Carbon flow through energycane agroecosystems established post-intensive agriculture

SUSAN E. CROW[18], JON M. WELLS[1], CARLOS A. SIERRA[2], ADEL H. YOUKHANA[1], RICHARD M. OGOSHI[3], DANIEL RICHARDSON[1], CHRISTINE TALLAMY GLAZER[1], MANYOWA N. MEKI[4], AND JAMES R. KINIRY[5]

[1]Dept. of Natural Resources and Environmental Management, Univ. of Hawaii at Manoa, 1910 East-West Rd., Sherman 101, Honolulu, HI 96822, USA (*Crows@hawaii.edu)

[2]Dept. of Biogeochemical Processes, Max Planck Institute for Biogeochemistry, Hans-Knöll-Str. 10, 07745 Jena, Germany

[3]Dept. of Tropical Plants and Soil Sciences, Univ. of Hawaii at Manoa, St. John Plant Science Laboratory, Room 102, 3190 Maile Way, Honolulu, HI 96822, United States

[4]Texas A&M AgriLife Research, Blackland Research and Extension Center, 720 E. Blackland Rd, Temple, TX 76502, USA

[5]USDA, Agricultural Research Service, Grassland Soil and Water Research Laboratory, 808 E. Blackland Rd, Temple, TX 76502, United States

Biomass production for bioenergy based on the tropical perennial C4 grass energycane (Saccharum officinarum X Saccharum robustum cv. MOL-6081) can offset fossil fuel and store soil carbon (C). We measured yields, soil C pools, and soil C stocks in a four-year field trial. Together with additional measurements of root inputs, we modeled C flow from plants to soils in the surface layer of no-till energycane planted after more than a century of intensive sugarcane agriculture. Aboveground yields ranged from 16.7 to 19.0 Mg C ha-1 over the four-year trial. C in free and occluded light fractions decreased while C in the mineral-rich dense fraction increased over the four-year study. Belowground system inputs, estimated from measurements and informed by convergence in the final soil fraction model, were 2.5 Mg C ha-1 yr-1. With this input value, we estimated that surface soils retained photosynthetically fixed C predominantly within the mineral associated organic matter pool for a mean and median of 177 and 110 years, respectively. Although we did not model C flow to deep soil layers, observed C accumulation (11.4 Mg C ha-1 yr-1) and root distribution down to 120 cm suggest that soil processes and resulting C sequestration at the surface are likely to persist deeper into the soil profile. Energycane, as a strong candidate for climate change mitigation, showed high biomass yields and allocation of resources to roots, with sequestered soil C expected to persist for over a century.