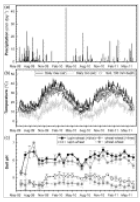

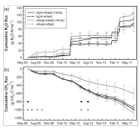

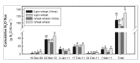

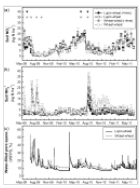

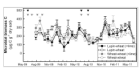

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Influence of crop rotation and liming on greenhouse gas emissions from a semi-arid soil

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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 (N_2O) and methane (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 t ha^{-1}) by three replicates. The lupin–wheat rotation only received N fertilizer during the wheat phase (20 kg N ha^{-1}), while the wheat–wheat received 125 kg N ha^{-1} during the two year study. Fluxes were measured using soil chambers connected to a fully automated system that measured N_2O and CH_4 by gas chromatography. Nitrous oxide fluxes were low (−1.4 to 9.2 g N_2O-N ha^{-1} 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 N_2O; total N_2O losses were approximately 0.1 kg N_2O-N ha^{-1} after two years for both lupin–wheat and wheat–wheat rotations when averaged across liming treatment. Liming decreased cumulative N_2O emissions from the wheat–wheat rotation by 30% by lowering the contribution of N_2O emissions following summer–autumn rainfall events, but had no effect on N_2O emissions from the lupin–wheat rotation. Daily CH_4 fluxes ranged from −14 to 5 g CH_4-C ha^{-1} day^{-1}. Methane uptake after two years was lower from the wheat–wheat rotation (601 g CH_4-C ha^{-1}) than from either lupin–wheat rotations (967 g CH_4-C ha^{-1}), however liming the wheat–wheat rotation increased CH_4 uptake (1078 g CH_4-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 N_2O fluxes and increased CH_4 uptake.

Highlights

► Including a grain legume in a cropping rotation did not enhance soil N_2O fluxes. ► Liming decreased N_2O fluxes from wheat–wheat, but not the lupin–wheat rotation. ► Liming decreased total N_2O fluxes by lowering fluxes following summer–autumn rain. ► Including a grain legume in the cropping rotation increased CH_4 uptake. ► Liming

Keywords

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

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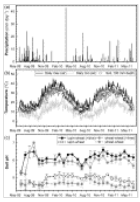
Figures and tables

Table 1



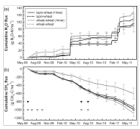


Table 2