

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

Xinyu Liu, Hao Cai, and Michael Wang

Systems Assessment Center Argonne National Laboratory



DEPARTMENT OF NERGY Argonne National Laboratory is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC.



Challenges and Barriers of Purpose-Grown Energy Crops

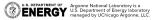
- Oilseed crops, such as canola, carinata, camelina, and pennycress, are a type of purposegrown energy crops that have high oil contents and favorable oil profiles for sustainable aviation fuel (SAF) production via technologies such as hydroprocessed esters and fatty acids (HEFA) conversion
- Incorporating 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 C RSA and Argonne's GREET 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.



