Best bet EM38 zones for Mallee soils

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- EM38 is a readily available tool and maps important yield-related characteristics of Mallee soils particularly well.
- Surveying when the soil is relatively dry, soon after harvest can produce a stable map of subsoil constraints and differences in plant unavailable soil water.
- Soil testing for at least salts (EC1:5) and soil water is needed to validate an EM38 map as in some cases correlations with these measures will be poor.
- EM38 maps were well-correlated with crop yield in the very dry-finishing 2006 season in which subsoil constraints were a major limiting factor.
- An EM38 survey can help to identify the boundaries and characteristics of constrained zones where there is an opportunity to reduce inputs, and higher potential zones where an economic response to higher fertiliser rates is more likely.

Electromagnetic (EM) mapping measures the apparent electrical conductivity of soil. It responds to a combination of soil water, salinity and texture in varying proportions. Mallee Sustainable Farming research has found EM38 (see page 6) mapping is particularly useful in Mallee soils, as it usually correlates well with important characteristics that drive crop yield potential. With several contractors offering EM38 surveys and maps for less than $5/ha, EM38 can be an easily accessible and worthwhile layer of information for Mallee growers entering into more soil-specific management.

Mapping soil salt levels (subsoil constraints)

Subsoil salinity (measured by EC1:5) is the major chemical subsoil constraint in the Mallee affecting plant available water. Results from over 30 paddocks across the South Australian, Victorian and New South Wales Mallee showed that for the 'typical' (median) paddock approximately 85% of the variability in EC1:5 can be explained by the EM38 measurement with an average error of 0.1dS/m. A typical paddock had EC1:5 levels ranging from 0.1-1.0dS/m (average of 0.4); a common threshold for yield loss is around 0.6dS/m.

Soil chloride and to a lesser extent, boron, are also well-correlated with EM38 in the Mallee. Where soil testing shows that the EM38 measurements are not well correlated with salts (EC1:5), the use for the EM38 map becomes less clear. In this study, this has been shown to happen in about 15% of Mallee paddocks. One common reason for this is the relatively low variation in EC1:5 and/or texture across a paddock.

Mapping soil water and plant unavailable water

In the typical Mallee paddock, an EM38 survey carried out when soil is relatively dry explains over 75% of the variability in the total soil water present. This is largely because soil water at this time is strongly associated with texture and salts – the key drivers of the EM38 measurement. If an EM38 survey and soil testing are conducted immediately post harvest, the moisture present is that which could not be extracted by the crop roots ie. plant unavailable water (assuming no late season rains). Across a typical paddock, the soil water content can be mapped to within about 20mm accuracy.

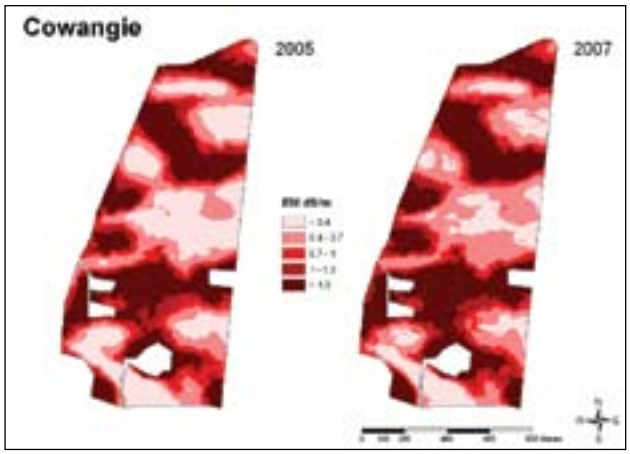

Figure 1. Comparison of EM38 maps and measurements taken in different years at Cowangie.

EM38 zone stability over time

'Fixed' salty subsoil constraints usually dominate the Mallee EM38 measurements, therefore, the 'zones' appearing on Mallee EM38 maps are relatively 'fixed' over time. Unfortunately, the salt in Mallee subsoil is not going to disappear in a hurry. This is illustrated in Figure 1, where the EM38 map from 2005 is very similar to a map from 2007. Higher soil water levels due to rainfall in 2007 had very little effect on the EM38 measurements on areas of the paddock with high salt subsoil constraints, but some effect is evident on the lighter sands. Overall, statistical correlation shows that the 2005 map explains 97% of the variation in the 2007 map. This is typical for Mallee EM38 maps, especially if surveys are completed when the soil is relatively dry. Because the 'zones' appearing on typical Mallee EM38 maps are relatively stable, maps from a few years ago can usually be used as a base for future management decision making.

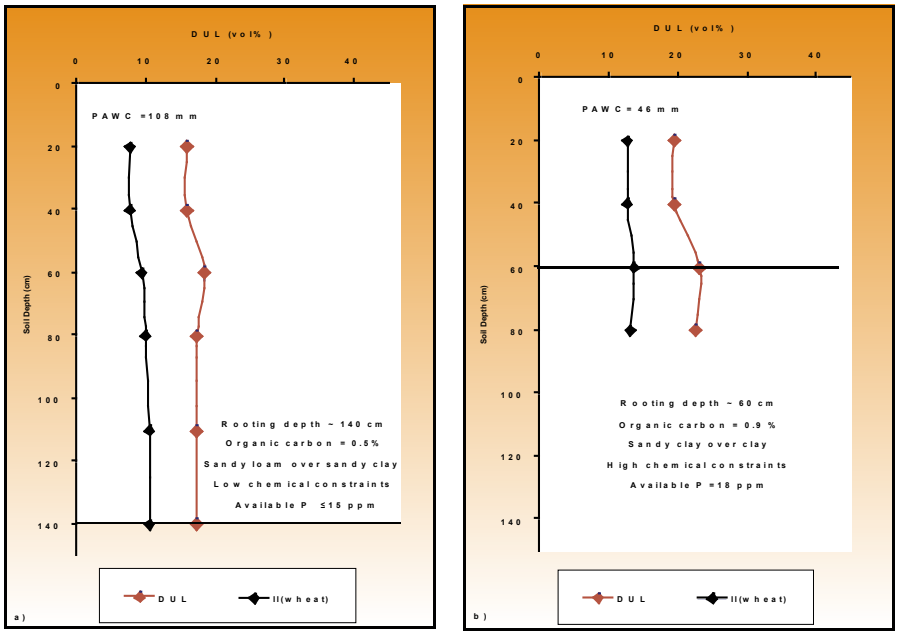

Figure 2. Field measured soil water characteristics including Plant Available Water Capacity (PAWC), wheat Lower Limit (LL) and rooting depth of a) an unconstrained soil, low EM38 zone and b) a constrained soil, high EM38 zone.

Soil water variability between zones

The variation in soil texture and subsoil constraints between zones largely determines how much of the water held in the soil profile is available to crop roots. In the unconstrained zones (low EM38), soils are typically sandier, allow roots to penetrate to more than 100cm and are often low in soil nitrogen and available phosphorous. In the zones with high EM38, the soils are typically higher in clay, may have clay subsoil and a much shallower rooting depth. Organic carbon and available nutrients are in higher concentrations than in the sands. In a paddock at Carwarp in the northern Victorian Mallee the plant available water capacity (PAWC) was 108mm in the soil class with the lowest EM38 and 46mm in the soil class with the highest EM38 (Figure 2).

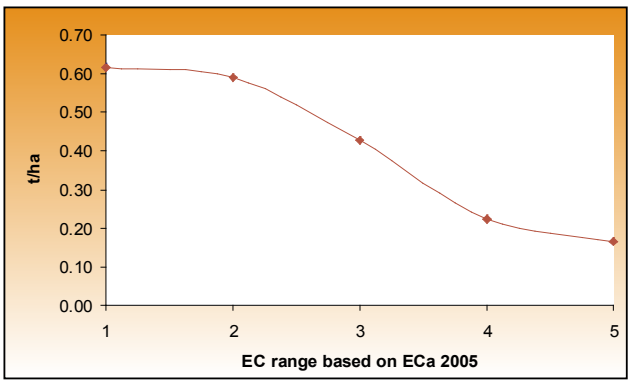

Figure 3. Mean 2006 barley yields across 5 EM-based soil classifications (1 lowest to 5 highest) at Carwarp.

Yield comparison with EM38

The relationship between EM38 and barley yield in 2006 at Carwarp is shown in Figure 3. Fertiliser treatment strips were applied across the paddock, but the very dry season meant that zero additional fertiliser was optimal across all the zones in the paddock.

A strong relationship between EM38 and yield should not be expected in every season-type. For example, in some seasons late rains make the availability of stored moisture less critical to crop yield and more even yields across the paddock would be expected. It is for this reason that multiple season types need to be considered when developing 'best-bet' zone management strategies.