Root Demographics of Three Bioenergy Crops: How Energy Sorghum Compares to Maize and Miscanthus

Janith M. Chandrasoma. Michael Masters, Dylan Allen, Scott M. McCoy, Chris K. Black, Adam von Haden, Elena Blanc-Betes, Ilsa B. Kantola, Nuria Gomez-Casanovas, Andrew D.B. Leakey
Wendy H. Yang, Evan H. Delucia

Bioenergy crops have gained significant attention as sustainable alternatives to traditional fossil fuels, with energy sorghum (*Sorghum bicolor*) and miscanthus (*Miscanthus x giganteus*) emerging as promising candidates. To fully understand the ecosystem benefits of these crops, carbon (C) turnover time in the soil must be quantified. Approximately 30% of global terrestrial net primary production is attributed to necromass from fine roots, assuming annual turn over. In systems where aboveground biomass is harvested, most soil organic carbon (SOC) is derived from root material, a continuously changing carbon source that is critical to the maintenance of the terrestrial C reservoir. Understanding the root demographics of these crops is crucial for identifying the fate of total belowground carbon allocation (TBCA), yet quantification of turnover rates remains methodologically challenging and highly uncertain. The primary objective of this work was to compare and analyze side by side root demographics of energy sorghum, maize (*Zea mays*), and miscanthus to follow the fate of TBCA, emphasizing the timing and magnitude of root production. Measurements were taken in replicated (n = 5) plots of maize, energy sorghum, and miscanthus (established in 2008) at the University of Illinois Energy Farm in Urbana, IL, USA. We installed 120 minirhizotron tubes to a vertical depth of 120 cm and used a specialized camera (BTC100x) to capture images along each tube's full-length. The root images were taken biweekly starting in late June of 2023. Each image session acquired 13200 images, which were analyzed for standing crop, root number, and root turnover using WinRHIZO TRON MF v.2019a. Above-ground plant phenotypic characteristics (plant height, leaf count, growth stage) were monitored weekly. Remote sensing imagery was collected monthly using a Phantom 4 Multispectral drone to supplement the aboveground plant phenotyping by monitoring crop growth rates using digital elevation models (DEM) and vegetation indices (VI). Deep soil cores were taken when tubes were installed, at the peak biomass, and before crop harvest. This data will provide valuable insights into the overall C balances in these bioenergy cropping systems, linking aboveground and belowground plant growth dynamics to SOC inputs and storage.

AGU 2023