TRAVEL, CONFERENCE or SCIENTIFIC EXCHANGE REPORT

Part 1 - Summary Details

Please use your TAB key to complete Parts 1 & 2.

CRDC Project Number: **CSP2302**

Project Title: Attend and Present at the XXI International N workshop at the School of Agricultural, Food and Biosystems Engineering – Universidad Politecnica de Madrid

Project Commencement Date: **19/10/2022** **Project Completion Date:** **2/11/2022**

CRDC Research Program: **1 Farmers**

Part 2 – Contact Details

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Part 3 – Travel, Conference or Scientific Exchange Report

(Maximum two pages)

1. A brief description of the purpose of the travel.

The purpose for attending the XXI N Workshop in person was to present the key findings from the CRDC QUT Targeted N project in remote sensing for N optimisation and precision agriculture.

The key findings presented at the workshop from the project include:

1. Vegetative Indices (VI) can estimate differences in crop N status within management zones,
2. A multivariate approach that considers soil moisture, canopy structure and soil background reflectance is required to accurately predict leaf N, petiole NO_3-N and lint yield across the entire field,
3. Sensor comparison has found that VIs derived from Sentinel-2 provide similar results and reflectance patterns to the Crop Circle
4. Sentinel-2 can therefore be used as a cost-effective source to estimate N status and inform N management decisions
5. Future Farm will significantly improve the way in which soil and crop sensors are used to inform decisions about the amount and timing of N inputs to maximise productivity and profit

In 2021 I presented at INI2021 virtually and connected with Dr Jose Gabriel and Dr Jose-Luis Pancorbo from the University of Madrid. I also connected with their team during my visit to Madrid (lead by Professor Miguel Quemada) and discussed their research using hyperspectral band sensitivity for nitrate-N and their research using clip and handheld sensors. They are undertaking very similar research with clip sensors, however, in maize and winter wheat. We are using near infra-red sensors developed by Hone in cotton.

There was an opportunity to attend other key sessions that are important to the cotton industry. The sessions were:

1. Remote sensing for N optimisation and precision agriculture.
2. Costs and benefits of halving N waste by 2030
3. N and circular economy. The role of affected stakeholders
4. Policy Strategies for reducing N waste

The sessions all align nicely with the strategic RD&E plan goals of the CRDC. Attending and participating in the meeting exposed me to the strategies implemented internationally to tackle N waste. It also made me aware of the policy frameworks that could be implemented in Australian agriculture and the impact on our productivity as well as the role of circular economy research to assist in reducing waste.

2. What were the:

a) major findings and outcomes

The major findings from the meeting were:

1. Considering the policy strategies for reducing N waste sessions: there is a major chasm between land managers and policy makers. The policy strategy session for reducing N waste showcased a number of talks with sophisticated nitrogen budget modelling. There were sessions that modelled nitrogen budgets for urban and rural systems. A considerable number of presentations centred on segregated systems and did not consider a synergistic approach in their analysis.

2. The remote sensing for N optimisation and precision agriculture session highlighted that we are at the forefront in Australia when considering remote sensing research. The entire day dedicated to this topic provided an opportunity to hear about different methodologies of postprocessing of data collected from Satellite, Drone, Handheld and proximal sensors. There was no clear technology to cover all applications.

3. N circular economy session highlighted the massive gap in understanding the overall emissions balance. I attended the circular economy field trip on the Wednesday (see Figure 2 in the appendix). The highlight from this session and field trip was the lack of full accounting during the processes. Considering the Madrid composting facility as an example illustrated that there is a need to fully account for the whole circular economy process. The cities plant residues (from pruning in parks and gardens) were trucked to the facility and past through many stages to be composted and sieved to a desired fraction before being returned to the city gardens. The many process (from cartage, loader, mulching, composting, and sieving) all required fossil fuels and thus producing high emissions. The circular economy process, returning plant material back to the city gardens in a compostable form, required significant energy inputs (fossil fuels) and processes (and not accounted).

b) other highlights

During the field trip we visited the "La Chimenea" field station (IMIDRA). The IMIDRA is the site where the research groups Agroecosystems Pollution by Agricultural Practices (COAPA) and Agsystem's (University of Madrid) undertake their field experiments in cover crop, permanent crops and herbaceous crops and study emissions using the same greenhouse gas sampling systems (Appendix - Figure 3 – bottom right) we have used at Myall Vale with Professor Peter Grace. It was interesting to see the results from the research. Topsoil incorporation of maize residue was shown to reduce nitrous oxide emissions during the cover cropping phase. Incorporation of vetch was also shown to reduce nitrous oxide emissions when compared to the residues being removed. The residue incorporation was seen to tie-up the N in the system when incorporated. When removed it allowed the losses from the soil surface. We also visited another site measuring ammonia losses using the micrometeorological integrated horizontal flux (IHF) method (Appendix - Figure 3). Low losses of ammonia were measured during heavy rainfall events after urea application and no differences in ammonia losses were found when comparing Urea and Urea + urease inhibitors.

3. Detail the persons and institutions visited, giving full title, position details, location, duration of visit and purpose of visit to these people/places. (NB:- Please provide full names of institutions, not just acronyms.)

I met with a number of key people working in sensors.

Dr Jose-Louis Pancorbo, Post-doctoral fellow at ETSIAAB (Higher Technical School of Agronomic, Food and Biosystems Engineering). Dr Pancorbo is working in field experiments evaluating the potential of spectral and thermal imagery to reduce environmental pollution by adjusting irrigation and fertilisation to meet crop requirements. He is working with a Dualex optical sensor and very similar to a SPAD meter.

Dr Jose Gabriel, Associated Researcher and Senior Scientist at INIA (National Institute for Agriculture and Food Research and Technology. Dr Gabriel is an engineer and is working with Field Spec device (Spectroscopy) to determine nitrogen in Maize to improve NUE through better management using technology.

Professor Miguel Quemada Saenz-Badillos, ETSIAAB (Higher Technical School of Agronomic, Food and Biosystems Engineering). Professor Quemada leads the team at the University of Madrid in the sensor engineering, working in N cycling in agricultural systems and application and decomposition of organic waste.

The visit with the sensor team occurred during the conference. It was primarily setup to discuss the relevance to our Future Farm project and sensors evaluated over the 4 years. We discussed the Shiny app. that was developed in the Future Farm project, and it was encouraging to receive positive feedback that this something new to assist growers/consultants to utilise satellite imagery without the complex steps of post-processing required to access the data and interpretation for field decisions.

4. a) Are there any potential areas worth following up as a result of the travel?

There were a number of connections with colleagues working in policy that would be ideal to connect and sort through the issues that may be coming to impact us in Australia. A key example is the Dutch Policy to reduce nitrogen oxide and ammonia emissions by 50% by 2030.

This has resulted in protests from Dutch farmers blockading the Hague. The policy is seen as impracticable by farmers that claim it will shut down their livestock enterprises. Another example was from fertiliser subsidy policy implemented in Sri Lanka that has impacted their economy. The European Green Deal is another policy that has implications for Australia as it targets no net emissions of GHG by 2050. This would be worth following up with colleagues from the EU and how it effects agriculture. I also attended the policy session with Dr Cameron Gourley (current Oceania centre director for INI). We have kept in contact and will continue the connection. I will continue to connect with the sensor team at the university of Madrid to keep abreast of any new and emerging technology.

b) Any relevance or possible impact on the Australian Cotton Industry?

The main impact for the Australian Cotton Industry is the implementation of regulatory policy in regard to excess nitrogen (waste). If we see a regular occurrence of algal blooms in our rivers or waterways, for example, we may see these polices become reality for our industry. The policies that are currently implemented in the European Union are having significant impacts. The protests that have taken place in The Netherlands are one example of significant impacts on farming through the implementation of emission policy. It is imperative that we as an industry reduce our N waste so that this does not occur in Australia.

5. How do you intend to share the knowledge you have gained with other people in the cotton industry?

The intention is to share with the industry at several events like the Australian Association of cotton scientist in 2023 (Toowoomba). I have also submitted an expression of interest to present at the Crop Consultants Association meeting in Narrabri on the 26th and 27th July.

Appendix

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Centro de Estudios e Investigación para la Gestión de Riesgos Agrarios y Medioambientales

POLITÉCNICA
UNIVERSIDAD POLITÉCNICA DE MADRID

WORK SHOP 2022 MADRID
Halving nitrogen waste by 2030

Certificate of participation

Is hereby granted that

Tim Weaver

has attended the **XXI International N Workshop**.

Tim Weaver has also participated:

Presenting a scientific communication as **oral**

Title of the communication(s):

Future Farm: Technology solutions for improved nitrogen application in Irrigated Cotton.

The XXI International N Workshop was held in the Universidad Politécnica de Madrid, Spain 24th – 28th October 2022.

Digitally signed by SANZ COBEÑA ALBERTO - 70061738N
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Luis Lassaletta, Alberto Sanz-Cobeña

Co-chairs

CEIGRAM. Universidad Politécnica de Madrid, Spain

Figure 1. Presenting at the XXI International N Workshop at the University of Madrid.

Figure 2. Circular economy tour – Madrid city park plant residues from pruning are processed at the "Migas Calientes" Composting facility. The composted residues are then trucked back to the garden beds in the city.

Figure 3. Measuring ammonia losses at the "La Chimenea" field station using the gold standard "Integrated Horizontal Flux" method. The shuttles are placed at standardised heights of 0.25, 0.50, 1.0, 1.5 and 2.75 m above the soil surface. The plots are circular (20 m radius) and measuring ammonia from Urea and Urea+ inhibitor applied plots. The ammonia is captured in the shuttles on the stainless-steel spiral coated in oxalic acid. It is then extracted from the stainless-steel spiral using deionised water. Bottom right - the GHG chambers in another field capturing nitrous oxide emissions under cultivation and min-till rotation experiments.