AUSTRALIAN Grape & Wine

Winegrape Assessment

in the Vineyard and at the Winery

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AWRI Australian Wine Research Institute

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1. Introduction

This document is a description and endorsement of current best practice in winegrape assessment. It describes and discusses those quality specifications that can be readily measured or ascribed a value. It has been developed by and for participants in the wine industry involved in the activities of buying and selling winegrapes, and is based on wide industry consultation. The aims of this publication are to bring more clarity, transparency, commonality and certainty to the sometimes contentious process of assessing winegrapes where the outcome may result in the rejection of the fruit or a change in the price paid. It should be seen as a tool to develop and improve relationships between buyers and sellers of winegrapes.

The 2021 update to this work addresses the need for improved industry guidance on quality assessment standards so as to build greater levels of transparency within grower-winemaker relationships. It was instigated by Australian Grape and Wine Incorporated (Australian Grape & Wine) and funded by the South Australian Wine Industry Development Scheme, with oversight from both winemakers and growers by way of a Project Reference Group. The group recognised the growing importance of sustainability within the Australian grape and wine industry, environmentally, socially and economically, and that effective communication and mutual respect between grape growers and wine producers are integral to this.

The requirement for upgraded industry guidance on best practice was initiated in response to an ACCC Winegrape Market Study, which aimed to improve

the competition for winegrapes by driving efficient production and promoting pricing mechanisms that encourage innovation. The report recommended a number of opportunities for improvement across the sector, including:

- that winemakers should use objective measures to determine grape payment amounts wherever possible
- that standardised sampling protocols should be followed in the vineyard
- that best practice quality assessment protocols should be reflected in an updated Code of Conduct for the sector.

A further aspect of the ACCC study was to conduct a review of industry guidance on quality assessment standards so that they reflect current best practice. The study stipulates that winemakers should reduce their reliance on subjective measures to determine payment and eliminate their use altogether where objective measures are available to measure the same or similar characteristics. Where they exist, the use

of industry-endorsed standard procedures (IESPs, available from: https://www.agw.org.au/industry-resources/winegrape-quality-assessment/industry-endorsed-standard-procedures/) for quality assessments affecting price will be a requirement of all signatories to the Code of Conduct for Australian Winegrape Purchases (the Code) as published in November 2020 on the Australian Grape & Wine website. Under the Code, supply agreements must also clearly outline any other quality testing and sampling methods that winemakers intend to use.

Endorsement of industry best practice will be meaningless unless individual growers and winemakers also adopt the recommended standards in their dealings with each other.

2. Best-practice grape supply agreements

Grape supply agreements should provide security and reliability of supply and sale of winegrapes. At the same time supply arrangements should be fair, equitable and mutually beneficial. The Code provides a framework to support such fair and equitable dealings between buyers and sellers of grapes. All winemakers who purchase grapes should become signatories.

Grapes are generally assessed, in the vineyard or at the winery, against maturity, purity and condition standards (MP&C standards). Grapes or the resulting wine may also be assessed to determine inherent quality. This may result in ascribing a particular 'grade' to them that affects the grape payment. MP&C standards, grading parameters/benchmarks

or other specifications or terms affecting price should be clearly communicated in supply agreements including the methods that will be used to assess or grade the grapes. This also extends to how price deductions or bonuses are to be applied. The timing and methodology of these assessments should be specified and, where an adverse assessment decision is made, evidence to justify the decision should be documented and be accessible to each party in the event of a dispute.

Tolerances should be written into grape supply agreements so that both parties understand what is expected. Specifications requiring stated tolerances include Baumé, TA, pH and other analytical specifications as well as purity conditions such as fungi, dust, matter other than grapes, smoke taint compounds, other environmental contaminants, or residues from agrochemicals.

Each winery will have its own tolerance levels for specifications detailed in the agreement. It is therefore important for growers to be made fully aware of the consequences of failing to meet tolerances. In some cases there may be a price penalty in proportion to the degree to which the grapes fail to meet tolerances. In other situations there may be downgrading to another grade or even rejection. Grape supply agreements should incorporate any other specifications required by the winemaker, such as those outlined in section 4, as well as information relating to the handling of excess crop.

Optimal cropping levels and expected yields may be negotiated and agreed upon as part of the grape supply agreement. It has therefore become increasingly important to estimate yield accurately in the vineyard prior to harvest to assist winery planning.

A responsibility of winemakers is to abide by the appropriate regulations as set out by Food Standards Australia New Zealand (FSANZ). Both grape growers and winemakers must also ensure they are aware of, and comply with, all other state and national regulatory requirements associated with the entire grape supply chain. These include biosecurity requirements for vineyard entry and equipment transfers, work health and safety risks to workers in the vineyard including exposure to viticultural chemicals (both for vineyard workers and visitors to the vineyard) and the various regulations relating to the bulk transport of grapes such as avoiding overloading.

Some wineries provide growers with constructive feedback on the vineyard assessments and the resultant wine quality of their grapes along with any recommendations to assist with improvement.

Just as the winery is responsible for wine production, vineyard owners carry the responsibility and risks associated with grape production, including general effects of the season, frost damage, pests and diseases, harvest, and, depending on where risk and title transfers from the grower to the winery, transport and delivery.

A summary of reasonable winery and grower expectations that relate to winegrape maturity, purity and condition standards and tolerances is provided on the next page.

Winery expectations:

- Growers will seek to understand any specific stylistic or quality attributes being sought by the winemaker.
- Growers will strive to produce grapes of appropriate maturity, purity and condition as per the grape supply agreement.
- Growers will manage cropping levels to meet any specified winery grape supply agreement tolerances.
- Growers will take reasonable steps to produce timely and accurate crop estimates.
- Grapes will be harvested and delivered within a reasonable timeframe of winery notification that they have reached maturity or any agreed specifications (such as target Baumé, TA or pH) and in accordance with any protocols stated in the grape supply agreement.
- The delay between the commencement of harvest and delivery to the winery should be minimised unless other instructions have been given by the winery.
- Growers will manage their vineyard with due care to the environment.
- Growers will manage their vineyard in accordance with quality assurance or sustainability programs where required, such as the industry standard Sustainable Winegrowing Australia program.
- Growers, with the assistance of wineries and programs such as Sustainable Winegrowing Australia, will continually strive to improve all aspects of their sustainability processes.
- Growers will comply with reporting requirements, such as reporting of agrochemical use in the form of a spray diary and submitting crop estimates when required.
- Growers will inform winery representatives of any information, change or significant event that could affect the expected grape quality or yield.
- Growers will comply with winery grape sampling requirements (such as those outlined in the IESPs for grape sampling).
- Growers will inform the winery of any viticultural chemical applications that will affect entry into the vineyard for sampling or assessment purposes.

Grower expectations:

- Winemakers will honour any rewards or bonuses promised in the grape supply agreement.
- Where winemakers use quality or MP&C assessments to determine pricing, they will clearly outline their methodology for assessments and document their results.
- Where available, winemakers will use IESPs or validated equivalent methods for making these assessments.
- Where bonuses or upgrades are awarded based on end-use, winemakers will work with their growers to make the quality linkage between grapes and end products clear and understandable including the processes to assign wines to end product categories.
- Winegrape specifications and tolerances will be written, clear, measurable and consistently applied, especially where downgrading can occur or pricing is affected.

- Any changes to winegrape specifications and tolerances will be negotiated in good faith, and changes will not be imposed by the winery without express agreement from the grower.
- Assessment staff will be trained and competent in vineyard and/or load assessment. If a problem arises the grower will be consulted to discuss and agree on an outcome.
- Growers will be provided reasonable and sufficient notice of any winery requests, including harvest and delivery.
- Grapes will be harvested as soon as possible after they meet agreed specifications (such as target Baumé, TA, pH or other analytical specifications) and with consideration, and potentially compensation, where the grower suffers loss due to a material delay in harvest outside of their control.
- Notification of possible downgrading, penalties or rejection will be in accordance with timeframes laid out in the Code (for Code signatories) and in any case as early as possible with consideration to the fact that the grower may wish to seek alternative arrangements to prevent further loss.
- Growers will be involved as much as possible when it comes to vineyard assessments and have the right to be present during a vineyard assessment.
- When entering a grower's property, winemakers will abide by relevant laws, including those relating to biosecurity and work health & safety and will follow growers' standards and protocols for managing risk that may exceed the relevant legislative requirements.

3. Winegrape quality

Wines and the grapes they are made from are highly differentiated products. They are influenced by a myriad of factors including variety, growing region, vineyard characteristics, vineyard management practices, seasonal conditions and winemaking practices. For this reason certain varieties, regions, vineyards, vintages, wineries, and wines can command significantly different prices. For the sake of efficiency and harmony within an industry that encompasses such highly differentiated products, clarity, common understanding and agreement on important characteristics are highly desirable. While seeking clarity and common understanding, it must also be acknowledged that some characteristics of grapes and wine are not readily quantifiable (and are to a degree subjective), and it is often these less quantifiable characteristics, such as flavour, that make grapes and wines highly sought after by consumers.

A useful model with which to consider grape quality is the quality triangle, which, for the purposes of grape transactions, groups all the factors that can influence grape quality into three sides of a triangle.

The winegrape quality triangle

Maturity, purity and condition

Maturity, purity and condition (MP&C) refer to those criteria that can be readily quantified or ascribed a value using an endorsed or agreed methodology. They are commonly specified in grape supply agreements between growers and winemakers so that both parties understand what is expected and have a commitment to ensure product specifications are met. They are covered in detail later in this publication.

Flavour and character

Flavour and character requirements, such as tannin structure, are determined by winemakers according to their product requirements and their winemaking styles. These are often difficult to quantify. Nonetheless, these characteristics are vitally important and, in situations where grape pricing will be influenced by flavour and character, winemakers need to take particular measures to ensure growers can have faith in the methodology used to assess these parameters. The timing of assessment is sometimes well after the receival point, as is the case for 'end-use' bonuses, which are allocated by some wineries according to the ultimate end-use of grapes in the product portfolio of the winery.

The special measures wineries take could include:

- Ensuring growers appreciate product portfolios, possibly through structured tastings
- Giving growers clear and realistic wine end-use expectations with reference to variety, region and vineyard
- Having assessment and assignment/allocation protocols that are specified and adhered to
- Following agreed and robust guidelines for any sensory assessment conducted for the purpose of imposing penalties, against an agreed base price in a manner that ensures the assessment is as objective as possible
- Communicating to growers the end-use outcomes.

Protocols and supporting behaviours

'Quality' is not limited to criteria that are quantifiable and measurable. There are process and procedural elements that cannot easily be measured. These elements include:

- Communication
- Notification
- Timeliness
- Assessment.

Vineyard assessments by wineries are undertaken according to certain internal protocols. These protocols might cover the frequency of visits, procedures for communicating with the grower/owner, decision procedures for downgrading or rejecting grapes and minimum training and experience for personnel undertaking vineyard or load assessments.

These protocols and supporting behaviours provide direction on how the other aspects of the quality triangle should be implemented and communicated. These protocols and supporting behaviours may go even further towards limiting uncertainty among growers in particular with respect to the outcomes

of their grape supply arrangements with winemakers. So while there are many factors that constitute quality, only those readily assessable are dealt with in the remainder of this document. The Code provides a number of examples of industry best practice relating to supporting behaviours.

4. Specification, criteria, tolerances and assessment

The following terms are widely used in this document and therefore require definition.

Specification means the notation of the characteristics that distinguish one load of grapes from another. Analytical specifications (such as Baumé, TA, pH) are common in grape supply agreements, as are specifications such as load temperature, the variety and vineyard block, additives, adherence to agrochemical withholding periods, restrictions on chemical use, container type and other delivery directives and crop levels.

Criterion means the measure or rule by which a judgment or estimate is made. Using the above example, the criterion for load temperature is degrees Celsius as measured by a calibrated thermometer using an agreed sampling protocol.

Tolerance means the permitted variation or range of values around the target that the winery will accept. It should not include the expected uncertainty of the measurement in use as this can only be applied to each individual determination. Again using the above example, the tolerance for load temperature at a particular winery may be that grapes need to be delivered at less than 30°C and that grapes delivered in excess of 30°C may be liable for penalty.

Assessment

Vineyard and load assessment procedures in one form or another have been in use in the wine industry for many years. In its 2019 Winegrape Market Study report, the ACCC recommended that:

- the current industry guidelines for quality assessment be reviewed and updated to reflect current best practice, including detailed information on standards for sampling
- uniform national standards for testing and measuring sugar and colour in grapes are developed
- winemakers use well-documented and objective testing and sampling methods for assessment of grapes in the vineyard and at receival.

As a consequence of the ACCC recommendations, several IESPs have been developed and are available in the 'Winegrape Quality Assessment' section of Australian

Grape & Wine's website (https://www.agw.org.au/industry-resources/winegrape-quality-assessment/). Other endorsed methods will be added to this website as they become available.

Furthermore, improved knowledge and innovation are providing growers and winemakers with new alternatives to assist them in ensuring that grapes more closely match winery requirements. This publication outlines the important specifications commonly used by wineries in assessing maturity, purity and condition of grapes in vineyards and at the receival point. While it describes a range of specifications used by wineries in grape supply agreements, it is not a set of standards, or a standardised approach towards defining assessment procedures.

The point of transfer of title, when ownership of the grapes passes from the grower to the winery usually occurs at a point in time after harvest and prior to processing and can be referred to as the receival point. This is logically the optimal point that final assessment against specification should take place; however, there are certain considerations that might justify an alternative approach. Where problems identified in the vineyard are highly likely to result in rejection, the potential cost savings of an assessment prior to harvest and delivery should be considered. Furthermore, identifying problems as early as possible allows the grower the opportunity to take action that might avoid grapes being downgraded or rejected. In any event, the timing and methodology of these assessments should be specified in the grower supply agreement and, where an adverse assessment decision is made, evidence to justify the decision should be documented and be accessible to each party in the event of a dispute (this is a requirement of signatories to the Code). Supporting evidence might include retention samples, digital images and/or documentation demonstrating compliance with sampling or assessment procedures.

Grapes that are downgraded or rejected represent a missed opportunity for both the grower and the winemaker. Grape supply agreements of Code signatories must outline assessment methods for the purpose of affecting price in accordance with the provisions of the Code. Where grape assessments will be used for the purpose of pricing, they must clearly outline MP&C standards that must be met and that the methods for assessment will be according to the IESPs as published in the Winegrape Quality Assessment section of Australian Grape & Wine's website, or another agreed method if an IESP is unavailable.

5. Assessment in the vineyard

Vineyard assessment is a form of quality assurance and has become a critical step in the winemaking process. It enables the winemaking potential of the grapes to be identified prior to receival at the winery and, more importantly, it reduces the risk of the delivery of unsound grapes to the winery.

Inspections during the growing season and especially during ripening, allow the winemaker, or winemaker's representative, to follow progress and determine the time of harvesting that will result in the best combination and expression of flavours and other attributes. Vineyard and berry assessment enables wineries to batch similar parcels of grapes and optimise both wine quality and winery efficiency.

Formal processes of vineyard and berry assessment should involve measurements wherever possible to objectively explain differences in quality between blocks. Some characteristics, such as flavour, cannot be easily or quickly measured using a tool or laboratory test and require subjective assessment following specific guidelines. Subjective assessment techniques that rely partly or fully on personal judgement may be considered ambiguous when they are not consistently and reliably reproducible by different assessors. Growers should be aware of this. Winemakers should clearly outline their methodology for subjective assessments to remove as much ambiguity as possible and include the methodology in their grape supply agreements.

Vineyard characteristics that may be assessed include leaf condition, bunch exposure, berry size, berry shrivel, sugar/acid balance, skin chewiness/thickness and tannin intensity. Where these characteristics are assessed for any purpose affecting payment, this must be clearly outlined in the grower supply agreement and an objective method such as a score card should be used.

Growers should be involved as much as possible when it comes to vineyard assessments and have the right to be present during a vineyard assessment. Notifications of concerns against specifications should be provided as soon as possible following these inspections and growers should be provided reasonable and sufficient notice of harvest and delivery.

A summary of the various assessments commonly conducted at the receival point is given in Table 1 on page 22.

6. Assessment at the grape receival point

The official receival point where transfer of title occurs is often at the winery. A load assessment point, such as the weighbridge, is a critical final checkpoint against specifications.

Load assessment verifies how well the grapes comply with specifications. With most specifications, results are possible within 15 minutes and there is usually an impetus to make assessments as soon as possible to avoid processing delays. Growers need to feel confident that the methodology being applied during assessment of the load is consistent and reliable, and that measurements are accurate. Sampling at the weighbridge can be difficult due to issues with accessing representative samples within the bins or truck loads. If the weighbridge assessment is going to be used as a tool for payment then the sampling must follow a validated procedure which complies with the IESP for sampling at the weighbridge, including using average results from multiple loads/bins for a single batch of fruit.

Fermentation leads to the release of volatile flavour compounds, not detectable in the grapes, which makes it difficult to predict the overall quality potential at the load assessment stage. Where grower supply agreements contain various grade prices or bonus provisions, ascribing a grade to the resulting wine rather than the grapes themselves is common practice. Where an assessment affecting payment is conducted post-crusher or in tank, consideration should be given as to whether winemaking processes (for example dilution, blending, oak additions or oxidation) have the potential to affect the final result, even for relatively objective measures such as Brix/Baumé and especially for small batches. Therefore post-crusher assessments should either be carefully managed or avoided altogether where the assessment could be carried out as accurately at the receival point.

A summary of the various assessments commonly conducted at the receival point is given in Table 1 on page 22.

7. Maturity, purity and condition criteria

The specifications used to assess grapes in the vineyard and at the winery can be split into three broad categories: maturity, purity and condition.

7.1 Maturity

Maturity is often determined by analytical specifications such as Baumé, TA or pH. Winemakers may also assess subjective measures contributing to 'flavour ripeness'. A range of components that may be considered are outlined below.

7.1.1 Total soluble solids, pH and titratable acidity

The sugar in grapes is often used as an indicator of maturity and is sometimes used as a basis for pricing. The majority of wineries measure sugar as total soluble solids (TSS) in degrees Brix or Baumé units. One unit of Baumé is equivalent to 1.8 degrees Brix.

Titratable acidity (TA) and pH are commonly measured with TSS to give an overview of grape maturity at harvest and may also be used for harvest scheduling. TA and pH are not commonly used as an element for pricing grapes. As TSS increases in the berries, the juice pH rises and the TA declines. TA indicates the total amount of organic acids in solution and the pH relates to the free hydrogen ions in solution, indicating the alkaline/acidity balance.

IESPs have been created for these three criteria, which can be used as the basis for their measurement, with prescribed calibration and quality assurance steps, as well as defined uncertainty of measurement. If an IESP is not used for the determination of these criteria and they are used to determine payment, the methodology used should be appropriately validated against the IESP to demonstrate that it provides equivalent results to a known uncertainty of measurement.

As TSS, TA and pH can be measured, they are commonly used as specifications, but there are other influences on quality. These are discussed later.

Measurement

Using juice samples (for both vineyard and load assessment), TSS, TA and pH are all measured with instrumentation that is calibrated to a standard solution as outlined in the IESP or a method validated against the IESP.

TSS is usually measured by refractometry, giving a value expressed in degrees Brix or Baumé.

TA is measured as free and bound hydrogen ions by titration with NaOH, expressed in g/L of tartaric acid equivalents.

Juice pH is measured using a calibrated pH meter and values are expressed in pH units.

Assessment and sampling for maturity in the vineyard

Sampling commences in the vineyard at around 8 Baumé onwards for most varieties (once berries have reached full veraison). It is best practice to sample twice weekly if resources allow, or once weekly as a minimum.

Variability is taken into account by taking samples that are representative of the block unit to be harvested. Samples should be taken at the same time of day for each sample date and preferably in the cool of the morning.

If final maturity measures form part of a payment program then vineyard sampling should be performed as close as possible to harvest. The sampling should be conducted as per the protocols in the IESP on vineyard sampling and subject to a final assessment at the point of transfer of title. If there is a significant weather event, or if irrigation is applied between sampling and harvest, the validity of the results may need to be reviewed and resampling may be necessary.

For general maturity testing there are many methods of vineyard sampling. The IESP can be modified as appropriate, or reference should be made to the publication: Growing Quality Grapes to Winery Specifications (Krstic et al. 2003).

Assessment and sampling for maturity at the receival point

Sampling devices range from mechanical core samplers to smaller manual devices. Whatever tool is used, the aim is to obtain a core sample that is representative of the load in a manner compliant with the IESP for sampling from bins or trucks. Alternatively, the sampling method should be validated to show that it produces statistically representative results. Training is therefore essential to ensure consistency of operation.

Results are recorded and acted upon as per winery procedures.

7.1.2 Colour (red grapes)

In some regions, growers have been encouraged to undertake practices that improve the intensity of colour of winegrapes, especially the varieties Cabernet Sauvignon, Merlot and Shiraz, and some grape supply agreements offer pricing incentives for increased colour. The main goal, however, has been to raise regional colour performance (particularly in the inland irrigated regions) and to provide further scope for batching.

The correlation of colour with other quality attributes continues to be investigated. Like other specifications, colour should not be used in isolation but in combination with other factors that make up the overall quality of the wine. However, growers need to be aware that winemakers make commercial decisions about their products and may

have varying colour tolerances for different varieties and wine styles.

Colour measured in the vineyard should ideally be verified at the receival point, with sampling methods that take account of variability, as outlined in the IESPs. It should be noted that such measurements are difficult to achieve in real time when using the IESP for colour at the weighbridge.

Measurement

Colour compounds (anthocyanins) form part of the phenolic make-up of wines and are predominantly found in the grape skins.

In the vineyard, visual assessment of colour can be made using a colour chart alongside a macerated sample of grapes. Although quick and inexpensive, this method is relatively subjective.

Colour may also be measured by:

- Spectrophotometry (which is the basis of the IESP)
- Other secondary methods, including near infra-red spectroscopy (NIRS).

Colour measurements are usually expressed as milligrams of anthocyanins per gram berry weight.

The spectrophotometric methods, of which the colour IESP is an example, can be time-consuming as they require careful sample homogenisation and extraction before measurement in a spectrophotometer. However, as it is a direct measurement it does not require complex calibration protocols, the method is valid for all regions and varieties and the equipment required is relatively inexpensive and simple to use.

Secondary methods such as NIRS are correlative techniques that enable more rapid analytical results. They must be calibrated against the IESP, often with differing calibrations for different varieties and regions that must be updated yearly and constantly monitored against reference analysis. Assuming an NIRS or other secondary method calibration is available, routine testing is simple and can be performed in less than a minute once a representative sample has been acquired and prepared. Representative sampling and sample preparation is crucial for accuracy of results for all analytical measurements, but particularly for colour determination. Instruments for secondary methods such as NIRS are available as bench-top tools, but remain expensive and require specialist technicians to maintain and validate calibrations.

Wineries that specify colour by measuring milligrams of anthocyanin per gram of berry may have varying tolerances for each red winegrape variety. Tolerances may also vary between regions.

Sampling for colour in the vineyard

All sampling for colour measurement from the vineyard should be conducted as per the IESP for vineyard sampling, as close as possible to harvest and subject to a final assessment at the point of transfer of title. Analysis should be performed as per the IESP on determining colour in grapes or a method that has been validated to show equivalent results. As for any sampling, it is crucial to understand vineyard variability prior to sampling and it has been shown that sampling for colour shows a greater variability than sampling for Baumé, TA or pH.

Sampling for colour at the receival point

Sampling for colour measurement at the winery should be done as per the IESP for bin and truck sampling at the weighbridge with due care to ensure a truly representative sample. It should be noted that for machine harvested fruit, care must also be taken to ensure that sampling is done from whole berries and that bins have not been allowed to sit for extended periods in hot or adverse conditions as this may impact the reliable determination of colour.

7.2 Purity

Fungal diseases, agrochemical residue and matter other than grapes (MOG) are detrimental in a load of winegrapes and while 100% purity can be difficult to achieve, avoiding MOG should be the aim of every grower.

Grapes are classified as food and therefore have to be able to comply with Food Standards Australia New Zealand (FSANZ).

Certain issues may not be apparent or measurable at the time of harvest but result in latent defects that make the resulting wine unsuitable for sale or significantly reduce its value. An example of this is smoke taint, which may, depending on the timing of the fire event, not be practicably measurable by sensory or analytical means in time for harvest decisions. Accordingly, some grape supply agreements contain clauses that allow for price deductions, penalties or rejection after the fruit has been accepted.

7.2.1 Diseases—powdery mildew, downy mildew, Botrytis and other moulds and rots

Diseases are detrimental to wine quality if they affect colour and flavour. They can also impart unpleasant taints. The percentage of disease that is acceptable can vary from winery to winery. Monitoring of pests and diseases in the vineyard and assessment of damage or infection can minimise problems and enable notice to be given before grapes arrive at the load assessment station. Powdery mildew

needs to be controlled as early as possible (preferably by veraison). Botrytis and other moulds and rots may only be evident close to harvest when moisture has affected grapes. Downy mildew is not an issue every year in most regions throughout Australia, although it can have a serious impact on grape quality, with loss of leaf function near harvest affecting the ripening process.

Measurement

Currently, the degree of disease infection is determined by visual examination during vineyard assessment and, in some cases, during load assessment at the winery. Assessments should be made in line with industry-endorsed guidelines on pest and disease assessment. These guidelines can be used in conjunction with digital tools available from a number of sources or using quantification in the vineyard using the Emmett and Wicks Disease Assessment Key (Emmett R et al. 2015). In this formal assessment process, a percentage incidence and severity rating of the disease is determined to assist in decision-making.

Assessment of disease in the vineyard

Inspections for any vine health problems should start at the latest by veraison, or earlier if resources allow. Assessment of diseases that may seriously threaten quality should be conducted in association with the winemaker. Assessors need to be trained in technical assessment of pests and diseases that can affect wine quality. It is important that the assessment method can be shown to produce results that are statistically valid, taking account of vineyard variability. Accurate and consistent documentation to support this should be retained.

It is recommended that growers conduct random monitoring. If background information is available, they may wish to undertake targeted 'hot spot' monitoring. If a disease is present in a 'hot spot' the remaining area can be assessed and compared. Thorough monitoring can involve 200 observations per 'hot spot' or block, stopping to assess 20 sites and assessing 10 bunches or leaves at each site by choosing one to five vines. Growers are advised, however, to consult purchasing wineries regarding their disease assessment protocols.

Assessment of disease at the receival point

It is difficult to accurately assess disease incidence and severity in loads, especially in machine-harvested red winegrapes at night. Consequently, wineries should ensure problems are recognised and assessed prior to harvest. When a load with disease-affected grapes arrives at the receival point, currently best practice is visual assessment, combined with sensory detection of off- odours and taints in the grapes.

7.2.2 Agrochemical residues

Use of spray diaries has been common practice for some years to help protect Australian wines from the risk of agrochemical residues exceeding maximum residue limits (MRLs) for export and domestic markets. MRLs vary from one country to the next and for some markets they do not exist at all. It is the grower's responsibility to adhere to the withholding periods recommended by their winery or The Australian Wine Research Institute (AWRI), and to use only products agreed in the winery specifications and registered for use in grapevines by the Australian Pesticides and Veterinary Medicines Authority. This will ensure the grapes produced will meet the requirements of the end-use market.

It is a requirement of most wineries that accurate spray diaries be maintained and returned to the winery prior to harvest. If this does not occur, grapes may not be accepted. Spray diaries are checked by wineries for discrepancies and monitoring for residues is carried out. Monitoring for residues is at the discretion of the purchasing winery and may occur in the vineyard, at the receival point or via testing of the final wine blend.

Measurement

The equipment required to test for agricultural residues is expensive and difficult to operate and maintain, putting it beyond the resources of a typical winery. Samples of grapes, juice or wine are sent to an accredited laboratory for testing. A delay of 10 days or more is to be expected for results.

7.2.3 Matter other than grapes (MOG)

With expanded use of machine harvesting since the late 1970s, MOG has become an issue in harvested grapes, as most contaminants (other than chemicals) are directly related to mechanisation. MOG includes all other vine material such as petioles, leaves, canes and broken arms of vines. MOG also includes foreign objects such as stones, picking utensils, trellis parts, metal objects and irrigation components. These are often difficult to detect in loads until in the crusher and it is highly variable as to how much material or how big an object will cause damage. It should also be noted that MOG can also be present in hand-picked loads. Machine harvesting technology has changed in recent years to greatly improve harvesting techniques and to reduce the amount of MOG in loads. Improvement is still needed, however, and often the harvester operator can play a major role in ensuring the purity of the harvest. Growers share the responsibility of reducing MOG in the vineyard. They should clean up vines after machine pruning to remove potential MOG such as brittle dead arms caused by Eutypa, ensure vine rows are clear of foreign objects, and control snails and other potential pests.

Winery tolerance for MOG may vary and grape supply agreements will often specify a level where price deductions or outright rejection will occur. An IESP for assessing MOG has been established using a series of reference photographs, and a rating scale of 0 to 5. The visual assessment requires a thorough inspection of every bin, truck or trailer. Core samplers may assist in detecting MOG that is not visible on the top of the load.

Assessment of MOG at the receival point

MOG can be quantified by extracting and weighing it out in samples taken from loads, but this is inefficient, time-consuming and too complicated to be a practical measurement tool. Sampling would need to be representative of the entire load. Development is also being undertaken using a range of automated camera systems; however, these are not yet available for common usage and the capital expense required may mean they will be beyond the resources of many wineries when available.

At the receival point, the current method for evaluating MOG is by visual assessment using the IESP for assessing MOG, which has been developed from the methods outlined in the Australian Winegrape Load Assessment Manual and posters. Future automated methods of MOG assessment will need to demonstrate the ability to meet or improve on the results from these processes.

7.2.4 Contamination

Contamination of loads of grapes can come from many sources including soil, fuel, oil or other lubricants, non-food grade materials, dilution with water, unwanted additives or animal matter including insect pests.

Some contaminants are more detrimental to the resultant wine than others and can some be easily detected via distinct odours. Contaminants that are severe are not tolerated and can result in instant rejection. If contamination is caused by a known accident, it is an expected courtesy that the grower will notify the winery immediately so that contamination to processing equipment and wine tanks can be prevented.

Assessment of contaminants at the receival point

There are no methods in place that can accurately measure contaminants in loads at the winery receival point. Often the contaminant is accidental and known, so action can be taken to prevent further losses. If unknowingly contaminated loads arrive at the receival point, visual and sensory assessment can guide decision-making. Evaluation relies heavily on notification from the vineyard backed up by sensory assessment at the receival point.

A thorough inspection of all trucks, trailers and bins should be undertaken to detect possible contaminants. Outsides of bins should be checked for excessive dirt, noting that this is also a biosecurity risk.

Some contaminants such as fuels and oils have strong odours and do not mix well with grape juice, so are easily detected. Soil contaminants are obvious from discolouration of loads, while dilution with water will be detected by a lower than expected Baumé.

7.2.5 Varietal integrity

The presence of varieties other than those expected to be in the load is not tolerated by wineries. Consumers expect, and the wineries are obliged by law to ensure, that the wine in the bottle is true to label. Varietal substitution constitutes an act of fraud.

Assessment of varietal integrity in the vineyard

Assessment in the vineyard is no substitute for a final inspection at the receival point; however, is an effective means for identifying and removing any rogue varieties present in the vineyard block prior to harvest.

Assessment of varietal integrity at the receival point

Visual assessment at the receival point is the only practicable method of ensuring varietal integrity.

Delivery records and paperwork should be checked to make sure the correct variety has been delivered. A thorough visual inspection of all trucks, trailers and bins should be conducted to look for possible varietal mixing. Results will be recorded and acted upon as per winery procedures.

7.2.6 Smoke taint

Wherever possible, assessment for potential smoke taint should be made before harvest against specifications clearly laid out in the grape supply agreement.

Where the outcome of a smoke taint assessment is intended to affect the price paid or result in rejection, the criteria and methodology involved to reach that assessment must also be clearly set out in the grape supply agreement along with the provider if a third-party is to be used and acceptable tolerances. If sensory analysis is to be used, then a standardised procedure demonstrated to achieve reliable, repeatable and accurate results should be followed, such as the objective method outlined in A procedure for conducting sensory evaluation for wine attributes (Williamson and Francis 2020).

7.3 Condition

Grapes that are evenly ripened, sound at the time of harvest and cool at delivery are in an ideal condition for winemaking. Berry damage, spoilage or other factors listed below can result in downgrades, price penalties or rejection. If so, the criteria and methodology involved to reach such an assessment must also be clearly set out in the grape supply agreement.

7.3.1 Uneven ripening

Uneven ripening can present as bunches that contain small hard berries that remain green while other berries ripen. Bunches may have poor or uneven colouring. There are no simple tools for accurately measuring uneven ripening or immature berries at receival. Consequently, assessments in the field or at the receival point are by visual means.

Assessment of uneven ripening in the vineyard

During routine vineyard inspections from veraison onwards, bunches are checked for signs of uneven ripening and immature berries. Options can be discussed among winery representatives and growers if there is a risk of not meeting minimum tolerances.

Assessment of uneven ripening at the receival point

A thorough visual assessment of the load can reveal uneven ripening and immature berries. However, it can be difficult to assess, especially in machine-harvested loads. A lower than expected Baume may be an indicator of uneven ripening.

7.3.2 Temperature

In Australia, air temperatures can be high, for example greater than 35°C, during ripening and harvest. Deterioration of berries is possible if they are exposed to high temperatures for long periods. Good logistical management is therefore key when managing vintage in hot conditions. This involves minimising the time from the commencement of harvest until the grapes are in tank where temperature can be controlled. Tolerances for temperature may vary from region to region. Wineries should not reject grapes with a relatively high temperature where best practice has been applied but should provide guidelines to growers for harvesting. For example, harvest in the cooler part of the night for all white varieties, then reds can be harvested during the day when conditions are warmer (below 25°C).

Measurement

Temperature is measured at the receival point using a calibrated thermometer suitable for use in loads and following an agreed sampling protocol suitable to the bin or truck.

Sampling for temperature at the receival point

Measurements are taken for at least half the bins. If there is a discrepancy between the bins and the temperature is elevated, then there is a need to measure further. For loads delivered in large vessels, it is recommended practice to measure temperature at three different points well below the surface of the grapes. Results are recorded and acted upon as per winery procedures.

7.3.3 Spoilage

Spoilage of grapes can occur for various reasons between harvest and crushing. This section refers to spoilage detected at the receival point, such as: premature fermentation, oxidation and acetification. All are considered highly undesirable.

Fermentation is detected in loads by checking for temperatures that are considerably higher than the average of other load temperatures measured during the same period. The load may also show signs of bubbling and have a fermentation odour. Foam or froth may be present on the surface of the load.

Oxidation appears in loads as browning of juice and brown berries on bunches.

Acetification in loads produces a vinegar-like odour caused by vinegar-producing bacteria and is often associated with bird damage, mould, rotting berries and the presence of vinegar flies.

Assessment of spoilage at the receival point

There are no methods at the receival point for accurately measuring spoilage. Visual and sensory assessments of grapes in trucks, trailers and bins can be used to detect major spoilage problems. Where signs of spoilage are detected, this should be recorded and acted upon as per winery procedures. Laboratory tests on the juice once in tank can confirm the assessment, if required.

7.3.4 Damaged berries

There are numerous events that can damage berries during ripening. This section refers to damage due to sunburn, excessive shrivelling, splitting, general berry breakdown, bird and insect damage.

Damaged berries are assessed in the vineyard during routine inspections and should be taken into account before the decision to harvest.

Visual and sensory assessments are the accepted methods for assessing damage.

Assessment of berry damage in the vineyard

Most berry damage occurs in the vineyard and can be addressed in the vineyard. Damaged berries should be prevented from arriving at the receival point unless otherwise agreed. Berry damage is assessed during routine vineyard inspections from veraison onwards. Options can be discussed if there is a risk of not meeting the minimum specification.

Assessment of berry damage at the receival point

It is difficult to accurately assess berry damage in loads, especially in machine-harvested reds at night. It is routine, however, for visual and sensory inspection of all trucks, trailers and bins for signs of berry damage.

Table 1 Summary of grape assessment specifications and recommended measurement protocols

Specification	Criterion/current method of measurement[1]	Recommended point of assessment[2]
Maturity		
Brix/Baumé	Quantitative- most commonly refractometry (°)	At the receival point
pH	Quantitative- pH meter	At the receival point
Titratable acidity (TA)	Quantitative- titration (g/L as tartaric acid)	At the receival point
Colour (red grapes)	Quantitative-Extraction and spectrophotometer, mg/g anthocyanins	At the receival point
Purity		
Powdery mildew, downy mildew, Botrytis and rots (other)	Visual and sensory	At the vineyard
Agrochemical residue	Confirmation of spray diary	Pre- receival or at receival
Contamination[3]	Notification where known, visual and sensory (smell)	At the receival point
Matter other than grapes (MOG)[4]	Visual assessment	At the receival point
Varietal integrity	Visual and DNA	At receival (DNA measure delayed)
Smoke taint[5]	Micro-fermentation of grape sample followed by sensory assessment	Pre-harvest if time permits
Condition criteria		
Uneven ripening	Visual	Pre-receival or at receival
Temperature	Quantitative	At the receival point
Spoilage[6]	Visual and sensory	At the receival point
Damaged berries[7]	Visual, sensory and formal assessment procedure	At the vineyard

[1] It is recommended that all assessments made for the purpose of price should be based on industry best practice, that an appropriate representative sampling method is followed and, where they exist, industry-endorsed standard procedures (IESPs) are used. This is a requirement of Code Signatories.

[2] Ideally the point of assessment should be as close as possible to the point of transfer of ownership of the grapes; however, the recommendations also take into consideration the likelihood of obtaining an accurate assessment. Where a potential problem has been identified, a preliminary assessment should be made prior to harvest.

[3] Contamination incorporates soil, oil, non-food grade material, fuel or any other lubricant, dilution with water, animal matter, unwanted additives or any other contaminant not acceptable by FSANZ. There are no methods in place that can accurately measure certain contaminants in bins or loads, so where contamination occurs as a result of an accident, notification from the vineyard backed up by assessment at the receival point is recommended.

[4] MOG incorporates all vine matter, or foreign objects such as trellis parts, stones, metal etc.

[5] A defined sensory procedure has been developed for assessing wines for positive and negative attributes such as smoke taint.

[6] Includes premature fermentation, oxidation and acetification

[7] Damaged berries: incorporates sunburn, shrivelled or dehydrated berries, split berries, berry breakdown, bird and insect damage.

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