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研究论文

小青杨组织营养品质和舞毒蛾幼虫生长对大气CO2浓度升高的响应

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摘要 利用开顶式气室研究了1年生小青杨绿叶、细根、粗根和树皮内营养成分对CO_2浓度升高的响应，并检验了上树取食的舞毒蛾幼虫的生长反应。结果表明：CO_2浓度升高环境下小青杨绿叶、细根、树皮和粗根中的氮含量显著降低，绿叶、树皮和粗根中的碳氮比显著增加，但细根中碳氮比增加未达到显著水平；CO_2浓度升高对所有杨树组织的总碳含量均无影响；CO_2浓度升高显著增加了绿叶中总可溶性糖和总非结构碳水化合物的浓度，而绿叶淀粉含量仅在部分采样日期发生显著增加，除细根可溶性糖含量在CO_2浓度升高处理下降低外，根系和树皮中各碳水化合物指标的浓度均未发生显著变化；CO_2浓度升高环境下2龄舞毒蛾幼虫上树取食13d后体重显著低于自然CO_2浓度处理下幼虫的体重，但幼虫继续在各自的实验处理下取食11d后，体重未表现出显著性差异。大气CO_2浓度升高对杨树各组织内的营养成分含量均有影响，绿叶营养品质变差可能是导致低龄舞毒蛾幼虫生长受抑制的主要原因。

关键词 CO_2浓度升高；小青杨；营养品质；氮；碳水化合物；舞毒蛾

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Effects of increased atmospheric CO2 on nutritional contents in poplar (*Populus pseudo-simonii*(Kitag.))tissues and larval growth of gypsy moth (*Lymantria dspar*)

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Abstract Changes in concentrations of chemical components in green leaves, litters, twigs and fine roots usually take place when the plants grow under elevated atmospheric CO2. Variations in phytochemistry may influence species interactions and ecosystem processes such as competition, consumption, decomposition, and biogeochemical cycling. Increase in atmospheric CO2 results in increase in foliar starch concentrations, carbon-based secondary metabolites, particularly phenolics, while reduction in foliar nitrogen concentrations. CO_2-induced changes in foliar chemistry tend to reduce leaf quality and may further affect insect herbivores. Increasing atmospheric CO_2 also has potential influence on decomposition as the chemical components of all plant tissues are changed.

To examine the likely changes in the nutritional quality of tree tissues and the performance of leaf-feeding forest insect under increased atmospheric CO_2, samples of poplar (Populus pseudo-simonii ［Kitag.］) grown in Open Top Chambers at ambient and elevated (650μl L^{-1}) CO_2 were collected for measuring nitrogen concentration, C/N ratio, soluble sugar and starch contents in leaves, barks, coarse roots (>2mm in diameter), and fine roots (<2mm in diameter). Gypsy moth (Lymantria dispar) larvae were reared on a single branch of experimental trees in a nylon bag with 1 mm×1 mm grid. The response of larval growth was observed in situ.

The results indicated that increase in CO_2 significantly reduced nitrogen concentration in poplar leaves (-8.94% in average within growth season), bark (-9.13%), fine roots (-5.35%), and coarse roots (-10.53%). C/N ratios of green leaves (+9.98% in average within growth season), barks (+9.54%), and coarse roots (+10.27%) increased significantly in response to increased CO_2. C/N ratio in fine roots increased only 4.12% (not significantly). Total carbon contents in all tissues were unaffected by CO_2 treatment. Elevated CO_2 significantly increased soluble sugar (+13.89% in average within growth season) and non-structural carbohydrate (+12.67% in average within growth season) in poplar leaves, but starch concentration increased 24.67% only on 20 July, no significant changes in leaf starch concentration were found on the other sampling dates. Carbohydrate concentrations in poplar roots and barks were insensitive to CO_2 treatment, but soluble sugar contents in fine roots decreased by 10.54% in response to elevated CO_2. When second-stadium gypsy moth larvae consuming poplars grew under increased CO_2 for the first thirteen days, their body weight was 30.95% lower than the larvae at ambient CO_2, but when larvae fed in the same treatment for the next eleven days, no significant difference was found.
Increase in atmospheric CO_2 had adverse effects on nutritional quality of *Populus pseudo-simonii* ［Kitag.］ tissues and the resultant variations in chemical components of green leaves had a significant but negative impact on the growth of early instar gypsy moth larvae.

Key words elevated CO_2 _ *Populus* *pseudo-simonii*［Kitag.］ _ nutritional quality _ nitrogen _ carbohydrate _ Lymantria dispar

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