Overview

Forever Green Initiative (FGI) researchers are investigating how **summer annual grain crops** can be integrated into Minnesota environments and crop rotations. These grains include sorghum, teff, buckwheat, pearl millet, Japanese millet, foxtail millet, and proso millet. One of the major challenges facing FGI is how to fit cover crops and winter annual crops into Minnesota's short growing seasons around corn and soybeans, both bred to be early-planted and late-harvested. Summer-planted grains can **increase the FGI's scope for winter annual and cover crop development** by providing a cash crop whose growing period complements that of the winter crops, allowing them **more time to develop spring biomass or mature grain**. This opens the door to double cropping, in which a winter grain—including the traditional winter wheat as well as newly developed pennycress, camelina, or winter barley cultivars—can be followed by a summer grain to provide **two cash crops in a single year**, a possibility which has previously proved difficult to achieve in our climate.

**Summer annual grains like millet, sorghum, teff, and amaranth** have become more prevalent in mass-marketed products and on restaurant menus. Additionally, there may be a price premium for summer annual grains if locally produced. The availability of high value summer-planted, short-season grain crops will complement the development of FGI winter cover crops. These cropping systems will provide **ecosystem services** and **profitable double-cropping opportunities** to growers, **nutritious and culturally valuable local foods** to consumers, and **highly marketable ingredients** to local food processing enterprises.

Each of these grains has a long and rich culinary and agronomic history, but none is currently well known in Midwestern farming systems. Consumers show increasing interest in including diverse grains in their diets for reasons including greater nutrition, unique flavors, gluten-free options, and the lack of GMOs. Many are consumed as whole grains and have even become prevalent in mass-marketed products, including crackers and breakfast cereals. Some, such as teff, are staple crops in the cultures of new immigrant groups, whose traditions are bringing new richness to Minnesota's food markets and culture.
Research Status and Goals

This project will invest in faculty, post-doctoral researchers, graduate students, technicians, undergraduate employees, and community collaborators who will assess the performance and marketability of these crops and determine how they can be managed to complement the growth periods of winter annual crops.

**Activities:** Multiple cultivars of each summer grain species will be evaluated at five on-farm sites and Minnesota Experiment Station Research Centers in 2017 and 2018. We will evaluate weed competitiveness, maturity dates, standability, reaction to diseases, seed shattering, and grain yield. We will also conduct soil tests to determine the influence of these crops on soil nutrient status. We will measure nutritional content of the grains, and work with colleagues in food science, nutrition, applied economics, and other fields to explore their potential to fit into Minnesota’s local foods markets and diverse culinary traditions.

**Outcomes:** Agronomic production guides as well as cultivar recommendations for Minnesota’s double cropping systems, with emphasis on traits such as improved yield, greater competitiveness against weeds, reduced shattering, and maturities consistent with double cropping with winter annuals.

Pilot Studies

We have recently conducted some small-scale evaluations of summer annual grains, particularly the different types of millets. We have been actively pursuing funding for more comprehensive research. We plan to conduct our agronomic trials in the southwest and south central regions of Minnesota, where the most intensively-farmed and least-diversified cropping land is located. Because in many cases these grains are unfamiliar, or familiar to only a portion of Minnesota consumers, we will incorporate tastings and cross-cultural culinary exchange into our field days, as well as planning cooking and tasting events in the Twin Cities area.

Commercialization Plan

Organic, natural, and local food markets are the most likely targets for commercialization. We believe that alternative crop production must be advanced simultaneously with market development to reduce risks for producers. Thus, we will also identify local markets and will develop a supply chain analysis for summer annual grain product entry into local and regional marketing channels. Our desired outcome is that local enterprise development will enable these locally produced crops to reach consumers who may be already seeking them out through ethnic markets as imports. We will also reach out to food processors, particularly those who are already engaged with the FGI’s intermediate wheatgrass project, to gauge and develop interest in using these grains in high-value packaged products targeted to nutritionally and environmentally conscious consumers.

**TIMELINE**

2017-20: Basic agronomic research and preliminary germplasm selection

2018-19: Breeding needs identified, summer grains breeding team formed, and supply chain analysis completed

2018-24: Market research and outreach to food processors and consumers

2020-24: Continued agronomic research incorporating the best available germplasm