WINEGRAPE GROWERS' COUNCIL OF AUSTRALIA INC.

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Winemakers' Federation of Australia
For the Industry by the Industry

Winegrape Assessment in the Vineyard and at the Winery





FINAL REPORT to

GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

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Winegrape Assessment in the Vineyard and at the Winery

[INCORPORATE WGCA, WFA & GWRDC LOGO]

WGCA-WFA Liaison Committee
August 2003

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ABSTRACT

Winegrape Assessment in the Vineyard and at the Winery 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 wine grapes, and is based on wide industry consultation. It should be seen as a tool to develop and improve relationships between buyers and sellers of wine grapes. The publication describes current best practice and therefore, by definition, will evolve over time.

PROJECT AIMS AND PEFORMANCE TARGETS

The aim of the project is to bring more clarity, transparency, commonality and certainty to the sometimes contentious process of wine grape specification, quality control and wine grape quality attribution in wine grape transactions.

The planned output from the project is the publication and distribution of the report *Winegrape Assessment in the Vineyard and at the Winery* to all grapegrowers and wineries in Australia.

The performance objective is widespread adoption and implementation of the best practice assessment procedures identified.

METHOD

The research was undertaken via a process of desktop research and interviews by the Principal Investigator, followed by discussion and endorsement by the WGCA-WFA Liaison Committee. As outlined in the original application, the research method addressed the following:

Purity and Condition

- To identify existing winery standards on purity and condition of wine grapes in the field and at the weighbridge
- Review existing practices and new literature to identify purity and condition attributes that could be measured in addition to those already nominated by wineries
- Nominate a set of maturity, purity and condition best practice assessment criteria based on existing practice and a review of research literature
- Separate all assessment criteria into those measured in the field, and those measured at the weighbridge

Point of Assessment and Notification

- Outline, in consultation with the WGCA-WFA Liaison Committee, minimum criteria notification of accept/reject/downgrade decisions
- Recommend appropriate sampling techniques (where appropriate) for assessment in the field and at the weighbridge

RESULTS/DISCUSSION

Refer attached report.

OUTCOME/CONCLUSION

Following publication and widespread distribution of the report, the project will have met all of the stated objectives.

The report will have widespread practical application, as it covers an identified R&D gap, and its release is being anticipated by a wide group of grapegrowers and winemakers, particularly those involved in its preparation. It is anticipated that the report will have widespread use by grapegrowers and winemakers in contract and other supply arrangement negotiations.

The project will bring more clarity, transparency, commonality and certainty to grape specification, quality control and wine grape quality attribution in wine grape transactions. It will improve economic returns by diminishing transaction costs and by enabling grapegrowers to more accurately meet winery specifications.

RECOMMENDATIONS

The WGCA-WFA Liaison Committee recommends widespread distribution of this report.

The Liaison Committee is also working on two related projects, namely:

- Grape purchasing agreements, and
- Protocols and supporting behaviours

It is anticipated that additional research on Protocols and Supporting Behaviours will be necessary.

COMMUNICATION

As outlined above, it is proposed that this report is widely distributed following publication.

ITELLECTUAL PROPERTY

There is no intellectual property worth protecting. The project should be disseminated widely.

1. Introduction

This publication 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 wine grapes, and is based on wide industry consultation. It should be seen as a tool to develop and improve relationships between buyers and sellers of wine grapes. The publication describes current best practice and therefore, by definition, will evolve over time.

The aims of this publication are to bring more clarity, transparency, commonality, and certainty to the sometimes contentious process of wine grape specification, Quality Control and wine grape quality attribution in wine grape transactions.

It is the first publication endorsed and released by the Liaison Committee of the Winegrape Growers' Council of Australia (WGCA) and the Winemakers' Federation of Australia (WFA). The Liaison Committee was formed in 2001 to address best practice arrangements regarding grape specifications and winery/grower relationships. The Liaison Committee has identified three areas that require attention.

Those three areas are:

1. Winegrape Assessment
2. Grape Purchasing Agreements
3. Protocols and Supporting Behaviours

Funded by the Grape and Wine Research and Development Corporation (GWRDC), this publication addresses the first of these three, and the Liaison Committee continues to work on the remaining areas.

The Liaison Committee recognises that its endorsement of best practice arrangements will be meaningless unless individual growers and wineries also adopt the recommended standards. In their dealings with each other, it is imperative that growers and wineries observe standards of ethical and fair behaviour. For this reason, the Liaison Committee regards the development of "behaviour" protocols as a priority, and is targeting the 2004 vintage as the deadline for their completion.

2. Grape Purchasing Agreements & Expectations

Grape purchasing agreements should provide security and reliability of supply and sale of wine grapes. At the same time supply arrangements should foster positive relationships between winemakers and growers to their mutual advantage.

Grape purchasing agreements should incorporate the Quality Control requirements and specifications of the purchaser. Winegrape maturity, purity and condition specifications and tolerances are commonly written into grape purchasing agreements so that both parties understand what is expected by each of the other and to have a commitment to ensure product tolerances are met.

A basic responsibility of growers of fresh produce, which includes wine grapes, is to abide by the code of Food Standards Australia New Zealand (FSANZ) and deliver grapes in a ripe, clean and cool condition. In addition, a grape purchasing agreement can specify tolerances concerning maturity, flavour, colour and purity. Purity and condition includes fungi, dust, matter other than grapes, or residue from agrochemicals.

Each winery will have its own tolerance levels with regard to specifications detailed in the agreement. It is important, then, for growers to be made fully aware of consequences of failing to meet tolerances. In some cases there may be a price penalty in proportion with the degree to which the grapes fail to meet tolerances. In other situations there may be downgrading to another category or even rejection.

Agreements should specify where risk and title transfers from grower to the winery.

Just as the winery is responsible for wine production, vineyard owners carry the responsibility and risks associated with grape production, harvest and delivery, including general effects of the season, frost damage and specific pests and diseases.

A summary of winery and grower expectations that relate to winegrape maturity, purity and condition specifications and tolerances follows.

Winery Expectations

- Growers will seek to understand the quality differentiation of the winery's products and the relationship of grape quality to those products.
- In general growers will strive to produce grapes of appropriate maturity, purity and condition as per the grape purchasing agreement.
- Growers will manage cropping levels to meet winery grape purchasing agreement tolerances.
- Growers will take reasonable steps to produce timely and accurate crop estimates.
- Grapes will be harvested at a targeted Baume set by the purchasing winery. Where the target Baume cannot be met, the minimum Baume must be met.

- The delay between the commencement of harvest and delivery to the winery should be minimised unless other instructions have been given by the winery.
- For machine harvesting, grapes will be harvested in the cooler part of the night to minimise spoilage, especially with white grapes.
- Growers will manage their vineyard with due care to the environment.
- Growers will manage their vineyard in accordance with quality assurance programs where required.
- Growers will comply with mandatory reporting requirements, such as reporting of agrochemical use in the form of a spray diary and submitting crop estimates when required.
- Growers are obliged to inform winery representatives of any information or change that could affect the expected grape quality or yield.
- Growers will comply with winery grape sampling requirements.

Grower Expectations

- Wineries will reward growers appropriately and sustainably for a reliable supply of consistent quality grapes that meet the winery specifications and the designated wine style expected within a region.
- Wineries will work with their growers to make the quality linkage between grapes and end products clear and understandable.
- To receive quality, timely support from winery grower services and viticultural staff to assist with seasonal vineyard management.
- Winegrape specifications and tolerances will be written, clear, measurable and consistently applied, especially when downgrading occurs and pricing is affected.
- Winegrape specifications and tolerances will not be changed by the winery prior to harvest without reasonable notice and not so soon before harvest that the grower cannot take appropriate action.
- Assessment staff will be technically trained and competent in vineyard and/or load assessment and all blocks will be assessed prior to harvest. If a problem arises the grower is to be consulted to discuss and agree on an outcome.
- Where vineyard assessment results in disease detection, a formal assessment of the block is to be made as early as possible and growers are to be given the option to be involved in the formal assessment.
- Notification for possible downgrading, penalties or rejection will be as early as possible to allow the grower time to seek alternative arrangements and/or to prevent further loss.

- Wineries will provide growers with constructive feedback (preferably prior to pruning) on the vineyard assessments and the resultant wine quality of their grapes along with any recommendations to assist with improvement.

3. Wine Grape Quality

Wines, and the grapes they are made from, are highly differentiated products. They are influenced by a myriad of factors including colour, variety, growing region, vineyard characteristics, vineyard management practices, seasonal vintage and winemaking influences. No other consumable product has such a degree of differentiation or identification with those factors. 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 encompassing such highly differentiated products, clarity, common understanding, and agreement on important characteristics is 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 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 “legs” of a triangle.

The Winegrape Quality Triangle



Maturity, Purity and Condition

Maturity, purity and condition refers to those criteria that can be readily quantified or ascribed a value. They are commonly specified in grape purchasing 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 further on in this publication.

Flavour & Character

Flavour and character requirements, such as tannin structure, are determined by wineries according to their product requirements and their winemaking styles. These are often difficult to quantify, both as a specification and as an assignment. Nonetheless these characteristics are vitally important and, in situations where grape pricing will be influenced by flavour & character, wineries need to take particular measures to ensure growers can have faith in the process of assessment and assignment of these parameters. This process of assessment and assignment may continue well after the receival point, as is the case of "end-use" bonuses used 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 protocols that are specified and adhered to with internal consistency
- Communication to growers of end-use outcomes

Protocols and Supporting Behaviours

"Quality" is not only defined by criteria that are quantifiable and measurable. There are process and procedural elements that can be defined, but not easily measured. These elements would include:

- Communication
- Notification
- Timeliness
- Assessment

For example, 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, and decision procedures for downgrading or rejecting grapes. Other areas might include protocols for disease detection and response; a protocol defining minimum training and experience for personnel undertaking vineyard or load assessments; or dispute resolution mechanisms and facilities in respect of pricing or rejection.

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 would go even further towards limiting uncertainty amongst growers in particular with respect to the outcomes of their grape purchasing arrangements with wineries. Whilst protocols exist, there are no industry endorsed protocols and supporting behaviours. There is therefore scope to develop these through the Liaison Committee.

So while there are many factors that constitute quality, only those readily assessable are dealt with in the remainder of this document.

4. Specification, Criteria, Tolerances & Assessment

The above 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. While that obviously includes characteristics such as the variety and vineyard block from which the grapes are sourced and when the grapes are anticipated at the winery, it also includes all the characteristics listed in Tables 1 & 2. For example, load temperature is one specification for a load of grapes.

N.B.: Krstic et.al. 2003, "Growing Quality Grapes to Winery Specification" refers to 'quality parameters' which term is synonymous with the term 'characteristic' above.

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.

Tolerance: means the permitted variation. 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

Although vineyard and load assessment procedures in one form or another have been in use in the wine industry for many years, there has not been industry endorsement of methods and procedures which can be used universally in grape purchasing agreements. Furthermore, improved knowledge and innovation is providing growers and winemakers with new alternatives to assist them in ensuring that grapes more closely match winery requirements.

This publication identifies the important specifications commonly used by wineries in assessing maturity, purity and condition of grapes in vineyards and at the receival point. Whilst it is a set of specifications used by wineries in grape purchasing agreements, it is not a set of standards, or a standardized approach towards defining assessment procedures.

Because most problems identified at the receival point can also be identified in the vineyard, emphasis is placed on assessment criteria in the vineyard, as well as at the receival point. An objective of growers and wineries should be to identify problems as early as possible, preferably in the vineyard, so that effective action can be taken to avoid grapes being downgraded or rejected. Grapes that are downgraded or rejected represent a missed opportunity for both the grower and the winemaker.

Ownership of the grapes passes from the grower to the winery at the receival point. It is at this point that final assessment to specification should take place.

5. Assessment in the Vineyard

Vineyard assessment is a form of quality assurance in the vineyard 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 prevents 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. Although the focus is on berry development, the vineyard and vine characteristics may also be assessed.

In addition, vineyard and berry assessment enables wineries to batch similar parcels of grapes, optimise wine quality and optimize winery efficiency.

Assessment in the vineyard should be carried out by winery staff within 1-2 weeks of harvest to:

a) Make an assessment as close to harvest as possible.
b) Give growers sufficient notice of harvest and notifications of concerns against specifications.

Formal processes of vineyard assessment involve measurements wherever possible and can help 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.

Other vineyard characteristics that do not yet have criteria are indicated as various canopy and berry characteristics. These characteristics are assessed utilising some form of a score card and it is to be expected that the assessment will remain subjective for some time, for example, leaf condition, bunch exposure, berry size, berry shrivel, sugar/acid balance, skin chewiness/thickness and tannin intensity. These are assessed to help with batching and determining a potential product in the vineyard.

The vineyard assessment specifications for the vineyard are summarised in table 1.

(See table 1)

6. Assessment at the Winery

The weighbridge or load assessment station is usually the winery's final and critical checkpoint against specification for grapes and is referred to as the receival point.

Load assessment verifies how well the grapes comply with specifications. The majority of the specifications assessed give results within 15 minutes to prevent delays in the production process. Growers need to feel confident that the methodology being applied during assessment of the loads is consistent and reliable, and that measurements are accurate.

Currently it is not easy to quantify an overall quality rating at the load assessment stage. For higher grades of wine, quality can sometimes only be finally determined after fermentation, particularly as post crushing processes can influence the expression of some quality factors in wine.

The specifications assessed at the receival are summarised in table 2.

(See table 2)

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

To the winemaker, maturity is determined not only by 'sugar ripeness' but also by 'flavour ripeness' of the berries. A range of components may be considered.

7.1.1 Total Soluble Solids, pH and Titratable Acidity

The sugar in grapes is often used as indicator of maturity and is sometimes used a basis for pricing of grapes. The majority of wineries measure sugar as total soluble solids (TSS) in degrees Brix and converted to Baume units.

One unit of Baume is equivalent to 1.8 degrees Brix. Baume gives a convenient indication of potential alcohol content of the wine to be produced from the grapes. Grapes of 13 Baume, if fermented completely, produce a wine of about 13% alcohol by volume.

Titratable Acidity (TA) and pH are commonly measured as well as with TSS to give an overview of grape maturity at harvest and are 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.

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.

Loss or Risk Potential

Not meeting the minimum tolerance can also affect the resultant wine quality as Baume is closely linked with other quality characteristics such as colour, flavour and alcohol. It is important for each parcel of grapes to reach a targeted maturity to maximise the quality potential at harvest. If the Baume is below the minimum tolerance set by the winery for a given variety, then penalties may occur resulting in a loss of income to the grower.

TA and pH are closely associated with Baume and can affect the resultant wine quality if out of balance. Acidity is important for flavour balance and a low pH leads to more stable colour and inhibits microbial spoilage. Winemakers take into consideration the TA and pH values and their balance with the Baume level in deciding when to harvest. Bonuses or penalties are uncommon for these two specifications.

Predisposing Elements (Causes for Loss)

Seasonal conditions greatly affect the maturity of grapes. Cooler regions tend to experience a slower increase in Baume and TA often remains high. In some years when temperatures remain cooler than average, the cool regions may struggle to achieve the targeted Baume. Warm to hot regions tend to show a faster increase in Baume and TA tends to drop away requiring adjustment in the winery.

It is commonly found that higher quality wines from a particular variety within a designated region are made from grapes that reach their targeted maturity earlier. Those that do not either are out of balance, younger vines, or are badly managed via inadequate management practices such as over cropping, over irrigating, inadequate pruning and poor canopy management.

High vineyard variability within a block of vines causes great concern as this can affect the maturity results if not taken into consideration when sampling the block.

Achieving a Baume below the minimum tolerance may result in poorer quality wines. Delivering grapes over and above the targeted Baume, on the other hand, can result in high alcohol wines that may not be allowable for export and which are not to style. Costs can be high to remove excess alcohol from a wine.

If TA is lower than required, then acid adjustment is required resulting in increased costs in the winemaking process.

Evaluation Process

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.

TSS is usually measured by refractometry, giving a value expressed in degrees Brix. The Brix value is then converted to Baume.

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

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 Baume 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 time and preferably in the cool of the morning.

There are many methods of vineyard sampling. The industry recommendation refers to the publication: **Krstic et.al. 2003** ***Growing Quality Grapes to Winery Specifications*** (CRCV project 1.1.2 Compendium of Winegrape Specifications and Measurement).

Assessment and sampling for maturity at the receival point

Sampling devices used 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. Training is therefore essential to ensure consistency of operation.

For loads delivered in grape bins it is recommended best practice to sample every bin twice and average the result. A minimum would be to sample at least 50% of the bins once. If there is discrepancy between the bins, then there is a need to sample further until variability is minimised.

For loads delivered in tipping trucks and/or trailers it is recommended best practice to sample each unit in three different sections and average the result.
Results are recorded and acted upon as per winery procedures.

Winery tolerances and timing of notification

- Best practice- Deliver grapes to a targeted Baume (set by the winemaker) for each variety as required for the designated wine style.
- Minimum tolerance- Applies in many grape purchasing agreements and should be observed to avoid penalties or possible rejection.
- Notification of results- If results fall below the minimum tolerance, growers must be notified immediately (within 2 hours is acceptable), to discuss the outcome. The appropriate winery staff should also be contacted immediately as processing may be delayed.

7.1.2 Colour (Red Grapes)

In recent seasons, growers have been encouraged to undertake practices that will improve the intensity of colour of winegrapes, especially the varieties Cabernet Sauvignon, Merlot, and Shiraz, and some wineries have given incentives through their grape pricing. 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 means of measurement of colour and the correlation of colour with other quality attributes continue to be investigated. Like other specifications, colour is therefore best not to be used in isolation but in combination with other factors that make up the overall quality of the wine.

Growers need to be aware that wineries make commercial decisions about their products and may have varying colour tolerances for different varieties.

Loss or Risk Potential

For those wineries that have set tolerances, if the colour result falls below the minimum tolerance for a given variety, then penalties may occur resulting in a loss of income to the grower or possible rejection.

Not meeting the minimum tolerance could also mean a loss for the winemaker who might have planned for a certain level of colour for a particular product.

Predisposing Elements (Causes for Loss)

Seasonal conditions and management practices influence colour development.

The colour compounds, known as anthocyanins, have an optimum temperature range of 17 to 26 degrees Celsius (***Growing Quality Grapes to Winery Specifications***, CRCV project 1.1.2 Compendium of Winegrape Specifications and Measurement) for their formation. This means that intense colour tends to be more difficult to achieve in extremely hot and extremely cold regions. It also means that a warm region normally will have better colour intensity in a cooler than average season.

Excessive exposure as well as too much shading may also affect the rate and uniformity of colour development. Vines described as being in good balance and which have not been invigorated, are best equipped to produce grapes with good colour.

Excessive irrigation, excess nitrogen, calcium deficiency and botrytis are some factors that have been associated with poor colour.

Evaluation Process

Colour measured in the vineyard will ideally be verified at the receival point, with sampling methods taking account of variability.

Measurement

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

Colour may be measured by the following techniques:
a) Near Infra-Red Spectroscopy (NIRS)
b) Spectrophotometry

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

NIRS is a correlative technique that enables rapid analytical results. Assuming an NIRS calibration is available, routine testing is simple and can be performed in less than a minute. Representative sampling is crucial for accuracy of results and it has become evident that NIRS calibrations need to be specific to a grape variety within its region, considering vintage variations. Currently a laboratory colour reference is essential for calibration backup. The NIRS equipment is available as a bench-top tool, but remains expensive.

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.

Assessment and sampling for colour in the vineyard

Refer to the publication ***Growing Quality Grapes to Winery Specifications*** (CRCV project 1.1.2 Compendium of Winegrape Specifications and Measurement).
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 maturity.

Assessment and sampling for colour at the receival point

Refer to the publication ***Growing Quality Grapes to Winery Specifications*** (CRCV project 1.1.2 Compendium of Winegrape Specifications and Measurement).

Obtaining a representative sample of whole berries from loads for a colour test can be difficult. Mechanical core samplers are used by some wineries to take a core of grapes and juice from a load and whole berries are sorted from that core sample.

Winery tolerances and timing of notification

- Best practice- Deliver grapes to a targeted colour level for each variety as required for the designated wine style.
- Minimum tolerance- Grapes should be delivered at the minimum tolerance where a winery has indicated, and especially where this may affect pricing.
- Notification of results- If results fall below the minimum tolerance, growers need to be notified as soon as results become available, to discuss the outcome.

7.1.3 Cropping level

The primary needs of wineries are supplies of grapes that have the potential to produce their intended wine styles.

Within the same region there can be a range of yields from different growers that will all meet specifications. There are, however, what appear to be the optimum yield ranges for achieving an individual winery's requirements. For this reason, many grape purchasing agreements have upper tolerances to yields.

Often the relationship between winemakers and growers will enable a negotiation on optimal cropping levels and expected yields.

Loss or Risk Potential

If growers exceed yield tolerance, there is a risk the surplus may not be accepted by the winery. If quality expectations are achieved however, negotiation may allow the grapes to be accepted.

Another potential risk of loss is that of regional integrity where a region is marketed and known as a premium producer of wines.

Vines that are continually over-cropped tend to use more resources such as water and nutrients, which may be costly and not sustainable.

Predisposing elements (causes for loss)

An over-cropped vine can be defined as one that: has a large crop and insufficient healthy, active leaves; cannot produce enough sugar to maintain all bunches and adequately ripen them; fails to produce grapes with the flavour profiles required; and has reduced reserves for the following spring.

Management practices such as over-irrigating and soil management techniques that promote high cropping and high vigour can greatly influence the vine balance and yield. In addition, pruning to a high bud number that does not match vine capacity may result in over-cropping. Excessive leaf loss due to environmental stress, pests or diseases is another possible negative effect on the balance of the vine.

Over supply of nutrients, in particular nitrogen, will affect the cropping level and possibly decrease quality.

Poor combinations of variety and rootstock can result in a vigorous, dense canopy and overcropped vines. Placing a poor combination in an environment that does not suit can worsen the outcome.

Evaluation process

It has become increasingly important to estimate yield accurately in the vineyard prior to harvest to assist winery planning.

Accurate estimation will enable the grower to make informed decisions about their yield management.

Measurement

Visual assessments, using scorecards at critical phenological stages, including 10cm shoot growth, post set and veraison, can rate vine balance and give a general indication of cropping level. At the same time an inspection can be made for any vine health problems.
For more accurate yield estimation, a **Yield Estimation Model** should be applied. Industry recommendation refers to: ***Winegrape Crop Forecasting Module*** (Dunn, Martin and Dunston, DPI Victoria).

The future holds much promise for more accurate yield estimation using precision viticulture techniques such as yield mapping with a GPS system at harvest. Optical remote sensing is another tool undergoing research for assisting in yield estimation.

Assessment of cropping level in the vineyard

Accurate yield estimations can only be obtained when vineyard variation is taken into account and the sampling is representative of this variation.

A **Yield Estimation Model** gives an appropriate estimation of final yield. The model is usually applied at six weeks after budburst, at veraison and again just prior to harvest.

Winery tolerances and timing of notification

- Best practice- Deliver grapes to a targeted wine style for each variety as required, by maintaining good vine balance.
- Maximum tolerance- Deliver grapes within the tolerance where a winery has written the specification and especially where it may affect pricing.
- Notification of results- If yield falls outside tolerance, growers need to be notified as soon as results become available to discuss the outcome. In the same instance, growers must notify wineries as soon as they become aware of any change in their estimated yield.

7.2 PURITY

Fungal diseases, agrochemical residue and any Matter Other than Grapes (MOG) are detrimental in a load of winegrapes and while 100% purity can be difficult to achieve it must 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).

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 also can 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 arriving 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 where moisture has affected grapes. Downy mildew is not an issue every year in most regions throughout Australia. Although it can seriously affect grapes, loss of leaf function near harvest can have a major effect on quality by affecting the ripening process.

Loss or Risk Potential

Diseases can be detrimental to wine quality causing contamination and taints.

Botrytis (*Botrytis cinerea*) - can cause severe problems in winemaking making it difficult to process the juice and wine. The presence of botrytis in wines can result in a loss of colour, flavour, off taints and reduced shelf life. In the vineyard crop loss can occur and secondary infections are common from yeast, other moulds and rots, bacteria and vinegar flies.

Powdery Mildew (*Uncinula necator*) - can cause off taints in wine that are detrimental to wine quality resulting in reduced shelf life. Consequently processing time and costs are increased and taints can sometimes be impossible to remove. Losses in the vineyard can occur due to restrictions of yield, maturity and uneven ripening. Splitting may occur resulting in secondary infections from other moulds and rots.

Downy Mildew (*Plasmopara viticola)* - can cause severe crop loss and, more often, leaf loss resulting in sunburn and uneven ripening or failure to ripen the grapes.

Moulds and other rots can cause severe faults in wine that are not only detrimental to wine quality but may be unacceptable for export due to health concerns, for example, grapes affected with the toxin ochratoxin A (OA). The predominant species producing OA are *Aspergillus ochraceus* resulting from *Aspergillus carbonarius*.

There are a number of other bunch rots and moulds that can have undesirable effects on wine quality. For example, *Rhizopus, Aspergillus* and *Penicillium* in combination can result in ***sour rot***. Sour rot is commonly found in Europe, USA and in some parts of Australia and is caused by a variety of micro-organisms, including yeast and acetic acid bacteria.

Predisposing Elements (Causes for Loss)

Unfavourable conditions during the growing season and near harvest present the primary cause for the onset of disease, resulting in crop loss or badly affected grapes if left uncontrolled.

Poor spray applications and poor timing of sprays can lead to an uncontrollable disease situation if weather favours disease development.

Some management practices in the vineyard can increase the risk of disease development. These include excessive use of nitrogenous fertilisers resulting in increased vigour and therefore excessive shading without adequate air circulation to dry out the canopy early in the day.

Not managing pest outbreaks can lead to secondary problems with disease such as light brown apple moth increasing the risk for botrytis, and mealy bug damage resulting in other moulds and rots.

Over use and poor timing of irrigation applications can produce thin skins and tight compact bunches increasing the risk for botrytis and other infections if splitting occurs.

Some varieties are more susceptible to disease than others, for example, bunch rot in Grenache and powdery mildew in Chardonnay.

Evaluation Process

While there are techniques available for quantifying disease incidence and severity in grapes, quantitative links to wine outcomes are not generally agreed.

Measurement

Currently, the degree of disease infection is determined by visual examination during vineyard assessment and during load assessment at the winery.

Quantification in the vineyard can be made using the **Emmett & Wicks** Disease Assessment Key. 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 winery. Assessors need to be trained in technical assessment of pests and diseases that can affect wine quality. It is important that the results obtained are statistically valid and the detail of recording needs to be accurate and consistent.

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, some wineries place more people in the vineyard to ensure problems are recognised and assessed early.

When a load with disease-affected grapes arrives at the receival point, currently, assessment is visual, combined with sensory detection of odours and off taints in the grapes.

Results are recorded and acted upon according to individual winery procedures.

Winery tolerances and timing of notification

- Best practice- Deliver grapes with 0% disease.
- Maximum tolerance- Deliver grapes at the maximum tolerance where a winery has indicated, and especially where it may affect pricing. Some general maximum tolerances used by wineries are:

    a) Powdery mildew- less than or equal to 3%

    b) Botrytis- less than or equal to 3%

    Note that a measure at the receival point would be based on a visual or organoleptic (taste and smell) assessment. Measures of incidence and severity using the Emmett & Wicks Disease Assessment Key could only be made in the vineyard.

- Notification of results- Where grapes are above the maximum tolerance, growers and wineries need to be notified as soon as detected in the vineyard to discuss and agree on the outcome. Botrytis and other rots and moulds can develop rapidly, therefore, notification of rejection or penalties may only be possible immediately prior to harvest.

Notification for powdery mildew should occur as soon as the disease is detected from routine vineyard assessments.

- If disease is detected at the receival point, the grower needs to be notified immediately (within 2 hours is acceptable), to discuss and agree on the outcome. The appropriate winery staff should also be contacted immediately as processing may be delayed.

7.2.2 Agrochemical Residue

Use of spray diaries has been common practice for some years now to help protect Australian wines from the risk of residue exceeding maximum residue limits (MRLs) for the export and the domestic market.

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 as recommended by their winery or The Australian Wine Research Institute (AWRI), and to use only those products listed that are registered for use in grapevines by the Australian Pesticides and Veterinary Medicines Authority.

Loss or Risk Potential

If growers do not adhere to the withholding periods recommended by their winery or The Australian Wine Research Institute they run the risk of delivering grapes with residue that exceed MRLs. Such grapes can result in wines with residue exceeding MRLs in one or more markets. Residue contamination of Australian wine represents a major threat to the Australian Wine Industry.

Predisposing Elements (Causes for Loss)

Common causes of excessive residue are:

- Poor spray calibrations resulting in a higher than recommended dose rate.
- Spraying vineyards with unregistered agrochemicals for grapevines.
- Spraying within the recommended withholding period.

Evaluation Process

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

Measurement

Samples of grapes, juice or wine are sent to the AWRI or other laboratories for testing. A delay of 10 days or more is to be expected for results.

Winery tolerances and timing of notification

- Best practice- Deliver grapes with **no** agrochemical residue.
- Minimum tolerance- Deliver grapes within the acceptable MRL.
- Notification of results- Results are often not known until post fermentation and sometimes not until after the final wine blend. The winery should contact the grower to inform them of any results that do not meet tolerances if not for imposing a penalty, then for feedback so that vineyard practices can be improved.

7.2.3 Matter other than grapes (MOG)

With expanded use of machine harvesting since the late 1970s, MOG has become an issue 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 could be present in hand-picked loads.

Machine harvesting technology has been changing 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 the purity of the harvest.

Growers share the responsibility of reducing MOG in the vineyard. They should clean up the vines after machine pruning to remove potential MOG like brittle dead arms caused by Eutypa, ensure vine rows are clear of foreign objects, and control snails and other potential pests.

Loss or Risk Potential

Losses can occur through processing problems caused by MOG, downtime for repairs to equipment, and the cost of equipment replacement. In some situations wineries have written into their grape purchasing agreements that growers may be liable for the cost of repairs if fault is established.

MOG can be detrimental to grape quality because of skin and berry damage, especially for whites. Wine quality can be affected through too much leaf in loads causing unwanted herbaceous character. Excessive leaves in the load may increase the risk of agrochemical residue because of vineyard sprays.

With excessive MOG, wineries are paying for unwanted waste, all of which must be removed at the crushing site.

Predisposing Elements (Causes for Loss)

Common causes of problems are:

- Poorly set up machine harvester units.
- Absence of or poorly maintained magnets on harvesters.
- Harvesting of vines late in the season when they may be stressed and grapes are difficult to remove.
- Frost damage resulting in dead shoots that easily break off.
- Stressed vines in general, where leaves fall easily and vine wood is often more brittle than normal.
- Harvesting in wet conditions where water weighs down leaves and sticks and the harvester fans are unable to remove them.
- Poor pruning techniques in the vineyard and especially where hand clean-up following machine pruning has been inadequate.
- Minimally pruned vines can increase the potential for MOG, as there is a considerable amount of dry and dead wood present where no pruning has occurred.
- Old vines that contain considerable amounts of dead wood (possibly due to Eutypa or other trunk diseases).
- Poorly re-trellised vines that have not had the old wood removed.
- Objects left in the vineyard to mark posts and sprinkler heads not removed prior to harvest.
- Failure to inspect bins and removal of foreign objects prior to use.

Evaluation Process

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.
At the receival point, the current method for evaluating MOG is by visual assessment utilising the methods outlined in the ***Australian Winegrape Load Assessment Manua*l** and **posters**.

Assessment of MOG at the receival point

A rating system of 0-5 utilising a series of photographs, has been established and winery tolerance may vary in relation to pricing penalties, if any.

The visual assessment requires a thorough inspection of every bin, truck or trailer presented for assessment at the winery. Establish a rating with reference to the photographs. Core samplers may assist in detecting MOG that is not visible on the top of the load.

Ratings are categorised below. Refer to the ***Australian Winegrape Load Assessment Manual*** and **posters**. *Note that the percentage of MOG given is only a guide.*

MOG 0
- These are loads with little or no MOG (less than 1 %).
- They will not cause quality or processing loss.
- All growers should aspire to this benchmark.

MOG 1
- Leaves, petioles and small pieces of canes or sticks may be present in low levels (1-2% total MOG).
- MOG at this level does not cause quality and processing loss.
- This level of MOG is acceptable.

MOG 2
- Considerable amounts of leaves, petioles, canes and small wood (still less than 3% total MOG).
- MOG at this level has the potential for quality and processing loss.
- Loads border on being not acceptable and penalties may start to apply.

MOG 3
- Excessive amounts of leaves, petioles, canes and small to medium sized wood (at or greater than 3% total MOG).
- MOG present at this level will cause quality and processing loss.
- This level of MOG is not acceptable.

MOG 4
- Large vine debris such as trunks, arms, excessive canes and potentially damaging foreign objects.
- MOG at this level will cause major quality and processing loss.
- This level of MOG is not acceptable.

MOG 5
- Damaging foreign objects and large objects that cannot be processed, including excessive amounts of large vine debris.
- MOG at this level is not acceptable and if in excess, loads may be rejected.

Winery tolerances and timing of notification

- Best practice- Deliver grapes at MOG 0 rating.
- Maximum tolerance- Deliver grapes less than MOG 2 rating.
- Notification of results- If results fall above the maximum tolerance, growers need to be notified immediately (within two hours is acceptable), to discuss and agree on the outcome. The appropriate winery staff should also be contacted immediately as processing may be delayed.

7.2.4 Contamination

Contamination of loads of grapes can come from many sources. For this section it mostly refers to loads that may be contaminated with 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 be easily detected via distinct odours such as fuels and oils. 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 is prevented.

In the event of an accident resulting in contamination of grapes, it is recommended that growers establish a value of the losses with the winery for the purpose of making an insurance claim.

Loss or Risk Potential

Contaminants cause taints and off characters in wine. Those posing greatest risks are fuels and oils used in harvesting and delivery equipment.

Excessive numbers of insects can cause taints and off characters in wine.

Contaminated winery equipment results in wine losses and increased cleaning costs.

Unwanted additives to grapes such as gibberellic acid in sultanas that were originally destined for table grape use can slow processing time, resulting in lower juice extraction.

Incorrect additions of potassium metabisulphite may affect wine colour in reds and the wider export potential for that wine.

Soil contaminants risk damage to winery equipment such as pumps and crusher parts and can contaminate red wine ferments. Soil carted on the bottoms of bins may be a potential source of phylloxera spread or unwanted diseases and pests.

Addition of water dilutes flavour, colour and sugar in the load.

Predisposing Elements (Causes for Loss)

Machine harvesters and loading equipment may contaminate loads with fuels and oils when hydraulic hoses come loose or fuel spillage occurs.

Delivery vehicles such as tractors, trucks and trailers can be sources of fuel contamination if leaks occur.

Uncovered loads that have to travel considerable distances or traverse unsealed roads increases the risk of sand and dirt contaminants.

Harvesting and loading bins in wet conditions on unsuitable surfaces can contaminate bins and loads, because of soil collecting on the bottom of bins.

Leaving grapes to stand in rainy conditions can result in dilution with water if not covered.

Undervine straw mulching may increase the risk of unwanted pests in loads.

Evaluation Process

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 not known and 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.

Assessment of contaminants at the receival point

A thorough inspection of all trucks, trailers and bins is undertaken to detect possible contaminants. Outsides of bins are checked for excessive dirt.
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 Baume.

Winery tolerances and timing of notification

- Best practice- Deliver grapes with no contaminants as nil tolerance can be expected for serious contaminants like fuels and oils.
- Maximum tolerance- Fuels, oils and other serious contaminants, nil tolerance. Other contaminants within winery tolerances.
- Notification of results- If winery staff are not notified of possible load contamination and a contaminant is detected at the load assessment station, growers need to be notified immediately (within two hours is acceptable), to discuss and agree on the outcome. The appropriate winery staff should also be contacted immediately as processing may be delayed.

7.2.5 Varietal integrity

The presence of varieties other than the one 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.

Loss or Risk Potential

It is detrimental to wine quality when the desired flavours and aromas are altered through the mixing of varieties.

Unwanted colour effects can occur in whites where red grape berries are present.

Label integrity is affected if a greater amount than the allowable percentage has been mixed, thus damaging the winery's reputation in the market.

The presence of malvidin diglucoside components, being an indicator of hybrid grapes (non-vinifera), is not acceptable in wine destined for the European markets.

Predisposing Elements (Causes for Loss)

Inter-planting of varieties in vineyards combined with machine harvesting that cannot be selective raises the risk of varietal integrity being compromised. Non-selective hand harvesting can also result in mixed varieties if not carefully monitored.

Rootstock shoots that have not been removed prior to harvest are a source of risk. Some can produce small coloured berries (e.g. Ramsey rootstock) and only a small amount will contaminate a load.

Harvesting and delivering the incorrect variety.

Poorly defined and identified harvest unit boundaries.

Evaluation Process

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

Assessment of varietal integrity at the receival point

Check delivery records and paper work to make sure the correct variety has been delivered.

Conduct a thorough visual inspection of all trucks, trailers and bins to look for possible varietal mixing.

Results are recorded and acted upon as per winery procedures.

Winery tolerances and timing of notification

- Best practice- Deliver grapes with 100% of the variety agreed.
- Minimum tolerance- Deliver grapes with 100% of the variety agreed.
- Notification of results- If results fall below the minimum tolerance, growers need to be notified immediately (within 2 hours is acceptable), to discuss and agree on the outcome. The appropriate winery staff should also be contacted immediately as processing may be delayed.

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.

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.

Loss or Risk Potential

Unripe berries can lead to wines that are out of balance, with undesirable flavours, aromas and poor colour.

Predisposing Elements (Causes for Loss)

Harvesting too early before the bunches have reached their full maturity.

Producing excessive crop that is too high for the functioning leaf area.

Presence of a second crop because of frost damage or trimming shoots too early.

Certain vine training methods that result in vertically separated fruiting zones can predispose to uneven ripening.

Unfavourable weather conditions during flowering and remaining cool for prolonged periods.

High variability within a harvest unit.

Evaluation Process

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.

Winery tolerances and timing of notification

- Best practice- Deliver grapes that have fully ripened to meet the target Baume.
- Minimum tolerance- Deliver grapes with minimal immature berries and no second crop so as to meet the minimum Baume tolerance as per winery agreement.
- Notification of results- If results fall below the minimum tolerance, growers need to be notified immediately (within 2 hours is acceptable), to discuss and agree on the outcome. The appropriate winery staff should also be contacted immediately as processing may be delayed.

7.3.2 Temperature

In Australia, air temperatures can be high, for example greater than 35º C, during ripening and harvest.

Deterioration of berries is possible if they are exposed to high temperatures for long periods. Managing vintage in hot conditions is therefore about good logistical management. 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 varieties, then when conditions are cooler (below 25ºC) reds can be harvested during the day.

Loss or Risk Potential

Processing hot grapes can require chilling, causing delays and increasing winery costs. Cold conditions can also increase processing costs due to having to heat up cold grapes to an adequate temperature for fermentation to commence.

Grapes harvested in hot conditions may be spoiled by oxidation, premature fermentation and may be excessively phenolic. Whites and sparkling wine styles require that grapes are harvested and maintained at lower temperatures.

Machine harvesting grapes in hot conditions can be difficult with high numbers of berries being left on bunches, resulting in a possible reduced tonnage for the grower. Attempting to remove the berries with the machine could result in a higher MOG rating, as the vines have to be shaken more vigorously to remove the berries.

Predisposing Elements (Causes for Loss)

Extended periods of hot conditions during harvest results in hot grapes.

Harvesting grapes, especially whites, during the day in hot conditions.

Carting hot grapes long distances and delaying delivery and the crushing process.

Breakdowns that cause considerable delays in harvesting and processing, particularly if during the day.

Evaluation Process

Measurement

Temperature is measured at the receival point using a calibrated thermometer suitable for use in loads.

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.

Results are recorded and acted upon as per winery procedures.

Winery tolerances and timing of notification

- Best practice- Deliver white grapes with temperatures of less than 20ºC and red grapes between 18 and 25ºC.

- Maximum tolerance- Deliver grapes that have been harvested in daily maximum temperatures of less than 30º C to prevent possible spoilage.

- Notification of results- If temperature exceeds tolerance, growers need to be notified immediately (within two hours is acceptable), to discuss and agree on the outcome. The appropriate winery staff should also be contacted immediately as processing may be delayed.

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 and can result in rejection.

Fermentation is detected in loads by checking for elevated temperatures in a load 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.

Loss or Risk Potential

Unwanted taints caused by spoilage are difficult to remove without affecting the wine style. Acetification in particular can greatly affect wine quality.

Wild yeast strains from premature fermentation can contaminate wineries.

Oxidation increases the loss of the natural varietal flavour and colour, altering the aroma of the wine. Although some wine styles require some oxidative handling this is preferred under controlled conditions.

Spoilage can increase the cost of processing the grapes and can lower the quality and value of the resultant wine. The extent of spoilage depends on the time spent in the delivery vessel, the temperature of the load at harvest and the condition of the berries prior to harvest.

Whites should be delivered within two hours of harvesting and preferably harvested/delivered in bins and not in bulk so skin contact is minimised. Reds are less at risk of spoilage and can handle longer delays of up to five or six hours.

Predisposing Elements (Causes for Loss)

Where there are time delays, spoilage risks can increase. Causes are poor logistical management and breakdowns.

Harvesting during excessive temperatures can increase the risk of spoilage.

Berry splitting caused by rain, fungal infection or some other means represents a loss of condition in itself, but also opens up the possibility of further spoilage through secondary infections and damage by birds and insects.

Machine harvesting resulting in split berries, opens the way for spoilage.

Grapes without the protection of potassium metabisulphite during harvest may result in spoilage.

Evaluation Process

There are no methods at the receival point for accurately measuring spoilage. Visual and sensory assessments are able to detect major spoilage problems, however, laboratory tests on the juice once in tank can confirm assessment if required.

Assessment of spoilage at the receival point

Visual and sensory inspection of all trucks, trailers and bins includes looking for signs of spoilage, especially if the load temperature is elevated. Results are recorded and acted upon as per winery procedures.

Winery tolerances and timing of notification

- Best practice- Nil tolerance. Deliver grapes with no spoilage as penalties can be severe and may result in rejection.
- Minimum tolerance- Nil tolerance for acetification and fermentation. Winery tolerances vary for oxidation.
- Notification of results- If spoilage results in a pricing penalty or rejection, growers need to be notified immediately (within 2 hours is acceptable), to discuss and agree on the outcome. The appropriate winery staff should also be contacted immediately as processing may be delayed.

7.3.4 Damaged Berries

Many things can damage berries during ripening. This section refers to those berries damaged due to sunburn, excessive shrivelling, splitting, general berry breakdown, bird and insect damage.

Damaged berries are assessed in the vineyard during routine inspections. The outcomes of berry damage are best addressed in the vineyard. Where berry damage is severe, the price for the grapes may be reduced or the grapes rejected.

Loss or Risk Potential

Secondary infections and reduced grape quality cause losses to growers while, for the winemaker, odours and off flavours in wine can be generated by severely damaged berries.

Sunburn results in undesirable phenolic characters and general loss of flavour if severe. Processing can be difficult where berries are excessively shrivelled or dehydrated, increasing winery costs and loss of income to the grower through reduced weight.

Predisposing Elements (Causes for Loss)

Unfavourable seasonal conditions, such as rain causing splitting and berry breakdown, or extended hot periods causing berry drying, sunburn and shrivel.

Premature stress resulting in considerable leaf loss and over exposure of bunches can result in sunburn shrivel or dehydration of berries.

Inadequate pest control of insects and snails may lead to damage and contamination of grapes and cause secondary infections.

Birds cause damage by puncturing the skin as berries are ripening. Isolated vineyards with no other food sources are at higher risk of bird damage.

Poorly set up and operated machine harvester units can split berries.

Inadequate or inappropriate canopy management can result in over exposure causing dehydration, sunburn or shrivel of berries.

Evaluation Process

Visual and sensory assessments are the accepted methods. Most berry damage occurs in the vineyard and should be prevented from arriving at the receival point unless otherwise agreed.

Assessment of berry damage in the vineyard

During routine vineyard inspections from veraison onwards, bunches are checked for signs of berry damage. 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.

Winery tolerances and timing of notification

- Best practice- Deliver grapes that are entire and unblemished (nil berry damage).
- Maximum tolerance- Deliver grapes with minimal berry damage that will not result in a pricing penalty.
- Notification of results- If results exceed the maximum tolerance, growers need to be notified immediately (within 2 hours is acceptable), to discuss and agree on the outcome. The appropriate winery staff should also be contacted immediately as processing may be delayed.

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Interviews and acknowledgments

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WGCA-WFA Liaison Committee

Table 1: Summary of vineyard assessment specifications.

Specification	Criterion/Current method of measurement	Timing of assessment prior to harvest	Recommended Grower/Winery Tolerances	
			Best practice	**Downgrade/Rejection**
Maturity				
Baume	Quantitative - most commonly refractometry, densiometry and hydrometry Based on representative sample	Commences post veraison, usually on a weekly basis.	Achieve target Baume for a designated winestyle	Outside Baume tolerance range
pH	Quantitative - pH meter, units	As for Baume	Achieve target pH where defined	Where defined in winery grape purchasing agreements
Titratable Acidity (TA)	Quantitative - g/L as Tartaric Acid	As for Baume	Achieve target TA where defined	Where defined in winery grape purchasing agreements
Colour (red grapes)	Visual and Quantitative Based on representative sample	From veraison onwards Primarily used to assist grape intake and batching.	Achieve target colour level for a designated winestyle	Below minimum colour tolerance, where winery has indicated.
Cropping level (and yield Estimation)	Formal crop assessment and estimation	Throughout season, depending on method: 10cm shoot growth, post fruit set and veraison	Achieve within target range	Exceeds winery maximum cropping level.
Purity				
Powdery Mildew Downy Mildew Botrytis Moulds and rots -other	Visual, quantitative assessment procedure.	Throughout the growing season	No disease	Exceeds winery tolerance
Agrochemical residue	Spray diary check. Random or targeted sampling of vineyards. Follow-up quantitative analysis by AWRI or other laboratory	Pre-receival	Compliance with winery spray diary and withholding periods	Non compliance with spray diary or exceeds export Maximum Residue Limit (MRL)
Varietal integrity	Visual and DNA	Pre-receival	100% expected variety	Nil tolerance
Condition criteria				
Uneven ripening	Visual	Veraison/post veraison	Even ripening	Below winery minimum Baume tolerance or exceeds winery tolerance for immature bunches
Damaged berries ♣	Visual, sensory and formal assessment procedure	Post veraison	No damaged berries	Exceeds winery tolerance
Other vineyard specifications that are not yet widely assessed (used to determine potential winestyle and assist with batching parcels of fruit)				
Various canopy & fruit characteristics ♦	Visual and sensory - recording details on a formal assessment sheet to score vineyard.	Post veraison onwards with final assessment near target baume.	**Best practice**: Provide growers with feedback on assessment prior to pruning to assist the grower with optimising quality for the following season.	

♦ **Various canopy & fruit characteristics** – characteristics assessed varies between wineries and can incorporate: shoot length, leaf condition, fruit exposure, berry size, berry shrivel, flavour intensity, sugar/acid balance, skin chewiness/thickness, tannin intensity, colour in red berries and phenolics in white berries.

♣ **Damaged berries**: incorporates sunburn, shrivelled or dehydrated berries, split berries, berry breakdown, bird & insect damage.

Table 2: Summary of load assessment specifications.

Specification assessed	Criterion/Current method of measurement	Timing of assessment	Recommended Grower/Winery Tolerances	
			Best practice	**Downgrade/Rejection**
Maturity				
Baume	Quantitative - refractometry densiometry and hydrometry	At receival	Achieve target baume for a designated winestyle	Outside Baume tolerance range
pH	Quantitative - pH meter, units	At receival	Achieve target pH where defined	Where defined in winery grape purchasing agreements
Titratable Acidity (TA)	Quantitative - g/L	At receival	Achieve target TA where defined	Where defined in winery grape purchasing agreements
Colour (red grapes)	Quantitative	Sample at receival	Achieve target colour level for a designated winestyle	Below minimum colour tolerance, where winery has indicated.
Purity				
Powdery Mildew Downy Mildew Botrytis Moulds and rots -other	Visual and sensory	At receival	No disease	Exceeds winery specification
Agrochemical Residue	Confirmation of spray diary	Prior to and at receival	Compliance with winery spray diary and nil residue	Non compliance or no spray diary
MOG ?	Refer MOG standards as per *Australian Winegrape Load Assessment Manual* and *posters*	At receival	MOG 0 rating (< 1% MOG)	Exceeds winery tolerance
Contamination ♥	Visual and sensory (smell)	At receival	No contaminant	Nil tolerance
Varietal integrity	Visual and DNA	At receival (DNA measure delayed)	100% expected variety	Nil tolerance
Condition				
Uneven ripening	Visual	At receival	Even ripening	Below Winery minimum Baume tolerance or exceeds winery tolerance for immature bunches
Temperature	Quantitative - degrees Celsius	At receival	Meets winery seasonal and winestyle specifications	Exceeds winery tolerance
Spoilage ?	Visual and sensory (smell)	At receival	No spoilage	Nil tolerance
Damaged berries ♣	Visual and sensory	At receival	No damaged berries	Exceeds winery tolerance
Other				
Grape purchasing agreement tonnes	Quantitative - weighing	At receival with prior notice of final delivery	Achieve target tonnage	Tonnage exceeds grape purchasing agreement tolerance

? **MOG** - "matter other than grapes" and incorporates: all vine matter, or foreign objects such as trellis parts, stones, metal etc.

♥ **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.

? **Spoilage** - incorporates fermentation, oxidation and acetification.

♣ **Damaged berries** - incorporates sunburn, shrivelled or dehydrated berries, split berries, berry breakdown, bird & insect damage.