Faidherbia albida transpiration and canopy conductance in a reference agroforestry system of West Africa

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08:30

Faidherbia albida is a fertilizer and forage woody species of agroforestry systems in semi-arid Africa., It is phreatophyte and shows reverse phenology (leafless in rainy season) what is expected to avoid competition for soil water with associated crops. Moreover, the root access to groundwater is assumed to prevent constraint on transpiration. However, the details of F. albida transpiration and canopy conductance under daily and seasonal conditions are poorly known. The on-farm study was conducted at Faidherbia-Flux station in the population-health-environment observatory of Niakhar, Senegal. Five mature trees were selected in the stand with a density of 6.9 tree ha-1. Sap flow, xylem and soil water content were continuously recorded over a complete year with meteorological variables and measurements of canopy phenology, leaf area index and leaf water potential. Maximal transpiration estimated from sap flow peaked around 210 L tree-1 day-1 in the early dry season (December) for an average tree (DBH of 48.5 cm and 260 m² of leaf area). The transpiration slowly decreased up to June before a sharp decrease following intense defoliation at the beginning of the rainy season in July. Predawn leaf water potential ranged between 0.25 in early dry season and 0.45 MPa in mid dry season, indicating a low water constraint. However, the reference canopy stomatal conductance per leaf area (at 1 kPa of air vapour pressure deficit, VPD) decreased from around 100 in early dry season to 50 mmol m-2s-1 in mid dry season suggesting a significant regulation. Moreover, in both case, the canopy stomatal conductance was highly sensitive to VPD with a 50% decrease at 3 kPa. This study provides new bases for transpiration modeling of Faidherbia albida in agroforestry parklands. It particularly suggests to also consider the influences of soil surface drying and air dryness on transpiration regulation of Faidherbia.