Geophysical Research Abstracts
Vol. 20, EGU2018-3501, 2018
EGU General Assembly 2018

Hydraulic redistribution of poplar trees in a column and field experiment – a stable isotope approach to identify tree-crop interactions

Rowena Gerjets (1), Falk Richter (1), Martin Jansen (1), and Andrea Carminati (2)

(1) Soil Science of Temperate Ecosystems, Georg-August-University of Göttingen, Büsgen-Institute, Germany (rowena.gerjets@uni-goettingen.de), (2) Soil Physics, University of Bayreuth, Bayreuth, Germany

Plants developed several strategies to tolerate drought periods. One short term strategies to water shortage is the closure of stomata when the transpiration demand is maximum (e.g. at noon) and cannot be sustained by water flow in soils. A different strategy is hydraulic lift, which is the redistribution of soil water from deep, wet soil layers to upper, dry soil layers via the roots. Trees, with their deep roots, are able to redistribute water to the top soils via hydraulic lift during nighttime and therefore avoid that the upper soil layers become too dry. Remarkably, the water transported by trees via hydraulic lift can also sustain transpiration of shallow-rooted crops. Hydraulic lift is potentially one of the most advantaging factors to temperate agroforestry systems.

To understand the relevance of hydraulic lift on tree and crops water, we conducted trace experiments with deuterated water in both column and field experiments. In the greenhouse experiment two soil drying stages were applied to simulate drought spells. Poplars and crops were grown in two separate columns which were connected via a small cross-rooting segment. Stable isotope signatures of soil and xylem showed the occurrence of hydraulic lift, and we were able to detect the transport of the tracer in the crops. The field experiment was conducted during a summer drought spell in 2016 in a short rotation coppice of monoculture poplar trees. Trees took up the labelled water and the soil water stable isotope signatures showed enrichment in deuterated water, but this was not sufficient to demonstrate the occurrence and amount of hydraulic redistribution. In conclusion, the experiments show that poplars are capable to redistribute water during drought spells. The agro-ecological impact of hydraulic lift in agroforestry systems needs further studies in varying environmental condition