



farmtalk



This article contains information most relevant to the less than 350 mm rainfall mallee farming region

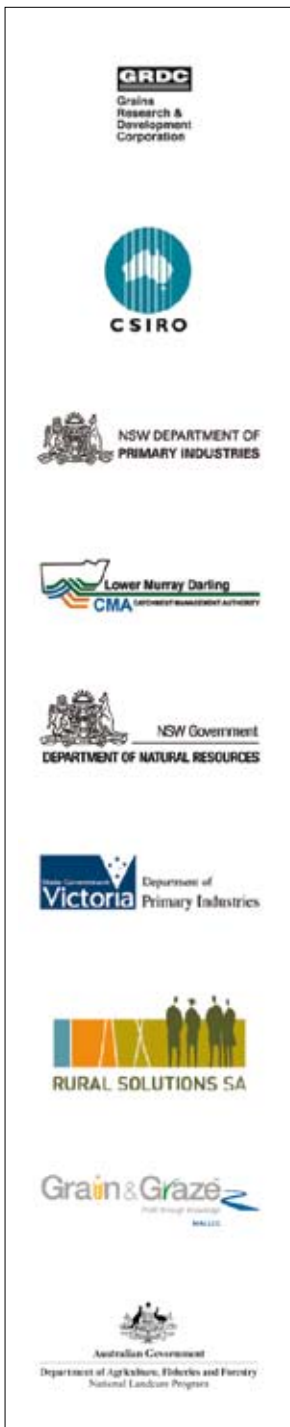
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Making use of EM in the Mallee

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The EM38 (in box behind vehicle) can produce rapid, paddock-scale soil surveys of some soil properties.

The issue

Most Mallee growers are now aware of electromagnetic induction technology (EM) as a potential tool for mapping variation in soil across paddocks and farms. Many growers are looking to make use of EM-based maps as part of the shift to better targeting of inputs to zones within paddocks based on yield potential.

EM38 measures soil electrical conductivity of water in the soil and the soil itself, which is influenced by the soil salt and water content, and the amount and type of clay in the soil. It can help to identify where important subsoil constraints may be present in Mallee paddocks and in assessing variation in the amount of soil water that can be available to plants.

Largely because of the saline geological history and dune systems of the Mallee landscape, relatively high correlations are usually found across a paddock between EM measurements and soil characteristics that are known to be important for Mallee crops such as subsoil salt, boron, texture and plant unavailable water.

It needs to be recognised that the EM responds to a combination of soil water, salinity, texture and temperature in varying proportions. Correlation with one characteristic can be poor and interpretation is not always simple.

This farmtalk uses results from over 30 paddocks across the Vic., SA and NSW Mallee to:

- Give a guide to how reliably EM mapping captures the soil water-related characteristics of most interest to growers.
- Look at what this means for getting most value from EM information in the Mallee environment.

What we know

Across a wide range of Mallee paddocks soil testing has been used to determine how well the EM38 measurements (in vertical mode) correlate with total soil water and important soil characteristics including salinity (EC 1:5)* and boron. As the main focus is on identifying salt-related characteristics (e.g. subsoil constraints and differences in plant unavailable water), EM surveys have been conducted when the soil is relatively dry (e.g. post-harvest).

In each paddock ten 1.5m soil cores were taken across the EM range at the time of the EM survey. Coring at the time of survey minimizes the risk of changes in soil characteristics such as soil water content affecting the correlations. Further work suggests that similar levels of accuracy can be obtained with 1m core depths.

Mapping soil salt levels

The results show that for the 'typical' (median) paddock approximately 85% of the variability in EC 1:5 can be explained by the EM measurement with an average error of 0.1 dS/m*. Keep in mind that the

* EM, EC 1:5 and Conductivity
Both EM and salinity (EC 1:5) are measurements of electrical conductivity in dS/m (deci-Siemens/metre). EC 1:5 is the conductivity of a 1:5 solution of soil and water, closely related to the amount of salt in the soil. EM relates to the conductivity of water in the soil and the soil itself, and is termed "apparent EC" because it does not come from passing an electric current directly through the soil.

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typical paddock had EC 1:5 levels ranging from about 0.1-1.0 dS/m (average of 0.4) and a common threshold for yield loss is around 0.6 dS/m. Soil chloride and to a lesser extent, boron, were also typically well-correlated with EM.

Mapping soil water

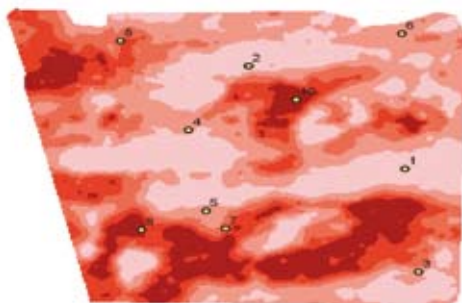
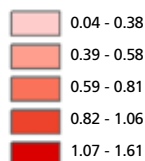
EM (done when the soil was relatively dry) was able to explain over 75% of the variability in total soil water and predict the soil water content to about 20mm/m accuracy in the typical paddock. The typical paddock had soil water levels ranging from 40-210mm with an average of 120mm at the time of surveying.

This means that if you are able to conduct a post-harvest EM survey at the stage where the only moisture present is that which couldn't be extracted by the crop roots (plant unavailable water), you will commonly be able to map this across the paddock to within about 20mm accuracy. It can be difficult to get the survey timing right though, and late season rain can be a complication. Rural Solutions SA are tackling this by developing a method that estimates plant unavailable water using other soil characteristics. EM maps can be used to produce maps showing likely variation in plant available water capacity across a paddock: a key tool in estimating yield potential variation and determining optimal input levels.

But it doesn't always work like this...

In about 15% of paddocks, EM could not account for more than half of the variation in soil salinity and water. Errors in soil water estimates of over 40mm were just as common. In some paddocks there may be little variation in the soil characteristics and/or salt and boron may never reach a level that will significantly affect the crop. In cases like these, the raw EM map without groundtruthing and calibration could be misleading for developing paddock zones.

EM
(apparent EC)
dS/m



Soil coring across the EM38 range

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Even in cases where EM is highly correlated, it is difficult to get value from an EM map without soil testing that confirms, firstly, how accurate the map is in representing the variation in important soil characteristics and; secondly, the range and levels of the soil measures and whether it is likely to be worth managing differently.

What it means

By looking at results from many paddocks across the Mallee it is clear that EM can regularly achieve strong and practical levels of accuracy. This means that as the ability to better target cropping inputs within paddocks increases, the Mallee is in the fortunate position of having a relatively cheap and cost-effective tool for use in mapping variation in important soil characteristics.

The important thing, however, is to groundtruth all EM data to avoid possible misinterpretation and gain maximum value from the EM survey. For a technical guide to conducting and interpreting EM surveys see: www.spaa.com.au/downloads/emprotocol.pdf

Where to next?

- EM38 can be used to provide a good guide to variation in key subsoil constraints and soil water characteristics in most, but not all, Mallee paddocks.
- Use expert knowledge and soil testing to make best use of this potentially valuable tool.
- The ability to reduce soil testing costs while maintaining adequate accuracy is being investigated.

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