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Development of resources and tools to improve oil content and quality in pennycress

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Statement of the Problem: Bioenergy crops, which have potential for jet fuel production and do not compete with food crops, are urgently needed. Our strategy to address the challenge is to develop pennycress (*Thlaspi arvense*), a member of the Brassicaceae, as a dedicated bioenergy crop, taking advantage of its ability to produce oil in its seeds that is ideally suited as a renewable source of jet fuel. Moreover, pennycress performs well on marginal land, has a short maturity time and grows off-season, serving as a winter cover crop, and complementing the food crops. However, to become an economically viable and sustainable source of jet fuel, molecular and genetic resources need to be developed, and integrated with techno-economic analyses to guide strategies for increase oil production through breeding and/or genetic manipulation. These are the gaps that this project intends to fill.

Methodology & Theoretical Orientation: 1) We are determining variation in genome-wide gene expression (derived from RNA-Seq) and intracellular metabolites (derived from metabolomics) in embryos from pennycress natural accessions. 2) We are generating a flux map of carbon partitioning in developing pennycress embryos, and will overlay metabolic maps with transcriptomics and metabolomics to identify metabolic bottlenecks in oil accumulation. Finally, we are using ^{13}C-metabolic flux analysis to validate bottlenecks in two accessions with contrasting oil contents. 3) We are analyzing techno-economics of pennycress based agronomic and supply systems to establish targets for oil metabolic engineering, and developing a public seed collection of pennycress mutants and transgenic lines to facilitate community synergy.

Findings: 1) Identify candidate genes and biomarkers associated with oil accumulation and composition 2) Identify targets to improve oil content and composition. 3) Establish metabolic engineering targets and develop community resources.

Conclusion & Significance: Taken together, the knowledge and resources will facilitate rational breeding and metabolic engineering of pennycress.

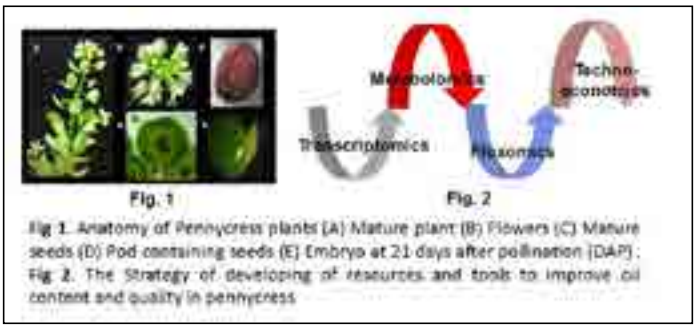

Fig 1. Anatomy of Pennycress plants (A) Mature plant (B) Flowers (C) Mature seeds (D) Pod containing seeds (E) Embryo at 21 days after pollination (DAP). Fig 2. The Strategy of developing of resources and tools to improve oil content and quality in pennycress

Biography

Fan Yang is a postdoctoral Researcher in Dr. Ana Alonso's laboratory at The Ohio State University. Her major interest is the plant metabolic engineering to improve bioenergy production and quality in bioenergy crops by combining fundamental mechanisms studies with applicable plant engineering studies. Her previous research focused on understanding the molecular mechanisms of monolignol transport in *Arabidopsis*; engineering secondary cell wall deposition in *Arabidopsis* and establishing gene regulatory network controlling phenolics metabolisms in maize. Her current project is to develop resources and tools to improve oil content and quality in Pennycress, a very promising bioenergy crop, by integrating transcriptomics, metabolomics and fluxomics tools. The resources are essential for increasing oil production and quality of oils for bioenergy in Pennycress.

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