Title	**Mapping and managing uring patches to reduce nitrous oxide emissions**
Project Timeframe	Jul 2017 – Jun 2020
Countries Involved	New Zealand (Manaaki Whenua-Landcare Research, Pastoral Robotics Ltd., AgResearch, Massey University) Ireland (Teagasc) Australia (Department of Parimary Industries – New South Wales)
Aims	To develop a new mitigation technology ("Spikey-R") for farmers and agricultural industries in New Zealand and internationally that can accurately locate and map the size and shape of urine patches, for use in measuring and reducing N_2O emissions from grazed pastures.
Research Highlights	• The Spikey-R unit was developed by extending Pastoral Robotics Limited's existing technology by incorporating a much denser array of electrodes (to measure the change in soil conductivity caused by urine deposition). • Over the project 576 measurements of urine patches where made by Spikey-R, with only five patches missed. • A 3-D model of urine patches developed in the project verified urine patch geometry in soils and enabled the determination of the interception of urine-N by targeted application of a nitrification inhibitor using a spray unit incorporating Spikey-R technology. • Spikey-R was an improvement over existing technologies when real-world performance (e.g. over different timeframes or weather conditions). • Potential for automation was considered along with accuracy of detection when developing Spikey-R. • International collaborations were made with Australia and Ireland, where validation experiments were carried out under varying soils and environmental conditions.

Future Work	• Need to further develop and investigate the Spikey technology by:
	
	   - identifying the best novel nitrification inhibitors and optimum application rates to reducing N_2O emissions
	
	   - demonstrating the effectiveness of these inhibitors in different soils and environmental conditions
	
	   - identifying any environmental consequences of inhibitor use, including detection in animal products (meat or milk) for human consumption and

	- developing an implementation strategy for the application of new inhibitor/s in collaboration with Primary Industry organisations in New Zealand and GRA-associated countries.
	• Research in reducing N_2O emissions from freshly deposited urine patches using novel nitrification inhibitors is in progress - preliminary results indicate none of the inhibitors applied 4 hours after urine application reduced N2O emissions. It is suspected that the inhibitors applied with "Spikey" spray unit after 4 hours of urine patch simulations under dry soil conditions at both sites were not able to capture most of the urine.
	• Future research will focus on 'how the N losses associated with urine-N be efficiently reduced by treating the patches between 4 and 48 hours of deposition by grazing animals?
Key Research Output(s)	Journal article(s) Giltrap, D., Jolly, B., Bishop, P., Luo, J., Bates, G., Lindsey, S., Berben, P., Palmada, T., Saggar, S. (2020) 3D modelling of urine patch spread in grazed pasture soils. *Agriculture Ecosystems & Environment,* 292: 106809. Giltrap, D., Portegys, N., Saggar, S., Hanly, J.A. (Under Review) Inhibitor interception of urine patch. *Science of the Total Environment.* Jolly, B., Luo, J., Mehra, P., Forrestal, P., O'Neill, M., Richards, K., Singh, B.P., Bates, G., Saggar, S. (Under Review) Evaluation of proximal sensing technologies for mapping bovine urine patches in grazing pastures. *Computers and Electronics in Agriculture.* O'Neill, M., Saggar, S., Richards, K.G., Luo, J., Mehra, P., Singh, B.P., Forrestal, P.J. (Under Review) Effect of urine patch simulation method on N2O emissions and N uptake in livestock grazed pasture. *Nutrient Cycling in Agroecosystems.* Singh, B.P., Mehra, P., Fang, Y., Dougherty, W., Saggar, S. (Under Review) Nitrous oxide emissions from cow urine patches in an intensively managed grassland: influence of nitrogen loading under contrasting soil moisture. *Science of the Total Environment.* Conference proceedings/presentations Forrestal, P., O'Neil, M., Richards, K., Bates, G., Smith, D., Jolly, B., Saggar, S. (2020) Performance of "Spikey" in locating and detecting freshly deposited urine patches in livestock grazed pasture soils of Ireland In: Nutrient Management in Farmed Landscapes. (Eds. C.L. Christensen, D.J. Horne and R. Singh). http://flrc.massey.ac.nz/publications.html. Occasional Report No. 33. Farmed Landscapes Research Centre, Massey University, Palmerston North, New Zealand. Pp.11.

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