How sensor technology is helping map soil in the paddock

GRAIN growers may one day soon be able to map soil in their paddocks without sending a single sample to the laboratory thanks to the efforts of an innovative young researcher. Edward Jones is a postdoctoral research fellow from the University of Sydney, who is working on new technology with GRDC investment, examining how sensors can be used to scan soil for properties such as clay content, water holding capacity, sodicity and pH.

His work has shown that by using a range of sensors to scan multiple soil samples across a paddock, it is possible to build an accurate digital soil map identifying variation within a paddock.

GRDC Manager Agronomy, Soils and Farming Systems – North, John Rochecouste, said the ability to map soil types in paddocks, without sending samples to the laboratory, would be an invaluable management tool for grain growers and potentially save them significant costs.

"Soil properties do not change rapidly, so once growers have developed a digital map it would become an important tool to guide their decision making and importantly it would not need to be updated annually," John said.

"Soil properties don't change significantly for pretty much decades, if not longer, unless there has been major intervention such as incorporating significant amounts of lime or gypsum.

"Things like sodicity and clay content are pretty fixed without intervention. While pH can decrease (acidify) gradually with time, but essentially they are pretty much fixed properties.

"Nutritional element can vary significantly over seasons so that's why nutritional sampling is treated differently. To 3D characterise a paddock is very expensive in terms of sampling costs, so this work by Edward is looking at significantly reducing this expense.

"Knowing your soil characteristics across a paddock, and the variation within paddocks, is invaluable information and really is the foundation for effective crop planning and management."

Calculating soil properties

But there is a series of complex steps required to develop sensors which can effectively calculate soil properties.

"To be able to predict properties of a new soil sample you must first build a soil spectral library. Fortunately, the University of Sydney has been stockpiling soil samples from research projects dating back decades," Edward said.

"So far in the project we have delved deep into this stockpile and scanned more than 8000 samples, primarily from the wheat-sheep belt of eastern Australia."

The digital soil scientist said when samples were scanned with one of the sensors, they produced a unique response, like a spectral fingerprint. From here he has been able to build models using the samples in the spectral library to estimate the properties of new samples that were scanned.

"The most exciting thing has been the speed at which this technology is developing. One of the sensors I am using is a visible near-infrared spectrometer – the same technology used to estimate grain protein and moisture content at receival depots," Edward said.

"When I started my PhD in 2014 one sensor was the size of a briefcase and cost around US$60,000. A sensor that I am currently testing is the size of a deck of cards and costs only US$3000."

GRDC Agronomy Soils and Farming Systems – South Stephen Loss with University of Sydney digital soil scientist Edward Jones, who has been working with a range of sensors – including a near-infrared spectrometer – to scan soil samples and develop a map identifying soil variations across a paddock. (PHOTO: GRDC)

He said the next generation sensor was the size of a postage stamp and could be incorporated into a phone case and run using a smart phone. The same sensor could also be used to scan plant leaves to diagnose a range of nutrient deficiencies.

"I am very excited for the day that this technology is widely available to growers and advisers, because getting as much information that you can about your soil is crucial to good crop management," Edward said.

"Understandably the sensor does have its limitations. Everybody wants to be able to predict plant available nitrogen, but the technology is not advanced enough at this stage.

"Some private companies are saying that they can predict all of a crop's nutritional requirements from a single scan and this is simply not true."

Be wary of 'sensored' fertiliser claims

Edward advised growers to exercise caution with any organisations claiming fertiliser recommendations could be made using sensor technology.

"At the moment, the sensor technology is not advanced enough to assess fertility management, so for that sort of information growers need to keep sending samples to the laboratory for accurate assessment."

Edward has been trialling the new sensors and digital soil mapping techniques at the US's northern NSW L'lara research property at Narrabri. His plan is to showcase these digital technologies destined for broadacre agriculture to growers, farm advisers and industry stakeholders at a field day in early 2020.

In the meantime, growers interested in more information can go *https://bit.ly/2Y7QePp*

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Micronutrients needed throughout the growing season

PLANT tissue analysis from recent trials has shown that fertiliser programs relying on micronutrient applications at planting or as early season foliar applications may be falling short later in the growing season.

Yara Australia Agronomy and Crop Solutions Manager, David McRae, says manganese, copper and zinc are essential for plant growth and function.

"The availability of these micronutrients throughout the whole season is important to maximise yield potential.

David McRae.

"Even though the plant's requirements for these micronutrients is small, efficient plant growth and function cannot occur without adequate levels.

"Up to 70 per cent of these essential micronutrients are taken up by cereals after the end of tillering (growth stage GS30).

"Shortages of micronutrients later in the growing season can limit grain yield by reducing grain numbers and weight, protein levels and the plant's ability to tolerant stress."

Plant tissue analysis is an important tool to monitor the nutritional status of crops throughout the growing season.

Wheat with nitrogen deficiency (left) versus plants with optimum N levels throughout the season.

Targeting plant tissue analysis

"One or two targeted samples taken after the end of tillering can quickly identify how the crop is progressing and what additional nutrients are required," Dave says.

"Our colleagues in New Zealand implemented this approach in the crop nutrition program implemented in Eric Watson's world record wheat crop of 16.71 tonnes per hectare achieved two years ago.

"They used YaraVita Gramitrel as the foundation of the micronutrient program, with YaraVita Zintrac and YaraVita Mantrac as required."

YaraVita Gramitrel contains a guaranteed minimum analysis of N 6.4 per cent, Mg 15 per cent, Mn 15 per cent, Zn 8 per cent and Cu 5 per cent.

"Gramitrel helps to 'unlock' the yield potential of cereal crops by providing a balanced combination of essential micronutrients, thereby maximising your return on investment in all crop inputs," Dave says.

It is applied to cereal crops at one to three litres oer hectare from the two-leaf stage to second node detectable (Zadoks GS12–32) and/or one litre per hectare from second node detectable to flag leaf fully emerged (Zadoks GS 32–39).

Micronutrients and water stress

Ongoing trials being conducted by Yara are investigating the important role micronutrients play mitigating transient moisture stress later in the growing season.

"YaraVita Gramitrel was applied at flag leaf stage GS37 and subject to permanent or transient water stress," Dave says.

"Gramitrel increased the plant's tolerance to abiotic stresses and yields when compared to no foliar application in the transient water stress treatments.

"The delayed senescence was attributed to the lower release of oxygen radicals or enhanced detoxification, therefore minimising cell damage and supporting leaf health."

Gramitrel is compatible with many crop protection products for easy, one-pass application.

"But always check the compatibility of all the tank-mix partners before mixing by visiting the Yara website or downloading the Yara Tankmix app," Dave says. ■

Trials are investigating the role of micronutrients in mitigating water stress.