Management options to fruitset

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Introduction
The aim of all viticultural management is to achieve sound grapes with the desired flavours and characteristics, at an economic level. Vineyard management prior to fruitset should aim to achieve successful inflorescence development and fruitset for the current year, as well as achieving for the following year good bud and therefore inflorescence primordia initiation.

Management options will vary from site to site, with climatic factors, soil characteristics and viticultural philosophies all impacting management decisions.

Management of stored and available nutrients, soil moisture, pests and diseases is imperative, however these issues are intertwined with climatic factors that together can make or break the winegrower.

Vineyard viability is a function of final yield and price received for the grapes versus operating costs, within the constraints of the environmental conditions of the site. Final yield is determined by the number of berries per vine and their final harvest weight. The number of berries per vine is a function of fruitset while the weight of the berries is largely determined by either explicit (e.g. irrigation) or passive (e.g. rainfall) management practices. The impact of management practices on fruit set and therefore the harvest yield, is of economic importance to the wine producer.

Quantifying fruitset
There is only one way to quantify fruitset, which is an accurate per cent of conversion of flowers into berries. This can be determined by counting the immature flowers before flowering and counting the number of berries retained post fruitset. This is a very difficult and time consuming task and many people have devised different systems to complete this operation, however all have the problem that their systems rely on a small sample of each block within the vineyard. This may not accurately represent the actual fruitset within each block or the entire vineyard.

The use of long-term averages as representation for flower number per bunch can also be inaccurate as the variability of the actual flower number per inflorescence is very large, both within a season and between seasons. Unless data on flower numbers has been collected for many years to provide a reference, it will not indicate if fruitset has been good, average or poor. One figure of per cent fruitset that has been suggested as normal is 50% (Bessis 1993 from May 2004).

Final yield estimation as an indication of fruitset
Calculating the expected final yield per vine is one method that can indicate if yield is adequate (but will not give any real indication of fruitset). This can be achieved by weighing bunches at a predetermined time post fruitset (say 21 days) and multiplying this by the increase in average berry weight from this time to harvest (determined from previous seasons) and the bunch numbers per vine. Using this figure will tell you if your vines are carrying more, average or less crop than you economically require.

Is a winegrower interested in fruitset per se, or in economic yield?
As a winegrower there is a problem with both measuring fruitset directly and also with final yield estimation: when you finally have all the data available to act on, it is too late to do anything to either improve fruitset or to improve harvest yield. Pro-active prediction of a poor (or good) season is very difficult using these quantifying techniques.

A guarantee of final harvest yield?
To guarantee final harvest yield the number of inflorescences at budburst must be adequate and these inflorescences must remain fully intact up to flowering. Adequate flowering must then occur and the crop maintained until harvest.

Problems in maintaining inflorescences to flowering
Outbreaks of controllable diseases such as powdery mildew (Uncinula necator) and downy mildew (Plasmopara viticola) have resulted in inflorescence loss or aborted flowering of up to 100%. Spring botrytis affecting shoots can also lead to significant losses of inflorescences. Black spot (Elsinoe ampelina) and phomopsis (Phomopsis viticola) can cause entire shoot loss and damage to developing inflorescences.

Pests such as the European earwig (Forficula auricularia) can be both detrimental, by causing leaf and inflorescence damage early in the season and beneficial, by attacking larval and pupal forms of pathogenic insects later in the season. Control using non-selective approaches requires serious consideration.

Weather events such as frost and hail can have devastating consequences on final harvest yield, by damaging shoots and inflorescences. Site selection to minimise hail and appropriate control measures for frost should be used where appropriate.

Grapevine stress associated with sudden high temperatures and low soil moisture has been associated with inflorescence drop (May 2004) but is unlikely to pose problems in most Australian vineyards due to adequate levels of soil moisture maintained via rainfall or irrigation. However if soil moisture is not monitored closely throughout this period and during flowering, then an impact on final harvest yield should be expected.

Grapevine nutrition
Nutrition has a large role to play in affecting fruit set. Too little of one nutrient (zinc, boron or molybdenum) or too much of another (especially nitrogen) can change the physiological behaviour of the grapevine and may have dire consequences on final harvest weight. Timely and accurate nutrient levels must be assessed each year and acted upon both for the current season and for the following season. Many winegrape growers still use a prescriptive approach based on information from past years or from other growers in the area. Unfortunately, this may lead to over application of certain trace elements that may have toxic effects on the grapevine (boron) or may cause an additional and unnecessary financial cost.
Analysis of petioles/leaf tissue is cost effective and can lead to corrective action if required. The results of analysis from petiole samples taken at flowering (which has been the standard timing for many years) are often not available for two weeks or more. When the results are received by the winegrower, flowering has finished and little corrective action can be taken to alter the concentration of nutrients and affect the current season’s fruitset. However, the results can be used as a guide for the following season and to maintain grapevine health during the development and ripening stages of the season.

A better option may be to use leaf tissue analysis about one month prior to historical flowering dates. The winegrower can then act on the results to adjust the levels of nutrient that may affect fruit set in the current year. Further leaf tissue analysis undertaken during the development and ripening stages of the current season can provide information for corrective action required to optimise the development and differentiation of buds and the ripening processes for the following year.

Generally, foliar applications of trace elements, especially zinc and boron are more cost effective than soil applications. The plant response is rapid, application can be timed to the period when the grapevine requires the element, there is less off-target application and the nutrient is not leached through the soil during irrigation or rain events over the course of the season. Most foliar elements can be applied in conjunction with foliar fungicides, so the additional cost of application is minimal. Long-term corrections to nutrient availability can be made by correcting soil imbalances and then fine tuning deficiencies via foliar or fertigation application.

Environmental conditions
The implications of physical ailments that effect fruit set are well understood Pest and disease control, nutrition and soil moisture can generally be corrected however weather conditions also affect flowering and fruitset.

Adverse temperature is commonly agreed to have detrimental effects on fruit set. Temperatures below 15°C and those above 32°C are strongly associated with poor fruitset. Strong wind at flowering has also been implicated and if associated with cold temperatures, can be catastrophic.

Short-term control options
Vigour control
During grapevine growth there is a hierarchy for the proportioning of assimilates to each plant part. Generally the growing shoot tips are stronger sinks than inflorescences and ripening bunches, which are stronger sinks than storage structures (trunk and root system).

In a vigorously growing shoot tip there is a greater use of assimilates created by photosynthesis than in the less vigorous shoots; thus there are fewer assimilates available to the inflorescences for flowering and for bud differentiation. In vigorous situations the per cent fruitset is often poor, increasing the amount of shoot and leaf growth which in turn increases the shading of developing buds. This reduces bud fruitfulness for the following season and a vicious cycle of ever reducing yield and ever increasing vigour occurs.

In such situations re-working of the grapevine or the trellis may provide beneficial results. This reworking may involve re-caning (in traditionally spur-pruned vineyards), leaving more buds (either as longer spurs, finger and thumbs or double-canes), and/or opening the canopy to reduce shading effects, promoting bud differentiation for the following season.

In traditional currant production the practice of cincturing the trunk has lead to increased fruitset. Cincturing is the process of cutting about two-thirds of the way around the grapevine trunk, or a shoot, to interrupt the flow of sap in the phloem tissue. Frisch (1991 from May 2004) indicated that cincturing increased fruitset in seeded varieties but can be only recommended in cases where poor fruitset can be predicted with some certainty, as the process is undertaken prior to fruitset.

Another option is the removal of the growing tips during flowering. This reduces the draw of assimilates to the growing tip, and allows the assimilates to be used to promote fruitset. However May (2004) states “…Shoot tip removal has proven successful in increasing per cent fruitset under favourable weather conditions but only when done during the period of cap fall, not before and not after. No information has come to hand to determine whether tipping will also be effective when weather conditions for fruitset are unfavourable…”

It is known that early season vigour is strongly related to stored carbohydrate reserves in the grapevine from the previous season. Much of this stored carbohydrate is laid down during the period from harvest to leaf fall. Removal of leaves soon after harvest can reduce this storage of carbohydrate and can negatively impact on the following seasons harvest yield (Smith et al. 2004). Where vigour is excessive and fruitset is poor, post-harvest leaf removal or pruning to reduce the impacts of vigour may, in certain situations, increase fruitset.

Where vigour is inadequate, a similar cycle of deterioration to that described above can occur. Poor health may lead to poor fruitset and poor health will lead to poor bud differentiation; decreasing yields each year. Poor grapevine health can be a function of inadequate nutrition, badly managed disease control/viral infection and/or poor soil health. Poor plant health can be rectified, although the process may take some years.

Long-term control options
Site selection and establishment
Original site selection is of paramount importance when establishing a new vineyard and will have the biggest influence on the vineyard’s long-term economic success or failure. Climatic data for the site should be analysed in respect to occurrence of frost and hail, period of ripening and disease pressure. Analysis of the data in relation to the timing of flowering and the period from budburst to flowering to determine the likelihood of poor fruitset and economic loss, is often overlooked.

Consistent economic failure of a vineyard due to poor fruitset may indicate poor initial site selection. If temperature can be implicated in poor fruitset on these sites, there is little that can be done (some people have tried importing large quantities of rocks to accumulate solar radiation to re-radiate during the night, thus increasing average temperatures, but this has not been economically successful, so far). If periods of high wind run during flowering occur, wind breaks may be a sound investment.

Rootstock selection
Once the site characteristics have been determined, appropriate varieties/clones and rootstocks should be selected that will perform well within these constraints. If good fruitset is doubtful, the use of Schwarzmann, Teleki 5C, 101-14 MGT and Couderc 3309 (Cirami 1998) should be considered but their use will also depend on the other characteristics of the site. For example, in a vigorous environment Couderc 3309 has been found to significantly reduce fruitset (Wolf and Pool 1988).

Frequency of loss
Economically we can reduce the impact of poor fruitset, by
including a yearly estimation of crop loss due to poor fruitset in long-term budgets. Using long term yield data to determine the probability of poor fruitset, plus the severity of the expected loss due to poor fruitset, a numerical value of economic loss can be determined. With this value in the budget, the long-term feasibility of the project can be assessed and owners/managers can at least be prepared to manage this loss should it occur.

If the frequency of poor fruitset is high then site selection or varietal/rootstock selection may be a significant contributor to poor performance. In this situation a full review of the vineyard should be undertaken and its long-term feasibility determined.

If the frequency of poor fruitset is low or sporadic there may be no requirement to change management in the future, as changes to improve fruitset may result in higher economic cost in good seasons by removing grapes to meet the required cropping levels (either imposed by wineries/winemakers, or to ripen the grapes successfully).

There may also be significant increases in disease risk from bunch rots as:
- Better fruitset leads to more berries;
- More berries leads to tighter bunches and heavier bunches;
- Tighter bunches increases potential for disease;
- Heavier bunches gives higher yield (which may or may not be beneficial). How does this relate to increased disease risk?

**Economics of good fruitset**

Management of yield is no longer a 'prune-and-forget' task, with the wineries taking all that is produced. Most wineries now recommend cropping levels, realistic or not, that the winegrower must meet. Achievement of the required cropping levels involves pruning tasks throughout the season. Tasks such as foliage management, shoot thinning and crop thinning, all have some impact on final yield.

Unfortunately if fruitset is poor, the economic viability of the project may be questionable, especially if this occurrence is frequent. However, if yields are too high, additional economic cost must be incurred to remove grapes, which may also threaten the economic viability of the project.

With most winemakers pushing the 'lower yield equals better quality' barrow, some may question whether fruitset should be improved, particularly if we are going to remove bunches only to satisfy the winemaker. The simple answer is that poor fruitset is generally a product of poor condition during flowering, which often leads to increased flowering time. This in turn leads to greater variability in the size and level of ripeness of berries, the uniformity of bunches and if grapevine uniformity is low, to a differential in overall grapevine performance. As quality is inversely proportional to variability, increasing fruitset should lead to better winegrape quality.

**References**


