THERE IS COMPETITION BETWEEN MAIZE AND *Cordia oncocalyx* TREES IN AGROFORESTRY SYSTEMS?

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INTRODUÇÃO

Agroforests have provided an alternative to conventional cropping systems, by including the management of larger plants (shrubs and trees). Some studies show the benefits of agroforestry in comparison to monoculture (Maia *et al*. 2007), although there is potential for water, light and nutrient competition between cultivated plants and trees. Isotopic techniques allow the indirect assessment of plant root access to resources, since the isotopic composition of the resource is not altered during plant extraction. If a plant were to obtain water from a single source, the isotopic composition of the plant's water would be identical to that of the source water. Isotopic techniques are an alternative for the study of water absorption by plants, and may lead to an understanding of mechanisms which allow the coexistence of species (Jackson *et al*. 1995). The oxygen (δ18O) and hydrogen (δD) isotopic composition of water are ideal tracers for the source of water absorbed by plants. If the δD and/or δ18O differs between water of different environmental pools (precipitation, aquifer, topsoil, subsoil, water bodies, etc) (Coutinho *et al*. 1996), comparing δD and/or δ18O values from all sources allows plant water to be related to that of available sources. Also, the depth from which water is taken up can be determined since surface waters are richer in heavier isotopes due to evaporation, while the isotopic composition of deeper water is different topsoil (Durand *et al*. 2007).

OBJETIVOS

The objective of this work was to determine the existence of water competition between Caatinga's native trees (*Cordia oncocalyx*) and crop plants (Zea mays) in agrosilvopastoral system (AGP) in the Brazilian's Northeastern.

MATERIAL E MÉTODOS

This work took place at Crioula farm, which belongs to the National Center for Goats and Sheep Research (EMBRAPA), Sobral, State of Ceará, Brazil. The predominant vegetation in the area is woody savannahs, locally called Caatinga. The agrosilvopastoral system (AGP) consists in a 1.7 ha area, where maize (*Zea mays* L.) and/or sorghum (Sorghum sp.) is grown in 3.0 m-wide alleys separated by rows of *Leucaena leucocephala* (Lam.) de Wit with 0.5 m between trees. Five plots measuring 8 x 8 m were delimited, with a *C. oncocalyx* individual at the center. Four rows of maize were planted on each side of the tree in a north-south orientation, with 1 m between plants. Within these plots, the treatments consisted of two rows of maize planted at four distances from the base of the C. oncocalyx tree: M1, M2, M3 and M4 for maize planted at 1, 2, 3 and 4 m from the base of the tree, respectively. The first two distances resulted in maize growing entirely below the canopy, the third distance was intermediary and at 4 m plants were completely exposed to the sun, outside the shade produced by the tree's crown at noon. The soil moisture was recorded (TDR sensors) at 0-30 and 30-50 cm depth. Maize and *C. oncocalyx* root samples were collected, along with soil and rainwater to analyze stable oxygen isotopes (δ18O). From the water

extracted from root and soil samples, as well as rainwater, approximately 1 µL of water was used to measure ratios between concentrations of water molecules with different combinations of H and O isotopes (HD16O, H216O and H218O).

RESULTADOS

The soil's volumetric water content was greater at the surface (up to 30 cm depth) in AGP in both months when measurements were made. Average soil moisture under AGP at 0-30 cm (0.49 m3 m-3) and at 30-50 cm (0.41 m3 m-3) in April. Soil excavations demonstrated that *C. oncocalyx* does not have a taproot, but rather many similar roots which reach 20 to 80 cm in depth. The isotopic composition of *C. oncocalyx* root sap water in AGP was similar to that of the subsoil (40-60 cm depth), and this indicates that the trees preferentially capture water from this depth. The δ18O of maize root sap showed that these plants take up water from soil below 20 cm depth.

DISCUSSÃO

Under maize, the δ18O value decreased in soil depth in the AGP in April, indicating greater evaporation in the topsoil (0-20 cm depth). The lower δ18O value in the subsoil, similar to rainwater, relates to previously infiltrated water. As distance from the surface decreases, evaporation increases and soil water becomes depleted in light isotopes (16O) and enriched in heavier isotopes (18O); the value of δ18O thus increases (Hsieh *et al*. 1998). In deeper soil layers δ18O values are similar to those of rainwater which infiltrated the soil (Durand *et al*. 2007). Water competition between cultivated grasses and tree species could be avoided due to root zone differentiation (Lehmann *et al*. 1998). The rooting depth of plants determines the area from which they can take up water, and this area either coincides with that of other species or it does not. Isotope ratios of maize and *C. oncocalyx* xylem water are consistent with those of the subsoil. The xylem water in deep-rooted perennial species is depleted in heavy isotopes (Ehleringer *et al*. 1991). If the δ18O of xylem sap resembles that of the subsoil, there is evidence that the plant is obtaining water from the subsoil through deep roots.

CONCLUSÃO

Maize and *C. oncocalyx* in this AGP system preferentially take up water from soil depths greater than 20 cm, which lead to a reduction in soil moisture at 30-50 cm depth. Thus, maize and C. oncocalyx compete for water.

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