United States Department of Agriculture

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# 2021 Annual Progress Report of Activities

## Introduction

*Figure 1: A summer cover crop trial at the GBPMC*

The Great Basin Plant Materials Center (GBPMC) is one of 25 Plant Materials Centers (PMC) operated by the United States Department of Agriculture-Natural Resources Conservation Service (NRCS). Each center is strategically located in an ecologically distinct area, creating a network of PMCs uniquely positioned to address local, regional, and national natural resource concerns. Our objective is to evaluate plants and vegetative technologies to support NRCS conservation programs and practices. The GBPMC is specifically tasked with resource concerns in the Great Basin, with a focus on rangeland restoration, soil health, and water conservation.

The GBPMC opened in 2006 and is the newest PMC in the nation. We are located in a cold desert in the rain shadow of the Sierra Nevada mountains where we receive a mean of 4.9 inches of annual precipitation, mostly in the winter. We manage 79 flood irrigated acres, 3 non-irrigated acres, and we conduct off-center field trials as needed.

This report highlights the activities of the GBPMC in fiscal year 2021. For more detailed information, please contact Christopher Bernau at 775-423-7957 ext. 4, or email at Christopher.Bernau@usda.gov.

### Technology Development Studies

#### Advanced line trial of Crimson Clover, Hairy Vetch, and Austrian Winter Pea: Year 2

The advanced line trial (ALT) of crimson clover, hairy vetch, and Austrian winter pea study is part of a national collaborative cover crop breeding network (see covercropbreeding.com). This project is directed by North Carolina State University, USDA's Agricultural Research Service (ARS), and other partners across the USA, including the GBPMC and several other PMCs. The objective is to evaluate legume cover crop germplasm selections in several geographic locations, and to advance superior performing cover crops to subsequent evaluations. The goal is to breed superior legume cover crops with a broad range of adaptation.

The ALT trial was planted on the GBPMC in October 2019 and again in 2020. Variables for both years include: percent stand establishment at 30 days after planting, percent spring stand establishment, end of season height, end of season biomass, and plant vigor. The data was submitted to the cover crop breeding program, and regional publications and information on germplasm performance can be found at covercropbreeding.com/publications. Superior performing genetic lines were conserved for an October 2021 planting, but we were unable to participate due to a lack of available irrigation water.

*Figure 2: Austrian winter pea seedlings*

We found crimson clover to be the weakest performer at our location, with poor emergence and almost no winter survival for any tested germplasm. Data for hairy vetch and Austrian winter pea germplasms was too variable to make any general statements.

## Thickspike Wheatgrass and Basin Wildrye Rangeland Adaptation Trial

*Figure 3: The thickspike wheatgrass and basin wildrye rangeland adaptation trial*

The thickspike wheatgrass (*Elymus lanceolatus*) and basin wildrye (*Leymus cinereus*) rangeland adaptation trial is a study done with the cooperation of the Agricultural Research Service (ARS). It was planted in October 2020 in a grazing enclosure maintained by the ARS in the northern end of Edwards Creek Valley, NV; 68 miles east of the GBPMC. The site is dominated by silt loam soils, received an average of 7.3 inches a year for the past thirteen years, and is typical of a lower elevation sagebrush steppe. The study includes five releases of thickspike wheatgrass ('Bannock', 'Bannock II', 'Critana', 'Schwendimar', and 'Sodar'), five releases of basin wildrye ('Continental', 'Magnar', 'Trailhead', 'Trailhead II', and Tetra germplasm), and two non-native plants occasionally included in rangeland plantings; 'Vavilov II' Siberian wheatgrass (*Agropyron fagile*) and 'Snowstorm' forage kochia (*Bassia prostrata*). The objective is to identify releases that may be useful in conservation of these sites.

We found that by spring all native plants produced less than one seedling per foot. 'Trailhead' and Tetra germplasm produced the largest number of seedlings for basin wildrye, and 'Sodar' and 'Schwendimar' produced the most for thickspike wheatgrass. 'Snowstorm' forage kochia had zero seedlings in any plot, and 'Vavilov II' Siberian wheatgrass had 5.85 seedlings per foot. First year plant establishment has not been collected yet, but early signs suggest survival may be limited. The study location received a fraction of its annual rainfall (5.6 inches), and the Mormon cricket (*Anabrus simplex*), an agricultural pest notorious for its voracious appetite, had high density swarms on site. The site will be monitored for establishment and survival for another year, and this study will be repeated adjacent to the first location in October 2021.

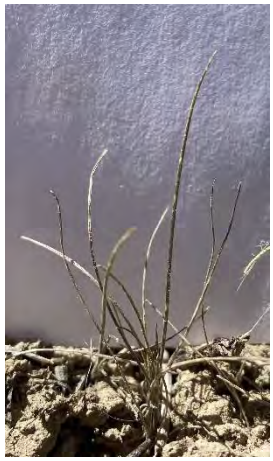

*Figure 4: A Siberian wheatgrass seedling.*

**Fava Bean Seeding Date Trial**

Fava bean (*Vicia faba*) is an annual legume that produces ample biomass, is frost tolerant, and ranks high in nitrogen fixation. The fava bean seeding date trial was designed to determine the best time to plant fava beans in northern Nevada. Planting time is important as fava beans can increase their frost tolerance if exposed to mild freezing temperatures in the first few weeks after planting. If you plant fava beans too early, they will be too mature when winter hits and have lower frost survival. If planted too late, they would be exposed to plenty of freezing temperatures but will not be mature enough to survive the winter.

*Figure 5: The fava bean seed timing trial*

To determine an optimum seeding date, we planted fava beans on October 8th, then again every two weeks till November 19th. It was a dry summer and irrigation was late, so our effective start date for the first planting was October 13th. Emergence was collected at 30 and 60 days after planting.

We had good emergence with the first planting, poor with the second, and none in the third and fourth. These results complimented previous years' findings, which had excellent emergence when planted on October 5th, and poor emergence when planted October 18th. This suggests that the first two weeks of October are the latest you would want to plant fava beans in Northern Nevada. Additional evaluation is needed to evaluate earlier planting dates.

This study was part of a larger fava bean collaborative effort with several other PMCs, Chico State, the ARS, and others. The results of the collaborative effort were published in Brasier et al. 2021. "A multi-environment analysis of winter faba bean germplasm for cover crop traits".

## Green Wheatgrass Filter Strip Demonstration

In October 2020 we planted a green wheatgrass (*Elymus hoffmannii*) filterstrip demonstration in collaboration with University of Nevada Reno Extension professor Dr. Maninder Walia. 'AC Saltlander' and 'Newhy' green wheatgrass were planted in alternating strips through salt-affected soils. The salts in these soils are highly variable, with pockets of low and high concentration, and even sodic conditions, all in the same field. Strips of vegetation in this field provide an interesting visual on salt adaptation. The objective was to provide a demonstration allowing producers to inspect establishment, height, and weed control of the two wheatgrasses through that dynamic soil. Unfortunately, site visits were canceled this year. There are tentative plans to repeat this demonstration in 2023.

*Figure 6: The Green Wheatgrass Filter Strip Demonstration.*

## Summer Millet, Sunn Hemp, and Cow Pea Cover Crop Trial

Millets (multiple species), sunn hemp (*Crotalaria juncea*), and cow peas (*Vigna unguiculata*) are staples in the cover crop tool box. Millets are used for rapid biomass production and nutrient capture, sunn hemp has rapid biomass production and fixes nitrogen, and cow peas fix nitrogen while being one of the most heat tolerant crops available. All three are fairly drought tolerant, which makes them important for drought prone landscapes like Nevada. In 2021 the majority of Nevada was listed by the U.S. Drought Monitor as in extreme drought or worse, annual precipitation was well below average for the second year in a row, and the reservoir from which we get our irrigation was forecasted to run out of water before the end of the growing season. With that in mind, this study was designed to evaluate the performance of these species under water stress. We evaluated eight varieties of millet (five species), one variety of sunn hemp, and three varieties of cowpea (Table 1). One irrigation was applied during seed bed preparation, and two irrigations were applied after planting (20 and 35 days after planting (DAP)).

*Figure 7: Thirty (top), sixty (Middle), and ninety (bottom) days after planting photos of the summer cover crop trial.*

*Table 1: Results from the summer cover crop trial.*

| Species | Variety | Emergence[1] | Percent of Plots Reaching 50% Bloom | DAP to 50% Bloom[2] | Biomass[3] (Dry lb/a) |
|---|---|---|---|---|---|
| Cowpea *(Vigna unguiculata)* | Chinese Red | Excellent | 0% | - | 1,454 |
| Cowpea *(Vigna unguiculata)* | Iron and Clay | Excellent | 0% | - | 2,391 |
| Cowpea *(Vigna unguiculata)* | Red Ripper | Good | 0% | - | 1,169 |
| Sunn Hemp *(Crotalaria juncea)* | Tropic Sun | Good | 25% | 81 | 4,229 |
| Browntop Millet *(Urochloa ramosum)* | Browntop | Excellent | 100% | 59 | 9,279 |
| Japanese Millet *(Echinochloa esculenta)* | Japanese | Excellent | 25% | 81 | 6,450 |
| Proso Millet *(Panicum miliaceum)* | Dove | Excellent | 75% | 59 | 9,957 |
| Proso Millet *(Panicum miliaceum)* | White | Excellent | 100% | 38 | 4,853 |
| Foxtail Millet *(Setaria italica)* | German | Excellent | 25% | 81 | 7,450 |
| Foxtail Millet *(Setaria italica)* | White Wonder | Excellent | 75% | 59 | 9,466 |
| Pearl Millet *(Pennisetum glaucum)* | Leafy 22 Hybrid | Excellent | 0% | - | 9,332 |
| Pearl Millet *(Pennisetum glaucum)* | Tifleaf 3 Hybrid | Excellent | 0% | - | 8,235 |

[1]Excellent = >90% emergence by 7 DAP; Good =70-90% emergence by 7 DAP
[2]DAP (Days After Planting) when the first plot, out of four replications, reached 50% bloom
[3]Biomass collected at 50% bloom, or at 90 DAP if the plot never reached 50% bloom.

Data collected was emergence at 7 and 14 DAP, DAP to 50% bloom, and biomass at 50% bloom or at 90 DAP if the plot didn't reach 50% bloom. All varieties evaluated had rapid emergence, with full emergence by 14 DAP. The cowpeas never reached 50% bloom and had limited biomass production, while a single sunn hemp plot reached 50% bloom. Neither cowpea nor sunn hemp controlled weeds very effectively, with cowpea performance likely compromised due to weed pressure. Millet performance varied by species, with four species producing above 9000 lb/a.

The 50% bloom date for millet varied considerably. This has implications for termination strategies. Varieties that never reached 50% bloom ('Leafy 22' and 'Tifleaf 3') may be terminated by frost in the winter, while the other varieties should be terminated at the 50% bloom date. Mowing would likely be an effective termination strategy. A few millet species are known to resprout after mowing, but the drought stress may be sufficient in preventing resprouting.

These findings are preliminary. We will be replicating this study again in 2022. This study is also part of a larger study that includes the California and Arizona PMCs. We also collaborated with

Heather Emmons, our state public affairs officer, to put together a digital walking tour of this study. The tour is titled, "Evaluating the Adaptation of Summer Cover Crops in Northern Nevada," and can be found on the Nevada NRCS YouTube channel.

## Indian Ricegrass Development

*Figure 8: Two accessions with pollination bags for seed collection. Left is a short form and right is a tall form.*

We continued our work evaluating twelve Indian ricegrass (*Achnatherum hymenoides*) accessions for a potential pre-varietal release. In previous years we collected seed from the field, germinated those seeds, and established plants in drip irrigated row fabric. Those row fabric plants survived the first growing season and produced seed in 2021. Indian ricegrass typically does not cross pollinate; however, they can cross pollinate when specific climatic requirements are met. Thus each collected inflorescence was bagged in a pollination bag before anthesis as an added precaution to prevent cross pollination. These bags were collected, and the seeds cleaned and weighed. Seed weights varied by accession and ranged from 119,871 to 216,305 seeds per pound. This fresh batch of seeds will be the focus of our evaluation. The next step is to scarify, cold stratify, and germinate the seeds over the summer before they are transferred into row fabric in October 2022.

We observed variations in ricegrass height in this first planting (Fig 8). By the end of April some accessions averaged 7-8 inches while the taller accessions averaged over 12 inches. The shorter accessions produced a fraction of the seeds as the taller accessions, which may have implications when growing Indian ricegrass for commercial production.

In addition, we collaborated with Heather Emmons, the Nevada Public Affairs Specialist, to create two Indian ricegrass videos for this project. Seed Options for Indian Ricegrass Part 1 presents six commercial releases, their adaptations, and strategies for their use. Seed Options for Indian Ricegrass Part 2: Searching for a 7th release discusses the process we are going through to evaluate these accessions for a potential public release. Both videos are available on the Nevada NRCS YouTube channel.

## Outreach

The GBPMC participated in several events in 2021. In May, we participated in a fava bean virtual field day. The event was attended by 64 people and included speakers from Chico state, the California PMC, and the GBPMC. We combined our fava bean seeding date data with California and presented on planting strategies.

In June we participated in the employee training, “Working Effectively with Organic Producers.” This training was available nationwide and attended by 25 staff. We presented on the benefits of cover crops, mix strategies, and termination methods.

In August we hosted a “Nevada PMC 101” training for all Nevada NRCS staff. The objective of this training was to cover the basics of the Plant Materials Program and the PMCs in the area. It was meant to be a refresher course for existing staff and an introduction to our program for all new staff. Guest speakers included Margaret Smither-Kopperl, Derek Tilley, Eninka Mndolwa, and Heather Dial.


*Figure 9: A screenshot from the Nevada PMC 101 training.*

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