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An original experiment to determine impact of catch crop introduction in a crop rotation on N2O production fate

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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 2001). 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 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 catch crop has been identified as an important mitigation option to reduce environmental impact of crops mainly thanks to their ability to increase CO_2 fixation, to decrease mineral nitrogen lixiviation and 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 budget and production dynamic. A crop plot was divided into two subplots, one receiving a catch crop (mustard), the other one remaining conventionally managed (bare-soil during winter). This set-up allowed avoiding climate effect. Each subplot was equipped to measure environmental parameters and N2O fluxes. Nitrous oxide fluxes were measured using six stainless steel automatic chambers coupled with an infra red gas analyzer every 6 hours. We first analyzed N2O flux rates obtained between the two treatments and then we quantified the impact of temperature and soil moisture on their daily and seasonal variations.