The effect changes in botanical dominance on soil nitrogen dynamics

Yui Osanai

The main purpose of this trip was to learn stable isotope techniques to trace the movement of nitrogen (N) through a grassland community dominated by the native grass species, *Austrodanthonia caespitosa* (C_3), *Austrostipa mollis* (C_3) and *Themeda triandra* (C_4). Since these species are different in many ways (e.g. photosynthetic pathways, phenology, foliage and litter N content), it is possible that the microbial community associated with each plant species may also differ in N transformation activity.

Major outcomes of the collaboration

The study was conducted from 28 June 2010 to 3 July 2010 at University of Queensland using the soil samples collected from underneath each species. The collaboration provided an opportunity to learn from one of the leading experts in the field of soil N transformations and plant-soil interactions. During the visit, I learnt the concept and theory behind the ^{15}N pool dilution technique as well as the labelling technique for the determination of isotopic composition. Upon receiving the isotopic analysis results, I will then be able to calculate both gross and net ammonification and nitrification rates to examine the effect of the co-occurring grass species on these key N transformations in the soil.

Significance to adapting and protecting Australia's terrestrial biodiversity

The grassland community is a diverse and widespread ecosystem in the Australian landscape, which has been substantially altered since European settlement. The successful management of grassy vegetation is a crucial aspect of maintaining biodiversity, as it contains a large number of threatened genotypes, species and communities (McDougall, 2008). The predicted shift in species dominance towards C_4 grasses at the expense of C_3 grasses under climate change (Williams et al., 2007) has the potential to alter the ecosystem dramatically because of the strong functional differences between these two dominant grass types.

The outcomes of this project will provide valuable information as to what extent predicted changes in botanical dominance will influence other members of the community by altering nutrient relations of entire ecosystem. This not only has an important ramification for maintaining biodiversity but also may assist in the management of exotic weeds, which often rely on high nitrate availability in the soil. The management of the grassland ecosystem also has potential to mitigate the current rate of rising atmospheric CO_2 concentration by acting as a global C sink. Hence the results from this study may assist in the development of guidelines whereby management can be directed to maintain certain mixtures of botanical composition to produce desired levels of soil N availability and soil carbon storage, thereby promoting the success of threatened plant species, reducing weed invasion and delivering important ecosystem services.

Future research

The phenological difference between C_3 and C_4 grass species is likely to affect the way these species influence N transformation, thus the results may differ depending on the time of a year. Seasonal variations in temperature and rainfall may also interact with the species effect, therefore, repeated study across a year would provide more complete picture of plant

species effects on N transformations. Furthermore, comparing laboratory isotope tracing study with *in situ* study would help to identify key factors affecting N transformation rates, thereby providing valuable information for the management of grassland ecosystems.

References

McDougall, K. L. (2008) Evidence for the natural occurrence of treeless grasslands in the Riverina region of south-eastern Australia. *Australian Journal of Botany,* **56,** 461-468.

Williams, A. L., Wills, K. E., Janes, J. K., Schoor, J. K. V., Newton, P. C. D. & Hovenden, M. J. (2007) Warming and free-air CO_2 enrichment alter demographics in four co-occurring grassland species. *New Phytologist,* **176,** 365-374.