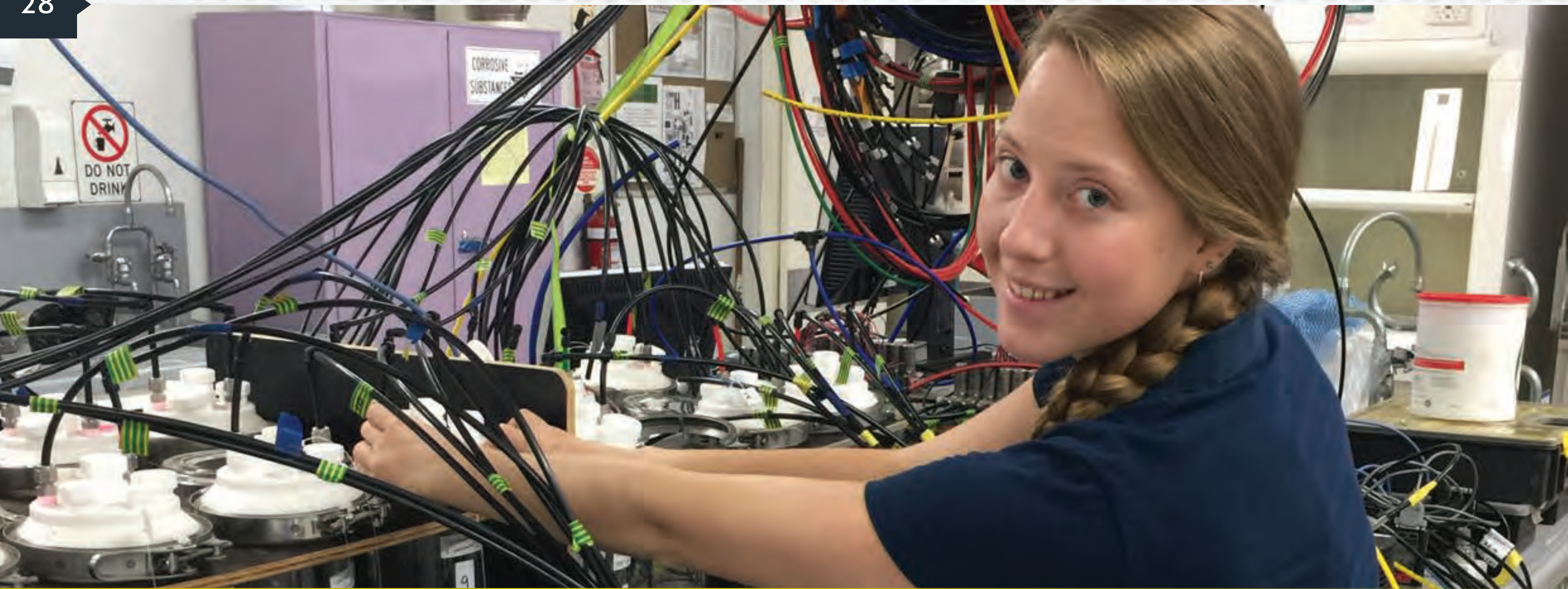

Novel laboratory approach uses robotics and micro-dialysis in nitrogen use efficiency research

The Queensland Government's Department of Agriculture and Fisheries (DAF) project, New technologies and management: transforming nitrogen use efficiency (NUE) in cane production *is one of three sugar research projects into NUE being conducted under the umbrella of the four year cross-industry* More Profit from Nitrogen Program. ***By Marguerite White***

The QDAF team is taking a novel approach to their research, with laboratory studies that are cutting-edge for the sugar industry. The team has devised a process for testing the characteristics of a range of nitrogen (N) fertiliser formulations under different management and environmental conditions within the laboratory.

The aim is to develop more targeted N formulations to better match N release to cane crop uptake demands, throughout seasons, by controlling N transformations and solubility, and combating N "leakiness" to the environment.

To do so, the team has designed equipment to rapidly test characteristics influencing optimal N application for cane crops of singular or combinations of enhanced efficiency fertilisers (EEFs).

Dr Matt Redding, QDAF's project research leader, explains: "Fortunately, in the area of novel EEFs there is no shortage of prospective technologies. New approaches and new materials with unique characteristics are in abundance in literature and the commercial sphere. On paper, a large number of formulations are theoretically sound in terms of delivering one or more of the desirable characteristics of EEFs."

However, this raises two dilemmas for NUE research:

(1) Field trials are expensive; and

(2) The very advantages of field trials, that they incorporate all those in-field variable characteristics, are also their disadvantage when it comes to incremental optimisation of untried technologies. Small changes are hidden behind apparent randomness related to the factors an agronomist cannot control.

"This is why the QDAF team is commencing studies in a more controlled, cost effective, environment," explains Dr Redding.

His team has developed a suite of equipment and methods to automate this process-based fertiliser problem solving. Being continuously improved, the cutting edge ensemble includes computer integration and automated 32 channel manifolds, reaction vessels plumbed with gas lines, probes previously used to measure brain fluid chemistry, a mechatronic plant growth accelerator (with 3D cameras), a rainfall simulator with automated sampling, and a bank of spectrophotometers. The rapid growth pot trials are using mechatronic technologies to carefully control the environment of the experiments, with robotics being used to schedule and apply water whilst taking 3D images to measure growth rates and N soil and plant content.

"We are narrowing our selection of EEFs for later field trials, using plant accelerator studies, laboratory micro-dialysis, and rainfall simulation techniques," explains Dr Redding.

"Given there is such an extensive list of possibilities, we need to efficiently evaluate and optimise, eliminate failures, and finally, economically select the materials that deserve a shot in the field. We can do this in a number of months, rather than years."

Where a field trial produces unexpected results, these testing technologies will also have a role to play. "We can delve into those issues at the process level, to explore further what may enable that technology to work more effectively in the field."

The QDAF team acknowledges that if a technology works in controlled circumstances, it may not work in the field, but this "proof of concept approach" reduces the likelihood of failure in the field.

"If a technology does not deliver the process advantages hoped for on a small scale – testing using large scale expensive experiments won't help," emphasises Dr Redding.

Trial and demonstration sites will be established in the third and fourth years in the Herbert/ Wet Tropics and Burdekin catchments for the QDAF project. In this phase, the team will be able to focus on completing field trials with a limited number of evidence-based EEF formulations for the sugar industry.

Already producing results, to date this approach has identified:

- An inhibitor treatment that can decrease runoff nitrate losses from the rainfall simulator by about half.
- Two inhibitor formulations that can increase plant nitrogen uptake after 12 weeks under highly leached but otherwise controlled conditions. This is a good early success as decreased initial fertiliser vulnerability to loss followed by mid-season availability is one of the key research targets.
- A novel inhibitor formulation that increases plant nitrogen uptake for the period from germination to 20 weeks in a model plant.
- Six novel inhibitor formulations capable of significantly decreasing nitrogen leaching losses.

More on the More Profit from Nitrogen Project can be found at http://www.crdc.com.au/more-profit-nitrogen

Australian Government
Department of Agriculture and Water Resources

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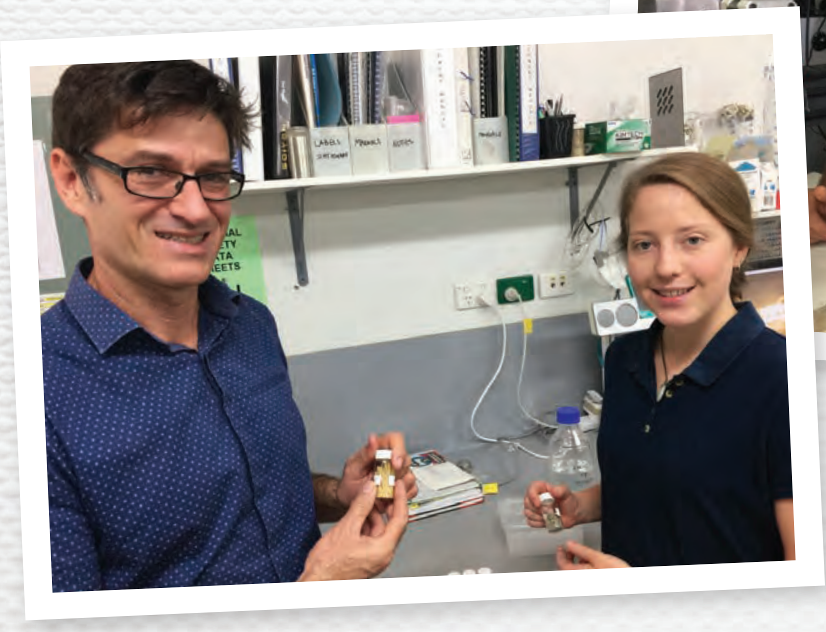
Below: Dr Matt Redding and Taleta Bailey with a number of EEFs being investigated for their potential to better match N applications to crop requirements.

Opposite: QDAF Technician Taleta Bailey checks the 16 micro-dialysis instruments each containing a different EEF formulation.



Above: University of Southern Queensland metatronics engineer, Dr Craig Lobsey and Dr Matt Redding demonstrate the robot designed to control the rapid growth pot trials