Forever Green Initiative

Perennial Flax

A NEW PERENNIAL OILSEED FOR FOOD, FIBER AND HORTICULTURAL USES

Overview

Golden flax, a summer annual crop, has a long agricultural history in Minnesota. The University of Minnesota was active in flax breeding and research throughout much of the early to mid 20th century. The crop was in high demand and used to produce industrial products such as linen, linoleum, paints and protective coatings. By the 1980s, commercial interest in flax faded with the advent of petroleum-based or synthetic alternatives to flax products.

However, today we are seeing a growing interest in flax (*Linum usitatissimum*) primarily due to the health benefits of oils high in omega-3 fatty acids. Flax has the highest concentration of omega-3 in the seed oil of any cultivated plant (~50% of total oil is linolenic acid), and clinical studies in humans have shown that diets rich in flax seed oil result in improved cardiac health. The food industry uses golden flax as an ingredient in whole grain foods, breads, cereals, snack bars, and crackers.

Forever Green has been active in researching and breeding perennial flax species (*Linum spp.*) that provide a similar nutritional profile as golden flax, but also provide important ecosystem services as a perennial crop. Under agricultural management in Minnesota, some perennial flax accessions could be harvested twice a year (June, September), providing forage for pollinators at times when annual flax and other bee-pollinated crops are not flowering. Flax would work very well in buffer zones on Minnesota farms while also producing a high-value grain for sale. This combination of ecosystem services and a high-value grain product would make perennial flax a useful addition to Minnesota cropping systems. Perennial flax is unique because of its ability to also be an ornamental bedding plant and a cut flower crop. Vase life experiments have shown that several perennial flax species have an average vase life greater than 9.2 days, exceeding the minimum number of postharvest days for a cut flower. Many species of perennial flax are cold hardy and retain green vegetation late into the fall and begin regrowth early in the spring, retaining soil-water and stabilizing soils. Perennial flax has a long flowering period which often continues well after the first frost, making it a useful late-season food source for pollinators.

This project will enhance yield and quality for multiple end uses in Minnesota by working with our food industry and horticultural partners to realize the long-term potential of perennial flax and its derived products.

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Research Status and Goals

We will study agroecology of perennial flax production and food and end use quality traits of perennial flax.

AGROECOLOGY

Activities: We are working with collaborating agronomists at North Dakota State University to determine appropriate production practices (especially weed control) for perennial flax that maximize value to consumers and producers, while optimizing environmental benefits. Two experiments were conducted in 2020 at field sites across Minnesota and North Dakota to determine optimal weed control for perennial flax. The first experiment compared several continuous living cover systems (organic), while the second evaluated herbicides (conventional). Food science research, in collaboration with food industry partners, seeks to find suitable grain and fiber characteristics for commercialization.

Outcomes: Develop best management practices for Minnesota producers to maximize yield and production of specialty food traits that are important for end markets and consumers.

BREEDING AND GENETICS

In Fall 2018, we added a full-time graduate student to conduct breeding research on perennial flax. Another graduate student began genomics research in 2020, along with a full-time research technician. They are supported by two faculty and one scientist.

Activities: The University has been conducting breeding activities for more than a decade on perennial flax species. Breeding efforts with these populations have produced lines that yield nearly 100 lb/acre more than the existing perennial flax 'Appar' (382 vs. 298 lb/acre) in one harvest, which is also about one-third of the annual flax yield in the region. With the addition of full-time graduate students, this program has been expanded to include promising lineages of perennial flax obtained from local collections, germplasm repositories, and our collaborators. We hope to: 1) further the improvement of yield and quality traits using recurrent selection of existing breeding populations of wild perennial flax from Eurasia and North America, 2) further the improvement of native Lewis flax (*L. lewisii*) using similar techniques to produce a cultivar with North American origins, high yield, and acceptable quality, and 3) develop ornamental cultivars of perennial flax suitable for the garden or cut flower market.

Outcomes: Provide superior germplasm to our agroecology, horticultural and food science partners to further our understanding of this new crop. Use these resources to help Minnesota producers integrate perennial flax into existing cropping systems.

COMMERCIALIZATION

By 2021, we plan to provide seed of a breeding line in large enough quantities to begin on-farm trials of perennial flax. No new equipment will be needed for many farmers, because standard windrowers and combines will be used for harvest. General Mills is already interested in evaluating selected germplasm for suitability in their natural foods product line. Particularly for southern Minnesota, developing a market such as this through the food industry in the Twin Cities appears to be the most promising route for commercialization. In the case of northwestern Minnesota, standard supply and value chains already exist for flax. Companies are already buying and marketing flax products from northern Minnesota. These producers can also access established networks in North Dakota and western Canada.

TIMELINE

2020–25 AND BEYOND

- Agroecology and food science research to prepare crop for large-scale production
- Breeding and genetics to improve yield, horticultural, and agronomic fitness while releasing new varieties
- Conservation of flax genetic resources in collaboration with USDA's Germplasm Resources Information Network

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