毛乌素沙地典型树种蒸腾耗水特征及其与气象因子的关系

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摘 要：【目的】通过对毛乌素沙地人工植被茎流蒸腾速率及其与气象因子的关系进行研究，探究旱柳(Salix matsudana)和小叶杨(Populus simonii)的蒸腾耗水量及影响因子。【方法】采用热扩散式插针茎流计(TDP)测定树干液流与自动气象站监测微气象因子，运用 Granier 公式计算出旱柳和小叶杨的蒸腾茎流量，研究其与气象因子的关系。【结果】旱柳和小叶杨的茎流日变化呈单峰“几”字型曲线，表现出明显的昼夜变化规律，7：00 左右茎流启动到 12：00 左右达到峰值，随后茎流速率降低，在 20：00 左右茎流下降速率逐渐趋于稳定；天气对茎流速率影响显著，晴天条件下旱柳最大茎流速率可达 9265.68ml •h-1，小叶杨最大茎流速率可达 5025.12ml • h-1，雨天情况下旱柳最大茎流速率为 7914.31ml • h-1，小叶杨最大茎流速率为 3310.61ml •h-1，整体看来晴天旱柳和小叶杨的最大茎流速率较阴雨天显著增大 30-50%，且旱柳最大茎流速率大于小叶杨；整个生长季旱柳各月的蒸腾耗水量由高到低依次为 8 月＞9 月＞7 月＞6 月＞10 月，小叶杨各月的蒸腾耗水量由高到低依次为 8 月＞9 月＞7 月＞10 月＞6 月；旱柳和小叶杨的各月平均日累计茎流耗水量均呈“S”形增长曲线分布，旱柳日累计茎流耗水量最高为 8 月 160328.60ml • d-1，小叶杨日累计茎流耗水量最高为 8 月 113911.89ml • d-1；旱柳和小叶杨的茎流速率与光合有效辐射、饱和水汽压差和空气温度呈正相关，与空气相对湿度呈负相关。【结论】毛乌素沙地人工乔木旱柳的蒸腾耗水作用更强列，对水分的消耗更大，空气温度是影响其液流密度的主要原因。

关键词：毛乌素沙地；旱柳；小叶杨；蒸腾耗水；气象因子

Characteristics of transpiration water consumption of typical tree species in Mu Us Sandy Land and its relationship with meteorological factors

Abstract:【Objective】To explore the transpiration water consumption and its influencing factors of Salix matsudana and Populus simonii by studying the transpiration rate of artificial vegetation stem flow and its relationship with meteorological factors in Mu Us sandy land. 【Method】The thermal dissipation probe sap flow meter (TDP) was used to measure the sap flow and the automatic weather station was used to monitor the micro-meteorological factors. The Granier formula was used to calculate the transpiration stem flow of S.matsudana and P.simonii, and its relationship with meteorological factors was studied.【Result】The diurnal variation of sap flow of S.matsudana and P.simonii showed a single-peak ' Ji ' curve, showing obvious diurnal variation. The sap flow started at about 7:00 and reached the peak at about 12:00, then the sap flow rate decreased, and the decrease rate of sap flow gradually stabilized at about 20:00. The weather has a significant effect on the sap flow rate. The maximum sap flow rate of S.matsudana can reach 9265.68 ml·h-1 in sunny days, and the maximum sap flow rate of P.simonii can reach 5025.12 ml·h-1. In rainy days, the maximum sap flow rate of S.matsudana is 7914.31ml·h-1, and the maximum sap flow rate of P.simonii is 3310.61ml·h-1.Overall, the maximum sap flow rate of S.matsudana and P.simonii in sunny days is significantly increased by 30-50 % compared with that in rainy days, and the maximum sap flow rate of S.matsudana is greater than that of P.simonii. The monthly transpiration water consumption of Salix matsudana in the whole growing season from high to low was August > September > July > June > October, and the monthly transpiration water consumption of Populus simonii was August > September > July > October > June. The monthly average daily cumulative stemflow water consumption of Salix matsudana and Populus simonii showed an ' S ' -shaped growth curve distribution. The daily cumulative stemflow water consumption of Salix matsudana was the highest in August 160328.60 ml·d-1, and the daily cumulative stemflow water consumption of Populus simonii was the highest in August 113911.89 ml·d-1; the sap flow rate of Salix matsudana and Populus simonii was positively correlated with photosynthetic active radiation, saturated vapor pressure difference and air temperature, and negatively correlated with air relative humidity.【Conclusion】The transpiration water consumption of artificial tree Salix matsudana in Mu Us sandy land is stronger, and the water consumption is greater. Air temperature is the main reason affecting its sap flow density.

Keywords: Mu Us Sandy Land; Salix matsudana; Populus simonii; transpiration water consumption ; meteorological factor