

Impacts of Pasture Conversion to Sugarcane on Water Fluxes and Water Use Efficiency in the Southeastern US

Background/Objective

Sugarcane expansion will likely reshape the bioenergy landscape in the Southeastern US. However, the ecohydrological implications of cane expansion, particularly following conversion from grazed pastures, a current dominant land use in the region, remain highly uncertain. Here, researchers investigated the impact of cane expansion on evapotranspiration (ET) and its partitioning, and the mechanisms influencing both ET components and water use efficiency (WUE) across multiple scales and growth cycles in subtropical Florida.

Approach

The study was conducted from 2019 to 2022 at Archbold Biological Station's Buck Island Ranch in Lake Placid, FL, which serves as a site in the USDA's Long-Term Agroecosystem Research network. The experimental design consisted of three plots, and researchers combined eddy covariance, biometric measurements, and process-based stomatal sensitivity models.

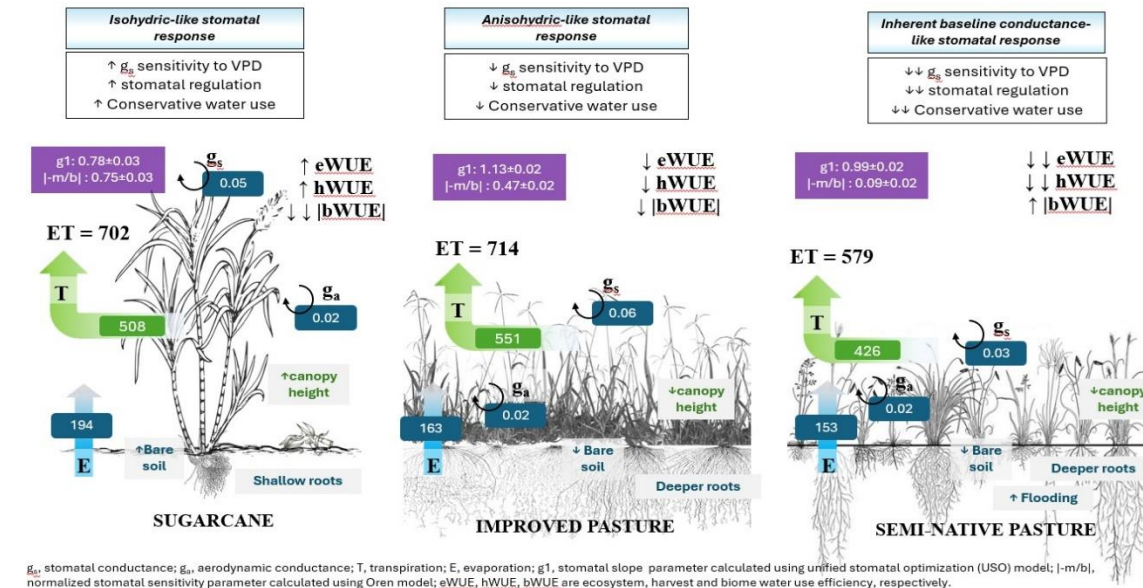
Results

ET was 1.7% lower in cane than improved pasture (IMP) but exceeded that in semi-native pasture (SN) by 21%. Transpiration (T) followed a similar pattern. Cane had more conservative water use and greater sensitivity of g_s to VPD compared to IMP. In contrast, SN had lower g_s and weaker stomatal sensitivity to VPD compared to cane, resulting in lower T. Canes became less water conservative as stands matured. Evaporation was higher in cane than pastures (19-26%), partially offsetting WUE gains.

Significance/Impacts

This work shows that large-scale pasture-to-cane conversion could produce widely contrasting hydrological outcomes, with the net regional impact depending on the proportion of each pasture type converted and on cane's high g_s sensitivity to VPD.

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Partial water cycle for sugarcane, improved pasture (IMP), and semi-native (SN) pasture. Values are means of plant cane, first ratoon, and second ratoon cane and corresponding periods for IMP and SN.