生态学报 2006 26 (2006(12)): 4050～405 ISSN: 1004-616x CN: 44-1063/R

研究论文

马占相思(Acacia mangium)树干液流密度和整树蒸腾的个体差异

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收稿日期 2005-8-16 修回日期 2005-12-20 网络版发布日期: 2006-12-25

摘要 利用Granier热消散探针观测了华南丘陵地区马占相思人工林（18a树龄）的树干液流（Sap Flow）。日变化的观测结果显示，不同大小胸径的14株样树液流密度（Js）个体间的差别较大（CV：36.42%～80.80%），日间最大液流密度从最高的80.05（$gH_2O\ m^{-2}\ s^{-1}$）到最低的11.25（$gH_2O\ m^{-2}\ s^{-1}$），差异显著。液流密度的个体差异与树形的大小并不显著相关（p>0.24），即液流密度的大小不是与树木形态相关联的固有特征。然而，树木胸径的大小却是影响液流随时间变化的重要因子。树形较大的树木日总液流量（Et, $kgH_2O\ tree^{-1}\ d^{-1}$）较高，但中等大小的树木却具有较高的单位基面积日液流量（Es, $kgH_2O\ dm^{-2}\ d^{-1}$），发现，单位基面积的日流量最大值并不出现在胸径最大的树木，而出现在胸径稍小的树木，意味着后者对自身结构的水分利用效率较高。由液流密度计算的整树蒸腾，个体间差异也比较大（3.35～72.42$kgH_2O\ tree^{-1}\ d^{-1}$），且与胸径以幂函数的形式呈现正相关（p<0.001）。尽管整树蒸腾在个体之间的差别较大，但随时间的变化规律却是一致的，整树蒸腾的变化格型基本上受环境因子的控制。以液流反映马占相思的蒸腾与冠层的实际蒸腾存在明显的时滞，14株样树的液流变化比光合有效辐射滞后40min至110min，相关分析显示，时滞的长短与树木的胸径、高度、边材面积和冠幅均不呈现明显的相关性（p>0.36）。

关键词 液流密度；整树蒸腾；胸径；时滞；马占相思

分类号 Q948.11；S718

The variations of sap flux density and whole-tree transpiration across individuals of *Acacia mangium*

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Abstract The Granier's probes were applied to monitor the sap flow of an 18-year old Acacia mangium forest stand in a typical hilly land of South China. Diurnal courses of sap flux density (Js) of 14 sample trees with different diameter at breast (DBH) showed significant differences across individuals (CV：36.42%～80.80%). The maximum Js ranged from the highest of 80.05 $gH_2O\ m^{-2}\ s^{-1}$ to the lowest of 11.25 $gH2O\ m^{-2}\ s^{-1}$. Meanwhile the individual variations of Js did not present a significant correlation with tree sizes (p>0.24), suggesting that the Js magnitude be not an intrinsic character associated with tree morphology. However, the tree size would be an important factor affecting the temporal change of Js. Although generally a larger tree tends to have a higher total daily sap flow (Et, $kgH2O\ tree^{-1}\ d^{-1}$), the highest sap flow calculated from basal area (Es, $kgH_2O\ dm^{-2}\ d^{-1}$) was not found in the tree with the largest DBH, but in those with slightly smaller DBH class, suggesting that medium-sized trees utilize their structure more efficiently in regard to water usage. The whole-tree transpiration calculated from Js also varied significantly across the individuals (3.35～72.42$kgH2O\ tree^{-1}\ d^{-1}$), and was positively correlated with tree DBH in a form of power function (p<0.001). The results indicated that tree size, population and community characteristics played important roles in measuring stand transpiration using the sap flow system. In spite of the obvious discrepancy among the examined trees, the whole-tree transpiration rate showed similar changing trends which mainly followed the change of climatic f

actors. A distinct time lag of sap flow behind the actual canopy transpiration, here refers to the ph otosynthetically active radiation, was found in A. mangium spanning from 40 to 110 minutes amon g the 14 sample trees. No significant correlation was found between the time lag and DBH, tree h eight as well as canopy size ($p>0.36$). After 20 years growth the A. mangiun forest, though cultiva ted, not only showed obvious heterogeneity in both structure and size, but also in the functional as pect (whole-tree transpiration) among individuals. The Granier's sap flow measurement system w as proven to be an suitable approach in monitoring whole-tree transpiration as well as the canop y water flux of man-made forest on the hilly lands of South China.

Key words sap flux density _ whole-tree transpiration _ DBH _ time lag _ Aca cia mangium

DOI

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