Apple CGC Meeting MINUTES

October 26, 2023

Geneva, NY in-person/zoom hybrid

104 Hedrick Hall. 635 W North St, Geneva, NY 14456

Attendees: Gayle Volk (Chair), Ben Gutierrez, Peter Bretting, Susan Brown, Matt Clark, Larissa Costa, Kate Evans, Gennaro Fazio, Chris Gottschalk, Oscar Hurtado-Gonzales, Peter Herzeelle, Robert Jones, Todd Little-Siebold, Jason Londo, Zoë Migicovsky, Cameron Peace, Greg Peck, Chris Richards, Anna Wunsch, Gan-Yuan Zhong

Walking tour of PGRU Apple collection with Ben G. and Gennaro F. Highlights included the deer fence, improved drainage, a low fire blight year after a few years of significant fire blight damage and pruning, many small replanted trees filling in gaps, removal of G1 and W3 plantings, lower fruit set due to spring freeze in 2023, observation that the trees in the current collection may not always be the highest priority to be conserved, 'Robusta 5' rootstock would be a great Success Story contribution

National Program Leader report (Peter Bretting, see attachment)

The National Plant Germplasm System currently has 607,000+ accessions representing 16,000+ species. There was mention of the value of outreach to apple commodity groups.

DBMU report (Gary Kinard, see attachment)

Plant Exchange Office: Anne Frances is the contact for Plant Exchange and Exploration activities.

GRIN-Global: There is some turnover in the DBMU staff, which may delay some feature updates in the coming year.

APHIS report (Oscar Hurtado-Gonzales)

APHIS facilitates trade and protects American agriculture. Oscar H. coordinates pome fruit import activities and can facilitate the export of germplasm upon special request. CTIFL (Interprofessional Technical Center for Fruits and Vegetables, France) has an apple testing lab in France that could provide European tested materials (or import US materials).

Curator Report and Discussion (Ben Gutierrez, see attachment and 2023 distribution spreadsheet)

Peter Herzeelle is the new orchard manager. Targeting aroma profiling in grape, apple, and tart cherry as well as bloom date for phenology. Bloom date data will be critical if/when orchards are replanted to be better organized for spraying and evaluation purposes. This new planting may be high density (yet still providing ample budwood). The rootstock is still under discussion. A cultivar x rootstock trial will ensure compatibility of wild species with the selected rootstock. Rootstocks will be checked to ensure that they are free of pathogens before they are used. Over 100 people visited the outreach day on Sept. 23, 2023. Approximately 30 tours were given, out

of 100+ requests. 2023 had lower fire blight infections, which allowed some of the severely pruned trees to recover. Preliminary trials are being performed to see if liquid nitrogen can eradicate fire blight in budwood.

Gan-Yuan Z. spoke about the resource challenges of the unit. The greenhouses and some office/labspace was removed after the fire a few years ago. The offices associated with the "clonal" group will be demolished. The Grape Genetic Research Unit and Plant Genetic Resources Unit will be located in the new Geneva Grape building when it is completed. Greenhouse space is limited at this time, but there is space to continue to graft to test the viability of the cryopreserved materials from Fort Collins each year.

Discussion about virus loads in the collection: Pathogen screening/testing is being performed in coordination with Oscar H. Will the new core collection have materials that are clean? What is the virus load in the current collection? Should the most frequently distributed collection materials be cleaned up? Should cryopreserved materials in Fort Collins be grown and tested to see if virus composition in the collection has changed over time?

Core collection subcommittee Report and Discussion (see 2023 Core collection spreadsheet)

Ben has been discussing the development and planting of a new core collection that will be located in the former G1 block. He is considering a core collection of up to 215 accessions with 4 replicates. These will be comprised of mostly (all?) domestica types. Others, if interested, could plant duplicated subsets of the core collection at their locations. The replicated planting will include cider and materials of interest to breeders. It will also likely include materials that are of interest across a wide geographic range (northeast, Midwest, south, west). Todd suggested the inclusion of a wide range of phenotypic diversity (likely historic cultivars) for use in tours and experiential learning. The core should also include standards for phenotyping that can be used as controls for disease resistance, etc. The goal should be to develop a core collection that will be used. Triploids have low value to breeding programs. Ben will continue to move this effort forward and share progress with the CGC.

Acquisition subcommittee Report and Discussion

The acquisition subcommittee (Ben G., Chris G., Jim Luby, Cameron P., Greg P., Oscar H., Gayle V.) has written a draft document describing priorities for new acquisitions in the collection. It includes criteria for Eligibility, Novelty, Vulnerability, and Accuracy. The document will be circulated as it is revised. The acquisition policy will be written so that it can be used for incoming materials and also to review the composition of the current collection. These additional documents are proposed:

1. Acquisition information document that is provided to potential donors.
2. Associated information submission document (donor, passport, phenotype, genotype [MUNQ, identity/uniqueness, pedigree relationships, species assignment, trait locus genotypes] image, historical context [origin, prevalence, past use, societal importance], utilization expectations)
3. Flowchart/pipeline for genotyping (who/what/where/how/options/costs) – Cameron
4. Rubric for determining eligibility for acquisition

5. Priority acquisition material list (replacements or new!, interspecific hybrids, CWR/species [in situ vulnerability, genetic erosion, access, etc), collection quantity and representation of CWR/populations
6. Draft letter to accept or decline and provide other options for preservation (self-propagation, other conservation orchards, contact regional historic apple enthusiast group, etc.)
7. Information page about alternative collection conservation options
8. Deaccessioning (and what to do about sport families)

It was recommended that we contact the Brogdale collection to see copies of their acquisition documents. Gayle will continue to move this effort forward and share progress with the CGC.

Genome Database for Rosaceae trait ontology/descriptor project (Sook Jung)

Sook Jung presented a new project improving the crop ontology for Rosaceae crops coordinated by GDR. Ben G. and Kate E. offered to help align other apple phenotyping efforts and standards with the new GDR proposed ontologies. Gayle V. is also interested in being in the loop.

Evaluation reports

The *M. angustifolia* genome sequence manuscript has been submitted. Diploid *M. coronaria* and *M. ioensis* sequence data are being generated (Chris G.).

SNP data are being collected for 192 crop wild relatives (*M. baccata, M. prunifolia*, etc) in the NPGS collection to determine trueness-to-species. Genome-scanning using the LGC Flex-Seq will be possible, if interested, please contact Cameron P. and provide (1) an estimate of how many samples it could be in each of 2024, 2025, and 2026, (2) your preference (or need) for number of SNPs (10K, 5K, 2.5K, or some other number), and (3) if you also want to be involved in deciding on the SNPs to include in the 10K set-up.

NLGRP, GRIN-U updates, Exploration report (Gayle Volk, see attachment)

Cryopreservation: At this time, 2289 apple accessions are cryopreserved with at least one tube at NLGRP. 34 of those only have 1 tube. In 2023, 35 apple accessions were processed, 18 had >40% viability, 7 had 20-30% viability.

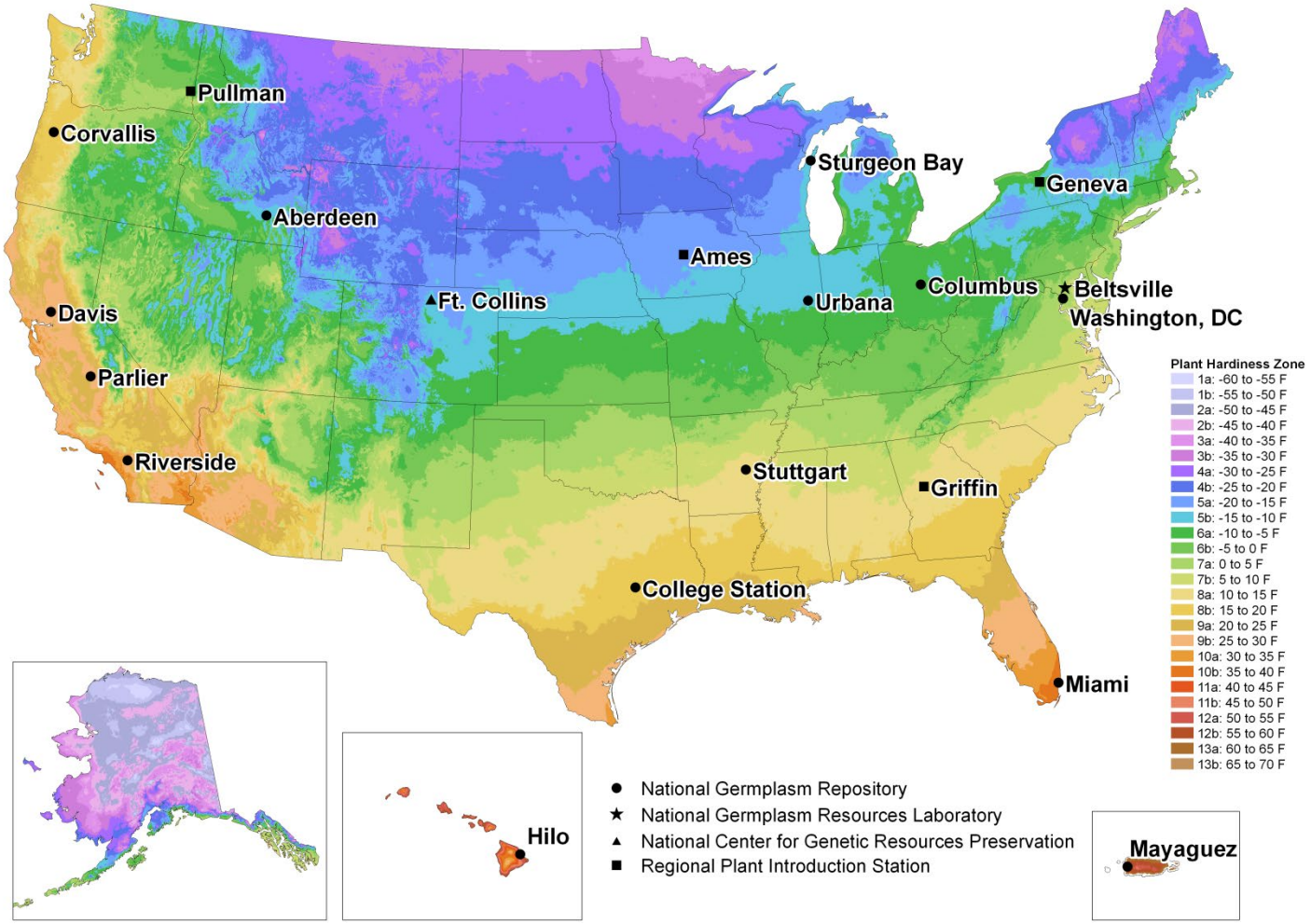
Education and outreach: GRIN-U.org and the GRIN-U Education youtube channel continue to grow in popularity. We encourage the submission of success stories! See the attached submission template.

Exploration: Gayle visited Vietnam in 2018 and 2023 to collect *Malus doumeri* from the north and south parts of Vietnam. Seed samples from 2018 are in liquid nitrogen in Fort Collins and trees are growing in Corvallis. Seeds from 2023 will be sent to quarantine after receiving approvals from the Vietnamese government (November or December 2023).

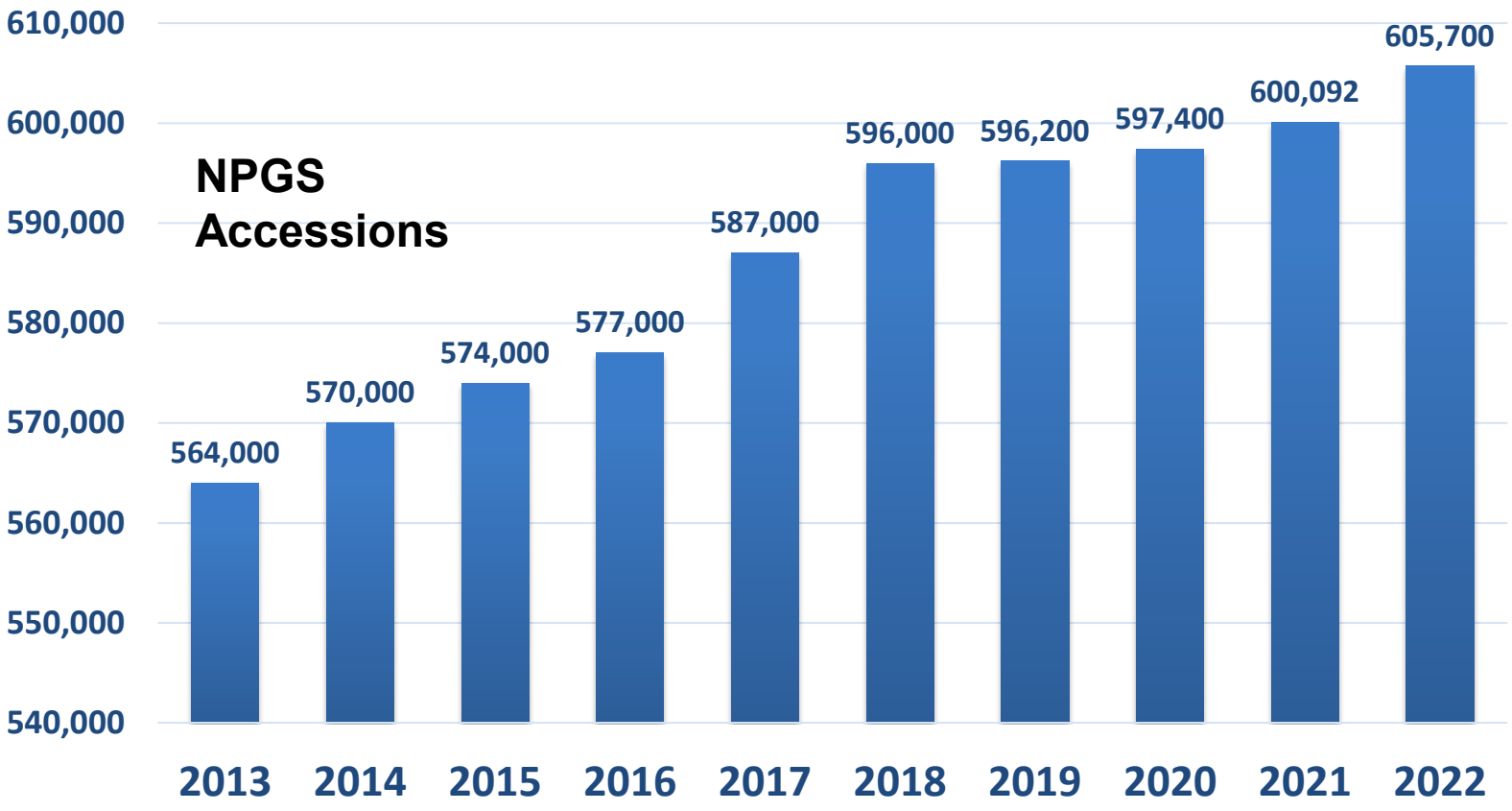
The National Plant Germplasm System: 2023 Status, Prospects, and Challenges

Peter Bretting
USDA/ARS Office of National Programs
Peter.bretting@usda.gov
Cell: 1.240.447.9983

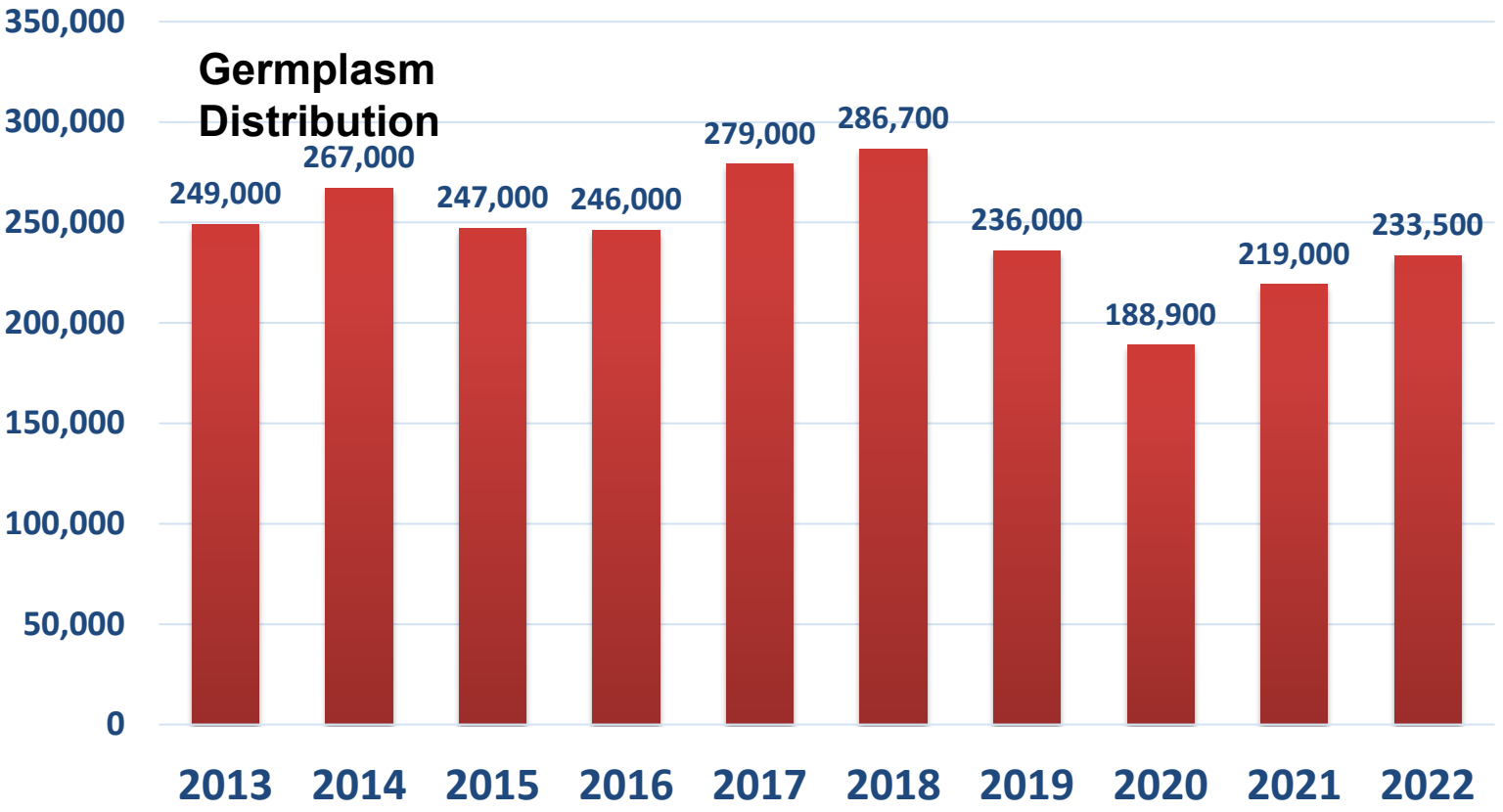
USDA National Plant Germplasm System (NPGS)



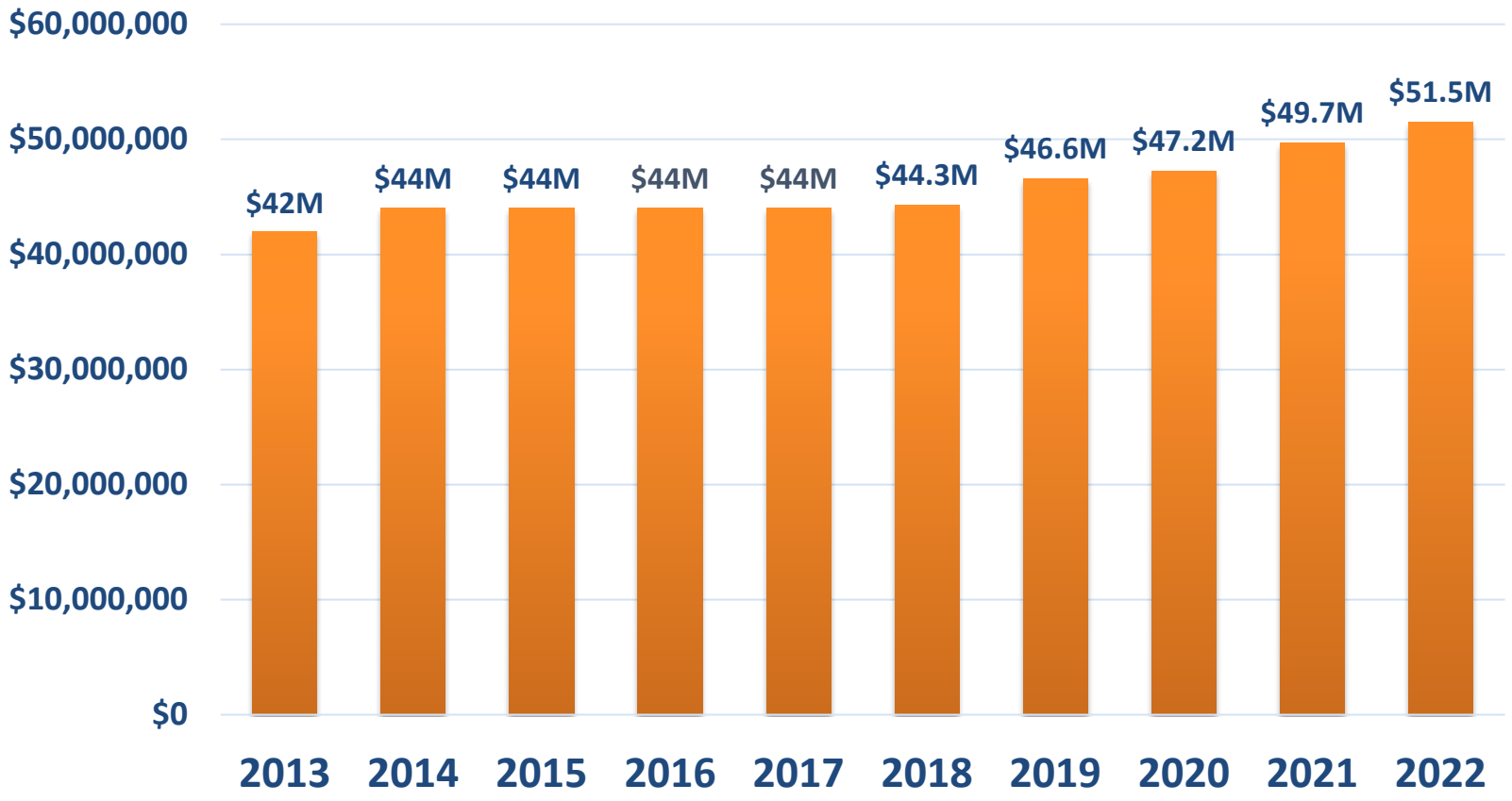
Number of NPGS Accessions 2013-2022



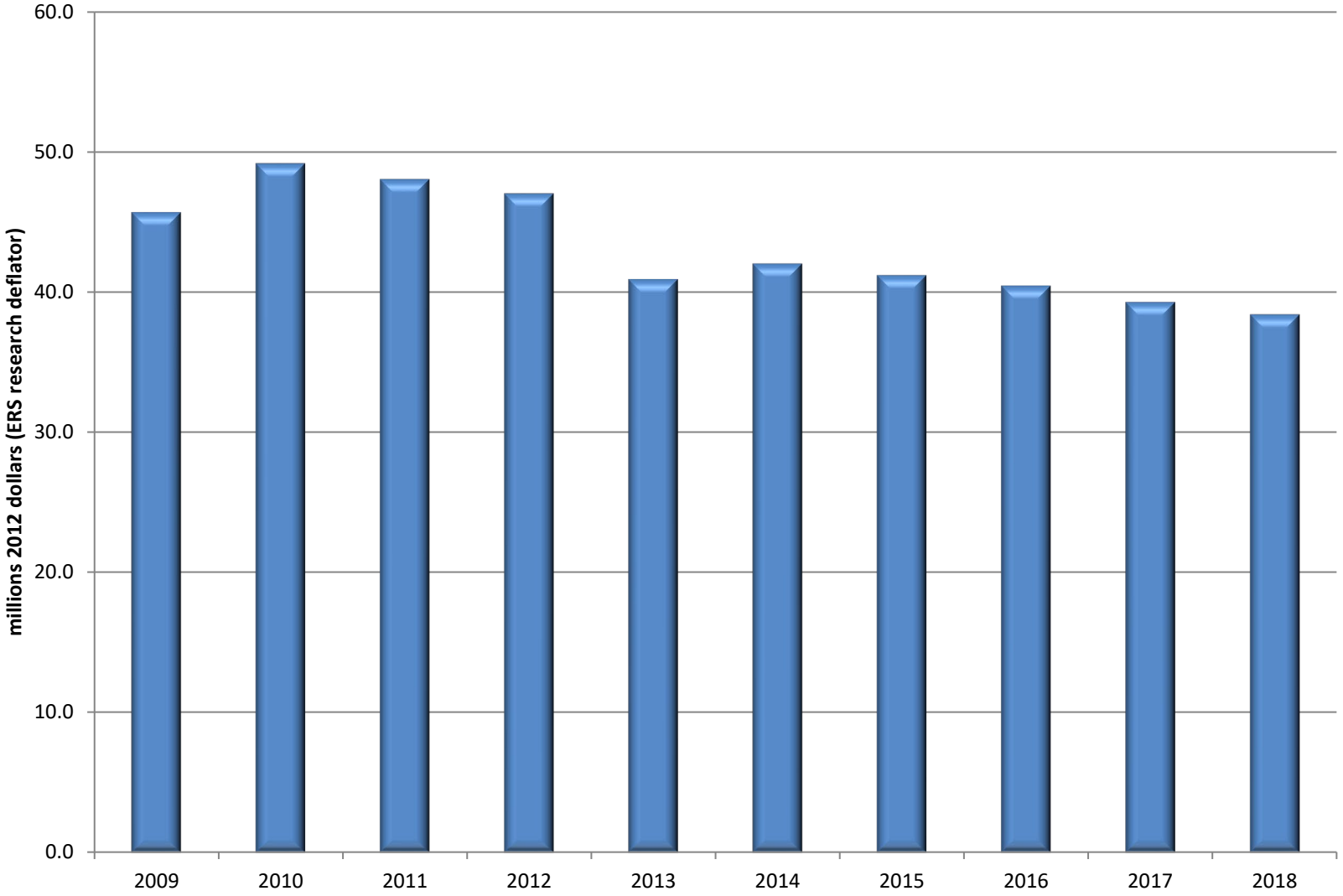
Demand for NPGS Germplasm
2013-2022



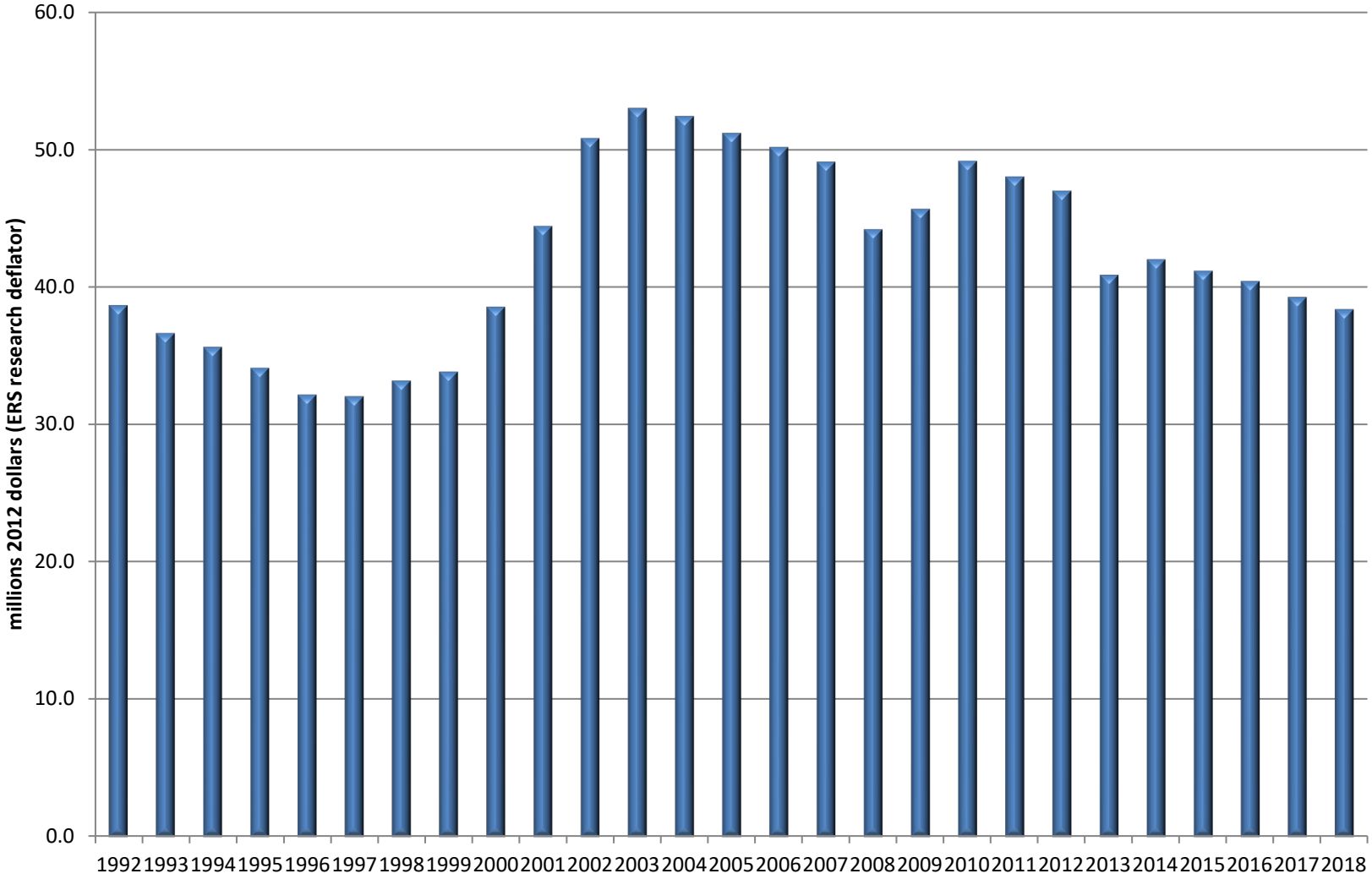
ARS National Plant Germplasm System Budget 2013-2022



ARS NPGS real (deflated) budget, 2009-2018



ARS NPGS real (deflated) budget, 1992-2018



Some key challenges for the NPGS

- **Expanding the NPGS operational capacity and infrastructure to reduce PGR management backlogs and meet increased demand for PGR and associated information.**
- **Increased operational costs (labor, inputs, overall inflation).**
  See https://www.ers.usda.gov/amber-waves/2022/june/investment-in-u-s-public-agricultural-research-and-development-has-fallen-by-a-third-over-past-two-decades-lags-major-trade-competitors/?cpid=email#
- **NPGS personnel transitions—hiring, training, etc.**
- **Developing and applying cryopreservation and/or in vitro conservation methods for clonal and some seed PGR.**
- **BMPs and procedures for managing accessions (and breeding stocks) with an increasing diversity of GE traits in more crops, the occurrence of adventitious presence (AP), and the products of gene editing.**
- **Acquiring and conserving additional PGR, especially of crop wild relatives.**

PGR Management Priorities: Foundations for Crop Innovation

- Acquisition
- Maintenance
- Regeneration
- Documentation and Data Management
- Distribution

- Characterization
- Evaluation
- Enhancement
- Research in support of the preceding priorities

NPGS Personnel Transitions

- **Farewell and best wishes to Stephanie Greene, Curator, (ARS- Ft. Collins), Barbara Hellier, Curator, (ARS-Pullman), Karen Williams, Botanist, (ARS-Beltsville) and Kim Hummer, RL (ARS-Corvallis).**
- **Welcome and best wishes to Robert Krueger, RL (ARS-Riverside); Marilyn Warburton, RL, Sarah Dohle, Curator, Paul Galewski, Curator, and Bailey Hallwachs, SOS Coordinator (all ARS-Pullman); Rebecca Povilus, Curator (ARS-Geneva); Claire Heinitz, RL (ARS-Davis and Parlier); Sukhwinder Singh, RL (ARS-Miami).**
- **We are recruiting staff at Ft. Collins, CO; Corvallis, OR; and Parlier, CA.**

PGR Management Training Initiative

- **Numerous NPGS PGR managers have retired recently; no formal, comprehensive program existed for training new PGR managers.**
- **G. Volk (ARS-Ft. Collins) and P. Byrne (CSU-Ft. C.) lead a project, supported by ARS and a NIFA grant, to design and develop a training program for PGR management to be delivered primarily through distance-learning.**
- **A now three module, 3 credit hour Colorado State online course Plant Genetic Resources: Genomes, Genebanks, and Growers was taught in Aug.-Sept. 2022-- the first time for the three-part course. http://pgrcourse.colostate.edu/**
- **Numerous PGR training/educational materials are freely accessible from GRIN-University at https://grin-u.org/**
- **Infographic posters for PGR, genebanks and conservation, and PGR and food security in 6 languages; download at http://genebanktraining.colostate.edu/trainingmaterials.html**

Adapting the NPGS to rapid global warming

- ***Crop Science*** **article published 25 May 2023**
- **Includes case studies, software for estimating future conditions, identification of potential adaptive strategies and actions.**

FY 22 ARS NPGS Budgetary Increases

- **Pecan PGR (ca. $600,000): College Station, TX.**
- **Coffee PGR (ca. $250,000): Hilo, HI**
- **Pulse PGR (ca. $100,000) Pullman, WA**
- **Pulse PGR (ca. $100,000) Urbana, IL**

USDA-ARS
National Germplasm Resources Laboratory
Beltsville, Maryland
2023 Report to PGOC, RTACs, and CGCs

The National Germplasm Resources Laboratory (NGRL) supports the acquisition, introduction, documentation, evaluation, and distribution of germplasm by the National Plant Germplasm System (NPGS) and other components of the U.S. National Genetic Resources Program (NGRP). The Laboratory is comprised of the Plant Exchange Office (PEO), the Database Management Unit (DBMU), and the Plant Disease Research Unit (PDRU).

Karen Williams, Botanist, retired on December 31, 2022, after 39 years of service to ARS-NGRL! We intend to fill this position by late 2023. The Research Plant Pathologist vacancy in NGRL was advertised through January 23, 2023. We hope this position will be filled by the summer of 2023.

Plant Exchange Office

Plant Exploration and Exchange Program:

- The PEO supports the collection of germplasm for the NPGS through management of the Plant Exploration and Exchange Program. Guidelines for developing plant exploration and exchange proposals will be distributed to CGC chairs in February 2023. Proposals must be endorsed by the appropriate CGC or other crop experts to be considered for funding.
- Five explorations were conducted in FY 2022. One international exploration was conducted in the country of Georgia for *Salix armeno-rossica* by in-country scientists. Four domestic explorations were completed in FY 2022, and include collections of:
    - *Monarda lindheimeri* (TX)
    - *Phaseolus polystachios* (FL, GA)
    - *Fraxinus anomola* and *F. velutina* (AZ, NM)
    - *Solanum jamesii* and *S. fendleri* (TX, NM)
- Several explorations that were approved in previous years were postponed because of the pandemic. Some of the postponed explorations have been rescheduled for FY 2023. The remaining postponed explorations will be rescheduled when feasible. Due to funding constraints imposed by proposals already approved, it may not be possible to approve new exploration or exchange proposals for funding in FY 2023. Please consult with PEO before developing proposals for FY 2023.
- All foreign explorations supported by PEO must comply with the principles in the Convention on Biological Diversity covering access and benefit sharing related to genetic resources. Prior informed consent to collect genetic resources is obtained from the host country before the exploration. The PEO is involved in most requests to foreign governments for permission to collect and negotiates the terms of agreements when necessary.

Collaboration on Crop Wild Relatives in the U.S.:

The NGRL is collaborating with NatureServe, the U.S. Botanic Garden, and the Oak Spring Garden Foundation to conserve *Vitis* species native to North America. An overview of the invitational workshop held in November 2022 can be found in the December newsletter of the National Grape Research Alliance.

GRIN Taxonomy for Plants:

- GRIN Taxonomy, available through GRIN-Global (https://npgsweb.ars-grin.gov/gringlobal/taxon/taxonomysearch), provides online current and accurate scientific names and other taxonomic data for the NPGS and other worldwide users. This standard set of plant names is essential for effective management of ARS plant germplasm collections, which now represent ca. 16,300 taxa. A broad range of economically important plants is supported by GRIN nomenclature, including food, spice, timber, fiber, drug, forage, soil-building or erosion-control, genetic resource, poisonous, weedy, and ornamental plants. Most of the search pages were rewritten in 2021 to allow a broader range of searches and provide the option to export most search results, and the World Economic Plants search was rewritten in 2022.
- GRIN Taxonomy includes scientific names for 28,003 genera (14,707 accepted) and 1,422 infra-genera (1,350 accepted) and 127,909 species or infra-species (70,317 accepted), with over 68,516 common names, geographical distributions for 62,940 taxa, 514,817 literature references, and 34,142 economic importance records. These numbers increase regularly.
- Since 2008, a project to provide thorough coverage of wild relatives of all major and minor crops in GRIN Taxonomy has been underway. We have completed our initial work on 388 major and minor crops from 174 genera, and CWR from 4,341 taxa have been mapped to these crops and others under progress. In addition, multiple crops have been updated to reflect recent publications on CWR genepools and breeding usages. An interface to query these data is available (https://npgsweb.ars-grin.gov/gringlobal/taxon/taxonomysearchcwr.aspx). We invite feedback from NPGS curators and CGC members for those CWR classifications already developed.

Facilitation of Germplasm Exchange:

The PEO expedites distribution of germplasm from the NPGS to foreign scientists and international genebanks through collaboration with USDA-APHIS at Building 580, BARC-East in Laurel. The order backlogs were significantly decreased in 2022, but international shipments remained challenging. Only one APHIS inspector is currently available to inspect NPGS outgoing shipments, and logistical delays related to global shipping are continuing.

In 2022, 662 public orders containing a total of 45,226 samples of NPGS accessions were shipped from Beltsville to individuals in 62 countries for research and education. In addition, PEO facilitated the agricultural inspection of arriving germplasm shipments containing accessions from foreign countries for researchers and curators at NPGS sites.

Crop Germplasm Committees:

- Many CGCs continue to meet regularly and are active. The pandemic created challenges for committees with a long history of meeting in person but has also created opportunities for more participation through virtual or hybrid meetings. Committees are urged to meet at least annually, and especially to update their Crop Vulnerability Statements. Several CGCs recently completed new versions. The NPGS has been fortunate to fill numerous vacant positions in the last two years, and we hope more will be filled in 2023. These new staff would especially benefit from active and supportive CGCs.
- The 2022 CGC Chairs meeting was held March 3, 2022, and the presentations are archived on the CGC page at https://www.ars-grin.gov/CGC.
- NGRL has a Zoom conferencing account that is available to the CGCs to use for hosting virtual meetings.
- Please send updates to the individual crop committees of the CGC page on GRIN (https://www.ars-grin.gov/CGC) to Gary Kinard.

Database Management Unit

GRIN and GRIN-Global:

- At the time of this report, the GRIN-Global plant database included the following:

    - 605,446 active accessions representing 2,565 genera of plants
    - 3,554,801 inventory records
    - 2,208,560 seed germination/viability testing records
    - 9,195,722 characteristic/evaluation records
    - 1,504,998 attachment files, primarily digital images

  These numbers increase regularly, some almost daily.

- Incremental improvements were made in the GRIN-Global public website throughout 2022. Some of the more impactful to users: The Advanced Search feature approach was improved including creating four quick-select search criteria (scientific name, plant name, repository, country of origin) that are commonly used. We also added the Accession Narrative field as searchable in the Advanced Search, so there are now a total of 20 fields that are searchable singly or in combination (up to four criteria simultaneously) as an Advanced Search. The algorithm to order or rank search results was made more logical for most users' expectations. For example, the weighting of results when the search term is a genus name would be higher ranked than a record where the search term occurs in the narrative/note field. Under GRIN Taxonomy, a Regulation Search feature was added. This feature complies data, into a queryable format, the regulates that entry of plant propagative material into the U.S. and its movement among U.S. states and territories. Regulations that govern the export of rare and endangered plants from the U.S. are also included. Regulation criteria that can be searched include taxon, geography, and regulation type. The capacity to search by plant

common name was added to the Crop Wild Relative section of GRIN Taxonomy. We added a 150-character count requirement to the Intended Use justification statement that is required to submit a germplasm request through the online shopping card checkout process. This was enabled to facilitate evaluating the legitimacy of the requests and to learn more about the research and services the NPGS is supporting. The compliance of the public website with current Web Content Accessibility Guidelines (WCAG) was improved. This strives to ensure users with sensory or mobility limitations can use the site effectively.

- Current information about the project, including user documentation and release notes from each version of the software, can be found on the project website at https://www.grin-global.org/.

Plant Disease Research Unit

The PDRU conducts research on pathogens that infect clonally propagated prohibited genus (i.e., quarantine) crops, including etiology, detection, and elimination by therapeutic procedures. This project provides direct support to the APHIS Plant Germplasm Quarantine Program and helps facilitate the safe introduction, conservation, and international exchange of valuable plant germplasm. PDRU also collaborates on virus related problems with NPGS germplasm repositories, state departments of agriculture, the National Clean Plant Network, and university scientists. Additional updates will be provided for those committees whose crops are within the scope this project's research.

Key NGRL Contacts

Research Leader
Gary Kinard (gary.kinard@usda.gov, 301-504-5951)

Plant Exchange Office
Anne Frances (anne.frances@usda.gov, 301-504-5421)
Jennifer Friedman (jennifer.freidman@usda.gov, 301-313-9341)
Melanie Schori (melanie.schori@usda.gov, 301-504-8895)

GRIN Data Management and Reporting
Benjamin Haag (benjamin.haag@usda.gov, 301-504-3441)

Crop Germplasm Committees
Gary Kinard (gary.kinard@usda.gov, 301-504-5951)

Plant Disease Research Unit
Ruhui Li (ruhui.li@usda.gov, 301-504-7653)

PLANT GENETIC RESOURCES UNIT REPORT TO THE APPLE CGC

October 26, 2023

Ben Gutierrez, Tori Meakem, Peter Herzeelle, and Gan-Yuan Zhong

OPERATIONS

The PGRU Clonal team operates with Gan-Yuan Zhong (lead scientist), Erin Galarneau (*Vitis* curator), Ben Gutierrez (Apple/Tart Cherry curator), Tori Meakem (Molecular Biologist), Peter Herzeelle (farm manager), and five permanent field technicians through USDA-ARS PGRU and NE9 funding. There is currently a vacancy for Dawn Dellefave's position, which was Database Management/Program Support, but converted to a Research Technician (GS 5-7). Position description is available here https://www.usajobs.gov/job/756589900. PGRU hosted five interns in 2023 who worked on apple, grape, and tart cherry characterization. Their research is highlighted on our website: https://www.ars.usda.gov/northeast-area/geneva-ny/plant-genetic-resources-unit-pgru/docs/intern-corner/.

FIELD PROJECTS

Plans for the new pesticide facility are moving forward and the design phase is completed. A temporary pesticide platform and mixing area were constructed to reduce potential hazards. We completed some field drainage projects last season, which helped to dry up parts of the orchard, with noticeable improvement in tree health.

FIRE BLIGHT

Remnants of severe fire blight infection still exist in the collection because we've favored heavy pruning over complete removal of infected accessions. Though this may have caused fire blight to persist, it gave us an opportunity to regenerate many of the severely infected accessions. Now, many of the severely infected accessions from 2020 were replaced with healthy trees. The modified management program for apple to account for streptomycin-resistance, including Kasumin, Blossom Protect, alternating applications of copper and Apogee every 7-14 days, seem to be improving overall orchard health. In 2021, chemical applications resulted in some phytotoxicity, but were corrected in 2022 and 2023. Russeting and fruit cracking was the main effect of copper applications in 2023. The cold spring weather in Geneva, NY during 2023 contributed to the lower incidence of new infection.

COLLECTION INVENTORY (FIELD)

Annual September inventories report the status of each tree in the orchard and provide lists for regeneration for fall and winter budding. Trees are rated in the following categories:

Available (Avail) -- No apparent disease or need to regenerate

Weak -- Diseased or low vigor candidates for regeneration

Dead -- Regeneration not possible

Removed -- Inventory removed from collection. Could be due to poor health or death, or removal to promote health of remaining tree and reduce overall maintenance.

The tables below indicate the current status of the permanent field plantings of the USDA Apple Collection. Of note are the amount of newly planted trees regenerated in response to the initial outbreak in 2020. Fewer trees are declining (trending towards Weak or Dead status) in health compared to previous years. Over the years, many of the trees initially listed as Weak have outgrown infection and were inventoried as Available (WEAK-

>Avail). Though apparently in decent health, they still may have fire blight cankers or untrained regrowth due to extensive pruning. These trees are being replaced with regenerated trees. Additionally, we are replanting replicate trees as a field backup; previously our practice was to only keep one tree once an accession reached a certain maturity. During the 2022 and 2023 seasons 856 trees were replanted, representing 428 accessions. The 2022 regeneration nursery will be dug and planted in October 2023, representing an additional 186 accessions reestablished in the permanent orchard.

Orchard inventory tables describe the distribution of health throughout the permanent orchards (top) and the change in status frequencies from 2022 to 2023 (bottom).

Status 2023	**Frequency**
Available	2215
Dead	24
Planted	856
Removed	2610
Weak	88
Grand Total	**5793**

Status Change 2022 -> 2023	**Frequency**
AVAIL->Dead	4
AVAIL->Removed	146
AVAIL->Weak	19
DEAD->Avail	12
DEAD->Planted	33
DEAD->Removed	31
DEAD->Weak	10
PLANTED->Avail	26
PLANTED->Dead	1
PLANTED->Removed	16
PLANTED->Weak	2
REMOVED->Avail	78
REMOVED->Planted	480
REMOVED->Weak	4
WEAK->Avail	177
WEAK->Dead	7
WEAK->Planted	79
WEAK->Removed	35

NEW ACCESSIONS

Over the past three years, 150 accessions have been added to the permanent orchard. Largely, this represents wild germplasm regenerated from the W3 block seedlings.

Species	**Count**
Malus domestica	50
Malus hupehensis	9
Malus kansuensis	1
Malus orientalis	1
Malus prattii	6
Malus sieversii	6
Malus spp.	2
Malus sylvestris	11
Malus toringo	14
Malus toringoides	30
Malus transitoria	9
Malus zhaojiaoensis	10
Grand Total	**149**

Cultivars		
Airlie Red Flesh	Joanna	Schoner Von Nordhausen 31/5
Amanda	Jongrines 22/63	Sheepnose
Barnack Beauty 29/101	Kaz 96 07-02	Three Counties
Betty	Kaz 96 08-03	Tina
Bietigheimer	Knobbed Russet	Tompkin’s King
Broxwood Foxwhelp	M.23	Tremlett's Bitter
Bulmer's Foxwhelp	M.24	Vicky
Clara	Maggie	Wallace Howard
Colorado Orange	Newtown	Yarlington Mill
Debbie	Oberwartha 5 (M. sylvestris)	
Duchess of Oldenburg	P Heirabad 85-1	
Fiesta	Panquerina	
Fiona	Porter	
GE-061	Porter’s Perfection	
Gilly	Prieta	
Greenchisel	Prince William	
Hagloe Crab	Q71 (Geneva x Braeburn)	
Helen's Apple	Regona	
Indo 18/57	Sary Sinap	
Jersey Black 51/23	Scarlet Surprise	
Joanna	Schoner Von Nordhausen 31/5	
Jongrines 22/63	Sheepnose	
Kaz 96 07-02	Three Counties	
Kaz 96 08-03	Tina	
Knobbed Russet	Tompkin’s King	

REGENERATION

Extensive accession regeneration is ongoing since 2020. Table below summarizes the 2022 and 2023 nurseries.

Year	Rootstock	No. Trees Grafted	No. Trees Survived	Grafting Success Rate	No. Accessions Grafted	No. Accessions Survived	Accession Success Rate
2023	EMLA7	932	754	65%	240	233	97%
2022	EMLA7	1,949	1,332	68%	520	484	93%
	G.890	213	72	34%	68	35	51%
2021	EMLA7	780	261	33%	268	144	54%
2020	EMLA7	654	364	56%	218	169	46%
	G.890	81	74	91%	27	27	100%
2019	EMLA7	247	135	55%	70	49	70%
	G.890	29	16	55%	15	10	66%
2017	EMLA7	14	11	79%	14	11	79%
	G.210	184	80	43%	59	38	33%
2016	EMLA7	140	39	28%	60	24	40%

STATUS OF W3 BLOCK

The W3 was partially removed (91%) in 2021. The remaining (140) individuals were regenerated in 2022 and 2023 and the mother trees will be removed as these are established.

REMOVAL OF THE G1 BLOCK

The 7 *M. sieversii* × 'Royal Gala' populations of the G1 block were removed in 2022 and the land will be used for the new high density core.

DISTRIBUTION

Distribution of plant germplasm is one of our most meaningful contributions to the research community. Requests for germplasm are managed through GRIN Global, either through the public website or directly with the curator. Apple receives a significant volume of requests from non-researchers. The National Plant Germplasm System has unified its response to these non-research requests, requiring a more substantive description of the intended use and automated identification of requests for personal use. In 2023 we received 133 requests through GRIN of which 118 were considered non-research related and rejected. So far, we have distributed 211 items in 4 requests in 2023. Most distribution for 2023 will occur as dormant bud requests. CGC members have requested to see more detailed information on the accessions requested. This information was compiled in the Distribution Stats.xlsx file included. These tables are interesting to understand requestor trends and where we can address gaps in utilization.

PROPOSAL HIGHLIGHTS FOR NEW CRIS PROJECT PLAN

Apple Rootstock and High-Density Apple Planting: The largest threat to the apple collection is fire blight, a bacterial disease which spreads quickly through an orchard and can kill susceptible trees within a season (Dougherty et al. 2021). Apple rootstocks can mediate scion qualities (Marini and Fazio 2018; Singh et al. 2019), which could improve PGRU maintenance practices through enhanced resistance to fire blight and other biotic and abiotic stresses, improve grafting success rate and nursery viability, reduced root suckering, and reduced tree size to accommodate higher density plantings.

Currently, the apple collection is maintained on 6 × 3.6 m spacings on M.7 rootstocks across 30 acres. M.7 is a semi-dwarf (50-60% size of a standard seedling) and is moderately resistant to fire blight but produces many root suckers, which requires annual maintenance through chemical control and pruning. Modern apple rootstocks have increased disease resistance to fire blight and other diseases and have reduced-to-no root suckering. PGRU has used G.890 and G.210 rootstocks sporadically in past years with mixed success but has not sufficiently evaluated their performance in the collection.

To evaluate new rootstocks, we will propagate a diverse panel of 100 PGRU *Malus* accessions onto four Geneva series rootstocks: G.890, G.210, G.30, and CG.6006, with M7 as a control (see Table 1 below). Each is a semi-dwarf rootstock that produces a tree 10-20% smaller than M.7 and has improved disease resistance, with reduced suckering relative to M.7 and a low tendency for biennial bearing compared to M.7. *M. domestica* and wild *Malus* accessions will be selected for evaluation based on genetic diversity using genetic data, ploidy variation, and phenotypic diversity. Scions will be indexed for viruses (**sub-objective 1.B**) through the USDA-APHIS Pome Quarantine Program as latent apple viruses can infect susceptible rootstocks impacting the perception of compatibility (Fazio et al. 2015). Virus-free scions and rootstocks will be used where possible to reduce the impact of graft success due to latent viruses (Fazio et al. 2015). Accessions will be grafted onto the rootstocks, with 4-5 replicate trees per accession following established PGRU nursery standards.

Table 1. Rootstocks to be evaluated for their suitability for apple germplasm preservation

Rootstock	Size	Disease Resistance	References
M.7 Control	Semi-dwarf (50-60%)	Moderate fire blight resistance	(Singh et al. 2019)
B.10	Semi-dwarf (40-50%)		No Reference
G.969	Semi-dwarf (40-50%)	Strong resistance to fire blight Phytophthora root rot	(Reig et al. 2018)
G.66	Semi-dwarf	Strong fire blight resistance	(Autio et al. 2017; Reig et al. 2018)

Nursery trees will be planted in a randomized block and maintained through best practices include topping, irrigation, fertilization, and pest control. After two years, nursery trees will be dug and re-planted as a randomized high-density planting for further evaluation, emphasizing training systems to promote vegetative growth and ease of maintenance (Lordan et al. 2018). Two annual inventories will determine graft success rates and tree survival rates throughout the nursery and early high-density stages. Growth rate, trunk width, height, graft compatibility, and survival rates will be measured each fall. Accession, species, rootstock, growth, and year factors will be analyzed using generalized linear mixed models.

UPDATE: After some extensive discussion with CGC members, we are revising the plan to develop a new core and test diverse *M. domestica* germplasm on rootstocks. We have developed a candidate core list of 213 accessions (see attachment). We are working with Nick to create subset lists of 50, 100, 150, 200+ to determine at each level how much genetic diversity is included. Many groups have different needs, and some want a smaller core which we can better manage for fruit quality. Others are seeking a larger core for genomic analysis at the expense of increased replication. As we define these subsets from our candidate list, the Core subcommittee with further refine this design. Likely the final core will only include 1-2 rootstocks, to favor replication and additional accessions.

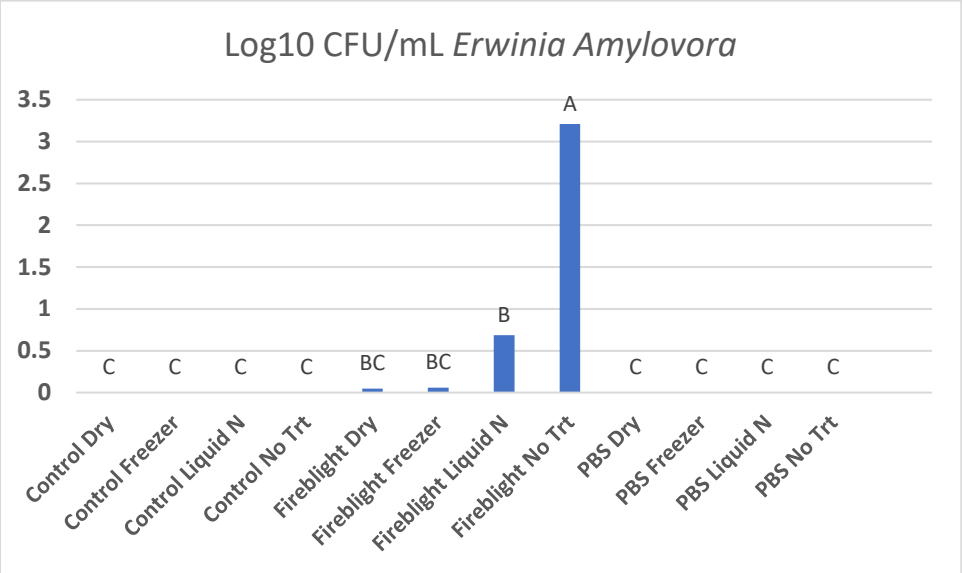
Apple Cryopreservation and Fire Blight (hypothesis driven): Fire blight, a disease caused by the bacterium Erwinia amylovora, is a major threat to the UDSA apple collection (Dougherty et al. 2021), requiring extensive interventions and regeneration of severely infected trees. Fire blight can be present in asymptomatic tissues (Tancos et al. 2017) and carried over during propagation which later proliferates in regenerating tissues, impacting PGRU propagation, distribution, and potentially cryopreserved germplasm. We hypothesize that

cryopreservation techniques will significantly reduce fire blight inoculum in apple propagules. Currently, it is uncertain whether E. amylovora can survive cryopreservation, although other microbes have been reported to survive cryotemperatures (Bajerski et al. 2020). To determine the impact of cryotreatments on fire blight-infected apple scions, dormant buds will be inoculated with fire blight (Bell and Van Der Zwet 1987) and processed following NLGRP protocols (Volk et al. 2020). Cryotreatments will occur early to mid-January in Geneva, NY, following at least three successive days at or below 0°C. Scions will be cut into 2 cm nodal sections and:

1. Desiccated to 25-30% moisture content at -5°C.Frozen to -30°C at the rate of 1°C/hour.
2. Exposed to liquid nitrogen vapor for at least 1 hour.

Sample subsets will be removed during each progressive step and stored at 5°C prior to E. amylovora culturing, including lab inoculated and non-inoculated controls. Each treatment will include five biological replicate samples, each with 10 to 20 buds. Five buds from each treatment replication will be grafted to determine bud viability. Depending on results, second-year samples will expand to cover more genetic diversity, including apple cultivars and wild progenitors amenable to cryopreservation. ANOVA will be used to determine statistical variation between treatments. Linear mixed models will be used to determine the effects of species and genotype diversity assay in the second year. If successful, methods for dormant bud cryopreservation could develop into a SOP for regeneration of priority and diseased accessions or international germplasm distribution. In a pilot study, we observed a 96% reduction of fire blight colony forming units (CFUs) in ‘Gala’ samples exposed to all three cryopreservation stages, compared to untreated, inoculated samples.

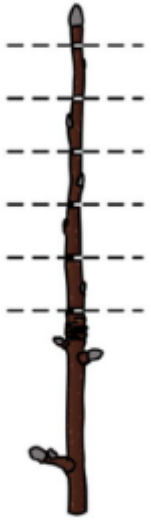
Results from winter 2023 protocol development



- Apple Cryopreservation
- Education & Outreach

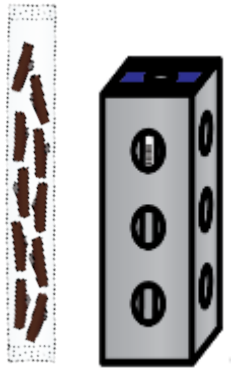
Gayle Volk
USDA-ARS-NLGRP
Fort Collins, CO 80521

Dormant Bud Cryopreservation at NLGRP

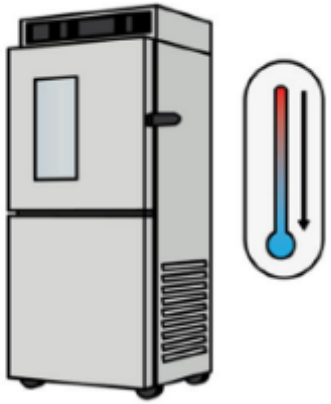


Harvest budwood in January, cut into single nodes

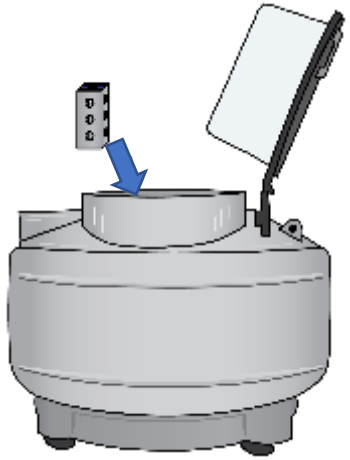
Dry at 0C to ~30% MC (fwb)



Package and place in cans



Cool to -30°C at 1°C/hour



Store in LN vapor (~-185°C)

Viability assessment

Grafting

2022-2023 NLGRP Clonal Cryopreservation Data Clean-up in GRIN-Global

Reviewed 33+ years of NLGRP clonal cryo data
- Added necessary fields
- Providing cryopreservation methods and regrowth methods
- Checked original data records to fill in missing information
- Standardized format and use of data fields

Developing downloadable, custom reports for curators available anytime

Writing NLGRP clonal manuals for data collection & documentation

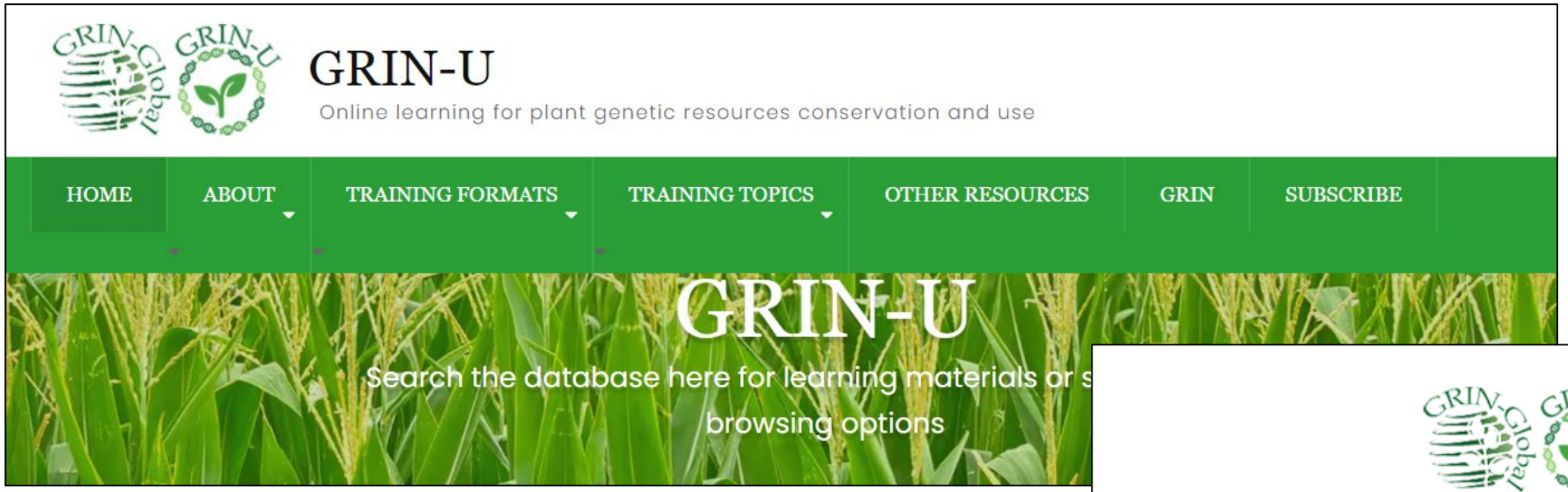
2289 Apple accessions are cryopreserved at NLGRP with at least 1 tube

34 of those accessions have only 1 tube

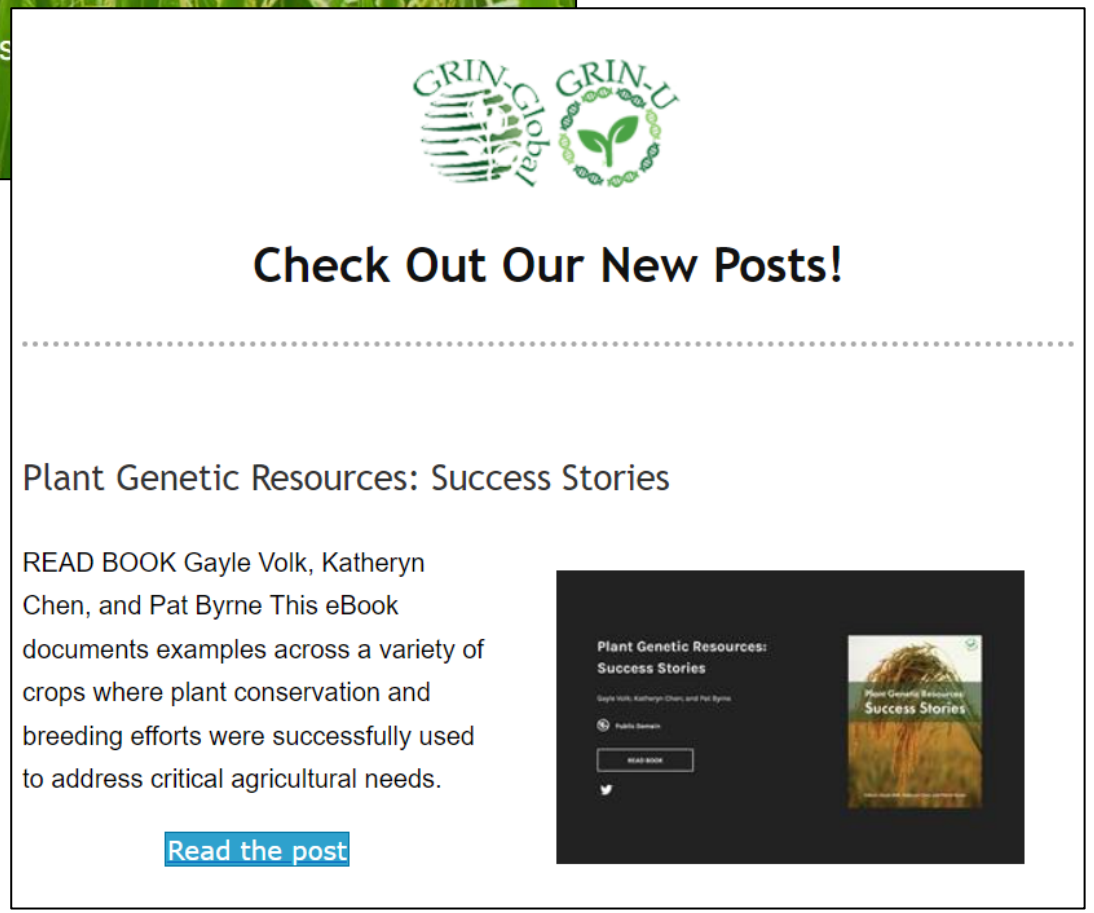
2023: Cryopreserved 35 apple accessions; 18 >40% viability; 7 20-30% viability

Developing training materials for Plant Genetic Resources Management and Use

- Many NPGS staff members are retiring
- Training content for current staff and future generations
- NIFA Grant: CSU, USDA, ISU 2020-2023



Quarterly email
sent to GRIN-U.org
subscribers
with updates



Public Ebooks on GRIN-U.org

Crop Diversity: A Virtual Crop Science Field Tour

Patrick F. Byrne; Meagan Schipanski; and Deana Namuth-Covert

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Fundamentals of Plant Genebanking

Gayle Volk

Public Domain

Crop Wild Relatives and their Use in Plant Breeding

Gayle Volk and Patrick Byrne

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Training in Plant Genetic Resources: Cryopreservation of Clonal Propagules

Gayle Volk

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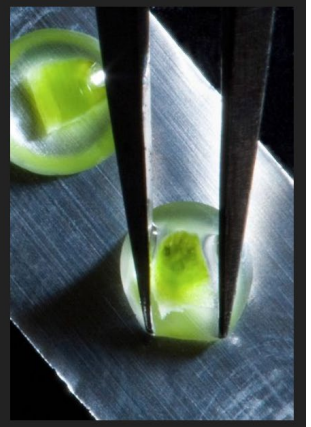
READ BOOK



Vitis cryo!

Field Tour of the USDA National Clonal Germplasm Repository for Tree Fruit, Nut Crops, and Grapes in Davis, California

Gayle M. Volk and John E. Preece

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READ BOOK

Vitis collection in Davis

Applications of Plant Pathology in Genebank Collections

Gayle Volk

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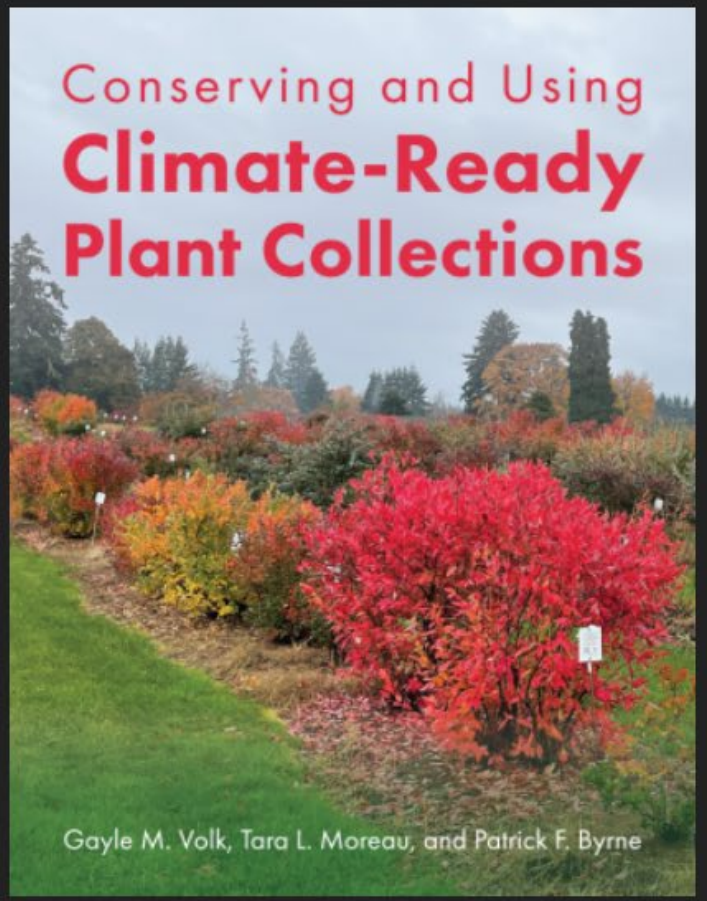
Conserving and Using Climate-Ready Plant Collections

Gayle M. Volk; Tara L. Moreau; and Patrick F. Byrne

READ BOOK



Released January 2023

Plant Genetic Resources: Success Stories

Eds. Gayle Volk; Katheryn Chen; and Patrick Byrne

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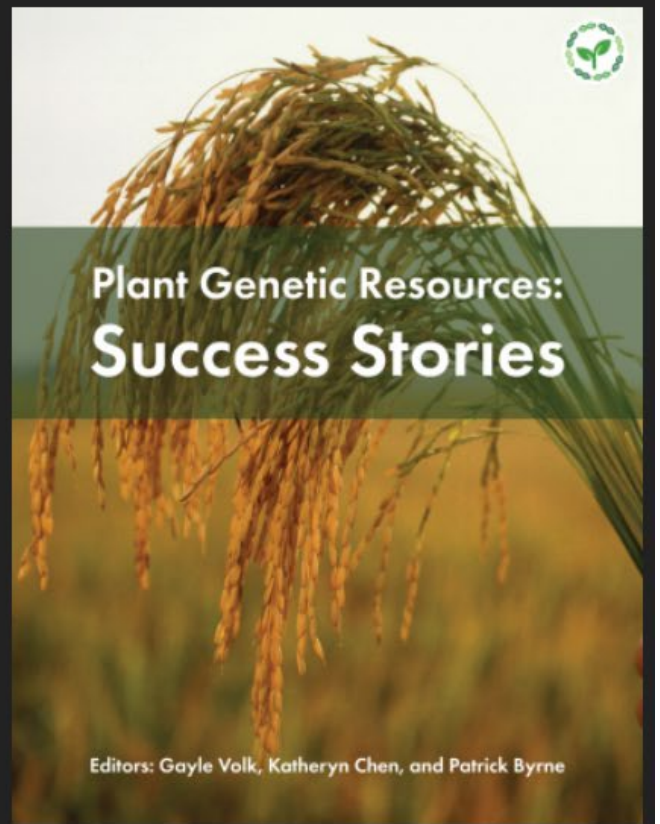
READ BOOK



Seeking Success Story Submissions

Plant Genetic Resources Success Story Submission Template

Documenting Success Stories

Documenting success stories and making them available to the public are important for ensuring continued support for plant genetic resources conservation and plant breeding efforts. Our goal is to document successes, broadly defined, that relate to plant genetic resources conservation and use, and crop improvement activities.

To ensure this information is accessible to the broadest possible audience, please keep content concise, minimize the use of jargon and acronyms, and write with a general audience in mind. It is the contributors' responsibility to seek permissions to share success stories from other researchers and breeders. Content may be edited and formatted before being posted on the public GRIN-U website and/or the National Association of Plant Breeders website. All edits will be shared with the contributor for final approval before posting to websites.

Once completed, email this form and 1-3 high-quality images to PGRSuccesses@gmail.com. For questions or comments, please contact Pat Byrne (Patrick.byrne@colostate.edu) or Gayle Volk (Gayle.Volk@usda.gov).

*Required fields

Contributor Information

***Contributor(s) name:** Author1 and Author2

Strawberry 'Cordial' - Late Season, Long Shelf Life

USDA-ARS Genetic Improvement for Fruits & Vegetables Laboratory

Strawberry cultivar 'Cordial', released in 2020 by the USDA, is a late-season cultivar for planting during the late part of the growing season in the Mid-Atlantic region of the U.S. It is a short-day strawberry, meaning that plants will flower as the daylength grows shorter in the northern hemisphere. 'Cordial' has large attractive fruits that are tough enough for rough handling, have increased shelf life, minimal proportion of produce lost to degradation, and possesses consistently high yields with low rot when grown in plasticulture production systems without fumigation/fungicide.

Cordial strawberries produced in plasticulture.

Photo from Lewers and Enns, 2022 (CC BY-NC-ND 4.0)

PROJECT GOALS

- ✓ Develop non-tart strawberries with increased shelf life
- ✓ Improve resistance to rot and provide consistent high yields

Problems Addressed

U.S. Department of Agriculture-Agricultural Research Service strawberry research efforts at Beltsville, MD, have resulted in release of several cultivars with high yields and good fruit flavor: 'Keepsake', 'Flavorfest', 'Allstar', 'Galletta', 'Ovation', 'Earlyglow', 'Chandler', etc. Decayed fruit, poor handling and refrigeration tolerance, foliar and fruit disease incidence, and reduced shelf life remained a production problem. The project therefore focused efforts on increasing shelf life, tolerance to rough handling, resistance to diseases, as well as reducing tartness and maintaining consistently high yields.

Solutions Developed

'Cordial' was developed by cross-pollinating B1893 × B1805. This new cultivar's average total yield was significantly higher than all cultivars tested, with one of the highest marketable yields. 'Cordial' showed significant resistance to crown rot, very mild bacterial angular leafspot disease symptoms, and mild powdery mildew disease symptoms. 'Cordial' fruit skin toughness rating was very high, and it exhibited fruit sweetness similar to 'Flavorfest', 'Keepsake', and 'Earliglow'. Due to its longer shelf life, less tartness, and disease resistance, 'Cordial' has the potential for a greater market share.

Written by: A. Mahama, S. Gray, W. Suza, K. Chen (editor)

To learn more about this and other success stories, visit colostate.pressbooks.pub/pgrsuccessstories

85 Videos,
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Virtual tours

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Cowpea Diversity 1: Origins and Importance

3.9K views • 1 year ago

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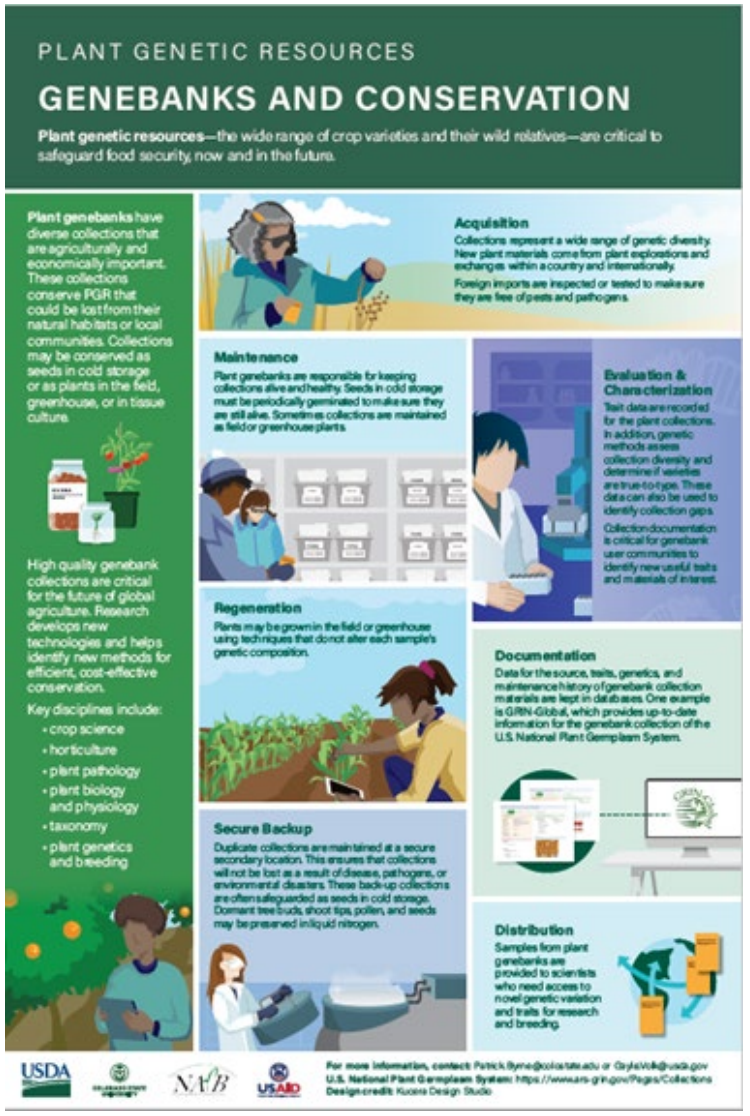
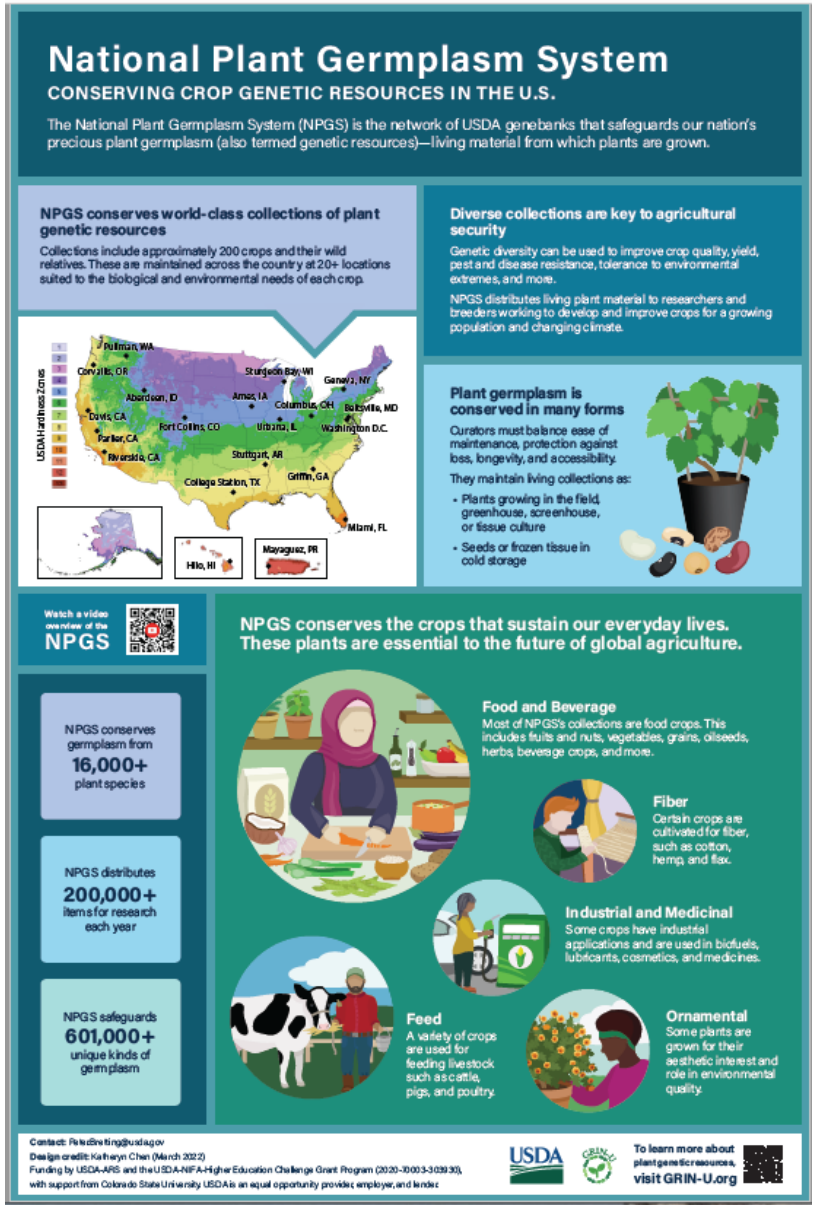
Infographics available on GRIN-U (posters or handouts)



English, French, Spanish, Arabic, Chinese, Portuguese



English, Spanish

English, French, Spanish

Updating!

USDA-ARS Germplasm Resources Information Network (GRIN)

USDA Agricultural Research Service
Department of Agriculture

Collections ⌄ Crop Germplasm Committees ⌄ National Genetic Resources Advisory Council GRIN-U Contact Us

What is GRIN?

The Germplasm Resources Information Network (GRIN) provides information about USDA national collections of animal, microbial, and plant genetic resources (germplasm) important for food and agricultural production. GRIN documents these collections through informational pages, searchable