

研究论文

华北平原大气氮素沉降的时空变异

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摘要 利用量雨器和湿沉降自动收集仪在华北平原9个监测点通过2a的试验, 研究了农田生态系统中大气氮素沉降的时空变异。结果表明: 华北平原大气氮素混合沉降的平均值为28.0 kg/(hm²•a), 降水中铵态氮和硝态氮量平均分别为3.76 mg/L和1.85 mg/L。不同地区比较, 北京大气氮素沉降为32.5 kg/(hm²•a), 明显高于山东和河北两省的23.6 kg/(hm²•a)。北京各监测点的大气氮素沉降也存在明显空间变异, 东北旺、房山的氮素沉降水平较高, 延庆、顺义的氮素沉降水平较低。大气氮素沉降的年内分布不均, 60%的沉降集中在降水较丰沛的6~9月份。氮素的输入与降雨量呈乘幂型正相关 (r²=0.67), 在农田生态系统中以铵态氮的沉降为主, 铵态氮的沉降量是硝态氮的2.0倍; 城市生态系统中以硝态氮的沉降为主, 铵态氮的沉降量是硝态氮的0.79倍。在东北旺试验点近两年的监测结果表明, 在等量降雨量条件下湿沉降输入的氮素 (18~20.6 kg/hm²) 明显低于混合沉降 (26.3 kg/hm²), 湿沉降的氮素输入仅占后者的73%, 而混合沉降中的超量部分主要来自铵态氮, 表明干沉降尤其是降尘带入的铵态氮也是华北平原大气氮素沉降的重要来源

关键词 [大气氮素沉降; 湿沉降; 华北平原; 北京地区; 农田生态系统](#)

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Spatial and temporal variation of atmospheric nitrogen deposition in North China Plain

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Abstract Attention to atmospheric N deposition, as a nutrient resource and as a part of acid deposition, is increasing with the acceleration of global N cycling. However, the information on atmospheric N deposition, especially the spatial and temporal variation of N deposition in the intensive agroecosystems within the North China Plain, is still scarce. Therefore, it is essential to determine the budgets and spatial and temporal variation of atmospheric N deposition in North China Plain in terms of the requirement of integrated N management and the assessment of N deposition effect on surrounding ecosystems.

A monitoring network was established to determine the spatial and temporal variation of atmospheric N deposition in the North China Plain over a 2-year period. The network included 9 monitoring sites: seven in Beijing city, one in Shandong province and one in Hebei province. Except one urban monitoring site in Beijing Academy of Agro-Forestry Sciences (BAAFS), all the other 8 sites were located at typical field areas. Rain gauges (diameter 20 cm, height 80 cm) were installed in all the nine sites for the collection of bulk deposition, and an Automatic Wet-only Sampler (AP

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S-III, Wuhan Tianhong Inc.) was installed at Dongbeiwang site, Beijing, for the collection of wet deposition (the sampler opens only when rainfall happens). Rainwater was collected, thoroughly mixed and stored in plastic bottles immediately after each rain event, then was frozen in a refrigerator until analysis by a Continuous Flow Analyzer (TRACC2000, Germany) within three months. Rain gauges and the wet-only sampler were cleaned by deionized water just after collection.

Annual bulk deposition of inorganic N in the North China Plain ranged from 19.2 to 38.5 kg/hm² and averaged 28.0 kg/hm². Concentration of NH⁺₄-N and NO⁻₃-N in rainwater averaged 3.76 and 1.85 mg/L, which were significantly higher than the values in background sites of China. Annual bulk deposition of inorganic N in the Beijing area was as high as 32.5 kg/hm², while lower annual N deposition of 23.6 kg/hm² was found in Shandong and Hebei provinces. Bulk deposition of inorganic N showed distinguished monthly variation due to monthly change of precipitation, and 60% of bulk deposition occurred from June to September. Bulk deposition of NH⁺₄-N was 2.0 times of NO⁻₃-N deposition in rural monitoring sites. However, the situation was reversed in an urban monitoring site (BAAFS). The results suggest that reduced N in precipitation is dominant in rural region but oxidized N is the major form in urban region. Furthermore, the positive relationship between inorganic N deposition and precipitation can be fitted well by a power equation ($r^2 = 0.67$), showing the increase of NH⁺₄-N and NO⁻₃-N inputs with increased precipitation. Wet deposition of N accounted for 73% of the corresponding bulk deposition, implying that dry deposition of N particular NH⁺₄-N input from dust is important in the North China Plain.

Key words [atmospheric deposition](#) _ [nitrogen](#) _ [precipitation](#) _ [North China Plain](#) _ [agro-ecosystem](#)

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