Forever Green Initiative

# Winter Camelina

## A NEW SHORT SEASON WINTER ANNUAL OILSEED CROP FOR USE IN DIVERSE ROTATIONS

## Overview

The University of Minnesota is a leading institution worldwide for developing new winter hardy cash cover crops. Winter camelina (*Camelina sativa*), which can be grown in the Midwest in conjunction with traditional summer crops like soybean and corn, is showing exciting potential as a new cash cover crop that can provide both ecosystem services and economic benefits to farmers in the Upper Midwest.

Industry is showing great interest in the wide range of end-use and co-product uses winter camelina provides, including healthy edible oils, biodegradable (plastic) packaging materials, lubricants, and biofuels. Camelina seeds contain about 36–45 percent oil with very high levels of α-linolenic acid, which is a heart-healthy omega-3 fatty acid, and tocopherol (i.e., vitamin E) that adds nutritive value. The oil is available for human consumption as well as for pet food and animal feed. The oil is also being researched for industrial biofuel and bioplastic products. The seed meal remaining after oil processing is a nutritious FDA-approved livestock feed that is rich in protein, essential fatty acids, and fiber. All of these products and uses equate to additional and appreciable economic returns for Midwestern farmers who grow winter camelina as a winter cover crop.

Winter camelina can be sown after harvesting crops like spring wheat or silage corn, or interseeded during summer in field corn, soybean, or sunflower. The emerged seedlings form rosettes in the autumn and cover the soil surface prior to entering winter dormancy. As rosettes, they protect the soil surface from erosion caused by high winds, intense rains, and/or snow melt. Additionally, these rosettes absorb nearly all labile soil nutrients, like nitrates, in autumn and spring, thereby almost completely eliminating nitrate and phosphorus contamination of ground and surface waters. This keeps well water safe for drinking, and it improves the quality of water in our wetlands, streams, rivers, and lakes.

In spring as the rosettes bolt (elongate) to form flowering stems, summer crops like soybean can be interseeded into the camelina crop. The camelina plants continue to mature and flower as the soybean germinates and emerges. Camelina flowers throughout the month of May in Minnesota, providing large quantities of nectar and pollen to pollinators in early spring when little else is in bloom. Winter camelina seeds are harvested in June while the understory soybean plants are still short enough not to be damaged by the cutting bar of a conventional combine. The soybean continues growth after the camelina harvest and matures at the normal time in September.

The successful development of adapted winter camelina varieties and planting of those varieties in millions of acres across Minnesota and surrounding states has enormous potential to generate economic rewards for Minnesota farmers while simultaneously protecting soil health and alleviating critical water quality issues.

### TIMELINE

#### 2020–25 AND BEYOND

- Agroecology research to develop best management guidelines for winter camelina production and integration into Minnesota cropping systems and track long-term impacts of this new crop on the environment.
- New and improved winter camelina germplasm will be evaluated for improved seed yield and early maturity resulting in new variety releases specifically adapted to Minnesota's diverse cropping systems and environments.
- Partnering with interested growers and commercial stakeholders to scale up production, postharvest handling, storage, cleaning and processing.

University of Minnesota
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# Research Status and Goals

Investing in people, tools and research drives the mission of Forever Green Initiative forward.

## AGROECOLOGY

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

**Activities:** UMN and USDA-ARS researchers and other collaborators have demonstrated that winter camelina is cold and freeze tolerant and can be double- and relay-cropped with traditional food and forage crops such as wheat, sweet corn and soybean. 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 resources, soil erosion prevention, and soil nitrate-N scavenging to improve water quality.

Future research goals include a) improving management practices to enhance double- and relay- cropping opportunities and economics, b) piloting new cropping systems that employ 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 diverse rotation systems; Extension documents, field days and workshops to address challenges with winter camelina production; and scientific reports identifying the ecosystem services provided by winter camelina.

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## BREEDING AND GENETICS

**Activities**: The winter camelina breeding program, which was launched in 2016, is focusing initial breeding efforts on identifying high yielding, early maturing lines with improved winter hardiness. Future breeding targets include a) higher oil content, b) reduced glucosinolate content, and c) improved protein and meal quality. These traits will expand the range of food and feed products that can be made with camelina. Studies to evaluate camelina traits that will improve establishment and yield in relay-cropping systems are also in development. The camelina genome will be used as a guideline to identify the genes controlling these traits and develop improved winter camelina varieties using non-GMO techniques.

**Outcomes:** High yielding, early maturing camelina varieties adapted to the climate in Minnesota and the Upper Midwest with valuable commercialization traits such as improved oil and protein quality.

## FOOD SCIENCE AND NUTRITION RESEARCH

Global demand for plant-based proteins continues to grow at an accelerated rate. In order for winter camelina's proteins to compete in this market, researchers must demonstrate that the proteins sourced from winter camelina are equivalent or superior compared to existing protein alternatives. UMN Food Science researchers are evaluating the functional and nutritional value of winter camelina, specifically its protein component. Work underway is multifaceted and requires a concerted effort between breeders and food and nutrition scientists. Specific objectives are: 1) Develop flavor-guided protein extraction methodology for optimal protein quality and yield following innovative approaches; 2) Screen lines for protein nutritional quality and functionality to develop optimal lines for food use. One camelina line will be selected for optimization of protein isolation conditions. Wild type seeds and defatted meals will be subjected to two protein extraction procedures and extraction conditions will be optimized for extraction yield, purity, flavor, and functionality. Breeders will provide seeds from 5 camelina lines with potential variation in protein composition and profile and will be used to produce protein isolates following the flavor guided optimized extraction. Protein structural, functional, and nutritional properties will be determined. Generated data from this work will feed back into the breeding program to continue to develop camelina as an edible protein crop for food applications.

## COMMERCIALIZATION AND PILOT SUPPLY CHAINS

Market opportunities for winter camelina exist with a range of regional, national and international companies interested in using the oil, meal and protein for food, feed, biofuel and bioproduct uses. Industry stakeholders are showing increased interest in winter camelina because of its winter hardiness and its ability to keep the soil covered during midwest winters. These partners are also interested in utilizing winter camelina cropping systems for sequestering carbon, reducing nitrate leaching and mitigating GHGs (greenhouse gas emissions) in their supply chains. Forever Green researchers are actively partnering with stakeholders to pilot large scale production acreages and supply chains of winter camelina. Plantings of several thousand acres will be strategically sited to maximize ecological services, including plantings on vulnerable well-head areas and important watershed regions. Additionally, these pilot supply chains will include investment in scaling up postharvest handling, storage, cleaning and processing. Importantly, research is also underway to study the life cycle of winter camelina production systems and gather more complete data on the ecological services a winter camelina cropping system provides.

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