



# ARS National Plant Germplasm System's Role in Native Plant Conservation

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# Outline

- Background on ARS
- Definitions & justification
- NPGS & native plant genetic resources
- Seeds of Success (SOS) collaboration
  - PGITRU/WPRIS & NLGRP
- Summary

*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")



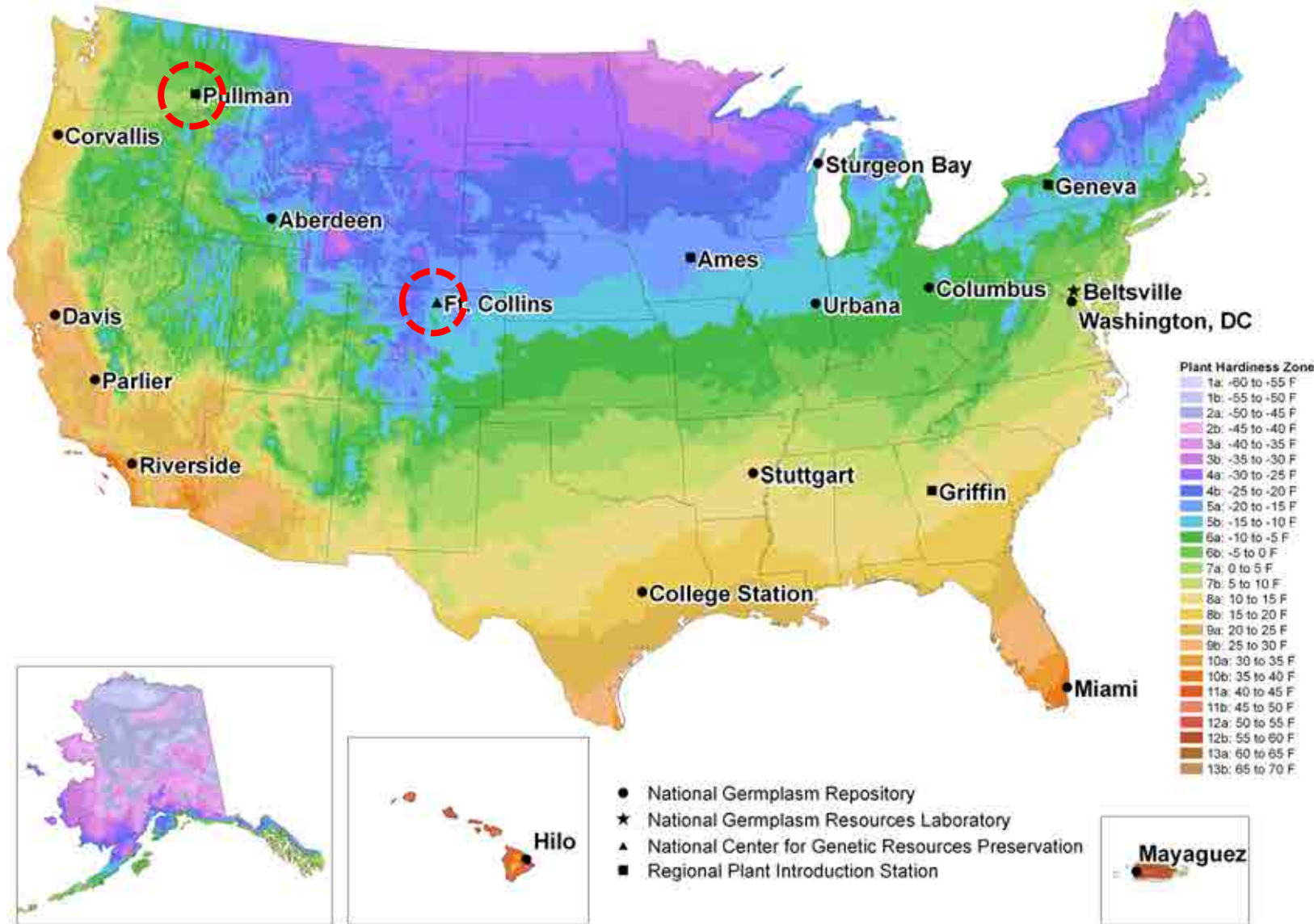
# Plant germplasm is key

- 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

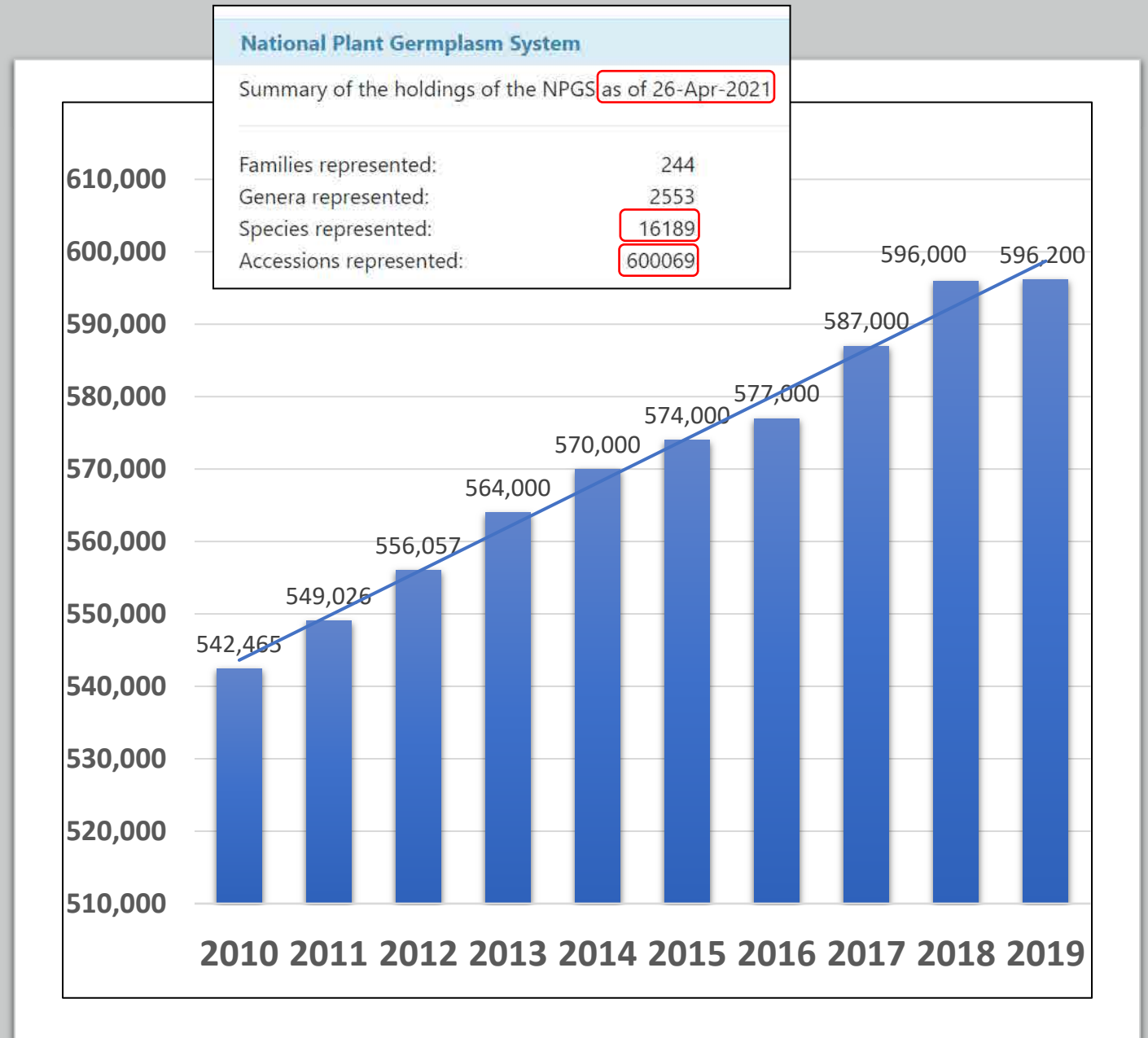
# National Plant Germplasm System



- 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





GRIN-Global Search v1.9.9.8

Basic Query

Search Now!

Find:

☒ Default

☐ accession

Matching

☐ Any Word

☒ All Words

☐ List of Items

Search Criteria

@accession.action.action\_name\_code = 'SOS' AND @accession.status\_code = 'ACTIVE' AND @accession.taxonomy\_species\_id IN (402285)

Clear Text

Search Results

Add To Query

Clear Query

Limit: 500000 Page Size: 100

Get Site

Accessions

Accession Action

Accession Source

Inventory

Inventory Action

Inventory M.P.

Source/Habitat Descriptor

Get Source Descriptor Observation

Orders

Order Items

Web Order Request

Cooperators

Source Cooperator

Taxonomy

Taxonomy Family

Taxonomy Genus

Ta

Show All Columns

Accession ID	Digital Object Identifier	Accession Prefix	Accession Number	Accession Suffix	Taxon	Name	Origin	Maintenance Site	Is Core?	Is Backed Up?	Backup Location 1	Backup Location 2	Status
1674107		W6	27070		Achnatherum hymenoides	CO932-015	United States, Colorado	W6	N	Y	NSSL		Active
1740254		W6	32493		Achnatherum hymenoides	5102-47	United States, Utah	W6	N	Y	NSSL		Active
1740326		W6	32577		Achnatherum hymenoides	AZ-93005-55	United States, Arizona	W6	N	Y	NSSL		Active
1740378		W6	32634		Achnatherum hymenoides	CO-93206-04	United States, Alaska	W6	N	Y	NSSL		Active
1740390		W6	32649		Achnatherum hymenoides	MT-06005-09	United States, Arizona	W6	N	Y	NSSL		Active
1740444		W6	32711		Achnatherum hymenoides	UT-03003-27	United States, Utah	W6	N	Y	NSSL		Active
1740472		W6	32747		Achnatherum hymenoides	UT-93005-07	United States, Utah	W6	N	Y	NSSL		Active
1802230		W6	35254		Achnatherum hymenoides	NV030-136	United States, Nevada	W6	N	Y	NSSL		Active
1808225		W6	35400		Achnatherum hymenoides	UT933-17	United States, Utah	W6	N	Y	NSSL		Active
1808226		W6	35401		Achnatherum hymenoides	UT933-18	United States, Utah, Emery	W6	N	Y	NSSL		Active
1808227		W6	35402		Achnatherum hymenoides	UT933-19	United States, Utah	W6	N	Y	NSSL		Active
1808228		W6	35403		Achnatherum hymenoides	UT933-20	United States, Utah	W6	N	Y	NSSL		Active
1808229		W6	35404		Achnatherum hymenoides	UT933-21	United States, Utah	W6	N	Y	NSSL		Active
1808230		W6	35405		Achnatherum hymenoides	UT933-22	United States, Utah	W6	N	Y	NSSL		Active
1808231		W6	35406		Achnatherum hymenoides	UT933-23	United States, Utah	W6	N	Y	NSSL		Active
1827121		W6	36806		Achnatherum hymenoides	NV030-242	United States, Nevada	W6	N	Y	NSSL		Active
1827122		W6	36807		Achnatherum hymenoides	UT080-26	United States, Utah	W6	N	Y	NSSL		Active
1827123		W6	36808		Achnatherum hymenoides	UT080-30	United States	W6	N	Y	NSSL		Active
1827124		W6	36809		Achnatherum hymenoides	UT933-120	United States, Utah	W6	N	Y	NSSL		Active
1827125		W6	36810		Achnatherum hymenoides	WY010-015	United States, Wyoming	W6	N	Y	NSSL		Active
1827126		W6	36811		Achnatherum hymenoides	WY010-1R	United States, Wyoming	W6	N	Y	NSSL		Active

Showing rows: 231 of 231

Connected to: https://npgsweb.ars-grin.gov/GRINGlobal/GUI.aspx

USDA

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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

Simple Search

List Search

Advanced Search

Results



Search

Additional search criteria:

Accession Source Habitat



Unknown source  
Weedy, disturbed, or ruderal habitat  
**Wild Habitat**  
(not defined)

Add Criteria

Clear

Search

# Major Phases – PGR Management

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





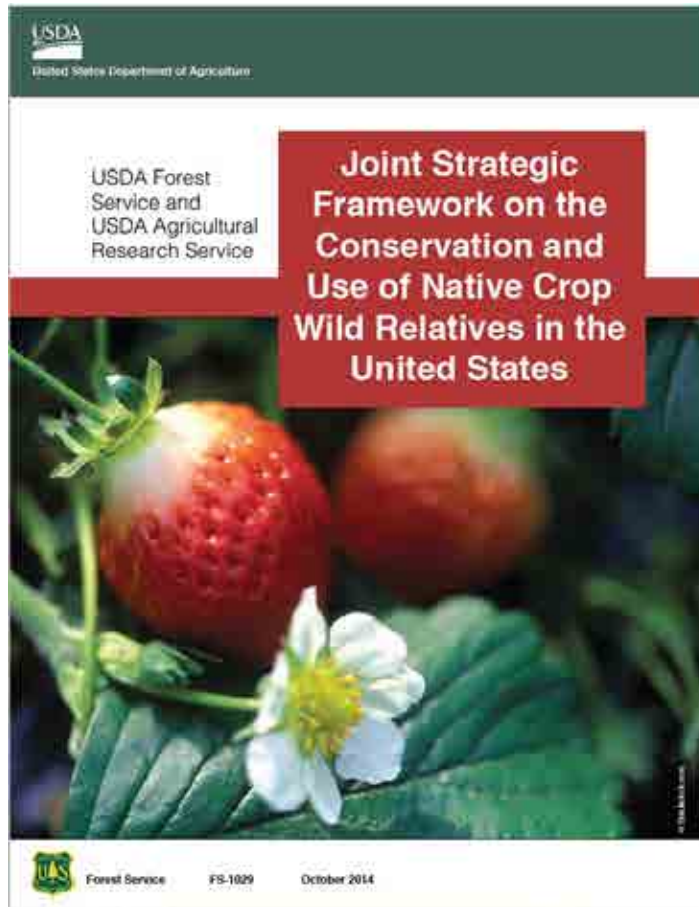


## *Ex situ* Conservation

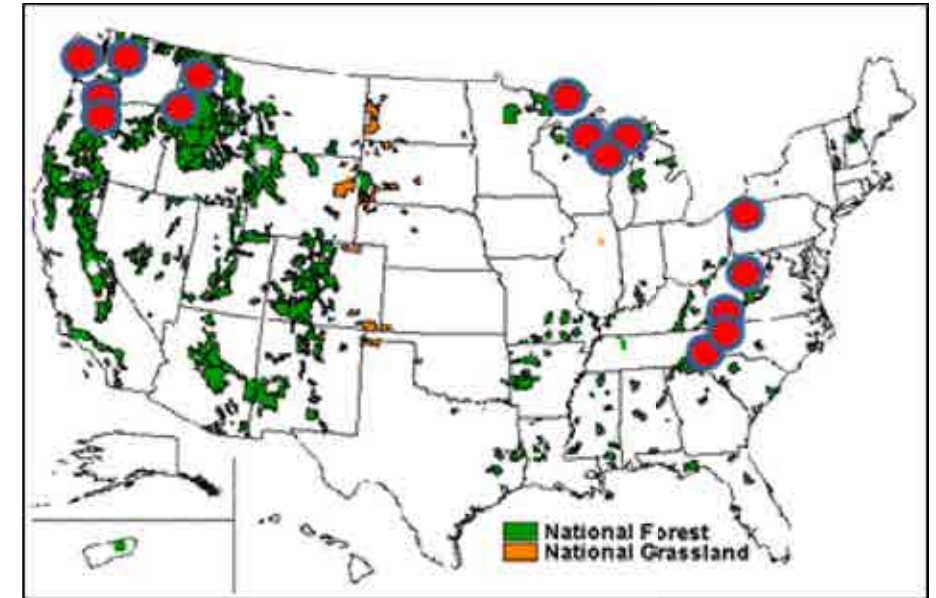
- 43,486 accessions, 6,211 taxa, 174 families
- 44% accessions through SOS
- Emphasis - Crop wild relatives and wild utilized species (ornamental, medicinal, forage, restoration, etc.)
- Past 5 years, NPGS distributed 5,846 orders
  - 50,509 seed packets of 13,882 accessions
- Distribute small seed quantities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



# Complimentary conservation (partnerships)



<https://www.fs.fed.us/wildflower/ethnobotany/documents/cwr/FrameworkNativeCropWildRelativesOct2014.pdf>



*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*

# U.S. NPGS Plant Exchange Office supported explorations

2019/**2020**/2021?



Photo: K.A. Williams

*Wild sunflower, Louisiana*

*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



SW19 report, p. 25

*Wild potato, Arizona*

Photos: J. Bamberg



United States Department of Agriculture

Agricultural Research Service

\*Adapted – K. Williams



# 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, 2020 117 (52) 33351–33357; first published December 14, 2020;  
<https://doi.org/10.1073/pnas.2007029117>

### Toward Integrated Conservation of North America's Crop Wild Relatives

Colin K. Khoury, Stephanie L. Greene, Sarada Krishnan, Allison J. Miller, Tara Moreau, Karen A. Williams, Lorraine Rodriguez-Bonilla, Carol S. Spurrer, Juan Zalapa, Gary Paul Nabhan

Author Affiliations +

Natural Areas J. 40(1):96-100 (2020). <https://doi.org/10.3375/043.040.0111>

HortScience 54(6):976–981. 2019. <https://doi.org/10.21273/HORTSCI13958-19>

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

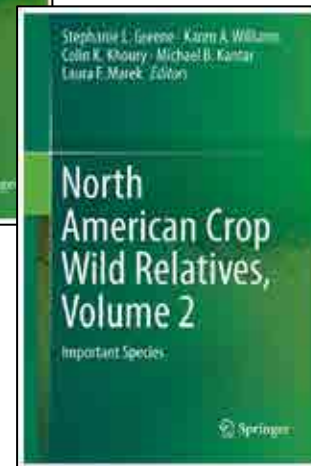
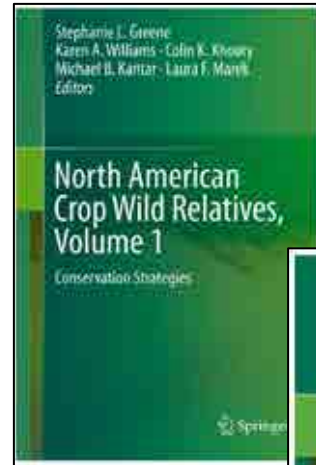
Jean Carlos Bettoni<sup>1</sup> and Aike Anneliese Kretschmar  
Santa Catarina State University (UFSC), Lages, Santa Catarina,  
88520000, Brazil

Remi Bonnart, Ashley Shepherd, and Gayle M. Volk<sup>1</sup>  
USDA-ARS National Laboratory for Genetic Resources Preservation, 1111  
S. Mason Street, Fort Collins, CO 80521



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Article

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

Lorraine Rodriguez-Bonilla<sup>1</sup>, Karen A. Williams<sup>2,\*</sup>, Fabian Rodriguez Bonilla<sup>3</sup>,  
Daniel Matusinec<sup>1</sup>, Andrew Maule<sup>1</sup>, Kevin Coe<sup>1</sup>, Eric Wiesman<sup>4</sup>, Luis Diaz-Garcia<sup>5</sup>  
and Juan Zalapa<sup>1,4,\*</sup>

### 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

Genet Resour Crop Evol (2018) 65:939–950  
<https://doi.org/10.1007/s10722-017-0585-3>



## RESEARCH ARTICLE

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

Nahla Bassil<sup>1</sup>, Amira Bidani<sup>1</sup>, Kim Hummer<sup>1</sup>, Lisa J. Rowland<sup>1</sup>,  
Jim Olmstead<sup>1</sup>, Paul Lyrene<sup>1</sup>, Christopher Richards<sup>1</sup>

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

John Bamberg<sup>1</sup>, Alfonso del Rio, Charles J. Fernandez & Ingrid Bamberg

American Journal of Potato Research 97, 531–533(2020) | [Cite this article](#)

98 Accesses | 8 Altmetric | [Metrics](#)

Bueno et al. BMC Res Notes (2019) 12:117  
<https://doi.org/10.1186/s13104-019-4152-0>

BMC Research Notes

## RESEARCH NOTE

Open Access

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

Erika Bueno<sup>1</sup>, Ted Kisha<sup>2</sup>, Sonja L. Maki<sup>3,4</sup>, Eric J. B. von Wettberg<sup>1,5</sup> and Susan Singer<sup>2,5</sup>





# SEEDS OF SUCCESS



- 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

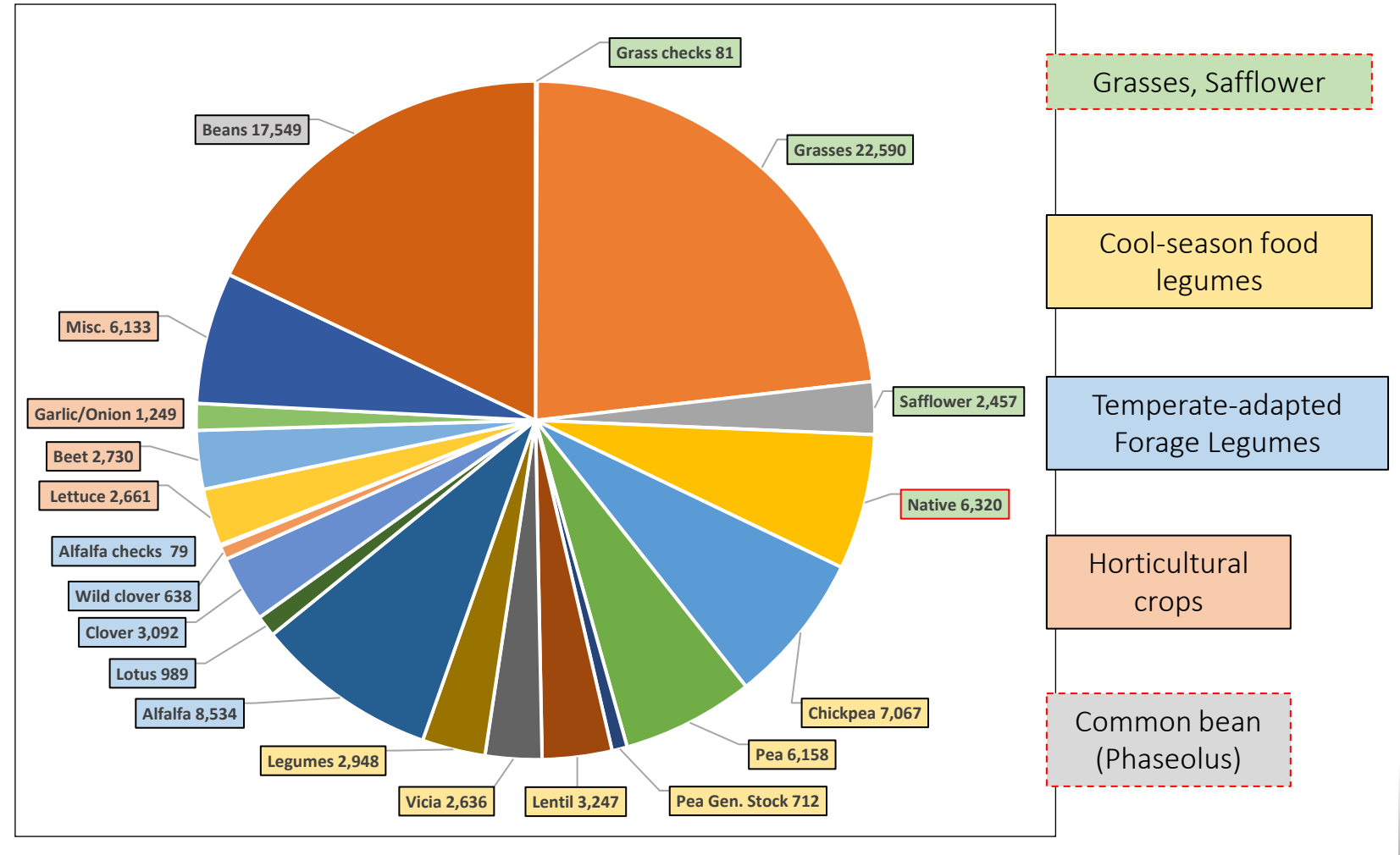
# PGITRU (WRPIS)

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



## Curatorial Programs

99,549 accessions in five curatorial programs



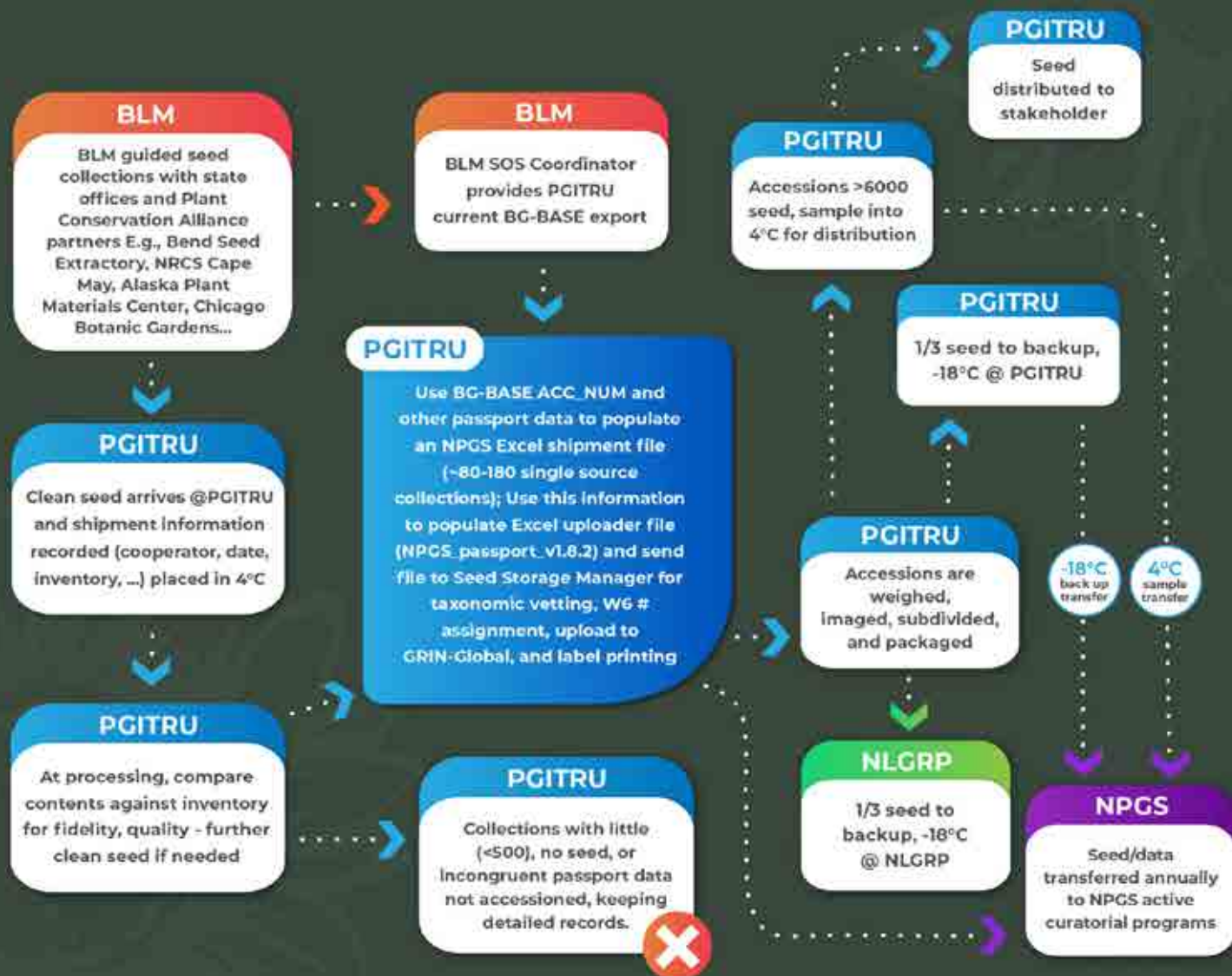
\*Adapted – J. Hu



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## SEED OF SUCCESS (SOS) COLLECTIONS NPGS PATHWAY





# 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

Summary

Passport

Taxonomy

Other

Pedigree

IPR

Observation

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

**193793**

Type: Institute identifier  
Millennium Seed Bank  
Project

**W6 27070**

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

Narrative

Grasslike 0.3-0.6 meters tall.

Group Note

Seeds of success project



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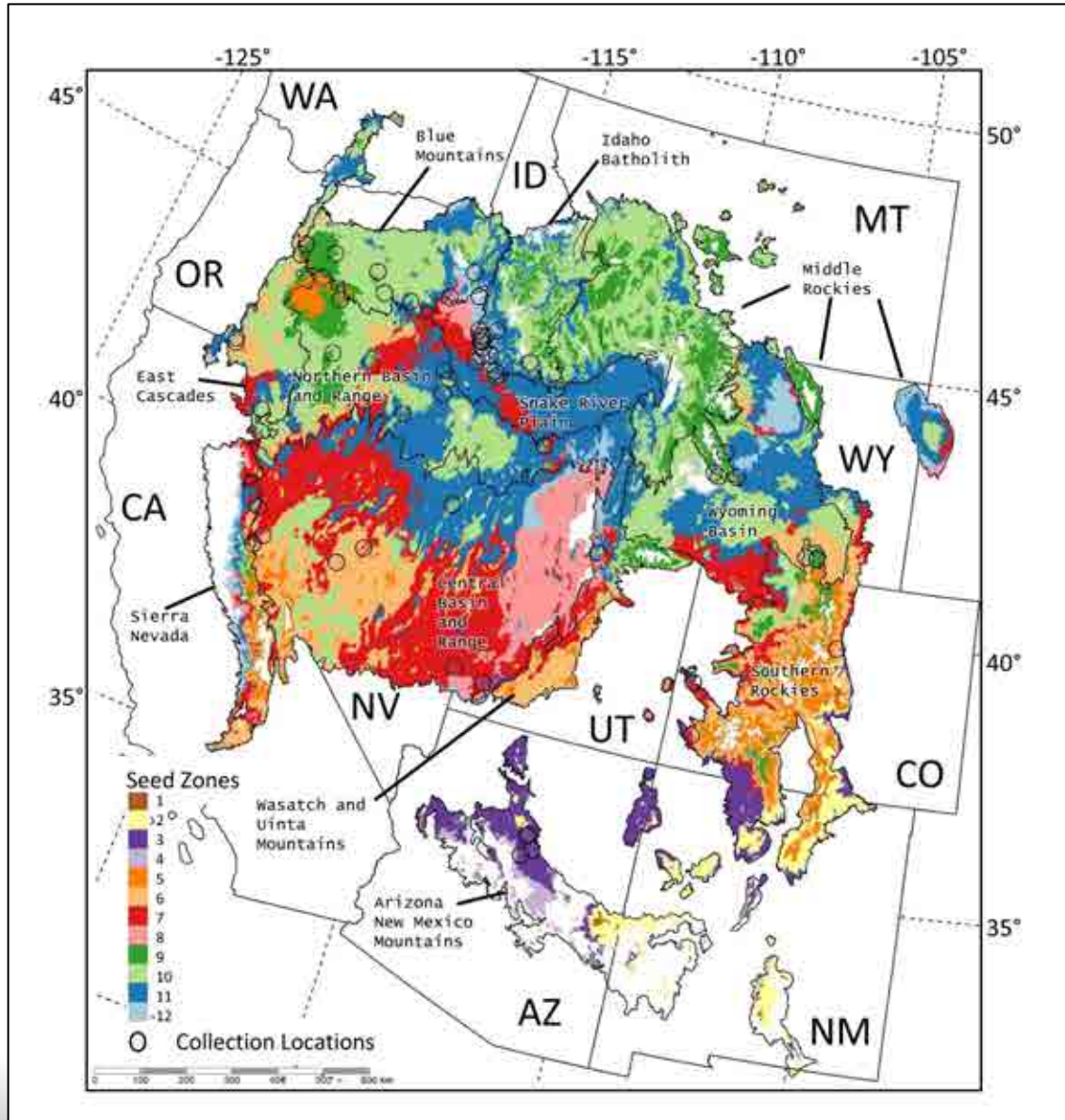
# Transfers

- 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



# 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



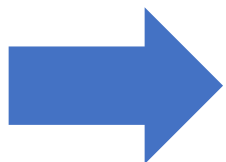
Colorado's low relative humidity  
contributes to optimal seed  
storage



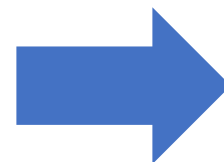
Seeds are dried at 5C and 25% relative humidity



Packets are subsampled for quantity and quality assessment



RH probes used to confirm dryness



Packaged in moisture-proof foil laminate pouch



Stored at -18 C

# SOS Seed Storage Process

Managed by C. Walters

# 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





# SOS Seed Research Topics

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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)

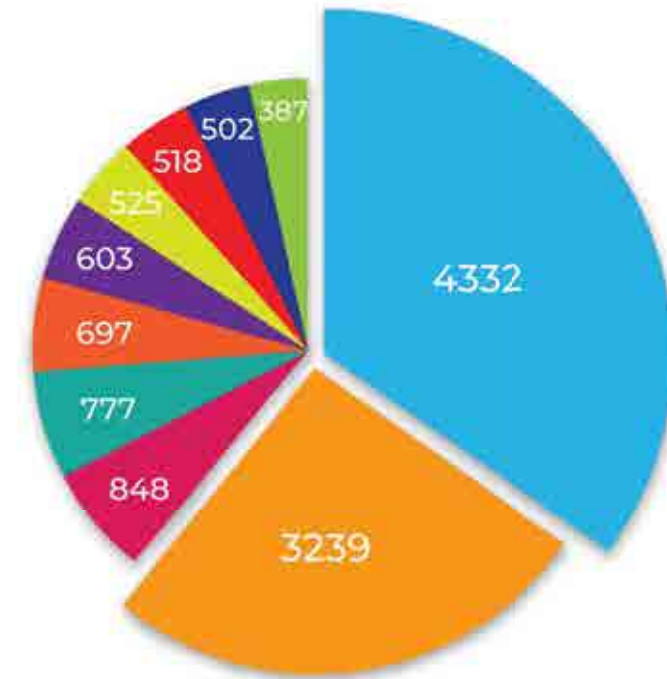
Adapted – C. Walters

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.

FAMILY	ACCESSIONS	GENERA	SPECIES
Asteraceae	4332	216	874
Poaceae	3239	102	335
Fabaceae	848	60	308
Rosaceae	777	45	150
Cyperaceae	697	16	225
Plantaginaceae	603	22	173
Chenopodiaceae	525	14	47
Apiaceae	518	30	121
Polygonaceae	502	11	122
Onagraceae	387	28	106



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