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# 黄土丘陵区不同土地利用下土壤释放$N_2O$潜力的影响因素

# Potential soil $N_2O$ emissions and its controlling factors under different land use patterns on hilly-gully loess plateau

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**中文摘要**:

采用室内培养试验,研究了不同水热条件对黄土丘陵区林地、草地和果园土壤释放$N_2O$的影响,同时测定了土壤中不同氮素形态的变化,旨在探讨影响土壤释放$N_2O$潜力的因素。结果表明:土样中$N_2O$通量与温度显著相关($r$=0.1599, $P$<0.05),均随温度的升高不断增大,35℃时达到最大。$N_2O$通量与土壤水分含量极显著相关($r$=0.2499,$P$<0.0001),在土壤水分含量较低时,各土样中$N_2O$通量与土壤水分含量呈正相关,土壤水分接近田间持水量时$N_2O$通量最大,超过田间持水量时$N_2O$通量急剧下降。土壤水分和温度对$N_2O$通量的影响可用拟合方程$F=a+b\times T+c\times T^2+d\times T^3+e\times T^4+f\times W$来描述。在培养条件下,土壤中$N_2O$的释放总量大小依次为:果园土>林地土>草地土,果园土释放$N_2O$的总量分别比林地土和草地土的释放总量多30%,14%。土壤氮素形态与$N_2O$的释放量有一定关系,但规律不明显。

English Summary:

Atmospheric concentrations of the greenhouse gas nitrous oxide ($N_2O$) have significantly increased since pre-industrial times owing to anthropogenic perturbation of the global nitrogen cycle. However,studies dealing with $N_2O$ fluxes from different land-use types on hilly-gully loess plateau are still scarce. Different land use types (i.e. forest, grassland, arable land) may lead to different soil $N_2O$ emissions. These soil emissions may be of significant importance for the composition of the atmosphere and it is of great importance to study the soil-atmospheric exchange of $N_2O$ in these ecosystems to get reliable estimates of the soil greenhouse gas budgets in semiarid areas under different land-use types. We aimed to estimate the potential of soil net $N_2O$ fluxes and the controlling factors for $N_2O$ production. A laboratory incubation experiment was conducted to determine the effect of soil temperature and soil moisture on $N_2O$ flux in forest, orchard and grassland on hilly-gully loess plateau. Forest (109° 10'E, 35° 05'N), orchard (107° 41'E, 35° 14'N) and grassland (106° 27'E, 36° 17'N) sites were selected. The main characteristics of the soil at the depth of 0-5 cm are as follows: Soil organic matter was in the range of 12.4 to 44.8 g/kg, total nitrogen was between 1.05 to 2.27 g/kg, bulk density between 1.168 to 0.803 g/cm$^3$ and pH value was between 8.88 to 9.04 in the three sites. At each site, twenty-four intact soil samples were collected in early spring 2010. Each sampling site was divided into six plots to obtain representative soil samples. Four intact soil cylinders per plot were collected from the uppermost mineral soil (0-5 cm from the top) using a PVC-cylinder (diameter: 7 cm, height: 5 cm). Undisturbed soil cores from each landuse type were incubated under 5 different moisture conditions: water content at wilting point (WW), natural water (NW), fracture capillary water (FCW), field water (FW) and saturated water (SW) content, which was in the range of 10.7 to 83.2%WFPS. Each water content was measured at 4 different soil temperature states (5, 15, 25 and 35° C) in the laboratory. Nitrous oxide fluxes of undisturbed soil cores were measured with the closed chamber technique and analysed by gas chromatography. Inorganic nitrogen, organic nitrogen and microbial nitrogen of soil samples were measured additionally. Our results showed that: soil $N_2O$ emission rates were positively correlated to soil temperature ($r$=0.1599, $P$<0.05). Maximum $N_2O$ production was measured at 35℃. Soil $N_2O$ emissions was positively correlation with soil moisture content($r$=0.2499, $P$<0.0001) until soil reached field capacity (FW). $N_2O$ fluxes reached the maximum when soil moisture was close to FW, but $N_2O$ fluxes declined sharply above FW. The soil $N_2O$ emissions could be described by a polynomial equation: $F=a+b\times T+c\times T^2+d\times T^3+e\times T^4+f\times W$, where $F$ is the $N_2O$ flux, $T$ is soil temperature, $W$ is soil moisture (WFPS%) and "a-f" are the regression parameters. $N_2O$ production was highest in Orchard soil > forest land > grassland soil. In orchard soil 14% and 30% more $N_2O$ was produced compared to forest and grassland soil. Soil nitrogen also influenced the soil $N_2O$ flux, but there was no clear pattern.

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