



Overview

Annual sunflower (*Helianthus annuus*) is a valuable oilseed crop, which is also grown for confectionary seeds and ornamental purposes. In agricultural systems, a perennial sunflower may **allow farmers to diversify their operations while improving profits and providing environmental benefits.**

Compared to annuals, perennial crops provide living ground cover for longer periods during the year as plants emerge from dormancy early in the growing season and are often less susceptible to frost. Additionally, **fall tillage is not necessary** during the multi-year lifetime of the perennial crop. It is for these reasons that perennial plants also **protect against soil erosion and improve water use.** During the extended growing season, plants take up soil moisture, decreasing year-round drainage line flow and loss of nitrogen from the soil. Our team combines traditional plant breeding with modern genomics tools to achieve the goal of developing a **perennial sunflower that is as productive as current commercial varieties but offers superior profit potential and ecosystem services for Minnesota farmers.**



PILOT STUDIES

Most of our work will be conducted at the University of Minnesota greenhouses and on the Minnesota Agriculture Experiment Stations (MAES). As most of Minnesota's sunflower production is in the northwestern part of the state, we have developed close collaborations with the Sunflower and Plant Biology Research Unit of the USDA in Fargo, ND and plan on testing experimental material in the Fargo/Moorhead area. We believe that state mandated buffer zones around rivers, ditches, and well heads provide an excellent opportunity for us to introduce this new perennial crop to landowners. Depending on the success of the buffer zone plantings we hope to work with sunflower growers to further expand perennial sunflower fields in Minnesota.

Forever Green Initiative: PERENNIAL SUNFLOWER

Potential as an oilseed crop

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Research Status and Goals

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

AGROECOLOGY

Best practices for growing, maintaining, and harvesting perennial sunflowers.

Activities: We will develop experiments to identify 1) optimum nitrogen fertilizer rates and row spacing for maximized grain yields, 2) how to best control the spread of clonal plants by belowground tissue, 3) optimal planting times for seed or rhizomes/tubers, 4) the number of years a stand should be maintained before it is replanted, and 5) the appropriate scale of genetic diversity (i.e. the number of clonal genotypes) to plant in given field. Following initial evaluations and the release of material, we will work with farmers to determine the environmental impacts of perennial sunflower, focusing on soil erosion and chemical leaching to groundwater.

Outcomes: Best management guidelines for perennial sunflower production, extension documents for addressing specific agronomic challenges, and scientific reports highlighting the environmental effects.

BREEDING AND GENETICS

Investments made in UMN faculty, post-doctoral researchers, graduate students, technicians, and undergraduate employees support the perennial sunflower breeding program.

Activities: The goal of the perennial sunflower program is to develop a high-yielding perennial sunflower with fertile seeds. Toward this aim, researchers at the University of Minnesota have hybridized the annual sunflower, *H. annuus*, with two cold hardy perennial species—Jerusalem artichoke (*H. tuberosus*) and rough sunflower (*H. divaricatus*). Hybridizations with Jerusalem artichoke are well underway, and have demonstrated impressive gains in flower head size over five generations of breeding. Crosses to the rough sunflower are currently underway. To increase the efficiency of selection and accelerate improvement, we are identifying the genetic basis of perenniality and domestication traits, such as flower head size, and seed viability. Our preliminary work in hybridizations with Jerusalem artichoke suggests a relatively simple genetic control of perenniality, and current efforts focus on maintaining perenniality while increasing head size and head filling.

Outcomes: Products from this research will include a perennial sunflower germplasm and ultimately a public release of perennial sunflower.

FOOD SCIENCE

Investments in technicians and materials will support our evaluation of the chemical profile of perennial sunflower seeds.

Activities: We ultimately aim to develop a perennial sunflower whose oil can be blended with, or used in place of, high oleic sunflower oil. Towards this goal, we will measure the seed oil profile of our perennial sunflower and compare it to commercially sold high oleic sunflower.

Outcomes: Evidence that perennial sunflower oil is comparable to high oleic sunflower oil, making this product an easy sell to vegetable oil companies and consumers. To the extent that perennial sunflower oil initially deviates from traditional sunflower oil, we will continue to select for oil composition that resembles that of annual sunflower.



Commercialization Plan

Market opportunities currently exist within the annual sunflower oil and birdseed market. We are in touch with birdseed companies and see this as a market for perennial sunflowers as we bring oilseed production up to scale. As we further develop our material, we will contact sunflower oil companies and explore two options towards commercialization: 1) Blending perennial and annual sunflowers for a consistent oil, and 2) Branding perennial sunflower as a green, sustainable product for a specialty oil.

TIMELINE

We are currently advancing breeding material to achieve the outcomes outlined above. We plan to generate enough seed for larger trials in 2018, when we will also begin agroecology and seed oil experiments. By 2020 we plan to have material available for use as a trap crop to reduce bird predation in nearby commercial annual sunflower fields. We aim to stabilize the genome of this hybrid by 2022 and at that time deploy plants in buffer zones. This should allow for an initial set of experimental plants on farms by 2026.