**SAES-422**

**Accomplishments Report**

**Project/Activity Number:** NE9

**Project/Activity Title:** Conservation and Utilization of Plant Genetic Resources

**Period Covered:** 10/01/2023 - 09/30/2028

**Date of This Report:** January 9, 2025

**Annual Meeting Date(s):** December 18, 2024

**Participants:** Clark, Matt-University of Minnesota; Frances, Anne-USDA ARS; Galarneau, Erin-USDA ARS; Gasic, Ksenija-Clemson; Gordon, Tyler-USDA ARS; Gottschalk, Chris-USDA ARS; Griffiths, Phillip-Cornell University; Gutierrez, Ben-USDA ARS; Hernandez, Chris-University of New Hampshire; Khan, Awais-Cornell University; Kothari, Neha-USDA ARS; Mazourek, Michael-Cornell University; Mykala, Robertson-USDA ARS; Oravec, Maddy-Cornell University; Povilus, Becky-USDA ARS; Rhodes, Rick-University of Rhode Island; Shade, Jessica-NIFA; Shanower, Tom-USDA ARS; Smart, Chris-Cornell University; Stansell, Zach-USDA ARS; Tobias, Christian-NIFA; Vogel, Greg-Cornell University; Volk, Gayle-USDA ARS; Zhong, Gan-Yuan-USDA ARS

**Brief summary of minutes of annual meeting**: Chris Smart (Director of Cornell AgriTech and NE9 Advisor), gave welcome to the group and provide brief overview of budget – spending is on track; 7% budget increase helps, but only keeps up with inflation for employee salaries. Gayle Volk and Neha Kothari (new National Program Leaders over National Plant Germplasm System, (NPGS)) gave updates from the NPGS. NPGS budget overall has been steady but not keeping up with inflation; some targeted increases within NPGS to specific crops, including hemp. Emphasized need to better highlight our work to stakeholders. One outlet is Impact Statements which highlight the commercial/research benefits of accessions from the NPGS genebanks. NE9 stakeholders encouraged to contribute to these. Proposal to have 2025 NE9 meeting combine with other RTACs in Texas. Group was supportive. Christian Tobias provided an overview of NIFA grant opportunities. Anna Frances requested NE9 stakeholders, in addition to the United States Department of Agriculture (USDA) curators, to review plant exploration and exchange proposals. Stakeholders provided updates on their individual research, with an emphasis on their need for diverse genetic resources. The need for pre-breeding material that incorporates desirable wild traits into a more accessible forms to accelerate breeding. Curators provided update on the status of the vegetable, hemp, and fruit collections associated with this project. Their highlights are provided in more detail below.

**Accomplishments:** The USDA Agricultural Research Service (ARS) Plant Genetic Resources Unit (PGRU) in Geneva, NY maintains diversity collections of select vegetables (12,762 accessions), hemp (640 accessions), and fruit (6,521 accessions). Targeted acquisitions over the past year have filled gaps (phenotypic, genotypic, and geographic) within the collections, expanding the resources available to stakeholders. Funding from NE9 provides critical resources for management and distribution of these collections. NE9 supports major efforts in supplying germplasm to screen and map high-priority horticultural and agronomic traits, such as important disease and pest resistances and traits contributing to human well-being. Many of these efforts are done in collaboration with scientists from SAESs. In 2024 the NE9 project received a vital 7% budgetary increase which significantly supports ongoing germplasm conservation efforts, maintenance of equipment, and staffing limitations. However, additional expenses including renewing land/facility leases with Cornell University and matching farm support salaries to keep pace with inflation will decrease our research capacity and purchasing power. Additional increases in the overall budget must be considered to maintain project integrity.

Maintenance of these collections requires substantial effort and regeneration of each accession is a rate limiting step, impacting the ability to distribute material to stakeholders. In 2024, 261 vegetable, 121 hemp, and 112 grape accessions were at various stages of the regeneration pipeline. The apple collection has gone through a period of orchard rejuvenation with the repropagation of close to 1,000 accessions in the past 3 years. Disease status is a primary concern for the distribution of clonal collections, particularly virus status. This reporting period, 300 apple accessions were tested for multiple viruses, which identified several that should be quarantined and treated before reintroduction. Plans for additional testing and virus remediation are underway for apple. Methods for high throughput testing of grapevine viruses is in discussion.

In 2024, PGRU distributed 8,337 distinct units (seed lots, propagules, fruit, etc.) to requestors. The collections have been extensively used worldwide to develop new cultivars and for other research purposes, including disease resistance, fruit quality traits, genetic diversity, and population structure. PGRU scientists characterize germplasm for priority traits to make the material more readily accessible. Much of this characterization and evaluation is performed in collaboration with scientists from the Northeastern US, other regions in the USA, and abroad.

**Activities:**

* Near completion of two large high-tunnel/greenhouses which will serve all NE9 crops.
* Led pollinator efficiency study comparing the quality of pollinator services provided by flies, honeybees, and bumble bees on winter squash to improve pollinator management decisions.
* Received ARSx funding for a project to crowdsource vegetable accession phenotyping. This is a multi-site, multi-collection project.
* Continued sample collection for whole-genome-scale sequencing for the entire USDA Physalis (tomatillo) collection.
* Investment in equipment resulted in doubling of squash seed collection/processing capacity; producing higher quality seed.
* Adjustments to tomato seed collection/processing protocols resulted in faster collection of tomato seed and higher seed quality.
* Two parallel seed inventory management projects were initiated to improve the accuracy of information between physical seed lots and information in the GRIN-Global database.
* Conducted genotyping/phenotyping project of most of the hemp collection. Samples were collected for sequencing, cannabinoid analysis, protein analysis, and fiber analysis.
* Initiated work for development of a stakeholder-driven low-cost mid-coverage hemp genotyping platform to help conserve and characterize diverse germplasm, develop mapping populations for priority traits, and identify critical candidates for pre-breeding populations.
* Ongoing research with high-density hemp plantings and selection for regulatory compliant germplasm.
* Received ARSx funding to develop pipeline for rapid introgression of wild apple germplasm into publicly available apple pre-breeding lines.
* Propagation of 140 plum cultivars for maintenance from Davis, CA to Geneva for cold hardy evaluation and cryopreservation.
* Exploration for *Vitis aestivalis* and *V. labrusca* resulted in 70 new accessions from new geographic regions to be incorporated for new flavors and disease resistances. 15 accessions returned to the collection from cooperators.
* Over 900 accessions of grape screened for powdery and downy mildew resistances with 40 resistance markers being characterized through NIFA-SCRI funding.
* 1200 accessions of grapevine sequenced using the rhAmpSeq platform with 2000 markers.
* Fruit quality metabolic evaluations continued for apple, grape, and cherry, covering over 600 accessions. Focus has been on phenolics, aromatics, and sugar and acid ratios.
* Collaborated with archeologists to evaluate and identify preserve fruit specimens found at Mount Vernon in Virginia.

**Milestones for 2025:**

* Regenerate seed for 150 vegetable accessions.
* Backup up 100 vegetable and hemp accessions at NLGRP.
* Rescue 50 jeopardized vegetable accession in greenhouse regeneration.
* Continue to refine regeneration protocols of seed crops.
* Improve soil and assess onion bulb production.
* Develop parents for hemp MAGIC populations with collaborators.
* Regenerate 25 hemp accessions in controlled-environment conditions.
* Upload 10,000 phenotypic data points to describe hemp germplasm collection.
* Acquired over 20 novel hemp genetic resources.
* Backup of clonal accessions and test viability of cryo-treated buds.
* Evaluate apple nursery for rootstock compatibility.
* Retrain vines to enable mechanical management.
* Re-evaluate set 1 of apple cultivars for fruit quality. Complete evaluation of 470 accessions for grape juice metabolites.
* Evaluated abiotic and biotic phenotypes in grape.

**Impacts:** Sustainability and diversification of agricultural industries depend on the development of superior cultivars to combat emerging pests and diseases, climate and environmental changes, and shifting consumer demands. Germplasm, or genetic resources (sources of genetic diversity), provides the foundation for crop improvement and genetic enhancement. However, genetic resources are at risk due to reduced diversity in large-scale cultivation, changes in environmental conditions, degradation of native habitats, and international inaccessibility. The mission of the USDA ARS NPGS is to acquire, safeguard, characterize, document, and distribute plant germplasm, which is accomplished through a cooperative effort with State, Federal, and non-profit partners.

**Activities:**

* Participated in over a dozen outreach events to educate the public about the mission of seed/gene banks. Altogether, thousands of people were interacted with during these events.
* Mentored six undergraduate interns in germplasm evaluation and maintenance.
* Held the first USDA-ARS Hemp Germplasm Laboratory Stakeholder meeting on Sept 11, 2024. Approximately 80 people attended this all-day meeting. Initial conversations were initiated to establish a Hemp Crop Germplasm Committee.
* Contributed to Crop Germplasm Committee discussions to inform stakeholders on the status of our collections.

**Indicators:** Key indicators for program success and impact include number of accessions distributed, number of accessions maintained and acquired, and number of observations (genetic or phenotypic) recorded.

**Publications:**

Arro J, Yang Y, Song G, Cousins P, Liu Z, Zhong G-Y, et al. (2024) Transcriptome analysis unveils a potential novel role of *VvAP1* in regulating the developmental fate of primordia in grapevine. F 4. <https://doi.org/10.48130/frures-0024-0004>

Chiwina K, Bhattarai G, Xiong H, Joshi N, Dickson R, Phiri R, Alatawi I, Chen Y, Stansell Z, Ling K-S (2024). Evaluation of Drought Tolerance in USDA Tomato Germplasm at Seedling Stage. Agronomy, 14(2), 380.https://doi.org/10.3390/agronomy14020380

Ford T, Aina A, Ellison S, Gordon T, Stansell Z (2024) Utilizing digitized occurrence records of Midwestern feral *Cannabis sativa* to develop ecological niche models. Ecology and Evolution 14:e11325. <https://doi.org/10.1002/ece3.11325>

Grunwald D, Wijesinghege CW, Gordon T, Stansell Z, Ellison S (2024) First Report of Tobacco Streak Virus in Cannabis sativa in New York. Plant Disease 108:1407. <https://doi.org/10.1094/PDIS-09-23-1810-PDN>

Mansfeld BN, Yocca A, Ou S, Harkess A, Burchard E, Gutierrez B, et al. (2023) A haplotype resolved chromosome-scale assembly of North American wild apple Malus fusca and comparative genomics of the fire blight Mfu10 locus. The Plant Journal n/a. <https://doi.org/10.1111/tpj.16433>

Sinclair G, Galarneau ER, Hnizdor JF, McElrone AJ, Walker MA, Bartlett MK (2024) Grape cultivars adapted to hotter, drier growing regions exhibit greater photosynthesis in hot conditions despite less drought-resistant leaves. Annals of Botany 134:205–218. <https://doi.org/10.1093/aob/mcae032>

Yang Y, Wheatley M, Meakem V, Galarneau E, Gutierrez B, Zhong G-Y (2024) Editing VvDXS1 for the creation of muscat flavour in Vitis vinifera cv. Scarlet Royal. Plant Biotechnology Journal 22:1610–1621. <https://doi.org/10.1111/pbi.14290>

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\*Limited to three pages or less exclusive of publications, details may be appended.