Soil Nitrous Oxide Mitigation Potential of Agricultural Practices in Mediterranean Environment

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Introduction

There is a high scientific interest in the monitoring of nitrous oxide (N_2O) emissions from agricultural soils. This is due to the fact that N_2O is a potent greenhouse gas (~ 300 Global Warming Potential), ozone depleting, and the production occurs mainly in soil due to the processes of nitrification and denitrification (Butterbach-Bahl et al., 2013). In particular, agricultural soils accounted for ~ 70% of the total annual N_2O emissions at European scale (EEA, 2015).
The agricultural practices, such as tillage intensity, nitrogen (N) fertilization and residue management affect the N_2O soil emissions (Snyder et al., 2014). However, the mitigation potential of management practices is difficult to assess due to a great background variability of the N_2O flux in time and space and this uncertainties is relevant in Mediterranean environment due to a lack of studies (Aguilera et al., 2013). Within the LIFE+IPNOA a transportable high-sensitivity instrument was developed and validated to measure N_2O emissions in a short time frame, directly in the field. Field trials, in two sites, were designed with the aim to identify the key drivers for N_2O emissions, testing the effect of tillage intensity, nitrogen rate and irrigation amount on the main crops in Tuscany region. The results of the project will be part of the Best Management Practices (BMPs) for N_2O emissions mitigation from agricultural soils. The aim of this work is to introduce the main results of the projects that will help to identify the BMPs for N_2O soil mitigation.

Methods

The field trials were located in two sites within Tuscany region: 1) the Centre for Agro-Environmental Research "E. Avanzi" (CIRAA), located in San Piero a Grado (Pisa) and 2) the Centre for Agricultural Technologies and Extension Services (CATES), in Cesa (Arezzo). N_2O monitoring was conducted for two years on durum wheat (*Triticum durum* Desf., var. Tirex), maize (*Zea mays* L., var. DKC4316), sunflower (*Helianthus annuus* L., var. Pacific), tomato (*Solanum lycopersicum* L., var. perfectpeel) and faba bean (*Vicia faba* minor L., var. vesuvio). Key factors for each crop were: tillage intensity (ploughing vs minimum tillage) and nitrogen rate (three levels: N0, N1, N2) for durum wheat and sunflower; irrigation (low and high irrigation level) and nitrogen rate for maize and tomato; tillage intensity for faba bean. The monitoring was carried out bimonthly and every 4-5 days for 5 times after N fertilization events and incorporation of residues with a mobile prototype, developed in the LIFE+IPNOA and equipped with a LRG N_2O/CO detector for N_2O and with a LGR Ultraportable Greenhouse Gas Analyser (CH_4, CO_2, H_2O) (UGGA) (Los Gatos Research Inc.) (Bosco et al., 2015). The instrument was connected to a flow-through non-steady state steel chamber. N_2O flux was calculated from the concentration increase during the chamber closure time, using a linear model. Cumulative N_2O emissions over crop growing period were calculated by linear interpolation of two close sampling dates and the integration of the function over time.

Results

The results collected during the two monitoring years allowed to have a range of the cumulative N_2O-N emissions along the two years, the sites and the treatments over the studied crops (Figure 1). A great