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研究论文

东北东部森林生态系统土壤呼吸组分的分离量化

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摘要 对森林生态系统的土壤呼吸组分进行分离和量化，确定不同组分CO_2释放速率的控制因子，是估测局域和区域森林生态系统碳平衡研究中必不可少的内容。采用挖壕法和红外气体分析法测定无根和有根样地的土壤表面CO_2通量（R_S），确定东北东部6种典型森林生态系统R_S中异养呼吸（RH）和根系自养呼吸（R_A）的贡献量及其影响因子。具体研究目标包括：（1）量化各种生态系统的R_H及其与主要环境影响因子的关系；（2）量化各种生态系统R_S中根系呼吸贡献率（R_C）的季节动态；（3）比较6种森林生态系统R_H和R_A的年通量。土壤温度、土壤含水量及其交互作用显著地影响森林生态系统的R_H（R_2=0.465～0.788），但其影响程度因森林生态系统类型而异。硬阔叶林和落叶松人工林的RH主要受土壤温度控制，其他生态系统RH受土壤温度和含水量的联合影响。各个森林生态系统类型的RC变化范围依次为：硬阔叶林32.40%～51.44%；杨桦林39.72%～46.65%；杂木林17.94%～47.74%；蒙古栎林34.31%～37.36%；红松人工林33.78%～37.02%；落叶松人工林14.39%～35.75%。每个生态系统类型RH年通量都显著高于RA年通量，其变化范围分别为337～540 gC•m^{-2}•a^{-1}和88～331 gC•m^{-2}•a^{-1}。不同生态系统间的RH 和RA也存在着显著性差异。

关键词 根呼吸； 异养呼吸； 土壤呼吸； 土壤温度； 土壤含水量； 温带森林

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Partitioning soil respiration of temperate forest ecosystems in Northeastern China

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Abstract Quantifying soil respiration components and their relations to environmental controls is essential to estimates of both local and regional carbon budgets of forest ecosystems. In this study, we used trenching-plot and infrared gas exchange analyzer approaches to determine heterotrophic (R_H) and autotrophic respiration (R_A) in soil surface CO_2 flux for six major temperate forest ecosystems in northeastern China. The ecosystems were: Mongolian oak forest (dominated by Quercus mongolica), poplar-birch forest (dominated by Populous davidiana and Betula platyphylla), mixed-wood forest (composed of P. davidiana, B. platyphylla, Fraxinus mandshurica, Tilia amurensis, Acer amono, etc.), hard-wood forest (dominated by F. mandshurica, Juglans mandshurica, and Phellodendron amurense), Korean pine (Pinus koraiensis) and Dahurian larch (Larix gmelinii) plantations, representing typical secondary forest ecosystems in this region. Our specific objectives were to: (1) quantify R_H and its relationships with environmental factors for the forest ecosystems, (2) characterize seasonal dynamics in the contribution of root respiration to total soil surface CO_2 flux (R_C), and (3) compare annual CO_2 fluxes from R_H and R_A among the six forest ecosystems. Soil temperature, Soil water content, and their interactions significantly affected R_H in the ecosystems, and explained 46.5%～78.8% variations in R_H. However, the environmental controlling factors of R_H varied with ecosystem types: soil temperature in hardwood and Dahurian larch forest ecosystems, soil temperature and water content in the others. The R_C for hardwood, poplar-birch, mixed-wood, Mongolian oak, Korean pine and Dahurian larch forest ecosystems varied between 32.40%～51.44%, 39.72%～46.65%, 17.94%～47.74%, 34.3

1%～37.36%, 33.78%～37.02%, 14.39%～35.75%, respectively. The annual CO_2 fluxes from R_H were significantly greater than that from R_A for all the ecosystems, ranging from 337～540 gC•m－2•a^{-1} and 88～331 gC•m^{-2}•a^{-1} for RH and R_A, respectively. The annual CO_2 fluxes from R_H and R_A differed significantly among the six forest ecosystems.

Key words root respiration _ heterotrophic respiration _ soil respiration _ soil temperature _ soil water content _ temperate forest

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