N_2O flux from planted and not planted cropland soils

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Introduction

Global climate is changing primarily because of anthropogenic greenhouse gas (GHG) emissions into the atmosphere (IPCC, 2014).The emissions of those GHG since the pre industrial area have driven large increases in the atmospheric concentrations of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Global CH_4, CO_2 and N_2O concentrations in the atmosphere increased at rates of 0.8%, 0.5% and 0.3% per year, respectively (Wang et al., 2013).

Agricultural soils release significant amounts of the N_2O to the atmosphere by increasing demands for food from a growing human population which share 2.8 Tg of N per year, i.e., 15.3% of the total amount of emissions, or 41.8% of anthropic emissions (Denman et al. 2007). N_2O is produced biologically in soils during denitrification, nitrification and nitrifier denitrification (Wrage et al. 2001). Many studies have shown that the N_2O emissions increases after N application with increasing soil water content and most rapidly above 60% water-filled pore space (WFPS). Hence, the main objective of the present study was to measure N_2O emission on temporal variability from agricultural soils, to identify the effect of a nitrogen fertilizer (NH_4NO_3) and the effect of vegetation on soil N_2O emission moreover on enzyme activity of microbial populations.

Materials and methods

From the study site Kartal we brought the soil to the lab and we put it into tubes which are filled to 15 cm with the soil and we used the remaining space as chambers for the emission measurements. Our lab experiment was divided into two periods each one divided into: bare soil and planted soil with wheat plants. NH_4NO_3 fertilizer was applied on the surface of the soil at the beginning of the study period with different levels and the pots were kept under favorable conditions (12 hours of light, 20-25v% soil water content, 20°C air temperature). The sampling for N_2O efflux and additional measurements were conducted each week during a 5 weeks. Closed chamber technique was used for measuring the emission of the greenhouse gas . For the field measurement the N_2O fluxes were determined by small static (closed) chambers (20 minutes of sampling). The N_2O concentration of the samples was measured by GC ECD technique. The FDA was applied to measure the enzyme activity of microbial populations.

Results and discussion

We found that; the soil N_2O emission was significantly higher at the higher soil moisture level (25%) because it increases in anoxic conditions where N_2O originates predominantly from denitrification and it was also affected by the increasing of fertilizer amount. Higher

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N_2O efflux was observed also in planted soil. Planted soil had 1.3 times higher N_2O emission than unplanted soil because the denitrification rates were increased in the presence of plants due to the oxygen consumption. The value of the N_2O emmision from the field was variable, this variation caused by the changement of the main drivers of the N_2O emission which are the soil water content and the addition of the fertilizer. Soil enzymatic activity based on FDA measurements showed no significant differences between the treatments, therefore our further aim to use another test to measure the activities of some main groups, e.g.: nitrifiers, denitrifiers.

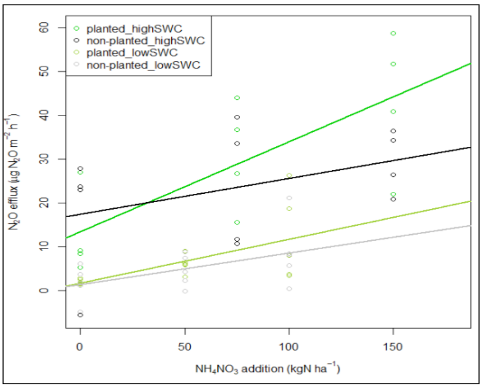

Figure 1: N_2O efflux at different treatmentfrom planted and not planted soils

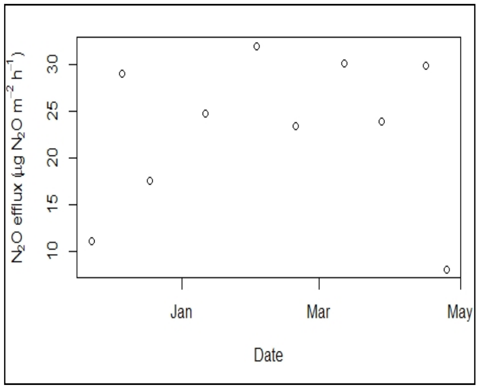

Figure 2: N_2O efflux from the field (11/ 2017-04/2018)

Conclusions

According to our results, we found a positive effect of soil moisture and also of plants on the N_2O efflux and there is a linear regression between the addition of the N fertilizer and the N_2O efflux. Our further aim was to study those effects in more details because there is a strong need to find correlations between the biological processes of the soil for mitigating GHG emission of the agriculture and for biogeochemical modelling approaches.

Acknowledgement

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