Nitrous oxide emissions from cotton growing soils of Australia

Peter Grace[1], Ian Rochester[2], David Rowlings[1], Ralf Kiese[3], Klaus Butterbach-Bahl[3], Yong Li[4], Deli Chen[4] and Brett Crothers[5]

[1]Institute for Sustainable Resource, Queensland University of Technology, 2 George St, Brisbane, QLD 4000, Australia,
[2]Cotton Catchments CRC, Wee Waa Rd, Myall Vale, NSW 2390, Australia,
[3]Institute for Meteorology Climate Research, Forschungszentrum Karlsruhe, Kreuzeckbahnstrasse 19, D-82467 Garmisch-Partenkirchen, Germany,
[4]School of Resource Management, The University of Melbourne, Parkville, VIC 3010, Australia,
[5]Benalla, Cecil Plains Rd, via Dalby 4870 QLD, Australia.

Nitrogen is an essential, but expensive input to cotton farming systems. It is also a significant source of N_2O, which is emitted during the water-logging of soil profiles upon irrigation. Reducing N inputs, or the losses of applied N to the atmosphere is beneficial in terms of increased nitrogen use efficiency, profitability and reducing the global warming signature of cotton farming systems.

Nitrous oxide emissions from on-station Best Management Practice (BMP) trials (grey clays with a moderate N loss potential), receiving both mineral (100 kg N ha^{-1}) and organic (333 kg N ha^{-1}) sources of N, ranged from 0.16-0.36% of applied N. On-farm N_2O emissions (black clays with a relatively high N loss potential) where split applications of N are applied, do not exceed 1% of applied N, with total gaseous N losses (excluding NH_3) being 16% of the applied N. The practice of split applications is increasing across the cotton industry and its positive impact on reducing emissions is becoming obvious.

Substantial leakage of nitrate from beds to furrows was experimentally confirmed in the on-farm component of this project and is a significant source of N_2O emissions. This is an area of concern, considering the majority of growers use furrow irrigation.

A combined experimental and simulation methodology has been utilised to advance our knowledge of a complex N cycle in cotton systems. Site specific BMPs for reducing N losses and associated greenhouse gas emissions have been generated using the WNMM and DNDC simulation models.