The Institution of Agricultural Engineers

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# The Environmental Team Award 2026

## Diogenes Antille & his Team

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The team conducted a four-year research project that investigated the role of Controlled Traffic Farming (CTF) in mitigating greenhouse gas emissions from intensively managed grain cropping systems and quantified substantial environmental benefits from adopting such an approach. In addition to **Dr Antille**, the team comprised **Jeff N. Tullberg** (Australian Controlled Traffic Farming Association Inc., Brisbane, QLD, Australia), **Jochen Eberhard** (University of Southern Queensland, Centre for Agricultural Engineering, Toowoomba, QLD, Australia), **Chris Bluett (**Australian Controlled Traffic Farming Association Inc., Buninyong, VIC, Australia) and **Clemens Scheer** (Karlsruhe Institute of Technology, Institute for Meteorology and Climate Research, Germany).

The main results from the project can be summarised as follows:

- $N_2O$ emissions from random-trafficked soil were consistently and significantly greater (by an average factor of 2.2) than those from non-trafficked soil in crop beds of the CTF system.
- Soil methane ($CH_4$) consumption was significantly increased in the non-trafficked CTF beds compared with random-trafficked soil or permanent traffic lanes, although overall $CH_4$ fluxes were small.
- CTF reduced the proportion of no-tillage field area affected by traffic from ~50% in non-CTF to <15% in CTF, for which it was estimated that CTF could reduce the Global Warming Potential of soil emissions of $N_2O$ and $CH_4$ by between 30% and 50% compared with random traffic systems.
- An estimate of the quantitative impact of CTF suggested a potential reduction in annual soil emissions from (Australian) dryland grain farming by 90–150 kg $ha^{-1}$ $CO_2e$. Therefore, converting 50% of the 22 M ha of dryland grains in Australia to CTF could reduce annual emissions from Australian cropping systems by between 12.0 and 34%.

- Converting from a system with 50% wheeled area to CTF with 12% area in permanent traffic lanes and based on the average fertiliser cost used in the analyses, possible nitrogen savings would be about AU$9,200 per 1,000 ha cropped.

The environmental benefits delivered by this research were further demonstrated by quantifying the impact of CTF on fertiliser and rainfall use efficiencies. It was shown that, in conventionally trafficked systems, improvements in nitrogen and rainfall use efficiency are constrained by soil compaction and that:

- Fertiliser N use efficiency (NUE) was 1.75 times higher in CTF compared with non-CTF.
- Rainfall use efficiency was between 15% and 65% higher in CTF compared with non-CTF, and runoff was reduced by up to 38%, depending on seasonal rainfall. Plant available water capacity was increased by ~10% in CTF compared with non-CTF.

The research has contributed to drive adoption of controlled traffic farming (CTF), which is now approaching ~40-45% of the Australian grains industry and is gaining interest within the (Australian) cotton and sugarcane industries. The project has also identified the synergism between CTF and no-tillage and its compatibility with variable rate and allied precision agriculture (PA) technology. It has informed work conducted by CSIRO that developed the methodologies used as part of the Australian cotton baseline and GHG mitigation assessments and these approaches are now established as the standard methodology for both the cotton and grains industries.

The research has been well received by both the scientific and engineering communities including, for example, through invited presentations delivered at International Controlled Traffic Farming Conference (Ballarat, Australia, February 2019), The International Soil and tillage Research Organisation (Virginia USA, September 2024), and The International Fertiliser Society (Cambridge, December 2024).

The work on controlled traffic farming has contributed to re-purpose international long-term experimental research on soil tillage and compaction by shifting its historical farming system's productivity focus to also embrace the impact of soil management and mechanisation practices on soil health and carbon sequestration. This is in line with the expectations (and need) to reduce the environmental impact of farming in the context of climate change. It is therefore anticipated that this project will further stimulate new research in Central Europe that will go some way to inform near-term environmental and soil management policy as EU agriculture aims to transition towards carbon neutrality.

Although centred on Australia, the work has important international implications in that it demonstrates the links between physical soil conditions as influenced by traffic and cultivation strategies, the emissions of greenhouse gases from soils and the efficiency of fertiliser and water inputs within cropping systems. It is therefore very appropriate that the team conducting the work be awarded the Environmental Team award from The Institution of Agricultural Engineers for 2026.

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