ARS National Plant Germplasm System’s Role in Native Plant Conservation

Brian M. Irish
Stephanie L. Greene
Consistent with its mission and role, the NPGS can contribute to conserving U.S. native plant germplasm

Many NPGS activities with natives align to the National Seed Strategy
ARS research

Delivers cutting-edge, scientific tools and innovative solutions for American farmers, producers, industry, and communities to

• Support the nourishment and well-being of all people;
• Sustain our nation’s agroecosystems and natural resources; and
• Ensure the economic competitiveness and excellence of our agriculture.

https://www.ars.usda.gov/about-ars/
Plant germplasm/plant genetic resources (PGR)
Seeds, fruits, cuttings, pollen, and more - the raw material that underpins food, fiber, forage, fuel, flowers, and restoration!

Plant accession
Plant material from a single species collected at one time from a specific location while capturing diversity present in a population (SOS lexicon = "collection")
Plant germplasm is key

• In meeting threats to global agricultural productivity through continued progress in plant sciences
• Plant breeders and other scientists need continued access to genetically diverse material to develop productive crops
• Genebanks are an important source of diverse plant germplasm

Norman Borlaug - American agronomist, Nobel Peace Laureate and who led “Green Revolution” initiatives
20 sites across nation
70+ year partnership among USDA, Land-Grant Universities, and SAES
Long-standing partnerships with commodity groups and the agricultural and horticultural industries
NPGS Accessions

- One of the largest national genebank systems
- > 600,000 accessions of > 16,000 plant species
- Large collections of major staple crops important to U.S. and world
- Germplasm Resources Information Network (GRIN)-Global: an international standard
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<th>Accession Number</th>
<th>Accession Suffix</th>
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<th>Is Backed Up</th>
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(Continued)
Select the tab for the type of search. Each tab has everything you need to do to perform that type of search.

Return up to 500

Simple Search List Search Advanced Search Results

Search

Additional search criteria:

Add Criteria
Major Phases – PGR Management

- Acquisition
- Maintenance
- Regeneration
- Documentation/Data Management
- Distribution
- Characterization
- Evaluation
- Enhancement
- Research in support of the preceding priorities

*Adapted – P. Bretting
Ex situ Conservation

- 43,486 accessions, 6,211 taxa, 174 families
- 44% accessions through SOS
- Emphasis - Crop wild relatives and wild utilized species (ornamental, medicinal, forage, restoration, etc.)
- Past 5 years, NPGS distributed 5,846 orders
  - 50,509 seed packets of 13,882 accessions
- Distribute small seed quantities in support of breeding, research, and education
Complimentary conservation (partnerships)

In situ reserves for cranberry CWR with USFS – sites under consideration

- USFS, ARS, U of Wisconsin
- 15 National Forests
- 21 populations *Vaccinium macrocarpon*
- 24 populations of *V. oxycoccos*

*Adapted – K. Williams*
U.S. NPGS Plant Exchange Office supported explorations

2019/2020/2021?

Amaranthus spp. - AZ, CA, NM, TX
Amelanchier spp. - KY
Chenopodium spp. - CA
Cladrastis kentukea - KY
Helianthus spp. - CA
Lupinus polyphyllus - WA
Monarda brevis - WV
Parthenium argentatum - TX
Solanum jamesii, S. fendleri - NM
Vaccinium spp. - FL

Woody landscape plants - NC, TN

*Adapted – K. Williams

Photos: J. Bamberg
Recent NPGS Research

RESEARCH ARTICLE

Crop wild relatives of the United States require urgent conservation action

Colin K. Khoury, Daniel Carver, Stephanie L. Greene, Karen A. Williams, Harold ...
See all authors and affiliations

PNAS December 29, 2022 117 (52) 33351-33357; first published December 14, 2022; https://doi.org/10.1073/pnas.2007029117

Toward Integrated Conservation of North America’s Crop Wild Relatives


Cryopreservation of 12 Vitis Species Using Apical Shoot Tips Derived from Plants Grown In Vitro

Jean Carlos Betrom 1, and Aike Amelie Kretschmar. Santa Catalina State University (UDESC), Laguna, Santa Catalina, 85250000, Brazil.

Remi Boumaart, Ashley Shepherd, and Gayle M. Volf 2. USDA-ARS National Laboratory for Genetic Resources Preservation, 1111 S. Mason Street, Fort Collins, CO 80526

Viability and vigour loss during storage of Rudbeckia mollis seeds having different mass: an intra-specific perspective

Published online by Cambridge University Press: 10 July 2020

Nicholas G. Genna, Christina Walters and Héctor E. Pérez

Assessing genetic diversity of wild southeastern North American Vaccinium species using microsatellite markers

Nahla Basili 1,2, Amira Boldan 1, Kim Hammerschmidt 1,2, Laura J. Reymond 1,2, Jim Olmstead 1,2, Paul Lyrene 1,2, Christopher Richards 1,2

A “Mega Population” of the Wild Potato Species Solanum fendleri

John Bamberg 1,2, Alonso del Rio, Charles J. Fernandez 1, Ingrid Bamberg 1,2

Amending Journal of Potato Research 97, 531-533 (2020) | cite this article

98 Accesses | 8 Altmetric | Metrics

The Genetic Diversity of Cranberry Crop Wild Relatives, Vaccinium macrocarpon Aiton and V. oxycoccus L., in the US, with Special Emphasis on National Forests

Lorraine Rodriguez-Borrella 1, Karen A. Williams 2, 3, Fabian Rodriguez-Borrella 1, David S. Schnitzer 1, Andrew Music 1, Kevin Cox 1, Eric Wrisman 1, Luis Diaz-Garcia 4, and Jean Zalazco 1, 3, 4

AMIA

BMC Research Notes

Genetic diversity of Chamaecrista fasciculata (Fabaceae) from the USDA germplasm collection

Silvia Bueno 1,2, Pedro Elvira 1,3, Elsa L. Mahi 1,3, Eric J. Beasley 4, Wernher 5, and Susan Singer 1,2

USDA United States Department of Agriculture
Agricultural Research Service
• Established in 2001 by BLM in partnership
  • Royal Botanic Gardens, Kew, Millennium Seed Bank
• An ongoing program with many partners that collect, conserve, and develop native plant materials for restoration in the United States
• R.C. Johnson, ARS Research Agronomist with PGITRU initiated collaboration (~2003)
• SOS and the NPGS have partnered to conserve and distribute key native plant materials
  • PGITRU - incorporates material into NPGS
  • NLGRP - secures long term storage backups
PGITRU (WRPIS)

- Pullman, WA (WSU)
- Established 1947 (1905)
- ~100,000 accessions
- Research scientists support PGR activities
- ~1,500 orders & 40,000 items distributed

99,549 accessions in five curatorial programs

- Grass checks 81
- Grasses 22,590
- Safflower 2,457
- Native 6,320
- Chickpea 7,067
- Pea 6,158
- Pea Gen. Stock 712
- Lentil 3,247
- Vicia 2,636
- Legumes 2,948
- Alfalfa 8,534
- Wild clover 638
- Clover 3,092
- Lotus 989
- Misc. 6,133
- Beets 2,730
- Lettuce 2,062
- Garlic/Onion 1,249
- Alfalfa checks 79
- Beans 17,549
- Safflower 2,457
- Cool-season food legumes
- Temperate-adapted Forage Legumes
- Horticultural crops
- Common bean (Phaseolus)

*Adapted – J. Hu
SEED OF SUCCESS (SOS) COLLECTIONS

NPGS PATHWAY

BLM
BLM guided seed collections with state offices and Plant Conservation Alliance partners, e.g., Seed Extractory, NICS Cape May, Alaska Plant Materials Center, Chicago Botanic Gardens...

BLM
BLM SOS Coordinator provides PGITRU current BC-BASE export

PGITRU
Seed distributed to stakeholder

PGITRU
Accessions >6000 seed, sample into 4°C for distribution

PGITRU
1/3 seed to backup, -18°C @ PGITRU

PGITRU
Accessions are weighed, imaged, subdivided, and packaged

PGITRU
1/3 seed to backup, -18°C @ NLGRP

NLGRP
Collections with little (~500), no seed, or incongruent passport data not accessioned, keeping detailed records.

NLGRP
1/3 seed to backup, -18°C @ NLGRP

NPGS
Seed data transferred annually to NPGS active curatorial programs
Processing

- Records are checked for accuracy
- Samples are cleaned, if needed
- Total and 100 seed weights obtained
- Digital voucher images collected
- Partitioned into three aliquots, if sufficient
Details for: W6 27070, Achnatherum hymenoides (Roem. & Schult.) Barkworth, CO932-015

Core Passport Data

- Taxonomy: Achnatherum hymenoides (Roem. & Schult.) Barkworth
- Top Name: CO932-015
- Origin: Collected – Colorado, United States
- Maintained: Western Regional PI Station
- Received by NPGS: 15 Mar 2005
- Improvement Status: Wild material
- Form Received: Seed

Source History

Donated
- PRE 2004. United States
  - Donator(s):
    - Bureau of Land Management, SOS project

15 March 2005. United Kingdom
Comment: Whom recieved it from Bureau of Land Management
- Donator(s):
  - Millennium Seed Bank Project

Accession Names and Identifiers

CO932-015
Type: Donor identifier
- Bureau of Land Management, SOS project

W6 27070
Type: Site identifier
- Western Regional Plant Introduction (W6) accession numbers
- USDA-ARS, Western Regional Plant Introduction Station

193793
Type: Institute identifier
- Millennium Seed Bank Project

Narrative
Grasslike 0.3-0.6 meters tall.

Group Note
Seeds of success project
Transfers

- Occurs biannually/annually
- Made available to NPGS curatorial programs nationally
- Accession, and GRIN-Global record, ‘ownership’ is transferred
- Priority site maintains inventory and data in active collection
- Original NLGRP backup sample not transferred (i.e., stays in Ft. Collins)
Germplasm evaluation

- Mountain Brome
- Tapertip onion
- Indian ricegrass
- Bluebunch wheatgrass
- Sandberg bluegrass
- Thurbers’ needlegrass
- Basin wildrye
- Bottlebrush squirreltail
- Sulfur-flowered buckwheat
Located in Fort Collins, Colorado. Ambient conditions are beneficial for seed storage.

Colorado's low relative humidity contributes to optimal seed storage.

National Laboratory for Genetic Resources Preservation

- Preserve and back up PGR collections under conventional (freezer) and cryogenic (liquid nitrogen) conditions- approaching 1 million samples (NPGS, Black box)
- Design and test strategies for exploiting genomic data to enhance management of NPGS PGR
- Formulate and validate strategies for sampling, preserving, and using crop wild relatives
Seeds are dried at 5°C and 25% relative humidity.

Packets are subsampled for quantity and quality assessment.

RH probes are used to confirm dryness.

Packets are packaged in moisture-proof foil laminate pouches.

Stored at -18°C.
Seed quantity and quality assessment

- Seed cleaned (if needed) - chaff quantified
- Species verified, maturity, seed fill, pest/pathogen, mechanical damage
- 100-seed weight
- Seed number
- Viability - Germination protocols or TZ

Adapted – C. Walters
SOS Seed Research Topics

DETERMINING GERMINATION PROTOCOLS; SEED ZONE OR OTHER ECOLOGIC CORRELATE?

DEVELOPING ALTERNATIVE ASSESSMENT METHODS (HIGH THROUGHPUT, RAPID PHENOTYPING, NON-DESTRUCTIVE TESTS)

DEVELOPING ALTERNATIVE ASSAY FOR SEED AGING (RNA DEGRADATION)

Adapted – C. Walters
As of April 2021, the NPGS had received **19,313** SOS accessions.

### COLLECTION HOLDINGS

SOS holdings in the NPGS are taxonomically diverse represented by 147 families, 1001 genera and **4333** species. The ten families with the most accessions are shown to the right.

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<th>FAMILY</th>
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~8,000 accessions not actively curated