The National Plant Germplasm System: 2017 Status, Prospects, and Challenges

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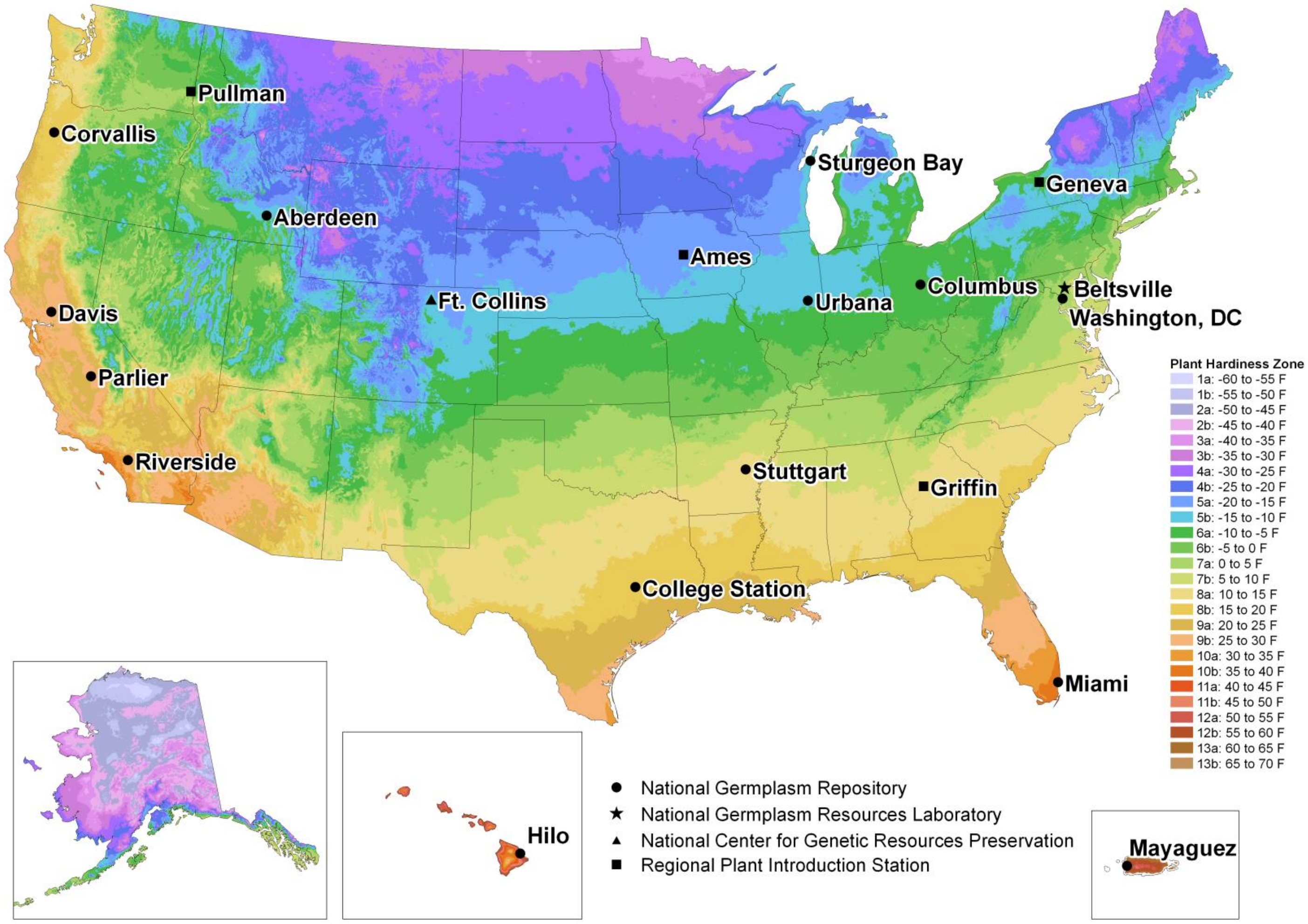
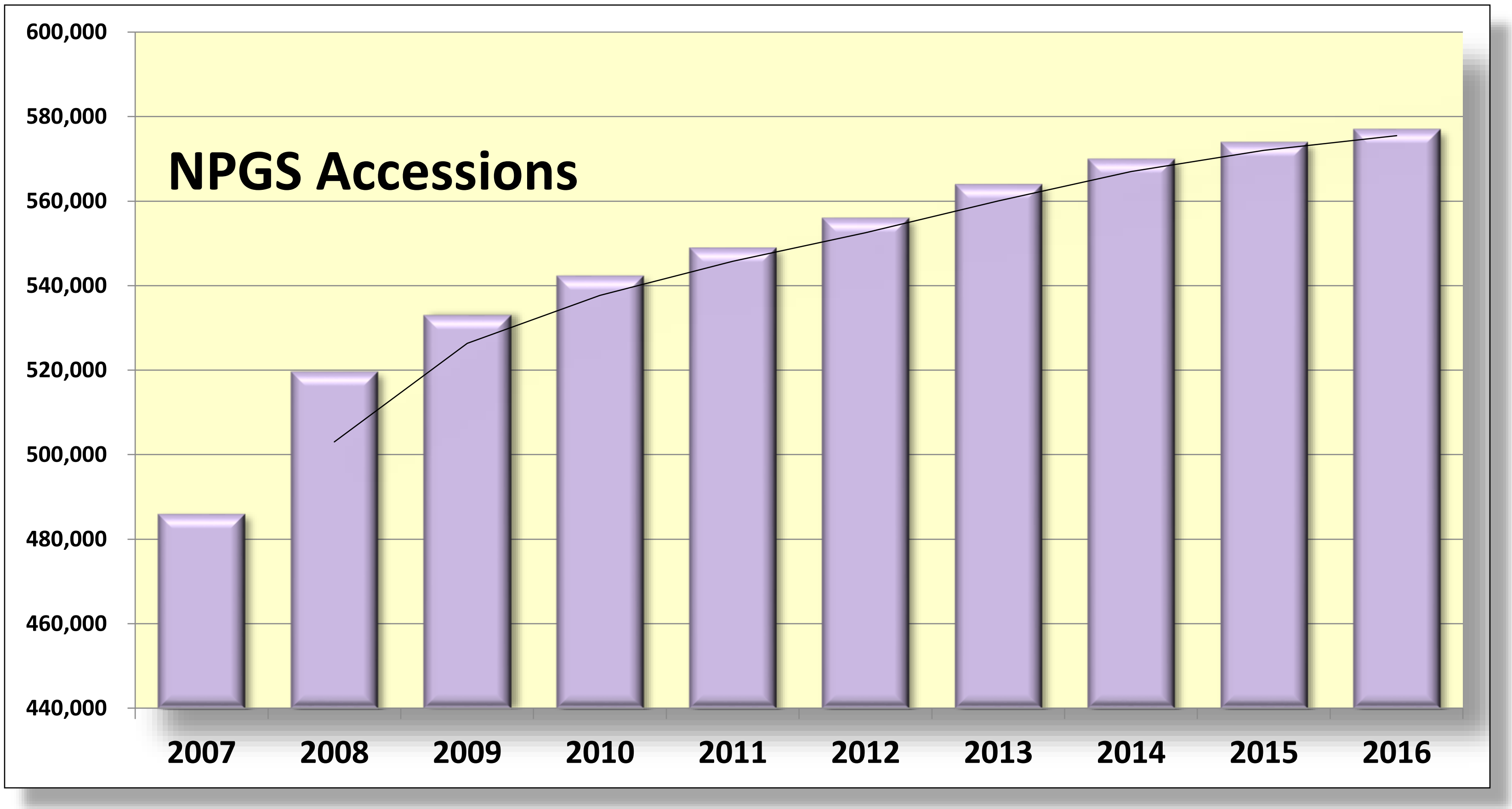
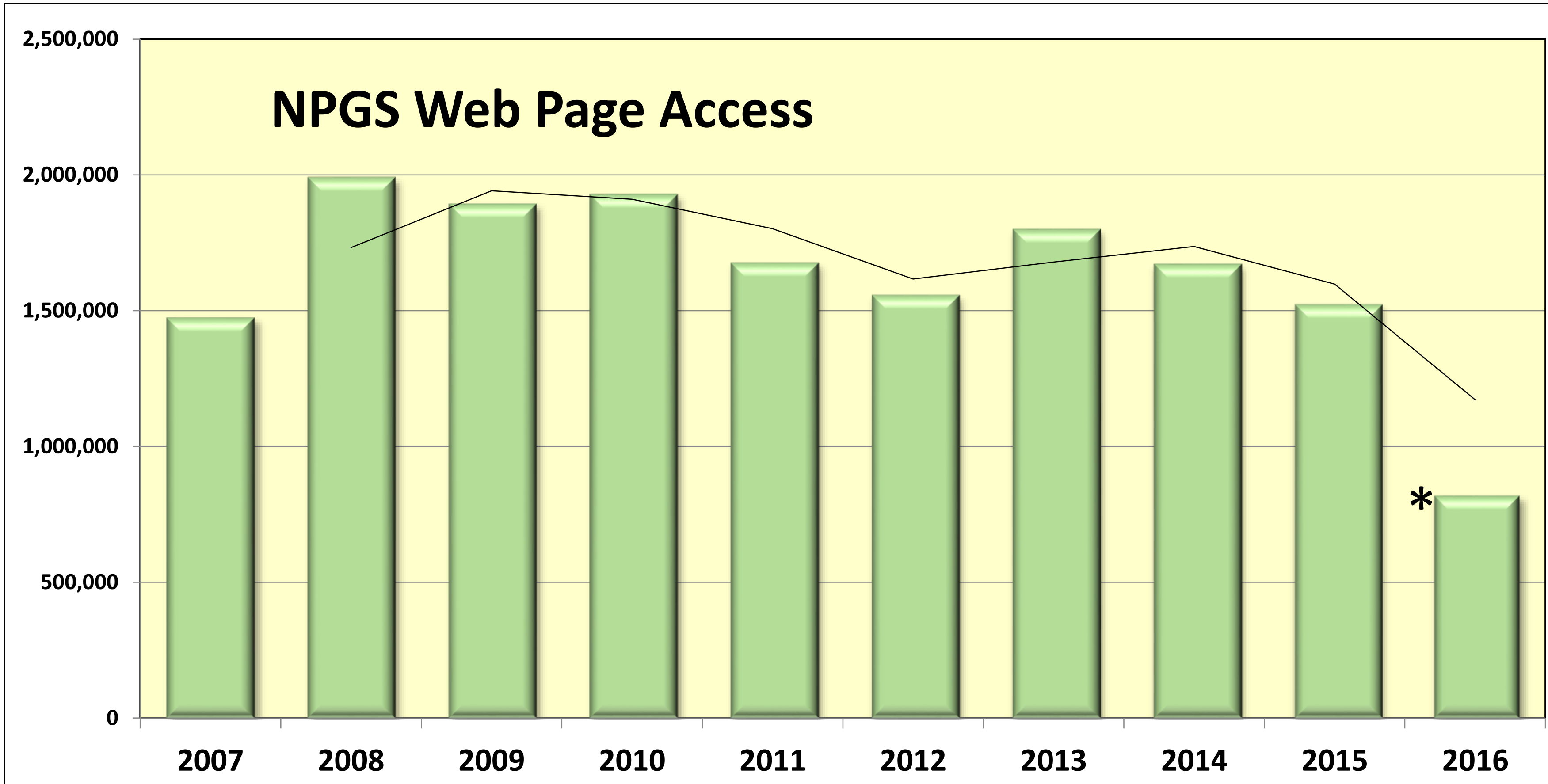
USDA National Plant Germplasm System (NPGS)



Number of NPGS Accessions 2007-2016

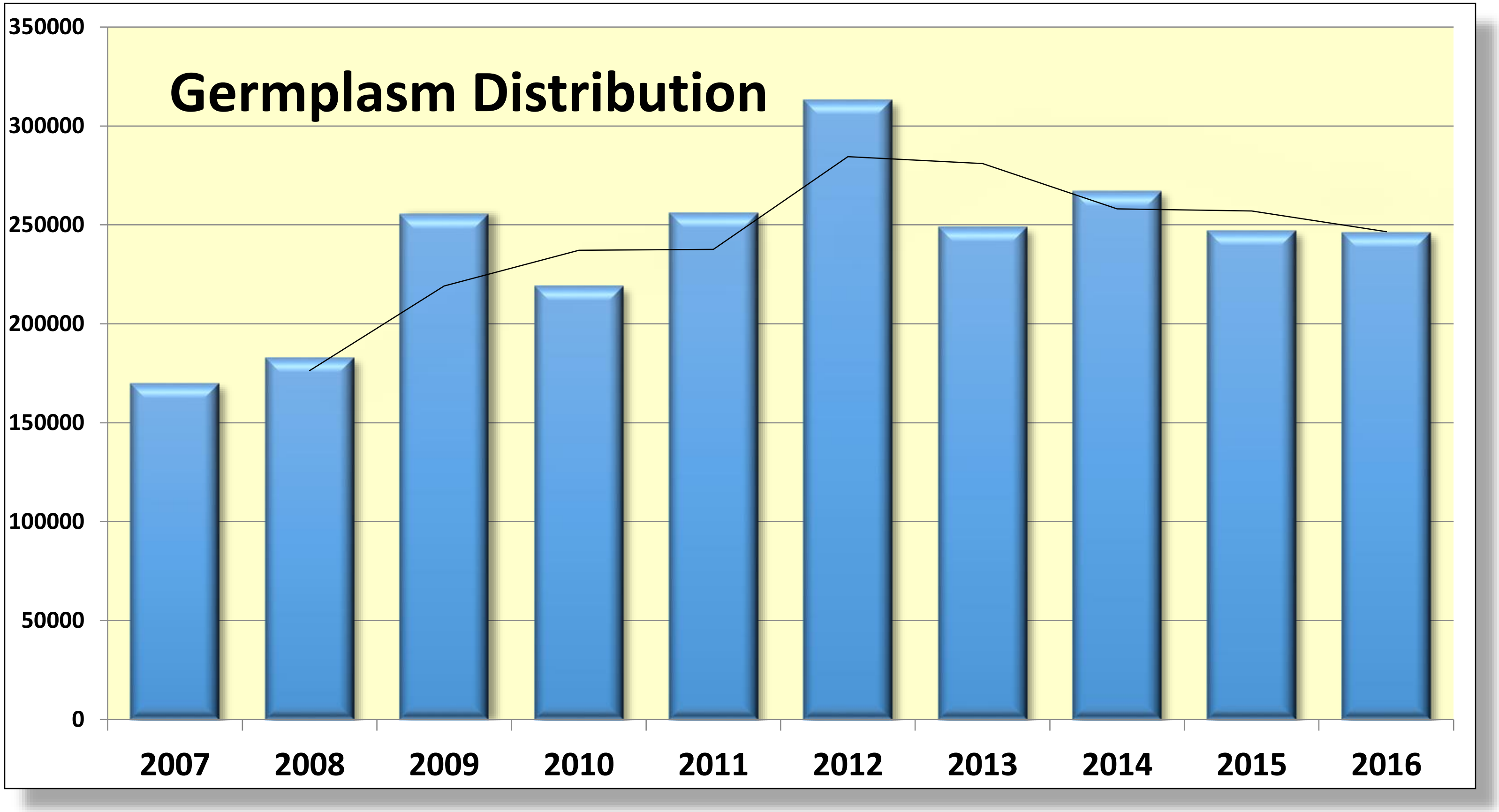


DEMAND FOR NPGS INFORMATION 2007-2016

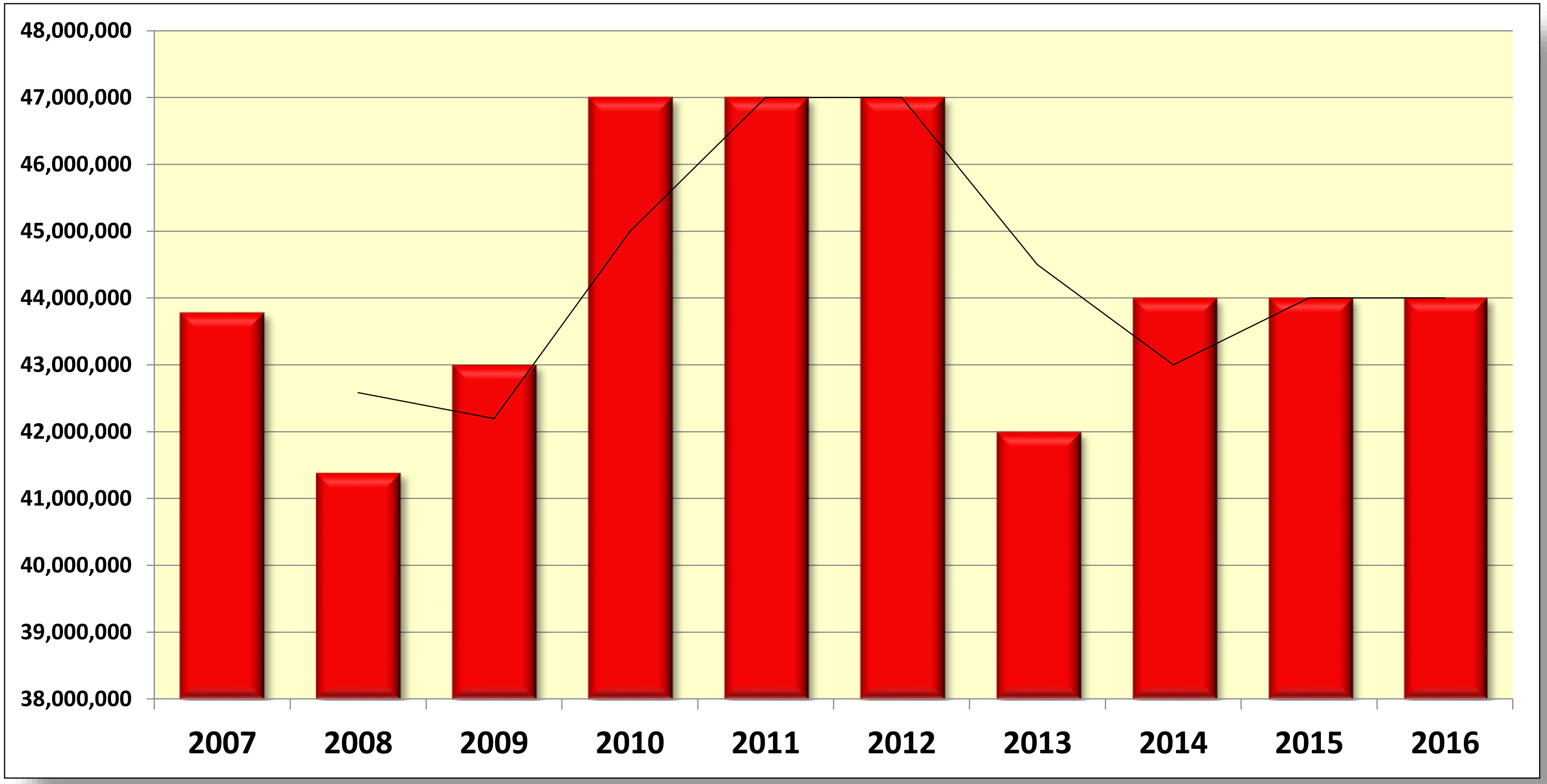


* New GRIN-Global measuring method instituted

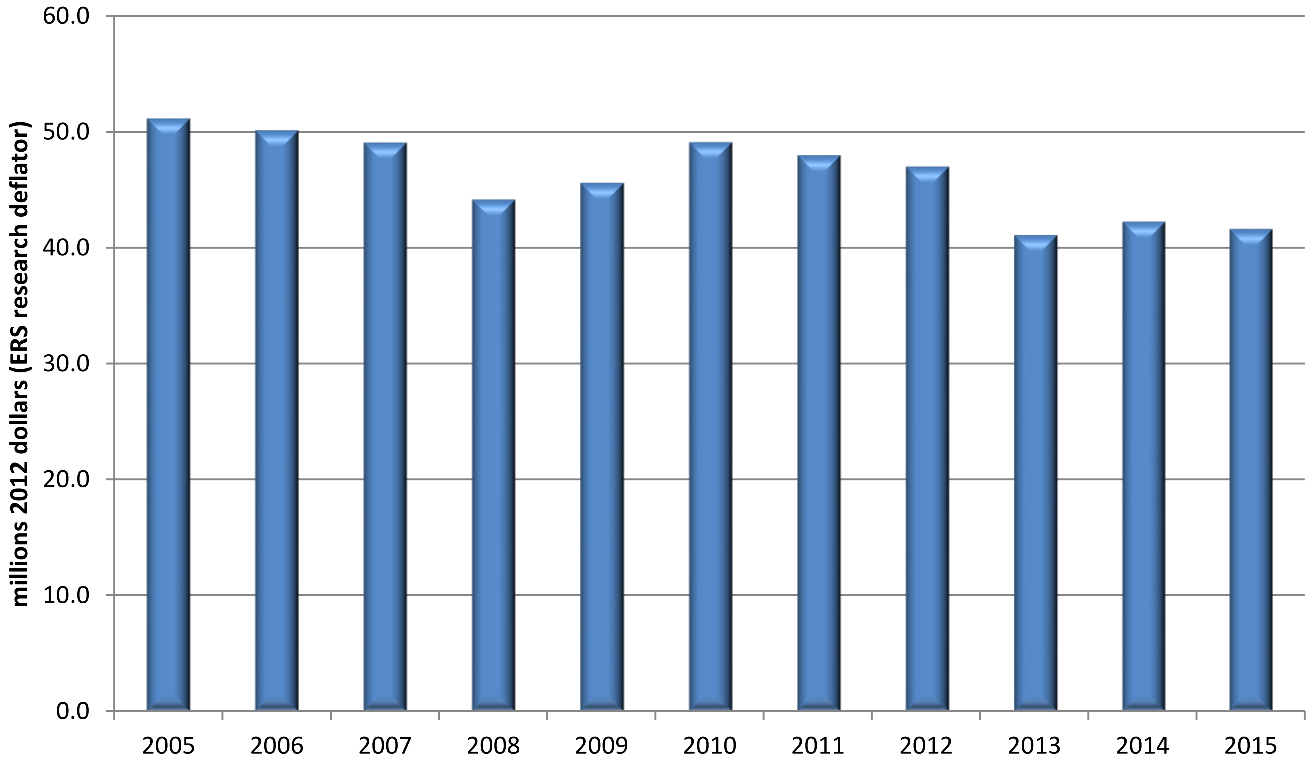
DEMAND FOR NPGS GERMPLASM 2007-2016



ARS National Plant Germplasm System
Budget
2007-2016



Real ARS National Plant Germplasm System Budget, 2005-2015, converted to 2012 dollars with ERS research deflator



Note: Deflator for 2015 is preliminary

Some key challenges for the NPGS

- Managing and expanding the NPGS operational capacity and infrastructure to meet the increased demand for germplasm and associated information.
- Recent and upcoming NPGS personnel retirements.
- Developing and applying cryopreservation and/or in vitro conservation methods for clonal germplasm.
- BMPs and procedures for managing accessions (and breeding stocks) with GE traits and the occurrence of adventitious presence (AP).
- Acquiring and conserving additional germplasm, especially of crop wild relatives.

Genetic Resource Management Priorities

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

Personnel Changes

- Farewell and best wishes to RLs Richard Percy (ARS-College Station), Randy Nelson (ARS-Urbana) and Gary Pederson (ARS-SRPIS, Griffin) for their retirements.
- Farewell and best wishes to Charlie Block, Plant Pathologist at ARS-NCRPIS, Ames who retired to take a position at the Iowa State University Seed Science Center.
- Best wishes to Tomás Ayala Silva, who transferred from the ARS-SHRS, Miami to ARS-TARS, Mayagüez to assume the curator position there.
- Welcome and best wishes to Peter Boches, new tropical crop curator at PBARC, Hilo, and Melanie Schori, new plant taxonomist for GRIN Taxonomy at NGRL, Beltsville.

2016 Retrospective Review of NP 301 Plant Genetic Resources, Genomics and Genetic Improvement

- Largest USDA/ARS National Program:
  - 155 individual research projects.
  - Conducted at more than 50 sites in the U. S.
  - More than 300 crop researchers, breeders, and curators.
- Includes all of USDA/ARS's plant breeding, plant genetics/genomics, information management, bioinformatics, plant genetic resources, plant biology, and plant biotechnology risk assessment research and service activities.
- Covers all major and most specialty crops

2016 NP 301 Retrospective Review Process

- **Composition of the Review Panel:**
  - **Chair: Dr. David Bubeck, Research Director, DuPont Pioneer, Inc.**
  - **Eight panel members: two from AAFC Canada, six from US Land-Grant Universities.**
- **Review Criteria:**
  - **Assess the <u>quality and impact</u> of NP 301's accomplishments during 2011-2015 relative to the NP 301 Action Plan.**
  - **Assess whether NP 301 collaborated effectively with public and private sector partners.**
- **Panel Report was delivered via seminar/webinar on 28 June 2016.**

Summary of NP 301
2011-2015 Accomplishments

- **Advanced crop genetics, molecular biology and physiology.**
- **Underpinned global crop breeding and research.**
- **Integrated global crop breeding and research.**
- **Reduced global crop genetic vulnerability.**
- **Increased global crop yield and product value.**
- **Accomplishments resulted from collaborations, and complemented private-sector efforts.**

NP 301 Retrospective Review Panel – Fundamental Observation

- **“As a collective effort, NP 301 is leading the world to exceptional innovation in Plant Genetic Resources, Genomics and Genetic Improvement. Without this program, the risk and vulnerability to U.S. and world agriculture would be substantial.”**

Review Panel Recommendations/Conclusions

- NP 301 should develop a **"crop genetic improvement strategy"** for each species:
  - Define the **goal, product, final output**
  - Define **the target criteria, both quantity and quality** for "product" output
  - Releasing improved germplasm at the optimal developmental stage is critically important for its successful adoption and use
- Develop a summary of total **FTE support** allocated to NP 301 goals to enable future assessment of **success relative to targeted outputs**.
- Ensure **needs and perspectives of farmers/producers** are incorporated into NP 301 priority-setting and highlight examples of how accomplished.
- NP 301 research and breeding for **climate change adaptation across several crops** (e.g., sorghum, soybean) should be applauded.

Review Panel Recommendations/Conclusions

- Crop **nutritional values** or shifts in **consumer demand, e.g., flavor,** were not highlighted.
- **Nutritional "trade-offs"** were not acknowledged; NP 301 should weigh the **needs of industry and the consumer**.

Review Panel Recommendations/Conclusions

- Focus on areas where **NP 301 research can make unique contributions**:
  - Breeding and research for **specialty crops like club wheat and potato**.
  - Consider future opportunities for **vegetable genetic improvement** for urban agriculture.
  - More emphasis on **alternative production systems**, such as organic.
  - Developing **"quick cooking" beans**.
  - Continue to refine **methods** of **native trait introgression**.
  - Extend ARS **cross-cutting research approach**, applied successfully to **citrus greening**, to other agricultural challenges.
  - Research with **<u>Arabidopsis</u>** can add value and enable other plant improvement approaches but use should be **limited to a model system**.

Review Panel Recommendations/Conclusions

- Genotyping by sequencing (**GBS**):
  - It has been applied to more than **500 plant species:, but are there any clear examples of this technique's impact on breeding?**
  - Research on crops such as maize is substantially impacted by **GBS**, but even with **maize quantifying commercial value** of GBS research is difficult.
- **Insufficient data and information management capacity** seem to have limited NP 301's performance and accomplishments:
  - **Genome databases** maintained by NP 301 are crucial to progress in crop research and breeding.
  - Existence of these databases might be entirely dependent on NP 301.

Review Panel Recommendations/Conclusions

- Areas for future attention and **increased investment**:
  - **Information management** capacity.
  - **Germplasm cryopreservation** methods for additional crops.
  - **Host-plant resistance**/tolerance to **emerging pests and diseases**.
  - **Bioenergy and feedstock** development.
  - **More nutritious crops** with **flavor** considerations.
  - **High-throughput phenotyping.**
  - **Consumer engagement** to drive future research directions.
- Be vigilant to ensure new technologies are available for fair and equitable use by all stakeholders – **IP considerations**
  - Protect taxpayer investment in research and breeding.
  - IPR issues will continue to increase in complexity with new technologies.

Review Panel Recommendations/Conclusions

Collaboration with public and private sector partners?

- Extent of **external research collaborations** is remarkable and commendable.
- Numerous **collaborative research projects** with universities, industry, NGOs and other government departments are having a positive impact on overall U. S. crop productivity.
- Increasing the scope of **international collaborations** is supported.
- **Germplasm acquisition** focused on domestic vs. international (2:1) activities, but involved many partners, honored international agreements and established benefit-sharing mechanisms with developing countries and institutes.