Overview

Winter camelina (Camelina sativa) has a long history as an oil seed crop dating to pre-Roman times. Camelina has great potential for use as a cash cover crop that can provide both ecosystem services and economic benefits to farmers in the Upper Midwest. Research efforts for camelina are being led by the University of Minnesota and USDA-ARS.

Camelina is closely related to pennycress, but unlike pennycress, it produces a high quality edible oil. Camelina seeds contain about 35-40 percent oil with very high levels of D-linolenic acid, which is a heart-healthy omega-3 fatty acid, and tocopherol (i.e., vitamin E) that adds nutritive value and long shelf-life to its oil. Furthermore, the seed meal remaining after oil processing is a nutritious FDA-approved livestock feed. Our team is working closely with General Mills, Inc., to explore camelina for healthy food-use applications in their commercial products.

Camelina can serve as a companion crop to soybean in relay-cropping systems (see picture upper right). In these systems camelina is sown in autumn, and the relay crop (soybean) is planted at the normal time in spring into the growing winter oilseed. Camelina is harvested with a conventional combine in mid to late June, opening the canopy to allow the soybean crop to grow quickly and mature at the normal time in September. The aggregate production of both crops (winter oilseed and soybean) is greater in terms of overall seed weight and oil yield than a traditional single crop of soybean. Projected economic returns also are higher for the combined winter oilseed-summer soybean system than for the mono-cropped soybean. Thus, growers in the Upper Midwest are expected to have higher profits with relay-cropping than mono-cropping.
Research Status and Goals

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

**AGROECOLOGY**

Develop the tools and knowledge to successfully integrate winter camelina in Minnesota agriculture.

**Activities:** UMN and USDA-ARS researchers along with other collaborators have demonstrated that winter camelina is extremely winter hardy and can feasibly be double- and relay-cropped with traditional food and forage crops such as soybean. Moreover, our team has shown that these dual crop systems are economically viable, require low agronomic inputs (e.g., fertilizer and water), and provide much needed ecosystem services including pollinator forages, soil erosion prevention, and soil nitrate-N scavenging to improve water quality.

Future research goals include a) developing better management practices to enhance double- and relay-cropping opportunities and economics, b) devising new cropping systems that employ a host of other companion crops with winter camelina in dual crop systems, and c) fully evaluating environmental benefits of using camelina as a cover crop (e.g., suppressing herbicide resistant weeds, reducing phosphorus run-off, and enhancing the diversity and abundance of beneficial insects).

**Outcomes:** Best management guidelines for winter camelina production and integration into corn-soybean systems; Extension documents and workshops to address challenges with winter camelina production; and scientific reports identifying the ecosystem services provided by winter camelina.

**BREEDING AND GENETICS**

**Activities:** The winter camelina breeding program, which was launched in 2016, is focusing initial breeding efforts on domestication traits such as reduced seed pod shatter and early maturity. Future research goals include breeding for a) higher oil content, b) reduced early maturity glucosinolate content, and c) larger seeds and higher yields to improve the marketability of winter camelina. In 2014, Canadian researchers sequenced and mapped the camelina genome. Our team will use this genetic blueprint to speed up our breeding efforts to develop reduced seed pod shatter lines with non-GMO techniques.

**Outcomes:** New and improved winter camelina germplasm including new variety releases within five years.

Pilot Studies

Several experiments are planned and some already implemented to optimize planting and harvesting management of winter camelina and improve soybean yields in relay-cropping systems. Experiments have also recently been initiated to explore the regional adaptation of double- and relay-crop systems with winter camelina across the state of Minnesota including plans to test these systems throughout the upper Midwest. Efforts are also underway to more fully determine the environmental and economic impacts of using winter camelina as a cover crop in dual cropping systems. In 2016, experiments were initiated to screen hundreds of camelina varieties from around the world to select for “winter-type” habit and freeze hardiness. Moreover, thousands of new winter camelina lines developed using a non-GMO technique were planted at multiple locations in Minnesota in 2016, and will be used to select improved lines with earlier maturity, reduced shattering, larger seeds, and higher yields and oil content. Continued support of these research efforts will ensure a rapid commercialization of winter camelina as a cash cover crop and adoption by Minnesota farmers as well as other farmers across the upper Midwest.

**COMMERCIALIZATION PLAN**

Currently market opportunities for camelina exist with General Mills and other companies interested in using the oil and protein for food uses. The initial pipeline for camelina involves small production fields planted, managed, and harvested by UMN and USDA-ARS. The seed is cleaned and processed by the Minnesota Crop Improvement Association. After cleaning, the seed is crushed and oil processed by the Agricultural Utilization Research Institute, which then provides the oil and protein products to companies or research organizations interested in developing uses for these products.

**TIMELINE**

2017 through 2022 and beyond

- Agroecology research to continuously improve agronomics and track long-term impacts of this new crop on the environment.

- Breeding work to improve seed yield and oil quality traits, which will result in new varieties specially adapted to Minnesota’s diverse agroecosystems.