



PLANT, SOIL AND ENVIRONMENT SYSTEMS THEME RESEARCH REPORT

2016



une
University of
New England

**School of Environmental
and Rural Science**



Introduction

The Plant, Soil and Environment Systems (PSES) research theme sits within the School of Environmental and Rural Science. An active and productive research team within UNE, PSES brings together a number of discipline areas (including soil science, agronomy, plant physiology, pollution science, microbiology and precision agriculture) to conduct and develop inter-disciplinary research across the plant, soil and environmental sciences to address real-world issues.

Working from the micro- through to landscape- and global-scales, our research aims to balance the competing demands for human development and the production of food and fibre with the need to achieve optimum outcomes for the regional, national and international environment.

As an internationally recognised team of researchers, our work is supported through competitively funded projects and collaborations with a wide range of regional, national and international research partners. Our research activity covers much of the Australian continent and extends out into Asia, Africa, Europe and the sub-Antarctic.





Theme Leader's Review

The team of researchers in the Plant, Soil and Environment (PSES) theme have had a very productive 2016 having generated more than 40 high quality papers and research outputs. In 2016 alone, the team attracted more than \$1.06 million and currently have an ongoing grant value in excess of \$9.9 million.

Soil Science within PSES achieved an ERA grade of "5 – well above world standard" in the 2015 assessment and work now continues to ensure equivalent success in 2018.



The PSES team continue to work closely with a wide range of agencies and funding bodies including State and Federal Government, Research and Development Corporations, Cooperative Research Centres, the Australian Research Council and the Australian Antarctic Division in Australia and a wide range of agencies (e.g. ACIAR, NGOs) internationally. This wide network of research collaboration ensures the highest quality of research and training here in PSES.

2016 saw the graduation of 9 Higher Degree Research candidates across PSES who now leave us as well-trained scientists and who will contribute significantly to plant, soil and environmental science both in Australia and in their home countries overseas. We wish them all well in their future endeavours.

Professor Brian Sindel – Theme Leader

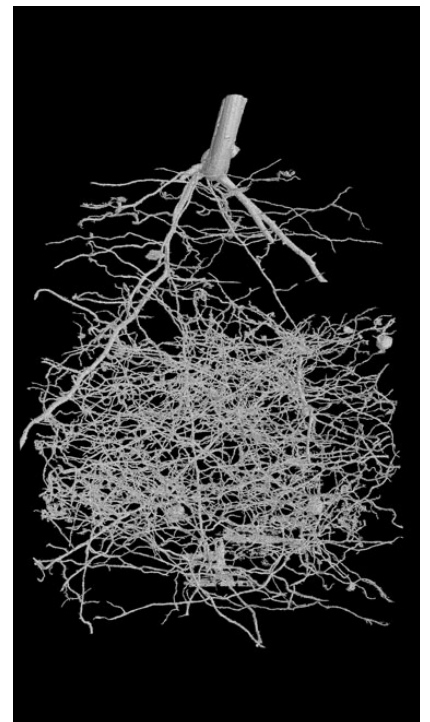
ROOT ZONE PROCESSES

How can soil root zone processes be optimised to enhance resource condition and use?



The rhizosphere surrounding plant roots sustains all terrestrial life. This is a complex and hidden system that requires multi-disciplinary research strategies to uncover its secrets. Within this research sub-theme, we study the relationships between root architecture, water uptake, nutrient and carbon distribution, and key physical, chemical and biological processes in the root zone and their optimization for enhanced plant productivity, resource condition and use.

The advanced techniques we bring to bear on these challenges include real time 3D tomography of root architecture, soil structure and change in biological communities; isotope tracking of carbon and other important plant nutrients; and soil biophysical measurements of root distribution and growth.



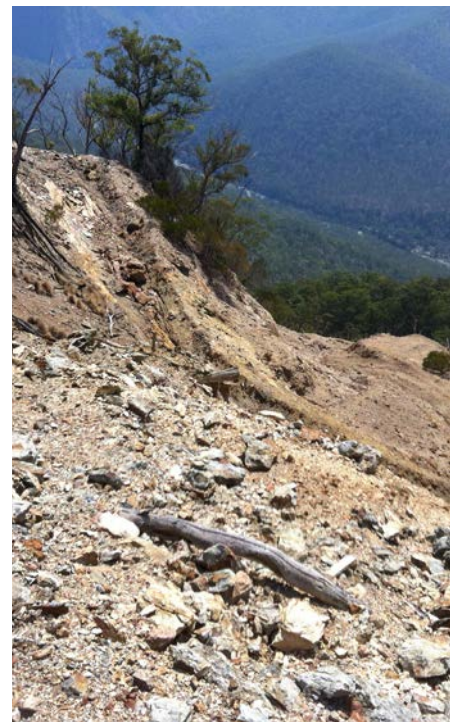
POLLUTION AND ENVIRONMENTAL STRESSORS

How can critical stressors affecting plant, soil and water conditions be managed to achieve environmental balance?



Our environment is faced with a myriad of stresses that threaten the ecosystem services on which all human and natural systems depend. Managing the consequences of these stresses costs billions of dollars worldwide each year. Some of the issues we are grappling with are pollution, fire, surface and groundwater water depletion, salinity, acidification and erosion.

Scientists in our multi-disciplinary team are using world-class laboratory and field facilities available at UNE to understand the critical processes driving these degradation changes. They identify effective management and mitigation strategies that then inform effective policies and ensure the long-term protection and productivity of the environment and, ultimately, human health.



PLANT PRODUCTION SYSTEMS

How can growth in Australian and world food and fibre production be sustained under increasing system constraints?



Maintaining the strong role of agriculture in Australia's economy and addressing global concerns about food security are key challenges for our nation. Changing socio-economic drivers, and environmental constraints, such as increasing temperatures and drought, along with threats from weeds, pests and disease, create a need to develop resilient farming systems that employ innovative technologies and diverse approaches to plant production. Understanding how plants function and respond to environmental as well as management factors in our extensive cropping, irrigated, horticultural and pastoral enterprises is central to ensuring that crops and pastures remain productive. At the same time, a thorough knowledge of whole farm systems is needed for effective and efficient use of finite resources by agricultural producers and other land managers.

Our team of researchers, uniquely placed in rural Australia with access to modern farms, advanced precision technology, information resources, genomic facilities and international partnerships, is conducting innovative research to tackle these local and global issues.



PSES STAFF

The PSES Research Theme consists of 15 academic and teaching staff, 14 adjunct staff, 7 administration and technical staff, and 3 postdoctoral fellows. These researchers have successfully supported up to 50 Higher Degree Research (HDR) candidates in 2016.

Academic Staff	Research Interests
Professor Brian Sindel	Weed ecology and management
A/Professor Chris Guppy	Crop agronomy and plant nutrition, soil P chemistry
A/Professor Paul Kristiansen	Horticulture, weed ecology/ management, organic and SE Asian farming systems
A/Professor Priti Krishna	Plant stress, hormone and root biology
A/Professor Brian Wilson	Soil carbon/ organic matter distribution and cycling
Dr David Backhouse	Plant diseases, fungi, plant-pathogen interactions
Dr Richard Flavel	Plant-soil interactions, rhizosphere, solution chemistry, whole farm systems
Dr Oliver Knox	Plant/microbial interactions, nematology, GM plants
Dr Lisa Lobry de Bruyn	Plant, soil and environment systems, soil health, community engagement
Dr Matthew Tighe	Fate and behaviour of trace elements, ancient contamination
Dr Mark Trotter	Pasture science, precision livestock management
Dr Nigel Warwick	Plant ecophysiology, soil-plant water and nutrient dynamics
Dr Susan Wilson	Pollutants in soils: processing, interactions, risk and remediation

Teaching Staff	Research Interests
Mr Craig Birchall	Agronomy and pasture systems
Mr Brendan Griffiths	Cotton production

Postdoctoral Fellows	Research Interests
Dr Yui Osanai	Soil carbon and nitrogen dynamics, environmental influence on storage and stability
Dr Sheikh Mohammad Fazle Rabbi	Plant root architecture, nutrient uptake by plants, x-ray tomography
Dr Alice Del Socorro	Entomology, semiochemicals as pest management tools, plant based insect attractants

Honorary and Adjunct Staff	Research Interests
Dr Zenebe Adimassu (IWMI Ghana)	Farming systems
Dr Jeff Baldock (CSIRO)	Soil carbon
Professor Graeme Blair	Soil C, agronomy, farming systems
Professor Annette Cowie (NSW DPI)	Soil C and N chemistry, biochar
Dr S Ghosh (CUGE Singapore)	Soil carbon, biochar, urban soils
Professor Peter Gregg	Entomology
Professor David Herridge	International development
A/Professor Robin Jessop	Cropping systems
Professor Robert Martin	Farming systems
Dr Tim McLaren (ETH Zurich)	Soil chemistry
Dr Malem McLeod (NSW DPI)	Farming systems
Dr BP Singh (NSW DPI),	Soil C and N chemistry, biochar
Dr M Veergathipillai (NSW OEH)	Soil chemistry, soil analysis
Professor Iain Young (University of Sydney)	Soil physics, rhizosphere

Technical and Administrative Staff	
Mrs Roz Mortimer	Administration
Mrs Leanne Lisle, Ms Elizabeth Marshall, Mr Gary Cluley	Environmental Analysis Research Laboratory
Mr Greg Chamberlain, Mr Paul Lisle	Field and Laboratory Assistance
Mr Michael Faint	Glasshouse Complex

RESEARCH HIGHLIGHTS

Agricultural and Rural International Research and Development

Researchers in PSES are involved in numerous agricultural development projects throughout South-east Asia, with activities in Indonesia, Thailand, Myanmar, Cambodia and Vietnam. We carry out research in a setting where agriculture is seen as a part of wider agribusiness. Farmers are active participants in the research, and private sector engagement is a key feature from project inception to final outreach and communication.



Projects range from addressing technical issues such as soil management, crop agronomy and farming systems integration, to broader agricultural challenges such as managing greenhouse gas emissions, herbicide resistance and crop diversification opportunities. Socio-economic, governance and policy issues are also an important consideration in our work, as these play a critical role in enhancing rural transformation and the adoption of technological innovation. Capacity building activities targeting in-country researchers and educators are also a commonly included in projects in order to extend the duration of impact beyond the life of the project itself.

Focussing on key economic crops including rice, vegetables and legumes, and emerging high value crops such as floriculture, spices and medicinal plants, these projects are supported by funding from the Australian Centre for International Agricultural Research (ACIAR), the Department of Foreign Affairs & Trade and the Department of Industry, Innovation and Science, as well as international donors such as the governments of Indonesia and Vietnam, and the Global Environment Facility.

Our international research and development builds on strong collaborative links in South-east Asia with government departments, universities and institutes, non-government agencies and the commercial sector, and also utilises the diverse experience and capacity of other Schools in the University of New England, particularly the UNE Business School.



RESEARCH HIGHLIGHTS

Pollution Science

Pollution Science Research has a focus on pollutants in soils: their processing and cycling, interactions, their effects, managing risks and remediation. Projects encompass both contemporary and ancient contaminated sites and soils working with a range of local to international collaborators. Activities include phytoremediation at large scale mine sites to exploring how soil microbes can be utilised to breakdown harmful soil pollutants to non-toxic end-products. The group is world recognised for expertise in comparative arsenic and antimony ecotoxicity and biogeochemistry.



2016 saw the completion of a large NSW Environment Trust funded project looking at contaminant risks and also the benefits of applying municipal waste derived organic outputs to soils. The project outcomes will underpin revised guidelines in NSW. Honours student Georgia Rogan sampled at ancient archaeological sites in Thailand where long-term % level copper contamination could pose a risk to rural farm communities, whilst new PhD student Sajanee Gunadasa started to understand how the risk of cadmium and arsenic contamination in Sri Lankan soils may be ameliorated with organic amendments. Five of the research group presented at the SETAC conference in Hobart, whilst outcomes from research quantifying threats from antimony contamination in aquatic ecosystems were presented to key State and local stakeholder groups of the Macleay River Catchment, NSW, to support contamination management in that system.



RESEARCH HIGHLIGHTS

Sub-Antarctic Weed Ecology and Management

Since 2012, PSES staff have been leading research in the sub-Antarctic, funded by the Australian Antarctic Division, in the ecology and management of invasive weeds, with particular focus on Australia's Macquarie Island. Projects examine the ecology of *Poa annua* (winter grass) and *Stellaria media* (chickweed).

Laura Williams was recently awarded her PhD for her work on winter grass and has published several papers having completed three summer field seasons on Macquarie Island as well as *ex-situ* studies. Laura has since returned to 'Macca' towards the end of 2016 with Dr Alex Fergus from the New Zealand Department of Conservation to work on the second of our projects.



Macquarie Island is about 1500 km south of Hobart (54°30'S, 158°57'E) in the Southern Ocean and has a cold, cloudy, wet, windy climate which can make the logistics of getting to Macquarie Island and conducting research there very difficult. The island (35 km long and ~5 km wide) is home to several million penguins, several hundred thousand seals as well as albatross and other sea bird species. This elongated undulating plateau is a world heritage area under the control of the Tasmanian Government but has also gained notoriety for the recent eradication of rabbits, rats and mice from the island through an extended program of baiting and hunting. Now that these damaging herbivores are gone, invasive plants pose the most serious environmental threat to the island as well as to the broader sub-Antarctic region, with the risk of invasion increasing with increased tourist traffic to the islands and changing climate patterns.



What will happen to these weeds following the removal of rabbits is part of the subject of our investigations. Moreover, the projects aim to investigate the ecology of these weeds, including their seedbanks, longevity and relationships to environmental factors as well as the effectiveness of various management practices including herbicides and their environmental fate.

RESEARCH HIGHLIGHTS

Terrestrial Carbon Research



The newly established **Terrestrial Carbon Research Group** led by A/Professor Brian Wilson applies rigorous science to questions relating to the storage, distribution and cycling of carbon in the terrestrial system. Research relates to the both above- and below-ground (soil) environment and the nature, quantity and mechanisms of carbon re-distribution through these systems.

Projects are funded by a wide range of regional, national and international agencies and the group works closely with collaborators to provide research results that can be applied by practitioners, government and non-government agencies alike. The group includes researchers from Australia, Ethiopia, Bangladesh, Japan and work continues in a range of Australian, African and Asian environments.

In 2016 two new researchers joined the group. Dr Yui Osanai began a 2 year post-doctoral project funded by the Cotton Research and Development Corporation evaluating soil carbon and nitrogen dynamics under cotton/maize crops in central NSW. We also welcomed Dr Debarati Bhaduri, a Visiting Endeavour Research Scholar from the National Rice Research Institute in Cuttack, India for a six month placement investigating the role of biochar application in modifying soil architecture, root morphology and soil C dynamics.



Work relating to the sources, cycling and distribution of soil carbon continues to unravel how carbon moves around the system and therefore the best ways to increase and stabilise carbon in the soil system to improve soil health and to help address climate change. Research is currently being conducted in cropping systems (e.g. Cotton), pastures, National Parks and offshore islands in NSW as well sites and systems in Singapore, India and Africa.



GRADUATES

Masters

Aaron Michael Ray *'The Relationship of Eggshell Structure to Eggshell Penetration by Salmonella Typhimurium in Table Eggs'*

Principal Supervisor: Associate Professor Julie Roberts

PhD

Mudhir Ismail Hwaidi *'Sorption of Sulfuryl Fluoride Into Wheat and its Impact on Efficacy, Fluoride Residues and Product Quality'*

Principal Supervisor: Professor Robert John Martin

Isaac Macharia *'Distribution, Characterisation and Management of Tomato spotted wilt virus and its Vectors in Tomato Production Systems in Kenya'*

Principal Supervisor: Dr David Backhouse

Hla Myo Thwe *'Nutrient Management in Rainfed Lowland Rice Farming System of Myanmar'*

Principal Supervisor: Associate Professor Paul Kristiansen

Karl Oscar Andersson *'The Speciation and Mobilisation of Phosphorus in Alkaline Vertosols'* Principal Supervisor: Dr Matthew Tighe

Sara Bayat *'The Application of Mixed Waste Organic Output (MWOO) to Soils: Effects on Metal and Metalloid Concentrations, Distribution, Bioavailability and Mobility in NSW Soils'*

Principal Supervisor: Dr Susan Wilson

Kristian Le Mottee *'The Ecology of Helicoverpa Punctigera: Adaptations for a Changeable Climate'* Principal Supervisor: Adjunct Professor Peter Gregg

Van Touch *'Climate Change in North-Western Cambodia: Impact Assessment, Vulnerability and Scope for Adaptation in Upland Agricultural Systems'*

Principal Supervisor: Adjunct Professor Robert Martin

Zhe Weng *'Short- and Long-Term Impacts of Plant-Biochar-Soil Interactions on Soil Carbon Cycling in a Subtropical Pasture'*

Principal Supervisor: Adjunct Professor Lukas van Zwieten



PUBLICATIONS

- 1 **Andersson, K O, Tighe, M K, Guppy, C N, Milham, P J, McLaren, T I, Scheffe, C and Lombi, E** (2016) XANES demonstrates the release of calcium phosphates from alkaline Vertisols to moderately acidified solution. *Environmental Science and Technology* (online early). DOI: 10.1021/acs.est.5b04814
- 2 **Andersson, K O, Tighe, M K, Guppy, C N, Milham, P J, McLaren, T I** (2016) The release of phosphorus in alkaline vertic soils as influenced by pH and by anion and cation sinks. *Geoderma*, 264:17-27.
- 3 **Barnett, M C, Forster N, Ray G A, Li L, Guppy C N and Hegarty RS** (2016). "Using portable X-ray fluorescence (pXRF) to determine fecal concentrations of non-absorbable digesta kinetic and digestibility markers in sheep and cattle. *Animal Feed Science and Technology*, 212: 35-41.
- 4 **Delgado-Baquerizo, M, Maestre, F T, Gallardo, A, Eldridge, D J, Soliveres, S, Bowker, M A, Prado-Comesaña, A, Gaitán, J, Quero, J L, Ochoa, V, Gozalo, B, García-Gómez, M, García-Palacios, P, Berdugo, M, Valencia, E, Escolar, C, Arredondo, T, Barraza-Zepeda, C, Bertrand, B, Bran, D, Cabrebra, O, Carreira, J A, Chaieb, M, Conceição, A A, Derak, M, Ersnt, R, Espinosa, C I, Florentino, A, Gatica, M G, Ghiloufi, W, Gómez-González, S, Gutiérrez, J R, Hernández, R M, Huber-Sannwald, E, Jankju, M, Mau, R L, Miriti, M, Monerris, J, Morici, E, Muchane, M, Naseri, K, Pucheta, E, Ramírez, E., Ramírez-Collantes, D A, Romão, R, **Tighe, M K**, Torres, D, Torres-Díaz, C, Val, J, Veiga, J P, Wang, D, Yuan, X and Zaady, E** (2016) Human impacts and aridity differentially alter soil N availability in drylands worldwide. *Global Ecology and Biogeography*, 25: 36-45.
- 5 **Divi U K; Rahman T and Krishna P** (2016) Gene expression and functional analyses in brassinosteroid-mediated stress tolerance. *Plant Biotechnology Journal*, 14: 419-432.
- 6 **England, J R, Paul, K I, Cunningham, S C, Madhavan, D B, Cavagnaro, T R, Baker, T G, Read, Z, Wilson, B R, Herrmann T, Lewis, T, Perring, M P and Polglase, P** (2016) Previous land use and climate influence differences in soil organic carbon following reforestation of agricultural land with mixed-species plantings. *Agriculture, Ecosystems and Environment*, 227: 61-72.
- 7 **Eskandari, S, Guppy, C N, Knox, O, Backhouse, D and Haling, R E** (2016) Improving mycorrhizal colonisation of cotton in sodic soils. *Rhizosphere*, 2: 48-50.
- 8 **Gupta V, Knox O and Bissett A** (2016) How does a cotton production system change the soil biology? *The Australian Cottongrower*, 37: 46-49
- 9 **Hobley, E, Le Gay-Brereton, and Wilson, B R** (2016) Soil charcoal prediction via ATR-FTIR spectroscopy. *Soil Research*, May 2016.
- 10 **Hobley, E, Baldock, J and Wilson, B R** (2016) Environmental and human influences on organic carbon fractions down the soil profile. *Agriculture, Ecosystems and Environment*, 233: 152-166.
- 11 **Hobley, E and Wilson, B R** (2016) The depth distribution of organic carbon in the soils of Eastern Australia. *Ecosphere*, 7: Jan 2016.
- 12 **Huynh, H T N, Lobry de Bruyn, L, Prior, J and Kristiansen, P** (2016) Community participation and harvesting of non-timber forest products in benefit sharing pilot-scheme in Bach Ma National Park, Central Vietnam. *Tropical Conservation Science*, 9: 877-902.
- 13 **Knox O** (2016) Regional trials yielding surprising data. *Spotlight*, Autumn 2016: 12-15.
- 14 **Knox O** (2016) Cotton nutrition tour: Top tips for growers. *The Australian Cottongrower*, 37: 33-33.
- 15 **Knox, O, Smith, R, Kelly, B, Korbel K, and Gupta V** (2016) Looking below the surface: Lessons from the landscape. *Spotlight*, Summer 2016-17: 23-26.
- 16 **Knox, O** (2016) Looking below the surface: What it means for you. *Spotlight*, Spring 2016: 13-17.
- 17 **Knox, O, Anderson, C M T, Ross, J L, Tann, C C R, and Gupta, V V S R** (2016) Organisms with potential to assist in the control of 'Helicoverpa armigera' in Australian cotton production systems. *Crop and Pasture Science*, 67: 1288-1296.
- 18 **Lobry de Bruyn, L A, and Andrews, S S** (2016). Are Australian and United States farmers using soil information for soil health management? *Critical Issues on Soil Management and Conservation*, Ed Tiziano Gomerio. *Sustainability* 2016, 8: 304.
- 19 **Lobry de Bruyn, L A** (2016) Response to Pauli, N., L. K. Abbott, S. Negrete-Yankelevich, and P. Andrés. 2016. Farmers' knowledge and use of soil fauna in agriculture: a worldwide review. *Ecology and Society*, 21: 31.
- 20 **Macharia, I, Backhouse, D, Wu, S-B and Ateka, E M** (2016) Weed species in tomato production and their role as alternate hosts of Tomato spotted wilt virus and its vector *Frankliniella occidentalis*. *Annals of Applied Biology*, 169: 224-235.
- 21 **Marshall, G R, Coleman, M, Sindel, B M, Reeve I and Berney P** (2016) Collective action in invasive species control, and prospects for community-based governance: The case of serrated tussock (*Nassella trichotoma*) in New South Wales, Australia *Land Use Policy*, 56: 100-111.
- 22 **McDonald, K S, Tighe, M and Ryder, D S** (2016) An ecological risk assessment for managing and predicting trophic shifts in estuarine ecosystems using a Bayesian network. *Environmental Modelling and Software*, 85: 202-216.
- 23 **McLaren, T M, McLaughlin, McBeath T M, Simpson, R, Smernik, R, Guppy, C and Richardson, A** (2016). "The fate of fertiliser P in soil under pasture and uptake by subterranean clover – a field study using ³³P-labelled single superphosphate. *Plant and Soil*, 401: 23-28.
- 24 **Montgomery, S C, Martin, R J, Guppy, C, Wright, G, Flavel, R J, Phan, S, Im, S, Touch, V, Andersson, K and Tighe, M K** (2016) Crop choice and planting time for upland crops in Northwest Cambodia. *Field Crops Research*, 198: 290-302.
- 25 **Montgomery, S C, Tighe, M K, Guppy, C, Wright, G, Flavel, R J, Phan, S, Im, S and Martin, R J** (2016). Yield responses of maize and sunflower to mulch under no-till farming conditions in northwest Cambodia. *Asian Journal of Crop Science*, 8: 71-86.
- 26 **Mohammadi, A, Cowie, A, Mai, T L A, Anaya de la Rosa, R, Brandão, M, Kristiansen, P and Joseph, S** (2016) Quantifying the greenhouse gas reduction benefits of utilising straw biochar and enriched biochar. *Energy Procedia*, 97: 254-261.
- 27 **Mohammadi, A, Cowie, A, Mai, T L A, Anaya de la Rosa, R, Kristiansen, P, Brandão, M and Joseph, S** (2016) Biochar use for climate-change mitigation in rice cropping systems. *Journal of Cleaner Production*, 116: 61-70.

PUBLICATIONS

- 28 Nguyen T H, **Lobry de Bruyn L A** and Koech R (2016) Impact of hydropower dam development on agriculturally-based livelihoods of resettled communities: A case study of Duong Hoa Commune in Vietnam. *International Journal of Water Resources Development*, 32: 978-997.
- 29 Rabbi, S M F, Daniel, H, Lockwood, P V, Macdonald, C, Pereg, L, **Tighe, M, Wilson, B R** and **Young, I M** (2016) Physical soil architectural traits are functionally linked to carbon decomposition and bacterial diversity. *Nature Scientific Reports*, 6: 33012.
- 30 Sahni, S, Prasad, B D, Liu, Q, Grbic, V, Sharpe, A, K and **Krishna, P** (2016) Overexpression of the brassinosteroid biosynthetic gene 'DWF4' in 'Brassica napus' simultaneously increases seed yield and stress tolerance. *Scientific Reports*, 6: 28928.
- 31 Smoucha, E A, Fitzpatrick, K, Buckingham, S and **Knox, O** (2016) Life Cycle Analysis of the Embodied Carbon Emissions from 14 Wind Turbines with Rated Powers between 50 Kw and 3.4 Mw. *Journal of Fundamentals of Renewable Energy and Applications*, 6: 1-10.
- 32 Tshewang, S, **Sindel, B M**, Gimiray, M, Singh Chauham, B (2016). Weed management challenges in rice ('*Oryza sativa*' L.) for food security in Bhutan: A review. *Crop Protection*, 90: 117-124.
- 33 Vasić, M, Duduk, N, Vico, I, Rančić, D, Pajić, V and **Backhouse, D** (2016) Comparative study of *Monilinia fructigena* and *Monilia polystroma* on morphological features, RFLP analysis, pathogenicity and histopathology. *European Journal of Plant Pathology*, 144: 15-30.
- 34 Vaughan, M, **Backhouse, D** and Del Ponte, E M (2016) Climate change impacts on the ecology of *Fusarium graminearum* species complex and susceptibility of wheat to *Fusarium* head blight: a review. *World Mycotoxin Journal*, 9: 685-700.
- 35 Verma, N, Lamb, D, Reid, N and **Wilson, B R** (2016) Comparison of canopy volume measurements of scattered eucalypt farm trees derived from high spatial resolution imagery and LiDAR. *Remote Sensing*, 8: 388.
- 36 Williams, L K, **Kristiansen, P, Sindel, B M, Wilson, S C** and Shaw J D (2016) Quantifying the seed bank of an invasive grass in the sub-Antarctic: seed density, depth, persistence and viability. *Biological Invasions*, 18: 2093-2106
- 37 Zhang, X, Crawford, J, **Flavel, R** and **Young, I M** (2016). A multi-scale Lattice Boltzmann model for simulating solute transport in 3D X-ray micro-tomography images of aggregated porous materials. *Journal of Hydrology*, 541: 1020-1029.

Book Reviews

- 38 **Lobry de Bruyn, L** (2016). *Conservation Agriculture in Subsistence Farming: Case Studies from South Asia and Beyond* Catherine Chan and Jean Fantle-Lepczyk (eds.). PB - CABI Publishing, CAB International, Wallingford, Oxfordshire, UK, 2015, xiv + 264 pages. *Ecological Management & Restoration*, 17: e5-e6.

Book Chapters

- 39 Bernzen, A and **Kristiansen, P** (2016). Challenges for organic agriculture in Australia - getting a 'fair go'. In: Adair, G. and Schwarz, A. (eds.) *Postcolonial Justice in Australia. Reassessing the 'Fair Go'*. Wissenschaftlicher Verlag Trier, Trier. pp. 91-107.

Research Reports

- 40 Nicholson, F, Taylor, M, Crooks, B, **Knox, O**, Walker, R, Misselbrook, T, Cardenass, L, Chadwick, D, Lewis, P, Else, M, Bhoga, A, Rollett, A, Williams, J, Newell Price, P, Becvar, A, Wood, M, Litterick, A. (2016) Field experiments for quality digestate and compost in agriculture: Work Package 2 Report - Digestate Nitrogen Supply and Environmental Emissions. Waste and Resources Action Programme (WRAP), Oxon, United Kingdom,.

GRANTS AND AWARDS

Current total grant value 2016 = \$9.9 million.

New grants awarded in 2016 – total of \$1 061 590

Lead Investigator	Research team	Project title	Total value	Funding body
Dr Richard Flavel	A/Prof Christopher Guppy, Prof Iain Young	Root system architecture in response to 'Systiva' seed treatment	\$33600	BASF Australia
A/Prof Christopher Guppy	NA	Phosphorus forms, associations and availability in subsoils	\$22000	Deutscher Akademischer Austausch Dienst (Australia-Germany Joint Research Cooperation Scheme)
A/Prof Brian Wilson	NA	Ecosystem process performance indicators	\$60000	Office of Environment and Heritage
A/Prof Brian Wilson	A/Prof Brian Wilson, Prof Heiko Daniel, Ms Rubeca Fancy	Radiocarbon age of dissolved organic carbon under contrasting land uses in NSW Australia	\$7500	Australian Institute of Nuclear Science and Engineering
A/Prof Paul Kristiansen	Prof Brian Sindel, Mr Michael Coleman, A/Prof Graham Marshall, Ms Christine Fyfe	A strategic approach to weed management for the Australian vegetable industry	\$900302	Horticulture Innovation Australia
A/Prof Brian Wilson	A/Prof Brian Wilson, Mr Arjan Wilkie, , Mr Philip Tickle, Prof David Lamb	Improved high-resolution carbon accounting in diverse landscapes for participation in carbon markets	\$23778	CRC for Spatial Information
A/Prof Christopher Guppy	A/Prof Christopher Guppy, Dr Richard Flavel	Evaluation of Si availability through foliar or solution culture application of a range of Si products	\$14410	Agripower Australia Ltd



Further Information

www.une.edu.au/pses

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