Measuring soil salinity

Water and soil salinity are measured by passing an electric current between the two electrodes of a salinity meter in a sample of soil or water. The electrical conductivity or EC of a soil or water sample is influenced by the concentration and composition of dissolved salts. Salts increase the ability of a solution to conduct an electrical current, so a high EC value indicates a high salinity level.

Electrical conductivity (EC) is also a term used to describe a measurement unit of salinity. The table below shows the different units used to measure salinity and their relationship to each other.

Salinity can be measured in a number of ways. Simple field tests using a hand-held salinity meter are quick and easy and are useful for conducting preliminary investigations, point sampling of selected areas and ongoing monitoring activities.

DeciSiemens per metre **dS/m**		**MilliSiemens per centimeter** **mS/cm**		**microSiemens per centimetre** **µS/cm**		**Electrical conductivity** **EC**		**parts per million** **ppm** **= (mg/L)**
1	=	1	=	1000	=	1000	=	640

Taking soil samples

To perform the test you will need a sample of soil from the rootzone of your crop. Take a sample with a corer or hand auger and place a couple of handfuls in a clean bucket. The samples should be taken from depths of approximately 30cm and 50cm. The 30cm sample is generally the main Rootzone and the other sample at 50cm is from the “heavier” subsoil. Samples from numerous sites at the same depth (i.e. 30cm) can be bulked together to get an average salinity reading for the block or patch you are testing.

Note that soil salinity will be highest before the rain break (winter) 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)

Texture

Field texture is subjective but is a measurement that provides a useful assessment of the way in which soil behaves in the field. You will need to have an indication of the texture of the soil samples collected in the field to be able to interpret the EC values as explained below (**EC$_{1:5}$**).

Abbreviations

Salinity measurements are often reported with subscript abbreviations to indicate the origin of the sample tested and the method used to determine the salinity measurement. The method used will influence the accuracy of the results and confidence in interpretation. Common abbreviations and their descriptions are explained below.

EC_w is the salinity of water. This can be measured in the field or a laboratory.

$EC_{1:5}$ measurments are determined by mixing 1 part soil with 5 parts distilled or deionised water. After mixing the sample and allowing the sediment to settle, the electrical conductivity of the solution is tested. $EC_{1:5}$ tests are generally performed in the field.

EC_{se} or **EC_e** is the electrical conductivity of a saturated soil extract which should be conducted by a National Association of Testing Authorities, Australia (NATA) accredited laboratory.

To measure $EC_{1:5}$ in the field:

This method is a reasonably accurate way of estimating sodicity, salinity and pH in most districts. It is most accurate if the soil is dried, ground and weighed out e.g. (20g soil plus 100ml water). But the test can also be performed in the field, as set out below. It is most convenient to analyse several soil samples at the same time.

Equipment:

1. Hand held salinity meter (Calibrated)
2. Clean jar, with sealing lid (400-500ml is ideal)
3. Clearly mark the jar at 250ml and 300ml level
4. Distilled, deionised or rainwater
5. Stirring rod

Procedure:

1. Depending on the soil texture and its moisture, the soil may be hard or moist (especially in clay soils) thus making it difficult to break down, if this is the case then use a cheese grater to break the soil down before adding to the distilled water. Alternatively use a stirring rod to crush soil in the distilled water.
2. Add distilled, deionised or rainwater up to the bottom mark (250ml) of the sample jar. Then add soil, crushed as fine as possible and air dried, until the level reaches the top mark (300ml, equivalent to approximately 50g soil). This equates to a 1:5 soil/water ratio.
3. Put the lid on and shake the solution vigorously for at least two minutes then allow it to settle for five minutes.
4. Dip the EC meter into the top, clear part of the solution and take a reading (Remember to wash the EC probe in rainwater after using it)
5. Compare the EC reading with the salinity thresholds table below (remember to apply the $EC_{1:5}$ conversion factor)

Note: EC meters can give readings in a variety of different units. This is dependant on the brand of meter and the salinity level of the sample. It is important to convert the reading into dS/m unit before you do any conversion to ECse or compare your readings to the attached Soil salinity threshold table.

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 below. This factor will allow you to convert your test results into soil salinity readings. Note that ECe 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 (From the conversion factor table); which is 4.3 dS/m, an approximate value for the salinity of the soil (ECe).

Salinity tolerance in irrigated crops
As a guide, sandy or loamy soils are moderately saline if $\mathbf{EC_{1:5}}$ is above .3 dS/m and clay soils are moderately saline if $\mathbf{EC_{1:5}}$ is above .6 dS/m.

Determining EC_{se}

$EC_{1:5}$ (dS/m) x conversion factor (cf) = $\mathbf{EC_{se}}$ (dS/m)

Soil Texture Group	Conversion Factor (multiply by $EC_{1:5}$)
Sand/Loamy Sand	17
Sandy Loam	14
Light Sandy/Sandy Clay Loams	9.5
Clay Loams and Light/Sandy Clays	8.6
Medium and heavy clays	6.7

Soil salinity thresholds for selected horticultural crops (EC_{se}) in dS/m units

Crop	Soil salinity threshold EC_{se} (dS/m)			
	0% yield loss	10% yield loss	25% yield loss	50% yield loss
Almond	1.5	2.0	2.8	4.1
Avocado	1.3	1.8	2.5	3.7
Citrus	1.7	2.3	3.3	4.8
Date Palm	4.0	6.8	11.0	18.0
Lucerne	2.0	3.4	5.4	8.8
Olive	2.7	3.8	5.5	8.4
Onion	1.2	1.8	2.8	4.3
Pistachio	4.0	4.5	5.0	6.0
Pomefruit	1.7	2.3	3.3	4.8
Potato	1.7	2.5	3.8	5.9
Stonefruit	1.7	2.2	2.9	4.1
Tomato	2.5	3.5	5.0	7.6
Vine	1.5	2.5	4.1	6.7
Beans	1.0	1.5	2.3	3.6
Eggplant	1.1	2.5	4.7	8.3
Cucumber	2.5	3.3	4.4	6.3
Capsicum	1.5	2.2	3.3	5.0

Dispersion Test

This test needs no special equipment and is very simple. It is a good indicator of permeability problems and sodicity.

Procedure

- Collect dry soil aggregates (Pea size crumbs of soil)
- Place each aggregate in about 50mL of distilled water (or demineralised or rainwater) in a flat-bottomed clear container (at least three replicates per soil sample). The containers should not be disturbed
- Aggregates will often (but not always) slake (crumble) soon after being placed in the water, however this is not dispersion
- The water around the edges of the soil aggregate in dispersive soils will become cloudy and milky looking (water looks dirty) because of the dispersed clay (Figure 1)
- For a highly dispersive soil dispersion will be obvious after about 10-30 minutes, for a moderately dispersive soil it may take two hours for dispersion to be obvious (Figure 1). Thirdly field indicators of moderate or severely dispersive topsoil's are usually obvious:
    - soil is prone to becoming boggy when wet because of structural instability
    - milky coloured water ponds on the soil surface after rain
    - water infiltrates into the soil slowly
    - soils are prone to water erosion
    - soils are hard setting and form a surface crust when dry
    - Cracks can appear in some dispersive soils as the soil shrinks on drying.

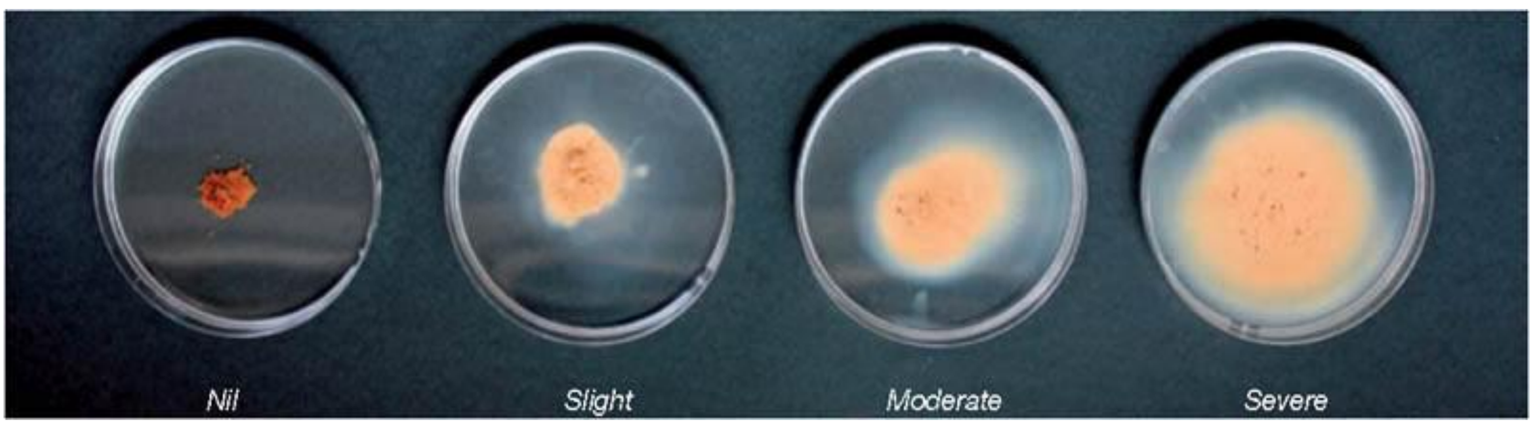

Figure 1: Degrees of soil dispersion