BRC Science Highlight
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A New Bioenergy Model that Simulates the Impacts of Plant-Microbial Interactions, Soil Carbon Protection, and Mechanistic Tillage on Soil Carbon Cycling

Background/objective

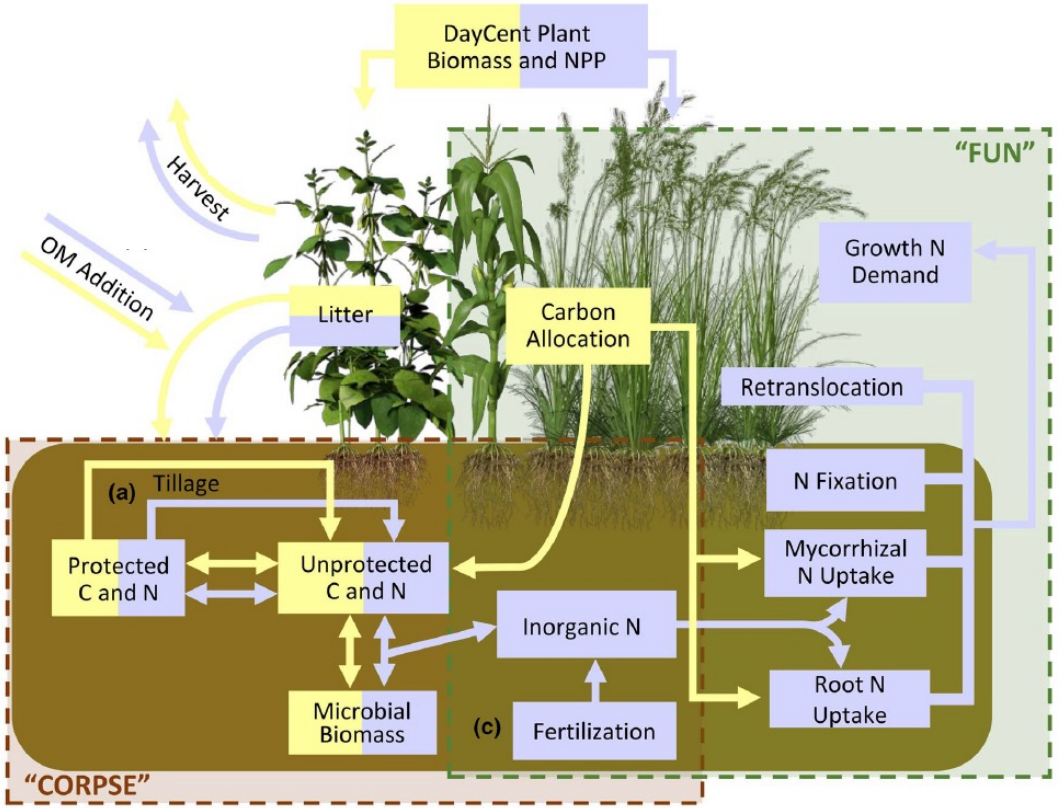
Development of bioenergy systems that provide both energy and ecosystem carbon (C) benefits requires the development of design decision tools for informing feedstock selection, location, and management. These tools require an improved predictive understanding of bioenergy systems. Researchers laid the foundation for this by developing the FUN-BioCROP (Fixation and Uptake of Nitrogen-Bioenergy, Carbon, Rhizosphere, Organisms, and Protection) model.

Approach

- Developed the new FUN-BioCROP model by:
  - Adapting the FUN-CORPSE model for use in bioenergy and using it to simulate annual and perennial bioenergy feedstocks under alternative temperature and C-allocation scenarios, and
  - Developing novel tillage process removing soil organic carbon (SOC) protection to increase microbial access and evaluating against typical tillage model.

Results

- Perennial cultivation increased SOC stocks, but with less protected SOC relative to unprotected SOC, leading to greater C loss under warming than annuals.
- Increased rhizosphere C inputs increased soil C for all feedstocks.
- New tillage mechanism estimated SOC that aligned with field observations with improved response to warming.



The FUN-BioCROP model is a version of the FUN-CORPSE model modified for use in bioenergy systems to simulate plant C allocation to N-acquisition and microbial soil organic matter decomposition.

Significance

FUN-BioCROP integrates new belowground process paradigms and an improved tillage mechanism. These results highlight the importance of belowground processes in evaluating the ecosystem C benefits of bioenergy crop production.

Juice et al. 2022. "**A New Bioenergy Model that Simulates the Impacts of Plant-Microbial Interactions, Soil Carbon Protection, and Mechanistic Tillage on Soil Carbon Cycling**." *GCB Bioenergy. DOI: 10.1111/gcbb.12914*

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