ARTICLE

CAN PETIOLE ANALYSIS HELP IMPROVE WINE QUALITY?

Introduction

The time of year has come when the nutrient levels in grapevines are usually analysed. The article below explains the reason behind this widespread practice and how to avoid problems with testing, plus how this information can be used to help improve wine quality.

Nutrients

Like all plants, vines need certain nutrients to ensure good growth and to produce healthy fruit. To make good wine from the grapes the range and quantities of nutrients must be optimum, including the correct amount of all essential nutrients. (Note: in this article the term 'nutrients' will be used in place of the less accurate but commonly used term 'minerals'). Nutrients for vine health are primarily extracted from the soil in which the vine grows. Healthy soil, which contains good levels of nutrients, is necessary for healthy plant growth.

Testing identifies deficiencies in the amounts of nutrients; these deficiencies can be ameliorated using supplementary nutrient application by soil fertilizers and/or foliar sprays.

Macro and micro nutrients

Many nutrients are required for healthy vine growth and these can be classified in several ways. A common way is to divide them into the concentrations of each nutrient required: macro and micro ranges.

The main macro nutrients are: N, K, Ca, Mg, P; the main micro nutrients include Cl, B, Fe, Mn, Zn, Cu. This range of nutrients, along with nitrate and sodium, is used by most grape growers as there is an accepted standard of levels for them, as shown below in Table 1.

This is also the list of nutrients offered in Winechek Laboratories Petiole analysis bundle. We have been advised by our clients that this is the list they prefer, and that they also prefer our "independent" service – that is, one not done by the same company that produces and sells them fertilizer

Deficient, adequate or toxic?

Research done on this topic in the USA is often quoted and is the basis for further trials that have been done in Australia (1). Table 1 is an outcome of this work and shows the optimum concentrations of the most important nutrients. Each nutrient has been divided in a "Goldilocks" way: Deficient (too low), Adequate (just right) and Toxic (too high).

Nutrient	Deficient	Marginal	Adequate	High	Toxic
Nitrogen , N (%)			0.80 – 1.10		
Nitrate Nitrogen, NO_3 (mg/kg)	<340	340 – 499	500 – 1200	>1200	
Phosphorous, P (%)	<0.15	0.15 – 0.24	0.25 – 0.50	>0.50	
Potassium, K (%)	<1.0	1.0 – 1.7	1.8 – 3.0		
Calcium, Ca (%)			1.2 – 2.5		
Magnesium, Mg (%)	<0.30	0.30 – 0.39	>0.40		
Sodium, Na (%)			0.10 – 0.30	0.40 – 0.50	>0.50
Chloride, Cl (%)			<1.0	1.0 – 1.5	>1.0 or 1.5
Zinc, Zn (mg/kg)	<15	15 – 26	>26		
Manganese, Mn, (mg/kg)	<20	20 – 29	30 – 60		>500
Iron, Fe (mg/kg)		7	70		
Copper, Cu (mg/kg)	<3	3.6	>6		
Boron, B (mg/kg)	<25	26 – 30	30 – 100		>100

Table 1: Standard nutrient guidelines for petiole analysis (1)

Plant tissue or soil testing?

The level of nutrient occurring in the vine can be determined from two main sources; either from plant tissue or from soil.

The most commonly analysed plant tissue is the petiole (leaf stem); although the testing of vine sap is also offered commercially. Another approach is to analyse the soil in which the plant lives; this is useful in some ways, however it only gives an estimate of the nutrient levels occurring in the vine.

The reasons why analysis of petioles is usually preferred are:
– the levels of nutrients in the soil do not necessarily match the levels in the plant tissue
-taking of representative petiole samples is easier than taking representative soil samples
-soil nutrient analysis is very dependent upon the test chemical used to extract the nutrients and the range of extractants varies
-foliar nutrient sprays, if used, affect the levels in the plant compared to the soil
-better standards for comparison are available for petiole compared to sap analysis

Specialised testing

The analysis of plant tissue such as petioles for a full range of nutrients is a highly skilled endeavour. Compared to wine analysis, a higher level of expertise is required for sample taking, sample preparation and analysis. As the concentration of many nutrients is at very low trace levels, special precautions are required throughout the whole procedure to avoid contamination. Trace analysis laboratories must therefore be carefully managed to avoid contamination.

Interpretation of results

The main purpose of petiole analysis is to determine if all nutrients in the vine are in the "Adequate" range. Due to changes in climatic conditions, management regimes and plant health, it can be a difficult task for any vineyard manager to keep the nutrients within this range. This is the main reason why these analyses are done on a recurring annual basis, particularly for vineyards that have vine health issues or where the fermentation kinetics of the fruit leads to concerns about a particular plot or vineyard.

Predictor of wine quality

Reference has been made to the issue of the quality of wine when compared to the nutrient level of the vines from which the fruit was sourced. In one study it was found that the level of nitrogen in the tissue samples was an indicator of flavour intensity in the resulting Sauvignon Blanc wines (2). Where nitrogen was deficient the fruit flavour was of a lower intensity.

In our laboratories several nutrient issues have been observed:

-high levels of Calcium have been found to cause wine instability
-high levels of Manganese have caused some of our customers to have wine rejected overseas
-high levels of Copper are also a concern for this reason

Anecdotally, it has been suggested that a number of stuck ferments in the 2013 vintage may have been caused by a lack of micro nutrients from the fruit. This is difficult to verify, but some winemakers have stated that after all normal precautions were taken, some unexpected stuck ferments still occurred and that lack of micro nutrients in the fruit was the most likely explanation.

It appears that more research work needs to be done on the issue of correlating the results of vine tissue nutrient levels and the resulting wine quality.

Tips for best results

There are several important steps to remember for petiole testing:
• make sure you get as representative a sample of the vineyard as you can
• take sample at full flowering (80% cap fall)

• wear clean latex gloves whilst taking the leaf samples to avoid trace nutrient contamination
• take samples in the morning before any moisture stress occurs
• keep samples in paper rather than plastic bags
• ensure sample dispatch complies with quarantine regulations, in particular in regard to Phylloxera

Conclusion

The nutrient levels of vines are important parameters that are typically measured by sampling the leaf petioles. The results from these analyses can be used to ensure that the levels of nutrients in the vine are adequate. The quality of the subsequent fermentation and the resulting wine can be affected by these levels, although the nutrient concentrations affecting wine quality is an area of research that needs much more attention.

References

1. The Grapevine: from the science to the practice of growing vines for wine, 2011, Patrick Iland Wine Promotions, Adelaide, 218-221

2. Smart, R.E. 2006, Practical Winery & Vineyard, Mar/Apr, 85