生态学报 2006 26 (2006(05)): 1523～1532 ISSN: 1004-616x CN: 44-1063/R

研究论文

沙地杨树人工林生理生态特性

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收稿日期 2006-1-24 修回日期 2006-4-20 网络版发布日期: 2006-5-25

摘要 自然条件下（5～10月份），利用Li-6400便携式光合作用测定系统对北京大兴地区集约栽培欧美107杨（*Populus*× *euramericana* cv.“74/76”）生理生态特性进行研究，探讨叶片在水分胁迫状态下光合作用、呼吸作用和蒸腾作用动态规律，并揭示其主要影响机理。实验结果表明叶片净光合速率（Pn）日变化均为单峰曲线，且Pn日平均值从春季到秋季呈下降趋势。从整个生长季来看，光合有效辐射*PAR*（*r*=0.815）和气孔导度*Gs*（*r*=0.805）与Pn的相关性显著，通过每月相关性分析，5、8月份影响Pn的主导因子为*PAR*和Gs，6、7月份影响*Pn*的主导因子为Gs，9、10月份影响Pn的主要因素为*PAR*。根据Fsrquhar和Sharkey提出的气孔限制和非气孔限制判断方法对Pn日变化进行分析，5月份8：00*Pn*达到峰值后由于气孔导度降低引起Pn下降，16：00以后由于非气孔因素*PAR*的降低，使得Pn继续降低；6、7月份8:00以后Pn降低限制因素同5月份一样由气孔导度降低引起，但是14:00左右，由于植物体内水分严重亏缺，叶片气孔不能正常开启使得叶片*Pn*、*R*和*Tr*均不能正常进行，8～10月份*Pn*降低主要受PAR限制。叶片呼吸速率（R）的主要影响因子为温度，且R的日变化和季节变化与大气温度（*Ta*）变化趋势基本一致，一天中清晨、傍晚Ta和R均为低点，14：00左右*Ta*和R都达到最大值，同样在季节变化中R和*Ta*在6、7月份最高，10月份最低。蒸腾速率（*Tr*）日变化全为单峰曲线，其最大值出现在12：00 ～ 14：00左右，*Tr*变化与许多环境因子和生理因子都具有密切的相关性，就整个生长季来说，PAR是其最主要的影响因子，然而叶片气孔限制值（*LS*）、Gs、叶片大气水汽压差（VpdL）、Ta等生理生态因素在不同月份分别起着极其重要的作用。

关键词 沙地； 欧美107杨； 杨树人工林； 生理生态特性

分类号 Q945.79

Physiological regulations of photosynthesis in a poplar plantation on a sandy soil

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Physiological regulations of photosynthesis in a poplar plantation on a sandy soil

Abstract Poplar（Populus× euramericana cv.“74/76”）is the most important plantation species in northern China. To fully understand the changes in photosynthesis at different temporal scales, respiration and transpiration under water stress are also needed. We installed a field experiment in a 3-year plantation (2m×2 m) in Daxing District of Beijing in 2005. From May to October, we measured several physiological characteristics using a Li-6400 Portable photosynthesis system between 6:00 and 20:00 hours on 5-7 mature leaves in the upper part of the canopy. We found that the diurnal change in net photosynthetic rate (*Pn*) appeared as a single-peak curve, with daily averages decreased from May to October. The correlation analysis with environmental and physiological variables suggested that photosynthetic active radiation (*PAR*) and stomata conductance (*Gs*) were the two most significant factors influencing Pn, especially in May and August. Gs appeared more important in July, while PAR was the most important factor in September and October. Vapor pressure deficit—a combined indicator of air temperature and humidity-was also important from August through October but not in May through July. When the underline mechanisms for diurnal changes of Pn in May were explored based on changes in stomata conductance, it appeared that Pn reached the peak value at 8:00 hour and decreased dramatically bec

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ause of lowered Gs until 16:00. But low PAR level seemed to be the limiting factor after the hou r. The above regulations were different in June and July when stomata were closed at around 1 4:00 hour as indicted by high leaf respiration and low transpiration rate (Tr). From August throug h October, the primary factor regulating Pn was PAR. We also found that R changed in a simila r pattern with air temperature, showing a strong temperature controlling mechanism. The diurnal c hange in Tr also showed a single-peaked pattern, with the maximum valued reached between 1 2:00-14:00 hour. Many factors were found to be influential on Tr, but PAR seemed to the mos t important responsible variable.

Key words sandy soil； Populus× euramericana cv.“74/76”； plantation _ photosynt hesis _ stomata _ respiration

DOI

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