Breeding Alfalfa for Intercropping with Intermediate Wheatgrass: Towards Perennial Grain-Forage Systems

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Alfalfa is the fourth most widely planted crop and the most widely grown forage crop in the US. However, the acreage planted to alfalfa, alfalfa-grass mixtures, and other perennial hay crops have continually declined in past decades. New market opportunities are emerging that have potential to improve alfalfa and forage profitability. Intermediate wheatgrass (IWG) is a perennial cool-season forage grass that is being domesticated for use as the nation's first commercially available perennial grain crop. Intercropping alfalfa with perennial grain crops like intermediate wheatgrass is a novel use for alfalfa with the potential to enhance forage and grain yields, limit nitrogen fertilizer inputs required for IWG grain production, and provide economic benefits to farmers.

Many unanswered questions remain regarding alfalfa management in dual-use perennial grain and forage cropping systems. This project focuses on major agronomic and breeding questions that must be addressed prior to widespread adoption of the system. The research and extension efforts will help alfalfa growers and the alfalfa industry determine the potential of alfalfa-IWG intercropping and improve management and germplasm to enhance system productivity. The primary goal of this project is perennial grain-forage system optimization by improving alfalfa genetics and fertility management in an alfalfa-IWG system. The primary project objectives are to: 1) Evaluate and select alfalfa populations for optimal performance in alfalfa-intermediate wheatgrass cropping systems; 2) Identify the optimal nitrogen application rate for production of grain and forage in alfalfa-intermediate wheatgrass cropping systems; 3) Support producers to incorporate perennial grain-forage intercropping on their farms by sharing research results and best practices, and creating opportunities for peer-to-peer learning.

The project was initiated in Fall 2021. Alfalfa plants were selected from a previous alfalfa-IWG intercropping experiment planted in Kansas, Minnesota, and Wisconsin and are currently undergoing seed increase along with the original base populations. Also in Fall 2021, an experiment was initiated in Fall 2021 to determine optimal nitrogen fertilization rates in alfalfa-IWG intercropping. The experiment was planted in Kansas, Minnesota, New York, and Wisconsin, with treatments including:

- Each species (alfalfa and IWG) planted **alone or as an intercrop**
- Alfalfa **varieties** (three varieties with fall dormancy rating between 3 and 5)
- Nitrogen **fertilization rates** (five rates: 0, 40, 80, 120, and 160 kg N per ha)

Planned data collection includes fall stand count, winter survival, grain and forage yields, and grain and forage quality parameters.