Calendar Year 2024 - Activity Report

USDA Agricultural Research Service
Western Regional Plant Introduction Station (WRPIS)
aka Plant Germplasm Introduction and Testing Research Unit (PGITRU)
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EXECUTIVE SUMMARY

The Western Regional Plant Introduction Station (WRPIS) is one of four regional plant introduction stations in the United States. Activities at WRPIS focus on acquisition, preservation, characterization, evaluation, documentation and distribution of assigned plant genetic resources and their associated information along with conducting mission-related research. This Station includes five curatorial programs and two research programs (alfalfa genetics and genomics for genebank activities). The operation is primarily funded by two CRIS projects [one in National Program (NP) 301 and one in NP 215] managed through the USDA ARS Plant Germplasm Introduction and Testing Research Unit (PGITRU), on the Washington State University (WSU) campus in Pullman, WA. The Temperate-adapted Forage Legume (TFL) Germplasm collections and the Alfalfa Genetics Research projects are on an ARS worksite in Prosser, WA co-located with the WSU Irrigated Agriculture Research and Extension Center (IAREC). The W6 Regional Multistate Research Project associated with the Station also contributes considerable funding (~14% of the total operating budget) to support its mission. The Hatch Multistate Research Funds (MRF) are managed regionally by the State Agricultural Experiment Station (SAES) and originate and are overseen by the USDA National Institute for Food and Agriculture (NIFA). The W6 funds cover the salary and fringe benefits for six full-time state employees working for the WRPIS as well as partial land costs, supplies/equipment and farm operations for regenerations, characterization, evaluation, and enhancement research. Goals are achieved through close collaboration among scientists with diverse expertise in fields like agronomy, horticulture, plant pathology, genetics, plant physiology and botany. The W6 project is implemented in close association and collaboration with scientists of SAES, other state and federal agencies as well as the private sector. The station's scientists also actively collaborate with colleagues at international centers, universities, and non-governmental organizations. Guidance for the complimentary project implementation comes from USDA National Programs and the Pacific West Area Office as well as from the W6 Regional Technical Advisory Committee (RTAC). The global crop plant research community continued to utilize extensively WRPIS germplasm collections. In 2024, 24,010 packets of seed samples and/or clonal propagules in 886 orders were processed and sent to 48 of 50 U.S. states and Puerto Rico, and to 38 countries. WRPIS scientists also made poster and/or oral presentations at various regional, national, and international conferences and participated in 17 peer-reviewed research and book chapter publications.

Highlights during the 2024 Calendar Year

- There are 102,127 accessions belonging to 997 genera, 4,616 species (5,268 taxa) in the WRPIS collection. W6 has 16% of the active NPGS accessions.
- We acquired 101 ex-PVP cultivars, including 3 beans, 88 grasses, 4 lettuce, 4 peas, and 2 safflowers. We also acquired 4 *Distichlis spicata* grass accessions, and an additional 356 native plant accessions collected by the Seeds of Success (SOS) project.
- W6 distributed a total of 24,010 packets of seed samples and/or clonal propagules in 886 orders to requestors, a decrease of almost 1/3 from last year (39,212). These included shipments to 38 foreign countries (representing 60% of the distributions) and 48 U.S. states and Puerto Rico. 6,209 of these items went to 12 of the 13 western states (none to Alaska). There was a larger decrease in number of items shipped within the U.S. than internationally.

- W6 uploaded 4,691 observation data points for 405 accessions and 1,302 images for 1,219 accessions into the Germplasm Resources Information Network (GRIN)-Global database.
- W6 entered 3,582 seed viability records into GRIN-Global during the reporting period. The National Laboratory for Genetic Resource Preservation (NLGRP) in Fort Collins, CO tested 2,946 accessions and 636 were tested by our germination lab**.**
- W6 shipped 1,974 seed inventories to the National Laboratory for Genetic Resource Preservation (NLGRP), Fort Collins, CO. As of April 22, 2025: 77% of the W6 Germplasm collection is available to distribute and 80% of the W6 germplasm collection has a back-up inventory.
- We began operations at the new Tukey research farm field space to replace space lost to the Pullman-Moscow Airport expansions a few years ago. The site is already being used for regenerations of accessions in the horticultural and agronomy programs in 2025.
- We created 2-page fact sheets for all programs and one for the Unit. The documents are easy to digest with infographics summarizing programs objectives and accomplishments.
- With the Agricultural Genetic Resources Preservation Research in Fort Collins, CO we created five videos explaining the WRPIS and our activities, including one featuring the 5 curatorial programs; an additional one for the Phaseolus program; seed cleaning; seed distribution and storage; and seed viability testing. Please click on the links to view each video.
- The Phaseolus program won an ARSX $100,000 prize to collaboratively, with SeedLinked and other genebank locations, run a community science project with ~1,000 volunteer growers characterizing germplasm across the US. They also collected wild germplasm in southwestern US to fill a geographic gap in the germplasm collection. Wild beans collected during this trip include *P. acutifolius* (18), *P. angustissimus* (1), *P. filiformis* (1), *P. grayanus* (2), *P. maculatus* (3), and *P. monatanus* (3), which will be added to the permanent collections as they are regenerated.
- In 2024 the TFL/Alfalfa Genetics programs hosted the North American Alfalfa Improvement Conference, Trifolium and Grass Breeders meeting in the Columbia River Basin. Over three days the organizing committee hosted pre- and post- conference meetings and visitors. During the field day, attendees had an opportunity to visit the WRPIS Prosser-based program field research sites.
- Prebreeding efforts continue in the TLF program with efforts focusing on disease resistance screening to spring black stem and leaf spot. Four maternal half-sib populations ranging from low to mid fall dormancy were developed from resistant plants with agronomic potential. These are to be evaluated again for disease resistance in recurrent selection efforts prior to release.
- The Agronomy program is integrating technological solutions for automation, digital record keeping, and phenotyping to better inform the collection for important traits and increase utility. They also genotyped the entire collection of safflower via genotyping by sequencing, and the data available to the public.
- The Seeds of Success program worked on the establishment of Palouse natives to identify candidate species for agronomic evaluations and seed production at scale for increased availability of native seed for restoration projects.
- The Cool Season Food Legume program worked with collaborators to identify markers linked to seed nutritional components (fiber, fat, protein, and minerals) in pea; and protein content in chickpea.

- In addition to the activities maintaining and regenerating seed-producing and clonal germplasm accessions, the Horticultural Crops and Beta program collected new and unique germplasm to add to the collections, including 10 varieties of rhubarb and populations of native *Lactuca* species and other medicinal and ornamental herbs.
- Research into high-throughput phenomics to link to Genome Wide Association Study (GWAS) pipelines to identify markers, genes, and pathways associated with traits of interest has yielded new methodologies to expand phenomics technologies and is being tried first in chickpeas.

Cover Story:

The Phaseolus bean germplasm collection is regenerated in greenhouses in Pullman and Central Ferry, WA. This is done to create clean seed, sheltered from insects that may vector viruses, and because much of our collection is photoperiod sensitive, requiring long nights to flower and set seed, and these long nights are only available during our northern latitude winters. Germplasm with low germination and seedling vigor is pregerminated and transplanted into warm moist pots to increase seedling establishment. Plants are then trellised, and pods are usually hand harvested. This produces high quality seeds of common, lima, and tepary beans when the greenhouse conditions are adequately controlled. Greenhouse production space is limited to 380 bean accessions. This has resulted in a significant backlog of needed regenerations especially for our photoperiod sensitive germplasm. The current collection has 4,847 accessions that are at least 30 years old, or the age is unknown (this is equal to 27% of the total collection). Of these older accessions, 2,713 are putatively photoperiod sensitive, requiring planting during periods of long nights.

ADMINISTRATION

Scot Hulbert (Administrative Advisor)
Christian Tobias /Jessica Shade – (NIFA Representatives)
Neha Kothari (ARS National Program Staff)
Tara McHugh (ARS PWA Area Director)
Marilyn Warburton (ARS Research Leader and Station Coordinator)
Melissa O'Dell (ARS Program Support Assistant)

Calendar year 2024 was a good year to continue to build on our new teams and new projects. With a small number of vacancies this year, we are onboarding new team members and implementing new protocols and protocols and settling into an efficient routine. We are also obtaining grant funding to start new characterization/evaluation and acquisition projects. Both the Pullman and Central Ferry Farm managers have assistants that they are training to take on as new managers, since both managers are eyeing retirement soon. The cool season food legume Curator has also retired, and we hope to replace this position. We are still in a very small lab space in Clark Hall, but construction on the new ARS building that will house our unit in the future is on track for a move in date early in calendar year 2026 (*see photos at the end of the report on progress!*). We continue our operations to deliver on the critical mission of acquiring, conserving, characterizing, evaluating and distributing valuable plant genetic resources and their associated information, and we have now begun to expand work in research to make our core

mission more efficient, and to increase our genetic characterization and phenotypic evaluation efforts.

PERSONNEL

Several personnel changes occurred in both the federal and state-funded projects in CY 2024 and the first few months of 2025. Carla Olson left the Program Support Assistant position and was replaced by Melissa O'Dell. The ARS term Farmer position in Central Ferry is temporarily being filled by Wyatt Keller, whom we were unable to make permanent due to the hiring freeze of federal workers starting early 2025. He has since been hired as a WSU team member covered by W6 funds. The long running vacancy in the Unit's ARS funded IT Specialist position (since 2020) was finally filled by Kehinde Ogundele, who then was lost due to the federal cut of permanent staff in early 2025. The Cool Season Food Legume Curator (ARS, Vice-Coyne) cannot be refilled due to the hiring freeze of federal workers starting early 2025. The Alfalfa Research Geneticist (ARS, Vice-Yu position) was replaced by a Postdoctoral Associate, Garett Heineck. The temporary Phaseolus (bean) Technician Lauren Schutt (ARS) has left, and the position was moved to the WSU W6 funds and is now filled by Gabriela Guerrero Florez. The position being temporarily filled by Scott Mattinson (WSU) was shifted to the permanent ARS position and then lost due to the federal cut of permanent staff in early 2025. The Seeds of Success (SOS) Support Scientist/Horticulturist position, Bailey Hallwachs, was lost due to the federal cut of permanent staff in early 2025. Two part time term positions in ARS (Wayne Olson and Bennie Keller) will be abolished and not refilled in May 2025, due to the federal cut of permanent staff in early 2025. Thus, of 26 ARS staff, 19 remain as ARS, and two are now paid by W6. All 6 previously paid W6 people remain. It is understood that the W6 project may not be able to cover compensation for all 8 people and a more sustainable level of staff will be sought after the possible federal reduction in force has happened, and the budgets understood for both ARS and W6 in FY 2026. At NIFA, personnel have also left, including Christian Tobias, our former liaison. We will now work with Jessica Shade.

PROJECTS

Federal funding for PGITRU (WRPIS), arrives for the project entitled "Genetic Resource and Information Management for Pulse, Temperate Forage Legume, Oilseed, Vegetable, Grasses, Sugar, Ornamental, and Other Crops". The project is relevant to USDA ARS, National Program 301- Plant Genetic Resources, Genomics, and Genetic Improvement and started a new 5-year cycle in 2023. In addition, the USDA ARS Alfalfa Genetics research project conducted at the Prosser worksite is entitled "Enhancing Resistance to Biotic and Abiotic Stresses in Alfalfa". This project is relevant to USDA ARS National Program 215 - Pasture, Forage, and Rangeland Systems. The Alfalfa Genetics project started a new five-year cycle in 2024 when the new plan was approved for implementation.

The current USDA NIFA W6 Regional Multistate Research Project entitled "Management and Utilization of Plant Genetic Resources and Associated Information" completed the third year of its 5-year cycle.

FUNDING

The total federal USDA ARS budget for FY 2025 for the PGITRU was $3,591,153, the same as FY 2024 due to continuing resolutions throughout the year and includes the budgets for the Plant Introduction genebank project ($3,129,654) and Alfalfa Genetics research ($461,499) projects. After indirect costs were assessed, the net balance was $2,903,622 with $2,563,900 dedicated to salaries and the remainder for supplies, equipment, repairs, and extramural agreements. The discretionary dollar amount per SY (7 in the Unit in 2024), an indicator of the financial health of the Unit, was $53,119 for the main budget and $0 for the Alfalfa Genetics research. The main project numbers are an improvement from last year due to several retirements and an attempt to replace the positions at a lower level; these numbers should stay pretty good for a few years until raises and promotions kick in unless funding is increased to compensate. The Alfalfa Genetics project numbers reflect the severe underfunding we currently face. The 'in kind' support from the W6 Western Regional Multistate Research Project, through WSU, was $536,653.

The Agronomy Curator Paul Galewski leads an inter-agency project between ARS and Bureau of Land Management (BLM) focusing on native plants called the SOS program. The project is entitled "Management, Evaluation, Acquisition, and Distribution of Native Plant Germplasm for Research and Restoration" with 2023 funding of $150,000 that covers a full-time Support Scientist/Horticulturist (Bailey Hallwachs) and temporary employees. The BLM collaboration funding also covers some travel and supplies.

A Pulse Crop Health Initiative (PCHI) project with a budget of $91,423 in 2023 is being led by Marilyn Warburton entitled Lentil 2.0: targeted genomic assisted improvement of seed protein concentration and is in its final year of four (2021-2024). A second PCHI project with a budget of $150,000 in 2024 is also being led by Marilyn Warburton and is entitled "ChickpeAI: Deployment of machine learning to develop chickpea with improved nutritional, functional and yield profiles". It is in year 1 of 4 (2024-2028).

The TFL program curator Brian Irish collaborated with the University of California, Davis, Cornell University and USDA ARS Madison, WI on a USDA NIFA Alfalfa Seed Alfalfa Forage System program grant submission as a Co-PI. Team was awarded grant with the TFL program set to receive $148,000 over three years to continue working on prebreeding approaches and seed production and release of collaboratively produced advanced breeding lines in alfalfa.

The TFL program curator Brian Irish was awarded a USDA ARS National Programs Postdoctoral Associate to focus on, "Diversity Estimation, Population Structure, Core Subset Validation and Maker Trait Associations in the USDA NPGS Alfalfa Plant Genetic Resource Collection Using Diversity Array Technology (DArT) Genotyping", with $200,000 over two years for salaries (in limbo). The scientists who had been identified was supposed to start in January 2025 but was not approved due to hiring freeze. We are waiting to hear about hiring now, and the status of these funds.

Sarah Dohle (Co-PI) and Marilyn Warburton (Co-PI) are in year 3 of a 4-year collaboration (2022-2026) on a $3.3M SCRI lima bean (*P. lunatus*) project lead by University of California, Davis, entitled, "Development of Genomic Resources to Improve Lima Bean Breeding for Consumer Quality and Agronomic Traits", which will include genotyping and characterizing the

available lima bean collection >700 accessions, among other activities. A portion of funding supports lima bean regenerations efforts at the genebank.

Sarah Dohle presented the pitch for Crowdsourced Characterizations for Genetic Resources at the ARSX2024 Safeguarding Sources Challenge: The Quest to Sustain Genetic Diversity event in Beltsville, MD and won $100,000 for her team's project plan in FY 2025.

Sarah Dohle is also on a new USDA NIFA grant entitled "Protein-Rich Wholesome Popping Beans to Enhance Agricultural Production, Nutrition, and Sustainability". Grant No.2024-51181-43288. $5,087,410. A portion of the funding supports collaborators phenotyping and genotyping the nuña bean collection which was made available through regenerations and prebreeding at the Pullman genebank. Data and seed for the entire nuña collection (84 accessions) will be uploaded to the GRIN-global database to be available to the public.

FACILITIES

The WRPIS in Pullman currently counts on 34,800 square feet of greenhouse facilities (22,375 sq. ft. Federal, 12,425 sq. ft. WSU), many of which have been recently upgraded and refurbished with new covers, electrical wiring, and switches; cooling pads, pumps, and motors, etc. This activity will continue in 2025. The unit also has access to ~149 acres of farmland (86.2 acres Federal, ~55 acres WSU). An additional new hoop house is being completed now for the SOS project on the Pullman Research Farm. We have finally been able to find land to replace the 28 acres of WSU field space lost to the construction of a new airport runway. WSU has granted WPRIS use of the land that was formerly used by the WSU Horticulture department for orchards, but which can't be used for trees anymore because it is near the airport and attracts birds. The FAA doesn't object to row crops so we can use this new field. We have started to remove trees and will progress as we have time. The flat land, proximity to the current WRPIS farm, and irrigation already in place are very useful. This additional space will allow for rotations between different species and agronomic practices during regenerations. WRPIS staff uses 8 laboratories (5 Federal, 5 WSU), and 20 offices (4 in Federal buildings, 6 in a Federal mobile office building, 10 in WSU buildings). We will have more space when the new USDA building is completed in early 2026 (see update below). The USDA ARS Alfalfa Research Geneticist and the TFL Curator have assigned office, greenhouse, and laboratory spaces at the Prosser worksite in both Federal and WSU facilities on the IAREC campus. However, we will be losing two labs and one office in the WSU Hamilton Hall building and moving to a larger lab and an office in the USDA ARS leased portion of the station, where we will avoid some charged bench fees. This will affect the Alfalfa Genetics program, but not directly the TFL program.

The construction of the new Plant Biosciences building on the WSU campus began in 2023 following the demolition of Johnson Hall. This new building will house USDA and WSU Units/Departments, faculty offices and laboratories. It will house all Pullman-based WRPIS scientific and technical staff and include six modern Unit-shared laboratory spaces. Construction is currently on schedule and should be completed in early 2026, after which WRPIS will occupy new facilities.

In Central Ferry, unfortunately our plans to install geothermal heating in the greenhouses has fallen through, which would have replaced propane heating that can cost several thousand dollars

a month during the winter to heat. We had hoped to save up to $20,000 per year after installation, but this project was cancelled following funding freezes. We may be able to look at installing air-source heat pumps instead, if funding permits in future years.

SERVICE ACTIVITIES

The **Agronomy and Native Plants Program** (Paul Galewski) manages 33,919 accessions of cool season turf and forage grasses, safflower and the native plant accessions collected in recent years by the BLM **SOS** which was coordinated and managed by the Support Scientist/Horticulturist (Bailey Hallwachs). The **Cool Season Food Legumes Program** (Vice-Cone/vacant) curates a total of 22,683 accessions of pea, chickpea, lentil, faba bean, and other legumes. The **Phaseolus/Beans Program** (Sarah Dohle) manages a collection of 17,735 accessions, all belonging to the *Phaseolus* genus. The **Temperate-adapted Forage Legumes Program** (Brian Irish) manages alfalfa, clover, trefoil, and their wild relatives with a total of 13,275 accessions. The **Horticultural Crops Program** (Alex Cornwall) manages 13,758 accessions of sugar beet, lettuce, garlic, and many miscellaneous species that have potential use for ornamental or medicinal purposes.

Acquisitions and transfers

During the 2024 calendar year, we acquired 101 ex-PVP cultivars, including 3 beans, 88 grasses, 4 lettuce, 4 peas, 2 safflowers and 10 heirloom cultivars of rhubarb. We also acquired 4 *Distichlis spicata* grass accessions, and an additional 356 native plant accessions collected by the SOS project.

There are 101,528 accessions belonging to 916 genera, 4,290 species (4,913 taxa) in the WRPIS collection. W6 has 16% of the active NPGS accessions. The total number of accessions held at the end of each calendar year over the previous ten years is shown in **Figure 1**. The main changes in numbers of accessions in the collection are due to the addition of SOS native accessions, many of which are then transferred to other NPGS priority sites, and many more incorporated into active WRPIS collections. The value of these agriculturally important additions to the WRPIS collections continues to grow as international access to germplasm is increasingly limited by the changing political environments.

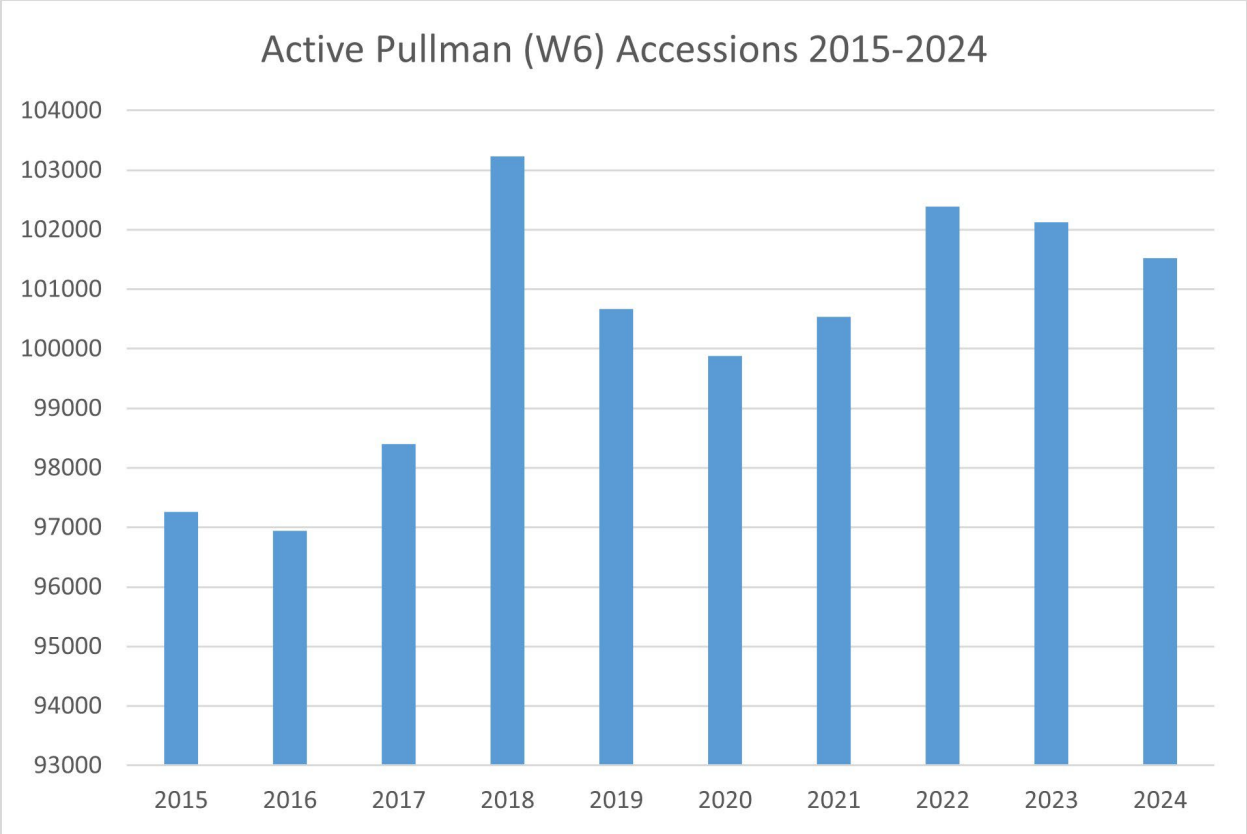


Figure 1. Total number of accessions (vertical axis) managed by WRPIS since 2015.

Conservation

Regeneration Activity: 1,581 packets were filled for regeneration and backup orders for curatorial programs, following the established, labor-intensive procedures and protocols for maintaining the genetic integrity and health of all germplasm collections. These included physical isolation, hand planting and transplanting, controlled hand and insect pollination, hand harvesting, cleaning, and packaging for storage and distribution. This is lower than 2023, partly because we had two Curator vacancies in 2024. As of May 2025, 680 accessions regenerated in 2024 had been stored (either in Pullman seed storage or sent to the NLGRP in Fort Collins, CO for backup). In addition, 865 were stored that had been planted for regeneration in 2022 or 2023 (usually perennial plants that take more than one year to reproduce). Overall, the number of backed up materials has not increased much in the past 12 months. Some newly acquired accessions have not been backed up yet, especially native materials, leading to an actual decrease in the percentage of accessions backed up in that program. The number of accessions that are available for distribution and safely backed up is shown in **Figure 2.** The proportion of unavailable accessions largely results from low seed quantity, but perhaps more systemic causes include low viability, inability to establish plants, or plants do not produce seed in the environments we are located in.

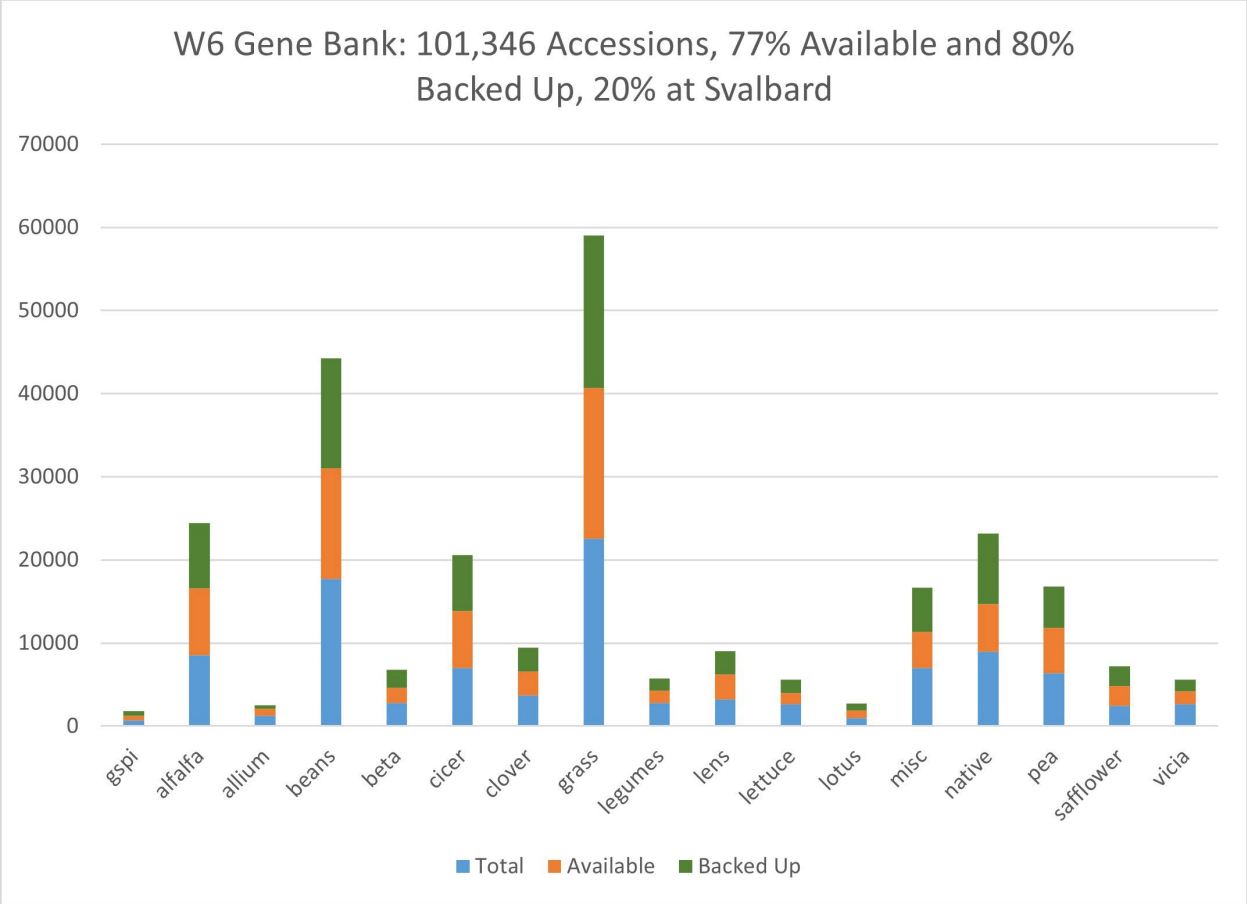


Figure 2: Number of the 101,346 active accessions that are available for distribution (77%) and backed up in Fort Collins, CO at the National Laboratory for Genetic Resources Preservation (NLGRP) (80%), and Svalbard Global Seed Vault (20%).

Characterization/evaluation

We uploaded 4,691 observation data points on 405 unique accessions into the Germplasm Resources Information Network (GRIN)-Global database. These data points are on 29 established descriptors for 3 different crop species. Our collaborators contributed 0% and WRPIS staff provided 100% of the evaluation data. 1,301 images were loaded on 1,219 accessions. 1,228 were of seeds, 47 of flowers, 13 were plants and 13 were "other". In addition, we entered 3,582 seed viability records into GRIN-Global during the reporting period. The National Laboratory for Genetic Resource Preservation (NLGRP) in Fort Collins, CO tested 2,946 accessions and 636 were tested by our germination lab.

The previous Cool Season Food Legume Curator, Clarice Coyne, postdoctoral associates, and Research Leader Marilyn Warburton published characterization data on chickpea entitled "Genome-wide Association Study in chickpea (*Cicer arietinum* L.) for enhanced nutritional composition", adding valuable data on protein and other nutritional seed components to information about the chickpea collection (http://doi.org/10.1007/s10681-024-03338-x). In pea, they published a paper entitled "Genome-Wide Association Study of seed mineral nutrients in peas for biofortification", adding information on important mineral nutrients for human health to the pea collection (accepted for publication); and another, "Association study of crude seed

protein and fat concentration in a USDA pea diversity panel" (http://doi.org/10.1002/tpg2.20485) adding information on protein and fat to the pea collections.

Agronomy Curator Paul Galewski has been working to integrate technological solutions for automation, digital record keeping, and phenotyping to better inform the collection for important traits and increase utility. In 2024, the entire collection of safflower was genotyped by sequencing, and the data available to the public. Boox tablets loaded with Field Book were implemented into the regeneration process. We experimented with how to collect data for specific traits including procedural data (QR codes, timestamps/tracking, ordering accessions, greenhouse inventories) and how to export and aggregate these data on a local backend. The need for a local backend is to store and curate data before upload to GRIN-Global since these systems were not designed to communicate with each other and are purpose built so neither can be changed quickly without disruption of critical genebank functions. In 2024, significant progress was made in data capture including photos as well as methods/analytics to utilize these data to set priorities for regeneration and general management/curation of the temperate grass collection.

For the Phaseolus program in collaboration with Darren Drewry from Ohio State University scanned 112 *P. acutifolius* and 93 *P. coccineus* accessions were evaluated by wet lab chemistry for protein, iron, and zinc content, part of an ongoing project to develop high throughput, non-destructive methods for measuring useful seed traits. A photoperiod neutral lima bean diversity panel including 89 accessions, was grown at Central Ferry, WA as part of the ongoing SCRI funded lima bean collaboration. Lima bean seeds were harvested at the succulent and dry stage for nutrient and other trait evaluations. Continued in-house research station field characterizations may not be within the bandwidth of the Phaseolus program with current resources, length of the growing season, and large amount of photoperiod accessions. In part to alleviate the field characterization backlog, the Phaseolus program is collaborating with SeedLinked and other genebanks in a community science project to have volunteer growers plant germplasm across the US and collect trait data with a user-friendly smartphone application. This collaboration was successfully piloted in 2024 and won ARSX funding support. Data such as 100 seed weight, seed and flower photographs are often collected during greenhouse regenerations, as well as taxonomic corrections, which are then added to GRIN-Global when the newly increased accessions become available.

In the Horticulture and *Beta* Crops program we obtained Hyb-Seq data using 1061 exome sequencing primers of 105 accessions of *Lactuca* germplasm covering 26 species. This data was used to infer a highly supported phylogeny of the genus *Lactuca* and solidify the delineation of the three genetic breeding pools for cultivated lettuce (*Lactuca sativa*). We were also able to use this data to identify gene regions that can be utilized as genetic barcodes for species identification. We take 30 descriptors on every *Beta* accession grown and 82 descriptors for accessions of *Lactuca* species. All accessions have photos taken of the plot and the plant at time of full flowering, as well as photos of flowers and pods when appropriate. Descriptors and photos are uploaded to GRIN-Global and made publicly available.

In alfalfa, multiple research studies were conducted continuing on characterizations and evaluations by Research Geneticist LongXi Yu (retired early 2024), Postdoctoral Associate/Research Geneticist Garett Heineck (onboarded late 2024) and/or Temperate Forage

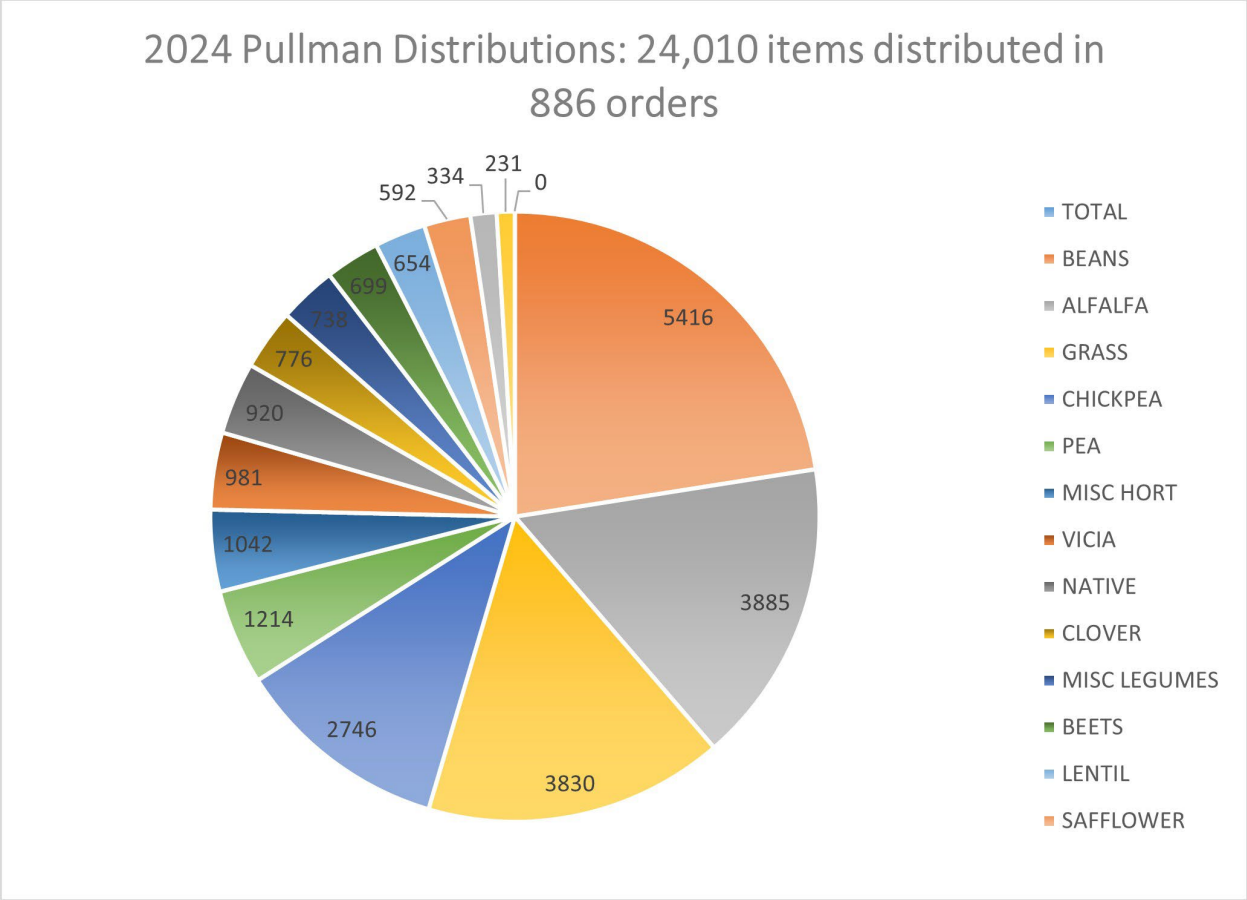
Legume Curator Brian Irish. This work was often in conjunction with the USDA ARS funded Breeding Insight group out of Cornell University. Projects characterizing alfalfa germplasm focused on a third and final year of data collecting in the Alfalfa Genetics Cage-20 experiment. Here, drought tolerant parental germplasm was polycrossed and 600 seedlings were clonally propagated and field established in RCBD for evaluation under drought stress conditions. This germplasm was also genotyped with Breeding Insight on the Diversity Array Technologies platform (DArT) with 3,000 SNP markers for development of trait associations. The TFL program also finalized forage quality data collection on a subset of 400 non-dormant alfalfa germplasm accessions. Samples were collected from a field established evaluation of the germplasm over two years and two harvests. Close to 2,500 samples have been scanned on near infrared spectrometer for model development. The same germplasm was genotyped with DArT panel for development of marker trait associations to forage quality.

Utilization

We distributed a total of 24,010 packets of seed samples in 886 orders to requestors, a decrease of almost 1/3 from last year (39,212). These included shipments to 38 foreign countries (representing 60% of the distributions) and 48 U.S. states and Puerto Rico. 6,209 of these items went to 12 of the 13 western states (none to Alaska). There was a larger decrease in the number of items shipped within the U.S. than internationally. The countries requesting the most germplasm were China (1,110), Ethiopia (972), and Germany (774). Although the top requesting countries tends to vary over years, China is consistently in the top three almost every year, a situation expected to change drastically in the next year because we are not currently shipping there. A total of 6,209 items went to 12 of the 13 western states (none to Alaska) in 231 orders to 152 unique addresses.

Germplasm users in 12 of the 13 Western states (AZ, CA, CO, HI, ID, MT, NV, NM, OR, UT, WA, and WY) received 6,209 items in 231 orders to 152 unique addresses from WRPIS in 2024 (**Table 1**). There were no orders to Alaska in 2024. In total, WRPIS distributed 16,096 items in 548 orders to all U.S. states. The number of items received from WRPIS by each state varied from 0 (Alaska) to 2,052 (Texas). Texas, Washington and California were the top three states in terms of receiving germplasm from WRPIS in 2024; this is slightly different than in previous years, but California and Washington tend to be in the top 3 most years.

Figure 3 shows the annual number of items distributed (e.g., seed packets, garlic bulbs, rhubarb crown pieces, etc.) in each crop group in 2024. The most requested plant group at WRPIS were the beans (5,416 order items) followed by alfalfa (3,885) and grasses (3,830). Other groups with high demand included chickpeas (2,746), peas (1,214) and horticultural crops program (1,042).



State	Items	Orders	State	Items	Orders	State	Items	Orders
Alabama	263	4	Maine	14	3	**Oregon**	480	24
Arizona	42	4	Maryland	594	14	Pennsylvania	75	10
Arkansas	184	4	Massachusetts	66	4	Puerto Rico	18	4
California	1,712	72	Michigan	80	8	Rhode Island	2	1
Colorado	189	19	Minnesota	492	20	South Carolina	410	10
Connecticut	2	1	Missouri	94	14	South Dakota	41	6
Delaware	1	1	**Montana**	213	6	Tennessee	229	2
Florida	1,083	15	Nebraska	435	4	Texas	2,052	22
Georgia	44	10	**Nevada**	379	4	**Utah**	59	9
Hawaii	3	2	New Hampshire	16	6	Vermont	91	4
Idaho	540	26	New Jersey	171	3	Virginia	300	10
Illinois	602	14	**New Mexico**	30	5	**Washington**	1,852	52
Indiana	64	12	New York	190	14	West Virginia	1	1
Iowa	162	13	North Carolina	63	14	Wisconsin	202	14
Kansas	59	12	North Dakota	917	19	**Wyoming**	710	8
Kentucky	52	5	Ohio	162	8			
Louisiana	16	2	Oklahoma	632	8	**U.S. Totals**	**16,096**	**548**

CURATORIAL PROGRAM SUMMARIES

1. **Agronomy (**Cool season grasses and Safflower) **Program**
   Curator: Paul Galewski (full-time)
   Technician: Zeke Brazington (full-time)
   Support Scientist/Horticulturist: Bailey Hallwachs, SOS Project (full-time)

The Agronomy program focuses on the conservation, preservation, and maintenance of germplasm for cool season grass and safflower. The Cool Season Grass (CSG) collection consists of 22,644 accessions representing a large swath of taxonomic diversity in the Poaceae tribe Pooideae. These taxa are the basis of local U.S. economies and industries related to turf, forage and hay, rangeland and grazing, and post disturbance restoration and succession plantings. Currently, 78% of the collection is available for distribution. Similarly, 77% of the collection is securely backed up at NLGRP in Fort Collins, CO.

Approximately 500 grass accessions were identified for regeneration in 2024. These selections were based on seed age, seed viability, and quantity of seed (Figure 1.1). A total of 410 accessions were grown and harvested at three locations in 2024. Locations include WRPIS farms in Pullman, WA and Central Ferry, WA. Additional accessions were produced in small gardens or in greenhouses near offices and headhouses. These spaces are generally utilized for accessions with low establishment, require specific germination protocols, and/or are classified as noxious weeds, the greenhouse is utilized to prevent escape into the broader environment.

Grasses are predominantly wind pollinated and outcrossing which requires isolation by distance (>50 m). Various genera and species are self-pollinated and are useful to rearrange plots to solve isolation by distance constraints when generating field maps. In 2024, we tested several algorithms and developed software to solve isolation by distance given constraints of field space and number of outcrossing species that can be isolated. These planting designs allow us to maximize regeneration for a given species if a need were to arise. Even by maximizing space for regeneration of a single outcrossing species, we can only regenerate 20 accessions given current resource constraints, namely field space and labor. Collaborative partnerships appear to be a good way to address these backlogs but would present new challenges such as validation of accessions for genetic purity. Tests are being conducted using non-critical NPGS material with ARS partners in Corvallis, OR. Those species include annual ryegrass, tall fescue, and chewings fescue. The hope is that data generated in these partnerships can be used to develop, test, and deploy tools to better manage the grass collection, and aid in the regeneration of NPGS material through strategic partnerships.

The safflower collection of 2,454 accessions is in excellent condition. In total 88 accessions were regenerated this year. The collection is 97% backed up at NLGRP and 96% of the accessions are available for distribution. Safflower was regenerated according to the standard operating procedures (SOP) and a lot was learned regarding machinery used for planting and harvest, labor requirements for regeneration, and materials for caging. In 2024, genetic analysis revealed a core collection for safflower, which contains 95% of the genetic variation in as few as 187 distinct individuals. The core collection will be one way to prioritize regeneration for safflower in the coming years and provide a set of diverse germplasm for the evaluation of functional traits.

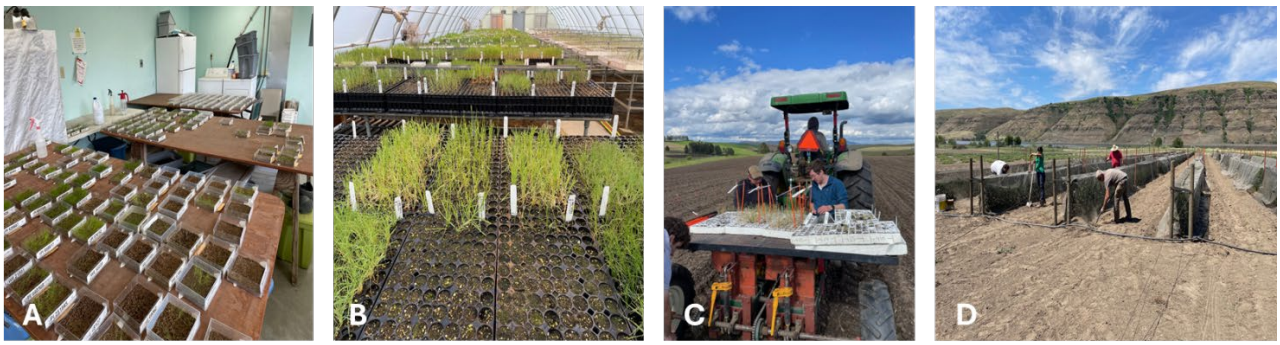


Figure 1.1. Regeneration activities of the Agronomy program. (A) Seed germination. (B) Establishing seedlings. (C) Transplanting plots D) Caging safflower plots.

From 2005 through 2024, WRPIS incorporated 22,678 SOS accessions, an average of 1,193 accessions/year with most of these coming from native SOS acquisitions. These accessions represent over 5,000 diverse species/taxa. Over the years, the SOS collected materials have been redistributed across NPGS genebank locations and are maintained currently at twelve sites in active curatorial programs outside of the WRPIS 'Native' maintenance policy (W6 Native) (Figure 1.2). Many accession transfers go into the active WRPIS curatorial programs (W6) including Cool Season Grass and Safflower, Cool Season Food Legumes, Horticultural Crops, Phaseolus (beans), and Temperate-adapted Forage Legumes.

The W6 Native maintenance policy group holds 8,899 accessions (Figure 1.2). The accessions in this maintenance policy are either in the queue to be integrated into active collections (e.g., recent SOS collections) or available for distribution through GRIN-Global (https://npgsweb.ars-grin.gov/gringlobal/search). No long-term active management (i.e., regeneration) plans currently exist for accessions that remain in the Native maintenance policy. Long-term WRPIS efforts have focused on informing leadership of the need for the establishment of a Native curatorial program that would serve to conserve, characterize, and preserve these important germplasm collections.

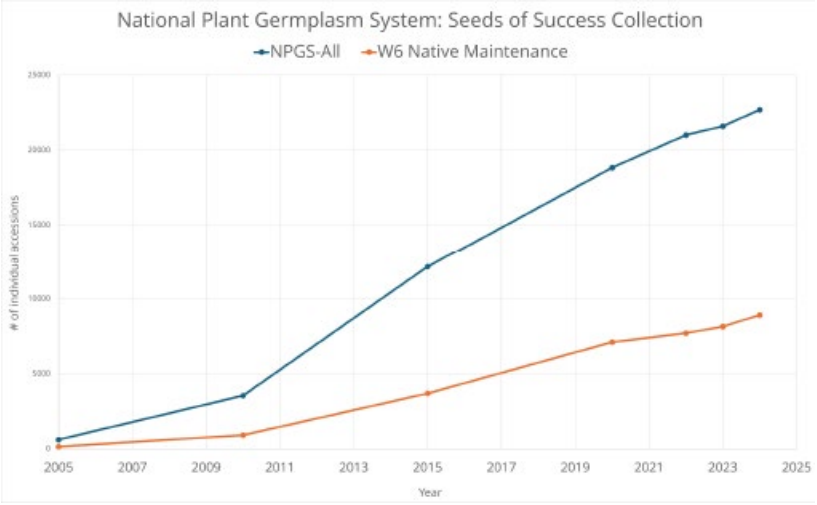


Figure 1.2. From 2005-2024, over 62% of the SOS collections have been transferred to active curatorial programs across the NPGS. This can be appreciated by the difference between what remains in the SOS collection (W6 Native Maintenance) compared to the entirety of the collection present in the NPGS.

NPGS SOS Transfer Collection

Most of the SOS accessions have been transferred to active curatorial programs for management, research, and regeneration (Figure 1.3). The accessions allow curators to fill genetic gaps within the respective collections. For example, the North Central Regional Plant Introduction Station (NCRPIS) in Ames, IA holds the amaranth, maize, medicinal, ornamental, sunflower, and vegetable collections. They have received nearly 950 SOS transfers and include multiple taxa such as *Agastache urticifolia* (Nettleleaf Giant Hyssop), *Drymocallis glandulosa* var. *glandulosa* (Sticky cinquefoil), *Helianthus annuus* (common Sunflower), and *Sphaeralcea ambigua* (Desert globemallow). In addition, SOS accessions help diversify what is available for distribution to requestors and stakeholders from the NPGS. The conserved genetic diversity allows breeders to develop more resilient crops. These resources are critical to global research and agricultural production efforts.

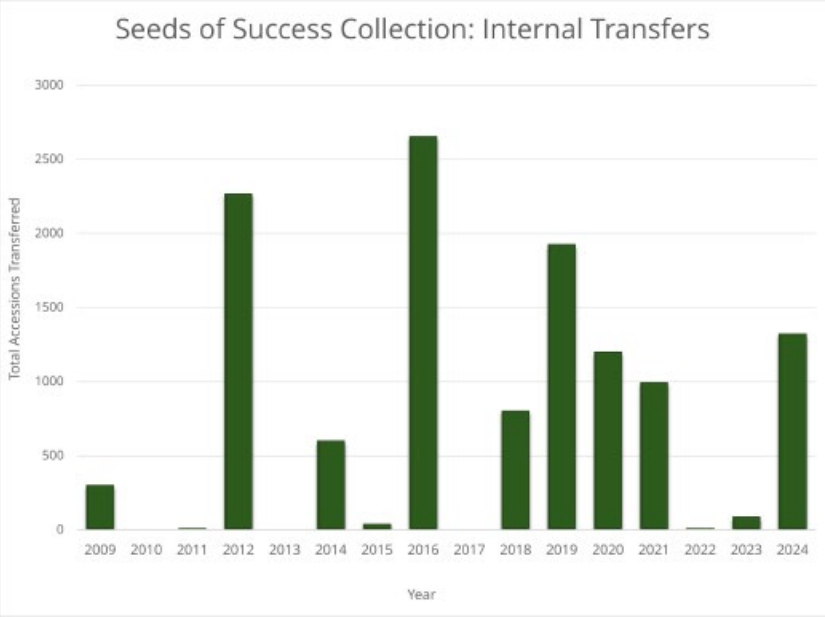


Figure 1.3. Every other year a list of the available SOS germplasm is offered to curatorial programs across the NPGS. The SOS is an excellent way to acquire germplasm that contributes to genetic diversity in the collections.

Distributions

In 2024, there were 361 SOS orders with a total of 2,369 accessions filled and distributed to requesters. Over 140 of those were made from the W6 Native maintenance policy, accessions that do not belong to a specific curatorial program. In the United States, 302 requests were made, while internationally, stakeholders in 26 countries placed 59 out of the total 361 orders. Intended use is recorded for all NPGS germplasm distributions, including SOS accessions. In 2024, the primary intended use category was ‘Research’ (92%). Under the research category ‘Genetic

Studies' (47%) was the primary use subcategory. Accessions were primarily sent to U.S. State Agencies including Agricultural Experiment Stations, Universities, and State Agriculture Departments.

2. **Cool Season Food Legumes Program**
   Curator: Vacant
   Technician: Britton Bourland (full-time)

This program manages the germplasm of all cool season food legumes (CSFL) including pea, chickpea, lentil, faba bean, grasspea and numerous *Lathyrus* and *Vicia* legume species with usage other than food, (primarily as forage crops). Pea is nested in *Lathyrus*, and lentil is nested in *Vicia* phylogenetically, so these taxa are curated together. The record distributions of pea genetic resources seen in the last 5 years due to the interest in the plant protein market seems to be slowing now, although request for lentils and, in particular, chickpea, are still very high. We grew 624 accessions for regeneration of low quantity or low germination (to make it available for distributions) or for security backup (Table 2.1). Although this number is lower than last year (1,193) we are regenerating many difficult wild species this year, which take more time and resources. Considerable diversity can be seen in flower color, and many other traits (Figure 2.1). Pea accessions (158 in total) were regenerated on the WSU campus in our greenhouse and insect-proof two-season shade-houses to prevent infection with Pea Seed-borne Mosaic Virus (PSbMV), along with 22 lentil low seed accessions. An additional 372 plots of chickpea and 500 lentil plots were grown in replicated trials for seed protein concentration and agronomic trait studies. Use of drone technologies were first introduced into the CSFL in 2021 and now routinely applied in 2024 for plant heights and biomass measurements.

Table 2.1 Number of regenerated Cool Season Food Legume accessions in 2024.

2024 CSFL Regen	
Genus	**# of accessions**
Pisum	158
Lens	22
Cicer	204
Lupinus	64
Lathryus	23
Vicia	105
Trigonella	48
Total 2024 regen	**624**

A chapter in the eBook published by the Genetic Resources Information Network collaborators and Colorado State University entitled "Landrace accession PI 180693 launches multiple disease resistance breeding in pea" was published by Clare Coyne, Marilyn Warburton, and Gayle Volk, demonstrating the use of genebank materials to find resistance to disease in peas. These chapters are an attempt to publicize some of the genebank success stories, and thus impact, of the National Plant Germplasm System and can be found at https://grin-u.org/plant-genetic-resources-success-stories/.

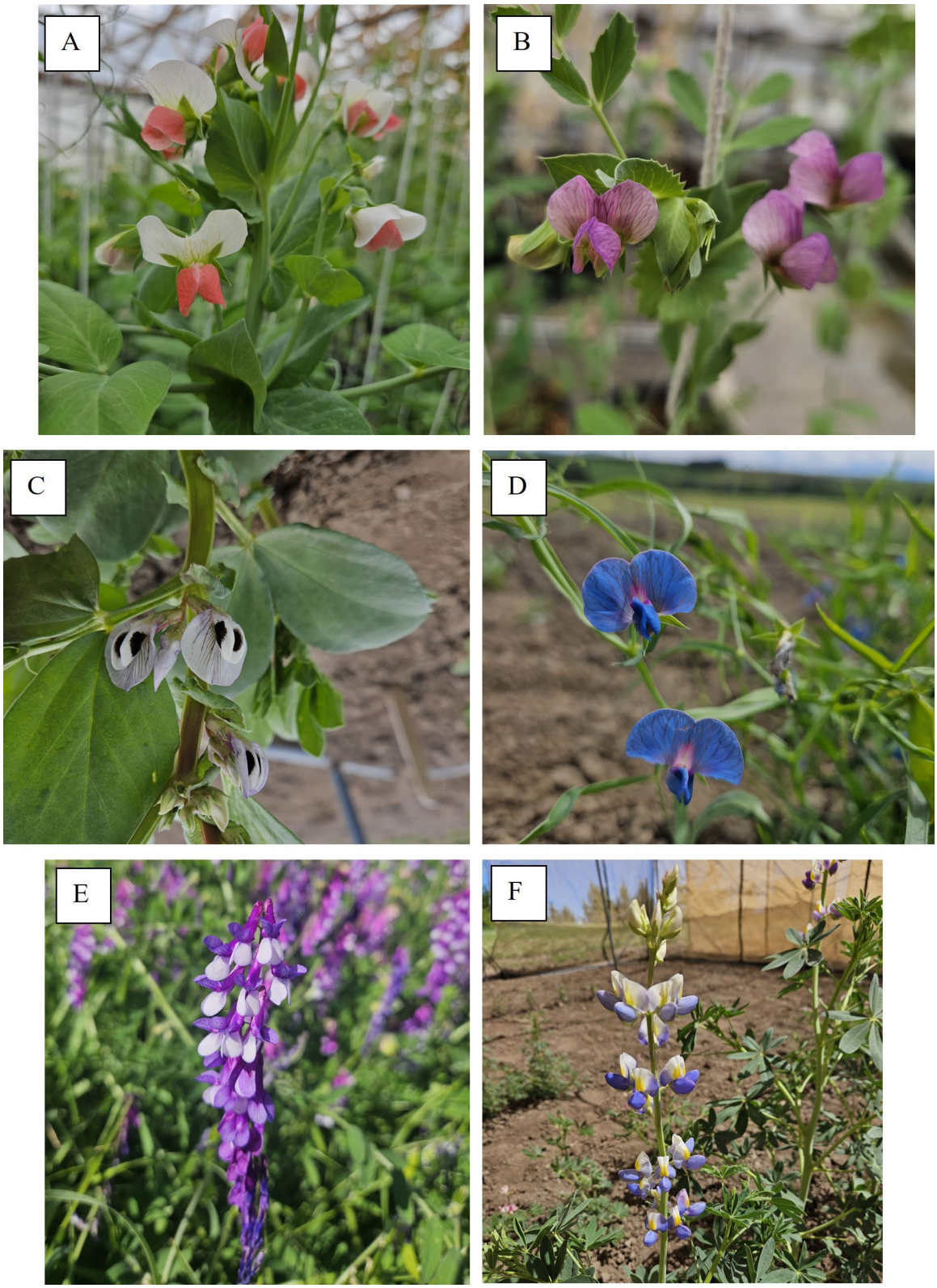


Figure 2.1. Flower A. *Pisum sativum* (domesticated). B. *Pisum sativum* (wild). C. *Vicia faba.* D. *Lathyrus sativus*. E. *Vicia villosa*. F. *Lupin mutabilis*.

3. **Temperate-adapted Forage Legumes Program**
   Curator: Brian M. Irish (full-time)
   Technician: Estella Cervantes (full-time)
   WSU Plant Technician: Adriana Cifuentes (full-time)
   WSU Timeslip: Evelia Caskey (full time/temporary)

The Temperate-adapted Forage Legume (TFL) genetic resources program is an important component of the WRPIS in Pullman, WA and operates at the USDA ARS worksite in Prosser, WA. The project focuses on acquiring, maintaining, characterizing, evaluating, and distributing alfalfa, clover, trefoil, and wild relative germplasm accessions as well as database-maintaining all associated documentation and promoting germplasm use.

For the 2024 growing season a total of 196 plots were scheduled for regeneration including 125 *Medicago* spp., 49 *Trifolium* spp., 20 *Lotus* spp., 1 *Acmispon* spp. and 1 *Hosackia* spp. accessions. In addition to the germplasm accessions to be increased, the 'Vernal' alfalfa cultivar was used to establish and harvest seed from 6 uncovered sentinel plots. No plots were overwintered from 2023 due to 'nasty' infestation of field site with bindweed – a noxious almost impossible to manage Convolvulaceae family weed, *Convolvulus arvensis*, that appeared from seed in the soil. Phenotypic traits for many accessions regenerated during the year were collected and captured by scanning and generating voucher images for flowers, pods, and seed. All threshed and chalcid-free seed from 2023 increases were submitted to the Pullman farm crew for additional cleaning if needed, and for eventual depositing in seed storage. All passport and associated information and voucher images were provided to technical personnel for loading into the GRIN-Global database. A total of 33 "breeder" plots were established to increase seed of spring blackstem and leafspot (*Ascochyta medicaginis*) disease resistant alfalfa populations as part of research in the TFL program or advanced red clover and/or alfalfa lines in collaborations with public forage breeders.

For the 2024 calendar year a total of 4,703 alfalfa, clover, trefoil, and their crop wild relative order items/seed packets were distributed in 92 orders to 79 unique cooperators/recipients. Just over 23% of the order requests, and subsequent shipments, were from/to international cooperators. A few of the requests were for many accessions including a Chinese project focusing on characterizing germplasm to gain insights into evolutionary dynamics, such as identifying the subspecies and ancestral species, and infer the divergence time and polyploidy among subspecies. Another Ethiopian distribution was for to explore, evaluate and select high yielder, disease and pest tolerant germplasm of alfalfa for varietal development for the farming systems of the study areas. In the U.S. alfalfa germplasm was distributed to collaborators in USDA ARS St. Paul, MN utilizing spectral camera technology to identify and characterize traits not visible to the naked eye, providing a deeper understanding of the baseline genetic and phenotypic diversity of alfalfa and its relatives. Two other larger distributions of white (211 accessions), red/Kura clover (250 accessions) were to U.S. academic institutions for research on molecular and classic breeding approaches.

A grant proposal submitted to the USDA NIFA AFRP grant program was recently approved late in CY 2024. This program will support continued efforts to develop pre-bred alfalfa germplasm adapted to norther climates in the U.S. This is a collaboration led by the University of California

and Dr. Charles Brummer, with collaborators at USDA ARS in Madison, WI and Cornell University. When funds are allocated/available, they are to be used to continue supporting evaluation and development of improved germplasm through breeding objectives across the breeding programs. Plans are to establish germplasm from 9 experimental breeding populations that have already been developed in a multi-location variety trial (four locations: Tulelake, CA; Prosser, WA; Madison, WI; and Ithaca, NY) for performance evaluation and release. This program also involves genotyping of subsets (~1,000 accessions) of the alfalfa germplasm on a Diversity Array Technologies platform (DArT) with 3-6,000 SNP markers and in close collaboration with Cornell University-based Breeding Insight group (Figure 3.1, left panel).

Figure 3.1. Left – Breeding Insight visitors/team, Alfalfa Genetics and TFL program team members and former Postdoctoral Associate during field harvest and site visit. Right – Alfalfa plant spring blackstem and leaf spot resistant selections being crossed to produced maternal half-sib seed in insect-proof cage.

As part of prebreeding objectives and, originally funded by the U.S. Farmer research initiative (aka “Alfalfa Checkoff”), alfalfa germplasm was screened for disease reaction to spring blackstem and leaf spot. This is an important foliar plant pathogenic disease for which no good disease resistance is found in current commercial cultivars. Close to 1,500 resistant plants were established in the field in 2019 and grown for three seasons. From those surviving plants, a subset of ~70 selections were observationally assigned to fall dormancy groups and chosen for their biomass and upright architecture for crosses and advancement of populations. These were established in 2024 in four larger 20’ x 20’ insect proof cages and maternal half-sib seed increased in four approximate fall dormancy groups (FD1&2; FD3; FD4 and >FD5) (Figure 3.1, right panel). The maternal half-sib populations will be screened once again for spring blackstem and leaf spot resistance and possibly field evaluated in the Alfalfa Genetics program for agronomic performance. Promising materials will be identified, advanced and scheduled for pre-bred germplasm release.

In 2024 we continued with established collaborations with public temperate forage legume breeders (e.g., USDA, academia) to evaluate and increase seed of advanced breeding lines (Figure 3.2). We are working directly with H. Riday of USDA ARS in Madison, WI, Z. Xu and Deborah Samac of USDA ARS St. Paul, MN, Charles Brummer with the University of

California, Davis, CA, Virginia Moore, with Cornell University, and Esteban Rios with University of Florida in Gainesville, FL.

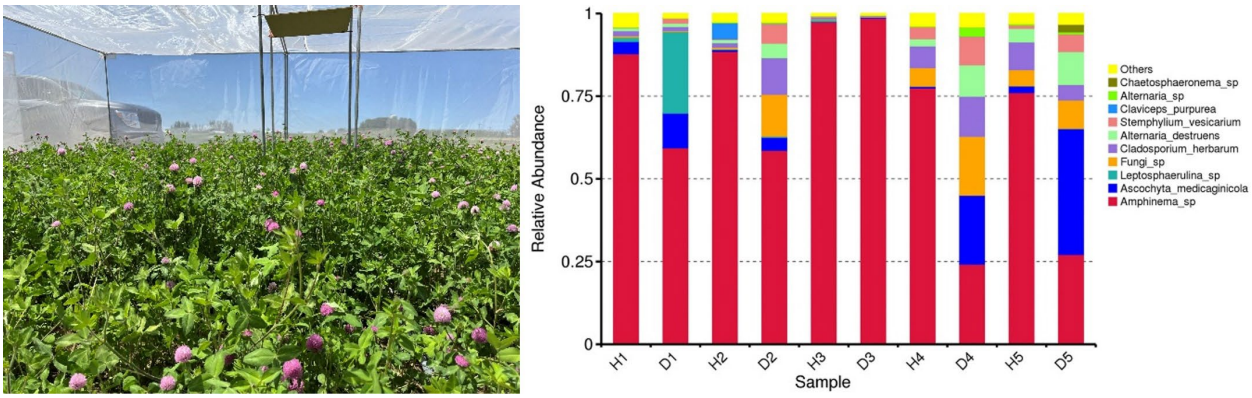


Figure 3.2. Left – Red clover advanced breeding line (from H. Riday) to be increased with stage to support bumblebee hive in middle. Right – figure from Nemchinov et al., publication showing abundance of fungal plant organisms and healthy and 'diseased' alfalfa samples from commercial fields.

The TFL program has also been working closely with Research Molecular Biologist, Lev Nemchinov of the USDA ARS Molecular Plant Pathology Laboratory in Beltsville, MD on describing molecularly impacts of pathogens and other organism on alfalfa performance. In 2024, field collections from commercially grown alfalfa were made of both apparently healthy and apparently diseased (i.e., symptomatic) plants. Plant samples were immediately frozen and shipped on dry ice for RNA extraction and sequencing. Via bioinformatics the plant sample's field pathobiome and its effects on gene regulations was explored with insights into how this is influencing plant performance.

Figure 3.3. Hosting the 2024 North American Alfalfa Improvement Conference in the Columbia River Basin area of Washington State. Left – during field tour visitors attend the TFL program's field grow-out site and listen to Curator, Brian Irish describe program. Right – field tour stopped at the Drex Gaunt commercial alfalfa export hay farm in Burbank, WA.

Lastly, CY 2024 was a big year for our local Prosser, WA research programs. A few years ago, the North American Alfalfa Improvement Conference, Trifolium and Grass Breeders decided to host the biennial meeting in the Columbia River Basin of Southeastern Washington. Over three

days the organizing committee hosted pre- and post- conference meetings and visitors. During the official field day, the close to 100 attendees had an opportunity to visit the WSU Irrigated Agriculture Research and Extension Center in Prosser, WA and the TLF and Alfalfa Genetics programs. The field tour included other stops to Guantt Farms which is a commercial alfalfa hay export operation in Burbank, WA and to Wagoner Farms a commercial alfalfa seed production operation in Touchet, WA (Figure 3.3).

A chapter in the eBook published by the Genetic Resources Information Network collaborators and Colorado State University entitled "Alfalfa NPGS Germplasm–Leafhopper Resistance" was published by Brian Irish, Charlie Brummer and Debbie Samac, demonstrating the use of genebank materials to find resistance to disease in lettuce. These chapters are an attempt to publicize some of the genebank success stories, and thus impact, of the National Plant Germplasm System and can be found at https://grin-u.org/plant-genetic-resources-success-stories/.

4. **Horticultural Crops and Beta Program**
   Acting Curator: Alex Cornwall (full-time)
   Technicians: David Van Klaveren (full-time); Sam Charpentier (full-time)

The Horticultural Crops and *Beta* Program is responsible for 13,757 accessions in four maintenance groups – *Beta* (sugarbeet, table beet, chard and leaf beet, fodder beet and wild *Beta* and *Patellifolia* species), *Allium* (garlic, leeks, chives and all wild *Allium*), Lettuce (cultivated lettuce and wild *Lactuca* and related genera) and Miscellaneous (minor forage legumes, industrial crops, current and potential ornamental species, medicinal and culinary herbs, rhubarb, and restoration and revegetation species). These collections comprise a significant proportion of the generic variability because of the extensive number of genera and species held in W6 (outside of the SOS program).

In 2024 we focused on regeneration and maintenance activities for all taxa in the program. We planted and harvested 320 *A. sativum* and other clonal *Allium* accessions, maintained plots of 60 accessions of rhubarb (*Rheum* spp.) harvested 63 inventories of miscellaneous accessions, planted and harvested 67 inventories of *Lactuca sativa* in the field, 24 inventories of *Lactuca* wild species in the greenhouse, and harvested 28 accessions of *Beta* species. For all our regeneration plots we take plant, plot, inflorescence, pod (if appropriate) images (Figure 4.1) and we also collect herbarium samples for the miscellaneous and *Allium* accessions.

Figure 4.1. (from left to right, top to bottom) *Allium stipitatum* flowering in field plots, W6 43643, *Wyethia amplexicaulis* flowers, PI 612657, *Lactuca sativa* head shape, PI 228393, *Colutea persica* flowers.

In addition to the activities relating to seed-producing germplasm accessions, we maintained the *Allium* and rhubarb clonal collections (363 accessions). We do all the cleaning and preparation work for distribution of these collections. In collaboration with a masters student from the Global Scholars program at Washington State University we were able to fingerprint with SSR genetic markers most of our current collection of rhubarb as well as an heirloom collection housed in Alaska. We were able to identify and collect plant material from 10 new accessions of rhubarb to add to the collection. The 10 varieties are currently being established in our nurseries before they are made available for ordering.

We were also able to participate in a local germplasm collection trip in Idaho to collect more populations of native *Lactuca* species and other medicinal and ornamental herbs. The *Lactuca* crop wild relative (CWR) species are highly underrepresented within the collection and this trip helped fill some of the gaps in the diversity.

Alex Cornwall continued work on his dissertation project. He was able to complete all data analyses and examine phenotypic variation of *Lactuca* spp. seed across all breeding pools using high resolution images. A primary component analysis was performed looking at cypselae color, surface area, and dimensions (Figure 4.2).

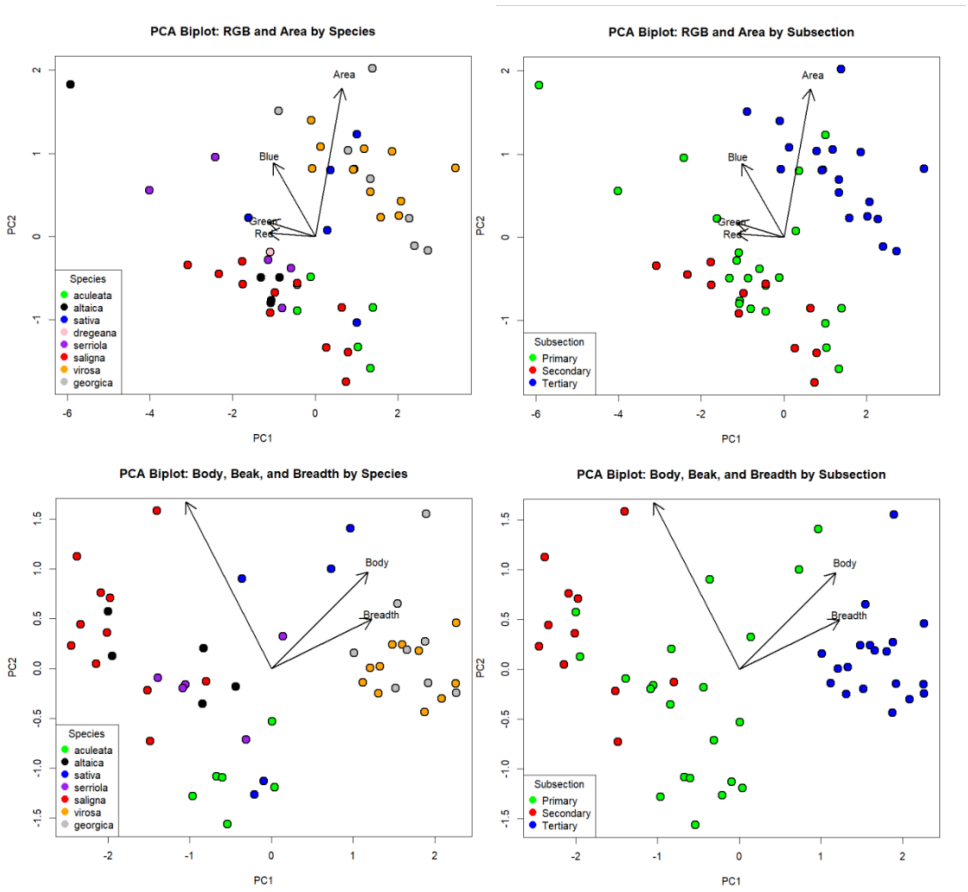


Figure 4.2 PCA biplots for color, surface area, and dimensions signifying species and breeding pool variation.

A chapter in the eBook published by the Genetic Resources Information Network GRIN-U collaborators and Colorado State University entitled *Verticillium* Wilt Race 1 resistance found in lettuce plant introductions was published by Barbara Hellier, Alex Cornwall and Marilyn Warburton, demonstrating the use of genebank materials to find resistance to disease in lettuce. These chapters are an attempt to publicize some of the genebank success stories, and thus impact, of the National Plant Germplasm System and can be found at https://grin-u.org/plant-genetic-resources-success-stories/.

5. **Phaseolus/Bean Program**
   Curator: Sarah Dohle (full-time)
   WSU Technician: Gabriela Guerrero Florez (temporary full time)

The Phaseolus Program manages a collection of 17,735 accessions in 56 taxa, all in the genus *Phaseolus*. It is the largest single genus collection at WRPIS. Approximately 75% of the collection is available for distribution from our Pullman location and backed up at NLGRP.

In 2024 the Phaseolus Program primarily focused on regeneration and documentation activities. From January 2024 to December 2024, we filled orders for regenerations of 448 inventories including: 235 accessions of original seed that had not previously been increased, and 213 accessions that had not been increased in 30 or more years or their last increase date is unknown (including some originally collected seed). Of those accessions, 68 (those which had enough seed) were sent to Costa Rica for regenerations to test a winter nursery location for the potential to produce photosensitive beans which have been particularly challenging to regrow in our greenhouses, especially runner beans (*P. coccineus*) and lima bean (*P. lunatus*).

As usual, all the *Phaseolus* regenerations are done in the greenhouse to prevent the spread of Bean Common Mosaic Virus (BCMV) within and among the accessions, and because much of our collection in need of regeneration requires long nights to produce seed. We focused regenerations on accessions which are not yet backed up. We attempted regeneration of 184 common bean (*P. vulgaris*), 102 lima bean (*P. lunatus*), 101 tepary bean (*P. acutifolius*), 30 runner bean (*P. coccineus*), 12 year bean (*P. dumosus*), and 2 wild *P. filiformis* (a desert adapted annual) accessions. To successfully grow seed with low vigor and germination rates we often need to pre-germinate and transplant germplasm from older seed.

Figure 5.1. Clockwise from top left. Lima bean field at Central Ferry taken with Unmanned Aerial Vehicle (UAV) measuring biomass accumulation, popping bean F1 seed from a prebreeding cross between a temperate adapted BCMV resistant cultivar and Peruvian nuña bean (*P. vulgaris*), wild tepary bean growing in lava rock crevice in desert in New Mexico during plant exploration, tepary bean regenerations in greenhouse, pregerminated common beans for transplanting to increase seedling establishment of low vigor germplasm.

The USDA NIFA SCRI funded popping bean project supported the planting for regenerations and simultaneously collecting leaf tissue for genotyping the total nuña (Peruvian popping bean)

collection of 84 accessions with 77 accessions now available for distribution. Sequencing, further characterization, and GWAS will be carried out by collaborators over the course of the project. Opportunistic crosses were also carried out to make more of the popping bean genetics available in a useful form, because most are photosensitive and thus can't be used by most non-tropical bean breeding programs.

The USDA NIFA SCRI-funded lima bean grant supported a second season of field characterizations and seed trait evaluations of much of our photoperiod neutral lima bean collection, as well as more dedication to lima bean regenerations which require longer growth periods and more physical labor.

The USDA ARS NPGS Plant Exploration Office supported a second year of wild bean exploration to southwestern U.S., primarily New Mexico, which has been a geographic gap in the germplasm collection. Wild beans collected during this trip include *P. acutifolius* (18), *P. angustissimus* (1), *P. filiformis* (1), *P. grayanus* (2), *P. maculatus* (3), and *P. monatanus* (3), which will be added to the permanent collection as they are regenerated. Wild *P. acutifolius* is capable of crossing with cultivated tepary beans resulting in fully fertile offspring. *P. angustissimus*, *P. grayanus* and *P. maculatus* are perennial beans and *P. filiformis* is an annual. All of the collected species/germplasm show important adaptation to heat and drought conditions. This trip also collected soil and nodules samples from the rhizosphere which may be useful for tepary bean cultivation. Microbial samples are preserved at the USDA Legume Microbial Collection at Beltsville, MD.

MISSION-RELATED RESEARCH PROGRAMS

6. **Alfalfa Genetics Program**
   Research Geneticist: Garett Heineck (Postdoctoral Research Associate, full-time)
   Technician: Martha Rivera (full-time)
   Farmer: Jose Luis Godinez (full-time)

This project focuses on enhancing alfalfa's resistance to biotic and abiotic stresses, including developing pragmatic screening techniques, broadly adaptable molecular markers, and public germplasm with improved resistance to these stressors. This program continues a five-year project plan written by L.X. Yu (retired) within National Program 215 (forages and grazing lands) was approved in 2023 and started in 2024. In November 2024, a Postdoctoral Research Associate, Garett Heineck, was hired to lead the program.

To fulfill the 5-year plan research objectives, improvements were needed to infrastructure and equipment. New grow lighting was installed in existing greenhouse facilities, rolling benches were fabricated, drainage systems cleaned, and new grates added (Figure 6.1A). To facilitate repair and maintenance on machinery and facilities, a new metal working shop was created (Figure 6.1B) including MIG and stick welding units, drill press, grinders, and metal saws. As new germplasm is tested and synthetic populations are generated, the program needs to be prepared for plot-scale testing. A used Wintersteiger double disc plot drill was procured and refurbished for alfalfa plot experiments (Figure 6.1C). The Alfalfa Genetics project has two unused labs that we need to clean and refurbish. These two lab spaces (Figure 6.1D) will be used

as a new forage quality and testing lab and a seed packaging room. To increase the efficiency of field operations, old equipment found at the research farm is being collected and refurbished. As an example, a field cultipacker and conventional seed drill (Figure 6.1E and F) were repaired and will be ready for future use in prepping and maintaining new field sites for spaced plantings and plot work. Many of these common area improved facilities and equipment upgrades could be used by the co-located TFL program.

The five-year plan was built on established research projects on alfalfa drought tolerance. Drought is an abiotic stressor affecting alfalfa production worldwide. Enhancing alfalfa drought resistance is important to meet the challenges of limited water resources and highly saline soils. A drought prediction model was created using WSU Ag Weather Net weather data and established constants for alfalfa growth and development. This model was used to predict the most drought-stressed harvest dates of prior experiments. The data from these dates was analyzed, and field plant selections were made (Figure 6.2A). Future work will consist of polycrossing the selections and seeding in a new field site where additional drought tolerance screening validation can be conducted. Engagement with industry stakeholders also took place to gauge research relevancy to the alfalfa industry and to discuss experimental designs for current and future work (Figure 6.2C).

In fall 2025, the selected parent plants will be transplanted into the new field site in H21 at Washington State University's Irrigated Agriculture Research and Extension Center (IAREC; Figure 6.2B). In spring 2026, half-sib progeny will be planted. Both parents and progeny, along with appropriate checks, will be screened under well-watered and drought-induced conditions. Results will shed light on the additive heritability of selecting for drought tolerance and the expected yield reductions and trade-offs of selecting for drought tolerance. In collaboration with the TFL group, the University of California, Davis, and the University of Minnesota, a new near-infrared reflectance spectroscopy (NIR) model will be developed for alfalfa stem quality. This will take place in the recently renovated alfalfa quality lab. The NIR model will be applied to a population of non-dormant alfalfa evaluated by the TFL program in Prosser in collaboration with University of California, Davis, likely segregating for stem quality parameters. Using DArT SNP genotype data previously collected with Breeding Insight on the same non-dormant alfalfa germplasm, a genome-wide association mapping study will be performed on the stem quality traits.

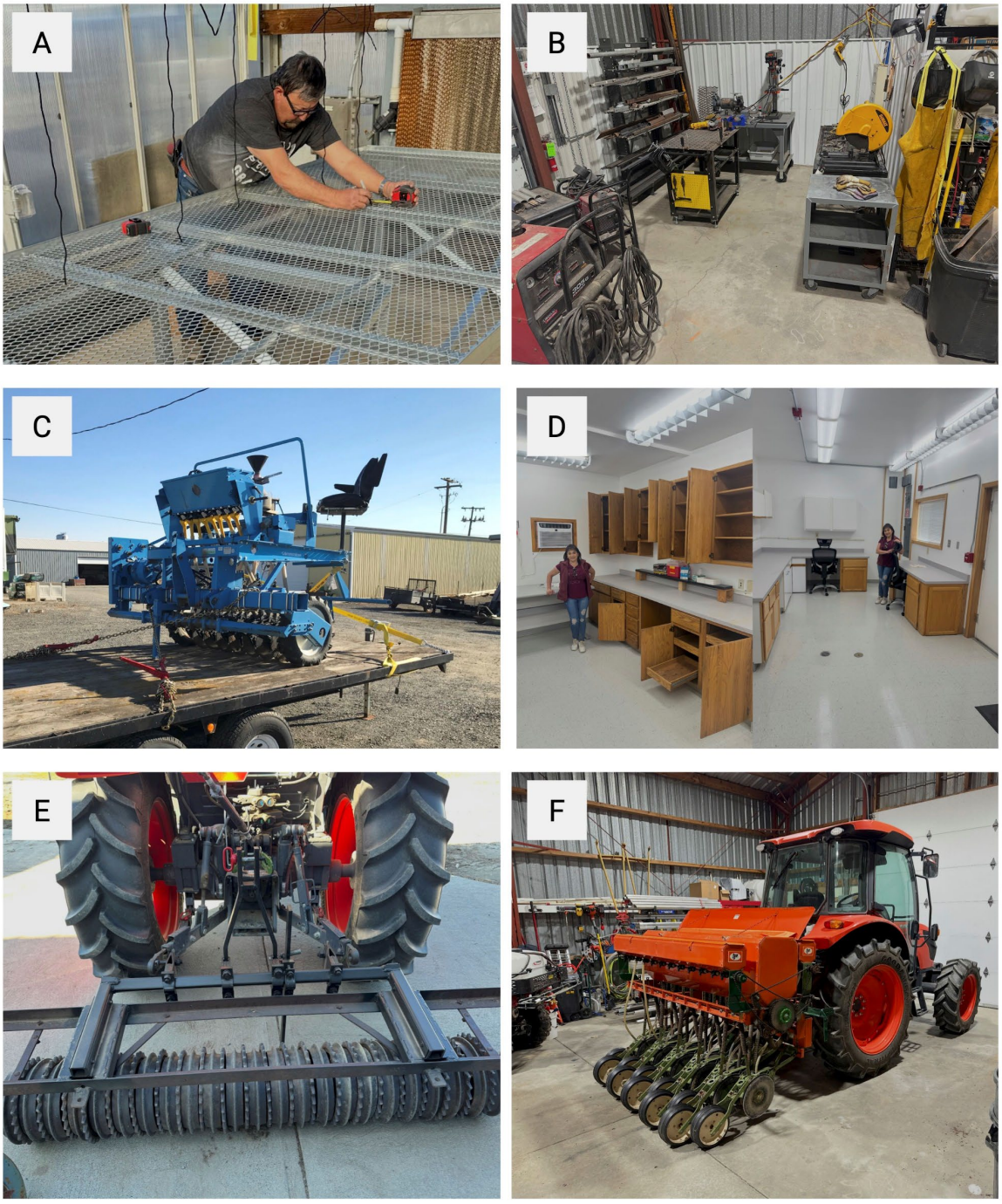


Figure 6.1. Examples of progress towards increased research capacity and efficiency. A) Renovation of three greenhouses for Alfalfa Genetics and temperate-adapted forage legumes; new bench space, drainage systems, lighting, and a proposal for new glazing. B) Metalworking shop for building and repairing field equipment. C) Procurement and repair of a double-disc cone drill for field plots. D) Renovation of a dirty lab for use as a forage quality testing and seed packaging laboratory. E) Repair and redesign of a cultipacker ~~and forage harvester~~ for plot work. F) Procurement of a double-disc conventional seed drill for maintenance of field sites and research plot borders.

Figure 6.2. Experimental design and establishment of a long-term field site at the Prosser IAREC headquarters location. A) Plant selections were made from previous projects based on predicted performance under drought-induced conditions. B) Preparing the field site and irrigation design for abiotic stress screening. C) Meeting with industry stakeholders to review the project plan and equipment readiness.

7. **Plant Pathology Program**
   Pathology Technician: Vacant

With the retirement of the pathology Technician Shari Lupien and abolishment of the Research Plant Pathologist position several years ago, the Plant Pathology Research Program is being retired. A temporary technician, Scott Mattinson, has been working on compiling the pathogen collection inventory so that we can offer the collections to anyone else interested in having them. We will safely destroy any other pathogens that are not of interest to anyone. The horticulture program, under Alex Cornwall, has finished developing plant tissue culture procedures using the basal stem disk as the explant for virus free in vitro propagation of garlic – a protocol developed (optimized) by the plant pathology program. This method can increase the rate of pathogen-free plantlets compared to standard shoot tip culture and will be put into use moving forward. Responsibility for supply and equipment procurement, coordination of equipment maintenance and repair, lab safety orientations, and scheduling and support of laboratory activities will be overseen by the Research Leader, Marilyn Warburton.

8. **Genetics Program**
   Supervisory Research Geneticist/Research Leader: Marilyn Warburton (full-time).
   Postdoctoral Researcher Associate: Renan Uhdre (full-time; in conjunction with WSU Crop and Soil Science Department).

As part of the new Pulse Crops Health Initiative project “ChickpeA1”, in 2024, the chickpea diversity panel, consisting of 277 accessions plus five commercial checks, was successfully grown in Central Ferry, WA, for seed increase. During the growing season, high-throughput phenotyping using Unmanned Aerial Vehicle (UAV) was conducted to collect image-based data for stand counts, days to flowering, flower density, plant height, plot pod counts, and biomass estimation. Ground truth data, measured by hand, were also collected from the same materials to calibrate and validate the remote sensing models. An image analysis pipeline has been implemented to process UAV images and extract key phenotypic traits. Flowering time was estimated from mid-to-late-season image datasets and validated by hand; correlations are still being calculated. Plant height and biomass measurements were obtained using UAV-based canopy models and validated by hand with a significant correlation higher than 75%. After harvest, the materials were processed and sent to the laboratory for post-harvest nutritional analysis. Grain was cleaned, and scanned for total protein, lipids, ash and moisture using DA7250 NIR (Perten Instruments, Shelton, CT). For NIR measurements, each sample was divided into two subsamples and measurements were performed on each subsample. Lipids and moisture in each seed sample were also measured. These data will serve as the foundation for subsequent genetic analyses, including GWAS to identify loci associated with key agronomic traits in chickpea and the best parents for crosses and speed breeding.

A fingerprinting study of Rhubarb (*Rheum* sp.) was designed to bring in new diversity into the rhubarb collections. A collection of heirloom rhubarb varieties is maintained privately near Wasilla, AK, near the site of the former location where the ARS rhubarb collection was housed. This study was undertaken to collect morphological data and assess the genetic relatedness of 20 rhubarb varieties grown in Alaska and compare them to accessions in the USDA ARS WRPIS.

Based on the genetic relatedness results of this study, 10 varieties were added to the WRPIS rhubarb collection (Figure 8.1). This study has ensured that the genetic variation of Alaskan rhubarb is quantified and conserved. Further, it provides information regarding rhubarb variety juice quality and morphological characteristics that are useful for growers and commercial entities for marketing and genetic improvement purposes.

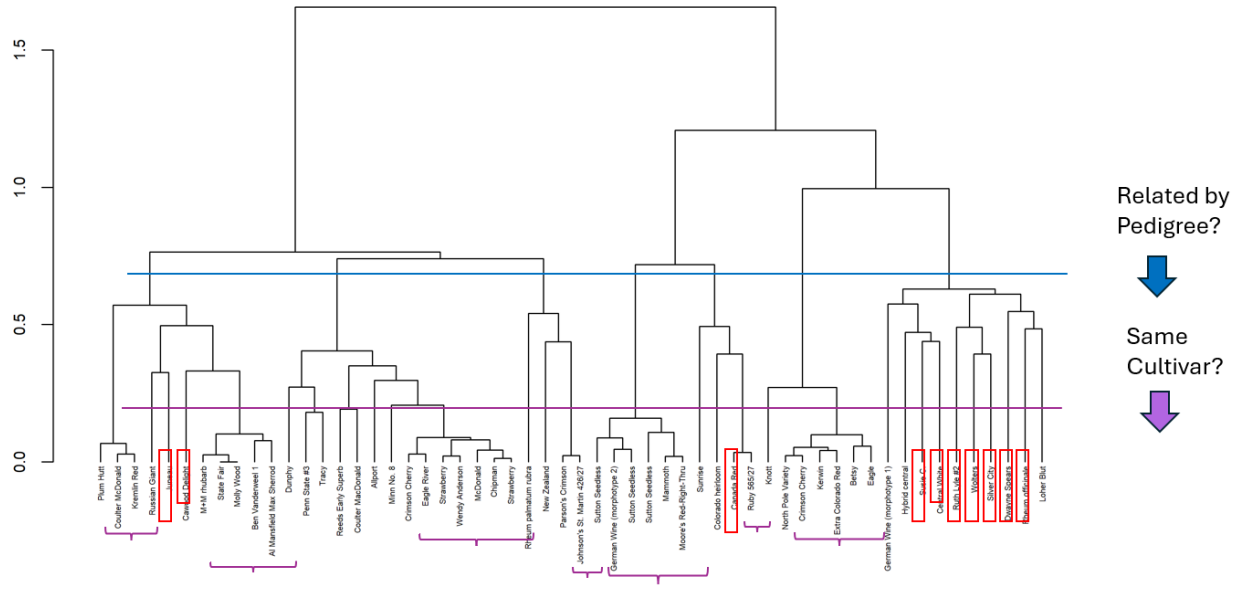


Figure 8.1. Ward's D2 dendrogram of Bruvo's distance between 58 rhubarb entries in the study. Entries that are joined in the same cluster below the purple line are likely the same clone, or very highly related. Entries that are joined in the same cluster below the blue line are also very likely highly genetically related. No individual in the study was genetically distant from all others. There were four clusters of accessions and some sub-clusters within two of the four clusters. The dendrogram indicates groups of entries, often mixed between the heirloom and WRPIS collections, that share similar genetic backgrounds.

COMMITTEES, SERVICE, PUBLICATIONS

During 2024, WRPIS scientists and curators served as ex officio committee members or chairs of their respective national Crop Germplasm Committees (CGC) and other academic or social organizations. Research Leader and Research Geneticist **Marilyn Warburton** was the past president of the Crop Science Society of America and is a fellow of that society. She is a member of the American Association for the Advancement of Science (AAAS) and the Council for Agricultural Science and Technology. She is an adjunct faculty with the WSU Department of Crop and Soil Sciences and is on the committee of two WSU MS students (Yi Ting and Ann Kowenstat, both of whom graduated in 2024). She co-supervises one Postdoctoral Research Associate at WSU and serves as the WRPIS Station Coordinator. She was the Crop Science Editor and has served on the Crop Science Editorial Board as a Technical Editor and Associate Editor of divisions C-1, C-7, and C-8. Horticultural Crops Curator **Alex Cornwall** is an ex-officio member of numerous CGCs including Root and Bulb Vegetables, Leafy Vegetable, New Crops, Sugarbeet, Medicinal and Essential Oils and Herbaceous Ornamental Crops. Alex is a member of the American Society for Horticultural Science and the

American Society of Sugarbeet Technologists. Temperate-adapted Forage Legume Curator **Brian Irish** is actively involved in the Cornell-led and USDA-funded Breeding Insight efforts to leverage recent improvements in genomics and open-source informatics components to accelerate genetic gains in alfalfa. He is currently serving as an inaugural member of the PWA Awards Committee (representing CAT4 SYs) to develop a culture of award recognition by facilitating and encouraging participation and nomination and successful receipt of awards for scientists in the area; a member of Alfalfa Crop Germplasm Committee, Clover and Special Purpose Legume Crop Germplasm Committee, Crop Science Society of America, North American Alfalfa Improvement Conference, Plant Germplasm Operations Committee & PGOC sub-committee genetic engineered (gene-edited) organisms. He is currently serving as an alternate reviewer on the National Alfalfa Variety Review Board (NAVRB) and is a reviewer for J. Plant Registrations, Crop Science, and Plant Disease. He is an adjunct faculty member with WSU Crop and Soil Sciences Department and a member of the CSSA and American Phytopathological Society. Alfalfa geneticist **Garett Heineck** is an adjunct faculty with the WSU Department of Crop and Soil Sciences and is on the committee of one WSU MS student (Natalie Strum) and one PhD student (Lauren Stubbs). He is the WSU Graduate Student Ph.D. Advisor for one student (Katherine Smith). Agronomy and safflower curator Paul Galewski is a member of Crop Science Society of America, co-chair of the genomics of genebanks workshop at plant and animal genome and participates in the new crops CGC and forage and turf grass CGC. Phaseolus curator **Sarah Dohle** is a member of the Crop Science Society of America, the Bean Improvement Cooperative, and the Institutional Biosafety Committee at Washington State University. She is pending confirmation as an adjunct professor of WSU Crop and Soil Science Department and was an organizer of the same department weekly seminar series. Agronomy and safflower **curator Paul Galewski** is a member of Crop Science Society of America, co-chair of the genomics of genebanks workshop at plant and animal genome and participates in the new crops CGC and forage and turf grass CGC.

In 2024, WRPIS scientists and curators were actively engaged in conducting mission-related research and serving the scientific community. Activities for 2024 were very busy, and personnel participated in technology transfer presenting research as oral and/or poster presentations (some virtual) at either scientific or public meetings and were involved in 17 peer reviewed scientific journal and/or book chapter publications. They were invited to review research proposals by funding agencies such as NIFA and participated as subject matter experts and in many ad hoc peer-reviews of manuscripts in scientific journals. Nine groups of students or stakeholders came to tour the farm, seed cleaning, seed storage, laboratory and greenhouse facilities at Pullman, Prosser, and Central Ferry during the year (**Appendix II**).

PUBLICATIONS – 2024

Peer reviewed/Book chapter (17)

Begna, S., Putnam, D., Wang, D., Bali, K., & Yu, L. (2024). Yield and Nutritive Values of Semi- and Non-Fall Dormant Alfalfa Cultivars under Late-Cutting Schedule in California's Central Valley. *American Journal of Plant Sciences*, *15*(10), 858-876.

Copp, C. R., DeShields, J. B., Kar, S., Clark, R. W., Hallwachs, B., Bondada, B., & Levin, A. D. (2025). Foliar Starch Accumulation Precedes the Cascade of Grapevine Red Blotch Disease Symptoms. *American Journal of Enology and Viticulture*, *76*(1).

Coyne, C.J., Warburton, M. and Volk, G. (2024). Landrace accession PI 180693 launches multiple disease resistance breeding in pea. Eds. G. Volk, K. Chen and P. Byrne. https://colostate.pressbooks.pub/pgrsuccessstories/

Hallwachs, B., Martin, E., Hellier, B. and Irish, B. 2024. Optimizing regeneration protocols for USDA ARS National Plant Germplasm System native Seeds of Success-collected *Astragalus* spp. genetic resources. *Native Plants Journal* (in press)

Hellier, B., Cornwall A. & Warburton, M.L. (2024). Verticillium Wilt Race 1 resistance found in lettuce plant introductions. Eds. G. Volk, K. Chen and P. Byrne. https://colostate.pressbooks.pub/pgrsuccessstories/

Irish, B. M., Brummer, E. C., & Samac, D. (2022). Alfalfa NPGS Germplasm–Leafhopper Resistance. Eds. G. Volk, K. Chen and P. Byrne. https://colostate.pressbooks.pub/pgrsuccessstories/

Johnson, J. P., Piche, L., Worral, H., Atanda, S. A., Coyne, C. J., McGee, R. J., ... & Bandillo, N. (2024). Effective population size in field pea. *BMC genomics*, *25*(1), 695.

Khan, A. W., Garg, V., Sun, S., Gupta, S., Dudchenko, O., Roorkiwal, M., ... & Varshney, R. K. (2024). Cicer super-pangenome provides insights into species evolution and agronomic trait loci for crop improvement in chickpea. *Nature genetics*, *56*(6), 1225-1234.

Medina, C.A. Lin, M., Zhao, D., Sapkota, M., Sandercock, A.M., Beil, C.T., Sheehan, M.J. Irish, B.M., Yu, L-X, Poudel, H., Claessens, A., Moore, V., Crawford, J., Hansen, J., Viands, D., Smith, K.P., Peel, M., Tilhou, N. Riday, R., Brummer, C.E. and Zhanyou Xu. 2025. Pre-breeding in alfalfa germplasm develops highly differentiated populations, as revealed by genome-wide microhaplotype markers. Scientific Reports https://doi.org/10.1038/s41598-024-84262-x

Nemchinov, L., Irish, B.M., Uschapovsky, I.V., Grinstead, S., Shao, J., and Postnikova, O.A. 2024. First report of Medicago trirhavirus 1 infecting alfalfa in Washington State, USA. Plant Disease. https://doi.org/10.1094/PDIS-05-24-1132-PDN.

Sari, H., Y. Ma, P.K. Mangat, R. Uhdre, O.I. Salia, F. Riaz, R.J. McGee, M.L. Warburton and C.J. Coyne. 2024. Impacts of germplasm characterization and candidate gene discovery, In: J. Kumar, D.S. Gupta, S. Kumar, eds. "The Lentil Genome", Chapter 10, p. 247-265. Academic Press, U.K. https://doi.org/10.1016/B978-0-443-19409-2.00011-9.

Sari, H., Uhdre, R., Wallace, L., Coyne, C. J., Bourland, B., Zhang, Z., ... & Warburton, M. L. (2024). Genome-wide association study in Chickpea (*Cicer arietinum* L.) for yield and nutritional components. *Euphytica*, *220*(6), 84.

Uhdre, R., Coyne, C. J., Bourland, B., Piaskowski, J., Zheng, P., Ganjyal, G. M., ... & Warburton, M. L. (2025). Association study of crude seed protein and fat concentration in a USDA pea diversity panel. *The Plant Genome*, *18*(1), e20485.

Warburton, M.L., J.S. Smith, S. Woolfolk, L.H. Hawkins, and W.P. Williams. 2023. Genes and genetic mechanisms contributing to fall armyworm resistance in maize. The Plant Genome e20311. https://doi.org/10.1002/tpg2.20311

Woolfolk, S.W., D. Jeffers, L.K. Hawkins, R. Uhdre, X. Ni, and M.L. Warburton, 2025. Integrated approaches to maximizing maize resistance to fall armyworm. *CABI Reviews*, 20(1), p.0013.

Yu, L. X., Lin, S., Medina, C., Patel, S., Xu, Z., Zanton, G., ... & Llewellyn, D. Identification of Genetic Loci Associated with Protein and Fiber Digestibility in Alfalfa. *Available at SSRN 4863740*.

Zhao, D., Sapkota, M., Lin, M., Beil, C., Sheehan, M., Greene, S., & Irish, B. M. (2024). Genetic diversity, population structure, and taxonomic confirmation in annual medic (*Medicago* spp.) collections from Crimea, Ukraine. *Frontiers in Plant Science*, *15*, 1339298.

APPENDIX I – WRPIS Staffing

Current Staffing (June 20, 2025)

Position (Title)	Name	Federal/State	Position type
Pullman			
Research Leader/Station Coordinator	Marilyn Warburton	Federal	PFT
Program Support Assistant	Melissa O'Dell	Federal	PFT
IT Specialist	Vacant (CEC)[3]	Federal	PFT
IT Specialist	Ed Faulkner[1]	Federal	TPT
Biological Science Technician	Renan Uhdre[2]	Federal	PFT
Biological Science Technician	Vacant[3]	Federal	PFT
Seed Manager/Computer Specialist	Lisa Taylor	Federal	PFT
Seed germination Technician	Melissa Scholten	Federal	PFT
Farm Manager, Central Ferry	Kurt Tetrick	Federal	PFT
Plant Technician (Farmer)	Wyatt Keller	State/WSU	TFT
Farm Manager, Pullman	Scott McGee	Federal	PFT
Plant Technician	Griffin Stauffenberg	State/WSU	PFT
Plant Technician	Jason Newell	State/WSU	PFT
Plant Technician	Madison Hatley	State/WSU	PFT
Plant Technician	KunFang Chiang	State/WSU	PFT
Agronomy and Safflower Curator	Paul Galewski	Federal	PFT
Biological Science Technician	Ezekiel Brazington	Federal	PFT
Horticulturist	Vacant[3]	Federal	TFT
Cool Season Food Legumes Curator	Vacant	Federal	PFT
Biological Science Technician	Britton Bourland	Federal	PFT
Horticultural Crops Curator	Alex Cornwall	Federal	PFT
Biological Science Technician	David Van Klaveren	Federal	PFT
Biological Science Technician	Sam Charpentier	State/WSU	PFT
Phaseolus Bean Curator	Sarah Dohle	Federal	PFT
Biological Science Technician	Gabriela Guerrero	State/WSU	TFT
Greenhouse maintenance	Dustin Golembiewski	Federal	PFT
Prosser			
Temperate Forage Legumes Curator	Brian Irish	Federal	PFT
Biological Science Technician	Estela Cervantes	Federal	PFT
Plant Technician (Farmer)	Adriana Cifuentes	State/WSU	PFT
Alfalfa Genetics Research Geneticist	Garett Heineck	Federal	TFT
Biological Science Technician	Martha Rivera	Federal	PFT
Plant Technician (Farmer)	Jose Luis Godinez	Federal	TFT

[1]Contracted under the USDA New Solutions agreements program

[2]Renan Uhdre is a WSU Postdoctoral Research Associate temporarily filling the position of biological sciences technician. He has recently taken a Term Faculty position with WSU and will continue to collaborate with WRPIS on pulse breeding and genetics.
[3]Bailey Hallwachs (SOS Support Scientist/Horticulturist), Kehinde Ogundele (IT specialist) and Scott Mattinson (laboratory manager) left under the federal deferred resignation program in April of 2025 and this position may not be refilled.

Important Note - Due to a federal hiring freeze, and the very slow pace of filling positions the year before that, we have two more full-time staff on the W6 funds than we had the year previous, and this may not be sustainable to the budget.

APPENDIX II – Research, Service and Outreach Activities (Calendar Year 2024)

Jan. 10-15: Paul Galewski attended the Plant and Animal Genome conference in San Diego, CA and presented a talk at the Genomics of Genebanks workshop at titled "Utility of the NPGS Beta collection to address challenges in agricultural productivity."

Jan. 17: Brian Irish participated in the local area's annual Northwest Hay Expo in Kennewick, WA.

Jan. 18: Several WRPIS members attended the Ardent Mills open house to tour the new milling and product research laboratory in Pullman, WA.

Jan 22, 2024: Paul Galewski presented at the WSU Crop and Soil Science department seminar with a talk titled "Genetic Resource Conservation at the Western Region Plant Introduction Station".

Feb. 2: Marilyn Warburton was a guest lecturer to the WSU Plant Breeding class (Crop Science 445).

Feb. 2: Marilyn Warburton and Clare Coyne attended the USA Pulses stakeholder dinner and mixer event.

Feb. 6-8: Marilyn Warburton participated in the Sustainable Intensification Thought Leader's Summit put on by the Feed the Future Sustainable Intensification Innovation Lab in Manhattan, KS.

Feb. 14-15: Alex Cornwall gave a tour and presentation to the WSU Crop Growth and Development class (HORT 202), with the presentation entitled "Biodiversity within the NPGS".

Feb. 19-21: Sarah Dohle, Marilyn Warburton and Clare Coyne participated in the Pulse Crops Working Group meetings in Pullman, WA.

Feb. 17: Several WRPIS staff hosted WSU undergraduate students as part of the WSU Crop and Soil Science Lab Crawl event

Feb. 28: Brian Irish was invited and provided a virtual presentation on the NPGS and the TFL program to the Pennsylvania Forage Association.

Mar. 20: Brian Irish, along with WSU leadership, visited with Washington State Hay Growers Association President, Andrew Eddie, and other forage producers about USDA ARS activities.

April 3-July 31: Sarah Dohle and Marilyn Warburton hosted visiting PhD student Victor Dada from the International Institute of Tropical Agriculture (IITA) Nigeria

April 10: Sarah Dohle hosted a tour for the Agriculture Education Students from WSU

April 25-26: Brian Irish was invited and participated with USDA ARS Dairy Forage Research Center (DFRC) and many of their stakeholders in roundtable discussions in Madison, WI.

May 30-31: Several WRPIS members hosted Acting National Program Leader, Gayle Volk, toured facilities and fields and produced short video recordings for developing GRIN-U produced content.

June 3: Sarah Dohle and Lisa Taylor hosted the National Program 301 NPL as he toured the facilities.

June 6: Marilyn Warburton and Paul Galewski attended the WSU Grass Ecology Field Day.

June 13: Alex Cornwall and Marilyn Warburton hosted the Herbaceous Crops Germplasm Committee meeting and tour of the WRPIS Facilities.

June 24-26: Brian Irish hosted and coordinated, and several WRPIS members attended, the North American Alfalfa Improvement Conference (and trifolium, and grass breeders) and the NE2210 forage breeders multistate project meeting at the Columbia Basin College in Pasco, WA. This included the planning and hosting of field tours to the WSU IAREC research station and USDA ARS forage programs as well as several commercial farms in the area. Paul Galewski gave a scientific talk overviewing the status of WRPIS collections relevant to the forage genetics community in attendance.

June 28: Brian Irish hosted scientific team contingent from Breeding Insight and showed the Alfalfa Genetics and TFL programs in Prosser, WA.

July 9-10: Several WRPIS members attended the W6 Regional Technical Advisory Committee meeting in Logan, UT.

July 12: Sarah Dohle and Lisa Taylor hosted a tour of bean greenhouse and cold storage with Seth Truscott and other members of the WSU community.

June 16-19: Alex Cornwall met with Ann Kowenstrot (a WSU graduate student) in Palmer, Alaska to assess an heirloom rhubarb collection and acquire novel cultivars for the NPGS collection.

July 28: Paul Galewski and Bailey Hallwachs gave a tour of the WRPIS Pullman Plant Introduction farm to Clearwater seed, specifically grass, native seed plots, and various cover crop species of commercial interest.

July 31: Sarah Dohle visited USA Pulses in Pullman, WA.

Aug. 12-8: Sarah Dohle hosted Darren Drewry from the Ohio State University to investigate high throughput phenotyping methods for evaluating seed traits in *Phaseolus*.

Aug. 8: Sarah Dohle toured the USDA Othello Bean Breeding Station with breeders from Archer Daniels Midland, hosted by Phil Miklas ARS.

Aug. 13-15: Several WRPIS members attended the Plant Germplasm Operating Committee meeting in Davis, CA. Sarah Dohle presented “Crowdsourced Characterization: 2024 Bean Pilot Project and Beyond with SeedLinked”. Paul Galewski and Bailey Hallwachs gave a Seeds of Success program update. Brian Irish provided a presentation on the implementation of the Field Book application. Lisa Taylor won the NPGS Special Achievement Award!

Aug. 15: Sarah Dohle presented to stakeholders about the USDA *Phaseolus* Germplasm Collection at the UC Davis Dry Bean Field Day in Davis, CA

Aug. 20: Sarah Dohle presented *Phaseolus* collection status report (virtually) at the CGC meeting during the w-4150: Breeding Phaseolus Beans for Resilience, Sustainable Production, and Enhanced Nutritional Value, meeting.

Aug. 17: Gabriela Guerrero Florez tabled alongside USA Pulses at the International Lentil Festival in Pullman, WA.

Sept. 8: Gabriela Guerrero Florez tabled at the Culinary Breeding Network's Variety Showcase event in Portland, OR.

Sept. 28: Sarah Dohle presented Bean Talk: Preserving and Sharing Genetic Diversity at the Koppel Farm community garden in Pullman, WA.

Sept. 3: Brian Irish hosted Delita Pardue from Sakata Seed America, toured the facilities and fields and discussed participation of Sakata staff on crop-specific CGCs in the unit.

Sept. 4: The WRPIS hosted Shihomi Uzuhashi and Ebana Kaworu of the National Agriculture and Food Research Organization (NARO), Tsukuba, Japan, to tour the facilities and discuss collaborative activities.

Sept. 17-19: several WRPIS members attended the North American Crop Wild Relatives symposium (virtual). Brian Irish attended virtually some of the presentations given during this year's Crop Wild Relative symposium, held in Denver, CO.

Sept. 23-27: Alex Cornwall attended the American Society of Horticultural Science Conference in Honolulu, Hawaii, and gave a presentation with the abstract: Cornwall, A.; Kowenstrot, A.; Warburton, M.; Miles, C. (2024). Alaska Can Grow More Than Giant Vegetables: The Potential of Rhubarb for Specialty Crop Producers. Oral presentation at The American Society of Horticultural Science Conference, September 27, 2024

Oct. 8: Alex Cornwall was a guest lecturer to the WSU Plant Genomics and Biotechnology class (HORT 480), giving a lecture entitled "Plant Genetic Resources".

Oct. 24: WRPIS hosted the Food Fact and Fun Fest for unit members, past and present, to discuss the history of the unit and present current achievements.

Oct. 28: Paul Galweski and Marilyn Warburton attended the Grass Crop Germplasm Committee meeting (virtual).

Nov. 6-March 31, 2025: Marilyn Warburton and Sarah Dohle hosted visiting PhD student Nicholas Vieira de Sousa from Universidade Estadual de Maringá in Brazil.

Nov. 13-14: Brian Irish and Lisa Taylor was invited to and participated in the Career Fair and student intern recruitment event in Mayaguez, PR. Set up display booth, with flyers, information and keepsakes, and recruited 3-4 students to participate in summer 2025 internship in our Unit.

Nov. 11-13: Marilyn Warburton attended the ASA, CSSA, SSSA annual meeting “CANVAS”. In San Antonio, TX and was the Ron Phillips Plant Genetics Lecturer for the International Annual Meeting November 10-13, 2024, and gave a talk entitled “Unlocking Nature's Vault: Innovative Tools for Plant Genebank Analysis”.

Nov. 18 and 20: Alex Cornwall was a guest lecturer to the WSU Crop Plant Genetics class (HORT 345), giving a lecture entitled “Biodiversity Management”.

Nov. 20: Brian Irish participated and invited to give presentation on behalf of the NPGS to the Idaho and Eastern Oregon Seed Association winter meetings in Boise, ID.

Dec. 2: Sarah Dohle presented Wild Beans and Citizen Science: Enhancing Genetic Resources at the Washing State University Crop and Soils Science weekly seminar series.

Dec. 3: Brian Irish was invited and provided a guest lecture in Per McCord’s HORT 310 Pomology class on tropical tree fruits crops (experience from previous position).

BONUS **(construction pictures)**

Progress images of the construction of the new USDA ARS Building, housing the WRPIS, on the Pullman Campus!

Top row - The old Johnson Hall, being torn down. New building finding its footing. Skeleton complete! Bottom row - Cladding added! Side view with Vogel Plant Science building in background, which the new building joins to. Other side view, with part of the pedestrian bridge to the WSU Plant Sciences building in view. PGITRU will be housed on the second floor.

Top left - Marilyn pointing to the Unit's cold room/seed storage. Bottom left - new genomic laboratory. Middle - Note the Unit's name on the doorway/entrance! Top right - office suites. Bottom right - Breakroom area for second floor.