Winter Cover Crops for Sustainable Aviation Fuel: Life Cycle Analysis and Key Issues

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Challenges and Barriers of Purpose-Grown Energy Crops

- Oilseed crops, such as canola, carinata, camelina, and pennycress, are a type of purpose-grown energy crops that have high oil contents and favorable oil profiles for sustainable aviation fuel (SAF) production via technologies such as hydroprocessed esters and fatty acids (HEFA) conversion
- Incorporating oilseed crops into existing crop rotations as a winter or second crop can avoid competition for land with primary summer cash crops, avoid potential land use changes, and potentially sequester soil organic carbon, among other soil benefits.
- However, there are challenges to overcome:
  - The current rarity of commercial-scale production of oilseed as winter or second crop makes it difficult to support large-scale planting of these crops;
  - Farmer's reluctance to make changes and concerns about potential negative impacts on primary cash crop following the oilseed cover crops, including the possible reduction in yield;
  - Farmers incur additional costs due to the extra labor, fertilizer, and energy requirements associated with planting, managing, and harvesting oilseed crops;
  - Farmers do not receive sufficient monetary incentives to encourage them to plant these cover crops.

The Role of LCA in Monetizing Benefits of Winter Oilseed Crops

- The 40(B) SAF Provision under the Inflation Reduction Act and some states such as Illinois provides tax incentives based on carbon intensity (CI) of SAF.
- Both ICAO CORSIA and Argonne's GREET LIFE-CYCLE MODEL model include SAF production pathways using oilseed crops as feedstock, many of which offer significant reduction in CI relative to that of petroleum jet fuels.
- LCA can play a key role in monetizing oilseed winter crop production for SAF via consistent and holistic analysis to derive comparable and reliable CI.
- Complexity of conducting reliable LCA of SAF production from oilseed winter crops
  - Various farming and management practices to produce oilseed crop can affect the CI of the feedstock;
    - Conventional vs no tillage for field preparation
    - Manure vs synthetic fertilizer as nitrogen source
  - Soil organic carbon (SOC) impacts associated with incorporating oilseed winter crop into existing crop rotations have yet been adequately addressed in LCA, a major information gap on the value proposition of winter oilseed crop production for SAF;
    - Some states such as Minnesota are proposing credit premium of 5% for cropland-derived biofuels produced on land using "soil-healthy" farming practices and fertilizer best-management practices.

Key Issues to Address in LCA

- Data availability and representation for oilseed winter or second crop, such as camelina, carinata, canola, and pennycress;
  - Argonne has on-going LCA effort in this area to support USDA, currently focusing on:
    - Collecting LCI data from literature and universities' agriculture extension;
    - Engaging industry stakeholders, such as Nuseed and Covercress for additional input;
    - Modeling CI for a range of SAF pathways with consistent methodology and background data.
- Address potential ecosystem services such as nutrient retention, SOC cumulation and water quality;
- Evaluate yield impacts of oilseed winter/second crops on main crops and associated carbon impact;
- Impact of oil quality from different oilseed crops on the convertibility to SAF.