

Developing New Crops to Enhance Soil & Water Resources

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Preservation of natural resources is important to quality of life and health of all citizens. The health of Midwestern lakes, rivers, and ground water is threatened by non-point sediment and nutrient pollutants. With the appropriate tools, agriculture can provide solutions to preserve and conserve soil and water. The Forever Green Initiative (FGI) at the University of Minnesota is developing these tools: new winter annual and perennial crops, as well as the associated efficient farming systems that improve water quality and manage water quantity.

The FGI is composed of teams of researchers, farmers, food product developers, and entrepreneurs from all aspects of the agricultural supply chain. Their goal is to develop and promote the use of new crops that enhance water and soil quality while bolstering rural and agricultural economies with high-value, commercially marketable products. The FGI innovations are based on perennial and winter-tolerant crops that create new economic opportunities and environmental benefits for Minnesota.



Intermediate wheat grass selection nursery.

Midwest agriculture is dominated by annual crops like corn and soybean that grow during the summer, leaving land bare much of the year. Without active plant root systems to hold soil in place and absorb water, fields are more vulnerable to wind and water erosion and nutrient leaching – major contributors to non-point source pollution. By adding perennial and winter-tolerant annual cover crops, we can improve water quality because these crops are active during most of the year, including the fall and spring when summer annuals are absent. For this reason, perennial and winter-annual crops, working in tandem with summer annuals, can capture solar energy, water, and nutrients with high efficiency. Perennials and winter annuals can enhance wildlife habitat. New efficient FGI cropping systems will improve water quality by providing continuous living cover, resulting in protection of soil by reducing water runoff, wind and water erosion, and loss of soil and nutrients that can occur when farmland is not covered by living plants.

The FGI has been active for almost 7 years. It has received funding from non-state sources, including competitive grants from federal, University of Minnesota, foundation, and commercial sectors. It currently engages over 60 faculty, graduate students, and research staff in a wide range of academic departments as well as USDA-ARS scientists in St. Paul and Morris, MN, and Fargo, ND. The FGI is attracting high-quality students to the programs to meet the future workforce needs in agriculture, food, energy, and natural resource industries. Brief profiles of some of the ongoing FGI projects follows.

- **Kernza/intermediate wheatgrass** is a perennial grass crop producing high yields of grain as a high-quality substitute for wheat and produces high forage and biomass yields. Its dense root system builds soil carbon, stores nutrients, and prevents soil erosion. It is highly tolerant of weather extremes (drought, intense storms) and can provide economic resiliency. Varieties with high grain and forage yield potential along with associated production systems will be developed.
- **Winter malting/food barley** has potential to serve as a cover crop and a high value crop that may be double-cropped with soybean. Modern breeding methods are being used to improve winter-hardiness.
- **Field Pennycress** produces an oilseed suitable for biodiesel. Camelina produces an oilseed with heart healthy edible oil. Plants are being developed into new winter annuals that can be planted after corn or soybean harvest and resume growth in early spring. They provide crucial soil protection during fall, winter, and spring, and produce high-value oil, suppress weed growth, and support honeybees and other pollinators.

- **Perennial Sunflower** is being developed that can produce highly valued food oils free of trans-fats while providing all of the benefits of perennial crops, including use of residual nutrients, soil protection, reduced costs, and better tolerance of droughts and floods.

- **Silphium** is a native perennial prairie plant having potential to be domesticated as an oilseed crop. It has excellent drought tolerance, a vigorous root system, upright stature, and favorable food oil composition.

- **Hairy vetch** is a winter annual crop that can reduce soil erosion, increase soil quality, sequester soil nutrients, and contribute biologically fixed nitrogen for use by following crops resulting in greatly reduced N losses to waterways. New varieties adapted for use as winter covers will be developed, and soil health benefits resulting from hairy vetch use will be investigated.

- **Perennial forage grasses and legumes** provide economic return from grazing or hay and also provide significant ecosystem benefits. Perennial ryegrass, meadow fescue, improved white clover, Kura clover, and alfalfa varieties will be developed, having great potential for use in haymaking and grazing systems, especially for the rapidly expanding grass-fed beef and organic dairy enterprises. Development of new winter-hardy varieties of grasses will increase yield and persistence under severe winters. The use of grasses in mixtures with new varieties of white clover, Kura clover, and alfalfa will provide a high-quality feed increasing farmer profitability while providing ecosystem services of soil conservation, soil carbon sequestration, wildlife habitat, and pollinator food source. Kura clover has a unique application as a living mulch crop into which corn or other grain crops are planted in strips established with zone tillage or killed with a herbicide. When the crop is harvested, the clover can regrow into the space where the corn was grown and can be grazed in the late fall and following year.



Camelina with soybean intercropping.



Kura clover living mulch.