VitiNotes

Cooperative Research Centre for Viticulture

www.crcv.com.au 2006

Vineyard activities 8: Measuring the infiltration rate of water into soil

The infiltration capacity is the maximum rate at which water can enter a particular soil.

Different soil types have different infiltration capacities, for example sandy soils are free draining relative to clays, resulting in higher infiltration capacities.

High infiltration capacities will reduce run-off and risks of waterlogging, however very high infiltration capacities, often found in sands, may mean some nutrients are lost from the root zone through leaching into deeper parts of the soil profile.

Infiltration capacities can be altered by soil management practices. As infiltration is related to soil structure, any practice that degrades the structure of the soil will have an adverse effect on infiltration. Therefore, monitoring infiltration rates under different soil management regimes is a good indicator of how the practice will influence the rate at which water can move into the soil.

There are several different ways of measuring infiltration which vary in their accuracy and complexity.

A relatively simple and accurate approach is the ring infiltrometer method. A metal 'infiltration ring' is pushed into the soil. Water is poured into the ring, and the rate at which the water soaks into the soil is measured.

LIMITATIONS OF THIS METHOD

Although this method has the advantage of being easy to use and easy to interpret, it does have its disadvantages.

For example, the water inside the infiltration ring often flows horizontally through the soil as well as vertically, thus giving results greater than would be achieved if the flow was confined only to downward movement through the soil profile.

There are ways to correct this but for comparative purposes they are not necessary. It must just be assumed that the proportion of the water which moves sideways is always similar.

As only a small area is used, this technique is very sensitive to worm and root holes and other cracks in the soil. Any crack in the soil surface will result in much faster flow than would otherwise be achieved. As these cracks are often not visible at the surface it is not always possible to avoid them when choosing a site.

EQUIPMENT

You will need 150mm deep metal rings. Commercial products may be available, or metal rings can be cut from clean empty 20 litre oil drums (380mm inside diameter).

Sharpen one edge of the ring so that it is easier to push into the soil. Draw a line with a water-resistant marking pen on the outside of the ring 50mm up from the sharp edge to mark the depth to push the ring into the soil. On the inside of the ring accurately draw two lines at 90mm and 100mm from the sharpened edge to mark the depth of water once the ring is installed in the soil.

Other items that you will need are:

- piece of flat board or plank about 2cm thick and long enough to span the diameter of the ring
- hessian bags
- garden clippers
- three 5 litre buckets with a small (2mm diameter) hole in the base
- metal or plastic rule (mm/cm scale)
- shovel
- about 50 litres of rain water or clean water suitable for irrigation
- stopwatch
- recording sheet and pen

TIMING

This measurement is best performed in spring or autumn when the soil is moist and not dry, hard or cracked.

WHERE TO MONITOR

Measures of infiltration can be taken under the vine-row or in the inter-row area depending on what information you want to collect.

Often the soils in the inter-row are more compacted and have a different infiltration rate than soils underneath vines.

You would ideally want to also measure the infiltration rates on the different soil types you have identified in your vineyard, and perhaps in locations of different elevation if you are on a sloping site.

It is a good idea to set up about three infiltration rings on the same types of soil in the areas being measured to account for soil micro-variation at each monitoring point.

You can use these groups of rings as your ‘defined measurement unit’ for a given soil type and calculate an average of the monitoring results from each of these (as long as they do not differ too greatly, in which case your infiltration rings may actually be sited on soils with different characteristics, despite surface appearances).

It is not a good idea to try to measure infiltration on cracking clay soils or in freshly cultivated paddocks because results will not be representative of that soil’s behaviour at all times. On stony and very hard soils, it may be difficult to push the ring into the soil.

METHOD

Preparation

1. At each location clip any plants on the site down to ground level, being careful not to disturb the soil. If the area is covered with a mulch or compost, clear it away to expose the soil surface. Avoid trampling on the area where the measurement is to be made.
2. Place wet hessian bags on the soil surface at each measurement site, fill the holed bucket with rainwater and place it on the bag allowing the water to slowly drain onto the bag overnight and gently wet the soil.
3. The next day remove the bucket and bag and insert the metal ring, sharp edge first, by gently pushing down on the middle of the ring with the flat board until the line marked on the outside is level with the soil surface all around the ring.

   If it will not push in by hand, the soil may not have wet deeply enough and you should gently remove the ring, replace the bag, refill the bucket and try again the next day.
4. Seal any large gaps along the edges of the ring with 'putty' made from moist, reworked soil rolled out to the thickness of a pencil (subsoil is best). Take care not to disturb the surface of the soil inside the ring. Once the site is prepared with the ring in place, the actual infiltration test can be done.

Measurement

All measurements should be recorded in units of milimetres (mm) and minutes (min) for the purposes of the following calculations:

1. Gently fill the ring with water, being careful not to stir up the soil, until the level is just on the upper line drawn on the inside of the ring (the water should be 50mm deep).
2. Using the rule and stopwatch, measure how far the water level drops in 6 minutes and record as 'depth'. If the level drops by more than 10mm in 6 minutes, record the number of minutes taken for the 10mm drop to occur, record as 'time'.

   Refill the ring with water and repeat the measurements several times until the times or the depths are similar to within one minute or 1mm. Calculate an average of the most recent, similar values in your measurements.

CALCULATIONS

The water intake rate in mm per hour is calculated as follows:

- INFILTRATION RATE = DEPTH (mm) x 10

  If you were able to take the measurements in 6 minute intervals.

OR

- INFILTRATION RATE = 600 ÷ TIME (min)

  If the water level dropped by more than 1cm in 6 minutes.

INTERPRETING RESULTS

The mm/hour value obtained can be interpreted from the information in the table below.

Note: These criteria cannot be applied to cracking clay soils.

Rate of water entry (mm/h)	Soil structural assessment
0–10	Very poor structure quality
10–30	Poor structure quality
30–70	Moderate structure quality
>70	Good structure quality

After Geeves et al. 1995

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:

- Geeves G, Cresswell H, Murphy B and Chartres C, (1995) Productivity and sustainability from managing soil structure in cropping soils of southern NSW and northern Victoria on lighter textured soil surfaces, CSIRO Division of Soils & NSW Dept. Land and Water Conservation.

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.

The CRC for Viticulture is a joint venture between the following core participants, working with a wide range of supporting partners.

ADFA

AWRI

National Wine & Grape Industry Centre

CSIRO

HAL Know-how for Horticulture™

Government of South Australia, Primary Industries and Resources SA

The University of Adelaide Australia

Victoria The Place To Be

Wine Grape Growers' Australia WGGA

wfa Winemakers' Federation of Australia For the Industry by the Industry

Australian Government Grape and Wine Research and Development Corporation