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case study

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Probe placement: using EM surveys

Irrigation scheduling involves applying the right amount of water, in the right place at the right time in order to maximise production and improve water use efficiency.

Soil moisture monitoring tools are commonly used in the irrigation industry to assist cotton growers like Andrew Parkes and Von Warner with their scheduling decisions. They provide soil moisture information at a specific location within a field.

To have confidence in any soil moisture monitoring tool you need to ensure it is located in the most representative part of the field, or fields in which it is used to schedule irrigations.

Have you ever considered how representative your moisture probe site is to the rest of your field? Traditionally growers like Von and Andrew would site their probes visually, from experience or "gut feel," but today these growers believe they can do it better.

A visual only offers an inspection of the surface and until recently this has been good enough but today we have the technology to look below the surface, to build a more defined and accurate picture of the majority soil types and ultimately remove the human error.

A moisture probe placed in the wrong spot can result in over or under irrigating the majority soil type in that field or management unit.

For example, a probe sited in a section of field where the soil is lighter and exhibits a lower water holding capacity, will not be representative of the majority soil type of the field.

If this is not factored into the scheduling decision it may result in more frequent irrigations than is required for the majority of the field, costing you valuable resources.

Mapping soil variation

Electromagnetic Induction (EM or EMI) surveying, used in conjunction with soil sampling, can be used to map soil variations across fields and farms. It does this by measuring the soils apparent electrical conductivity (ECa) of the soil. This has been shown to be highly correlated to clay content, salt and soil water.

NSW Government Department of Primary Industries

pct Precision Cropping Technologies Pty Ltd

McGregor Gourlay Agricultural Services

This fact sheet has been adapted for CottonInfo from a former Cotton CRC publication. The adapted fact sheet is co-authored by Janelle Montgomery, CottonInfo/NSW DPI, Brooke Sauer, McGregor Gourley Agricultural Services, and Nick Barton, Precision Crop Technologies.

Best Practice

So how do you know if high readings are due to salt, high soil moisture or increasing clay content?

To account for soil moisture the EM survey should be conducted when the profile is full of moisture, ideally at the end of a fallow period or after an irrigation.

In a non-saline soil an EM map can be a surrogate for clay content and therefore indicate changing water holding capacity of the soil. In saline conditions, the ECa readings will be a function of both clay and salts.

Either way ground truthing is essential to calibrate the instrument. This involves the collection and analysis of soil samples from known positions and relating the results to the EM readings. Mapped EM data can then be used for other applications including the identification of "majority" soil type.

Benefits of EM surveys

Andrew and Von are convinced about the benefits of EM soil surveys on their farms.

Both growers have used calibrated EM maps to examine soil variability across their fields in order to position moisture probes in sites that are representative of the field, ensuring that their probes are located within the majority soil type, year in and year out.

"Using EM survey to assist siting moisture probes has given me more confidence with my scheduling decisions" Von said. "It gives me the ability to draw down water and stretch irrigations if necessary".

Von did point out that moisture probes are just one tool he uses to schedule irrigations. "Keeping a close eye on weather forecasts and visual inspection of the crop is still vital."

For Andrew, the change in practice for siting moisture probes occurred when capacitance probes first came to the fore. The use of telemetry meant these probes could be placed anywhere in the field.

Previously he would position the probe tubes in a section of paddock that looked representative, but was also easily accessed. Back in 2001-02 he was sitting down with Andrew Smart from Precision Cropping Technologies, Narrabri, looking at yield maps.

"I asked him how he knew the probe was placed in the right area in terms of soil water holding capacity." Andrew Smart said.

"An initial EM survey using an EM38 showed that the EM data on our farm was heavily influenced by clay content and therefore data from the EM survey could be used to provide a detailed map of potential water holding capacity to around 1.2-1.5 metres."

Andrew Parkes then took a GPS reference of the probe site and found that as luck should have it, he had placed the probe in a site that was close to the fields "majority" soil type (hence "majority" water holding capacity), but it also pointed out the variability of soil in this field.

In fact, close to the probe site was a section of field that was much lighter in texture, and he could have just as easily placed the probe there by mistake and then irrigated the field by that area.

How did he know that scheduling based on the soil majority had a positive impact in terms of production?

"Yield maps were examined with the data collected from the EM survey and a close correlation between yield and EM readings was found." Andrew Smart said.

Figure 1 (over the page) shows a trend that as EM increases so do yields, to around mid range where it starts to trend down again. The majority soil type had an EM reading between 120-140, which matched the areas of the field with the highest yield.

This illustrates that they are managing the field and its water based on the majority soil type, as the highest yields are occurring in the majority soil area. Figure 1 also shows the lighter soils yielding less because they would have been more stressed from lack of timely water. A cotton plant growing on soils with the high clay content (indicated by high EM readings) is more likely exposed to waterlogging as in some cases these soils can drain slowly and naturally store more water. However, both these soil types only make up a small area of the field.

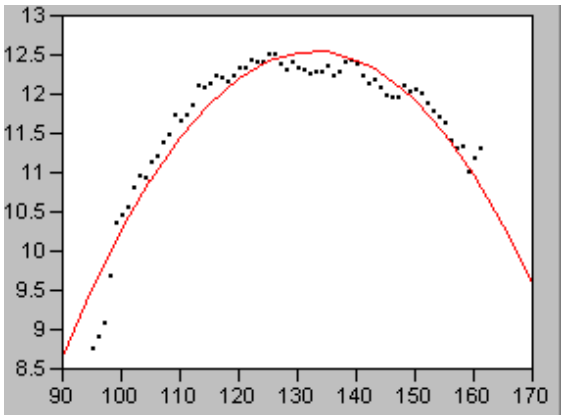

Figure 1: Relationship between EM reading (x axis) and Yield (Bales/ha).

To further enhance probe placement, an EM soil variability map (Figure 2) can be overlayed with a directional slope map (Figure 3) to examine changes in micro-elevation. This highlights areas above (ridges) or below (hollows) a plane of best fit (where water neither sheds quickly nor pools).

These data layers are combined to highlight the majority soil type and eliminate the hollows and ridges leaving a selection of the field that represents the ideal location for the probe (Figure 4).

In conjunction with this type of map, Andrew (Parkes) reminds us that ground truthing is still critical, "You need to check your probe is placed in an average plant stand which is also representative to the rest of the field."

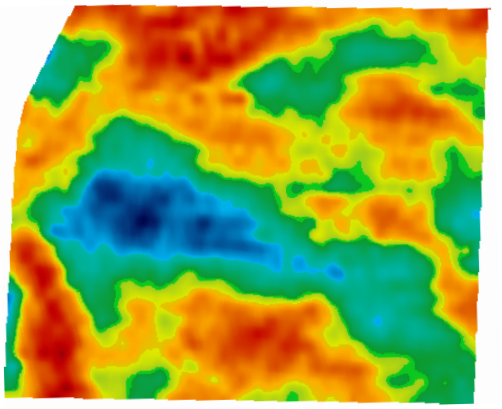

Figure 2: EM 38 Map showing field soil variability.

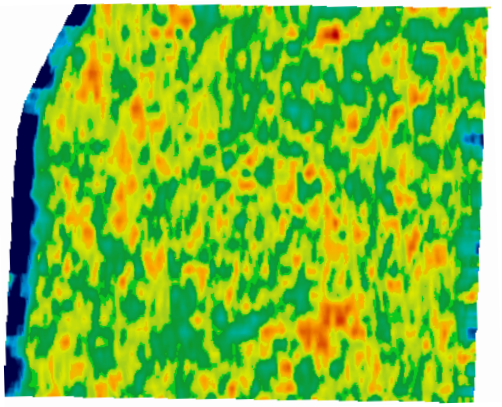

Figure 3: Slope map showing minor variations in slope that could affect water retention or runoff on soil moisture.

Figure 4: Final map which best represents majority soil type.

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