

University of Minnesota Forever Green Initiative

Annual Progress Report to the Legislature

2023 Minn. Laws Chap. 43 Art.1 Sec. 2 Subd. 4(a)

Per the requirements set forth in Minnesota Statute 3.197, the cost to prepare this report was \$300.

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The Forever Green Initiative received \$802,000 in AGREETT funding in FY24.

Abstract:

The Forever Green Initiative (FGI) at the University of Minnesota is developing and improving winter-hardy annual and perennial crops that protect soil and water while driving new economic opportunities for growers, industry, and communities across Minnesota. By combining these novel crops with traditional annual crops, farmers can keep the soil covered all year round. This approach to farming with “continuous living cover” can greatly enhance the efficiency and sustainability of Minnesota agriculture. Uniquely, FGI combines basic research with crop commercialization efforts, so that it can be profitable for farmers to produce these crops across rural Minnesota. This comprehensive approach moves new crops out of the lab and onto the landscape, where they can make a difference for farmers, the environment, industry, and society. The FGI portfolio includes over 15 crops (Figure 1), each supported by a multidisciplinary team that may include expertise in the areas of genomics, breeding, agronomics, natural resource sciences, food science, sociology, economics, and commercialization. The AGREETT funding from the Legislature provides long-term stability for key FGI personnel, including crop breeders and staff leadership. In this first year of funding, we have identified the individuals whose salaries will be covered, reprogrammed their remaining salary funds to support their research programs, and made progress against key objectives. All AGREETT funds were provided directly to FGI; none were used for finance or other UMN administrative costs. However, two of the personnel covered by this funding, Hunter and Cureton, have administrative duties directly related to Forever Green operations, such as budgeting, project management, and grant program administration.

Forever Green Initiative Crop Portfolio



Perennial Crops

- Kernza®
- Perennial wheat
- Perennial oats
- Perennial cereal rye
- Perennial flax
- Silphium/silflower
- Perennial sunflower
- Alfalfa
- Kura clover
- Native polyculture
- grassland mixtures

Winter Annuals

- Winter camelina
- Pennycress
- Winter barley
- Winter & spring field pea
- Winter hybrid rye
- Winter durum
- Hairy vetch

Native Woody Crops

- Hazelnuts
- Elderberry
- Shrub willow
- Agroforestry

Figure 1. The Forever Green Initiative crop portfolio.

Objectives and Accomplishments:

Note: Due to the contracting process with MDA, funds were secured on December 1, 2023, with some retroactively applied back to October 9, 2023. Therefore, accomplishments during this reporting period are minimal.

1. **Advance perennial grain breeding and crop development.** Funds have been allocated to support the salary of Dr. Prabin Bajgain, lead breeder on Kernza® intermediate wheatgrass (*Thinopyrum intermedium*), perennial cereal rye, and other perennial cereal crops, which protect soil and water quality while providing highly nutritious grains as well as livestock forage. Existing salary funds were reprogrammed to support research technicians; purchase field and laboratory supplies and equipment; genotype the Kernza® breeding population, and pay for greenhouse space and land rental to accommodate increasing population sizes. Since October 9, 2023, Dr. Bajgain has acquired approximately \$377,000 in funding to support research and breeding of perennial grains, presented at two invited meetings/conferences, published one peer-reviewed article (two in review), and is mentoring one undergraduate student under the University of Minnesota's Undergraduate Research Opportunities Program (UROP) project on nitrogen use efficiency of Kernza.

2. **Advance winter oilseed breeding and crop development.** Funds have been allocated to support the salary of Dr. Julia Zhang, lead breeder on domesticated pennycress (*Thlaspi arvense*), a novel winter oilseed crop for Minnesota that can protect the soil while providing feedstock for low-carbon fuel and high-protein meal for animal feed. Existing salary funds were reprogrammed to support a laboratory technician, undergraduate labor, a graduate student assistantship, and field/greenhouse/DNA marker laboratory breeding activities. Since October 9, 2023, Dr. Zhang has worked with the public & industry partners to devise pennycress research & commercialization strategies; served in the Executive Leadership Team of a pennycress CAP grant - IPREFER; presented research results in ASA, PAG and a symposium on Nitrogen Management and Environmental Impacts in Winter Oilseed Cropping Systems; developed 4 grants as PI or Co-PI, and so far two (1-PI; and 1-coPI) were funded; led the field and molecular breeding activities; collected fall season data in the yield trials grown in MN and ND; selected and advanced breeding populations in the greenhouse using DNA markers generated in the marker lab; created new breeding crosses; trained and supervised full-time technicians and undergraduate students; recruited technician, postdoc and graduate student candidates.

3. **Advance winter and spring pea breeding and crop development.** Funds have been allocated to support the salary of Dr. Steve Mulkey, lead breeder on winter and spring pea, a key ingredient for the emerging plant-based protein market that also improves soil fertility and can cover the soil over the winter. Existing salary funds were reprogrammed to support a graduate student, a research technician and undergraduate labor, as well as to acquire needed equipment. Since October 9, 2023, Dr. Mulkey has overseen field trials to evaluate and advance over 500 winter pea breeding lines at multiple stages in the breeding cycle; generated over 120 new crosses for winter and spring pea germplasm; and received approval for two FGI grants; one as the principal investigator examining the mechanisms that lead to variation in protein content and quality in peas (a potential obstacle to their uptake in the burgeoning plant protein industry), and the second as a Co-Investigator examining methods of optimizing establishment and phenotyping of multiple crop species.

4. **Advance hybrid hazelnut breeding and crop development.** Funds have been allocated to support the salary of Dr. Lois Braun, lead breeder on hybrid hazelnuts, a high-value agroforestry crop that provides delicious nuts as well as wildlife habitat, carbon sequestration, and water quality benefits. Existing salary funds were reprogrammed to support a research technician and undergraduate labor. Since October 9, 2023, Dr. Braun has written two FGI grant proposals, of which one, for the hazelnut breeding program, was selected for funding; written the annual grant reports for the multi-state Upper Midwest Hazelnut Development Initiative's USDA-NIFA Specialty Crop Research

Initiative (SCRI) grant and co-written a pre-proposal for a new SCRI grant; helped plan the 2024 Upper Midwest Hazelnut Development Initiative conference; made revisions on a paper on N fertilization of hazelnuts, which has been accepted for publication; and started evaluating 2023 nut yield data and planning for the 2024 field season.

5. **Enhance FGI's management capacity and prepare for leadership transition.** Funds have been allocated to support the salary of Dr. Mitch Hunter, FGI Associate Director. Dr. Hunter is providing necessary additional management capacity for this rapidly growing program, with responsibility for: supporting the crop research teams, overseeing the FGI grant program, budgeting, strategic planning, communications, and strategic partnerships. Dr. Hunter is also preparing for the impending leadership transition—when Co-Directors Dr. Don Wyse and Dr. Nick Jordan retire—by developing a new FGI Executive Committee that includes elected faculty members, to develop new faculty leaders and institute more representative governance. Existing salary funds were reprogrammed to support FGI priorities, including extending the term of employment of FGI Commercialization Team staff. Since October 9, 2023, Dr. Hunter has secured a major grant from the Cargill Foundation (\$2,500,000 over five years); overseen review panels and final funding decisions for the 2023 FGI Grant Program; launched a strategic planning process with professional consultants, and co-led a symposium on Nitrogen Management and Environmental Impacts in Winter Oilseed Cropping Systems.
6. **Advance the commercialization, adoption, and scaling of FGI crops.** Funds have been allocated to support the salary of Colin Cureton, MS, FGI Director of Commercialization, Adoption, and Scaling. Cureton provides management, strategy, and operational leadership in bridging new perennial and winter annual crops to the wide range of stakeholders involved in advancing their success on the landscape and in the market. Cureton also provides program leadership for FGI, serving on the leadership team and the Executive Committee, and informing overall strategy. Since October 9, 2023, Cureton has supported development of a multi-million dollar research, commercialization, and scaling partnership with a major MN-based processor, represented UMN Forever Green in MBOLD coalition communications, supported reorientation of Kernza market actors to current market conditions, participated in State working group for a low-carbon fuels standard, expanded de-risking of grower adoption from Kernza to three winter annuals, and continued to manage a 4 FTE commercialization team spanning diverse activities on new perennial and winter annual crops.