Geophysical Research Abstracts, Vol. 8, 05679, 2006
SRef-ID: 1607-7962/gra/EGU06-A-05679

Effects of different N-mineral fertilizations on photosynthetic activity and biological denitrification process at two different stage of maize growth in a Mediterranean cropland.

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It's well known N-fertilization can greatly affect both plant photosynthesis and denitrifying activity of soil in agroecosystems. Moreover it's noteworthy soil biological processes such as denitrification can interfere on soil-plant relationship because of competitive demand of microbial community for N-mineral source.

The aim of this study was to investigate the possible interactions between photosynthetic activity and biological denitrification of soil in a Mediterranean cropland under irrigated field conditions. This is of great concern since actually only few data are available for Mediterranean agroecosystems.

The experimental site, also registered as contributing to the FLUXNET network, is located near Eboli, in Campania region, South Italy. Even if the parent material of the soil at the site is carbonate, most of the material has an alluvial origin, with a clay texture in the top 0.2 m, then more sandy and silty-clay at 1.2 m, moreover it is very rich in carbonates and is characterized by hydromorphic traits related to winter waterlogging.

After manuring and maize sowing, three plots were determined in the field with three different mineral-N supply: 5q/ha control (C), 3q/ha low mineral-N fertilization (N-),

high mineral-N fertilization 7q/ha (N+).

Measurements of gas exchange (portable gas exchange system Li-Cor 6400, NE, USA), denitrification rate (Acetylene Inhibition Technique, on intact soil cores) and N_2O fluxes from soil by closed chambers were performed in each different plot, at two different stages of maize growth (35 days and 50 days). Analyses of nitrate concentration, pH, soil temperature, WFPS and organic matter were also carried out.

On the first sampling date, no differences were detected in NO_3^- concentration between C and N- plots, while significant higher NO_3^- values were found at the N+ plot. In response to the NO_3^- pattern, the highest denitrification rate and N_2O fluxes were measured at N+ plot, moreover despite the similar NO_3^- concentrations, an higher denitrification activity was found in C as compared to N-, according to the higher WFPS in this plot.

Differently from denitrifying activity, comparable values of maize photosynthesis were found at the three plots, suggesting that CO_2 assimilation was not affected by the different amount of NO_3^- concentrations at this stage of maize growth.

On the second sampling data, no decrease was detected in NO_3^- pool concentration in all the plots, probably because of the slow release to the soil of mineral-N from the manure applied on the field.

Also denitrification rates in N+ and N- did not show significant changes referring to the first sampling, with the highest value being detected in N+. On the contrary very low denitrifying activity and N_2O fluxes from soil were observed in C, probably ascribed to the low WFPS at the sampling time. The measure of photosynthetic activity has shown significant difference among plots, in particular the higher and the lower values were found in N- and N+ plots, respectively, as compared to control. It may be hypothesized that different NO_3^- concentrations affect CO_2 fixation mainly in the late stage of maize growth, indicating that a reduction in nitrogen supply induces limitation in the photosynthetic performance during the full development of photosynthetic apparatus. Nevertheless it could be suggested that the higher photosynthetic rate in N+ plot is due to a prolonged ontogenesis derived by richness of N supply.

It may be that an interaction between plant and soil systems occurred. In fact despite no significant changes between the two samplings in denitrifying activity in N+ and N-(at similar values of WFPS), a steep decrease in N_2O emissions was found on the second date in both plots. It's well known plant-derived C in soil can affect denitrifier bacteria, so it might be argued that the roots of the growing maize plants could have released some metabolizable C compounds able to modify the $N_2O/(N_2+N_2O)$ ratio.