EC in Soil

The analysis of Soils for Electrical Conductivity EC_{TRIME}

Notes and Disclaimer: The analysis of electrical conductivity in soils is a complex subject. This resume is not intended as a study document in soil science nor does it discuss the technical complexities of the devices used .

For agricultural and horticultural soils, the measurement of Electrical Conductivity is an immensely important measurement. Electrical Conductivity measures the amount of total dissolved salts (TDS) or total dissolved ions in water. To complicate matters, some ions such as Sodium and Chloride will contribute more to EC than others such as Phosphorus and Potassium.

Plants require nutrients such as Nitrogen, Phosphorus, Potassium, Magnesium in large quantities hence they are called major nutrients and also smaller amounts of elements such as Iron, Manganese , Molybdenum and these are called micro nutrients or sometimes referred to as trace metals. Fertilisers are supplied to plants as compounds for example Ammonium Nitrate which supplies Nitrogen in the form of Nitrate or Ammonium. Micro-organisms will break down these compounds so they are more readily available for uptake by the plants. Levels of some ions such as Chlorides are less desirable and in great quantities can be harmful to plant growth.

The quantity of ions or salts in a soil is of huge importance. Too much or too few nutrients will create a restriction in plant growth.

Measurement of EC in water is relatively straightforward. An EC probe (usually platinum) is inserted in the water and a reading in mS/cm is reported on the meter's display. This is relatively easy because water is a homogenous medium. Soil on the other hand is not and this has caused great difficulties when trying to measure its conductivity. To work around this, the analysis on agricultural and horticultural soils has been carried out by mixing a volume of soil and a volume of water and measuring the EC on the suspension or filtered extract. Different countries and different regulatory bodies have specified methodologies and in general results have been good enough to use for fertilisation recommendations and programmes. This analysis was generally carried out by a laboratory and whereas results were and are reliable the method is slow, time consuming and expensive.

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Over the years manufacturers have tried to come up with solutions whereby an instrument could be used directly in soils without having to resort to laboratories. The EC reported by these instruments is referred to soil bulk electrical conductivity. Whereas there has been some success, there are so many influential variables such as temperature, soil moisture and granular composition that results have not been adequate for reliable fertilisation studies. Mostly soil bulk conductivity was of academic rather than practical interest.

Kurt Koehler of Imko who produce the TRIME TDR soil moisture instruments has studied the subject in detail and has come up with a breakthrough. By using coated rods and measuring over the length of the probes, TRIME can now accurately report soil EC_{TRIME}. This measurement takes account of soil moisture by volume and temperature. Because soil moisture is so important in the calculation of EC, all TRIME devices now incorporate TDR calibration curves for a selection of different soils. Special graphs have been constructed so that the user can convert the EC_{TRIME} reading to grams/litre of dissolved salt. So far curves are available for sandy and loam soils and it is intended to produce a handful of curves to cover most situations. At this moment in time, conversion of EC_{TRIME} to mg/l TDS is done manually.

This incredible breakthrough whereby a TDR instrument can be used to derive a true soil EC measurement will no doubt become the new standard for soil fertilisation analyses.

Below are two graphs produced by the EC_{TRIME}, one in sand and one in loamy soil.