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Hydrological effects of combining Italian alder and blackberry in an agroforestry system in South Africa

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Water limitation provides the potential to hinder the productivity of agricultural systems especially in arid and semi-arid regions. In agroforestry systems interactions between trees and crops range from mutually beneficial to critically competing, shaping the demand for resources, such as water. In this study, we investigated the hydrological effects of an Italian Alder (Alnus cordata) windbreak on an irrigated blackberry plantation near Stellenbosch, South Africa. We determine the key components of the water budget in the system and compare them at two positions: alongside the windbreak, and amongst the crop away from the windbreak's influence.

We measured soil water content depth profiles in the summer months, from October 2019 to March 2020, in both locations with four consecutive time domain reflectometry (TDR) tube sensors, each integrating over 20 cm depth. Potential evapotranspiration (ET) was estimated from site based meteorological observations. We surveyed and classified the local soil, and defined soil chemical and physical properties (e.g. texture, matrix potential). The windbreak structure was measured on a single tree basis (e.g. tree height, volume and biomass) using manual and terrestrial laser scanning methodologies.

The data indicate that high potential ET, caused by high summer temperatures and strong winds, dominates the water budget at the study site, exceeding the water input of the drip irrigation. We found differences in the water dynamics between the two sites, e.g. greater soil water content at greater distances from the windbreak. Possible reasons are: (1) the water demand of trees increases underground competition for water, and/or; (2) microclimatic conditions closer to the windbreak increase ET. Modelling of the windbreak influence on the ET and further analysis of water fluxes will be conducted as next steps to combine the results from the sensors and the joint field campaign.