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DMPP-added nitrogen fertilizer affects soil N2O emission and microbial activity in Southern Italy

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Arable sites contributes to global N2O emission due to massive utilization of nitrogen fertilizers. N2O derives from the biological processes such as nitrification and denitrification influenced by soil nitrogen availability. The use of nitrogen fertilizers added with nitrification inhibitors represents one among the proposed strategy to reduce soil N2O emission form arable sites. The aim of this work was to evaluate the effects of 3,4-dimethylphyrazole phosphate (DMPP), a nitrification inhibitor, on N2O emission and microbial activity of a soil cropped to potato in Southern Italy. The experiment was a randomized block design with two treatments applied and three replicates: control (C) and DMPP (Entec®, K+S Nitrogen) plots, both supplied with the same amount of ammonium nitrate. The nitrogen fertilizer was supplied in three events: at 0 Day After Sowing (DAS; 100 kg N ha-1), at 57 DAS (30 kg N ha-1), and at 71 DAS (30 kg N ha-1). Soil N2O emission was monitored by both dynamic and static chambers. Static chambers were located both on hills and furrows whereas dynamic chambers were located on furrows. Air samples were collected from chambers at different times and analysed by a gas chromatograph (SRI 8610C, Gas Chromatograph). Fluxes were estimated as a linear interpolation of N2O changes over a 30 min time. Microbial biomass and basal respiration were determined as CO_2 evolution, analysed by means of an IRGA (Li6200, Licor), on 2 g of fresh soil over a 4h incubation time. Microbial biomass was determined by Substrate Induced Respiration method. Data show no statistical differences in N2O fluxes measured with either dynamic chambers between C and DMPP plots in studied period. However, after the first fertilization event, when the fertilizer was applied as 100 kg N ha-1, the average N2O fluxes measured with static chambers were higher in DMPP plots compared to C plots. In the same period, the microbial biomass significantly decreased in DMPP plots as compared to C plots, whereas an opposite trend for basal respiration was observed, thus evidencing a stressful condition for nitrifying microbial population. After 57 and 71 DAS, when fertilizer was applied as 30 kg N ha-1, the microbial biomass was similar between C and DMPP plots, whereas basal respiration resulted statistically lower in DMPP plots than C plots. During these periods, average DMPP N2O fluxes were also comparable or lower. In conclusion, our data evidence a stressful condition for soil microbes and in particular for nitrifiers when a higher DMPP quantity is supplied. On the contrary, when lower quantities of DMPP-added fertilizers are supplied (e.s. 30 kg N ha-1) effectiveness of DMPP in reducing soil N2O emission is guaranteed by reducing the nitrifiers activity without negatively affecting their growth.