Mackay Irrigation Project

CANEGROWERS MACKAY

FACTSHEET 5

TRACKING SOLUTES IN THE SOIL PROFILE TO BETTER UNDERSTAND IMPROVED NUTRIENT MANAGEMENT VIA IRRIGATION STRATEGIES

The intent of the Mackay Irrigation Project (MIP) is to practically improve productivity via irrigation strategies to achieve better nitrogen use efficiency (NUE) with tailored advice on crop water use (CWU) and water use efficiency (WUE).

The project uses soil moisture probes with built in volumetric ion content (VIC) sensors. Due to the qualitative nature of the VIC output, the probe may not be useful for many research purposes. However, the probe may prove itself an important fertigation management tool to provide near-continuous real-time information on fertiliser penetration, spread and subsequent changes during crop growth.

This offers a practical means of tracking on a real-time basis where the applied fertiliser salts move within the soil and the rate of plant uptake of these nutrients.

While the sensors cannot determine individual ion constituents, it can be used to optimise the timing of strategic soil sampling and so assist with nutrient management. This has the dual impact of an economic benefit for the operator as well as a positive environmental benefit to our waterways.

Near-continuous data of soil water and soil salinity taken at multiple levels in the soil profile provides a picture of:

- where the roots are taking up water
- the depth of the active root zone
- the day-to-day concentration changes of salts and applied fertilisers.

Note: Readings may not be representative in heavy clays or soils with a high cation exchange capacity (CEC). Soil moisture and temperature affects salinity readings (Figure 1). In general, then, if VIC increases as a result of higher temperatures and soil moisture, and then decreases - even though soil moisture content and temperature increases during the course of the season - then this is an indication of nutrient supply within the soil. This can then be tracked at 10 cm increments throughout the soil profile.

FINDINGS SO FAR - KEY MESSAGE:

Solute availability can be synchronised with crop uptake via timeous irrigation

Using another approach by summing VIC values down the soil profile (Figure 1) and comparing this to summed temperature and soil moisture levels. The graph below clearly shows declining solute levels in the first pane with increasing temperature (middle pane) and increasing soil moisture contents (bottom pane).

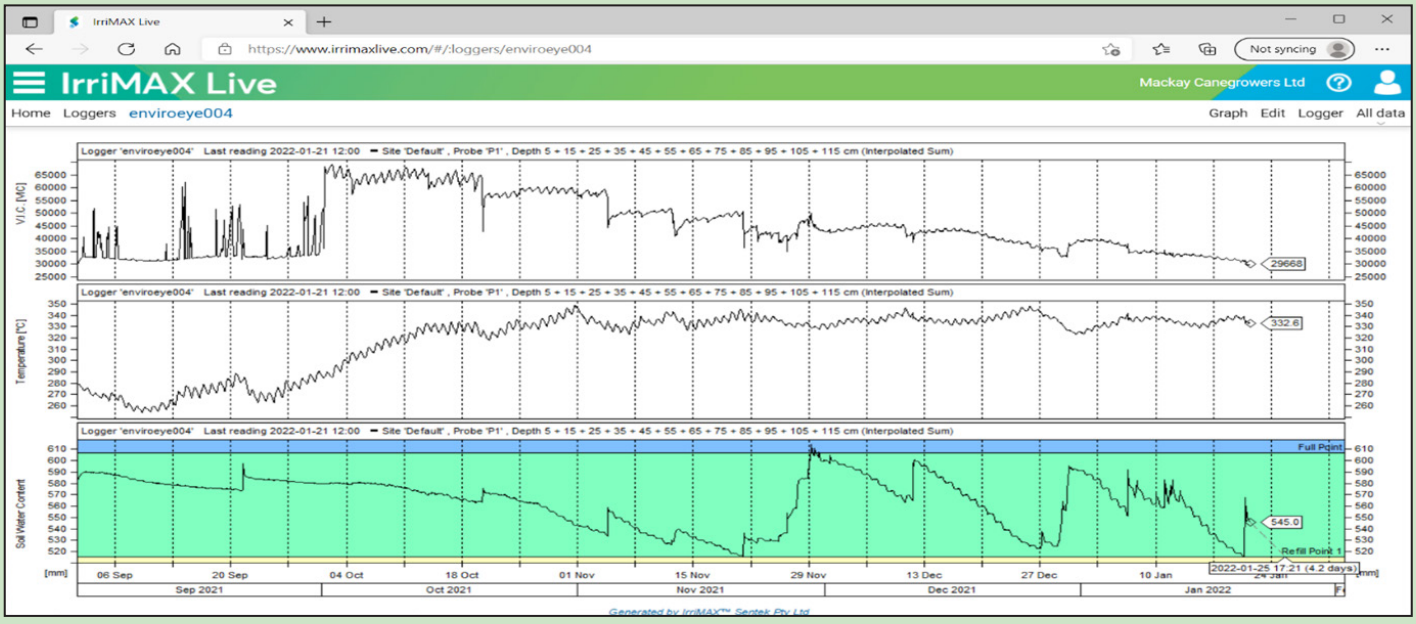

FIGURE 1

This project is a part of the Mackay Whitsunday Water Quality Program, funded by the partnership between the Australian Government's Reef Trust and the Great Barrier Reef Foundation.

Australian Government | REEF TRUST | Great Barrier Reef Foundation

Initiating root activity and fertiliser solubility for plant uptake early in the season is critical to ensuring that the plant uptake of nutrients is achieved as early as possible from both a water quality and productivity perspective.

"Soil water and nitrogen (N) availability are critical factors for maximizing plant growth, production, and quality, especially in crop growing areas where water stress is prevalent. These two factors interact with each other, controlling various metabolic processes, biomass formation, overall growth, and nutrient allocation in plants". (Nguyen et al, 2017)[1]

APSIM modelling indicates the same outcomes as VIC probes (see Figure 3).

1: *Nguyen, G.N., Joshi, S. & Kant, S. (2017) Chapter 13 - Water availability and nitrogen use in plants: effects, interaction, and underlying molecular mechanisms. In Plant Macronutrient Use Efficiency (eds Hossain, M.A., Kamiya, T., Burritt, D.J., Tran, L.-S. P. & Fujiwara, T.), pp. 233-243. Academic Press, Cambridge, USA.*

DRYLAND CROP

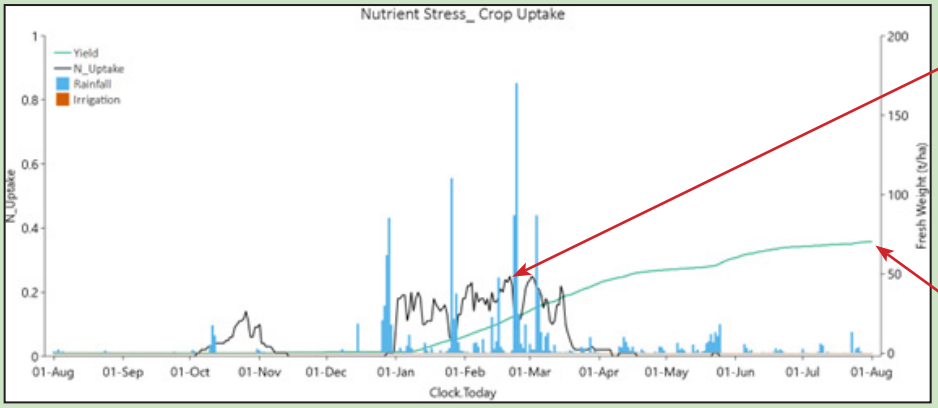

FIGURE 2

Figure 2 shows a dryland crop where N solutes only become available late in the season means reduced crop N uptake and increased losses to runoff, drainage and gaseous losses.

Dryland Yield = 68t/ha

IRRIGATED CROP

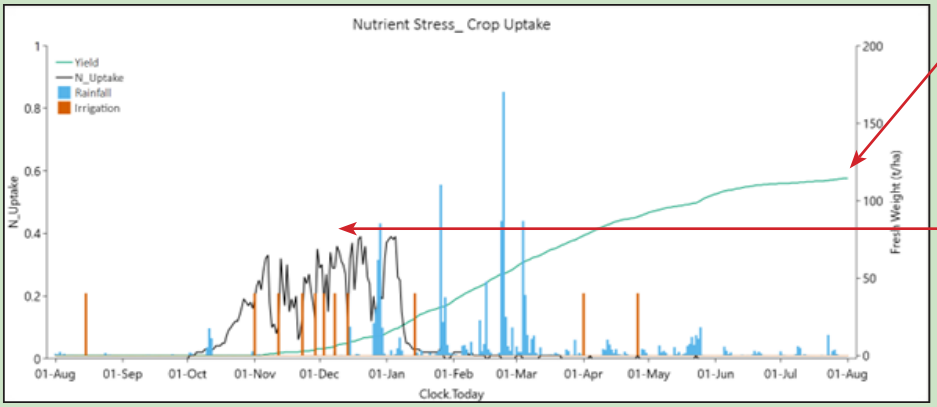

FIGURE 3

Irrigated Yield = 115t/ha

Figure 3 shows how initiating crop establishment and development by meeting crop demand for water (see Factsheet 3) and synchronising N application to crop growth means increased N uptake and decreased losses to runoff and drainage.

Note the majority of the crop N uptake has occurred pre-heavy rainfall events.

Continuous gains for environment and productivity by improving irrigation strategies and water management

A win-win scenario created by applying the right amount of water at the right time