Alfalfa
A PERENNIAL PROTEIN CROP FOR PROTECTING THE ENVIRONMENT

Overview

Alfalfa is the third most widely grown crop in the U.S. with a direct annual value of over $9 billion. It is the main forage crop for meat and milk production systems worldwide grown on about 80 million acres and generating approximately $30 billion annually. Alfalfa is oftentimes referred to as the ‘Queen of the Forages’ due to its wide adaptation, nutritional content, and perennial nature. As a result of these important attributes, alfalfa can be an important crop in a growers rotation that aids in the protection of water and soil resources, enhances soil fertility, and sequesters soil carbon.

What may be surprising to some is that alfalfa produces more total protein per acre than any other crop while requiring no synthetic nitrogen input. This is important for many reasons, including reducing input requirements for growers and the strong market demand for novel plant proteins for new consumer food and animal feed products. UMN Forever Green crop and food science researchers believe alfalfa has great potential to provide another source of protein for human consumption and feed for non-ruminant animals such as fish and crustaceans.

Researchers are developing new crop breeding technologies, including genomic prediction, gene editing, computer vision, and artificial intelligence to develop alfalfa varieties that produce more from each acre planted (especially in low fertility soils); deliver more energy to animals, reduce waste and potential water pollution; and increase longevity of soil cover in winter and spring by improving cold tolerance. Optimized cropping systems, including alfalfa in rotation with annual crops, can significantly reduce soil erosion and increase carbon storage, thus protecting water quality, improving soil quality, fertility and lengthening the period of continuous living soil cover.

MORE INFORMATION:
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Research Status and Goals
Investments made in faculty, post-doctoral researchers, graduate students, technicians, undergraduate employees, and site support:

ARTIFICIAL INTELLIGENCE, BREEDING AND AGRONOMICS

Activities: UMN researchers will be prioritizing the identification of germplasm to breed for improved and/or optimized traits, including enhanced protein and oil concentration and quality for conventional and alternative uses; extreme-cold tolerance/winter survival/frost tolerance to increase winter and spring soil coverage and more reliable yields; higher biomass yield, improved nitrogen fixation, wet soil tolerance, and cultivation with grasses. as well as develop germplasm for low phosphorus (P) fertility and to reclaim P from manured soils.

The agronomic team will focus on working with growers through research and on-farm trials that research optimal cropping systems that include alfalfa. These systems will be evaluated for their ability to minimize greenhouse gas emissions, increasing soil carbon sequestration and maximizing farmers profitability. Additionally, the research teams will provide best management practice recommendations to spur farmer adoption and increase alfalfa acreage in Minnesota.

Outcomes: Novel germplasm and new alfalfa varieties with optimized cropping systems will enable growers to achieve better benefits and higher profitability in conventional and new cropping systems. Products will include improved varieties, guidelines for production, and scientific reports on cultivars and agronomic strategies.

COMMERCIALIZATION PLAN

Develop new breeding methods and improved germplasm for the alfalfa industry, optimize cropping systems, and empower the creation of new value-added products that increase profits for producers and improve environmental conservation through use of perennials on the landscape. As a next generation protein crop, UMN researchers will be identifying end-users in various market channels, including human food, animal feed and plant based protein sectors to engage in early stage pilot projects and product research and development.

Ongoing Studies

1. Root type selection developed stable lines with highly-branched roots and stress tolerant taproots that will be combined with nitrogen fixation and nitrate uptake traits for specific applications on the landscape.

2. Selection for stem cell wall digestibility resulted in lines with improved digestion by ruminants. Comparisons of digestibility between genetically modified lines and selected lines are underway. Stacking of the selected lines with genetically modified lines will be explored to increase digestible biomass yield and animal performance.

3. New breeding methods using computer vision and the Microsoft FarmBeats artificial intelligence (AI) platform are being testing for accurate real-time live phenotyping for cold-tolerance, canopy structure, disease resistance, winter and spring soil coverage, and to increase yield.

4. Testing of wet processing and leaf-stem separations of nonlodging alfalfa for high protein feed and food products.

5. Genomic markers for disease resistance to increase stand life and forage yield.