Understanding the factors that influence grapevine yield

Many Australian grapegrowing regions experienced lower than average yields in the past season and are now reflecting on the possible causes. Information gathered from across a number of regions suggests that, for many, low yield was caused by both fewer and smaller bunches. Both bunch number and berry number per bunch can be affected by external environmental influences (light exposure, temperature, humidity and wind) and the internal physiology of the grapevine (water, nutrient and hormone status). It is important to understand the different timings of these influences and the contributions of the different components of yield in order to manage and avoid low yields in the future. In this column **Dr Mardi Longbottom** explores key questions on the factors that influence yield.

What determines the number of bunches per vine?

The number of bunches per vine accounts for approximately 60% of yield variability, so it is important to understand the timing and potential impacts on this component. Bunch number per vine is primarily determined in the season prior to harvest (at around flowering time) when inflorescence primordia (IP) differentiate within the compound buds. For fruit that was harvested in 2020, bud initiation occurred in 2018. This is sometimes referred to as the 'yield potential' or, when the number of IP per bud is known, as 'fruitfulness'.

There is a direct correlation between bud fruitfulness, shoot light exposure and temperature. High light exposure and high temperatures have been found to promote fruitfulness in developing grapevine buds. The supply of adequate water and all essential nutrients (especially N) are also important. The yield potential decreases when vines are pruned during dormancy as fruitful buds are removed. However, the actual bunch number per vine is not determined until after budburst in spring.

Some vineyards annually assess bud fruitfulness to understand seasonal fluctuations in potential yield. In the absence of these tests, it can also be helpful to review the weather conditions around flowering to provide an indication of whether potential yield will be higher or lower than in previous years. The results of fruitfulness tests can then be used to make more informed pruning decisions. For example, when fruitfulness is low, more buds can be left at pruning to compensate for the low potential yield.

Which factors can influence fruit set?

Fruit set describes the process of transition of the ovary to a berry after fertilisation and it occurs at 'flowering'. To quantify the percentage fruit set on a bunch it is necessary to know the number of flowers per inflorescence, and the resultant number of berries after fruit set. Fruit set is the second largest contributor to yield variability (approximately 30%); however, in practice it is rarely measured and growers generally rely on past experience when 'poor fruit set' is attributed as the cause of low yield. Poor fruit set is generally characterised by 'loose' bunches with fewer berries. Millerandage, or 'hen and chicken', is also a symptom of poor fruit set.

The success of fruit set can be obstructed before flowering even occurs if the flower or components of the flower do not form properly, for example with deficiencies of nutrients such as molybdenum, boron and zinc. The flowering process (i.e. the successful transfer of pollen to the stigma and growth of the pollen tube to the ovule) can be interrupted by several environmental influences, especially weather. Hot and dry conditions can dry out the stigma, making it unreceptive to the pollen and pollen tube growth. Cold conditions slow the growth of the pollen tube and can cause incomplete fertilisation and failure of the ovary to grow into a berry. Wind and rain can both displace pollen from the stigma so that fertilisation is impossible.

There are a number of strategies to protect against poor fruit set including ensuring adequate supplies of water and nutrients and manipulating the timing of flowering to increase the chances of improved weather conditions

at flowering. Delaying pruning until after budburst (2-3 leaves; E-L 9) is a technique proven to delay flowering so that it may coincide with more suitable weather conditions for optimal flowering and fruit set, and also the potential avoidance of spring frost damage (Petrie et al. 2017). Another pruning strategy that can be used as insurance against poor fruit set is to leave additional buds, for example, through using sacrificial canes. If fruit set is good, surplus fruit can be easily thinned by removing the sacrificial canes.

Which factors affect berry weight?

Berry weight accounts for approximately 10% of yield variability or, to put it another way, changes in berry weight are likely to have the least impact on overall yield. Berry weight is primarily determined by the volume of solutes in berries, which is a function of both the number of cells within each berry (determined immediately after fruit set) and cell size. Both the number and size of berry cells are primarily determined by water availability during the growing season.

Late-season berry shrivel can be caused by the natural decline and death of phloem in the rachis preventing the transport of solutes and water into the berry; dehydration from hot conditions; or bunch stem necrosis (BSN). Once the natural decline of berry tissue or BSN has commenced, the only way to prevent further yield loss is to harvest. If berry shrivel is caused by dehydration, irrigation can replace lost water. Late pruning and delayed harvest can be used as a proactive measure to reduce berry dehydration during hot weather (Petrie 2017).

Are there any other factors that should be considered?

In addition to ensuring the supply of adequate water and nutrients and employing the pruning strategies mentioned, when considering steps to protect yield, it is also important to control pests and diseases. Eutypa, viruses, mites, downy and powdery mildew and botrytis can all have detrimental impacts on yield.

In assessing the potential causes of low yield it's important to consider all of the factors that may have contributed within the past two seasons. In the most recent season, a number of Australian regions experienced conditions including very cold spring temperatures and dry winter and spring seasons. Individually these conditions can be detrimental to yield and together they can combine to result in very low yield.

For further information on yield or any other technical grapegrowing or winemaking questions, contact the AWRI helpdesk on helpdesk@awri.com.au or 08 8313 6600.

References

Petrie, P.R., Brook, S.J., Moran, M.A., Sadras, V.O 2017. Pruning after budburst to delay and spread grape maturity. *Aust. J. Grape Wine Res.* 23: 378-389.

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