



How do four-year-old intercropped trees share soil water with wheat in temperate alley-cropping experimental site: evidence from $^2\text{H}_2\text{O}$ artificial labeling?

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Despite numerous studies investigating competition and/or facilitation for soil water resources in alley-cropping systems (AC), share of water at the early stage of trees establishment in AC has been poorly examined. This work aimed to explore the water share between crops and trees after four years of tree establishment in AC at the Ramecourt block design alley-cropping experimental site. In mid-spring, we injected 300 mL of a 10 % deuterated water at 30, 50 and 100 cm soil depth at 1.5 m distance from a referent tree (alder, hornbeam or wild cherry) in AC, in pure-forest control plot with ryegrass (FC) and in a randomly chosen area in monocrop wheat control (CC) plots. The tracer uptake was monitored by collecting tree leaves and wheat and ryegrass (RG) whole-plant samples every two weeks in labeled and unlabeled area. For deuterium natural abundance analyses, the global mean of $\delta^2\text{H}$ was significantly lower for wheat ($-44 \pm 4 \text{ ‰}$) than RG ($-27 \pm 6 \text{ ‰}$) and trees ($-20 \pm 3 \text{ ‰}$), indicating that the most active sites of water absorption were different between these species. The mean wheat $\delta^2\text{H}$ was $2481 \pm 523 \text{ ‰}$, $715 \pm 218 \text{ ‰}$, and $133 \pm 68 \text{ ‰}$ at 30, 50 and 100 cm labeling depth respectively. It was significantly higher in AC ($2883 \pm 585 \text{ ‰}$) compared to CC ($1131 \pm 274 \text{ ‰}$) only at 30 cm labeling depth. For trees, the $\delta^2\text{H}$ of labeled samples remained negative unlike wheat. Particularly in AC, alder and wild cherry presented significant higher $\delta^2\text{H}$ 15 and 45 days after labeling, respectively from 50 and 100 cm labeling depth, compared to unlabeled samples. We concluded that trees and wheat took up their water in upper soil layer but in AC, they favored wheat water absorption in topsoil and were able to flexibly shift their water source from deep layer in case of low water availability in the upper soil layer.