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研究论文

大气氮沉降对阔叶林红壤淋溶水化学模拟研究

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摘要 在氮饱和的森林生态系统中，氮沉降的增加将导致NO- 3淋溶的增加及土壤酸度的提高，从而影响土壤质量及林业的可持续发展。然而，大气氮沉降对我国南方红壤地区森林生态系统中土壤的影响研究还很少，尤其是氮沉降引起的土壤淋溶液化学组成方面。研究中，以中国科学院红壤生态实验站林草生态试验区阔叶林红壤为对象，在恒温(20℃)条件下，通过土壤淋洗柱（直径10cm、高60cm）进行了8个月间隙性淋溶试验，来模拟研究不同氮输入量（0、 7.8、26mg月$^{-1}$•柱-1和52mg月$^{-1}$柱$^{-1}$）对阔叶林红壤NO^-_3、NH^+_4、SO^{2-}_4、H+和土壤盐基离子(Ca^{2+}、Mg^{2+}、K^+和Na^+)的淋溶和土壤酸度的影响。结果表明，随氮输入量增加，淋溶液中NO^-_3、EC、 H^+和总盐基离子逐渐增加，但淋溶液中无NH^+_4。不同氮处理时，土壤有机氮总表观矿化量分别为189.6、263.9、372.8mg月$^{-1}$•柱$^{-1}$与554.2mg柱-1，氮输入明显促进了土壤有机氮的矿化，且土壤有机氮的表观矿化量与氮输入量间呈正线性相关（R2=0.997**）。无氮（0mg月$^{-1}$柱$^{-1}$）、低氮（7.8mg月$^{-1}$柱$^{-1}$）、中氮（26mg月-1柱-1）和高氮（52mg月$^{-1}$柱$^{-1}$）输入处理下，土壤交换态盐基淋溶总量分别占土壤交换性盐基总量的13.6、18.4、27.7%和48.1%。不同的盐基离子对氮输入的反应不同，Ca^{2+}和Mg^{2+}淋溶量随氮输入量的增加而增加，对Na+和K+则无明显影响。土壤交换态离子中随淋洗液输出最多的为Ca^{2+}（无氮、低氮、中氮和高氮输入处理的土壤交换态输出量占土壤交换态的比例分别为22.6、31.4、46.7%和82.5%），其次为Na^+（无氮、低氮、中氮和高氮输入处理的土壤交换态输出量占土壤交换态的比例分别为16.0、10.7、17.6%和26.3%），最少的为Mg2+（无氮、低氮、中氮和高氮输入处理的土壤交换态输出量占土壤交换态的比例分别为5.0、6.9、11.1%和16.9%），几乎没有土壤交换性K+输出。与对照相比，有氮处理后土壤中硫酸根离子的淋失量明显减少（p<0.05）。表层土壤pH值随氮输入量的增加而显著下降，各处理间差异极显著(p<0.01)。可见，大气氮沉降的增加将加速阔叶林红壤的养分淋失和土壤酸化的程度。

关键词 阔叶林；红壤；大气氮沉降；盐基离子；养分淋溶；土壤酸化

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The leaching solution chemistry of a broad_leaved forest red soil under simulated N deposition in Southern China

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Abstract In nitrogen (N) saturated forest ecosystems, N deposition has been shown to increas

e NO-3 loss and soil acidity. This reduces soil quality and further influences the sustainable development of the forest. However, the effects of N deposition on forest ecosystems in the red soil region of southern China are not well understood, especially the response of soil leaching solution chemistry to N deposition. In this study, a soil column experiment was conducted to investigate the effects of N deposition on soil leaching solution chemistry for eight months at 20℃. The soil column (10 cm diameter and 60 cm high) was filled with soil collected from a broad_leaved forest at the Red Soil Ecological Experiment Station, Jiangxi Province. The simulated N deposition rates were 0 (control), 7.8, 26 and 52 mg N month-1 col-1. The concentrations of NO^-_3, NH^+_4, SO^{2-}_4, H^+, Ca^{2+}, Mg^{2+}, K^+ and Na^+ in the leachate were measured and basic soil physical and chemical properties were also determined. Results showed that NO-3, H+, exchangeable base cations (Ca^{2+}, Mg^{2+}, K^+ and Na^+), and EC in the leachate increased as simulated N deposition rates increased, but no NH+4 was detected in the leachate of any treatment. Net mineralized soil N increased from 189.6 mgN•col-1 in the control treatment to 554.2 mgN•col-1 in the 52 mgN•month-1•col-1 treatment. N input significantly accelerated the mineralization of soil organic N, and a positive linear relationship existed between the apparent mineralization rate of soil organic N and N input (R2=0.997**). The percentages of total exchangeable base cations leached from the soil to total exchangeable base cations increased from 13.6% in the control treatment to 18.4, 27.7% and 48.1% in the 7.8, 26 and 52mgN•$month^{-1}$•col^{-1} treatments respectively. Exchangeable base cations responded differently to N deposition. Ca^{2+} and Mg^{2+} leaching losses increased as N deposition increased, but N deposition had no effect on the leaching of K+ and Na+. The percentage of exchangeable Ca^{2+} leached from the columns increased from 22.6% in the control treatment to 31.4, 46.7% and 82.5% in the 7.8, 26 and 52 mgN•$month^{-1}$ col^{-1} treatments. Similarly the percentage of exchangeable Mg2+ leached from the columns increased from 5.0% in the control treatment to 16.9% in the 52 mgN•$month^{-1}$•col^{-1} treatment. In contrast, the percentage of exchangeable Na+ leached from the four treatments was 16.0, 10.7, 17.6% and 26.3% in the 0, 7.8, 26 mg N•$month^{-1}$•col^{-1} and 52 mgN•$month^{-1}$ col^{-1} treatments respectively. No exchangeable K+ was observed in the leachate of any treatment. N deposition resulted in a significant decrease (p<0.05) in the amount of sulfate leached from the columns compared to the control. The pH of the surface soil also decreased significantly as N deposition increased. The results from this study indicated that increased N deposition rates will increase soil nutrient losses and soil acidity under broadleaf forests in the red soil region of southern China.

Key words broad-leaf forest; red soil; atmospheric nitrogen deposition; base cations; nutrient leaching; soil acidification

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本刊中 包含“阔叶林；红壤；大气氮沉降；盐基离子；养分淋溶；土壤酸化”的 相关文章

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