Project to unlock enhanced efficiency fertiliser potential

Australian grain growers could unlock tools to improve nitrogen use efficiency and reduce on-farm greenhouse gas (GHG) emissions through a national research project examining enhanced efficiency fertilisers (EEFs).

EEFs use chemical or physical approaches to regulate the release of nitrogen and its availability to plants.

They aim to reduce the risk of nitrogen loss by better synchronising the supply of fertiliser to crop demands.

The four-year, $17.33M project is a co-investment of the Grains Research and Development Corporation (GRDC) and will be led by the University of Melbourne alongside several research organisations and industry partners.

GRDC managing director Nigel Hart said the strategic investment was developed in response to grower needs with managing input costs and sustainability front of mind for the industry.

"As an organisation investing on behalf of Australian grain growers, we are keenly aware of the pressures our sector is facing from high input costs, particularly for nitrogen," he said.

"There is a very real need to ensure we are using the most efficient fertilisers in the most efficient way.

"This research led by our partners at the University of Melbourne is critically important with the increasing need to understand and reduce emissions where we can as part of the long-term sustainability goals of farming operations and Australian agriculture more broadly."

Project lead associate professor Helen Suter from the University of Melbourne said a number of EEF technologies were commercially available but relatively little was known about their efficacy in different climates and agroecosystems, and their economic and environmental benefits to the grains industry.

A new $17 million research project will examine the potential of enhanced efficiency fertilisers to improve nitrogen use efficiency. (Arjun Pandey/University of Melbourne)

"Growers are looking for recommendations of what technologies work where, when, why and how, to make informed decisions about their nitrogen management strategies," she said.

"The project will establish a network of field trials across Australia in representative soils and cropping systems, where commercially available EEF technologies will be evaluated alongside conventional nitrogen fertilisers.

"These technologies include urease inhibitors (to reduce ammonia loss), nitrification inhibitors (to reduce nitrous oxide, nitrogen and leaching loss), dual (urease and nitrification) inhibitors and controlled release fertilisers (both targeting all loss pathways)."

Controlled-environment studies will complement the field-based activities, allowing a mechanistic understanding of soil nitrogen cycling and loss pathways, and will support modelling activities aimed at quantifying the environmental impact and potential nitrogen use efficiency gains associated with the use of EEFs across the grains industry.

The EEFs trialled will target key nitrogen loss mechanisms (denitrification, nitrate leaching, volatilisation) in different cropping regions and quantify crop nitrogen uptake to determine nitrogen use efficiency and return on investment.

The fate of nitrogen will be tracked in soils and plants using nitrogen-15 stable isotope labelled fertilisers.

GRDC sustainable cropping systems manager Cristina Martinez said EEFs had been raised across several GRDC National Grower Network forums and were front-of-mind for many growers given increasing sustainability requirements.

"Enhanced efficiency fertilisers are a potential option for reducing on-farm GHG emissions while also improving nitrogen use efficiency," she said.

"There are a few reasons for their low adoption amongst grain growers, which include higher cost - relative to standard fertiliser products - and uncertainty about how they behave and perform in the field and the return on investment they provide."

The project, 'Enhanced efficiency nitrogen fertilisers in the grains industry: an opportunity to reduce GHG emissions and increase Nitrogen Use Efficiency (NUE)' will run for four years, with results anticipated to be available to growers from 2028.

Researchers dig deep for sustainable farming

Digging deep into South Australia's history of soil biology, researchers from the South Australian Research and Development Institute (SARDI) have gained a better understanding of how soil microbiome functions to ensure sustainable broad acre farming into the future.

SARDI senior research officer in the agronomy program Dr Andong Shi recently published an article in Advances in Agronomy titled 'Impact of agronomic management on the soil microbiome: A southern Australian dryland broadacre perspective.'

With a key component of a farming system being the soil ecosystem, Dr Shi said it was crucial to understand the effects past changes in land management practices had on current farming systems in order to help improve future systems.

"The aim of the article is to increase awareness of the importance of soil biology in farming systems, as it is often ignored, particularly when compared to the traditional soil analysis where the chemical and physical properties are often measured and monitored," Dr Shi said.

"We hope that by learning from the past, we can harness the benefits of soil microorganisms in sustainable farming practices to help increase soil fertility, reduce environmental footprint and maintain or enhance crop productivity."

The soil microbiome is a collective concept, including all the microorganisms in the soil, living or dead, as well as their metabolites and genetic materials in the close vicinity.

"Our management of soil has a direct influence on shaping how the soil microbiome functions," Dr Shi said.

"Management practices alter the food source, water availability and accessibility, as well as the shelter for the soil microbiome.

"As a result, the changes in these elements exert feedback on the whole soil ecosystem.

"Therefore, the way that we manage the soil reflects on how healthy the soil ecosystem is, how well it functions, and how productive and sustainable it will be for crop and pasture production in the future."

This study is part of a larger soil microbiome project called 'Past, present and future drivers of soil change', which is co-led by SARDI's associate professor Rhiannon Schilling, and associate professor Stuart Roy from the University of Adelaide, along with Dr Krista Sumby from the University of Adelaide and professor Timothy Cavagnaro from Flinders University.

The project also involves Birchip Cropping Group in Victoria, Kalyx Australia in Western Australia and the Thomas Elder Institute.

One of the project's core aims is to determine whether the diversity and composition of soil communities from past farming systems differ from those of current farming systems.

To investigate this, soil DNA samples collected over the past 20 years from southern Australian farms have been analysed.

The end goal is to assess changes in the soil microbiome alongside the evolution of broadacre cropping management practices in the southern Australian farming zone.

Dr Sumby said the findings to date for the soil DNA revealed changes in the soil microbiome composition over the past two decades.

"We are currently untangling if and/or how this correlates with changes in climate and broadacre cropping practices over the same time period," she said.

To access Dr Shi's article, visit doi.org/10.1016/bs.agron.2024.02.008

Researchers getting the soil core with PVC pipes. (PIRSA)