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高氮和NO_2^-对中亚热带森林土壤N_2O和NO产生的影响

Generation of N_2O and NO in mid-subtropical forest soil as affected by high N and NO_2^-contents

中文关键词:N_2O NO ^{15}N 氮沉降 真菌 共脱氮

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中文摘要:

利用^{15}N同位素标记方法，研究在两种水分条件即60%和90% WHC下，添加硝酸盐(NH_4NO_3，N 300mgkg^{-1})和亚硝酸盐($NaNO_2$，N 1mg kg^{-1})对中亚热带天然森林土壤N_2O和NO产生过程及途径的影响。结果表明，在含水量为60% WHC的情况下，高氮输入显著抑制了N_2O和NO的产生($p < 0.01$)；但当含水量增为90% WHC后，实验9h内抑制N_2O产生，之后转为促进。所有未灭菌处理在添加NO_2^-后高氮抑制均立即解除并大量产生N_2O和NO，与对照成显著差异($p < 0.01$)，在60% WHC条件下，这种情况维持时间较短(21h)，但如果含水量高(90% WHC)这种情况会持续很长时间(2周以上)，说明水分有效性的提高和外源NO_2^-在高氮抑制解除中起到重要作用。本实验中N_2O主要来源于土壤反硝化过程，而且加入未标记NO_2^-后导致杂合的N_2O ($^{14}N^{15}NO$)分子在实验21h内迅速增加，表明这种森林土壤的反硝化过程可能主要是通过真菌的“共脱氮”来实现，其贡献率可多达80%以上。Spearman秩相关分析表明未灭菌土壤NO的产生速率与N_2O产生速率成显著正相关性($p < 0.05$)，土壤含水量越低二者相关性越高。灭菌土壤添加NO_2^-能较未灭菌土壤产生更多的NO，但却几乎不产生N_2O，表明酸性土壤的化学反硝化对NO的贡献要大于N_2O。

英文摘要:

An experiment using the ^{15}N -labeling method was carried out to investigate effects of application of ammonium nitrate (NH_4NO_3, N 300mg kg^{-1}) and nitrite(Na NO_2, N 1mg kg$^-$) on generation of N_2O and NO in mid- subtropical forest soils, different in water regime (60% and 90% of WHC), in Southeast China. Results show that in soils 60% of WHC in soil water content, generation of N_2O and NO was significantly inhibited by high nitrogen input (p <0.01) ; while in soils 90 % WHC in soil water content, a similar phenomenon was observed with the generation of N_2Owithin the first 9 hours of incubation, but afterwards the trend turned reversely; When NO_2^- added the inhibitions of high nitrogen input were lifted for all unsterilized soils, addition of NO_2^- immediately offset the inhibitive effect of high soil N content and triggered off generation of a large amount of N_2O and NO, forming a sharp contrast to CK (p <0.01). Such a phenomenon did not last long (for 21 h only) in soils 60% of WHC; but it did quite a long time (over 2 weeks) in soils 90% of WHC, which suggests that high water availability and exogenous NO_2^- played an important role in offsetting the inhibitive effect of high soil N content. In this experiment, N_2O was generated mainly in denitrification process of the soil, and what is more, the addition of unlabeled NO_2^-led to rapid increase of hybrid N_2O ($^{14}N^{15}NO$) molecules within the first 21 hours of the experiment, demonstrating that denitrification in the forest soil may probably proceed mainly through codenitrification by fungi, which may explain over 80% of the denitrification. Spearman rank correlation analysis indicates that there is a significantly positive correlation between the NO and N_2Oproduction rates (p <0.05) in non-sterilized soils, and the lower the soil water content, the higher the correlation between the two. After addition of NO_2^-, sterilized soil produced more NO than unsterilized soil, but almost no N_2O, which indicates that in acid soils chemical denitrification contributes more to NO than to N_2O.

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