鄂东南低丘马尾松林和枫香林土壤异养呼吸及温湿度敏感性

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Soil heterotrophic respiration and its sensitivity to soil temperature and moisture in *Liquidambar formosana* and *Pinus massoniana* forests in hilly areas of southeast Hubei Province, China.

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摘要

采用野外监测方法,研究了鄂东南低丘地区主要森林类型枫香林和马尾松林土壤异养呼吸、土壤温湿度的年动态；并通过室内试验研究了土壤呼吸随土壤深度的变化以及表层土壤(0～5 cm)异养呼吸的温湿度敏感性,建立了表层土壤异养呼吸的温湿度响应模型,探讨全球温暖化对该区土壤异养呼吸的潜在影响.结果表明：枫香林和马尾松林0～5 cm土壤呼吸速率分别是5～10 cm、10～15 cm层的2.39、2.62倍和2.01、2.94倍,说明土壤异养呼吸主要发生在土壤表层（0～5 cm）；枫香林和马尾松林0～ 5 cm、5～10 cm及10～15 cm土壤的Q_{10}分别是2.10、1.86、1.78和1.86、1.77、1.44；枫香林和马尾松林表层土壤呼吸对温度(T)的响应符合指数模型［$R=\alpha\exp(\beta T)$］,对湿度(W)的响应符合二次函数模型($R=a+bW+cW^2$)；0～5 cm土壤对温湿度双因子的响应符合$\ln R=a+bW+cW^2+dT+eT^2$模型,且异养呼吸对湿度的响应具有温度依赖性,即在高温下敏感,低温下敏感性下降；应用表层土壤异养呼吸温湿度模型预测枫香林和马尾松林土壤异养呼吸年动态及总量,枫香林土壤异养呼吸量的模拟值比实测值略高,而马尾松林比较接近,说明该方法具有较好的应用价值.在全球温暖化的背景下,该地区马尾松林和枫香林的土壤呼吸会明显上升.

关键词： 枫香林 马尾松林 土壤异养呼吸 Q_{10}

Abstract:

Field monitoring was conducted to study the annual dynamics of soil heterotrophic respiration and soil temperature and moisture in *Liquidambar formosana* and *Pinus massoniana* forests in hilly areas of southeast Hubei Province, China. At the same time, laboratory experiment was performed to study the heterotrophic respiration rate along soil profile, and the sensitivity of surface soil (0-5 cm) heterotrophic respiration to soil temperature and moisture. Then, a model was established to valuate the potential effects of warming change on the soil heterotrophic respiration in study area. In *L. formosana* and *P. massoniana* forests, the soil heterotrophic respiration rate in 0-5 cm layer was 2.39 and 2.62 times, and 2.01 and 2.94 times of that in 5-10 cm and 10-20 cm layers, respectively, illustrating that soil heterotrophic respiration mainly occurred in 0-5 cm surface layer. The temperature sensitivity factor (Q_{10}) of soil heterotrophic respiration in 0-5 cm, 5-10 cm, and 10-20 cm layers was 2.10, 1.86, and 1.78 in *L. formosana* forest, and 1.86, 1.77, and 1.44 in *P. massoniana* forest, respectively. The relationship between surface soil heterotrophic respiration and temperature (T) well fitted exponential function $R=\alpha\exp(\beta T)$, and that between surface soil heterotrophic respiration and moisture (W) well fitted quadratic function $R=a+bW+cW^2$. Therefore, the relationship of surface soil heterotrophic respiration with soil temperature and moisture could be described by the model $\ln R=a+bW+cW^2+dT+eT^2$, which suggested that the response of soil heterotrophic respiration to soil moisture was depended on soil temperature, *i.e.*, the sensitivity decreased with decreasing soil temperature. The calculation of the annual soil heterotrophic respiration rate in the two forests with the established model showed that the calculated respiration rate was a slightly higher in *L. formosana* forest but close to the measured one in *P. massoniana* forest, illustrating the applied importance of the model. Our results suggested that the soil heterotrophic respiration in the *L. formosana* and *P. massoniana* forests in hilly areas of southeast Hubei Province would have an obvious increase under the background of global warming.

Key words: *Liquidambar formosana* forest *Pinus massoniana* forest soil heterotrophic respiration Q_{10}

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