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# The estimation of soil sodicity and pH using NIR spectroscopy

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## Background

Dispersive sodic soils create establishment problems for rice which often lead to lower yields. In the Western Murray Valley 50 to 60 per cent of rice soils have a surface sodicity ranging up to Exchangeable Sodium Percentage (ESP) of 29. Sodic soils slake, making the water muddy, reducing light and temperature at the seed, increasing seed burial and increasing loss of root grip for young seedlings.

Soil acidity in irrigated areas of southern NSW is increasing and potentially can lead to reduced production from crops in rotation with rice.

Inexpensive NIR testing of soil properties could encourage expanded field sampling to measure within field variability. Literature reports the investigation of NIR sensors attached to field cultivation equipment to measure soil properties. Sample locations identified by GPS allow mapping of soil properties (Fig. 1) and subsequent targeted, variable rate lime/gypsum applications to address soil problems. This work aimed to evaluate the ability of Near Infrared Reflectance (NIR) to determine soil sodicity and pH levels.

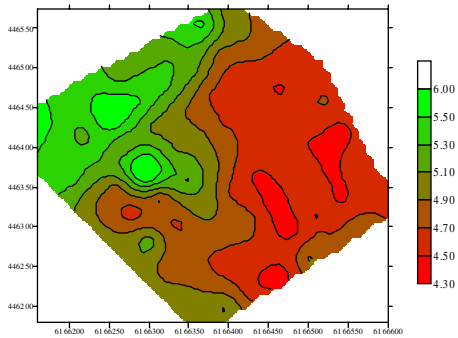


Figure 1. Variation in surface soil pH($CaCl_2$) of a rice field

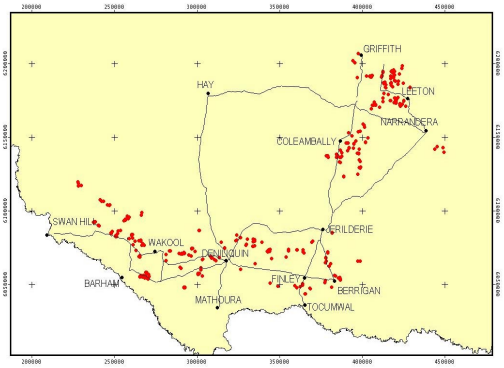


Figure 2. Distribution of soil samples used in project

## Methodology

Over 500 archived soil samples (0 to 10cm) from throughout the rice industry were used in this project (Fig. 2). Laboratory analyses (pH, Al, Ca, Mg, Na, K) and parameters such as CEC and ESP are available for these samples.

Soil analysis results were ranked for each soil property being investigated. These samples were divided into two subsets - a calibration and a verification set by selecting each fourth sample from the ranked data set.

NIRsystems 6500 scanning spectrophotometer was used to obtain spectra of these samples at 2nm intervals between the 400 and 2500 nm wavelengths. Scans were made on finely ground samples in a 50mm standard cell. A calibration was developed from the wavelength spectra obtained from the scans and laboratory analyses. The verification subset was then used to determine the predictive ability of the calibration developed for each soil property.

## Results

The NIR predicted ESP with a Standard Error of Prediction (SEP) of 3.0 (Fig. 3a). The verification plot for pH (Fig. 3b) shows pH can be predicted with a SEP of 0.34 pH units. Cation Exchange Capacity (CEC) proved to be the most accurate calibration with a SEP of 2.15 (Fig. 3c).

Ca and Mg were predicted well by the NIR as was the Ca:Mg ratio with a SEP of 0.29 (Fig. 3d). A good prediction of the Ca:Mg ratio means we can be confident that the NIR is estimating the Ca and Mg individually and not being influenced by the CEC relationship.

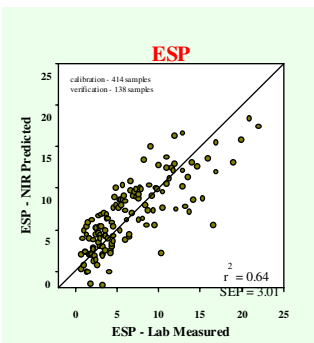


Figure 3a. ESP verification plot

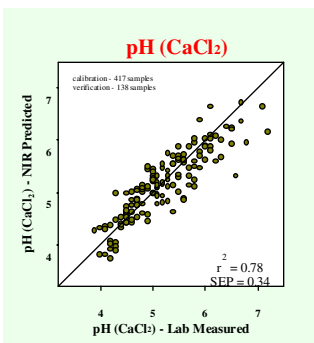


Figure 3b. pH verification plot

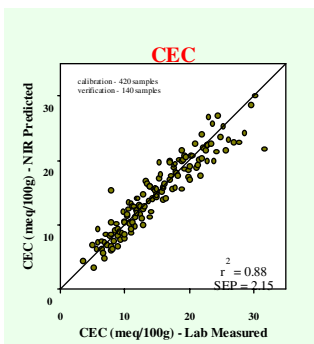


Figure 3c. CEC verification plot

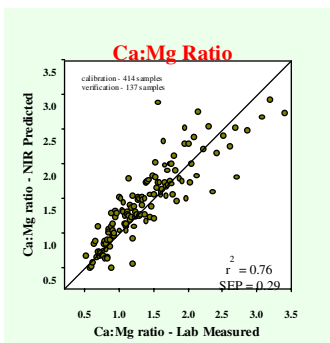


Figure 3d. Ca:Mg ratio verification plot

## Future Work

Explore how well the NIR technique estimates the soils exchangeable Al content. Look at the effect of particle size (grinding to <2, 1, 0.5 and 0.25mm) and scanning technique (cell size and use of plastic bags) on accuracy of estimating the level of soil constituents. Investigate the relationships for soil samples from deeper in the soil profile.

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