**State Reports**

**Alaska, Rob Carter -** Not present and no report submitted.

**Arizona, Lisa Taylor**

2018 recipients of W6 germplasm; emailed 9 recipients and 4 responded.

**Lydia Bailey (NAU):** *Amsinckia tessellate* and *Eriogonum nidularium*; **Intended use:** Study of herbicide effect on biological soil crusts, native and non-native plants, and crust effect on plants; Material arrived in good condition and germinated readily; Due to greenhouse mechanical failures with our watering system, I ended up killing all the germinates and ultimately excluded plants from the experiment; It was part of an experiment, but the experiment was redesigned after a pilot and excluded from the final experimental design; No publications

**Kara Gibson (NAU):** *Festuca arizonica*, *Lupinus argenteus*, *Lupinus kingii*; **Intended use:** These seeds will be used in a greenhouse mesocosm experiment investigating interactions among mycorrhizal fungi, microfauna, and mesofauna in soils from untreated vs. thinned and burned ponderosa pine stands at Valles Caldera National Preserve, NM. The experiment will be performed by Mildred Diaz who has received a Hooper Undergraduate Research Award to fund this project. She will plant mesocosms with nonmycorrhizal, ectomycorrhizal, arbuscular mycorrhizal, and legume species. At the conclusion of the experiment, she will quantify mycorrhizal colonization and plant performance; The material arrived in good condition and germinated, rooted, and grew well; Yes, this material was instrumental in completing this undergraduate research project; The plant germplasm was part of a research experiment. We grew only one generation and have no future for the material; We have not completed any publications or news items related to the material, but Mildred Diaz presented the results from her experiment at the NASA Undergraduate Research Symposium.

**Robin Groose:** *Medicago sativa subsp. falcata*; **Intended use:** Public education, demonstrations; Material arrived in good condition. Germinated well and now healthy plants; I am using this purely for demonstration of diploid alfalfa in my garden; No pubs or news.

**Jack Valdivia:** *Lactuca sativa*; **Intended use:** I will research heat tolerance and drought stress in lettuce; (*2019):* "It arrived in good conditions. I sow 15 seeds inside a greenhouse under a blue light and red light. With other lettuce varieties like Grand Rapids, Parris Island COS, and Vulcan. After 2 weeks I had no germination in any of the seeds, so I discard bad germination for slugger. I sow in pots and slugger germinate and grow. I did not have the opportunity to evaluate this year."

Response this year: "The lettuce seed was slugger an Iceberg variety. I planted it on trays but had no luck with the Germination. So, I could not continue the project."

**Mike Cavelle:** *Heracleum sphondylium subsp. Montanum, Epilobium canum subsp. Latifolium*; **Intended Use:** Investigate survivability of hummingbird/bee attracting species that are drought

resistant and high-temperature tolerant; arrived in good condition; have germinated ¼ of sample; No intention to publish is planned.

# 2021 W6 Germplasm requested and distributed to Arizona.

| PI Name | Contact Info | City, State | Category | Species | Common Name | Intended Use |
|---|---|---|---|---|---|---|
| Jon Nickerson | jcn@greengoseed.com | Wellton, Arizona | Private | Lactuca sativa | Lettuce | To breed resistance for Verticillium R.1 into iceberg and romaine. |
| Stephanie Slinski | sslinski@arizona.edu | Yuma, Arizona | Academic | Lactuca sativa | Lettuce | We are using the seed to test populations of Fusarium oxysporum f.sp lactucae. |
| Macgyver Blumenshine | theschoolofneil@gmail.com | Mesa, Arizona | Private | Nepeta cataria | catnip | We are interested in breeding two varietals of catnip; a vining type, and a ground cover type. Our current plan is to grow a few generations within the species, selecting features we want, then cross breeding with hardy species of vining plants/ large ground cover plants. |
| Edauri Navarro-Perez | enavar14@asu.edu | Tempe, Arizona | Academic | Aristida purpurea var. purpurea, Bouteloua gracilis, Elymus elymoides, Elymus trachycaulus, Pascopyrum smithii. | Purple three-awn, Blue grama, Squirreltail, Slender wheatgrass, Western wheatgrass. | My research is focus on understand how root properties/traits vary among different species in different soil conditions. Moreover, how these root properties affect soil properties. |
| Daniel Westwood | drwestwood@email.arizona.edu | Flagstaff, Arizona | Academic | Phaseolus vulgaris, Vicia faba | Common Bean, Fava Bean | Test viability in both northern and southern Arizona climates; compare and contrast Aleppian varietals with native varietals; document historical cultivation and culinary uses and trace to native varieties where possible and demonstrate similarities in cultural backgrounds related to food and agriculture. |
| Jesse Verellen | jesseverellen@email.arizona.edu | Tucson, Arizona | Academic | Phaseolus filiformis | wild bean | This project aims to determine the potential of Phaseolus filiformis as a cultivated, annual food crop, particularly at elevations above its natural range in the Sonoran Desert. First, the various accessions will be evaluated in terms of adaptability to horticultural systems, especially in regards to the presence or absence of delayed germination. Drought tolerance will also be studied carefully; as the most xerophytic of Phaseolus species, it will be illuminating to determine whether a crop could potentially be produced with little or no supplemental irrigation. As the project progresses, selections will likely be made with respect to agronomic qualities, high yield being foremost among them. Other characteristics may be explored as well, in terms of selecting for early maturity, and examining if cold or frost tolerance could be selected for. In any case, Phaseolus filiformis displays many fascinating and possibly useful traits, and deserves to be planted, grown, and studied in depth. |
| Desalegn Serba | des.serba@usda.gov | Maricopa, Arizona | Government | Sporobolus airoides, Sporobolus wrightii, Achnatherum hymenoides, Elymus elymoides subsp. Brevifolius | Alkali sacaton, giant sacaton, Indian ricegrass, squirreltail. | To evaluate for turf and study the genetic diversity |
| Zach Williamson | zlwilli@email.arizona.edu | Tucson, Arizona | Academic | Phaseolus vulgaris | Common Bean | Serial passages and propagation of several isolates of BCMV/BCMNV. |
| Lydia Bailey | LydiaNBailey@gmail.com | Flagstaff, Arizona | Academic | Amsinckia tessellata, Eriogonum nidularium | Fiddlenecks, Wild Buckwheat | Study of herbicide effect on biological soil crusts, native and non-native plants, and crust effect on plants. |
| Fernando Campa | fcampa01@icloud.com | Yuma, Arizona | Private | Lactuca sativa | Lettuce | Compare old varieties with new actual varieties |
| Mike Cavalle | Michaelcavalle@gmail.com | Yuma, Arizona | Private | Heracleum sphondylium subsp. Montanum, Epilobium canum subsp. Latifolium | Hogweed, Hummingbird Trumpet | Investigate survivability of hummingbird/bee attracting species that are drought resistant and high-temperature tolerant. |
| Kara Gibson | ksg75@nau.edu | Flagstaff, Arizona | Academic | Lupinus kingii, Lupinus argenteus, Festuca arizonica | King's lupine, Silvery Lupine, Arizona Fescue | Greenhouse mesocosm experiment investigating interactions among mycorrhizal fungi, microfauna, and mesofauna in soils from untreated vs. thinned and burned ponderosa pine stands at Valles Caldera National Preserve, NM. The experiment will be performed by Mildred Diaz who has received a Hooper Undergraduate Research Award to fund this project. She will plant mesocosms with nonmycorrhizal, ectomycorrhizal, arbuscular mycorrhizal, and legume species. At the conclusion of the experiment, she will quantify mycorrhizal colonization and plant performance. |
| Robin Groose | groose@uwyo.edu | Tucson, Arizona | Academic | Medicago sativa subsp. Falcata | Yellow Alfalfa | Public education |
| Shannon Lencioni | slencioni@usgs.gov | Flagstaff, Arizona | Government | Achnatherum hymenoides | Indian Ricegrass | To understand the genetic differences of the species through out the arid west to better provide information on seed zones for restoration. |
| Steven Smith | azalfalf@ag.arizona.edu | Tucson, Arizona | Academic | Medicago sativa subsp. Sativa | Alfalfa | Standard Checks |
| Mike Tolliver | contaminatedsoulz@yahoo.com | Phoenix, Arizona | Private | Artemisia vulgaris, Phaseolus vulgaris, Beta vulgaris subsp. Vulgaris | Common Mugwort, Common Bean, Sugar Beet | Public education, demonstrations. Research use notes - We established multiple community gardens that are located in urban neighborhoods to alleviate the food desert effect. Food accessibility are more difficult wihin urban areas were residents who have limited access to fresh produce such as fruits and vegetables. Food deserts often serve lower-income neighborhoods usually in which residents are forced to rely on unhealthy food options such as expensive processed foods from convenience stores, gas stations, and fast-food restaurants. Our Community gardens provide accessibility for fresh food to be in closer proximity located in local neighborhoods. |
| Jack Valdivia | jjvaldivia@hotmail.com | San Luis, Arizona | Private | Lactuca sativa | Lettuce | I will research heat tolerance and drought stress in lettuce. |
| Zachary Ventrella | zachary.ventrella@nau.edu | Flagstaff, Arizona | Academic | Asclepias subverticillata, Astragalus lonchocarpus, Brickellia californica, Dieteria canescens var. canescens, Erigeron divergens, Eriogonum racemosum, Gutierrezia sarothrae, Heterotheca villosa, Penstemon strictus, Purshia mexicana. | Horsetail milkweed, Milkvetch, California Brickelbush, hoary tansyaster, spreading fleabane, wild buckwheat, snakeweed, hairy goldenaster, Rocky Mountain Beardtongue, Mexican cliffrose. | Provenance study of common pollinator plants used in restoration of western arid lands. Through this work, we hope to develop better seed zone guidelines and predict pollinator response to climate change. The second phase of the study will be to plant seed production trials to implement a farm based seed development program for pollinator plants. For the common garden provenance trials, we are hoping to plant materials from across the CO Plateau with varying environmental characteristics and geographic distance. In addition to these populations, we would like to have some from other ecoregions in the arid west. |
| Zachary Ventrella | zachary.ventrella@nau.edu | Flagstaff, Arizona | Academic | Olneya tesota | ironwood | Our group at NAU will be studying multi species restoration on the Salt River. We would like to use Ironwood as one of our test species. |
| Zachary Ventrella | zachary.ventrella@nau.edu | Flagstaff, Arizona | Academic | Asclepias subverticillata, Astragalus lonchocarpus, Brickellia californica, Dieteria canescens var. canescens, Erigeron divergens, Ericameria nauseosa, Heterotheca villosa, Penstemon strictus, Purshia mexicana. | Horsetail milkweed, milkvetch, California brickelbrush, hoary tansyaster, spreading fleabane, Chamisa, hairy goldenaster, Rocky Mountain Beardtongue, Mexican cliffrose. | Pollinator plant provenance trial project with replication at 3 different locations across the Colorado Plateau. The trials will help to determine pollinator plant fitness in response to climate change. The project is funded by a USDA AFRI grant, awarded to Kevin Grady, PhD Northern Arizona University. |

**California, Charles Brummer**

Charlie Brummer emailed ~45 individuals who resided in California and had requested germplasm from one or more NPGS repositories in 2021 and ~75 who requested in 2018 (some overlap between the groups) and received 23 replies. Overall, people are extremely thankful for the NPGS and happy with the service from NPGS. Several concerns were raised by the users.

- Requestors do not necessarily know the curators (or that there even are curators) and are (apparently) unaware that they can contact curators with questions, special requests, etc. I wonder if there should be a more transparent way for people requesting germplasm to contact the curator.
- One requestor mentioned that finding the GRIN-Global portal was difficult and they had to get it from another user. I'm not entirely sure what to do about this, or if it's a real problem, but I have also had difficulty at various times trying to find the search page starting from a blank Google search.

Survey Questions Included:

1. *Did you receive your order in a timely fashion, were the seeds/propagules in good condition, and were you able to use the materials for the purpose you wanted?* (Yes – 22; No – 1)

   - Yes and no, it took a while to receive the seeds and not all of them had the germination % indicated on the bag

2. *How did you use the materials you received?*

| | |
|---|---|
| Variety Development | 3 |
| Research | 15 |
| Education | 5 |
| Other | 3 |

   - Use the seed to interplant between my new orange trees. I was looking for a nitrogen fixer for soil health.
   - Primarily as standard checks for Fall dormancy and disease standard tests.
   - Not used to date; maintained in freezer
   - Within two research projects, in the first project we phenotyped the germplasm for agronomic and N traits, and currently testing a small selection of the population in cover crop mixes.
   - The order was for 5 accessions (maintained as *Thinopyrum elongatum*) for which the chromosome number indicated by NPGS data was 2n=56, contrary to the diploid number (2n=14) expected for material with that binomial.

3. *Did you release any plant material(s) in 2021 that were partially or fully derived from NPGS germplasm?* (Yes – 0; No – 20)

   - Not directly, but "UC Tiger's Eye" may be ultimately derived from the Chilean introduction PI 282054, but it is hard to say definitively. Other recent releases are derived from materials that are in NPGS, but whether they were sourced from this at some point is unclear.

4. *Did any of your publications from NPGS germplasm?* (Yes – 5; No – 15)

   - Parker, T., & Gepts, P. (2021), Population genomics of *Phaseolus* spp.: A domestication hotspot. In: Rajora OP (ed) Population Genomics: Crop Plants. Springer Nature Switzerland.

- Parker, T., Palkovic, A., Brummer, E. C., & Gepts, P. (2021). Registration of 'UC Sunrise'heirloom-like orange and white mottled bean. *Journal of Plant Registrations*, *15*(1), 43-47.
- Parker, T., Palkovic, A., Brummer, E. C., & Gepts, P. (2021). Registration of 'UC Southwest Red' heirloom-like red and white mottled bean. *Journal of Plant Registrations*, *15*(1), 21-27.
- Parker, T., Palkovic, A., Brummer, E. C., & Gepts, P. (2021). Registration of 'UC Southwest Gold' heirloom-like gold and white mottled bean. *Journal of Plant Registrations*, *15*(1), 48-52.
- Parker, T., Palkovic, A., Brummer, E. C., & Gepts, P. (2021). Registration of 'UC Rio Zape' heirloom-like dry bean. *Journal of Plant Registrations*, *15*(1), 37-42.
- Parker, T., Palkovic, A., Brummer, E. C., & Gepts, P. (2021). Registration of 'UC Tiger's Eye' heirloom-like dry bean. *Journal of Plant Registrations*, *15*(1), 16-20.
- Parker, T. A., Cetz, J., de Sousa, L. L., Kuzay, S., Lo, S., de Oliveira Floriani, T., ... & Gepts, P. (2022). Loss of pod strings in common bean is associated with gene duplication, retrotransposon insertion, and overexpression of PvIND. *New Phytologist*.
- Parker, T. A., Berny Mier y Teran, J. C., Palkovic, A., Jernstedt, J., & Gepts, P. (2020). Pod indehiscence is a domestication and aridity resilience trait in common bean. *New Phytologist*, *225*(1), 558-570.
- Abbasi J, Dehghani H, Dvorak J, McGuire PE. 2020. Perennial growth and salinity tolerance in wheat×wheatgrass amphiploids varying in the ratio of wheat to wheatgrass genomes. Plant Breeding 139(6):1281–1289. doi: 10.1111/pbr.12856
- LoPresti, EF, VS. Pan, J. Goidell, M.G. Weber, & R. Karban. (2019) Mucilage-bound sand reduces seed predation but not by reducing apparency; a field test of 53 plant species. Ecology, e02809.
- Pan, VS, M McMunn, R Karban, J Goidell, MG Weber, EF LoPresti. (2021) Mucilage binding to the ground protects seeds of many plants from harvester ants: a functional investigation. Functional Ecology, 35: 2448-2460
- Pan, VS, C Girvin, EF LoPresti. Attachment strength of seed mucilage prevent seed dislodgement in high surface flow: a mechanistic investigation. Annals of Botany, mcac045, doi: 10.1093/aob/mcac045
- The following publications are made from the studies where we grow the germplasm; https://doi.org/10.1002/csc2.20794; https://doi.org/10.1002/agj2.21032; https://doi.org/10.1002/agj2.20717.

5. *Do you have any comments, questions, or suggestions regarding the germplasm repository you worked with, about the germplasm system in general, or about the use of the germplasm you received that you would like to share with the committee?*

- The germplasm allowed us to prepare preliminary results for grant applications to fund our research and we are preparing manuscripts for publications (submission planned in 2022).
- I am in the process of putting together a manuscript regarding said germplasm. We were very appreciative of the seeds we received. This service provided by the USDA is invaluable to research. At the time, I was working in collaboration with the University of California, Davis.
- The seeds were used to train RST's, registered seed technologists, and placed in seed herbariums.
- Using the germplasm to find disease resistance to incorporate into our breeding lines.
- Everything was generally great. It would be good if along with the seeds collection years and locations were included, it took me a while to track down collection locations for each accession. Additionally, it would have been helpful to be able to place multiple orders for an accession at once and have an option to explain why the additional seeds are necessary rather than needing to keep placing single orders over time.

- Excellent quality and service. Thanks! Sending my thanks to all the folks affiliated with GRIN-NPGS, it's an amazing resource, and I hope that is recognized!
- Thanks for the excellent service from the NPGS.
- We have taken photos of the seeds that we harvested from our plots and publish them in this website. Feel free to include it to the germplasm information if you find it useful. I should mention that some of these seeds might be different from the original seeds that we received, and some lines had mix seeds in them, so we tried to select the best representative of each line. Thanks – Hossein. https://www.favabeanresearch.com/germplasm

**Colorado, Geoff Morris** – Not present and no report submitted.

**Hawaii, Ahmad Amjad**

In 2021, there was one NPGS – W6 orders received from the University of Hawaii at Manoa. The order was used for evaluation for the micro-climates in Hawaii to determine best suitable locations to grow Nuña beans, in preparation for a large-scale project/proposal with multiple states in the Western region.

Summary table of 2021 germplasm users for the State of Hawaii.

| User | Organization | Phone | Email | Order# | Species | # | Intended Use |
|---|---|---|---|---|---|---|---|
| Amjad Ahmad | University of Hawaii | 808-724-9011 | alobady@hawaii.edu | 336271 | Phaseolus vulgaris | 8 | Statewide evaluation for suitability to micro-climates. The beans is currently tested for year 2 to confirm the results of year 1 of the evaluation. The evaluation is part of a NIFA proposal submission for Nuna beans for value-added production with multiple Western region states. No publications yet, since the evaluation is still on going. |

**Idaho, Joseph Kuhl**

In 2021, 1,561 items were requested in Idaho from the National Plant Germplasm System. The total number of items was like 2019 and 2020 when 1,385 and 1,683 items were requested, respectively. A total of 24 orders were placed from Idaho in 2021, considerably lower than the number of orders placed in 2019 and 2020 when 79 and 70 were placed, respectively). The major user group (assessed by the number of items requested) in 2021 was privates companies requesting 883 (57%), a close second was USDA scientist with 702 items (45%). In past years USDA, ARS scientists have been the major user group requesting more items than other groups. Among private companies 25:2 Solutions LLC requested 855 (96%) items requested by companies and 55% of the total items requested. The number of requestors in 2021 by individuals, companies, state, and federal entities was 2, 5, 2 and 3.

In 2018, 108 items were requested in Idaho from the National Plant Germplasm System. A total of 16 orders were placed in Idaho in 2018. A total of 12 requestors placed orders including individuals, companies, state, and federal entities 1, 5, 2, and 2, respectively.

**Montana. Michael Giroux/Matt Lavin**

Michael Giroux is stepping down as the Montana representative and Matt Lavin is replacing him.

Summary table of 2021 germplasm users for the State of Montana. In 2021, there were five NPGS – W6 orders received. All orders will be used for either variety development, genetic diversity studies, botanical/taxonomic research, and plant pathology studies; There were only three unique users, two from Montana State and one from the USDA.

| User | Organization | Phone | email | order | Species | # | Intended Use |
|---|---|---|---|---|---|---|---|
| Allison Rognlie | Montana State University | 406-994-2231 | allison.rognlie@montana.edu | 332012 | *Phaseolus vulgaris* | 1 | Botanical/Taxonomic Investigations. Research use notes: We have discovered a highly variable DNA sequence in Pisum and want to know if we can distinguish most of the Pisum core collection and all P. fulvum using this sequence. We only need a small number of the core accessions because we already have most of them. |
| Allison Rognlie | Montana State University | 406-994-2232 | allison.rognlie@montana.edu | 332012 | *Beta vulgaris subsp. vulgaris* | 1 | Public Education, Demonstrations. Research use notes: Seed increase for developing an indigenous seed bank at Montana State University |
| Allison Rognlie | Montana State University | 406-994-2233 | allison.rognlie@montana.edu | 332762 | *Phaseolus vulgaris* | 1 | Public Education, Demonstrations. Research use notes: Seed increase for developing an indigenous seed bank at Montana State University and a seed saving program serving Montana's indigenous communities. |
| John Gaskin | USDA ARS-Sidney, MT | (406) 433-9444 | john.gaskin@ars.usda.gov | 336903 | *Hydrolea ovata* | 1 | Entomological Investigations. Research use notes: Test that a biocontrol agent of field bindweed does not attack this closely related plant species |
| John Gaskin | USDA ARS-Sidney, MT | (406) 433-9445 | john.gaskin@ars.usda.gov | 340091 | *Lupinus albifrons* | 1 | Weed Science. Research use notes: Host specificity studies for biocontrol of related weeds. Seeds will be passed on to USDA ARS EBCL in Montpellier, France. Thank you! |
| Norman Weeden | Montana State University | 406-994-5171 | nweeden@montana.edu | 332439 | *Pisum sativum or Pisum fulvum* | 41 | Botanical/Taxonomic Investigations. Research use notes: We have discovered a highly variable DNA sequence in Pisum and want to know if we can distinguish most of the Pisum core collection and all P. fulvum using this sequence. We only need a small number of the core accessions because we already have most of them. |

Summary table of 2018 germplasm users for the State of Montana.

Twenty-three recipients received a total of 2,394 plant germplasm accessions in Montana during the last year. 1,723 of the accessions went to one private breeder with the next biggest portion (369) going to Montana State pulse breeder Kevin McPhee.

| NPGS Site | Sent # | Species | Primary Purposes |
|---|---|---|---|
| DAV | 1 | grapes | Breeding cold hardiness |
| NE9 | 1 | Tomatoes | Educational |
| NSSL | 1 | cereals | Varietal development |
| SOY | 2 | soybean | Varietal development |
| NC7 | 29 | Corn, camelina | Varietal development |
| COR | 30 | Raspberry, apples, pears | Breeding for short season fruit varieties |
| S9 | 71 | Guar, cowpea | Guar breeding, cowpea for sawfly parasitoids |
| GEN | 72 | Grapes, raspberries, apples | Home orchard breeding and demonstrations |
| W6 | 416 | Pulse crops | Pulse crop breeding, genetics studies, disease |
| NSGC | 1772 | Wheat and wheat relatives | Breeding and production of “ancient grains” |
| Total | 2395 | | |

We also continue to have several individuals requesting accessions of various species including tree fruit and raspberries to screen for those that may tolerate MT winters.

**Publications:**


- Adhikari, S., Menalled, F., Weaver, D. (2018) Farming system and wheat cultivar affect infestation of, and parasitism on, *Cephus cinctus* in the Northern Great Plains. Pest Management Science: v. 74 i. 11 p. 2480-2487
- Banerjee, A.K., Harms, N.E., Mukherjee, A., Gaskin, J.F. 2020. Niche dynamics and potential distribution of *Butomus umbellatus* under current and future climate scenarios in North America. Hydrobiologia. DOI: 10.1007/s10750-020-04205-1.
- Blake, N. K., Varella, A. C., Bicego, B., Martin, J. M., Cook, J. P., Heo, H. -., Acharya, R., Sherman, J. D., Nash, D., Talbert, L. (2018) Maturity traits related to climate adaptation affect quality characteristics in hard red spring wheat. Crop Science: i. 58 p. 1954-1963

- Brown, M.M., J.M. Martin, A.C. Hogg, L. Wright, C. Hale, P.M. Carr, and M.J. Giroux. Teosinte Branched 1 mutations increase tillering. Crop Science, published June 2022.
- Brown, M.M., J.M. Martin, E.M. Jobson, A.C. Hogg, P.M. Carr, and M.J. Giroux. (2022). Evaluating the impact of Rht hypomorphic mutations in durum wheat. Crop Science 62, 247-258. https://doi.org/10.1002/csc2.20672
- Chang, H., Sang, H., Wang, J., McPhee, K. E., Zhuang, X., Porter, L., Chilvers, M. (2018) Exploring the genetics of lesion and nodal resistance in pea (*Pisum sativum* L.) to *Sclerotinia sclerotiorum* using genome-wide association studies and RNA-Seq. Plant Direct: p. 1-17
- Cook, J. P., Acharya, R. K., Martin, J., Blake, N. K., Khan, I. J., Heo, H., Kephart, K., Eckhoff, J., Talbert, L., Sherman, J. (2021) Genetic Analysis of Stay-Green, Yield and Agronomic traits in Spring Wheat. Crop Science/Crop Science Society of America: v. 61 i. 1 p. 383-395.
- Dyer, W., Burns, E. E., Keith, B., Talbert, L. (2018) Non-target site resistance to flucarbazone, imazamethabenz, and pinoxaden is controlled by three linked genes in Avena fatua L. Weed Research: v. 58 p. 8-16
- Echegaray, E. R., Barbour, C. R., Talbert, L., Stougaard, R. N. (2018) Evaluation of *Sitodiplosis mosellana* (Diptera: Cecidomyiidae) infestation and relationship with agronomic traits in selected spring wheat cultivars in northwestern Montana, United States of America. The Canadian Entomologist: v. 150 p. 675-683
- Gaskin, J.F., Coombs, E., Kelch, D., Keil, D., Porter, M., Susanna, A. 2020. A species of plumeless thistle, *Carduus cinereus* (Asteraceae), new to North America. Madrono. 66(4):142-147. DOI: 10.3120/0024-9637-66.4.142.
- Godoy, J., Gizaw, S., Chao, S., Blake, N., Carter, A., Cuthbert, R., Dubcovsky, J., Hucl, P., Kephart, K., ... Talbert, L. (2018) Genome-wide Association Study (GWAS) of Agronomic Traits in a Spring Planted North American Hard Red Spring Wheat Panel. Crop Science/Crop Science Society of America: v. 58 p. 1838-1852
- Hogg, A., P. Carr, J. Eberly, C. Chen, C. Kowatch, F. Crutcher, P. Lamb, K. McNamara, E. Haney, K. Kephart, V. Smith, L. Dykes, X. Chen, L. Huang, and M.J. Giroux. Registration of 'Lustre' Durum Wheat. Journal of Plant Registrations, Accepted January 18, 2022, in press.
- Jobson, E. M., Johnston, R. E., Oiestad, A. J., Martin, J. M., Giroux, M. (2019) The wheat Rht-B1b semi-dwarfing allele reduces flag leaf photosynthetic rate and modifies seed development. Frontiers in Plant Science: v. 10 i. 51
- Jobson, E. M., Martin, J. M., Schneider, T. M., Giroux, M. (2018) The impact of the Rht-B1b, Rht-D1b, and Rht-8 wheat semi-dwarfing genes on flour milling, baking, and micronutrients. Cereal Chemistry: v. 95 p. 770-778
- Jobson, E.M., J.M. Martin, R. Sharrock, A.C. Hogg, and M.J. Giroux. (2021a). Identification and molecular characterization of novel Rht-1 alleles in hard red spring wheat. Crop Science. 61:1030–1037. https://doi.org/10.1002/csc2.20375
- Jordan, K., Wang, S., He, F., Chao, S., Lun, Y., Paux, E., Sourdille, P., Sherman, J., Akhuovna, A., ... Talbert, L., ... Akhunov, E. (2018) The genetic architecture of genome-wide recombination rate variation in allopolyploid wheat revealed by nested association mapping. The Plant Journal: v. 95 p. 1039–1054
- Sherman, J., Varella, A., Lanning, S., Martin, J., Heo, H., Nash, D., Blake, N., Cook, J., Talbert, L. (2018) Effect of a gene for high dough strength on whole wheat baking parameters of hard white spring wheat. Cereal Chemistry: v. 95 p. 411-417
- Varella, A. C., Talbert, L., Achhami, B. B., Blake, N. K., Hofland, M. L., Sherman, J., Lamb, P., Reddy, G., Weaver, D. (2018) Characterization of resistance to *Cephus cinctus* Norton (Hymenoptera: Cephidae) in barley germplasm. no. Journal of Economic Entomology: v. 111 i. 2 p. 923-930
- Jobson, E.M., J-B. Ohm, J.M. Martin, and M.J. Giroux. (2021b) Rht-1 semi-dwarfing alleles increase the abundance of high molecular weight glutenin subunits. Cereal Chemistry 98:337-345.

- Swaminathan, P., Ohrtaman, M., Carinder, A., Deuja, A., Gaskin, J.F., Fennell, A., Clay, S. 2020. Water deficit transcriptomic responses differ in the invasive *Tamarix chinensis* and *T. ramosissima* established in the southern and northern United States. Plants. 9(1):86. DOI: 10.3390/plants9010086.
- Vetch, J.M., B. Tillett, J.M. Martin, A.C. Hogg, and M.J. Giroux. TaMFT homeologs are associated with preharvest sprouting in winter wheat. Plant Genome, published online 6/2022.
- Weeden, N., Coyne, C., Lavin, M., McPhee, K. E. (2021) Distinguishing among *Pisum* accessions using a hypervariable intron within Mendel's green/yellow cotyledon gene. no. Genetic Resources and Crop Evolution: v. 68 p. 2591-2609.

**Nevada, Melinda K. Yerka**

**Summary:** Table 1 summarizes NV use of the NPGS in 2021. Five (10 in 2017, 15 in 2018, 13 in 2019, 14 in 2020) individuals from Nevada placed 10 orders (17 in 2017, 39 in 2018, 30 in 2019, 26 in 2020) and received 154 (91 in 2017, 2138 in 2018, 193 in 2019, 331 in 2020) accessions from the NPGS in 2021. Researchers affiliated with the Nevada System of Higher Education (NSHE, includes the University of Nevada System and the Desert Research Institute, DRI) continue to be the primary institutional users (139 accessions, 90%). All users were contacted via email and 1 out of 5 responded. Users reported no manuscripts published.

| PI Name | Contact Info | City, State | Category | Species | Common Name | Intended Use |
|---|---|---|---|---|---|---|
| Donna Harris | Donna.Harris@uwyo.edu | Sheridan, Wyoming | Academic | Phaseolus vulgaris Phaseolus acutifolius | Common Bean, Tepary Bean | Dry bean breeding program |
| Donna Harris | Donna.Harris@uwyo.edu | Sheridan, Wyoming | Academic | Psium (multiple species) | Pea | Genetic studies for drought resistance and potentially for breeding purposes. |
| Donna Harris | Donna.Harris@uwyo.edu | Sheridan, Wyoming | Academic | Elymus (Multiple species) Festuca idahoensis, Koeleria macrantha, and Pseudoroegneria spicata. | Wheatgrass, Fescue, Junegrass | Breeding for restoration purposes in native grasslands. |
| Donna Harris | Donna.Harris@uwyo.edu | Sheridan, Wyoming | Academic | Phaseolus vulgaris | Common Bean | Identify genomic regions controlling popping trait and introgress into elite material for breeding purposes. |
| John Temte | johntemte@gmail.com | Cody, Wyoming | Private | Poa pratensis | Kentucky Bluegrass | NSF grant to better understand the genome of Kentucky Bluegrass, and we will genome size/genotype these lines and sequence the genome of Kentucky Bluegrass. |
| Jim Heitholt | Jim.Heitholt@uwyo.edu | Powell, Wyoming | Academic | Cicer arietinum | Chickpea | Screen for tolerance to drought using deficit irrigation. In 2020 and 2021: screened six released cultivars and now we need to look at chickpea mini-core. |

| | Pathology | Genetics | Chemistry | Variety Devo | Education Teaching | Taxonomy | Anthro-pology |
|---|---|---|---|---|---|---|---|
| **# accessions used for each purpose** | 0 | 0 | 0 | 15 | 0 | 35 | 95 |
| | | | | | | | |
| **accessions used for each purpose** | 0 | 0 | 0 | 9.7% | 0 | 22.7% | 61.6% |
| | | | | | | | |

**Katelyn McDonough**, UNR Dept. of Anthropology. Research use notes: Botanical/Taxonomic Investigations. These seeds will be used to build a comparative botanical collection for paleoethnobotanical analysis. This collection will be made available for archaeological research and for educational purposes.

**David Rhode**, Desert Research Institute (DRI). Research use notes: Historical, Cultural and Anthropological Research. Research use notes: Archaeological and paleoenvironmental seed identification, identification of archaeological and paleoenvironmental collections and training students in seed identification, identification of seed remains from paleoenvironmental and archaeological contexts, reference specimens to identify archaeological, ethnographic, and paleoenvironmental collections.

**Laura Shriver**, UNR Dept. of Biology. Research use notes: Botanical/Taxonomic Investigations: Evaluating past SOS collections with contemporary re-collections from the same population. I am doing this in a paired

design with one population that has burnt between collection times, and "unburned pair" of another population of the same species, from as close-by as possible, collecting in a similar timeframe that did not burn between collection dates. I am growing out the seeds and comparing before/after and burnt/unburnt to see if the populations may be evolving in response to fire. We are asking 1) how plant traits have changed over time in burned vs. unburned populations and 2) if burned populations are better competitors with cheatgrass.

**Cathy Silliman**, UNR Dept. of Biochemistry & Molecular Biology. Research use notes: Botanical/Taxonomic Investigations. The purpose of these seed lots is to investigate different traits of species along their range between the Mojave and Great Basin Deserts. Germination and greenhouse experiments will be conducted, and the results will used to obtain funding for a master's project on climate change.

**Hal Barkdull**, no affiliation listed. Research use notes: Varietal Development – Breeding. Looking to breed plants that withstand the unique climate of the high mountain desert of Nevada.

**New Mexico, Ian Ray**

Five individuals from New Mexico placed 5 orders and received 11 accessions from the W6 program in 2021. New Mexico State University was the largest user of these materials (82%), followed by Los Alamos National Labs (9%), and the general public (9%). See Table below.

| PI | Contact Info. | City | Public/Private/ Government/ Academic | Species (no. accessions) | Common name | Intended use |
|---|---|---|---|---|---|---|
| Tiana Nez | beall33@nmsu.edu | Las Cruces | Academic | Sporobolus contractus (4) | Spike dropseed | Botanical research |
| Sara Fuentes-Soriano | sfuensor@nmsu.edu | Las Cruces | Academic | Heterotheca subaxillaris (2) | Golden aster | Weed science research |
| Ian Ray | iaray@nmsu.edu | Las Cruces | Academic | Medicago sativa (3) | Alfalfa | Breeding & genetics research |
| Kyra Gonzalez | kegonzalez@lanl.gov | Los Alamos | Government | Brachypodium distachyon (1) | Purple false bromegrass | Research |
| Laurel Goodluck | laurie.goodluck@gmail.com | Albuquerque | Public | Phaseolus vulgaris (1) | Common bean | Historical/cultural/ anthropological research |

Notes:
T. Nez, Graduate student research on *Sporobolus* seed germination.
S. Fuentes-Soriano, weed science, survey morphological traits.
I. Ray, provide salt tolerant/sensitive controls for undergraduate research internship related to alfalfa genome-wide association study of seed germination salt tolerance.
K. Gonzalez, research – lab testing.
L. Goodluck, writing a non-fiction children's book on indigenous food sovereignty… I am requesting seeds that are part of my Native American Heritage for research (Agency: https://www.fullcircleliterary.com)

**2018 follow-up report:** Six individuals from NM collectively received a total of 89 accessions from the W6 program in 2018. New Mexico State University was the largest user of these materials (95%). Four germplasm recipients did not respond to the follow-up inquiry including: Melanie Gisler (Institute for Applied Ecology, nonprofit org.), Loretta Sandoval (general public), Attelia Hollander (Los Alamos National Labs), Rachel Hosna (graduate student who completed degree and is no longer at NMSU). Two recipients responded including Drs. Chris Cramer and Ian Ray (on behalf of Harpreet Kaur). See below.

**PI:** Chris Cramer, New Mexico State University
**Species:** Received 78 accessions representing a diverse array of 29 species
**Stake Holder:** General agricultural producers.

**Use/Impact:** Accessions will be evaluated for attractiveness to pollinators and beneficial insects. Chris Cramer stated the following: "The progress so far is that several of the species are waiting to be evaluated. I have plants of some accessions that are in pots or in a field at the Fabian Garcia Science Center waiting to be evaluated at a final location, the NMSU botanic garden. Currently the garden is not yet ready to receive those plants as the infrastructure is not complete and will not support the growth of plants. Initially when we received seeds, some accessions did not produce any plants as no seeds germinated. Of the accessions that produced plants, I have lost plants of some accessions due to the long period of time since the seed was obtained and the inability of plants to survive that long in pots. Some of the accessions produce plants abundantly such that they became weedy in our environment. I am still seeing seedlings of those species germinating around the farm. Plants of some accessions died because they were not cold hardy here in NM. With a quick look of the list, a currently have plants of ~15 accessions from the list. Once the irrigation system is installed in the botanic garden, I would be interested in revisiting some of the requested accessions to see how the plants perform under different circumstances." **Data/Publications:** None indicated.

**PI:** Harpreet Kaur, Ph.D. candidate at New Mexico State University (Advisor: Ian Ray)
**Species:** 3 accessions of *Medicago sativa* (alfalfa)
**Stake Holder:** Alfalfa seed industry and New Mexico hay growers
**Use/Impact:** The 3 accessions provided tolerant/susceptible controls for conducting Ph.D. research for alfalfa genome-wide association studies (GWAS) of resistance to *phytopthora* seedling root rot. This disease is a major cause of seedling and mature plant death in most alfalfa producing areas in North America.
**Data/Publications:** Phenotypic data for resistance to *Phytophthora megasperma* were collected from 150 seedlings each of 250 half-sib families derived from an elite NMSU breeding population. The study was repeated twice. GWAS analyses of these data, in conjunction with >10,000 DNA markers, are being conducted to identify alfalfa genome regions that are associated with *P. megasperma* resistance. The data are also being analyzed using multiple genomic selection models to identify superior models for accelerating improvement of alfalfa resistance to this disease. A Ph.D. dissertation describing these results will be defended in summer 2022 and will be submitted for peer-reviewed publication in fall 2022.

**Oregon, Shaun Mehlenbacher**

Oregonians continue to use the PI system extensively. Users include state and federal researchers as well as private seed companies and private individuals. Oregon is a major user in the western region, along with California and Washington. This report is for the work conducted by Oregon's state representative S. Mehlenbacher who has a W-6 companion research project.

**Shawn A. Mehlenbacher**, Dept. of Horticulture, Oregon State Univ., Corvallis, OR 97331.

**Identify high level eastern filbert blight (EFB) resistance.** We continue to identify sources of high-level EFB resistance and assign each major locus to a linkage group (LG). In cooperation with Tom Molnar at Rutgers University, we have identified more than 100 sources of resistance. Resistant accessions are crossed with susceptible selections, and the resulting seedlings exposed to EFB under a structure topped with diseased branches. In progenies that segregate 1:1 (resistant: susceptible), resistance is assigned to a LG based on correlation with mapped simple sequence repeat (SSR) markers, with the initial focus on regions where resistance was previously mapped (LGs 6, 2 and 7). Resistance assigned in the past year is two Crimean selections (H3R07P07 and H3R07P11) to LG6; 3 Turkish selections (OSU 1229.082, OSU 1240.131 & OSU 1289.028) and OSU 1168.098 from Sochi, Russia to LG2, and Crimean selection H3R12P62 to LG7. To date, 30 sources have been assigned to a LG: 17 on LG6, 5 on LG2, 8 on LG7. Resistance from 20 sources (13 *C. avellana*, 2 *C. americana*, 5 hybrids) has not yet been assigned, but crosses have been made to investigate them.

SSRs developed by previous grad students Merve Şekerli and Golnaz Komaei Koma were published in two articles, one in the Journal of the American Society for Horticultural Science and the other in Frontiers in Plant Science, and those on LG6 or LG2 or LG7are currently being used. Resistance from five other sources was not correlated with markers on LG6 or LG2 or LG7 and merit further investigation: Moscow #37, selection H3R07P11 from Crimea, hybrid selection OSU 401.014, *C. americana* 'Winkler' and *C. americana* OSU 366.060. Additional SSRs were chosen at 25 cM intervals on all LGs for use when resistance is not mapped to LG 6, 2 or 7. Segregation results showed that Dickum Hybrid OSU 1044.086 (presumably *C. americana* x *C. avellana*) and three selections (OSU1233.007, 1233.145, and 1242.146) from seeds collected in Giresun, Turkey transmit resistance to about half of their offspring. These new sources of resistance will be assigned to a LG in the future.

**Pairwise crosses were made** to combine pairs of R genes. A few selections with "R gene pyramids" are in replicated yield trials and more seedlings are in the field.

**Fine mapping.** Ph.D. students Brianna Heilsnis and Rion Mooneyham are fine mapping the EFB resistance regions on linkage groups (LGs) 2 and 7, respectively. Fine mapping populations were generated for LG2 resistance [sources OSU 759.010 (Georgia) and OSU 1187.101 (Holmskij, Russia)]. Fine mapping populations were generated for LG7 resistance [sources 'Ratoli' (Spain) and OSU 1166.123 (Sochi, Russia)]. Seedlings that show recombination in a 20 cM region surrounding the resistance loci are the focus for disease inoculation and further mapping. Many new DNA markers will be developed in the target regions.

**Quantitative resistance.** The OSU hazelnut breeding program has also identified a diverse set of 78 selections with a level of quantitative resistance similar to the checks 'Sacajawea' and 'Tonda di Giffoni'. These develop a few small cankers following structure exposure. The selections with few and smaller cankers include 'Mortarella', 'Sant Pere', 'Closca Molla', 17 selections of Turkish origin, and 19 others from eastern Europe/Caucasus. The numbered selections are from imported seed lots shared by OSU and Rutgers. Testing is being repeated to better document the resistance. For further genetic studies, selections with quantitative resistance were crossed in pairs and the seedlings planted in NJ and MO along with the parents.

**Hybrid hazelnuts.** Selections from crosses of the American hazel (*Corylus americana*) and the European hazel (*C. avellana*) were exposed under the structure. Of the 48 selections recently tested, 23 had more disease than the check 'Sacajawea', 16 had less disease than 'Sacajawea', and an additional 9 had no cankers. It appears that the American hazel transmits quantitative as well as major gene resistance. Selections from the $F_1$ generation and seedlings of the $F_2$ generation (from pairwise crosses of unrelated $F_1$ selections) are being shared with partners at Rutgers Univ., Univ. of Nebraska-Lincoln, and Univ. of Missouri). Early results from NJ show that most of the $F_1$ parents expressed moderate to severe EFB, but segregation in the $F_2$ followed a distribution curve expected for quantitatively controlled traits; tolerance and resistance were recovered in the offspring. Transgressive segregation was common; individual seedlings had less EFB than either parent. The results support development of $F_2$ populations.

**Pollen-stigma incompatibility.** Incompatibility in hazelnut is sporophytic and controlled by a single locus. Each year we identify the S-alleles of about 60 selections. Fine mapping of the S-locus, led by M.S. student Ryan Hill, was published.

**Publications:**


- Hill, R., C. Baldassi, J.W. Snelling, K.J. Vining and S. Mehlenbacher. 2021. Fine mapping of the locus controlling self-incompatibility in European hazelnut. Tree Genetics and Genomes 17:6. https://doi.org/10.1007/s11295-020-01485-5

- Komaei Koma, G., M. Sekerli, J.W. Snelling and S.A. Mehlenbacher. 2021. New sources of eastern filbert blight resistance and simple sequence repeat markers on Linkage Group 6 in hazelnut (*Corylus avellana* L.). Front. Plant Sci. 12: 684122 doi: 10.3389/fpls.2021.684122
- Mehlenbacher, S.A. and T.J Molnar. 2022. Hazelnut breeding. In: Plant Breeding Reviews, Irwin Goldman (ed.). Published 22 October 2021. copyright 2022. (book chapter). https://doi.org/10.1002/9781119828235.ch2
- Şekerli, M., G. Komaei Koma, J.W. Snelling and S.A. Mehlenbacher. 2021. New simple sequence repeat markers on Linkage Groups 2 and 7 and investigation of new sources of eastern filbert blight resistance in hazelnut (*Corylus avellana*). J. Amer. Soc. Hort. Sci. 146(4):252-266. doi: 10.21273/JASHS05040-21

**Utah, Kevin Jensen**

In 2021, there were seven NPGS – W6 orders received. All orders will be used for either variety development, genetic diversity studies, botanical/taxonomic research, and plant pathology studies; (3) government, (2) university, and (2) private users.

Summary table of 2021 germplasm users for the State of Utah.

| User | Organization | Phone | Email | Order# | Species | # | Intended Use |
|---|---|---|---|---|---|---|---|
| Matthew Robbins | USDA-ARS | 435-760-3082 | Matthew.robbins@usda.gov | 338921<br>333136 | *Festuca brachyphylla* | 13 | 338921 - Genetic Studies. Research use notes: Study the genetic diversity of *Festuca brachyphylla* entries in NPGS GRIN related to other fine fescue species.<br>333136 - Genetic Studies. Research use notes: To use as a reference accession for *Festuca brachyphylla*. We will genetically compare our own material against these accessions. |
| Chelsey Larson | Tree L Farm | 801-510-8095 | Chelsey71@icloud.com | 332071 | *Rheum x rhabarbarum* | 25 | Varietal Development – Breeding. Research use notes: To create crosses and hybrids which are adapted to the unique climate of the high desert of the confluence of the Colorado Plateau, Mojave Desert, and Great Basin in the difficult soils and elevation. I am working on creating varietals from heritage and historical edible landscaping plants which are no longer commonly available in the locale yet tend to be more adaptable. I am currently working with seeds from 40 crosses and am in need of more genetic material for the breeding. |
| Grason Matthews | Individual – Breeding Crops | 801-616-9444 | grasonmatthews17@gmail.com | 335784 | *Lupinus* | 1 | Breeding. Research use notes: Breeding frost resistance into potatoes, earlier fruiting tarwi, earlier fruiting roselle |
| Daniel Winkler | USGS | 516-996-3690 | dwinkler@usgs.gov | 336848 | *Encelia; Lupinus; Psilostrophe* | 7 | Botanical/Taxonomic Investigations. Research use notes: We will use the requested species in a ecological competition experiment that explores the interaction of invasive species presence and nitrogen deposition rates on native plant reproductive success. |
| David Jarvis | Brigham Young Univ. | 801-422-3093 | david_jarvis@byu.edu | 335651 | *Dysphania graveolens; Machaeranthera tanacetifolia; Cyperus fendlerianus; Bromus ciliates; Dysphania graveolens* | 5 | Class Instruction. Research use notes: As part of two graduate courses taught at Brigham Young University, students will produce a reference genome assembly of *Dysphania ambrosioides* and perform comparative genomic analyses of related species. |
| Alma Laney | Utah Valley Univ. | 801-863-8520 | alaney@uvu.edu | 337921 | *Medicago* | 1 | Plant Pathological Investigations. Research use notes: These accessions will be used to investigate the impacts of plant virus infection and will be conducted by undergraduate researchers. |

2018 Users

David Gedge – Lupinus … Variety Development

In 2018 I received germplasm of various Lupinus species. My attempt to establish the seed at my garden in Saratoga Springs, UT was not successful, and I did not succeed in making any interspecific crosses. I therefore have no reportable results, products developed, or manuscripts written.

In the late 1980's and early 1990's I successfully crossed *Lupinus mutabilis* with various wild north American *lupines*. This was done while I was working in Woodland, CA and Idaho Falls, ID. These interspecific crosses gave me hope that I could develop a high yielding protein crop. My work then took me to eastern South

Dakota. The climate there did not lend itself to successful growing of what I had made in California and Idaho and what I had developed was lost.

When I retired and moved to Saratoga Springs, I thought I would attempt to redo what I had started in California and Idaho. Two things dissuaded me from working towards that goal. First: I was not successful in establishing the wild species and the *L. mutabilis* had poor growth. Second: One of the keys to my crossing attempts involved a wild natural interspecific cross found just east of Dixon, CA. This wild lupine had the ability to flower and set seed in the heat of a Sacramento delta summer. I was not able to make a second collection of this wild *lupine*. Lacking these two things I decided my time would be best spent in other endeavors.

**Washington, Per McCord**

**2021 Report**; Number of requestors: 30 (US State agencies and all universities – 8; ARS – 11; Commercial Company – 6; Individual – 5)

**2018 Report**; Number of requestors: 42; Number of responders: 21 (50%); Bad email addresses: 3; Representation (US State agencies and all universities: 18 (8 responses); ARS: 11 (7 responses); US Commercial Company: 11 (5 responses); Individual:2 (1 response); Total publications: 4 (published/accepted), 1 (in review)

**William Brightly**; University of Washington: **Use/impact:** Intended to evaluate silicon concentration in palea and lemma of grass species, with the goal of evaluating preservation potential in the fossil record. Delays in reopening greenhouses, and departure of primary researcher limited progress. **Data/Publications:** Evaluation of germination potential. No publications.

**Tanya Cheeke**; Washington State University: **Species:** *Bromus tectorum, Symphoricarpos albus*. **Use/impact:** Research & educational experience for WSU undergraduates. Unexpected variation in germination time and growth rates prevented use in additional experiments. **Data/Publications:** none.

**Weidong Chen**; USDA-ARS; **Species:** *Phaseolus vulgaris*; **Use/impact:** Germplasm was screened for disease resistance. Screening data used to help identify and clone resistance genes; **Data/Publications:** Disease screening data (disease not specified). No publications.

**Ginny Coffman**; USDA-ARS; **Species:** *Pisum sativum*; **Use/impact:** These pea accessions were screened for resistance to the pea aphid (*Acrythosiphon pisum*); **Data/Publications:** Accessions PI 288263, PI 171810, PI 340130, PI 638516 and PI 628276 were highly resistant and accessions PI 279827 and PI 263031 highly susceptible to the pea aphid based on the ability of these lines to limit aphid reproduction after 10 days of feeding on the plants. PI 628276 was determined to be the most aphid resistant line of the lines evaluated. No publications yet.

**Wilson Craine**; Washington State University; **Species:** *Fallugia paradoxa, Poa fendleriana, Purshia mexicana* var. *stansburyana*; **Use/impact:** PI responded but has no record of requesting these accessions; **Data/Publications:** None.

**Alejandra Feliciano**; Washington State University; **Species:** *Clarkia amoena, Lupinus bicolor*; **Use/impact:** Germplasm was used (with others) in selection of interspecific seed mixtures for modeling plant community assemblies and invasibility. Mixtures of these seed failed, and were not used in the final project/publication; **Data/Publications:** Feliciano, A., and L. Chalker-Scott. 2022. Functional methods for describing community assembly and predicting invasibility of plants in the field. *Frontiers*, in review.

**Alison Hicks**; NW Botanista; **Species:** *Lactuca sativa*; **Use/impact:** Lettuce seeds were compared with other seeds regarding germination rates and seed viability. NW Botanista (a summer camp) is now closed; **Data/Publications:** None.

**Brian Irish**; USDA-ARS; **Species:** *Medicago arabica, M. cretacea, M.* hybr., *M. lupulina, M. minima, M. monspeliaca, M. orbicularis, M. polymorpha, M. polymorpha* var. *denticulata, M. polymorpha* var. *polymorpha, M. praecox, M. rigidula, M. rigiduloides, M. sativa* subsp. *caerulea, M. sativa* subsp. *falcata, M. sativa* subsp. *sativa, M. sativa* var. *viscosa*; **Use/impact:** All alfalfa and wild relative germplasm (*Medicago* spp.) was screened for disease reaction to *Phoma medicaginis*, the causal agent of spring blackstem and leaf spot of alfalfa. We are in the throes of wrapping up this project that set out to 1) optimize inoculation procedures, 2) characterize disease reaction in a set of ~80 alfalfa Standard Check cultivars, 3) define host range across Medicago spp. and to screen and try to identify sources of disease resistance in ~3,000 alfalfa accessions; **Data/Publications:** The spring blackstem inoculation optimizations are being shared with the North American Alfalfa Improvement Conference Standard Test committee who will consider modifying the Standard Test with our recommendations. All summarized mean disease reaction data will be uploaded to GRIN-Global to be associated with specific accessions. Several abstracts have been prepared (APS, NAAIC), but no peer-reviewed publications yet.

**Eric Lee-Mader**; Northwest Meadowscapes LLC; **Species:** *Fritillaria camschatcensis, Ligusticum apiifolium, Lupinus latifolius, Microseris laciniata, Pedicularis groenlandica, Plabiobothrys figuratus, Rhinanthus minor, Valeriana sitchensis*; **Use/impact:** Accessions were intended to be planted for a common garden study. However, germination was poor. PI thinks seed age or heat exposure during transit may have been the cause of poor germination; **Data/Publications:** None.

**Aaron Mahoney**; Storm Seeds, Inc.; **Species:** *Phaseolus vulgaris, Pisum sativum*; **Use/impact:** Germplasm was used for testing disease or insect differentials in breeding lines of processing beans or peas; **Data/Publications:** Germplasm was used as checks for disease testing and confirmed resistance to inoculated checks in greenhouse and field trials. Research field trials are still ongoing. COVID-19 resulted in the postponement of earlier field trials and data collection. No publications.

**Rebecca McGee**; USDA-ARS; **Species:** *Lens culinaris* subsp. *culinaris, Pisum abyssinicum, P. sativum, P. sativum* subsp. *asiaticum, P. sativum* subsp. *elatius, P. sativum* subsp. *sativum, P. sativum* subsp. *transcaucasicum, P. sativum* var. *arvense, P. sativum* var. *pumilio, Trigonella foenum-graecum*; **Use/impact:** Germplasm requested was evaluated, and used in one or more of the following ways: Parent in an improvement cross; parent in a mapping population; member of a diversity panel; or discarded; **Data/Publications:** None.

**Philip Miklas**; USDA-ARS; **Species:** *Phaseolus vulgaris*; **Use/impact:** The Garrapato germplasm line below was used for candidate gene analysis of the recessive bgm-1 gene which is the most important source of resistance to Bean golden yellow mosaic virus. The disease ranges from South Florida – Caribbean – Central American and Mexico. Garrapato landrace was determined to be the source of the causal mutation of the actual resistant gene – a NAC transporter. The other two lines were used to dissect the sources of resistance QTL which interact with bgm-1; **Data/Publications:** Soler-Garzón, A., A. Oladzad, J. Beaver, S. Beebe, R. Lee, J. Lobaton, E. Macea, P. McClean, B. Raatz, J. C. Rosas, Q. Song, P. N. Miklas. 2021. NAC candidate gene marker for bgm-1 and interaction with QTL for resistance to Bean golden yellow mosaic virus in common bean. Front. Plant Sci. 12:628443. doi: 10.3389/fpls.2021.628443

**Niall Millar**; Washington State University; **Species:** *Pisum sativum* subsp. *elatius*; **Use/impact:** Seeds were used for an experiment on the effect of domestication on legume-*Rhizobium* mutualism in peas. The growth of wild and domesticated peas, with and without rhizobia, was compared across five levels of N fertilization; **Data/Publications:** No significant differences were found between wild and domesticated germplasm. Manuscript in preparation.

**Darrin Morrison**; Morrison Farms; **Species:** *Vicia faba*; **Use/impact:** Germplasm was intended to be evaluated as an overwintering cover crop for nitrogen fixation. A wet winter apparently inhibited germination and/or survival, and none of the accessions survived the winter; **Data/Publications:** None.

**Steve Norberg**; Washington State University; **Species:** *Medicago sativa* subsp. *sativa*; **Use/impact:** Accessions were used as controls, and some for fall dormancy checks; **Data/Publications:** DNA analysis was performed on the accessions and multi-environment yield and quality data were generated. Publication: Lin, S., C.A. Medina, **S. Norberg**, D. Combs, G. Wang, G. Shewmaker, S. Fransen, D. Llewellyn, Long-Xi Yu. 2021. Genome-Wide Association Studies Identifying Multiple Loci Associated with Alfalfa Forage Quality. Frontiers in Plant Science. https://doi.org/10.3389/fpls.2021.648192

**Renee Petipas**; Washington State University; **Species:** *Medicago lupulina*; **Use/impact:** Germplasm was intended to be inoculated with microbes isolated from herbarium specimens of *M. lupulina*. Wild-collected germplasm (not from WRPIS) was used instead; **Data/Publications:** Manuscript in preparation.

**Lyndon Porter**; USDA-ARS; **Species:** *Cicer arietinum, Lens culinaris* subsp. *culinaris*, *Pisum abyssinicum, P. sativum, P. sativum* subsp. *asiaticum, P. sativum* subsp. *elatius, P. sativum* subsp. *sativum, P. sativum* subsp. *transcaucasicum, P. sativum* var. *arvense, P. sativum* var. *pumilio*, *P. sativum* var. *sativum*; **Use/impact:** The Lentil (*Lens culinaris*) and pea *(Pisum sativum*) genetic resources were screened for resistance to the pea aphid (*Acrythosiphon pisum*). The chickpea (*Cicer arietinum*) resources were screened for resistance to Pythium seed rot caused by *Pythium ultimum*; **Data/Publications:** Out of 188 lentil accessions screened for resistance to the pea aphid, twenty were determined to be resistant and fifteen candidate genes were identified as being associated with the resistance. Out of 301 pea accessions screened for resistance to the pea aphid, 48 were determined to be resistant and seventeen candidate genes were identified as being associated with the resistance.

The research associated with chickpea resistance to *Pythium ultimum* is still being conducted and no preliminary results are available. Publications: Porter, L. Resistance in lentil (*Lens culinaris*) genetic resources to the pea aphid (*Acrythosiphon pisum*). *Entomologia Experimentalis et Applicata*, accepted.

**Jenna Price**; Sakata Seed; **Species:** *Beta* hybr., *B. lomatogona, B. patula, B. vulgaris* subsp. *maritima, B. vulgaris* subsp. *vulgaris, Patellifolia webbiana*; **Use/impact:** Germplasm was evaluated for agronomic traits and downy mildew and *Cercospora* resistance; **Data/Publications:** Accessions were identified with resistance to downy mildew, annual growth habit, and green leaves/stems. Five of the nine accessions were used for breeding in beet. No publications.

**William Whitson**; Cultivariable; **Species:** *Perideridia, bolanderi, P. gairdneri, P. howellii, P. oregana, P. parishii, P.* spp.; **Use/impact:** Germplasm is being used for breeding; **Data/Publications:** Genus takes several years to reach maturity, so no data available yet. Results expected over the next two years.

**Long-Xi Yu**; USDA-ARS; **Species:** *Medicago sativa* subsp. *sativa*; **Use/impact:** Germplasm was used in a drought tolerance experiment; **Data/Publications:** Genotypic data deposited in NCBI (National Center for Biotechnology Information). Publication: Lin S, Medina CA, Boge B, Hu J, Fransen S, Norberg S, Yu L-X. (2020) Identification of genetic loci associated with forage quality in response to water deficit in autotetraploid alfalfa (Medicago sativa L.) BMC Plant Biol. 20:303, https://doi.org/10.1186/s12870-020-02520-2.

**Zhiwu Zhang**; Washington State University; **Species:** *Medicago sativa* subsp. *sativa*; **Use/impact:** Germplasm was requested for use in a phenomics experiment at the new facility in Pullman. The experiment was not scheduled in time, so the requested germplasm was not used; **Data/Publications:** None.

**Wyoming, Lisa Taylor**

Table 1: 2021 W6 Requests for Germplasm for Wyoming.

| PI Name | Contact Info | City, State | Category | Species | Common Name | Intended Use |
|---|---|---|---|---|---|---|
| Donna Harris | Donna.Harris@uwyo.edu | Sheridan, Wyoming | Academic | Phaseolus vulgaris Phaseolus acutifolius | Common Bean, Tepary Bean | Dry bean breeding program |
| Donna Harris | Donna.Harris@uwyo.edu | Sheridan, Wyoming | Academic | Psium (multiple species) | Pea | Genetic studies for drought resistance and potentially for breeding purposes. |
| Donna Harris | Donna.Harris@uwyo.edu | Sheridan, Wyoming | Academic | Elymus (Multiple species) Festuca idahoensis, Koeleria macrantha, and Pseudoroegneria spicata. | Wheatgrass, Fescue, Junegrass | Breeding for restoration purposes in native grasslands. |
| Donna Harris | Donna.Harris@uwyo.edu | Sheridan, Wyoming | Academic | Phaseolus vulgaris | Common Bean | Identify genomic regions controlling popping trait and introgress into elite material for breeding purposes. |
| John Temte | johntemte@gmail.com | Cody, Wyoming | Private | Poa pratensis | Kentucky Bluegrass | NSF grant to better understand the genome of Kentucky Bluegrass, and we will genome size/genotype these lines and sequence the genome of Kentucky Bluegrass. |
| Jim Heitholt | Jim.Heitholt@uwyo.edu | Powell, Wyoming | Academic | Cicer arietinum | Chickpea | Screen for tolerance to drought using deficit irrigation. In 2020 and 2021: screened six released cultivars and now we need to look at chickpea mini-core. |

Table 2: 2018 W6 Requests for germplasm for Wyoming.

| PI Name | Contact Info | City, State | Category | Species | Common Name | Intended Use |
|---|---|---|---|---|---|---|
| Donna Harris | Donna.Harris@uwyo.edu | Sheridan, Wyoming | Academic | Phaseolus vulgaris Phaseolus acutifolius | Common Bean, Tepary Bean | Dry bean breeding program |
| Donna Harris | Donna.Harris@uwyo.edu | Sheridan, Wyoming | Academic | Psium (multiple species) | Pea | Genetic studies for drought resistance and potentially for breeding purposes. |
| Donna Harris | Donna.Harris@uwyo.edu | Sheridan, Wyoming | Academic | Elymus (Multiple species) Festuca idahoensis, Koeleria macrantha, and Pseudoroegneria spicata. | Wheatgrass, Fescue, Junegrass | Breeding for restoration purposes in native grasslands. |
| Donna Harris | Donna.Harris@uwyo.edu | Sheridan, Wyoming | Academic | Phaseolus vulgaris | Common Bean | Identify genomic regions controlling popping trait and introgress into elite material for breeding purposes. |
| John Temte | johntemte@gmail.com | Cody, Wyoming | Private | Poa pratensis | Kentucky Bluegrass | NSF grant to better understand the genome of Kentucky Bluegrass, and we will genome size/genotype these lines and sequence the genome of Kentucky Bluegrass. |
| Jim Heitholt | Jim.Heitholt@uwyo.edu | Powell, Wyoming | Academic | Cicer arietinum | Chickpea | Screen for tolerance to drought using deficit irrigation. In 2020 and 2021: screened six released cultivars and now we need to look at chickpea mini-core. |

**Tonya Espinoza**: *Aira caryophyllea subsp. Caryophyllea, Echium plantagineum*; **Intended use:** Placing in Herbarium for seed ID purpose; This material was a useful addition to our herbarium.

**Kristin Hufford:** *Nassella viridula, Astragalus bisulcatus*; **Intended uses**: My lab is working on a project with the BLM to characterize genetic and morphological variation in cultivated and wild grass species; We are currently looking at genetic and morphological (trait) differences among populations of *Astragalus bisulcatus* a species of interest in rangeland rehabilitation and may serve as a sage-grouse food source; We have some information suggesting that while cultivars are genetically different, their growth behavior is complex. In one species (a different one than this collection) we found they remain about where they are planted. For this species there is some evidence of spread through the habitat they are planted in; One publication is in draft form but not yet ready for submission.

## WRPIS Station Report, Marilyn Warburton

## Research Highlights

- Although this will be finished in 2022, the PGIRTU is in the last steps of submitting its next 5-year cycle National Programs 301 project plant for peer-review and renewal.
- Coordinated by co-editor, Long-Xi Yu, a book entitled “The Alfalfa Genome” was published by Springer in 2021. It contains 16 chapters covering history, classical and molecular breeding as well as advances in genomics associated to the alfalfa crop.

- At the time of this report (June 2022), there were 100,532 accessions belonging to 994 genera, and 5,226 taxa in the WRPIS collections with the site accounting for ~17% of the active NPGS accessions.
- In 2021, 1,333 accessions were acquired: 1,248 native plant accessions collected by the Seeds of Success (SOS) program, 80 expired IPR accessions, 3 chickpea acquisitions including two irradiated mutants, and 2 *Sporobolus* accessions (1 transfer and 1 wild-collected population that was increased and adapted to Northern Plains environment).
- A total of 35,075 order items were distributed in 791 orders to 581 unique requestors with addresses in 48 U.S. states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and 48 foreign countries. 68% percent (23,859) were distributed to the U.S. and 32% (11,216) were distributed internationally. A total of 7,695 order items from WRPIS went to all 13 Western states in 214 orders to 147 unique requestors. Requesters in all domestic states received germplasm samples from WRPIS during the reporting period with a total of 5,508 order items from WRPIS went to the 13 Western states.
- A total of 379 observation data points on 364 accessions were uploaded into the Germplasm Resources Information Network (GRIN)-Global database. These data points were for 3 established descriptors of 2 different crops. WRPIS staff provided 100% of the evaluation data. No voucher images were uploaded to GRIN-Global in 2021.
- Seed viability records uploaded to GRIN-Global totaled 1,775 during the reporting period. The National Laboratory for Genetic Resources Preservation (NLGRP) in Fort Collins, CO tested 1,194 accessions, and 581 were tested by WPRIS personnel.
- A total of 1,545 seed inventories were shipped to the NPGS NLGRP, Fort Collins, CO for secured backup and 47 accessions were sent to be placed in the Svalbard Global Seed Vault.
- In 2021, the Native Plant Program and the Horticultural Crops Program, began evaluating optimized regeneration protocols for five different native *Astragalus* species (*A. bisulcatus*, *A. lonchocarpus*, *A. lentiginosus*, *A. drummondii* and *A. canadensis*). Evaluations focused on field establishment (fall 2020) of transplants at two sites (Pullman/Prosser) and testing three different pollinator treatments: caged honeybees, caged alfalfa leaf cutter bees, and an uncaged native pollinator treatment. Little to no information exists on how best to manage these crop wild relatives *Astragalus* plant genetic resources.
- The *Phaseolus* program developed a near-infrared spectroscopy (NIR) calibration curve for bean seed protein, which was used to measure the seed protein of the BeanCap genomewide association panel. With this data and the sequencing data publicly available for the BeanCap population, protein levels with genomic locations and genes can be associated. This will lead to information on genes for future marker aided improvement of this important trait.
- The Cool Season Food Legume program published a collaborative pea evaluation study promoting genomic selection's potential. A set of 482 pea accessions genotyped with 30,600 SNP markers and phenotyped for seed yield and yield-related components highlighted the best genomic prediction model. This was then used to evaluate all USDA Pea accessions that were genotyped but not phenotyped, sparing the unit the expense of having to phenotype.
- A collaborative team led by Long-Xi Yu, mapped genetic loci associated with drought and high salinity, two abiotic stressors affecting alfalfa production worldwide. The genes identified can be used for gene pyramiding, gene editing and developing markers for marker-assisted selection for drought and salt tolerant alfalfa once they are validated.

**Personnel changes – unfilled positions**

Several key personnel changes occurred in both the federal and state-funded projects in CY 2021 and the first few months of 2022. A new **Research Leader** and **Research Geneticist** was hired to fill the position that had been vacant for 2 years. The **Agronomy Curator** (cool season grasses and safflower) was hired in 2021, and another in 2022, as the first candidate did not work out. The ***Phaseolus/*Bean** curator position was also filled in 2022 as well. The vacancy created in the Unit's **IT Specialist** position after Bo Gao resigned in 2020 is still

being recruited, but the new position description under the USDA's Client Experience Center (CEC) has been approved and should be advertised soon. The **Biological Science Technician** position responsible for greenhouse maintenance and efforts was filled by Ezekiel Brazington, but he was transferred to fill the vacancy created by the retirement of the Agronomy Curator, Bob Guenthner. Therefore, unfortunately, the greenhouse maintenance technician position is once again vacant. Another retirement, of Marie Pavelka, now creates a vacancy in the Horticultural Crops **Biological Science Technician** position. Both these positions are considered critical, and work is underway to recruit replacements. Finally, the Seeds of Success **Support Scientist** (Term) position has been filled in early 2022 by Bailey Hallwachs, a support Scientist/Horticulturist who now replaces Mike Cashman.

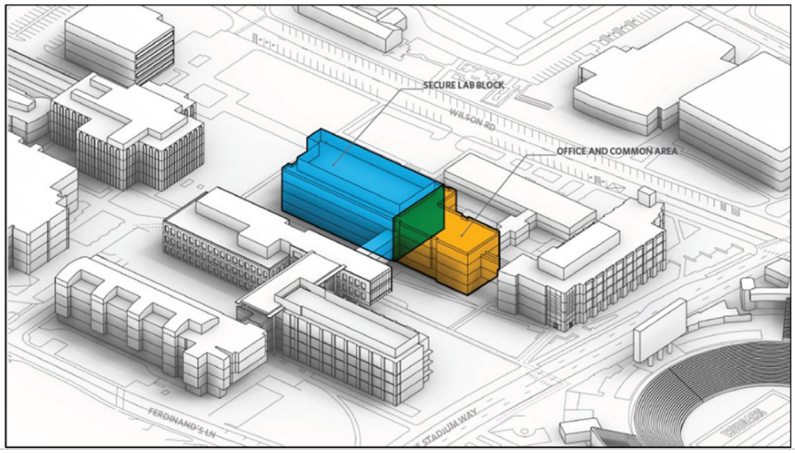
The W6-supported WRPIS project team is no longer fully staffed with the departure of staff in two of the positions. Work is underway to replace these two positions, as it has not been possible for the W6 farm crew to keep up with seed cleaning requests from all the programs.

**Facilities**

The WRPIS currently counts on 34,800 square feet of greenhouse facilities (22,375 sq. ft. Federal, 12,425 sq. ft. Washington State University) and ~149 acres of farmland (86.2 acres Federal, ~55 acres WSU). 28 acres of WSU field space was lost to the construction of a new airport runway, and 12 new acres leased for our use in Valeska, ID, 21 miles north of WSU. We are beginning to develop that land now and may be able to begin planting in 2023. The first project is construction of a secure building approximately 30' x 30' for securing equipment/tools and storing field supplies; a bathroom; and grass terraces to protect the fields from erosion. 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). This is a decrease of 2 labs and 2 offices since 2021 due to the move out of Johnson Hall on the WSU campus in order to make space for the new USDA building, (see update below). The 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, and facilities there remained unchanged.

The construction of the new Plant Biosciences building on the WSU campus (**Figure 1**) will begin in 2023. 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. The new building will be built on what is the current Johnson Hall footprint. Johnson Hall is now vacated, and all WRPIS moved into adjacent (and smaller) Clark Hall until the new building is finished. Johnson Hall is scheduled for demolition in January 2023, following asbestos abatement. The new building is scheduled to be completed in late early 2026 and WRPIS will occupy new facilities.

**Figure 1.** Proposed location and concept of the new Plant Biosciences building on WSU campus, superimposed on Johnson Hall (*to be demolished*) footprint.



## Germplasm Management

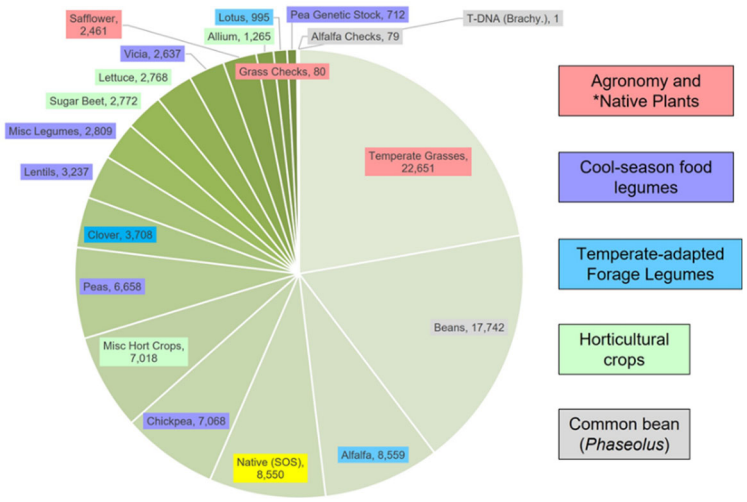



**Figure 2.** The five curatorial programs and assigned major crop groups at WRPIS (June 2022).

## Germplasm Acquisition

During the 2021 calendar year, there were 1,333 new accessions added to the WRPIS collections including 1,248 native plant accessions from the SOS project.

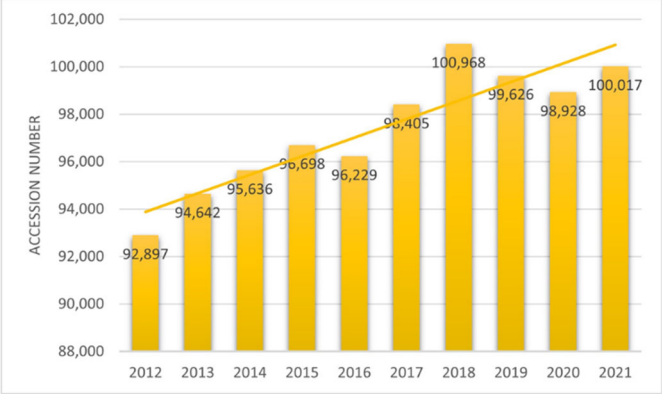



**Figure 3.** Total number of accessions managed by WRPIS since 2012 (numbers recorded at the end of each calendar year).

## Germplasm Distribution

In 2021, the order number was 791, unique requesters distributed to was 581, and the number of items distributed was high 35,075.

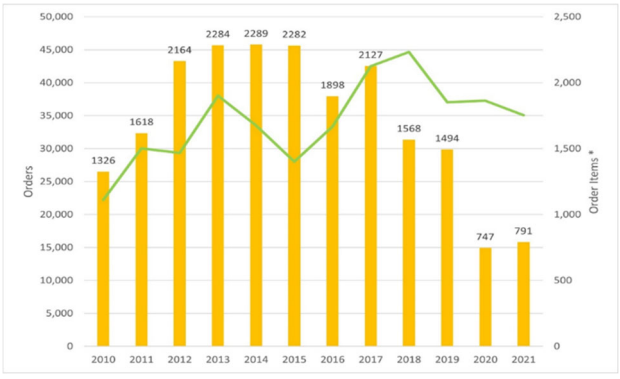



**Figure 4.** Number of orders and order items distributed annually by WRPIS from 2010 to 2021. *(e.g., - seed packets, garlic cloves, etc.).