

# **PGOC, NRSP-6, and Regional Plant Introduction Stations Update**

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# Plant Germplasm Operations Committee

- 2016 PGOOC meeting was held from June 14-16, 2016 at Fort Collins, Colorado
  - ✓ Chair: Joseph Postman, Chair-elected: John Preece
  - ✓ The 2017 PGOOC meeting was originally scheduled for the USDA/ARS National Arboretum in Washington, DC for November 2017, but it has been postponed because of budgetary concerns.
- International visitors from Canada, Brazil, ORPOICA of Colombia, CIAT of Columbia, Mexico, and Vietnam.
- Kim Hummer's talk on germplasm exploration activity in Vietnam.
- Reports from ONP and various NPGS functional groups and subcommittees
  - ✓ Office of National Programs Report – Peter Bretting
  - ✓ USDA National Germplasm Resources Lab, Plant Exchange Office – Gary Kinard and Karen Williams
  - ✓ USDA National Laboratory for Genetic Resources Preservation –Harvey Blackburn
  - ✓ NPGS Regional Plant Introduction Station Updates – Candy Gardner (Ames, IA), Gan-Yuan Zhong (Geneva, NY), Gary Pederson (Griffin, GA) and Jinguo Hu (Pullman WA)
  - ✓ GRIN-Global – GRIN-Global team
  - ✓ Status of -18C storage at NPGS sites – Gary Pederson
  - ✓ Managing genetic resources with reduced budget – John Preece
  - ✓ Cat 4 promotion – Gary Pederson

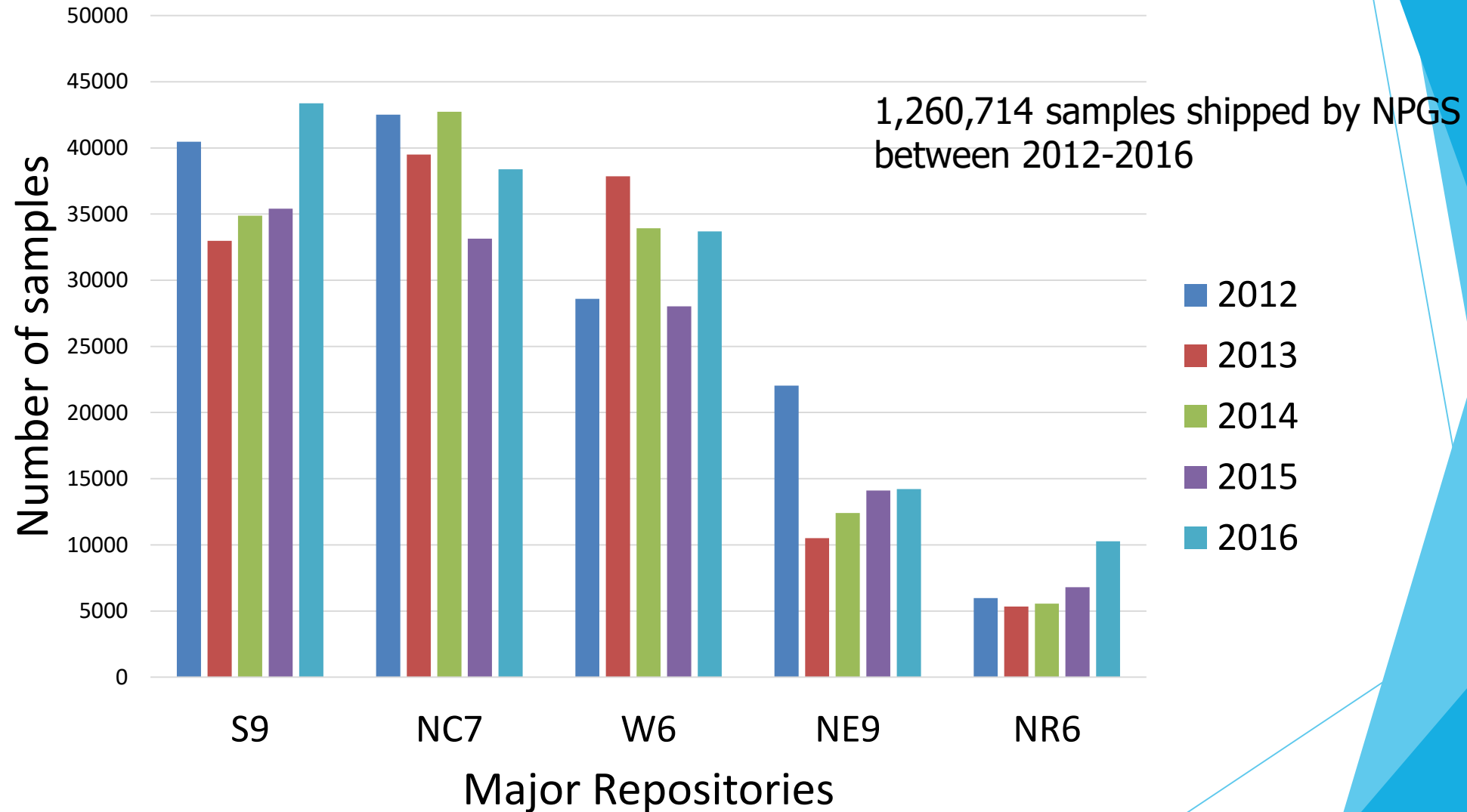
# Plant Germplasm Operations Committee

- Reports from ONP and various NPGS functional groups and subcommittees
  - ✓ Economic Research Service Impact Study of NPGS – Gary Kinard
  - ✓ GMO and germplasm collection - Stephanie Greene/Brian Irish
  - ✓ Curator's discretion to accept or reject requests for plant materials –John Preece
  - ✓ GIS and Georeferencing, Crop Wild Relatives – Stephanie Greene
  - ✓ NPGS Operations Manual – Peter Bretting
  - ✓ Molecular Markers in GRIN – Chris Richard
  - ✓ Updating "Seeds for Our Future" brochure – Gary Kinard
- Critical and Emerging Issues
  - ✓ **Order processing challenges: requests from non-researchers.**

# US Regional Plant Introduction Station Functions

- ▶ Acquire, conserve and distribute plant genetic diversity and associated information
- ▶ Encourage use of germplasm (User-focused)
- ▶ Conduct research to improve genetic resource management programs
- ▶ Evaluate and characterize germplasm to facilitate targeted research objectives
- ▶ Prebreeding activities to facilitate utilization

# Distributions



# Potato Genebank (NRSP-6)

## Curation and Distribution

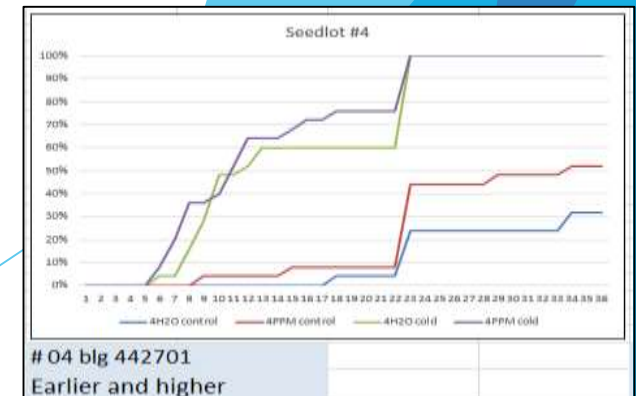
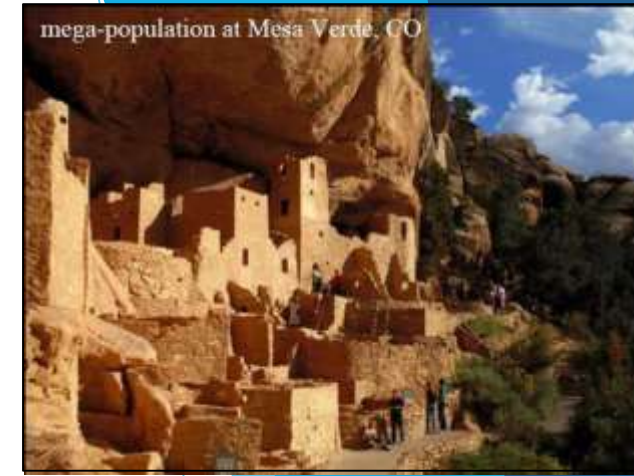
- Preservation, evaluation and distribution of ~5,000 botanical seed accessions of about 100 species; ~1,000 in vitro clones are also preserved.
- Increased 143 accessions as botanical seed populations and 3,090 accessions as clones.
- Distributed a total of 19,173 accessions in 2016, including 14,275 domestically and 4,898 internationally
- Collected 26 new germplasm collections from Arizona and received 45 new cultivars and breeding clones from cooperators in 2016.
- Carried out virus tests on 1,009 accessions, germination tests of 1,509 accessions, and ploidy determination of 34 accessions.



# Potato Genebank (NRSP-6)

## Characterization and Evaluation

- Classification of core collections, new “cog” technique and SNP fingerprinting of most accessions.
- Used AFLP to find an *in situ population* with 82% of the species’ total diversity.
- Discovered alternating temperatures greatly enhances germination of some seedlots.
- Testing new inbred diploid breeding method for *Criolla* (egg yolk) style speciality potato.
- Produced first proven and available hybrids with *S. jamesii*, a species with many valuable traits.
- Bred new cultivar for Peruvian altiplano with local cooperators.

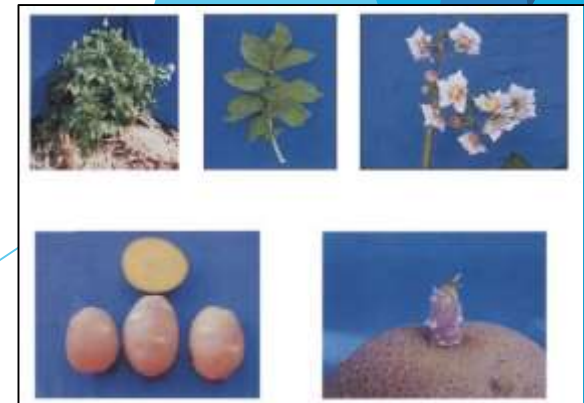




# Potato Genebank (NRSP-6)

## Impact of NRSP-6 on potato industry

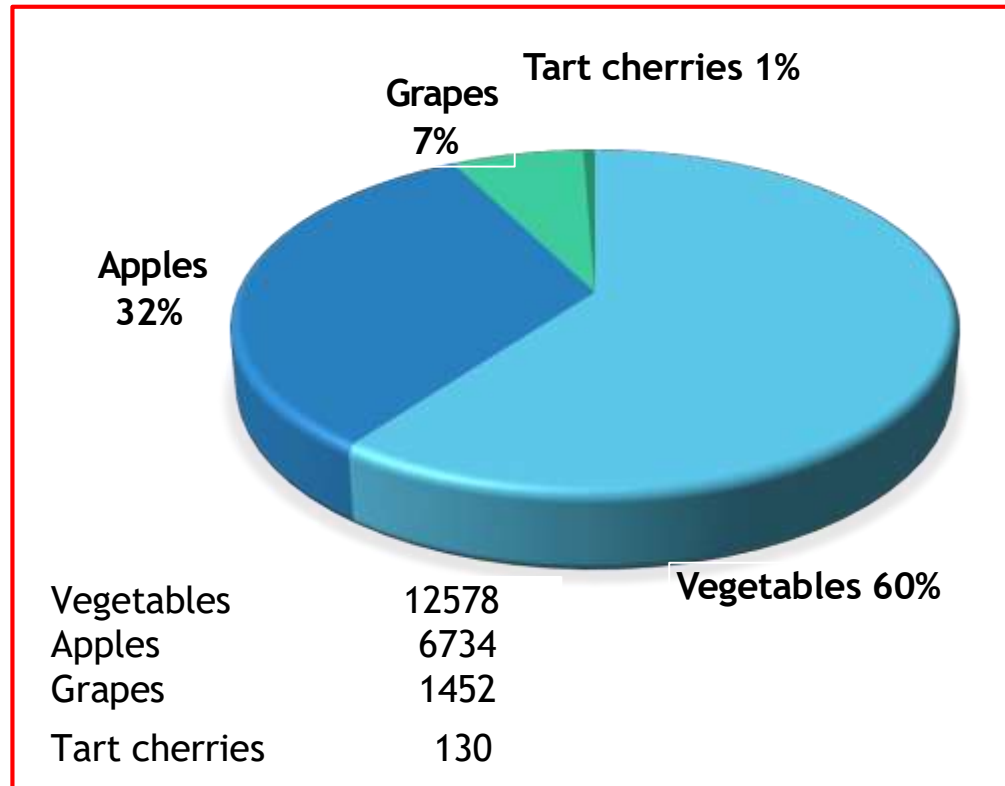
- **Breeding tools:** Stocks and discoveries that came directly from Sturgeon Bay made it possible to make hybrids with wild diploid species *and* the sequencing of the potato genome.
- **Discovering and deploying traits:** better selections for golden flesh, frost and drought resistance in Peruvian highlands, increased folate, resistance to tuber greening, big-tuber wild species mutants.
- **NRSP6 exotic germplasm in the pedigrees of many recently-released cultivars:** Sierra Rose, Peter Wilcox, Hodag, Simplot Innate intragenic cultivars.





# North-Eastern Regional (NE-009)

## Crops managed



## Two curatorial programs:

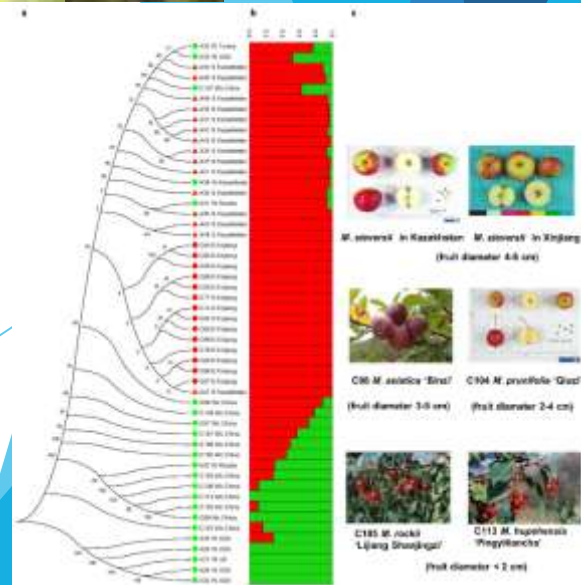
- ❖ Vegetable Crops (**Joanne Labate & vacant position**) tomato, onion, radish, winter squash, cabbage, cauliflower, broccoli, other cole crops, celery, tomatillo, asparagus, buckwheat and other vegetables.
- ❖ Clonal Crops (**Thomas Chao & vacant position**) apples, grapes and tart cherries.

# North-Eastern Regional (NE-009)

## Highlights:

- Distribution of 14,214 germplasm samples in 2016 and 73,290 from 2012 – 2016.
- Added to the *Malus* repository 197 seed and 144 field accessions and to the *Vitis* repository 29 seed and 7 field accessions (377 accessions in total) from 2012-2016 through exchange, import, and exploration.
- Establishment of 1,970 regeneration plots during 2012 – 2016 (317 in 2016) for seed production of vegetable germplasm to distribute and replenish stocks.
- Genotypic data for hundreds of samples each of *Vitis*, *Malus*, tomato, *Brassica rapa*, onion, radish, and winter squash will help to quantify diversity and relationships for germplasm collections.

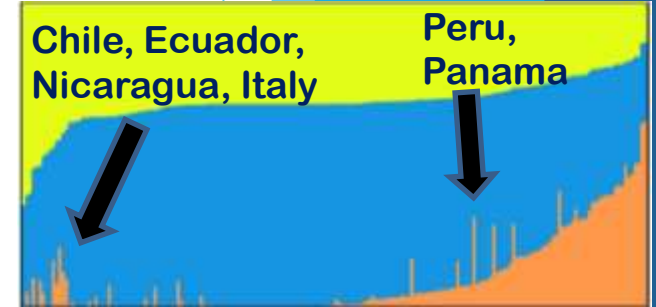
Over 200 growers attended the Cornell Fruit Field Day stop at the Clonal Collection 7-20-2016



# North-Eastern Regional (NE-009)

## Highlights:

- The enormous genome size of onion (16GB) has impeded conventional molecular marker development, however, genotyping-by-sequencing discovered >700 high quality, mappable SNP markers in an onion F2 population.
- Tomato molecular markers confirmed that there is not extensive genetic distinction among types, e.g., ornamental, processing, breeders lines, home gardening etc., but outlier landrace accessions were identified that could provide novel alleles for crop improvement
- Northern Organic Vegetable Improvement Collaborative (NOVIC) is developing new vegetable cultivars adapted to northern climates. Two commercial organic varieties were released and seed was sold in 40 states.



Tomato population structure

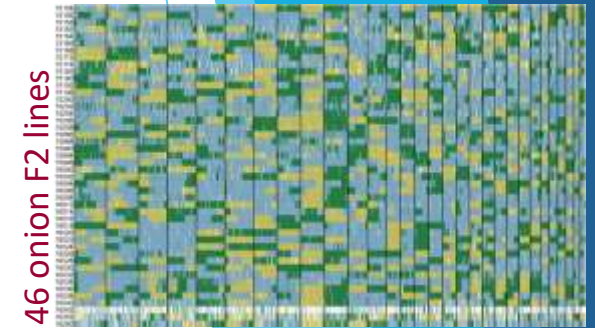


Seed saving demonstrations

# North-Eastern Regional (NE-009)

## Highlights:

- GBS-derived SNP markers from 1,251 progenies belonging to 7 F1 populations from 'Royal Gala' x 7 *M. sieversii* revealed about 476,000 putative SNPs. Both male and female linkage maps were constructed.
- *Malus* collection was surveyed for potential for hard cider production based on fruit traits such as juice acidity and astringency in 2016.
- New phenotyping methods – drone technology



15 linkage groups  
Onion molecular marker map



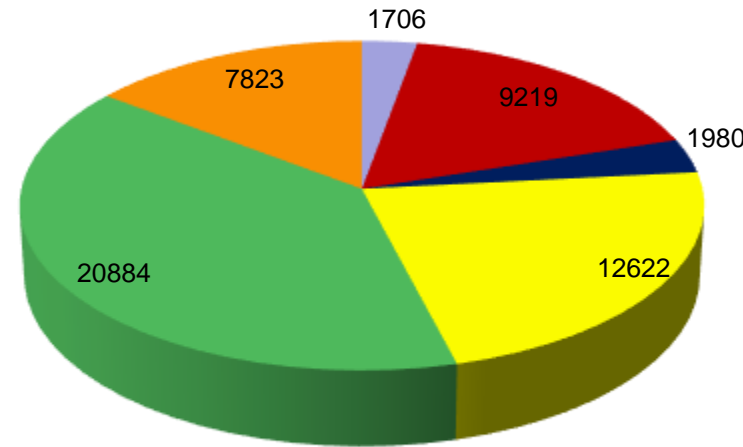


# North Central Regional (NC-007)

## Curation and Distribution

- Strategic collection development; 725 new accessions in 2016; 2381 in past 5 yrs
- Maintain and provide high quality, true to type, well-documented germplasm for research and education objectives for primarily heterogeneous, heterozygous, out-crossing crops; 38,222 packets of 18,000 unique accessions distributed to 919 requestors in 2016
- Pollinator insect management program provides six insect species on demand to support regenerations
- Characterization and evaluation to increase collection usefulness
- Provide technical expertise for GRIN-Global.

54,234 Accessions



- Medicinals, Mints, Ornamentals
- Amaranth, Quinoa, Grasses, Perilla, Misc.
- Woody Ornamentals
- Oilseeds - Brassica, Helianthus
- Maize, Maize Relatives
- Vegetables



# North Central Regional (NC-007)

## Focus on Development and Implementation of GRIN-Global

- Software developer embedded with curatorial personnel provides expertise to create wizards, peripheral applications, and enhancement of Curator Tool functions
- Maize curator serves as business analyst, and personnel devoted to testing and training
- Partnership with the Database Management Unit to achieve NPGS objectives
- Iterative development to address issues identified by testers and system users
- Use of an array of virtual servers and other technologies for robust testing of beta versions

## Assist users with workflows and tools

- Participation in GRIN-Global Advisory Committee to develop system-wide thinking and collaboration to improve and evolve the GRIN-Global System
- Technical exchanges with institutions such as CIMMYT and the Australian Grains Genebank





# North Central Regional (NC-007)

## Collection Development Activities

Among many factors to consider, the importance of the species and risk of habitat loss or extinction take priorities.

- Continued collection of wild *Helianthus* (sunflower) across its native distribution; ornamental focus on *Fraxinus*, *Cornus*, *Gymnocladus*, *Cladrastis kentukea*, and other native plants; expired Plant Variety Protected maize and tropical x temperate introgression lines; vegetable, oilseed, and other crop wild relatives
- Conserving Ash Tree Germplasm for Future Re-establishment (threatened by the emerald ash borer); comprehensive collection of all native species across their range for the past 12 years.
- Collaboration with ARS researchers in Madison, WI to expand diversity of *Daucus* allied Apiacea, complete taxonomic revision of the *Daucus* complex



# North Central Regional (NC-007)

## Seed Health Testing and Capacity Development

- Seed health testing to support international seed shipment (primarily maize and sunflower); 3176 laboratory seed health tests, and 3985 field inspections (5 yrs)
- Development of seed health assays that can be utilized to assure seeds meet phytosanitary requirements for distribution – *Pantoea stewartii*, *Acidovorax avenae*
- Characterization of tropical *Pantoea* isolates that cause false positives when testing maize seed for the Stewart's wilt pathogen, *Pantoeae stewartii*, via ELISA methods. False positives → failure to obtain phytosanitary certificates → distribution not allowed
- PCR methods development for *A. avenae* infestation of melon seeds
- Screening of all cucurbit seedlings for Squash Mosaic Virus via ELISA

# North Central Regional (NC-007)

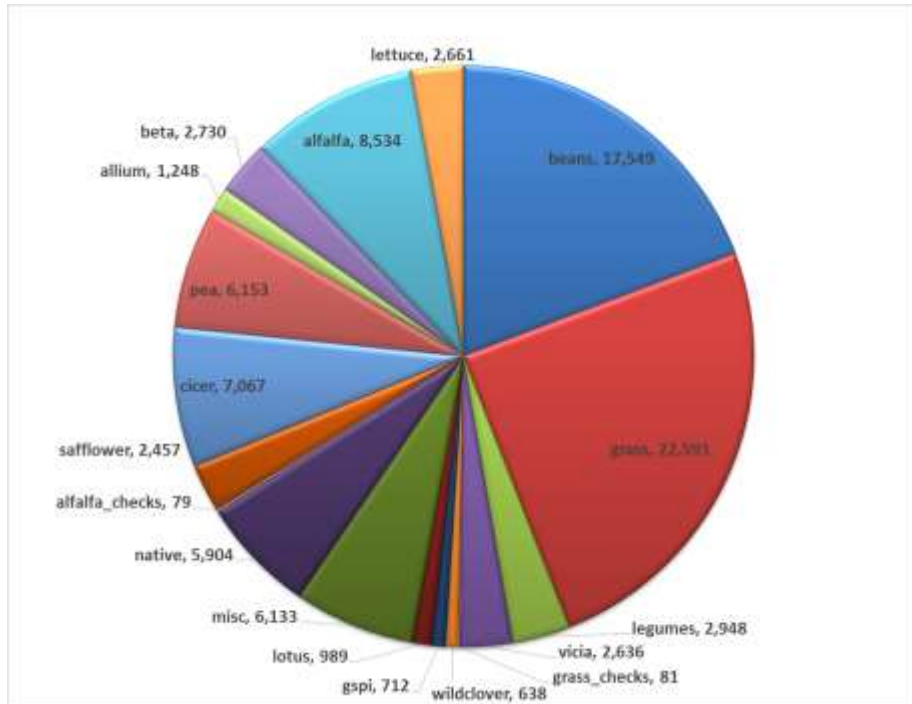
## Viability Research

- Determinations of failure of *Ulmus* sp. to maintain viability at 4 C for one year; viability maintained at -18 C
- Seed dormancy breaking of *Setaria italic* using home medical oxygen concentrators
- Viability assays – nearly 12,000 over past 5 yrs, or 22% of the collection
- Germination methods development
- 10 year determination of effects of storage conditions on *Calendula officinalis* germination, part of a long-term study

## Genetic Characterization

Collaboration between Iowa State University Vegetable Curator K. Reitsma and ARS taxonomist D. Spooner resulted in identification of the first instance in flowering plants of a sequence of potential nuclear genome origin inserted into the plastid genome, and produced a well-resolved *Daucus* phylogeny, using nuclear and plastid markers (Spooner et al. 2017).

# Western Regional (W-006)



## Five curatorial programs:

1. Agronomy and grasses (**Vicki Bradley**)
2. Beans (**Theodore Kisha**)
3. Cool season food legumes (**Clare Coyne**)
4. Temperate forage legumes (**Brian Irish**) located at Prosser, WA
5. Horticultural and miscellaneous crops (**Barbara Hellier**)

## Three research programs:

1. Plant pathology (**Frank Dugan**)
2. Genetics (**Jinguo Hu**)
3. Genetics (**Long-Xi Yu**), located at Prosser, WA

## Two farms:

1. Pullman Farm (**Sean Vail**)
2. Central Ferry Farm (**Kurt Tetrick**)

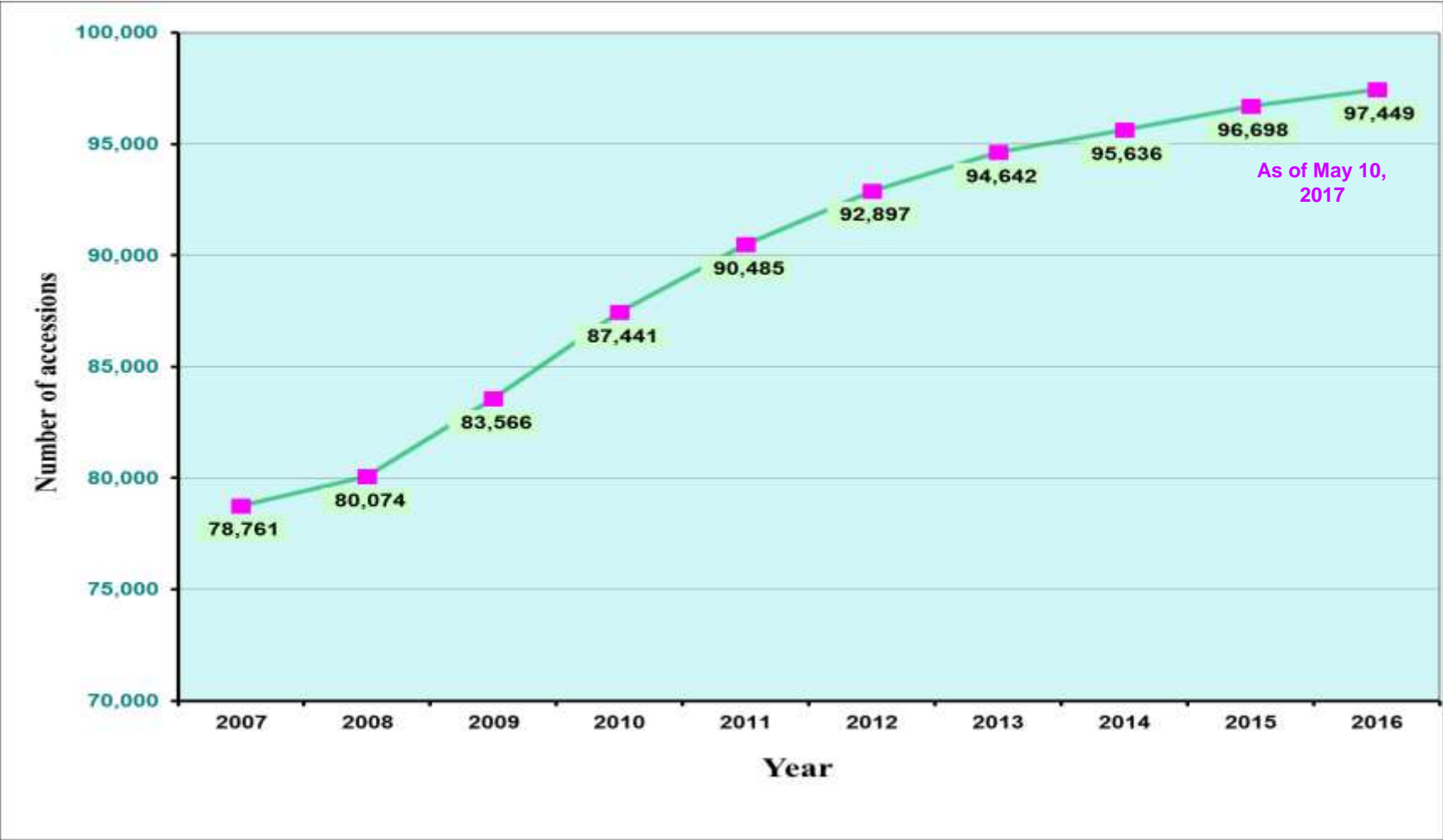


# Western Regional (W-006)

## W6 Station Statistics

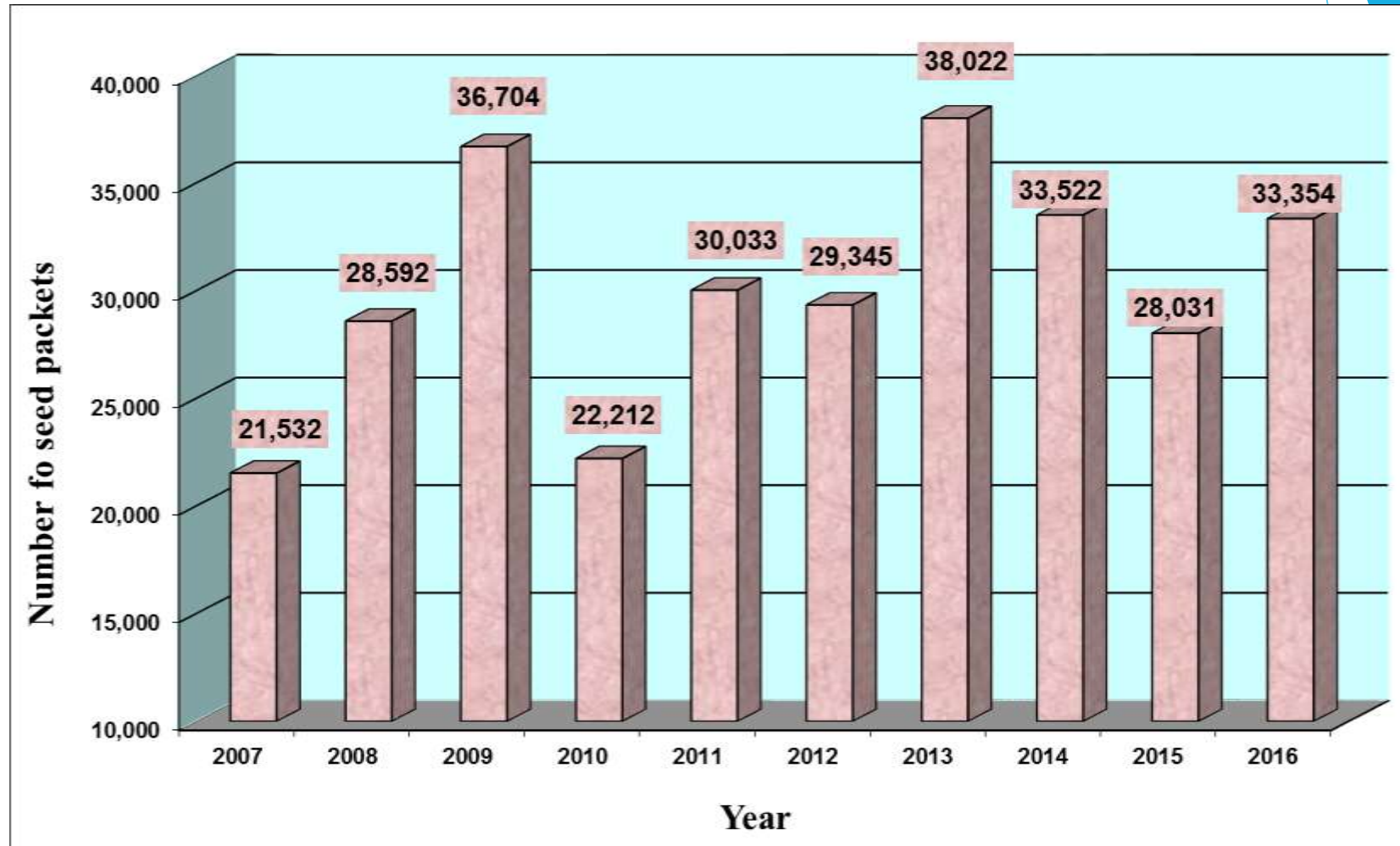
- As of May 9, 2017, there were 95,636 accessions belonging to 5,159 species/taxa in over 1,000 genera in the WRPIS collection.
- We distributed a total of 33,354 packets of seed samples in 1,364 orders. About 74% (24,772 packets) were sent to addresses in each of the 50 domestic states and 26% (8,582 packets) to 46 foreign countries. The 13 Western states requesters received 10,990 packets.
- We uploaded 65,164 observation data points on 9,876 accessions of 20 different crops into the Germplasm Resources Information Network (GRIN)-Global database.
- We shipped 2,392 seed samples to the National Center for Genetic Resources Preservation (NCGRP), Fort Collins, Colorado and 4,706 samples to the Svalbard Global Seed Vault, Svalbard, Norway for secured backup.

# Changes of total number of accessions managed by WRPIS in the past ten years





# Serving the global plant research community by providing needed genetic resources



Number of seed packets distributed by WRPIS in the past ten years

# Western Regional (W-006)

## W6 Station Impact

- Alfalfa is the fourth most valuable crop in the United States following corn, soybeans and wheat. In a pedigree analysis of 500 U.S. alfalfa varieties, 69% had one or more parents that could be traced to a PI accession (Bauchan and Greene, 2002. Plant Genetic Resources Newsletter 129:1–8). The approximate 9,000 accessions of alfalfa germplasm continue to provide needed genes for genetic improvement of this crop. A **total of 14,353 packets of samples were distributed** in the past five years.
- Lettuce is one of the most popular fresh vegetables consumed in the US with an annual farm-gate value over 2 billion since 2007. Public researchers and private breeders are relying on the genetic resources maintained by the W6 project to continue improving the lettuce crop to meet future challenges including good taste, quality, and appearance to satisfy consumers and high nutrient uptake efficiency and strong pest and disease resistance to reduce the cost of growers. During the past five years, we distributed a **total of 9,492 packets of seed samples** to researchers and breeders worldwide.

# Western Regional (W-006)

## W6 Station Impact

- **The *Thinopyrum* species from W6 are a rich source of stem rust resistance.** Novel sources of resistance to wheat stem rust *Ug99* have been identified recently in 242 accessions belonging to five *Thinopyrum* species with most of the *T. Elongatum* and *T. ponticum* accessions showed near-immunity to *Ug99* and other wheat stem rust races (Zheng, et al., 2014 Crop Science 54:2663-2672). Wheat lines carrying *Ug99*-effective stem rust resistance gene *Sr43* from *T. ponticum* on shortened alien chromosome segments were produced using chromosome engineering, and molecular markers linked to *Sr43* were identified for marker-assisted selection (Niu et al., 2014. Theor Appl Genet 127:969–980).



# Western Regional (W-006)

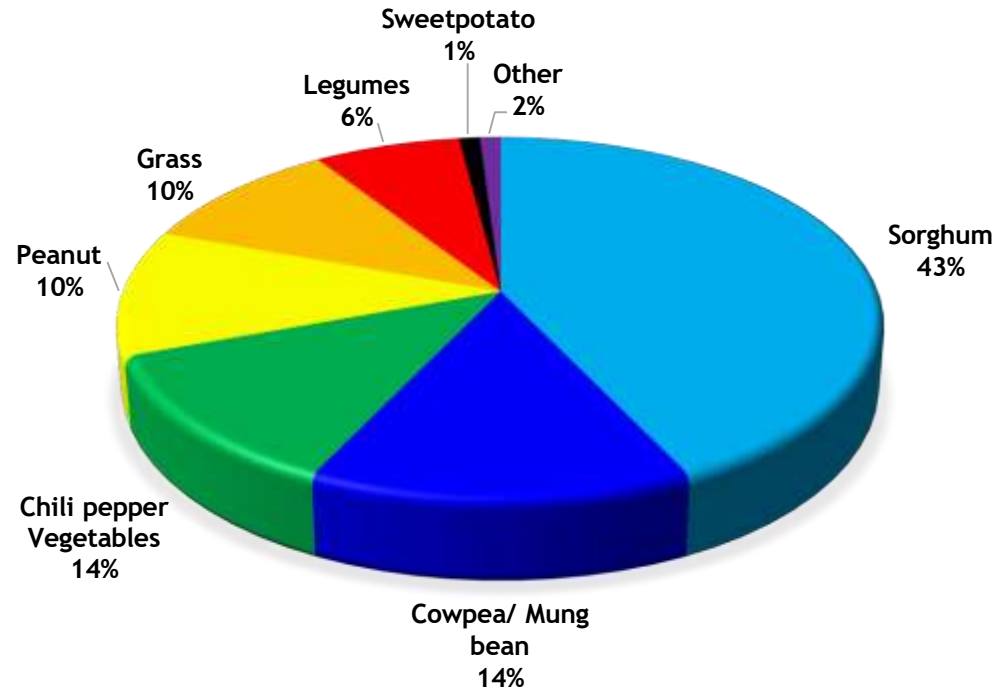
## W6 Station Impact

A new faba bean (*Vicia faba* L.) line developed in Pullman, WA with good cover crop traits (higher biomass and smaller seed) is in the process of germplasm release for cover crop development. These photos show that this faba bean line (right) did better than vetch (left) in competing with weeds on an organic farm in California. This is the second year field trial planted on November 18, 2016.



# Southern Regional (S-009)

## Crops managed



## Curators and Scientists

- Warm-season grasses and sorghum  
Melanie Harrison
- Chili pepper, watermelon, sweet potato, and vegetables  
Bob Jarret
- Vigna, annual clover, and misc. legumes  
Brad Morris
- Peanuts  
Shyam Tallury
- Genetic research  
Ming Li Wang

# Southern Regional (S-009)

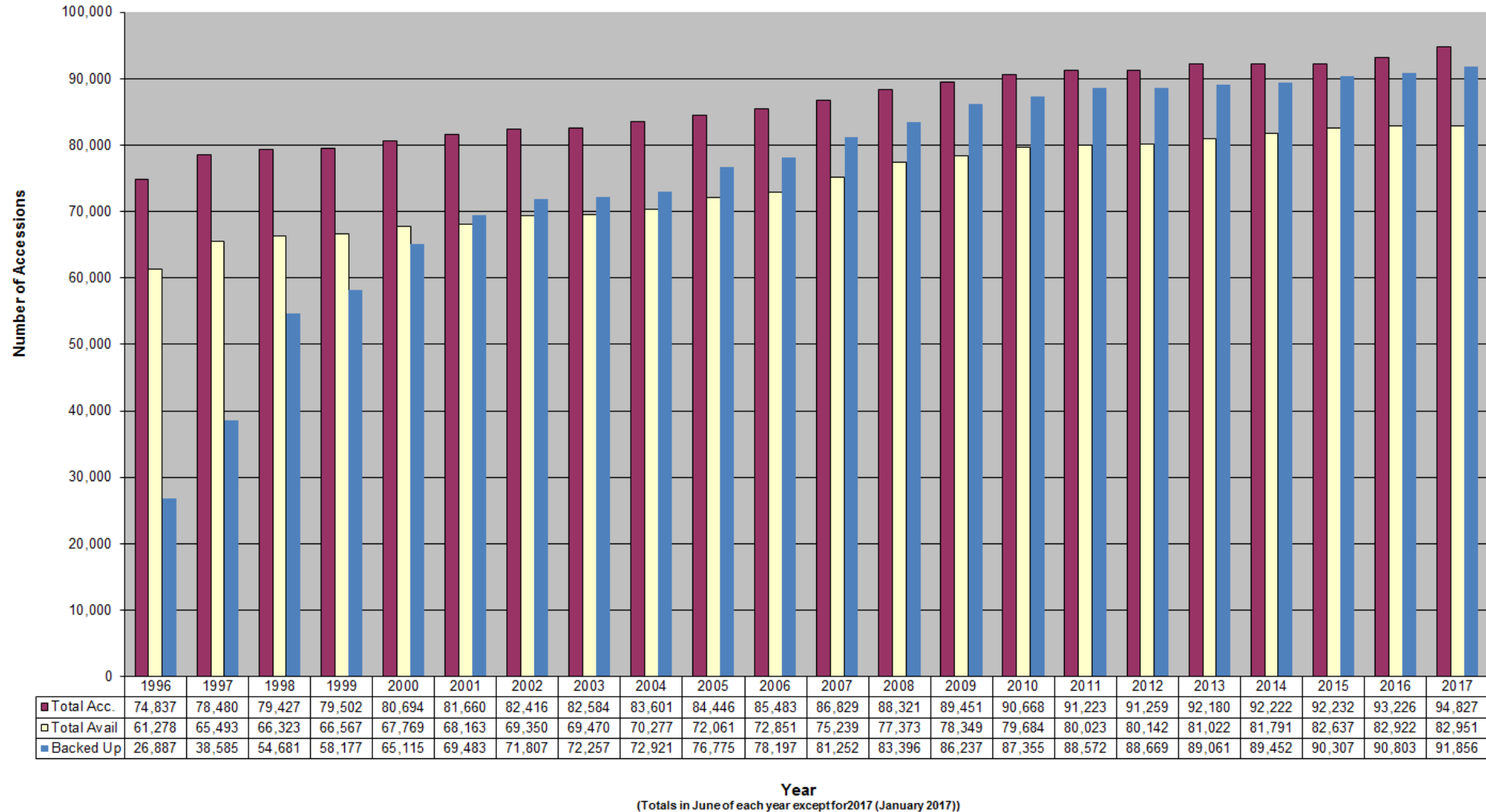
## **Highlights:**

- S-009 collection had 94,827 accessions of 1,605 species with 90% available for distribution.
- 97% of the collection is backed up at Ft. Collins, CO, and 14% is backed up at Svalbard, Norway.
- 43,365 accessions were distributed in 965 orders to users in 48 states and 47 countries in 2016.
- Germination tests, started in Griffin in 2002, have now been conducted on 84,945 accessions or 90.9% of the collection. Only 13% of seed samples available for distribution have viability less than 50%, while 54% of seed samples available for distribution have viability greater than 75%.



# Southern Regional (S-009)

## Curation and Distribution



# Southern Regional (S-009)

## **Highlights:**

- For improved seed longevity, bulk seed of accessions (85% of collection) are stored in -18C freezer storage.
- Acquisition of native grasses including switchgrass, big bluestem, little bluestem and indian grass continued with the collection of 27 accessions in mid-Atlantic states bringing the total number collected since 2008 to 177 accessions.
- Effort is being made to transfer accessions maintained solely as back up in Fort Collins, CO to the working collection in Griffin, GA including approximately 5000 sorghum accessions.

# Southern Regional (S-009)

## Personnel Changes:

- Peggy Morgan was hired as the Program Support Assistant on March. 6, 2016.
- Gary Pederson retired as Research Leader, annual clover curator, and acting sorghum curator on Jan. 3, 2017.

The position is being filled in an Acting Role by Melanie Harrison (Jan 4 - April 1) and Brad Morris (April 2 - August 4).