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Nitrous oxide emissions from crop sequences of grass-clover and wheat

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Organic farming is based on the principle of farm internal nitrogen cycling. Soil N input is managed by fertilization with manure if there is animal stock at the farm. Stockless farms use so called Green Manure, i.e. leguminous crops integrated in a crop sequence of cash crops. A mix of grass and clover is commonly used for this. The crop is either harvested and residues incorporated or whole plants are mulched and incorporated.

In order to estimate greenhouse gas (GHG) emissions from organic farming and derive management recommendations, nitrous oxide (N2O) emission data from cultivation of leguminous crops is needed. Currently there is a deficit of published data, in particular for Germany. Hence, N2O fluxes from grass-clover and subsequent wheat cultivation were studied over two years at four sites, which are distributed evenly over Germany. Treatments were (i) harvest of grass-clover and incorporation of residues in fall followed by cultivation of winter wheat, (ii) incorporation of residues in spring followed by summer wheat, (iii) mulching of grass-clover and incorporation in fall followed by winter wheat, (iv) conventional winter wheat with mineral fertilizer. Treatment effects on N2O emissions were marginal compared to site effects such as soil and climate. Overall, direct emissions from the organic treatments were remarkably similar to those from conventional winter wheat with best practice application of mineral fertilizer. Incorporation in spring resulted in higher emissions than incorporation in fall, but there was no consistent difference between incorporation of residues and mulching. Based on the present study regional emission factors for crop sequences of grass-clover and wheat in Germany can be derived.