



Intermediate Wheatgrass

A PERENNIAL, MULTIFUNCTIONAL FOOD, FEED AND ECO-FRIENDLY CROP

Overview

As the first commercially available perennial grain crop in the United States, intermediate wheatgrass will change agricultural landscapes by providing valuable ecosystem services. The Forever Green Initiative is striving to advance intermediate wheatgrass production and end-use opportunities to commercialize this crop while providing new economic opportunities to Minnesota farmers, protect the environment, and supply the nation with a new, healthy grain.

Intermediate wheatgrass (*Thinopyrum intermedium*, IWG) provides year-round soil coverage and uniquely large belowground carbon inputs from roots. Farmers growing this crop will likely sequester more carbon and reduce greenhouse gas emissions. Research is showing IWG reduces nitrogen and phosphorus contamination of freshwater and marine ecosystems, and reduces weed competition which minimizes the need for tillage or herbicide applications. With continuous soil cover, farmers will also greatly reduce soil erosion, potentially turning agriculture into a soil-forming ecosystem, much like the natural ecosystems it replaced.

The IWG breeding project at the University of Minnesota has made great strides in targeted trait improvement, resulting in increased seed size and seed yields significantly larger than those of original populations. This has led to production and sales of this crop under the trade name Kernza® (trade name is property of The Land Institute, a nonprofit organization that has led development of the crop since 2003). UMN released its first commercial variety of Kernza Intermediate Wheatgrass in 2019. They named their variety MN-Clearwater, as a nod to the many lakes in our state and importance of clean, safe water throughout Minnesota

The UMN food science team and commercialization team is working with a range of interested commercial partners to determine how IWG can be incorporated into their food products as a green and earth-friendly crop. Food companies, restaurants and businesses have especially been interested in incorporating IWG into their product lines and on their menus in order to attain sustainability goals and gain valuable marketing advantage by reducing their greenhouse gas footprint.



Research Status and Goals

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

AGROECOLOGY

Increase intermediate wheatgrass yields and measure the environmental benefits possible from this new crop.

Activities: Field experiments are addressing crop rotations, optimum nitrogen fertilizer rates and row spacing for maximized grain yields, incorporating legumes into intermediate wheatgrass stands to reduce nitrogen fertilizer needs, harvesting or grazing forage to complement grain yields, and improving grain harvest efficiency methods. Projects address agronomic development, reductions in nitrate leaching to groundwater, reductions in soil erosion, and better understanding Kernza's potential for sequestering carbon in roots and soil.

Outcomes: Best management guidelines for intermediate wheatgrass productions, Extension education documents for farmers and producers, and scientific reports describing intermediate wheatgrass merits.

BREEDING AND GENETICS

Improving intermediate wheatgrass for profitable production in the Midwest.

Activities: Projects are focused on domestication traits such as reduced seed shattering, improved free grain threshing, and seed size. There is plentiful genetic variation for these traits in our breeding germplasm and rapid gains have been made with seed size increasing at a rate of about 5 percent per breeding cycle. The first five IWG variety candidates entered statewide yield tests in 2016 and the first commercial release was in 2019. A dozen more candidates are currently being evaluated. To increase the efficiency of selection and accelerate its improvement, we have optimized and established genomics tools based on DNA fingerprinting. These genomics tools can shorten the breeding cycle from three to five years to less than one year and allow us to evaluate more plants than is possible with field-based selection alone.

Outcomes: Continuously improved IWG germplasm, including new variety releases with increased grain yield and grain harvestability.



FOOD SCIENCE

Quality traits characterization and viable methods to store, process, and utilize intermediate wheatgrass in commercial foods.

Activities: Continue to characterize intermediate wheatgrass quality traits (starch composition, gluten protein profiling, dietary fiber content, antioxidants, and problematic enzymes), evaluate its use for various food applications (e.g. flour blends, cereal-based products, baked goods), improve storage and shelf life, and measure the effect of refinement and processing methods on quality characteristics. Tempering, a critical pre-treatment step before milling, is commonly used for hard red wheat to optimize its flour production. Recent research has shown that tempering conditions when optimized for intermediate wheatgrass have positive impacts on the physio-chemical and functional properties of intermediate wheatgrass flour. Improving the functionality of intermediate wheatgrass as a flour ingredient will expand the applications of the grain in baking and product applications and result in breads and baked goods that better match consumer expectations.

The food science team is also working closely with brewers and maltsters to optimize intermediate wheatgrass for malting, brewing and distilling applications. The craft brewing industry has seen dramatic growth across the country, which has resulted in a high demand for new ingredients to meet the expanding consumer interest. Additionally, many brewers are committed to sourcing ingredients grown in Minnesota, and seek ingredients that promote ecological and social benefits. As a result, intermediate wheatgrass has garnered considerable interest from brewers across the state, country and even globally.

Outcomes: Guidelines for directing end-use products development using intermediate wheatgrass, evaluation of new varieties for guiding breeding efforts toward achieving grain quality objectives, and scientific papers documenting strategies used to characterize and improve intermediate wheatgrass.



PHOTO: METTE NIELSEN

Clusters of Production: Piloting Sustainable Supply Chains

Intermediate wheatgrass, with its extensive root system, has proven to be effective at mitigating nitrate leaching into groundwater resources. This has caught the attention of rural water associations and city utilities that recognize the opportunity to mitigate serious and costly drinking water issues by planting IWG to protect source water. As a result, “clusters” of production have started to develop across Minnesota in areas where local leadership and associations have partnered with growers to strategically plant, harvest, store and process the IWG in vulnerable wellhead areas. Restaurants, bakers, brewers and retail businesses in the regions are working with the grain, adding to their product offerings, menus and store shelves. Lastly, the Minnesota legislature, the Clean Water Legacy Council and Department of Agriculture also recognize the economic and ecological benefit of this work and have spurred cluster production and supply chain development through funding support.

COMMERCIALIZATION PLAN

Increased production and acreage of MN-Clearwater is currently underway, with an estimated 700 new acres planted in 2020. Incremental scaling of seed supply and food production acreage is on track and will continue to align with the source water protection strategy as a high priority.

Recent additions of two new Minnesota-based seed cleaners—one for seed and one for food grade production—has allowed for the incremental expansion of market development. The seed company has worked closely with the UMN to manage the cleaning and distribution of IWG seed to Minnesota growers. Additional Minnesota seed companies have expressed interest in commercial seed distribution and efforts are underway to strategically expand seed cleaning, production and distribution. A food grade grain company is working with Minnesota growers to source food-grade Kernza and now offers wholesale and direct-to-consumer distribution of Kernza grain and flour. Businesses interested in sourcing Kernza for menus or product development can now procure a safe, consistent and reliable supply of Kernza.

Market testing and product development is currently underway by a range of commercial partners. General Mills recently tested a small run of a breakfast cereal; Perennial Foods, a start-up company in Minnesota, is now selling Kernza grain and flour for home use; a cracker company in Pennsylvania is sourcing MN-Clearwater for its sprouted grain Kernza cracker and restaurants, brewers, distillers and bakers across the country have been incorporating it into their menus. Grain and flour samples for product research and development have been and will continue to be shipped to interested companies of all sizes. Shipments have been sent across the state, country and even overseas.

Markets are poised to grow as grain becomes more available and the supply chains improve. Notably, Kernza growers are in the process of formulating a market structure, such as a co-op, that will provide economic, technical and research support for farmers currently or considering growing Kernza.



TIMELINE

2020–25 AND BEYOND

- Agroecology research to continuously improve agronomic production practices and track long-term impacts of this new crop on the environment.
- Breeding work to expedite IWG's domestication timeline using cutting-edge genomic tools that will lead to development of new varieties with improved grain yield.
- Food science research to analyze food quality applications, characteristics and benefits.
- Work with growers and communities to strategically site new acres of IWG in vulnerable source water and drinking water areas to protect water.
- Engage with food and beverage companies to foster product research and development and spur demand for IWG produced by Minnesota farmers.