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Mitigation of greenhouse gas emissions from soil in the cultivation of tomato in a Mediterranean environment.

Iride Volpi, Simona Bosco, Giorgio Ragaglini, and Enrico Bonari
Scuola Superiore Sant'Anna, Institute of Life Sciences, Pisa, Italy (i.volpi@santannapisa.it)

To keep global warming below 1.5°C, agriculture will have to contribute as the other sectors to achieve net negative emissions by the end of century [1]. Enteric fermentation and agricultural soils account for about 70% of agricultural non-CO_2 emissions, and soil is the main source of nitrous oxide [1]. The challenge is to identify agricultural practices for GHG emissions mitigation and crop yield conservation, especially in the Mediterranean where few studies were conducted.

In this study we measured soil fluxes of nitrous oxide (N_2O), carbon dioxide (CO_2) and methane (CH_4) in a field trial in Tuscany region (Italy), for two cropping seasons (2014 and 2015) of tomato (*Solanum lycopersicum* L.) Perfect Peel, managed in fertigation. The main treatment was irrigation with two levels: Ir1 (50% ET) and Ir2 (100% ET). The secondary treatment was N fertilization with three levels: N0 (0 kg N ha^{-1}), N1 (120 kg N ha^{-1}) and N2 (170 kg N ha^{-1}). Soil GHG fluxes were measured using a mobile instrument developed within the project LIFE+ "Improved flux Prototypes for N_2O emission reduction from Agriculture" (IPNOA) (www.ipnoa.eu), equipped with high performance gas analysers and through-flow non-steady state chambers [2]. Ancillary measurements were meteorological data, soil temperature and moisture, soil mineral nitrogen. Cumulative N_2O emissions during the crop growing season ranged between 140 g N_2O-N ha^{-1} and 1230 g N_2O-N ha^{-1}. They were significantly lower: in 2014 than in 2015 (-51%), in Ir1 than in Ir2 (-34%) and in N0 than in the fertilized plots (-44%) and they were ordered as N0<N1<N2 in 2014 and as N0=N2<N1 in 2015. Cumulative CO_2 emissions ranged between 2771 kg CO_2-C ha^{-1} and 4130 kg CO_2-C ha^{-1} and in 2014 they were significantly lower in N1 than in the other two N levels (-18%), while in 2015 they were significantly lower in N0 than in N1 (-7%), and N2 recorded an average value. Cumulative CO_2 emissions were significantly lower in Ir2 than Ir1 (-25%) in N0 in 2014, while in 2015 we observed the opposite (+37%). In N1 and N2, CO_2 emissions were not different between Ir1 and Ir2 in both years. The CH_4 uptake of soil ranged between -231 g CH_4-C ha^{-1} and -38 g CH_4-C ha^{-1} and it was not affected by the treatments. Fresh fruit biomass was significantly higher in 2014 (143 $\pm$7 t ha^{-1}) than in 2015 (75 $\pm$4 t ha^{-1}) and it was significantly higher in the fertilized plots (+48%) than in N0. The main result of this study highlighted the chance to mitigate soil N_2O emissions reducing the irrigation level in fertigation, while preserving the tomato yield. Differently, the reduction of N fertilizer rate, mitigated soil N_2O emissions only in the first year and decreased the tomato yield as average of the two cropping seasons.

[1] Intergovernmental Panel on Climate Change, IPCC (2014) Climate Change 2014 Synthesis Report of the Fifth Assessment Report.

[2] Livingston GP and Hutchinson GL (1995) Enclosure-based measurement of trace gas exchange: applications and sources of error. In: Matson PA, Harriss RC (Eds.), Biogenic Trace Gases: Measuring Emissions from Soil and Water. Blackwell Science, Cambridge. 14–50.