



Vineyard activities 5: Assessing soil structure

Current titles in this Vineyard activities series include:

1. Taking soil samples
2. Measuring soil pH
3. Measuring soil salinity
4. Measuring organic carbon in soil
5. Assessing soil structure
6. Measuring soil porosity
7. Measuring soil strength
8. Measuring the infiltration rate of water into soil
9. Examining grapevine root systems
10. Monitoring soil moisture

Soil structure is one of the major factors affecting winegrape production and profitability.

Poor soil structure can limit root development, water infiltration and water availability for crop growth.

Good soil structure allows water and air to move freely into the soil, therefore avoiding waterlogging and run-off. Plant roots are able to explore a larger volume of soil and thus have to access more water and nutrients.

The deterioration of soil structure occurs by two processes:

1. Slaking of aggregates
2. Dispersion of clay

Slaking is defined as the rapid disintegration of large aggregates (>2–5mm) of soil into smaller aggregates (most of which are <0.25mm) by pure water (e.g. rain water). As slaked soil dries, the small aggregates settle together and create smaller soil pores than the previous larger aggregates. Slaking occurs because of a lack of strong organic bonds between soil particles and micro-aggregates.

Dispersion is when dry soil is wet with pure water (e.g. rain water) and the clay structures that bind the fine aggregates and large particles (sand and silt) break down. The clay particles then go into suspension

in the water. As the soil dries out, the clay particles block the pores between the remaining aggregates. This blockage prevents the flow of water and air through the soil.

Dispersion is enhanced when the soil has high levels of exchangeable sodium concentrations, and by excessive tillage when the soil is wet.

Soil structure can be modified and improved by inputs of organic matter such as mulches, composts or cover crops. These help stabilise aggregate macro-structure.

The application of gypsum to soil stabilises aggregate micro-structure and prevents clay dispersion.

Excessive tillage can break down both the macro- and micro-structure of aggregates leading to hardsetting and crusting of surface soils.

EQUIPMENT

There is a simple method to measure soil slaking and dispersion by placing an aggregate in water and observing its breakdown. You will need:

- shallow, clear, open containers
- rain water or distilled water
- a handful of soil from each soil layer being assessed
- recording sheet and pen

TIMING

This assessment is best undertaken when normal soil sampling is conducted.

METHOD

1. Take three surface soil and three subsoil samples from each site as described in points 1–5 in *Vineyard activities 1 -Taking soil samples*. Make sure surface soil and subsoil are not combined so that they can be analysed separately.
2. From each sample, select three aggregates about the size of a pea.
3. Place them carefully, equally spaced apart, in a shallow container filled with rain or distilled water (you can also do this test using your irrigation water if you are interested in its effect on structural stability of the soils in the vineyard).
4. Watch the aggregates closely during the first few minutes and note whether they float on the surface or sink, and the rate at which smaller particles break away from the larger sample (slaking).
5. After two hours, record whether slaking was complete, partial or absent.
6. Leave the dish untouched for 20 hours and then assess dispersion. A 'cloudy' or 'milky' halo around the slaked fragments of the aggregate indicates partial dispersion. Complete dispersion is indicated when the base of the container is completely covered with a layer of clay leaving only a pile of sand where the aggregate was placed.
7. If no dispersion occurred, take another sample from the air dried soil, remove any gravel, stones and plant fragments and moisten with rain or distilled water while kneading into a ball of about 40mm diameter. Add small amounts of water as necessary until the ball of soil just begins to stick to the hand.
8. Break the ball of soil open and remove some soil to make three pea size balls and place them in a clear container as described above.
9. Watch and record the results.

INTERPRETING RESULTS

The soil is a slaking soil if the aggregates have broken down into micro-aggregates at the end of the test period. Dispersive soils come in four broad types depending on the amount of dispersion, as indicated in the table below.

Type 1	There has been complete dispersion so that a cloud of clay covers the bottom of the dish in a thin layer and the aggregate has almost disappeared. A small heap of sand may be left where the aggregate was placed. This type of soil is very likely to experience structural breakdown due to dispersion and will require treatment.
Type 2	There has been partial dispersion so that the dispersed clay spreads into thin streaks and crescents around the aggregate on the bottom of the container. This type of soil may experience some structural breakdown due to dispersion and could benefit from treatment.
Type 3	This soil only disperses after the clay has been worked. This means that very sound management practices can avoid crusting and erosion, but there is little room for error.
Type 4	Little dispersion occurred during the test, indicating that the aggregate structure of the soil is pretty stable. The soil should not crust, and will have good rates of water entry, though it may still be susceptible to compaction.

FURTHER INFORMATION

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

The information in this Vitinote has been trialed by viticulturalists as part of the Cooperative Research Centre for Viticulture's Viticare On Farm Trials project. For information about On Farm Trials, visit www.crcv.com.au/viticare/

A key reference on these topics is:

- Nicholas P, (Ed.) (2004) Soil, irrigation and nutrition, Grape Production Series 2, SARDI, Adelaide.

Another useful reference is:

- Nicholas P, Magarey PA and Wachtel M, (Eds.) (1994) Diseases and pests, Grape Production Series 1, Hyde Park Press, Adelaide (a glove box edition of this book is also available).

Both of these publications are available from Winetitles, 08 8292 0888, or visit www.winetitles.com.au.

Also see:

- Cass A, McKenzie N and Cresswell H, (1996) Physical indicators of soil health, in Indicators of Catchment Health: A Technical Perspective, Eds Walker, J and Reuter, DJ, CSIRO Publishing, Melbourne, pp.89-108.
- McGuinness S, (1991) Soil Structure Assessment Kit: a guide to assessing the structure of red duplex soil, Centre for Land Protection Research, Department of Conservation and Environment, Bendigo.

Water management for grapevine production: Research to Practice® and *Grapevine nutrition: Research to Practice®* are training programs whose delivery can be fine-tuned to suit each region. They include topics on soil management issues.

Visit the web site at www.crcv.com.au/viticare/vitinotes/ for updates and more Vitinote titles.

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