Salinity notes

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How to Texture Soils & Test for Salinity

Testing a soil sample is a reliable way to assess how salts are affecting plant growth. Even though it is quicker and easier to test water samples, a soil salinity test shows the soil conditions around plant roots, taking into account the influence of soil texture. Identifying current soil salinity conditions and recording salinity trends will help you recognise and predict soil salinity problems, and help you make sound land management decisions.

Taking soil samples

To perform the test you will need a sample of soil from the rootzone of your crop or pasture. Dig a hole with a shovel and take a sample (a few handfuls placed in a plastic bag). **This sample should be taken from a depth of 5-30cm.** If you have time (especially if sampling from near trees or in a deep-rooted pasture) take a sample from below 30cm (that is, in the lower rootzone). Take samples from both "heavier" and "lighter" country (different soil types).

Note that soil salinity will be highest before the rain break or before commencing irrigation, so you may want to test your soils then. Also note that the test result will be artificially high if you have added gypsum (a calcium salt) to the paddock recently (don't test within three months of gypsum application).

The soil salinity field test

Soil salinity can be measured by a simple field test. This will give an indication of the amount of salt in your soil. The test is reasonably accurate in indicating if salts may cause yield losses or soil management problems, but is not as accurate as laboratory analysis (the field test's expected error may be at least 10%). Sending soil samples away for laboratory testing is strongly recommended, and most commercial soil tests include salinity as one of the properties tested.

The field test for salinity is also called an **$EC_{1:5}$ ("EC one-to-five") test** because a ratio of 1 part soil sample to 5 parts distilled water is used to find the salinity of the sample.

The three steps in a soil salinity test are:

1. **Assess the texture** of your soil sample.
2. **Measure the salinity** of a solution made up of distilled water mixed with the soil you have collected.
3. **Multiply the test result by the conversion factor** based on soil texture to get soil salinity (EC_e), which shows how soil salinity will affect plant growth.

Determining soil texture

Texture is an estimate of the relative amounts of sand, silt and clay particles in a soil. To convert your test result to actual soil salinity (EC_e) you need to texture your soil sample. Knowing the texture of your soil is important for many other reasons too; as texture affects fertility, water holding capacity, internal drainage, irrigation scheduling and soil workability for tillage. Soil texture usually changes with depth; so determining the texture of each visible change in the soil profile will help you understand the soil types on your farm.

Converting test results to soil salinity

In simple terms, a given amount of salt in sandy soils will be more concentrated in its effect on plant roots than an equivalent amount in clay soils. This is because sandy soils hold less water to dilute the salts than clay soils (they have a lower available water content). Find the multiplication factor for your textured soil sample on the Conversion Factor Table (Table 2). This factor will allow you to convert your test results into soil salinity readings. Note that EC_e is the term used to indicate actual soil salinity.

For example, if your soil is a light clay with a test result ($EC_{1:5}$) of 0.5 dS/m, multiply 0.5 by 8.6; which is 4.3 dS/m, an approximate value for the salinity of the soil (EC_e).

Note: these conversion factors are calibrated for southern NSW soils; based on Slavich & Patterson (1993) *Estimating the Electrical Conductivity of Saturated Paste Extracts from 1:5 Soil:Water Suspensions and Texture*. Different factors may be more suitable in other areas so, if in doubt, contact your local soil scientist.

Lab testing of soil samples

The soil samples you have collected can be sent away to a laboratory for full analysis, which identify a wide range of soil properties, including salinity, pH (acidity), sodicity (ESP), and amounts of phosphorus (P), nitrogen (N), potassium (K), sulfur (S), calcium (Ca), magnesium (Mg) and organic matter. Regular soil tests allow you to monitor the health and condition of your soil, and make better land management decisions.

How to texture soils

1. Take a sample of soil sufficient to comfortably fit in the palm of your hand. Break up or remove any aggregates (clods of soil 2 mm or larger). Remove any stones, leaves or twigs.
2. Moisten the soil with water, a little at a time, and knead it until the soil forms a ball approximately 3 to 5 cm in diameter and so the ball just fails to stick to the fingers, adding more soil or water if necessary. The sample should not be saturated (water dripping out of the ball) or too dry (some soil is dusty and not wet at all). Make sure the soil is wet right through (this moisture content is around field capacity) and there are no lumps.
3. Continue kneading and moistening, if necessary, until there is no apparent change in the feel of the soil ball. Do not overwork the ball (no more than 3-4 minutes).
4. Assess the soil for coherence (see Table 1) by squeezing the moist ball in the hand. Knead ball for a further minute.
5. Assess feel (Table 1) as you knead the ball.
6. Ribbon the soil ball by pressing it between the thumb and forefinger and squeeze it into a ribbon until it breaks. Try to make a thin continuous ribbon about 2 mm thick.
7. Measure the length of the ribbon. Repeat this a few times to get an average ribbon length.
8. From the results for coherence, feel and ribbon length, estimate the soil texture group from Table 1. Remember this test is only an approximation; but with practice, you can quickly estimate texture of soils in the paddock.

Steps 1 and 2

Step 2

Step 6

Step 7

Table 1: Soil Texture Groups

Soil Texture Group	How to identify the Soil	Coherence	Feel	Approx. Ribbon Length	Approx % Clay	$EC_{1:5}$ to EC_e conversion factor
Sands (sand, loamy sand, clayey sand)	Have little coherence and cannot be moulded into a stable ball. Individual sand grains stick to fingers.	nil to slight	sandy, gritty	nil to 15mm	up to 10	**17**
Sandy loams (sandy loam, fine sandy loam)	Can be moulded into a stable ball. Sand grains can be seen and/or felt.	slight to just firm	sandy	15-25mm	10-25	**13.8**
Loams (loam, silty loam, sandy clay loam)	Soil ball is easy to manipulate and has a smooth spongy feel. Greasy to the touch & discolours fingers if organic matter present. Very silky and smooth if silty loam. Sandy clay loam (medium sand in a fine matrix) will ribbon 25-40mm and looks sandy.	firm	spongy, maybe greasy	about 25mm	20-30	**9.5**
Clay Loams (fine sandy clay loam, clay loam, silty clay loam)	Can be formed into a stable ball that is smooth and plastic to manipulate. May feel slightly sandy or silky.	firm to strong	smooth	40-50mm	30-35	**8.6**
Light Clays (sandy clay, silty clay, light clay, light medium clay)	Handles like smooth plasticine. Slight resistance to rolling out and shearing. Rod of light medium clay can be formed into a ring without cracking.	firm to strong	plastic	50-85mm	35-45	**8.6**
Medium & Heavy Clays	Smooth and very plastic with a moderate to strong resistance to rolling out and shearing. Heavy clay handles like stiff plasticine. Ribbon or rod can be formed into a ring in the palm without cracking.	strong	plastic	over 85mm	more than 45	**7**

COHERENCE
The way the moist ball of soil holds together:
Nil to slight coherence: soil won't hold together, or stay in a moulded ball. e.g. sands
Slight to firm coherence: holds together well, but needs water to form ball. e.g. loams
Strong coherence: holds shape very well. e.g. medium clay

FEEL & OTHER FEATURES:
How the balls looks and feels as you knead it:
Sandy: feels gritty and you can see coarser sand grains. Fine sand grains (which may be too small to see) make a grating sound as you rub the soil between fingers and thumb.
Spongy: typical of **loams**; also, high organic matter content gives a spongy feel.
Silky: a smooth, soapy, slippery feel is typical of high **silt** content.
Plastic: ball can be deformed & holds its new shape strongly. Feels sticky. Typical of **clays**.
Resistance to Shearing: how firm the soil feels as you form a ribbon. (Place the ball of soil between your thumb and forefinger and squeeze, sliding your thumb across the soil.) The firmness is a good way to distinguish light, medium and heavy clays. A light clay is easy to shear: a medium clay is stiff, a heavy clay is very stiff and often takes two hands to squeeze into a ribbon.

How to conduct a soil salinity field test

To perform the field test you will need a soil sample, some distilled water (good rainwater is suitable), a testing container (such as a jar with a lid) and a calibrated salinity meter (see Salinity Note 2: *Understanding Salinity Meters*):

1. Take a soil sample and leave it to dry as long as possible (leave sample bag or container open for at least a day to let moisture escape). It can be oven-dried on a tray in a cool oven.

2. Crush dried sample so there are no large aggregates (clods of soil 2mm or larger). You may need to crush these aggregates with a mortar-and-pestle, rolling pin or hammer. Remove any foreign matter, plant material and stones from the sample.

3. **The test involves adding one part soil for every five parts water. So if you add 50g of soil (weighed on scales) to the testing container, then you need to add 250ml of water.**

4. Shake the container for three minutes to make sure the salts dissolve. For clay loams and clay soils, more shaking (for one minute every 3 minutes repeated three times) will bring more salts into the solution and increase the accuracy of the test.

5. Allow the solution to settle for a minute before testing.

6. Place the salinity meter in the solution (but not in the soil in the bottom of the jar) and read the display once it has stabilised.

7. Wash the meter electrodes and sample jar with distilled or rainwater, and dry.

8. **Convert your salinity meter readings to soil salinity (EC_e) by multiplying the value by the Conversion Factor based on the texture of the soil sample (see Table 2 below).**

What Do the Readings Mean?

Differing types of crops and pastures have different levels of tolerance to salinity. At a soil salinity of 2dS/m, salts in the soil have minimal impact on the yield of most agricultural crops. When soil salinity rises to 6 dS/m most agricultural crops have begun to be affected. Refer to the *Soil & Water Salinity Calculator* or *Water Salinity Guidelines* for the relative tolerance to soil salinity of common crops and pastures.

Soil salinity information can be used to assist in making land management decisions. To make these decisions clearer, you should class your land according to its soil salinity and relative risk of further soil salinisation occurring. For more advice on managing land by land use classes contact your local salinity officer or refer the Salinity Note: *Managing Land by Salinity Classes.*

Table 2: $EC_{1:5}$ to EC_e Conversion Factors

Soil Texture	Multiplication Factor
Sands	17
Sandy Loams	13.8
Loams	9.5
Clay Loams & Light Clays	8.6
Medium & Heavy Clays	7

EM Surveying

Electromagnetic induction (EM) surveying can be used to determine soil texture or salinity over large areas. This indirect method measures the reflected (secondary) electromagnetic field from the soil, with more conductive soils generating a larger signal. EM readings are influenced by salt concentration and water content (hence their use in salinity surveys), by soil texture (hence their use in rice soil suitability surveys) and by the presence of metal objects and electrical fields. Results need careful interpretation to account for all these factors.

This information has been produced as part of Salt Action, the community and government initiative for managing salinity in NSW.

Author, design, editing, artwork and layout:
Simon Gibbs, Salt Action, Forbes

For more information, contact your local Salinity Officer at NSW Agriculture:
Condobolin (02) 6895 2099
Dareton (03) 5027 4409
Deniliquin (03) 5881 9999
Forbes (02) 6850 2922
Griffith (02) 6960 1300

Salt Action

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