hopefully in the fullness of time there will be an extension of these principles to fruit of lower value, which is currently important for Australia’s export effort.

References