


Western Illinois University

## Commercialization of Pennycress (*Thlaspi arvense* L.) as a Sustainable Aviation Fuel Source

Dr. Win Phippen  
Western Illinois University  
School of Agriculture

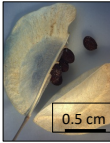

Indiana CCA Conference 2025  
Indianapolis, IN  
December 10, 2025




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## Pennycress (*Thlaspi arvense* L.)


- Closely related to canola, camelina, and Arabidopsis
- Grows throughout temperate regions of the world
- **Diploid genome (sequenced), 86% identity to Arabidopsis**
- **Extreme cold tolerance**
- **Relatively short life cycle**
- **Naturally high yields of seeds rich in oil and protein**
- Not invasive, is easily controlled

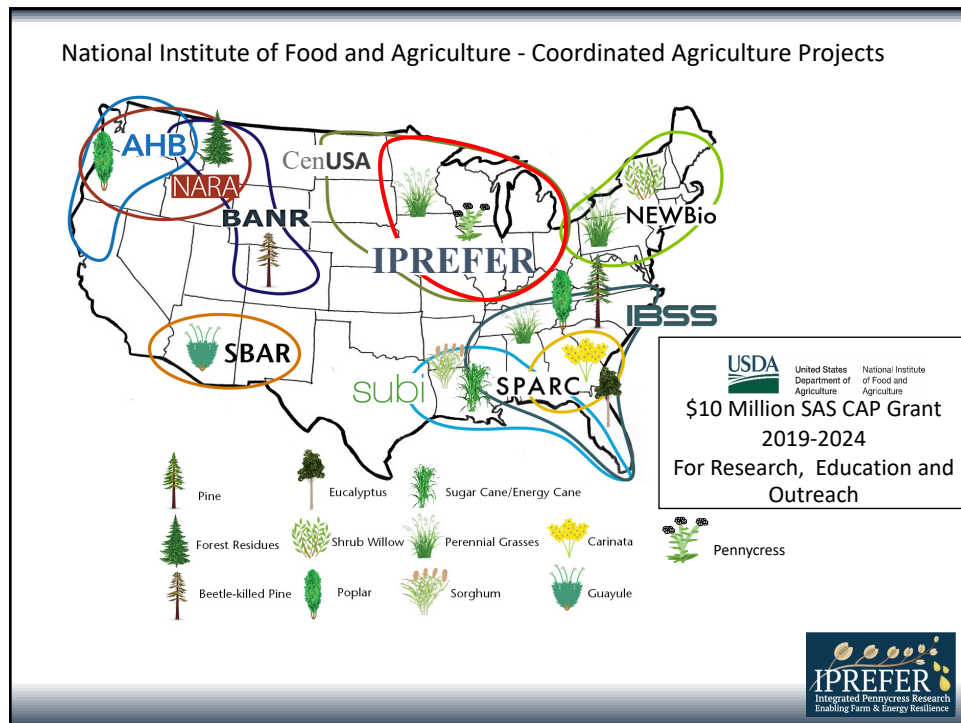
Naturally-occurring stand near Bloomington, IL



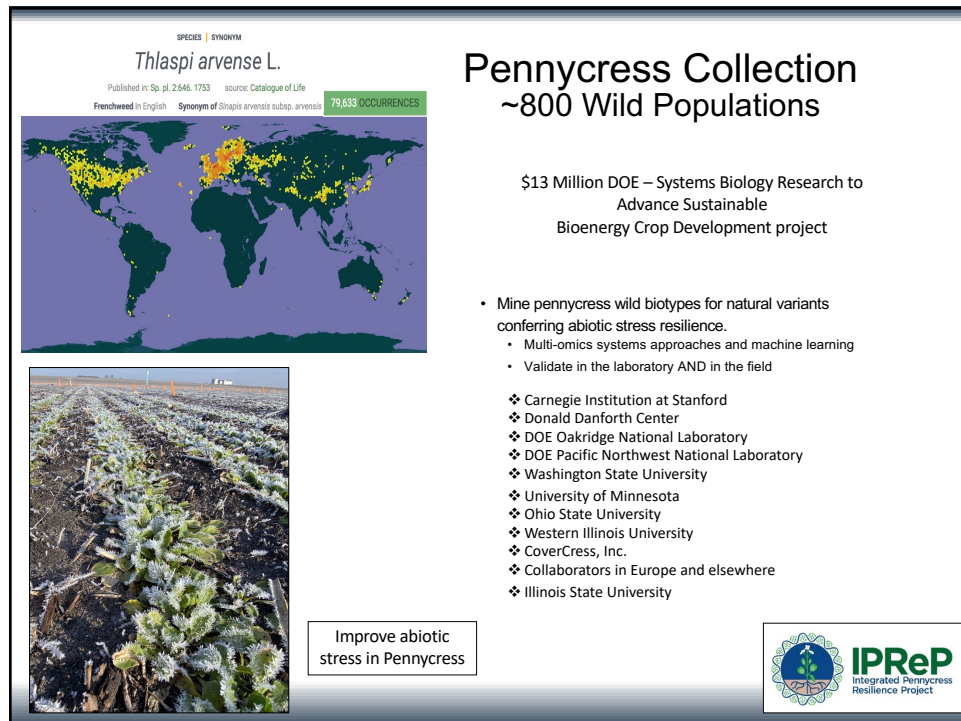
Planted field near Galesburg, IL



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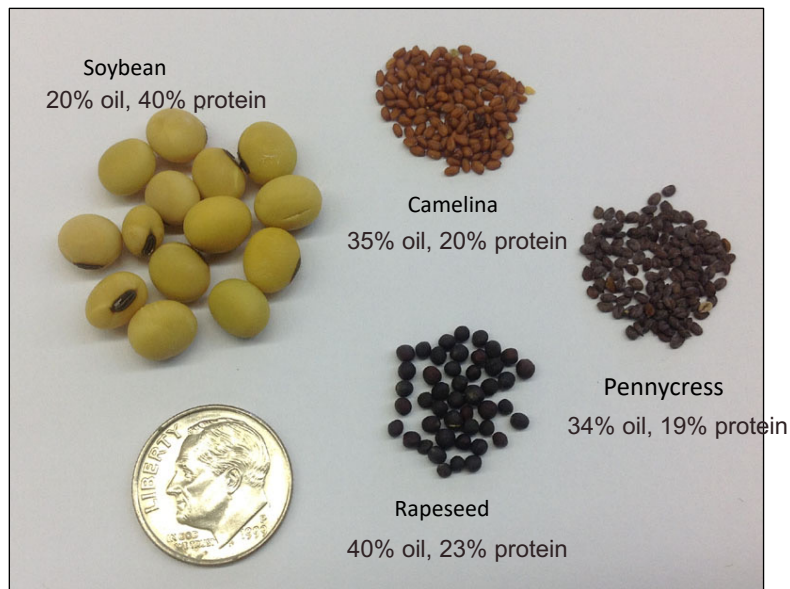


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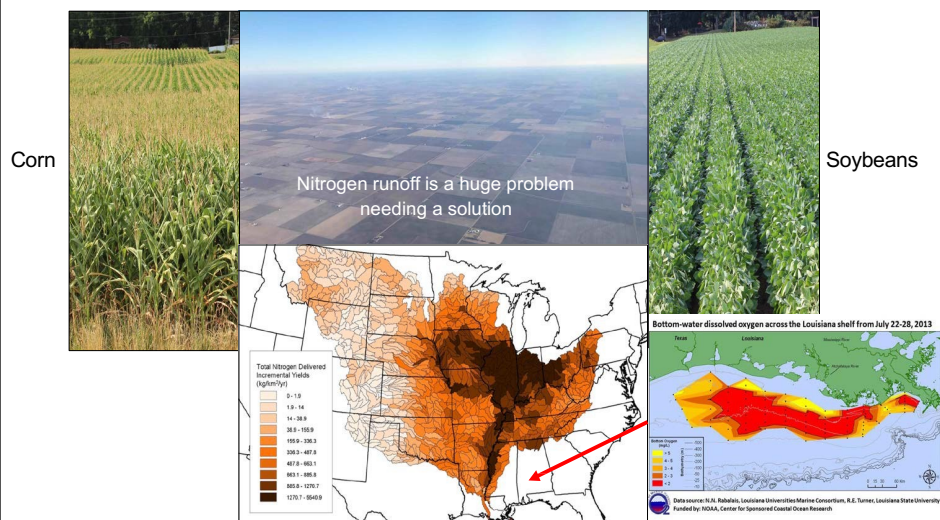
## Field Pennycress (*Thlaspi arvense* L.)



From: Sedbrook et al. (2014) *Plant Science* 227: 122-132

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Covercress/pennycress could reduce water pollution by soaking up nitrogen in otherwise barren farm fields

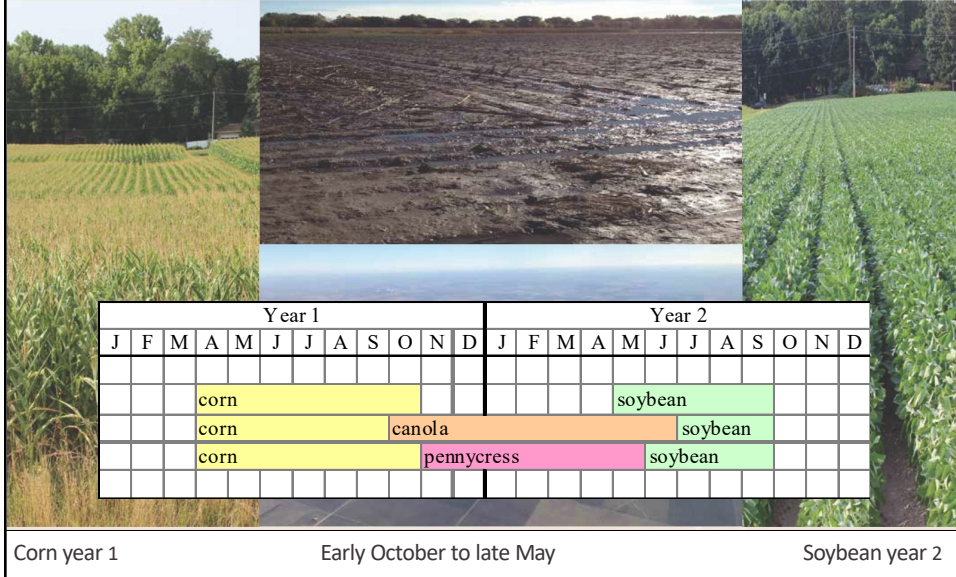


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## Midwest farmland is unnaturally barren 8 months each year

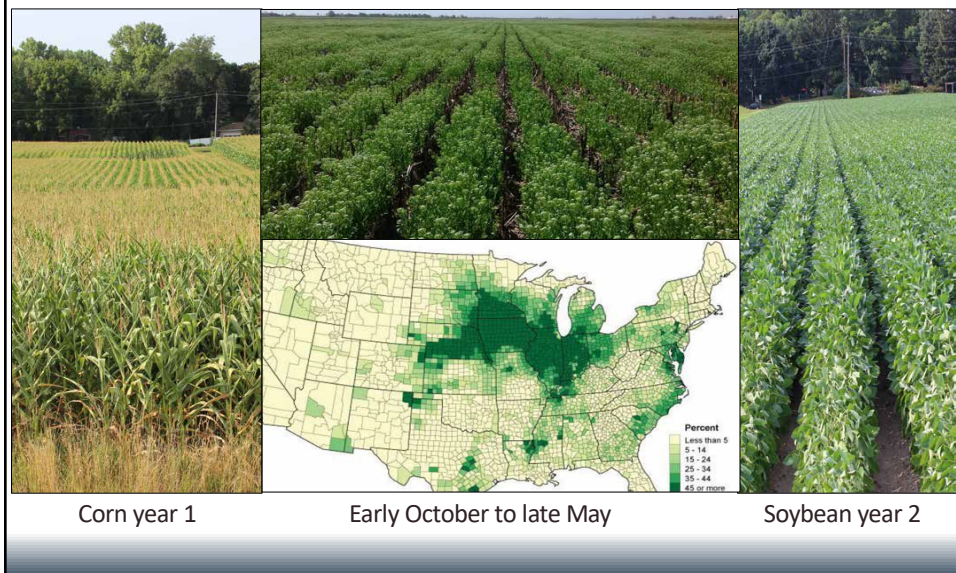
Barren soils are prone to nutrient leaching and soil erosion.



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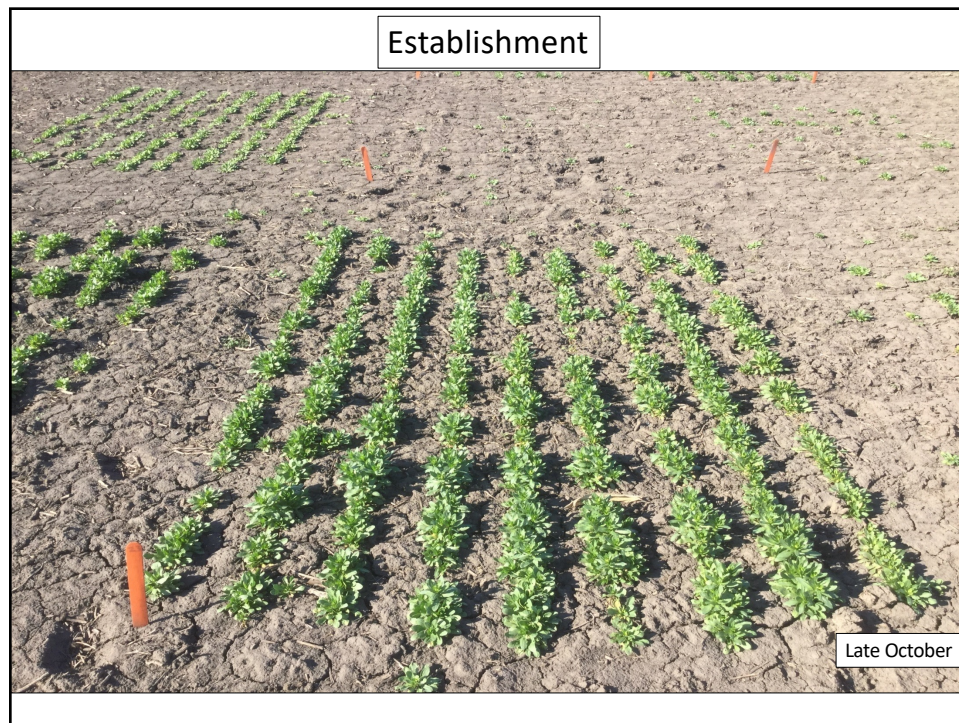
## Pennycress potential

Planted throughout the 80 million acre U.S. Midwest Corn Belt



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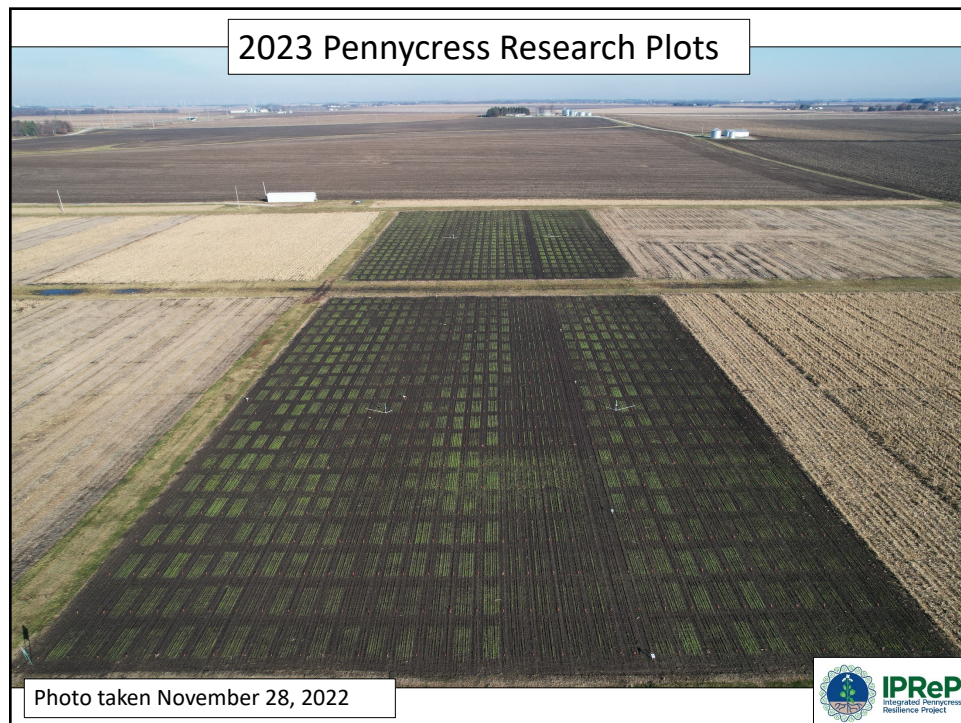


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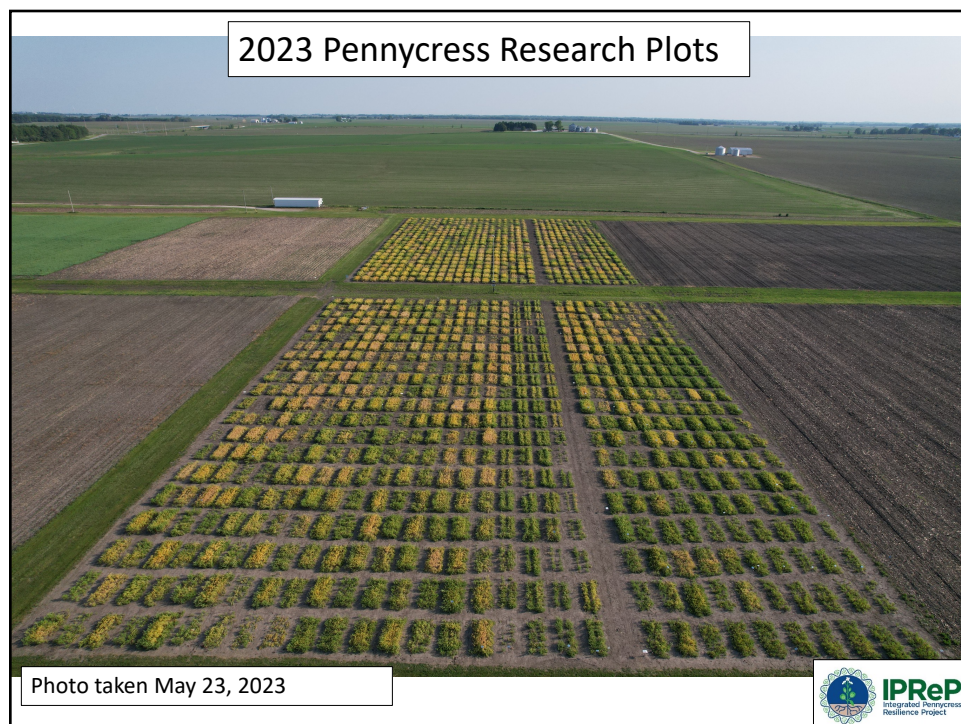


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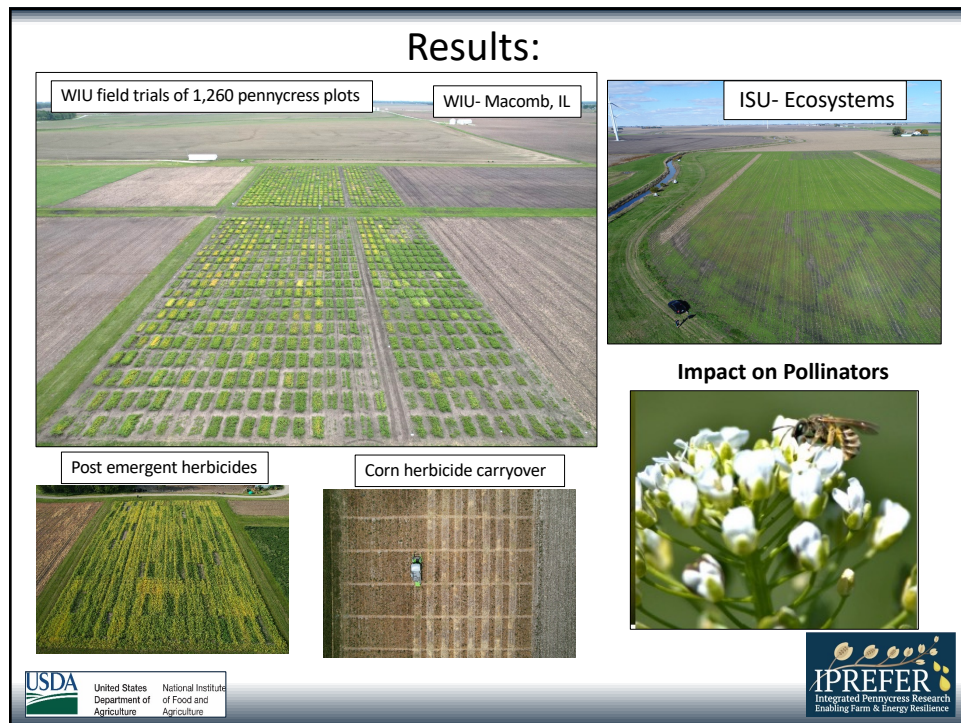




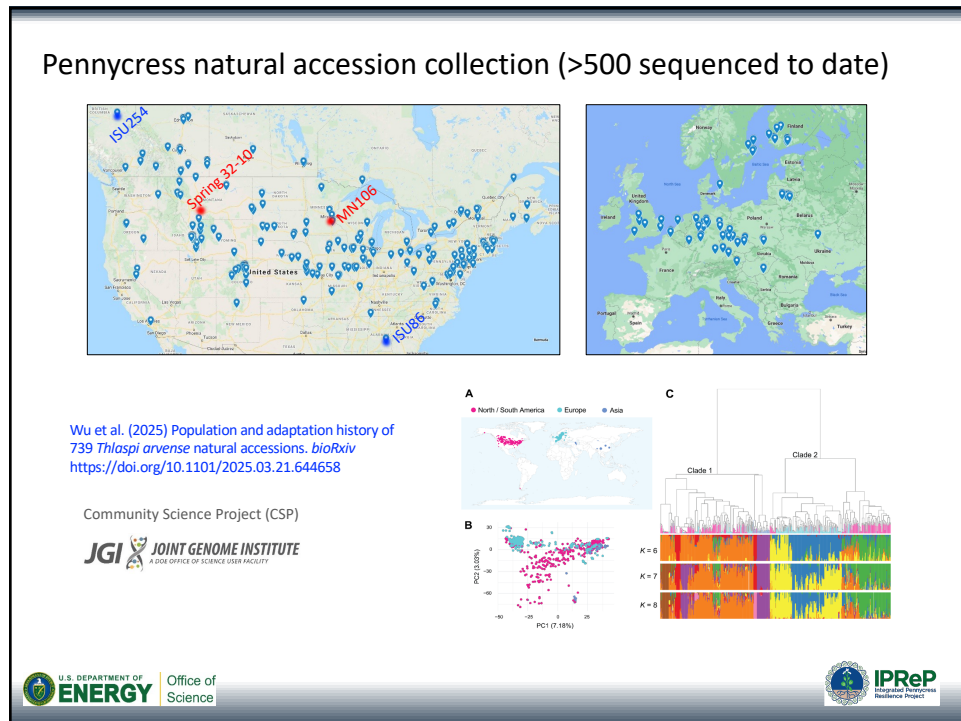
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## Pennycress abiotic stress challenges

Drought stress and potential death



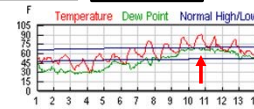
Freeze/thaw stress and water logging




Under drought stress, pennycress growth is delayed and yields are decreased



Pennycress flowers become sterile at 32 °C (90 °F)




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Western Illinois University

### 2025 Pennycress Research Plots




Pacific Northwest  
NATIONAL LABORATORY







ILLINOIS STATE UNIVERSITY  
*Illinois' first public university*



DONALD DANFORTH  
PLANT SCIENCE CENTER  
DISCOVERY | COMMUNITY | IMPACT




MICHIGAN STATE UNIVERSITY



WASHINGTON STATE UNIVERSITY

Photo taken April 16, 2025



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Integrated Irrigations Resilience Project

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University

2025 Pennycress Research Plots



Water Logging

Photo taken April 16, 2025


**THE OHIO STATE UNIVERSITY**  
COLLEGE OF FOOD, AGRICULTURAL,  
AND ENVIRONMENTAL SCIENCES

**IPReP**  
Integrated Pennycress  
Resilience Project

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University

2025 Pennycress Research Plots



Fall and Spring Drought stress

Photo taken April 2, 2025

**Pacific Northwest**  
NATIONAL LABORATORY

**MICHIGAN STATE UNIVERSITY**

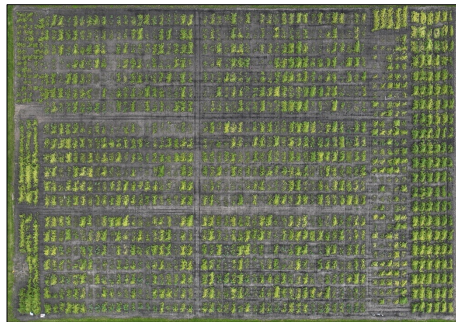
**ILLINOIS STATE UNIVERSITY**  
*Illinois' first public university*

**IPReP**  
Integrated Pennycress  
Resilience Project

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# Multi-Spectral Imaging



Full Color image



NDVI  
Normalized Difference Vegetation Index  
measures the density of green vegetation  
(seen as Bright Red)



2024 Pennycress Plots  
Macomb, IL



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## Variety Development Through Breeding and Gene Editing



Controlled crosses in WIU greenhouses



Wild Pennycress

High Erucic  
High Glucosinolates  
High Fiber

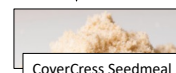


CoverCress™

Low Erucic  
Low Glucosinolates  
Low Fiber



✓ Biodiesel,  
renewable diesel  
and jet fuel

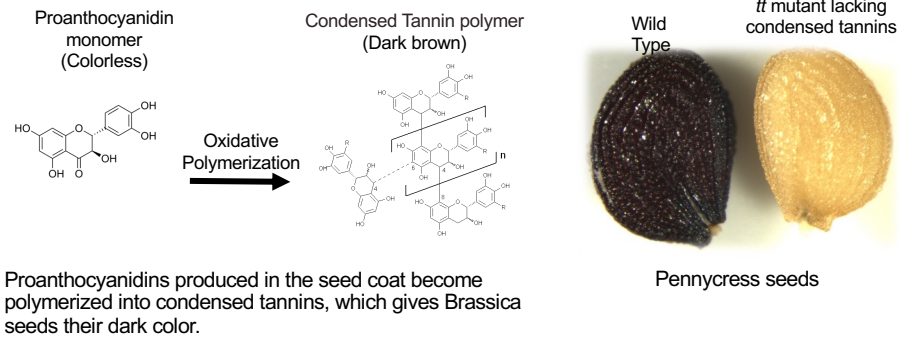


✓ High protein meal  
for poultry, swine  
and cattle feed



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Mutations in *transparent testa* (*tt*) genes lack condensed tannins and other indigestible fiber (ADF), making the seeds more nutritious.



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Combine Harvest

UW-Lancaster

Seed Cleaning

**IPREFER Multi-State Trials**

CoverCress – Hoyleton, IL  
 WIU - Macomb, IL  
 ISU - Normal, IL  
 OSU- Custar, OH  
 UW-Lancaster, WI  
 UW-Madison, WI  
 UMN-Rosemount, MN  
 UMN-St. Paul, MN

WIU Multi-State Trials



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frontiers

Frontiers in Energy Research

REVIEW

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From Farm to Flight: CoverCress as a Low Carbon Intensity Cash Cover Crop for Sustainable Aviation Fuel Production. A Review of Progress Towards Commercialization

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OPEN ACCESS

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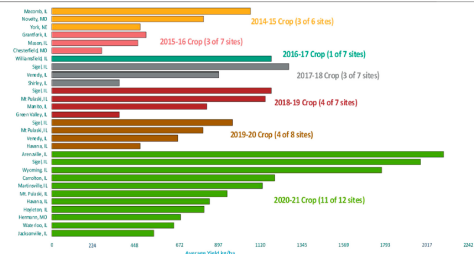
**\*Correspondence:** Winthrop B. Phippen, wbp@iprefer.com

Thapsi arvense L. (Field Pennycress; pennycress) is being converted into a winter-annual oilseed crop that confers cover crop benefits when grown throughout the 12 million-hectares U.S. Midwest. To ensure a fit with downstream market demand, conversion involves not only improvements in yield and maturity through traditional breeding, but also improvements in the composition of the oil and protein through gene editing tools. The conversion process is similar to the path taken to convert rapeseed into Canola. In the case of field pennycress, the converted product that is suitable as a rotational crop is called CoverCress™ as marketed by CoverCress Inc. or golden pennycress if marketed by others. Off-season integration of a CoverCress crop into existing corn and soybean hectares would extend the growing season on established croplands and avoid displacement of food crops or ecosystems while yielding up to 1 billion liters of seed oil annually by 2030, with the potential to grow to 8 billion liters from production in the U.S. Midwest alone. The aviation sector is committed to carbon-neutral growth and reducing




SCAN ME


Phippen W. B., R. Rhykerd, J. C. Sedbrook, C. Handel, and S. Csonka. 2022. From Farm to Flight: CoverCress as a Low Carbon Intensity Cash Cover Crop for Sustainable Aviation Fuel Production. A Review of Progress Towards Commercialization. *Frontiers in Energy Research* 10:1-11. Doi: 10.3389/fenrg.2022.793776




Year/Crop	States	Approx. Average Yield (kg/ha)
2014-15 Crop (3 of 6 sites)	Illinois, Indiana, Iowa	~100
2015-16 Crop (3 of 7 sites)	Illinois, Indiana, Iowa	~110
2016-17 Crop (1 of 7 sites)	Illinois	~120
2017-18 Crop (3 of 7 sites)	Illinois, Indiana, Iowa	~130
2018-19 Crop (4 of 7 sites)	Illinois, Indiana, Iowa, Missouri	~140
2019-20 Crop (4 of 8 sites)	Illinois, Indiana, Iowa, Missouri	~150
2020-21 Crop (11 of 12 sites)	Illinois, Indiana, Iowa, Missouri, Ohio, Wisconsin, Minnesota, Michigan, Kentucky, Tennessee, Arkansas	~160



United States Department of Agriculture





National Institute of Food and Agriculture




IPREFER Integrated Pennycress Research Enabling Farm & Energy Resilience

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United States Department of Agriculture



National Institute of Food and Agriculture



IPREFER Integrated Pennycress Research Enabling Farm & Energy Resilience


Commercial seed increase

Arenzville, IL

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## Large scale planting




Vertical tillage

Followed by:




Direct drill


or





Broadcast



Vertical tillage seeder



Drone seeding in standing crops

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## Head Seeder

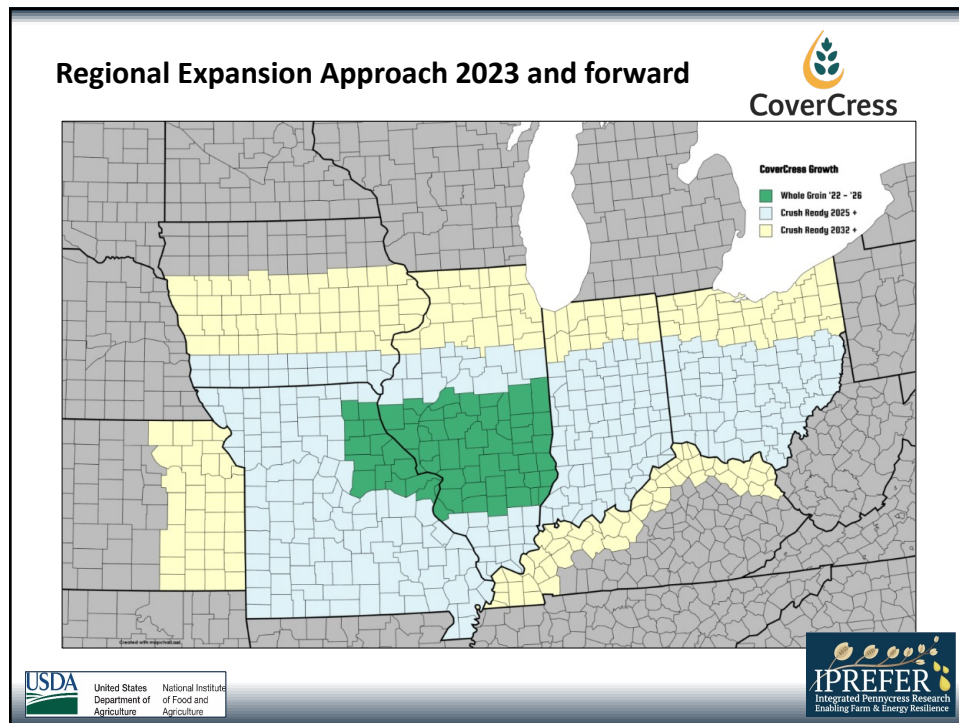


**Red Barn Solutions LLC Harvest Seeder**

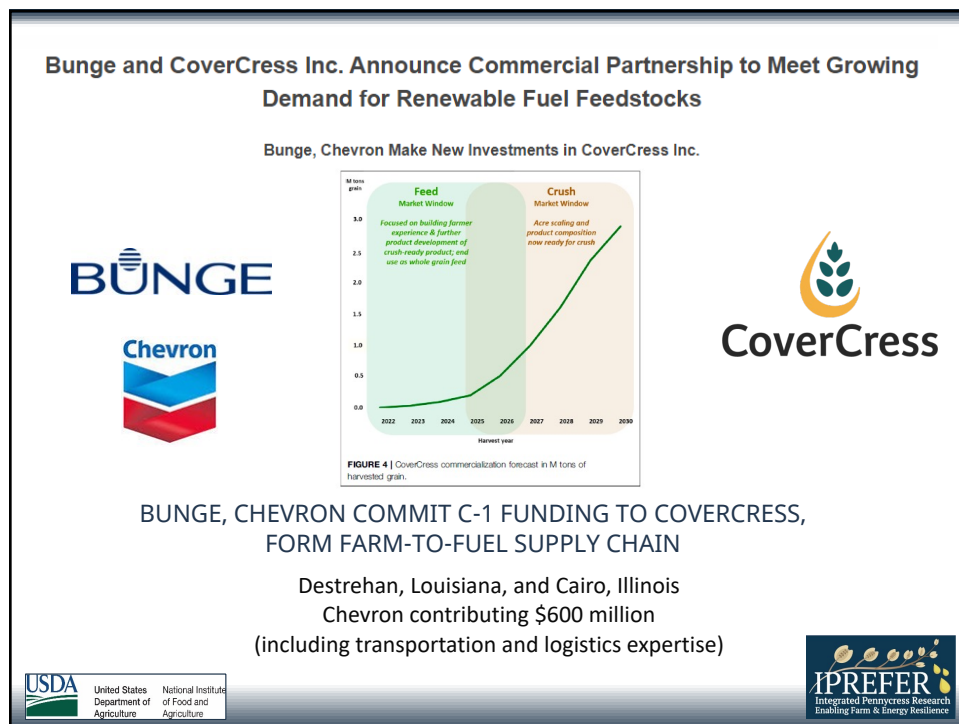


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**CoverCress**

**INTRODUCTION TO THE COVERCRESS®**  
**FARM ADOPTION PROGRAM, GRAIN PRODUCTION**  
**PROGRAM & AGRONOMIC GUIDE**

**Scan me for the 2025**  
**CoverCress**  
**Agronomic Guide**

**CoverCress**

**USDA** United States Department of Agriculture National Institute of Food and Agriculture

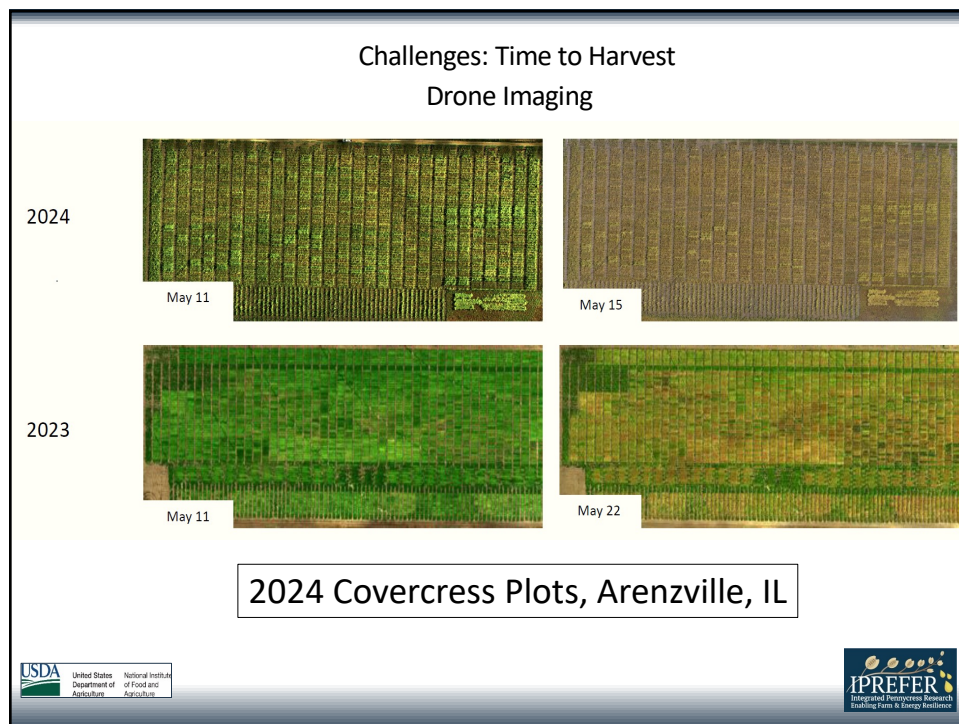
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Integrated Penumcress Research  
Enabling Farm & Energy Resilience

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## New Agriculture Sector




Carinata




### Intermediate Crops



Crops that are planted between two main crops to cover the soil



Camelina



CoverCress

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September 2021, US Biden Administration held a Sustainable Aviation Summit where they announced a Sustainable Aviation Fuel (SAF) Grand Challenge

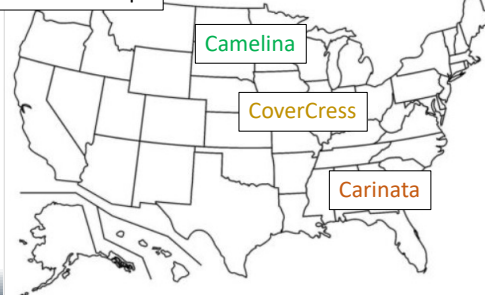
#### Goals:

- Near term, produce 430 million gallons per year by 2030 (10% of U.S. demand)
- Long term, produce 100% of U.S. aviation fuel demand by 2050 (42 billion gallons per year)

#### Worldwide aviation fuel consumption was 95 billion gallons in 2019

- dropped to only 52 billion gallons in 2020
- increased to 57 billion gallons in 2021

#### Dedicated oilseed crops



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## IPREFER Website: www.IPREFERCAP.org



## IPReP Website: www.pennycressresilience.org

