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研究报告

三江平原典型小叶章湿地土壤硝化反硝化作用与氧化亚氮排放

孙志高[1,2], 刘景双[1], 杨继松[1,2], 李新华[1,2], 周旺明[1,2]

[1]中国科学院东北地理与农业生态研究所, 长春 130012;
[2]中国科学院研究生院, 北京 100039

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摘要 应用C_2H_2抑制原状土柱培育法研究了三江平原典型小叶章湿地土壤N_2O排放速率及反硝化速率的变化，分析了它们与环境因子的关系，并估算了N_2O排放量及反硝化损失量. 结果表明：草甸沼泽土和腐殖质沼泽土N_2O排放速率的变化基本一致，其范围分别为0.020～0.089 kg N·hm^{-2}·d^{-1}和0.012～0.033 kg N·hm^{-2}·d^{-1}, 前者的N_2O排放速率均明显高于后者(平均为1.79±1.07倍)，且其差异达到显著水平($P<0.05$)；二者反硝化速率的变化并不一致，其范围分别为0.024～0.127 kg N·hm^{-2}·d^{-1}和0.021～0.043 kg N·hm^{-2}·d^{-1}，前者的反硝化速率一般也要高于后者(平均为1.67±1.56倍)，但其差异并未达到显著水平($P>0.05$)；硝化作用在前者N_2O排放和氮素损失过程中发挥了重要作用，而反硝化作用则是导致后者N_2O排放和氮素损失的重要过程；氮素物质基础不是影响二者硝化-反硝化作用的重要因素；温度对前者硝化 反硝化作用的影响比后者更为明显，其反硝化速率与5、10和15 cm地温均呈显著正相关($P<0.05$)；二者所处湿地水分条件的差异是导致其N_2O排放速率及反硝化速率差异的重要原因. 生长季内，前者的N_2O排放量和反硝化损失量分别为5.216 kg N·hm^{-2}和6.166 kg N·hm^{-2}，而后者分别为3.196 kg N·hm^{-2}和4.407 kg N·hm^{-2}；在二者的反硝化产物中，N_2O/N_2的比率最高，分别为5.49和3.76，表明N_2在后者反硝化产物中所占的比例明显高于前者，说明季节积水条件会导致N_2O/N_2比例降低.

关键词 N_2O排放速率 反硝化速率 硝化-反硝化作用 草甸沼泽土 腐殖质沼泽土

分类号

Nitrification-denitrification and N_2O emission of typical *Calamagrostis angustifolia* wetland soils in Sanjiang Plain

SUN Zhi-gao[1,2],LIU Jing-shuang[1],YANG Ji-song[1,2],LI Xin-hua[1,2],ZHOU Wang-ming[1,2]

[1]Northeast Institute of Geography and Agricultural Ecology, Chinese Academy of Sciences, Changchun 130012, China;
[2]Graduate University of Chinese Academy of Sciences, Beijing 100039, China

Abstract

With intact soil core and by using acetylene inhibition method, this paper measured the N_2O emission and denitrification rates of typical *Calamagrostis angustifolia* wetland soils in Sanjiang Plain, analyzed their relationships with environmental factors, and estimated the total amounts of N_2O emission and denitrification loss. The results showed that meadow marsh soil and humus marsh soil had a similar change range of N_2O emission rate (0.020-0.089 kg N·hm^2·d^{-1} and 0.012-0.033 kg N·hm^2·d^{-1}, respectively), but the former had a much higher N_2O emission rate than the latter, and the difference was significant ($P<0.05$). As for denitrification rate, its change range was 0.024-0.127 kg N·hm^2·d^{-1} for meadow marsh soil and 0.021-0.043 kg N·hm^2·d^{-1} for humus marsh soil. Meadow marsh soil also had a higher denitrification rate than humus marsh soil, but the difference was not significant ($P>0.05$). In meadow marsh soil, nitrification played an important role in N_2O emission and nitrogen loss; while in humus marsh soil, denitrification was the main process inducing N_2O emission and nitrogen loss. For these two soils, nitrogenous compounds were not the important factor affecting nitrification-denitrification. In meadow marsh soil, temperature had more evident effect, where nitrification-denitrification had a

significant positive correlation with the soil temperature at the depths of 5 cm, 10 cm and 15 cm ($P<0.05$). Soil moisture condition was another important factor inducing the difference of N_2O emission and denitrification rates. In growth season, the amount of N_2O emission and denitrification loss was 5.216 kg N·hm^{-2} and 6.166 kg N·hm^{-2} for meadow marsh soil, and 3.196 kg N·hm^{-2} and 4.407 kg N·hm^{-2} for humus marsh soil, respectively. In the denitrification productions of meadow marsh soil and humus marsh soil, the maximum value of N_2O/N_2 ratio was 5.49 and 3.76, respectively, indicating that the proportion of N_2 in denitrification productions was higher in humus marsh soil than in meadow marsh soil, and the seasonal waterlogged condition could induce the decrease of N_2O/N_2 ratio.

Key words N_2O emission rate | denitrification rate | nitrification-denitrification | meadow marsh soil | humus marsh soil

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通讯作者