viti-notes

[vineyard activity guides]

Research to Practice

Measuring soil salinity

Viti-note Summary:

- Method
- Interpreting results
- Useful conversions

Other topics in this Viti-Notes series include:

- Measuring the infiltration rate of water into soil using the ring infiltrometer method
- A method for examining grapevine root systems
- Soil moisture monitoring
- Measuring soil porosity
- Measuring soil strength
- A method for assessing soil structure
- Taking soil samples
- Measuring soil pH
- *Measuring soil salinity*
- Measuring organic carbon in soil

Salinity is a measure of the concentration of soluble salts in the soil. The most common salt is sodium chloride: however, others include bicarbonates, sulphates and carbonates of calcium, potassium and magnesium. Some salts are useful, e.g. many fertilizers are in a salt form, but too much salt of any kind is detrimental to plants and other organisms.

Vitis vinifera varieties are moderately tolerant of salinity (i.e. high total salts). However, a concentration of salts in the root zone that is too high can damage plant health and reduce crop yields. A very high concentration of soluble salts can kill vines. Measurement of soil salinity is generally used to determine the salt status of a soil, particularly if vines are showing salt toxicity symptoms. It is also used to gauge the impact on soils irrigated with saline water, particularly in combination with deficit irrigation.

Soil salinity is measured as electrical conductivity (EC) in units of decisiemens (dS/m). Salt is extracted from the soil using one of two methods, the most accurate and reliable of which is the saturation extract, though this method must be done in a soil testing laboratory. Alternatively, measurement can be made in the vineyard using an inexpensive EC meter and a (1:5) soil and water suspension.

Equipment

Portable handheld EC meter, plastic jars with screw-on lids, distilled or rain water, thermometer, recording sheet and pen.

Timing

This measurement is best undertaken when soil sampling is conducted. Make sure any surface soil samples are taken within the irrigation wetting pattern, although it may also be a good idea to take some mid-row samples as well.

Salinity in the root zone often comes from a saline watertable; therefore the subsoil, and possibly a deeper level soil sample, should also be measured.

Method

1. Take three surface soil and three subsoil samples from each site (as described in points 1-5 the *Taking soil samples* activity guide in this Vitinote series). Make sure surface soil and subsoil are not combined so that they can be analysed separately.
2. Crush large aggregates and remove any gravel so that you have a fine mix to test.
3. Make sure to refer to instrument instructions and periodically calibrate your EC meter.
4. Unscrew jar lid and fill the lid level with soil. Do not compress the soil. Pour into jar*.
5. Add 5 jar lids of distilled water and screw lid on tight. Shake periodically over one hour.
6. Let the mixture stand undisturbed for half an hour or a little longer if the suspension is not clear. If the suspension cannot be clarified, the measurement can still be taken in the knowledge that EC will be slightly overestimated (0.01 to 0.03 dS/m). This error is acceptable for a field estimate that can be used to decide whether to submit samples for saturation extract analysis.
7. Rinse the EC meter electrodes in rain or distilled water and dry gently with a tissue.
8. Take a reading by immersing the electrode in the water above the settled soil as per manufacturer instructions. Make sure the electrodes are fully covered. Take care to minimise electrode contact with soil at the bottom of the jar.

9. Allow reading to stabilise. Record EC value.
10. Using thermometer record water temperature.
11. Rinse electrode on the EC meter between each reading.

**If you have scales and volumetric flask then the accuracy of the 1:5 soil to distilled water ratio can be improved by using 20g of air-dried soil and 100ml of distilled water. Jar lids are used in the field when scales are not available.*

Interpreting results

If the soil water solution was not at 25°C at the time of measurement then an approximate correction has to be applied (unless the meter has an automatic correction—check the manufacturer's instructions):

- Increase the EC value by 2% for each degree above 25°C.
- Decrease the EC value by 2% for each degree below 25°C.

The tables below indicate the salinity hazard for grapevines measured as described above ($EC_{1:5}$) and also as recorded by laboratory soil-water saturation extract tests (EC_{se}).

Acknowledgement

The Australian Wine Research Institute would like to acknowledge:

- Cooperative Research Centre for Viticulture (CRCV) and all involved in the VitiNotes series (1996 – 2006).

Further information

- Nicholas, P. 2004. Soil, irrigation and nutrition. Adelaide: Winetitles.
- Cass A, 1998. Measuring and managing chemical impediments to growth. Australian Grapegrower and Winemaker, July 1998, pp13-16.
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Table 1. Hazard rating of differing $EC_{1:5}$ levels at different soil types.

Salinity Hazard	Measured as $EC_{1:5}$ (dS/m)			Effect on vines
	Sandy Loam	Loam	Clay	
Non-saline	<0.15	<0.17	<0.4	None
Slightly saline	0.16-0.3	0.18-0.35	0.41-0.8	Own-rooted will be affected
Moderately saline	0.31-0.60	0.36-0.75	0.81-1.6	Some rootstocks may tolerate
Very saline	0.61-1.2	0.76-1.45	1.6-3.2	Growth greatly reduced
Highly saline	>1.2	>1.45	>3.2	Vines die

If EC 1:5 values exceed 0.15 dS/m (sands), 0.18 dS/m (loams) or 0.3 dS/m (clays), then you should submit soil samples to a commercial laboratory for saturation extract analysis.

Table 2. Hazard rating of differing EC_{se} levels. Both tables modified after Cass

Salinity Hazard	Measured as saturation extract EC_{se}	Effect on vines
Non-saline	<2	None
Slightly saline	2-4	Own-rooted will be affected
Moderately saline	4-8	Some rootstocks may tolerate
Very saline	8-16	Growth greatly reduced
Highly saline	>16	Vines die

Useful conversions

You may wish to convert your EC measurements to other units. Shown right are some conversions.

1 dS/m	= 1 mmho/cm
1 dS/m x 640	= 1 ppm salt (approximate)
	= 1 mg/l salt (approximate)
1 dS/m x 1000	= 1 µS/cm
	= 1 EC unit.

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