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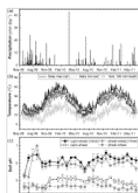
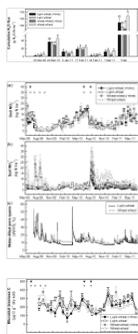


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## Agriculture, Ecosystems & Environment

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### Influence of crop rotation and liming on greenhouse gas emissions from a semi-arid soil

Louise Barton<sup>a</sup>, Daniel V. Murphy<sup>a</sup>, Klaus Butterbach-Bahl<sup>b</sup>[Show more](#)

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#### Abstract

Semi-arid lands represent one fifth of the global land area but our understanding of greenhouse gas fluxes from these regions is poor. We investigated if inclusion of a grain legume and/or lime in a crop rotation altered greenhouse gas emissions from an acidic soil. Nitrous oxide ( $\text{N}_2\text{O}$ ) and methane ( $\text{CH}_4$ ) fluxes were measured from a rain-fed, cropped soil in a semi-arid region of Australia for two years on a sub-daily basis. The randomised-block design included two cropping rotations (lupin–wheat, wheat–wheat) by two liming treatments ( $0, 3.5 \text{ t ha}^{-1}$ ) by three replicates. The lupin–wheat rotation only received N fertilizer during the wheat phase ( $20 \text{ kg N ha}^{-1}$ ), while the wheat–wheat rotation received  $125 \text{ kg N ha}^{-1}$  during the two year study. Fluxes were measured using soil chambers connected to a fully automated system that measured  $\text{N}_2\text{O}$  and  $\text{CH}_4$  by gas chromatography. Nitrous oxide fluxes were low ( $-1.4$  to  $9.2 \text{ g N}_2\text{O-N ha}^{-1} \text{ day}^{-1}$ ), and less than those reported for arable soils in temperate climates. Including a grain legume in the cropping rotation did not enhance soil  $\text{N}_2\text{O}$ ; total  $\text{N}_2\text{O}$  losses were approximately  $0.1 \text{ kg N}_2\text{O-N ha}^{-1}$  after two years for both lupin–wheat and wheat–wheat rotations when averaged across liming treatment. Liming decreased cumulative  $\text{N}_2\text{O}$  emissions from the wheat–wheat rotation by 30% by lowering the contribution of  $\text{N}_2\text{O}$  emissions following summer–autumn rainfall events, but had no effect on  $\text{N}_2\text{O}$  emissions from the lupin–wheat rotation. Daily  $\text{CH}_4$  fluxes ranged from  $-14$  to  $5 \text{ g CH}_4\text{-C ha}^{-1} \text{ day}^{-1}$ . Methane uptake after two years was lower from the wheat–wheat rotation ( $601 \text{ g CH}_4\text{-C ha}^{-1}$ ) than from either lupin–wheat rotations ( $967 \text{ g CH}_4\text{-C ha}^{-1}$ ), however liming the wheat–wheat rotation increased  $\text{CH}_4$  uptake ( $1078 \text{ g CH}_4\text{-C ha}^{-1}$ ) to a value similar to the lupin–wheat rotation. Liming provides a strategy for lowering on-farm greenhouse gas emissions from N fertilised soils in semi-arid environments via decreased  $\text{N}_2\text{O}$  fluxes and increased  $\text{CH}_4$  uptake.

Highlights



- ▶ Including a grain legume in a cropping rotation did not enhance soil N<sub>2</sub>O fluxes. ▶
- ▶ Liming decreased N<sub>2</sub>O fluxes from wheat–wheat, but not the lupin–wheat rotation. ▶
- ▶ Liming decreased total N<sub>2</sub>O fluxes by lowering fluxes following summer–autumn rain. ▶
- ▶ Including a grain legume in the cropping rotation increased CH<sub>4</sub> uptake. ▶
- ▶ Liming

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**Keywords**  
 Grain legume; Lupin; Methane; N fertilizer; Nitrous oxide; Wheat

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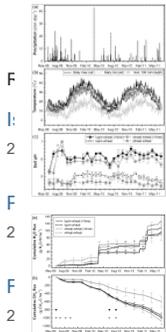
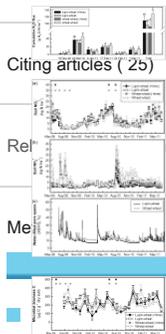
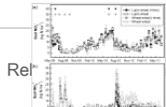


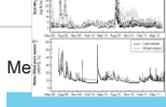
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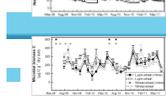
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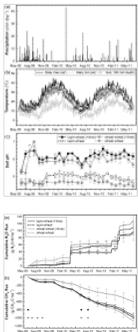
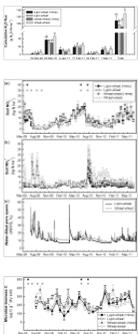


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