

2020 Washington State Annual Report to the W-6 Technical Advisory Committee

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Summary:

In 2020, 117 Washington State residents requested a total of 9,562 germplasm samples from 12 National Plant Germplasm System (NPGS) repositories or stations (Appendix I, Table 1) and received germplasm (in the form of seeds and cuttings) in 191 orders. Recipients were with universities (26 [WSU 19, UW 2, Clean Plant Center 1, Skagit Valley College 1, St. Martin's University 1, Western WA University 1, Whitman College 1]), USDA (10), private research groups (12), commercial firms, seed companies and nurseries (16), non-profit organizations (5), and schools (2), as well as 32 private individuals. Of the 117 recipients, 9 did not give an email address, so 108 recipients received our notice to report their results, and 2 email addresses were invalid. Of these, 30 (26%) provided feedback regarding the germplasm they received (Appendix I, Figure 1).

Significantly fewer requests were submitted in 2020 compared to previous years; this was noted in all categories except for private individuals, where the number of requests was the same (31). University requests were down by nearly half (2019 – 46, 2020 – 26), while requests from commercial firms, seed companies and nurseries went from 24 to 16.

Specific requests consisted of 332,022 separate order lines, and included 358 individual taxa. Most requested materials were *Medicago* (2,901), *Hordeum* (2,612), *Triticum* (1,189), *Solanum* (456), *Pisum* (335), *Prunus* (286), *Sinapis* (256), and *Malus* (217). The germplasm material was used in diverse scientific disciplines such as agronomy, anthropology, archaeology, botany, genetics, horticulture, plant pathology, entomology, and soil science, and contributed significantly to scholastic and economic activity in the State of Washington (Appendix II).

The utilization of the germplasm material from the NPGS in 2020 included the colonization of roots by beneficial microorganisms (Aufrecht), identifying heritage apples and finding lost varieties (Benscoter), development and testing of marker databases for *Malus* and *Pyrus* spp. (Cotton), research with specialty grains (Despain), screening for potential sources of resistance or tolerance to little cherry virus-2 and the X-disease phytoplasma (Harper), genotyping and phenotyping sweet cherry cultivars from leaf samples (Johnson), nursery plant breeding and propagation (Kuntz), growing maize samples for college microbiology lab course (Moss), trials of fava beans in search of reliable overwintering varieties for cool climate conditions (Rome), and studying the evolution of a plant immune receptor in legumes (Snoeck).

Germplasm material was used by private research firms (1st Choice, Corteva Agriscience, Cultivariable Seeds, Gene Shifters, NuPhy, Pacific Northwest National Laboratory, Vareda), and by commercial nursery and seed propagators for investigations for commercial suitability (Ferry Boat Seeds LLC, Gardens of Eden, Highland Specialty Grains, Johann's Garden Nursery, L&H Seeds, M&A Farm, Northwest Plant Co., Resilient Seeds, Storm Seeds Inc., Wagner Seeds,

Watershed Garden Works). Other commercial requests came from Dungeness Chestnuts, Refill the Earth, Wild Weigel's Mountain, and Yakima Chief Ranches.

Individuals and civic organizations requested material for evaluation and testing of various plant material for local production (M. Yaco, Fox Island Victory Garden; M. Clark, Eldercroft; R. Foss, Entre Hermanos; L. McKenzie, Organic Seed Alliance), propagation of optimal tree fruit species for home orchards (Western Cascade Fruit Society, Olympic Orchard Society, San Juan Island Grange, Whitman County Historical Society), and schools (Orcas Island School District).

A new factor noted in 2020 was the instance of delay by the U.S. Postal Service in delivering orders, which resulted in the plant material being unusable. Recipients were clear that “the shipment failure was in no part due to USDA personnel, and instead was a result of poor handling by the USPS.” Some responses reported that they weren't able to get all their requested material. “I am disappointed that we were not able to get any scion wood this year. Of course, I understand the covid thing, but we really look forward to our trials” [J. Shannon]. Several recipients stressed the importance of the NPGS service, and mentioned in particular the value of NPGS as a system for acquiring material for research work. B. Despain, specialty crops breeder for Highland Specialty Grains, wrote that “NPGS gives me access to plant genetic materials that I would never be able to access on my own. It has been and is a valuable part of the plant breeding and research programs of which I have been a part.” A. Singh-Cundy (Western WA U.) wrote, “The availability of the germplasm is a shot in the arm for my research program, and I wanted to say how much I appreciate this service.”

Publications

Germplasm recipients reported the following publications that included materials they received from NPGS in 2019, as well as materials received earlier:

1. Attavar, A., L. Tymon, P. Perkins-Veazie, and C.A. Miles. 2020. Cucurbitaceae germplasm resistance to verticillium wilt and grafting compatibility with watermelon. *HortScience*, 55(2):141-148.
2. Bradshaw, M., E. Goolsby, C. Mason, and P.C. Tobin. 2021. Evolution of disease severity and susceptibility in the Asteraceae to the powdery mildew *Golovinomyces latisporus*: major phylogenetic structure couples with highly variable disease severity at fine scales. *Plant Disease*, 2021; 105 (2): 268 DOI: [10.1094/PDIS-06-20-1375-RE](https://doi.org/10.1094/PDIS-06-20-1375-RE)
3. Callaway, T.D. and A. Singh-Cundy. 2019. HD-AGPs as speciation genes: Positive selection on a proline-rich domain in non-hybridizing species of *Petunia*, *Solanum*, and *Nicotiana*. *Plants* 2019 8(7), 211; <https://doi.org/10.3390/plants8070211>.
4. Merrick L.F., S.R. Lyon, K.A. Balow, K.M. Murphy, S.S. Jones, and A.H. Carter. 2020. Utilization of evolutionary plant breeding increases stability and adaptation of winter wheat across diverse precipitation zones. *Sustainability*. 2020; 12(22):9728.
5. Msolla, S.N., P. Miklas, D. Fourie, M. Kilango, and T. Porch. 2020. Description of Baetao-Manteiga 41 and 'Yunguilla' superior Andean common beans for Tanzanian production. *J. Plant Regist.* 2020:1-8.
6. Wei, W., N. Pierre-Pierre, H. Peng, V. Ellur, G.J. Vandemark, and W. Chen. 2020. The D-galacturonic acid catabolic pathway genes differentially regulate virulence and salinity response in *Sclerotinia sclerotiorum*. *Fungal Genet. Biol.* 145.

Appendix I: Summary of requests 2020.

Table 1. NCGR stations from which material was requested in 2020.

Site	Orders	Items
COR	33	246
DAV	7	292
GEN	14	241
NA	3	17
NC7	24	458
NE9	5	78
NR6	12	469
NSGC	24	3,831
NSSL	1	1
S9	18	103
SOY	9	72
W6	41	3,754
Total	191	9,562

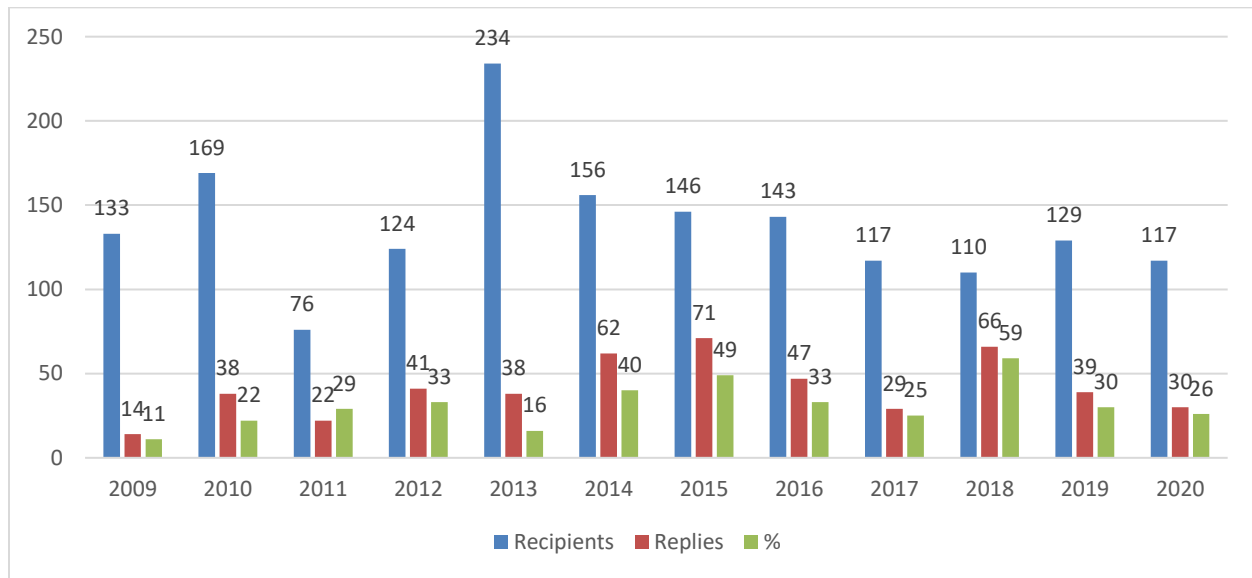


Figure 1. Number of Washington State germplasm recipients, responses, and percent of responses, by year.

Appendix II: Summary of responses.

1. *The samples and their packaging arrived in good condition.*
☐ Yes ☐ No *If no, please explain:*
2. *Germination from the seed or growth from plant material was satisfactory.*
☐ Yes ☐ No *If no, please explain:*
3. *How did you use or plan to use the materials you received?*
☐ *Research*
☐ *Education*
☐ *Other*
Please provide details:
4. *Did you release any plant material(s) to the public in 2019 that was partially or fully derived from any NPGS germplasm(s) that you received in 2019 or previously?*
☐ Yes ☐ No *If yes, please provide details about the released plant material(s):*
5. *If you published an article in 2019 that includes NPGS germplasm that you received in 2019 or earlier, please provide the publication citation (authors, title, journal, etc.):*

1. Jayde A. Aufrecht, Pacific Northwest National Laboratory, Richland, WA 99352

1. The samples arrived in good condition.
2. Germination from the seed or growth from plant material was satisfactory.
3. Material was used for research. We are studying *Brachypodium distachyon* root exudation and the colonization of roots by beneficial microorganisms.
4. No plant material was released.
5. Not applicable.

2. David Benscoter, Whitman County Historical Society, Chattaroy, WA 99003

1. The samples arrived in good condition.
2. Germination from the seed or growth from plant material was satisfactory.
3. Material was used for research. I am part of a group dedicated to identifying heritage apples and in particular, finding lost varieties. Having heritage apples growing in our own orchards is crucial so we can someday compare apples from our orchard to those we find in the field. So far, we have identified 23 lost apple varieties.
4. No plant material was released.
5. No publications.

3. Louisa Brouwer, Ferry Boat Seeds LLC, Friday Harbor, WA 98250

1. The samples arrived in good condition.
2. Germination from the seed not yet determined. The requested material is spring oats. We received it in fall 2020 and will plant in spring 2021.
3. Material was used for research on spring oats. The material will be evaluated for its performance as a cover crop, relative to other commercially available spring oat varieties.

4. No plant material was released.
5. No publications.

4. Elizabeth Byszeski, Freeland, WA 98249

1. The samples arrived in good condition.
2. Germination from the seed or growth from plant material was satisfactory.
3. Material was used for research with *Fragaria x ananassa* on growth ability in climate, various soils and containers at Whidbey Island, WA.
4. No plant material was released.
5. Not applicable.

5. Kandice Chatterton, Wagner Seed Co. Warden, WA 98857

1. The samples arrived in good condition.
2. Germination from the seed or growth from plant material was satisfactory.
3. Material was used for research with *Zea mays* subsp. *mays*. The germplasm went into our yield trials as LCS and crossing blocks.
4. No plant material was released.
5. Not applicable.

6. Kim Cotton, NuPhy Plants, Pullman, WA 99163

1. The samples arrived in good condition. In both orders the actual plant material was in good condition. Order 41219 came without any packing slip or information on the lines. We sent a shipping box to them with a return shipping label and packing slip; they did not use the box, label, or packing slip. But Ben was very communicative and helpful and informed us when the material would be arriving. Given the challenges that COVID restrictions caused, I felt it was handled appropriately.
2. Germination from the seed or growth from plant material was not applicable – our requests were for leaf material.
3. Material was used for research to develop and test marker databases for *Malus* and *Pyrus* spp., and as references to confirm variety of internal and client materials. All requests were for leaf material.
4. No plant material was released.
5. No publications.

7. Robert Dash, Orcas Island School District, Deer Harbor, WA 98243

1. The samples arrived in good condition.
2. Germination from the seed or growth from plant material was satisfactory.
3. Material was used for education and publishing, to produce SEM micrograph images of *Glycine soja* for a book about food and climate change.
4. No plant material was released.
5. Not applicable.

8. Brett Despain, Highland Specialty Grains, Moses Lake, WA 98837

1. The samples arrived in good condition.

2. Germination from the seed or growth from plant material was satisfactory.
3. Material was used for research. We do breeding and research with specialty grains such as specialty wheats, barley, buckwheat, mustard and amaranth.
4. No plant material was released.
5. No publications.

9. Max Feldman, USDA-ARS, Prosser, WA 99350

1. The samples arrived in good condition.
2. Germination from the seed or growth from plant material was satisfactory.
3. Material was used for research with *Solanum chacoense* and *Solanum tuberosum*. We are using three of the clones to introgress self-compatibility in to diploid clones primarily from wild species. We are using the haploid induction line (IVP 101) to extract dihaploids from tetraploid germplasm curated by our program.
4. No plant material was released. In 2020 we worked to increase the amount of plantlet materials to work with. We are a long way away from public release.
5. Not applicable.

10. Scott Harper, WSU Clean Plant Center, Prosser, WA 99350

1. The samples arrived in good condition.
2. Germination from the seed or growth from plant material was satisfactory.
3. Material was used for research, to screen for potential sources of resistance or tolerance to little cherry virus-2 and the X-disease phytoplasma.
4. No plant material was released.
5. No publications.

11. Brian Irish, Plant Germplasm Introduction & Testing Research Unit, USDA-ARS, Prosser, WA 99350

1. The samples arrived in good condition.
2. Germination from the seed or growth from plant material was satisfactory for the most part. We requested and received over 2,844 alfalfa accessions and of these a small percentage had low germination (> 3%) in our greenhouse plantings and are being prioritized for regeneration.
3. Material was used for research and propagation.
 - Annual (Spring and Fall plantings) seed increases/regenerations.
 - Larger collections of *Medicago sativa* and other *Medicago* spp. are being screened for disease reaction to foliar fungal plant pathogens. Disease resistant material will be selected and made available to plant breeders for incorporation into commercial cultivars which lack these traits.
 - DNA barcoding to develop voucher sequences in diverse taxonomic backgrounds, to correctly assign taxonomy to unidentified, misidentified, and mislabeled accessions of *Medicago*, *Trifolium*, and *Lotus* germplasm.
 - 400 *Medicago* accessions were requested and are being established in a space plant field nursery for evaluations and selection (grant funding).
4. No plant material was released.
5. Not applicable.

12. Alexandra Johnson, WSU IAREC, Prosser, WA 99350

1. The samples did not all arrive in good condition. There was a problem with shipping via the USPS for the initial shipment of leaf material. While subsequent packages arrived in great condition, some of the samples from the first shipment were not present in subsequent shipments (material no longer available). It should be noted the first, mishandled shipment eventually arrived, and that while most of the samples were unusable, the samples were well packed. Ultimately, the shipment failure was in no part due to USDA personnel, and instead was a result of poor handling by the USPS.
2. Germination from the seed or growth from plant material was satisfactory.
3. Material was used for research. The provided sweet cherry leaf samples were for genotyping and for investigating phenotypic response to infection from three different, economically important pathogens. For the samples that arrived in good condition (minus those that were initially mishandling by USPS), all samples were suitable for genotyping and phenotyping. We received this material as part of the project '*Germplasm evaluation for sweet cherry genetic diversity and disease resistance.*'
4. No plant material was released.
5. Not applicable.

13. Johann Kuntz, Johann's Garden Plant Nursery, Buckley, WA 98321

1. The samples arrived in good condition. There was only one instance of an accession being marked as included in a shipment, but was missing from among the samples.
2. Germination from the seed or growth from plant material was satisfactory. Overall I had a high success rate with cuttings (both grafting and rooting depending on species). In one instance the cuttings received were very slender and didn't survive. I had a high germination rate for seeds of many species, but there were a few species which are known to be difficult to germinate so it's hard to tell if failure to germinate was error on my part, delayed dormancy which will still sprout in the future, or simply seeds which have lost viability. I've held onto flats with sown seed which did not sprout in case it is simply a case of delayed dormancy.
3. Material was used for breeding and propagation. In some cases I have used the material to establish stock plants to scale up propagation to supply to the public via my nursery. However, I'm also doing breeding work with a number of species ranging from simple selection among seedlings for those of the most desirable traits to then further propagate clonally or in some cases the seedlings are being used to hybridize with other plants in my collection to select for novel new combinations of traits. For example, I was able to cross a number of *Helianthus* species in 2020 which resulted in a fair amount of apparently viable seed which will be sown in 2021 to evaluate and further cross to concentrate certain traits in the progeny.
4. No, but I will be ready to release some plants to the public in 2021. However, some of my breeding work will require a few more years before anything is likely refined enough to release.
5. I have not published any articles relating to NPGS germplasm.

14. Mark Lee, Edmonds, WA 98020

1. The samples arrived in good condition.
2. Germination from the seed or growth from plant material was satisfactory.
3. Material was used for research. My focus is on edible landscaping plants that thrive in my own microclimate north of Seattle. I grow plants from seed and look for variation in early or late

blooming and ripening, novel flavors, or anything out of the ordinary. I dabble in plant breeding, such as crossing early ripening pears with more traditional varieties, or crossing red-fleshed apples with varieties. I plan to follow an open-source model (not patents) for anything worthy of sharing.

4. No plant material was released.

5. No publications.

15. Steve Lyon, WSU Bread Lab, Burlington, WA 98233

1. The samples arrived in good condition.

2. Germination from the seed or growth from plant material was satisfactory.

3. Material was used for research with *Triticum aestivum* subsp. *aestivum* in variety development; introgression of genetic resistance to local diseases.

4. No plant material was released.

5. See “Publications” above.

16. Per Hilding McCord, WSU IAREC, Prosser, WA 99350

1. The samples arrived in good condition.

2. Germination from the seed or growth from plant material was satisfactory.

3. Material was used for research, I received pollen from NPGS, which I used in making new crosses in the sweet cherry breeding program.

4. No plant material was released.

5. No publications yet.

17. Phil Miklas, USDA-ARS, Prosser, WA 99350

1. The samples arrived in good condition.

2. Germination from the seed or growth from plant material was satisfactory.

3. Material was used for research with *Phaseolus vulgaris*. The accessions we requested this past year were used primarily to track down sources of various virus resistance genes that we are trying to tag with linked markers and to validate the mutations in the candidate genes.

4. No plant material was released.

5. See “Publications” above.

18. Brit Moss, Dept. of Biology, Whitman College, Walla Walla, WA 99362

1. The samples arrived in good condition.

2. Germination from the seed or growth from plant material was satisfactory.

3. Material was used for education. Grew maize b73 seedlings for Molecular Biology lab course and harvested RNA from tissues for RT-PCR experiments.

4. No plant material was released.

5. No publications.

19. Nickisha Pierre-Pierre, USDA, Pullman, WA 99164

1. The samples arrived in good condition.

2. Germination from the seed or growth from plant material was satisfactory.

3. Material was used for research. We created mutants of *Sclerotinia sclerotiorum* by deleting genes in the D-galacturonic acid catabolic pathway that we believe are responsible for

virulence. We used the leaves of the soybean plants to test the difference in virulence between the wild type and the mutants. The mutants showed a smaller lesion size than wild type.

4. No plant material was released.

5. See “Publications,” above. In the citation we used soybean seeds PI 170889.

20. Krista Rome, Resilient Seeds, Ferndale, WA 98248

1. The samples arrived in good condition.

2. Germination from the seed or growth from plant material was satisfactory.

3. Material was used for research. Continued trials of fava beans in search of reliable overwintering varieties for interior Whatcom County.

4. No plant material was released.

5. Not applicable.

21. Sherri Rynearson, WSU, Pullman, WA 99164

1. The samples arrived in good condition.

2. Germination from the seed or growth from plant material was satisfactory.

3. Material was used for research with *Triticum aestivum* subsp. *aestivum*. All materials were used as positive controls for molecular markers.

4. No plant material was released.

5. Not applicable.

22. Jonathan Eb Schnore, WSU, Pullman, WA 99164

1. The samples arrived in good condition.

2. Germination from the seed or growth from plant material was satisfactory.

3. Material was used for research with *Poa pratensis* and *Festuca arundinacea*. Initiated breeding programs for most of the germplasm requested.

4. No plant material was released.

5. Not applicable.

23. Jon Shannon, Shaw Island, WA 98286

1. The samples arrived in good condition.

2. Germination from the seed or growth from plant material was satisfactory.

3. Material was used for research with diverse cultivars of *Malus domestica*.

4. No plant material was released.

5. No publications.

24. Dan & Jess Tucker Simone, San Juan Grange #966, Friday Harbor, WA 98250

1. The samples arrived in good condition.

2. Germination from the seed or growth from plant material was satisfactory.

3. Material was used for research and education. We are experimenting with wild *Crataegus monogyna* as a rootstock for *Mespilus germanica*, trials will be used to educate the public once the scions develop into fruiting trees.

4. No plant material was released.

5. No publications yet.

25. Anu Singh-Cundy, Western Washington University, Bellingham, WA 98225

1. The samples arrived in good condition.
2. Germination from the seed or growth from plant material was satisfactory. It was quite low for one species (*Arabidopsis lyrata lyrata*), but I got a couple of plants to grow up and once they flower, I hope to raise my own seed stock.
3. Material was used for research with *Arabidopsis* and *Monarda* species.
4. No plant material was released.
5. See “Publications,” above.

26. John Stewart, Gardens of Eden, Cashmere, WA 98815

1. The samples arrived in good condition.
2. Germination from the seed or growth from plant material was satisfactory. Note that cv. ‘Svart Valdres’ doesn't seem to match the USDA descriptive narrative. It is a red skin, white flesh potato.
3. Material was used for research with cultivars of *Solanum tuberosum*. All materials are being used in our ongoing drought resistance, heat tolerance & winter hardiness trials, as well as our ongoing breeding projects. We have rebooted our operations here in 2020 to eliminate virally infected stock.
4. No plant material was released.
5. No publications.

27. Megan Sullivan, Northwest Plant Co. Ferndale, WA 98248

1. The samples arrived in good condition.
2. Germination from the seed or growth from plant material was satisfactory.
3. Material was used for propagation. We requested Boysen43 for commercial propagation.
4. No plant material was released. I believe we've requested other plants in the past and they would either be for commercial propagation or research purposes. Our plants generally go to commercial growers. We would have used the germplasm that we received to propagate new tissue culture plants if it was for public use or if we had a license to propagate.
5. No publications.

28. Simon Pieter Snoeck, University of Washington, Seattle, WA 98195

1. The samples arrived in good condition.
2. Germination from the seed or growth from plant material was satisfactory in most cases. Some seeds had an extreme low germination %, sometimes I was able to propagate myself which solved the problem.
3. Material was used for research; I am studying the evolution of a plant immune receptor in legumes.
4. No plant material was released.
5. No publications yet.

29. Dan Vorhis, Muscle and Arm Farm, Freeland, WA 98249

1. The samples arrived in good condition.
2. Germination from the seed or growth from plant material was satisfactory.

3. Material was used for research, education, and plant propagation. I am building an orchard of heritage apple trees for the purposes of:
- finding which cultivars perform well in our area (Whidbey Island)
 - putting together reliable data on relative bloom times for pollination compatibility information
 - I teach a few fruit-related classes each year, and use the opportunity to educate my neighbors on what their options are for planting quality apple trees: dessert, culinary, sweet and hard cider, brandy, drying, pickling, etc.
 - I'd like to breed a high quality, red or pink-fleshed dessert apple.
 - I propagate apple trees and sell or give away a few locally, so eventually a tree created using scion wood from my trees grown using USDA scion wood could find its way onto another orchard in the area.
4. No plant material was released.
5. Not applicable.

30. Mario Yaco, Fox Island Victory Garden, Fox Island, WA 98333

1. The samples arrived in good condition.
2. Germination from the seed or growth from plant material was satisfactory.
3. Material was used for research, education, and plant breeding, aiming to develop a triticale, a hybrid of wheat and rye, without ergot, and highly productive in marginal soils. Why? A new way to grow crops in marginal soils could help feed the world.
4. No plant material was released.
5. No publications yet. It's still early in the growing phase. Thank you!