



A field study of depletion-replenish water storage mechanism in tree stems in semi-arid region

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Trees in arid and semi-arid regions are faced with water shortages at most times, and the use of water storage in tree stem is an important mechanism and pathway for adaptation to drought. In this research, we have explored the tree saplings in semi-arid areas by continuous monitoring and analysis of the sap flux at stem top and stem breast, in the main growth season. A primary objective is to find out when and how trees use stem water storage as a reservoir, and more specifically if there is a difference in stem flow start time between stem top and stem breast. Our study shows that in sunny day of the growing season, the sap flow at stem top start time is later than the sap flow at stem breast, with the maximum of time lag about 60 mins, and the daily sap flow peak time of stem top is later than that of the stem breast by 1-2 hrs. The maximum daily flux at stem top is about 1.4-2.1 times greater than that at stem breast. Stem water storage increases the drought tolerance of trees. The depletion stage of stem water storage mainly occurs in early morning, and then enters the replenishing phase in the afternoon. In a sunny day, with the increase of soil water deficit with relative extractable water (REW) (or the relative effective soil water index) less than 0.43, demand for water storage of stem is more significant, and its role is mainly based on the depletion process. When the soil moisture condition is improved, the process is dominated by replenishing. From the results of continuous observations throughout the growing season, the depleting and replenishing processes can achieve equilibrium in a short period of time (like a few days). This research has advanced our understanding of the utilization mechanism of tree stem storage water in semi-arid areas.