Pennycress as an Emerging Bioenergy Crop: How Does the Microbiome Impact Performance and Resilience Factors in the inland Pacific Northwest?

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https://www.pennycressresilience.org/

Project Goals: This project employs evolutionary and computational genomic approaches to identify key genetic variants that have enabled *Thlaspi arvense* L. (Field Pennycress; pennycress) to locally adapt and colonize all temperate regions of the world. This, in combination with knowledge of metabolic and cellular networks derived from first principles, is guiding precise laboratory efforts to create and select high-resilience lines, both from arrays of random mutagenesis and by employing cutting-edge CRISPR genome editing techniques. This project will deliver speed-breeding methods and high-resilience mutants inspired by natural adaptations and newly formulated biological principles, to be introduced into a wide range of commercial pennycress varieties to precisely adapt them to the desired local environments.

Abstract: Pennycress (*Thlaspi arvense*; field pennycress) is under development as a winter annual oilseed bioenergy crop for the 80 million-acre U.S. Midwest Corn Belt and other temperate regions including the Pacific Northwest. Pennycress has unique attributes such as extreme cold tolerance and rapid spring growth. Off-season integration of domesticated pennycress varieties into existing corn and soybean acres would extend the growing season on established croplands, avoid displacement of food crops, and yield up to 3 billion gallons of seed oil annually. Pennycress oil has a fatty acid composition well-suited for conversion to biodiesel and biojet fuel. Academic, governmental, and industrial stakeholders are working closely to commercialize domesticated pennycress varieties that can yield over 1,500 pounds per acre of seeds producing 65 gallons of oil per acre annually; the first commercial planting of Covercress (domesticated pennycress) occurred this past fall, 2021. However, the adaptability of first-generation Covercress varieties to and resilience against environmental challenges including drought, heat, and flooding is extremely limited. Therefore, crucial work remains to identify mechanisms conferring stress tolerance for incorporation of next generation elite pennycress varieties into current agronomic systems. While the rhizosphere microbiome is known to confer many plant growth-promoting characteristics to most crops, very little is known regarding pennycress adaptations and reciprocal dependence on the rhizosphere assemblage for stress resistance and tolerance. We will present our initial findings detailing and seeking to understand the pennycress rhizosphere microbiome. We believe dynamic interactions of the soil microbiome with the pennycress metabolome form crucial relationships to support agronomic development of

this oilseed bioenergy crop in the inland Pacific Northwest and Midwest. Key findings from this work will be translatable to improving other Brassica crops important for bioenergy including camelina, carinata, rapeseed, and canola.

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