生态学报 2007 27 (2007-05): 1960～1968 ISSN: 1004-616x CN: 44-1063/R

研究论文

不同土地利用方式下土壤呼吸及其温度敏感性

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收稿日期 2006-1-7 修回日期 2007-2-20 网络版发布日期: 2007-5-25

摘要

采用静态箱-气相色谱法对四川盆地中部紫色土丘陵区3种土地利用方式（林地、草地和轮作旱地）土壤呼吸进行测定，结果表明，林地、草地和旱地土壤呼吸速率变化范围分别为78.63～577.97、39.28～584.18和34.48～484.65 mg CO_2•m^{-2}•h^{-1}，年平均土壤呼吸速率分别为264.68、242.91、182.21 mg CO_2•m^{-2}•h^{-1}。3种土地利用方式的土壤呼吸速率季节变化趋势均呈单峰曲线，林地和草地土壤呼吸速率最大值均出现在夏末(7月底与8月初之间)，旱地土壤呼吸速率最大值出现的时间比林地和草地要早，在6月底与7月初之间；最小值均出现在12月底与翌年1月初之间。土壤温度和土壤湿度是影响本地区土壤呼吸的主要因子，双因素关系模型(R = aebTwc)较好地拟合了土壤温度和土壤湿度对土壤呼吸的影响，二者共同解释了土壤呼吸变化的64%～90%。土壤呼吸的温度敏感性指数Q_{10}值受土壤(5cm处)温度和土壤(0～10cm)湿度的影响。分析表明3种土地利用土壤的Q_{10}值与土壤温度呈显著负相关关系，而与土壤湿度呈显著正相关关系。

关键词

土地利用；土壤呼吸；温度敏感性；静态箱-气相色谱

分类号 S154,S181

Soil respiration and its sensitivity to temperature under different land use conditions

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Abstract

Soil respiration, as an important source of atmospheric carbon oxide (CO_2), has received considerable attention in the recent years. Changes in land use or soil management practices affect the status of soil organic carbon (SOC), and hence alter CO_2 emissions from terrestrial ecosystems into the atmosphere. Soil respiration rates as well as soil temperature and moisture were measure

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d with closed chamber-chromatographic technique at three plots with different land-use (i.e., forest, grassland and rotated upland cropland) in an experimental station of CERN (Chinese Ecosystem Research Net) located in the Central Sichuan Basin. Over the studied period, soil respiration rates varied from 78.63 to 577.97 mg CO_2 m^{-2} h^{-1} at the forest plantation, from 39.28 to 584.18 mg CO_2 m^{-2} h^{-1} at the grassland plot, and from 34.48 to 484.65 mg CO_2 m^{-2} h^{-1} at the cropland plot. The seasonal variations of the soil respiration rates measured across the three plots showed a similar pattern with a single peak occurred in the summer and a depression in the winter. The relationship of soil respiration rate (R) with soil temperature (T) and soil moisture (W) fit well to the equation R = aebTwc (a, b, c were constants). The results indicated that soil temperature and soil moisture together could explain 64%-90% of the seasonal variations in soil respiration rate. The temperature dependence of soil respiration (Q_{10}) has been widely used in estimating soil respiration rate. This parameter has commonly been treated as a constant near to 2.0 in many ecosystem models although it has been documented that Q_{10} value varies with temperature and moisture. Owing to the nonlinear relationship between Q_{10} and respiration rate, a small change in Q_{10} could cause a significant variation in the modeled soil respiration flux. Therefore, accurately quantifying Q_{10} and its variability is crucial for estimating ecosystem carbon budget. Our research showed that the Q_{10} values were positively related to the moisture in the top soil (0-10 cm) and negatively related to the soil temperature at 5 cm depth. Based on the equation shown above, 1℃ increase in soil temperature at 5 cm depth will reduce the Q_{10} value by 0.08, 0.06 and 0.07 for the forest, grassland and cropland plots, respectively; and 1% decrease in soil moisture will reduce the Q10 value by 0.14, 0.10 and 0.11 for the forest, grassland and cropland plots, respectively. The modifications with the Q_{10} value will make the calculated soil respiration rates more reliable.

Key words land use _ soil respiration _ ecosystem model _ temperature sensitivity _ closed chamber chromatographic

DOI

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