An original experiment to determine the impact of a catch crop introduction in a crop rotation on N2O and CO2 fluxes

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Résumé

The raise in N2O concentration from the preindustrial era (280 ppb) to nowadays (324 ppb) is estimated to account for approximately 6% of the predicted global warming (IPCC 2014). Worldwide, soils are considered to be the dominant source of N2O, releasing an estimated 9.5 Tg N2O-N y-1 (65% of global N2O emissions), of which 36.8% are estimated to originate from agricultural soils (IPCC 2014). Most N2O originating from agricultural soils is a by- or end-product of nitrification or denitrification. The fate of N2O produced by microbiological processes in the subsoil is controlled by biotic (crop species, occurring soil organic matter, human pressure via mineral and organic nitrogen fertilisation) and abiotic (environmental conditions such as temperature, soil moisture, pH, etc.) factors. In cropland, contrary to forest and grassland, long bare soil periods (from the end of spring to the middle of the next year one) can occurred between winter and summer crops with a high level of mineral (fertilizer) and organic (residues) nitrogen remaining in the soil, causing important emissions of carbon and nitrogen induced by microbial activities. Introduction of cover crop has been identified as an important mitigation option to reduce environmental impact of crops mainly thanks to their ability to increase CO2 fixation, to decrease mineral nitrogen lixiviation and to also reduce the potential fate of N2O production. Uncertainty also remains about the impact of released mineral nitrogen coming from crushed catch crop on N2O production if summer crop seedling and mineral nitrogen release are not well synchronized. To verify those assumptions, a unique paired-plot experiment was carried in the south-west of France from September 2013 to august 2014 to test impact of management change on N2O fluxes and soil respiration. A crop plot was divided into two subplots, one receiving a catch crop (mustard), the other one remaining conventionally managed (bare-soil during autumn). This set-up allowed avoiding climate effect. Each subplot was equipped to measure environmental parameters, N2O fluxes and soil respiration. Nitrous oxide and CO2 fluxes were measured with six stainless steel automatic chambers coupled with an infra red gas analyzer every 6 hours. Main results showed that introduction of a catch crop reduced significantly autumnal N2O emissions. But our study also showed that positive effect could be partly counteracted during the following growing season with higher N2O emission than on the subplot conducted conventionally.

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