Developing Alfalfa for Intercropping with Intermediate Wheatgrass

To*wards Perennial Grain-Forage Systems*

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Abstract

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, initiated in Fall 2021, 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.

Table 1. Project Timeline

	2021	2022	2023	2024
N-rate study	Protocol development, planting in KS, MN, NY, WI	Year 1 data collection & analysis	Year 2 data collection & analysis	Year 3 data collection, analysis, publication
Alfalfa selection	Alfalfa selection & seed increase	Seed increase	Protocol development, planting in KS, NY, WI	Data collection, analysis, publication, variety release
Extension	Hiring	Farmer & industry interviews, field days	Field days; fact sheet, webinar, and video development	Field days; publication and dissemination of materials

Identifying optimal **nitrogen rate** for alfalfa-IWG intercropping systems

In Fall 2021, an experiment was initiated to determine optimal nitrogen fertilization rates in alfalfa-IWG intercropping. The experiment was planted as an incomplete factorial in **four locations:**

- Kansas
- Minnesota
- New York
- Wisconsin

Factors (see Table 2) include:

- Alfalfa variety
- Nitrogen fertilization rate
- Cropping system

Planned data collection includes:

- Fall stand count
- Winter survival
- Grain and forage yield
- Grain and forage quality

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Table 2. N rate trial treatments

Factor	Levels
Alfalfa variety	1. Fall Dormancy 3 variety 2. Fall Dormancy 4 variety 3. Fall Dormancy 5 variety
Nitrogen fertilization (kg N per ha)	1. 0 2. 40 3. 80 4. 120 5. 160
Cropping system	1. Alfalfa monoculture 2. IWG monoculture 3. Alfalfa-IWG intercrop

Breeding alfalfa for intercropping with IWG

In 2021, alfalfa plants were selected from a previous alfalfa-IWG intercropping experiment planted in **three locations:**

- Kansas
- Minnesota
- Wisconsin

96 plants were selected from each location based on survival and plant vigor:

8 varieties * 4 reps/variety * 3 plants/rep = 96 plants

The base populations and the populations selected from each location are currently undergoing seed increase. We anticipate planting these populations in an alfalfa-IWG intercropping trial in 2023.

Left: N rate trial in Arlington, WI, Oct. 2021 (Photo courtesy of Valentin Picasso/Ed Bures).

Right: Alfalfa seed increase (Photo courtesy of Jamie Crawford).

Extension needs for alfalfa-IWG intercropping systems

To determine extension needs for alfalfa-IWG intercropping systems, we are conducting a **stakeholder needs assessment.** This assessment includes ongoing farmer and stakeholder interviews and planned presentations, facilitated discussions, and surveys in conjunction with 2022 field days held in the collaborators' regions.

Pending the results of the needs assessment, we plan to produce a range of **extension outputs** including:

- Fact sheets
- Webinar
- Informational video