Project 104
Algorithm-based exploration of double cropping with oilseed crops for SAF

Emmy Wang (eaw5806@psu.edu), **Yuning Shi** (yzs123@psu.edu), **Lara Fowler** (lbf10@psu.edu) and **Armen R. Kemanian** (kxa15@psu.edu)

Motivations and Objectives

- Double cropping oilseed crops into the fallow period between summer cash crops is an opportunity to increase SAF production.
- Pennycress (*Thlaspi arvense* L.) is a potential SAF feedstock.
- Minimizing fallow by double cropping avoids further land use and provides winter cover.
- However, it is costly to experimentally identify suitable regions for double cropping with pennycress.
- **This research examines the use of an automatic crop sequence builder, Cycles-A, to explore the economic feasibility of pennycress as a winter break crop.**

Methods and Materials

- We apply the autonomous crop rotation sequencing agroecosystems model **Cycles-A** to assess the feasibility of inserting pennycress into existing crop rotations under varying price points. Example presented for Darke county, Ohio.
- **Scenario**: 50 simulations were run across the years 1980-2024 for oilseed feedstock prices ranging from .5 times to 1.2 times that of winter wheat.
- **Crop Profiles:** Corn, soybean, pennycress, and winter wheat crop profiles from the Cycles database
- **Weather Data**: North American Land Data Assimilation System phase 2 (NLDAS-2)
- **Soil Data:** USDA Gridded National Soil Survey Geographic Database (gSSURGO)

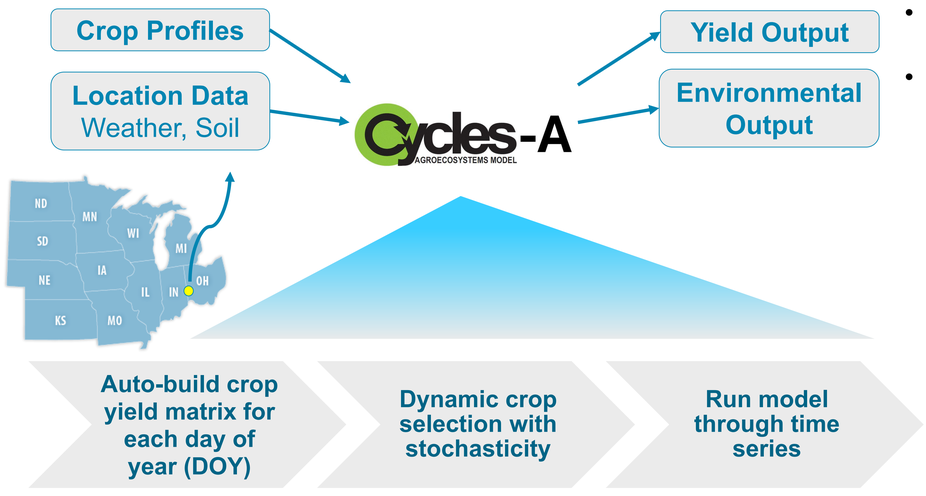

Figure 1: Cycles-A workflow

Summary

- Cycles-A is a powerful tool to explore SAF production *in silico*, informing R&D, industry, and policy makers.
- Preliminary results of this study will inform practical field experiments by indicating suitable sites and planting logistics based on variable oilseed feedstock prices and their corresponding carbon intensity.

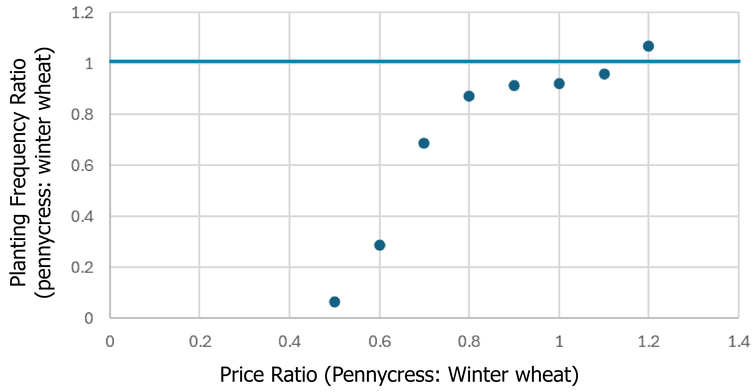

Figure 2: Increase of planting frequency of pennycress based on oilseed feedstock price

- The model automatically accounts for yield and price dependencies.
- Pricing carbon or other externalities further shape the crop sequence selection.
- Price bounds that favor a certain % of pennycress in the landscape are easily identified. In this example, Pennycress appears in 26.7% of the years when the prices is 1.2 times higher than that of winter wheat.

Lead PI: Armen Kemanian,
Pennsylvania State University
Project manager: Prem Lobo, FAA

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Results and Discussion

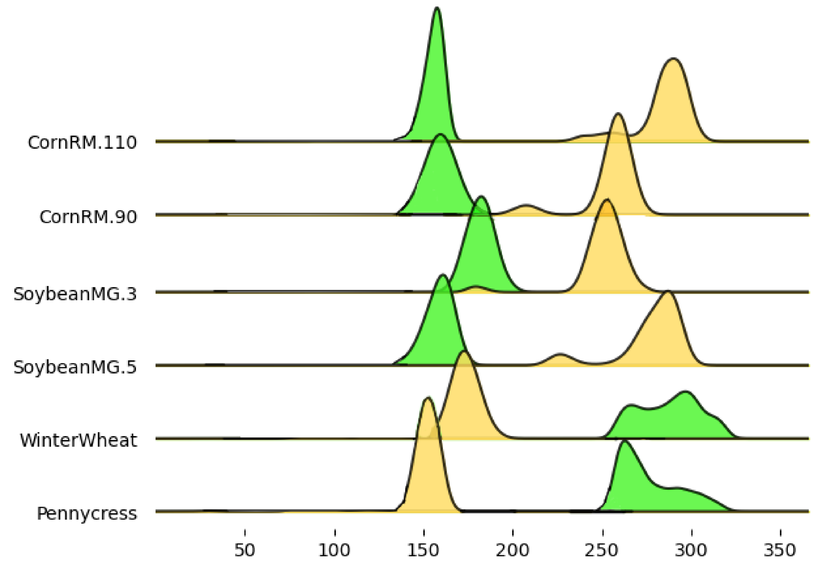

Figure 3: Planting DOY (green) and harvest DOY (orange) frequencies of all crops for when pennycress price is 1.1 times winter wheat

- Model shows pennycress fitting into an earlier planting and harvesting window than winter wheat.

Conclusions and Next Steps

- Cycles-A rapidly identifies suitable areas for pennycress production.
- The results indicate that the price of pennycress feedstock would need to be at least 1.2 times higher than that of winter wheat for it to achieve comparable profitability.

Next steps

- Incorporate more oilseed crops that would expand the climatic range of SAF double-cropping.
- Expand locations of simulation to entire CONUS
- Explore other externalities from farming intensification to ensure SAF production provides not only fuels but other services to society

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<-For more information about Cycles-A AGROECOSYSTEMS MODEL