Partitioning of soil water among native tree species growing in mixed stands in Panama: evidence from the stable hydrogen isotope composition

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Complementary soil water use among coexisting tree species may lead to increased productivity of mixed stands compared to that of the corresponding monocultures. However, data on plant water acquisition strategies among different tree species grown in tropical plantations are scarce. Stable isotope analysis represents a technique to assess spatial uptake of soil water by different tree species and thus, complementary water use. The goal of this study was to determine partitioning of water resources in mixed tree stands. The study was conducted in a 6-year-old experimental plantation in Sardinilla, Central Panama. The natural abundance of Deuterium (δD) in soil water (0-10, 10-30, 30-50, and 50-70 cm soil depth) and plant (xylem) water from 5 native tree species grown in mixed stands were analyzed during the dry season 2007. A multiple source mass-balance approach (IsoSource) was used to determine to proportional contribution of water from different soil depths. Soil water δD values decreased sharply to 30 cm and then remained relatively constant with increasing depth. Average soil water δD values were -19 ‰ for 0-10 cm depth, -34 ‰ for 10-30 cm depth, and -40 ‰ for 30-70 cm depth. Average xylem water δD ranged from -14 ‰ to -39 ‰. Frequency histographs produced from the multiple source mass-balance analysis showed that trees differed in their vertical water uptake pattern. While Hura crepitans and Cedrela odorata obtained up to 90 % of their water from the upper 0-30 cm, other species especially those with higher transpiration rates such as Anacardium excelsum, Luehea seemannii and Tabebuia rosea took up more than 50% of their water from greater depth (> 30 cm). These results point to vertical partitioning of soil water resources among coexisting species during the dry season.