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模拟氮沉降对太岳山油松林土壤呼吸的影响及其持续效应

### Effects and its sustained effect of simulated nitrogen deposition on soil respiration in *Pinus tabulaeformis* forests in the Taiyue Mountain, China

关键词: [模拟氮沉降](#) [土壤呼吸](#) [持续效应](#) [油松林](#)

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摘要:以太岳山油松林为研究对象,对林地分别作3种凋落物处理:对照(C)、去凋(B)、去凋+切根(A),并设计了4个氮水平:对照(CK,  $0 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{a}^{-1}$ ),以N计,下同)、低氮(LN,  $50 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{a}^{-1}$ )、中氮(MN,  $100 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{a}^{-1}$ )和高氮(HN,  $150 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{a}^{-1}$ ),研究了土壤呼吸速率在施氮后的连续变化,以及与温度、湿度、微生物生物量C、N、土壤酶活性的关系.结果表明:去凋+切根、去凋、对照样方不同施氮水平下土壤呼吸速率基本都在施N后的第1 d处在最高峰,随即下降,切根+去凋、去凋处理样方的土壤呼吸速率在施氮后第3 d趋于稳定,而对照处理样方的土壤呼吸速率一直处于下降状态.施氮在一定程度上抑制了切根+去凋处理的土壤呼吸速率,而促进了去凋处理、对照处理的土壤呼吸速率,并且土壤微生物生物量C、N的变化与土壤呼吸速率变化一致,土壤呼吸速率与土壤酶活性、土壤湿度的拟合关系不显著( $p > 0.05$ ),而与土壤温度的拟合关系显著( $p < 0.05$ ).以土壤温度、土壤湿度构建的复合模型 $R_s = ae^{bT}W^c$ 预测土壤呼吸的准确性高于单因子模型,施氮降低了每种凋落物处理指数关系模型( $R_s = ae^{bT}$ )的决定系数 $R^2$ ,并且施氮降低了切根+去凋、去凋处理的温度敏感性指数 $Q_{10}$ ,而对对照处理的 $Q_{10}$ 无明显影响.

**Abstract:** The dynamic of soil respiration after simulated nitrogen deposition in different litter treatment subplots was studied in a natural *Pinus tabulaeformis* forest in Taiyueshan, Shanxi Province. Three litter treatment subplots including control (C), litter exclusion (B), litter and root exclusion (A) were established. Nitrogen levels were implemented as: CK ( $0 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{a}^{-1}$ ), LN ( $50 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{a}^{-1}$ ), MN ( $100 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{a}^{-1}$ ) and HN ( $150 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{a}^{-1}$ ). The relationships between soil respiration and soil temperature, moisture, microbial biomass and soil enzyme activity after each nitrogen application were studied. The results showed that soil respiration rates in different litter treatment subplots were the highest on the first day and then gradually decreased after each nitrogen application. Soil respiration rates were steady after the third day for the litter exclusion (B) and litter and root exclusion (A) subplots, however, the respiration rate in control (C) subplot consistently decreased with nitrogen application. External nitrogen inhibited the soil respiration rate in litter and root exclusion (A) subplot, but promoted respiration in litter exclusion (B) and control (C) subplots. The variation of soil microbial biomass C and N was similar with soil respiration rate. The relationships between soil respiration and soil enzyme activity, and soil moisture were not significant, while there was a significant relationship between soil respiration and temperature ( $p < 0.05$ ). The hybrid model  $R_s = ae^{bT}W^c$  with soil temperature, soil moisture appeared to have better precision than the single factor model in predicting the soil respiration. Nitrogen deposition decreased the determination coefficient  $R^2$  of  $R_s = ae^{bT}$  of different litter treatments. Furthermore, nitrogen deposition reduced  $Q_{10}$  in the litter and root exclusion (A) and litter exclusion (B) subplots, but did not significantly reduce the  $Q_{10}$  in the control (C) subplot.

**Key words:** [simulated nitrogen deposition](#) [soil respiration rate](#) [sustained effect](#) [Pinus tabulaeformis forest](#)

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