Overview

Field pennycress (*Thlaspi arvense*) is a new, extremely winter hardy oilseed cash cover crop that can improve soil and water quality being developed by the University of Minnesota and the USDA-ARS. Pennycress is sown in autumn on land that is otherwise dormant and uncovered over the winter and is then harvested with conventional combines in mid-to-late June. Production of pennycress in the Upper Midwest will not displace traditional crops and will reduce loss of nitrogen through leaching and runoff as compared to a traditional corn-soybean rotation. Pennycress can produce over 2000 lbs seed/acre and seeds contain 30-38 percent oil. Although nonedible, pennycress oil is exceptionally cost-effective for making advanced biofuels. By planting both pennycress and soybeans, growers in the Upper Midwest will have higher total seed yield leading to higher profits compared with planting soybeans alone while contributing to improved quality of ground and surface waters; improved soil health; sequestration of carbon, nitrogen, and phosphorus; and early-spring food for wild and domesticated pollinators.
Research Status and Goals

Investments made in faculty, post-doctoral researchers, graduate students, technicians, undergraduate employees, and sites support:

**AGROECOLOGY**
Deploy pennycress production to the Minnesota landscape and measure the environmental benefits possible from this new crop.

**Activities:** More than ten experiments currently underway address pennycress agronomic needs and include method and timing of pennycress planting, in season management, and harvest; the effect of pennycress on following crops, water quality, weeds, and other pests; and economic and environmental benefits. More years, environments, and experiments are needed to determine best practice guidelines for integrating pennycress into cropping systems in Minnesota and throughout the Midwest.

**Outcomes:** Best management guidelines for pennycress production and integration into corn-soybean systems, Extension documents and workshops to address pennycress production, scientific reports identifying the ecosystem services provided by pennycress, and the knowledge necessary for farmers to improve their land and increase profit margins.

**BREEDING AND GENETICS**

**Activities:** Initial efforts have focused on domestication traits such as reduced seed shatter and early maturity. In addition to these traits, we are also breeding for higher oil content, reduced glucosinolate content, and larger seeds which will improve the marketability of pennycress. Thousands of lines have been screened for these valuable traits with the most promising lines undergoing seed increase for further testing. The University pennycress genetics program has successfully sequenced the pennycress genome and has been key to developing reduced seed shatter lines with non-GMO techniques. These reduced shatter lines, as well as other potential new lines, are being tested in several locations in Minnesota and represent the best of the first generation of pennycress breeding lines. With further investment in research sites with diverse soils and environments, these lines will rapidly be replaced by the next generation exhibiting higher yields and oil content, and other desirable traits.

**Outcomes:** New and improved pennycress germplasm and variety releases within five years.

Pilot Studies

A number of plot-scale pennycress research projects are distributed throughout central and southern Minnesota. These research projects include optimization of pennycress planting and harvesting methods and improvement of relay cropping system performance. Plans are underway to expand this research throughout Minnesota and the Upper Midwest. Research trials to determine the environmental and economic impacts of pennycress are underway. On-farm research studies are underway and preliminary results expected in 2017.

**COMMERCIALIZATION PLAN**

Market opportunities for pennycress oil include the renewable jet fuel industry and production of biopolymers. Initial production of pennycress seeds will be managed by UMN, Minnesota Crop Improvement Association, and the Agricultural Utilization Research Institute (AURI). Oil and protein products are provided to companies such as PepsiCo who are interested in developing products made with pennycress oil. Development of a larger pennycress production enterprise is underway. The University is working with Commercial Aviation Alternative Fuels Initiative (CAAFI) to develop plans for production of renewable jet fuel from pennycress feedstock.

The proposed market pipeline under development will make pennycress germplasm developed by the University available for local companies such as Land O’ Lakes, Inc. to sell commercial seed for planting to members of their cooperative. Other local companies such as Conservis Corporation and Wenck will provide management and logistics services for the seed production and processing. JetBlue Airways Corporation and other airlines are committed to renewable jet fuel and are interested in fuel produced from pennycress.

**TIMELINE**

2017 through 2022 and beyond

- Agroecology research to improve agronomics and track long-term environmental impacts
- Breed for early maturity, low seed shattering, improved seed yield and oil quality traits resulting in new varieties for release to farmers