VitiNotes

Cooperative Research Centre for Viticulture

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Grapevine nutrition 3: Petiole analysis

Current titles in this Grapevine nutrition VitiNote series include:

1. Nitrogen fertilisation
2. Phosphorus fertilisation
3. Petiole analysis
4. Potassium fertilisation
5. Soil acidification
6. Liming
7. Trace elements

Petiole analysis is a useful tool to assess the nutrient content of vines at a selected time in the growth of the plant. It can be used to determine appropriate fertiliser applications in the general maintenance of a vineyard (nutrient monitoring) or to assist in determining the cause of specific problems (diagnostic testing).

Nutrient monitoring can be used to assess the adequacy of current fertiliser practice. Nutrient concentrations in a vine vary from year to year as the uptake of nutrients is affected by the seasonal conditions. Monitoring the nutrient concentrations of vineyards over a number of years enables growers to observe trends in the nutrient concentrations and make appropriate adjustments to their fertiliser programs to ensure nutrient requirements are met.

Diagnostic testing can be undertaken to assist in the diagnosis of lesser performing vines or to confirm a diagnosis made on the basis of visible deficiency or toxicity symptoms in vines. Diagnosis is made by comparing analysis results with published standards, or by comparing analyses from 'good' and 'bad' vines.

Standards used to interpret the petiole analysis data have been developed from research in California and trials in Australia using petiole samples taken at full flowering (80% cap-fall). As different cultivars and rootstocks have different abilities at taking up nutrients, these standards should be used as a guide only. Also, these standards are for optimal growth, which may not be appropriate for optimum wine quality. Hence, it is advisable for growers to build up a database of analyses for the different blocks in a vineyard so that they can fine-tune individual block-by-block requirements.

COLLECTING SAMPLES

Since the nutrient status of all parts of a vine varies enormously over the growing season, as well as between different parts of the vine, samples must be taken from the same plant part at the same time to match that used to generate the standards against which the analytical data will be compared. In Australia, the best standards have been developed for petiole samples collected at full flowering (80% cap-fall).

SAMPLING METHOD

Site selection

- Select an area of vines with the same variety, rootstock and of similar age, vigour and health on a uniform soil area. To assist in diagnosis of a problem, take two samples — one from the problem area and one from a healthy area.

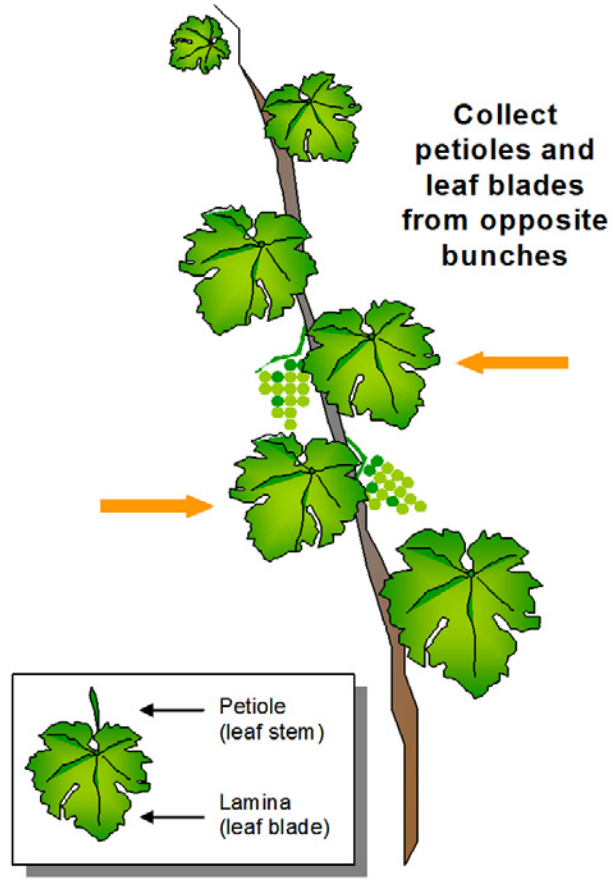
- Avoid edge rows and the end two panels of a row.
- Take samples from across the selected area in an X or W pattern to obtain a representative sample.

Time of sampling

- Sample at flowering when 50– 80% of the flower caps have fallen off.
- Preferably sample before 10am before any moisture stress and nutrient translocation may occur.

Petiole selection

- Use clean hands.
- Pick the whole leaf opposite a basal bunch, as per the diagram (right).
- Break off the leaf blade and discard it. Place the remaining petiole in a paper bag. Samples will deteriorate and/or change composition in a plastic bag. Minimal handling will avoid potential contamination of the sample.
- Collect at least 100 petioles from across the selected area. If the petioles are small, additional petioles should be collected in order to provide sufficient material for a representative sample.
- Fold the end of the bag over firmly, twice.
- Ensure your name, collection site and date are detailed on the bag.
- Keep samples cool.
- Complete all required laboratory forms. One copy of the forms should be sent with the samples to the laboratory whilst another copy should be retained by the grower.
- Ensure the packaging and transfer of the sample complies with quarantine regulations.
- Keep samples in a domestic fridge until delivery or despatch to the adviser or laboratory. Avoid mailing samples on a Thursday or Friday to reduce the delay in delivery of the samples to the laboratory.



Laboratory selection

Laboratories can use either dry tissue or sap analysis to determine nutrient levels of grapevine petiole samples. The standards presented in this VitiNote are for dry tissue analysis only.

Sap testing is widely used in a range of horticultural crops, e.g. potatoes and strawberries, to monitor nutrient status (particularly nitrogen) during the growing season.

There have been a number of attempts to use nitrate test strips in vineyards, but the major difficulties identified for petiole testing also apply to these types of sap tests, in particular the absence of reliable standards and the variability in nutrient concentration in vines.

Some viticulturists use simple on-site sap testing techniques to monitor their vineyard nitrogen levels and feel that the information gained is beneficial.

continued page 4

Table 1. Petiole nutrient standards for grapevines in Australia

Nutrient (measured as)	Test result values					Comments
	Deficient	Marginal	Adequate	High	Toxic	
N (%)			0.8-1.10			Use 0.9-1.25% N for vines on Ramsey rootstock. In WA use 1.7-2.2% N for Red Globe.
NO^3-N (mg/kg)	<340	340-499	500-1200	>1200		Californian possibly toxic range (>1200 mg/kg) not supported by field observation in SA, Vic and WA. In WA use 2000-4000 as adequate for Red Globe. Data should be interpreted carefully in conjunction with %N, with more credence being placed on the latter. In many cases vigour or leaf colour may provide a more appropriate index of N status.
P (%)	<0.2	0.2-0.24	0.25-0.50	>0.50		Responsive vines in SA had values >0.1%, hence a critical value of 0.2% was suggested. For vines on Ramsey in Sunraysia use 0.30-0.55 as adequate.
K (%)	<1.0	1.0-1.7	1.8-3.0			For vines on Ramsey rootstock in Sunraysia use <3% and 3-4.5% for deficient and adequate levels. When deficiency is suspected, sample again 6-8 weeks later, selecting the blade of the most recently matured leaf. A value of <0.5% in petiole or 0.8% in blade plus petiole confirms deficiency. WA experience (Goldspink 1996) suggest that when %N is at the higher end of adequate, adequate range for K is >1.3%. There are large differences in petiole K concentrations between varieties and rootstocks.
Ca (%)			1.2-2.5			
Mg (%)	<0.3	0.3-0.39	>0.4			Values are often much higher than 0.4% with no observable toxic effects.
Na (%)					>0.5	
Cl (%)					>1.0-1.5	Based on survey work in SA and validated in field trials in NSW (Prior et al. 1992, 1996). High petiole Cl of vines on Ramsey rootstock is indicative of water logging (Stevens and Harvey 1995, 1996). In the absence of other stresses vines appear to tolerate higher levels.

Nutrient (measured as)	Test result values					Comments
	Deficient	Marginal	Adequate	High	Toxic	
Fe (mg/kg)			>30			In commercial testing laboratories petioles are not normally washed so contamination from dust will usually lead to higher values. Leaf symptoms are a more useful diagnostic aid.
Cu (mg/kg)	<3	3-5	6-11			Values >15ppm are indicative of surface contamination with Cu sprays.
Zn (mg/kg)	<15	16-25	>26			Deficient and marginal as used in commercial tissue analysis services.
Mn (mg/kg)	<20	20-29	30-60		>500	Contamination from foliar sprays is possible.
B (mg/kg)	<25	26-34	35-70	71-100	>100	If a value in the toxic range is obtained, follow up with a blade analysis: value above 150 mg/kg is indicative of B toxicity.

Reuter DJ and Robinson JB (Eds) 1997 Plant analysis: An interpretation manual. Inkata Press, Melbourne.

How were the Standards established?

Californian Standards of Cook (1966) and Christensen et al. (1978) modified following survey work in South Australia (Robinson and McCarthy 1985) and field trials in Victoria and Western Australia (Treeby and Nagarajah- unpublished data; Goldspink- unpublished data).

A few companies offer a more comprehensive sap analysis for nitrogen and other soluble nutrients but, as with test strips, there are as yet no published standards, although some have been developed for Sultana for dried fruit production in the Sunraysia district.

Even within a particular type of analysis, not all laboratories use the same testing procedures so data obtained from one laboratory cannot always be compared with those from another. Some organisations or companies may send their samples overseas for testing where both extraction methods and the way data is expressed differ from the methods commonly used here.

Interpretation of petiole analyses

The standards presented in Table 1 are for dried petioles taken from a basal leaf opposite a bunch cluster at full bloom.

In grapevines, unlike some annual crops, it has not yet been possible to develop precise tissue analysis standards. These presented are for optimal vine growth which may not be suitable for specific grape quality production. In addition, different cultivars or rootstocks have different abilities at taking up nutrients.

Use of a consultant or adviser with knowledge of local conditions is often beneficial to make the most out of the petiole analysis.

ACTION

Interpretation of petiole test data categorises petiole nutrient status as deficient, low (marginal), adequate (satisfactory), high or excessive (toxic) enabling review of fertiliser practices. However, recommendations concerning the nutrient management of vines require additional information such as knowledge of soil type, nutrient supply, variables which affect petiole nutrient content (e.g. moisture, temperature or plant growth rate), end use (e.g. fresh market, type of wine), and target yield. Local advisers can draw upon a broader local knowledge to assist growers in the interpretation of petiole analysis results.

FURTHER INFORMATION

Product or service information is provided to inform the viticulture industry about available resources, and should not be interpreted as an endorsement.

Further detail on petiole testing and plant tissue analysis can be found in the *Grapevine Nutrition: Research to Practice*™ training manual, Cooperative Research Centre for Viticulture, Adelaide 2005.

Useful references on these topics are:

- Robinson JB, (1997) Grapevine Nutrition, in Viticulture Vol 2 Practices, Eds Coombe BG & Dry PR, reprinted 2001, Winetitiles, Adelaide, pp178-208.
- Reuter DJ and Robinson JB, (Eds) (1997) Plant analysis: An interpretation manual, Inkata Press, Melbourne.

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