应用生态学报 2006 17 (12): 2321-2326 ISSN: 1001-9332 CN: 21-1253/Q

研究报告

豚草叶片和果实气体交换特性与11种土壤重金属相关性

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收稿日期 2005-8-12 修回日期 2006-6-28 网络版发布日期 接受日期

摘要 对10个样地中Cu、Pb、Zn、Mn、Cr、Co、Ni、Cd、As、Sb和 Hg 11种土壤重金属含量及样地内豚草叶片和果实气体交换特性进行测定. 结果表明，样地内豚草叶片的净光合速率在1.88～9.41 μmol·m^{-2}·s^{-1}，而果实的净光合速率最高可达2.81 μmol·m^{-2}·s^{-1}. 叶片的呼吸速率、气孔导度、光合速率和水分利用效率的平均值分别为1.81 μmol·m^{-2}·s^{-1}、75.7 mmol·m^{-2}·s^{-1}、6.05 μmol·m^{-2}·s^{-1}和4.72 μmol·mmol^{-1}，分别是果实的5.26、0.64、1.31和1.69倍，说明非同化器官幼嫩果实具有与叶片相当，甚至更强的呼吸、光合能力和水分利用效率；研究地点重金属Ni达到轻微污染水平，其它重金属含量都接近或者显著低于重金属污染的阈值. 相关分析和多元回归分析显示，大部分土壤重金属（如Cu、Pb、Zn、Cd、As、Sb和Hg）含量的高低对豚草气体交换特性没有显著影响，仅部分重金属含量与豚草的叶片、果实气体交换特性密切相关，如Ni和Cr对豚草叶片、果实的气孔导度及水分利用效率显著相关；Cr与豚草叶片饱和光合速率显著相关；而As与豚草果实的气孔导度显著相关. 表明大部分土壤重金属对叶片和球果的气体交换没有直接影响，而Ni、Cr和As可以在轻微污染甚至没有达到污染水平时影响豚草的气体交换特性.

关键词 豚草 叶片和果实气体交换 土壤重金属 气孔导度 水分利用效率

分类号

Gas exchange features of *Ambrosia artemisiifolia* leaves and fruits and their correlations with soil heavy metals

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Abstract

Ambrosia artemisiifolia can survive well in the habitats of heavy human disturbance and partial soil pollution. Weather its photosynthetic features benefit their survival is worthwhile to concern. With a refuse dump in Changchun City (43°50′N, 125°23′E) as study site, this paper analyzed the contents of soil Cu, Pb, Zn, Mn, Cr, Co, Ni, Cd, As, Sb and Hg at ten plots, and measured *in situ* the gas exchange in *A. artemisiifolia* leaves and young fruits. The results showed that the study site was slightly contaminated by Ni, but the contents of other soil heavy metals were approached to or substantially lower than their threshold values. The net photosynthetic rate of leaves ranged from 1.88 to 9.41 μmol·m^{-2}·s^{-1}, while that of young fruits could be up to 2.81 μmol·m^{-2}·s^{-1}. Averagely, the respiration rate, stomatal conductance, photosynthetic rate, and water utilization efficiency of leaves were 1.81 μmol·m^{-2}·s^{-1}, 75.7 mmol·m^{-2}·s^{-1}, 6.05 μmol·m^{-2}·s^{-1}, and 4.72 μmol CO_2·mmol^{-1} H_2O, being 5.26, 0.64, 1.31 and 1.69 times as much as those of young fruits, respectively, indicating that the respiratory and photosynthetic capacities and water use efficiency of *A. artemisiifolia* young fruits were equivalent to or higher than those of its leaves. Many test heavy metals, such as Cu, Pb, Zn, Cd, As, Sb and Hg, had no significant effects on the gas exchange features of leaves and fruits, but there were significant correlations of Ni and Cr with the stomatal conductance and water use efficiency of leaves and young fruits, Cr with the gross photosynthesis of leaves, and As with the stomatal conductance of young fruits, suggesting that a majority of test soil heavy metals had no direct effects on the gas exchange in *A. artemisiifolia* leaves and fruits, but soil Ni, Cr and As with the contents approached to or substantially lower than the threshold values could affect the gas exchange features of *A. artemisiifolia*.

Key words *Ambrosia artemisiifolia* Gas exchange in leaves and fruits Soil heavy metals Stomatal conductance Water use efficiency

DOI:

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