

2020 NC7 RTAC Meeting AGENDA

June 29-30, 2020, Online

Participants:

NC7 Representatives: Aaron Lorenz, Univ. of Minnesota served as Chair and recorder for the meeting; Joseph Colletti, Iowa State Univ., Academic Advisor Sherri Flint-Garcia, Univ. of Missouri-Columbia; Lori Hoagland, Purdue Univ.; Amy Iezzoni, Michigan State Univ.; Thomas Lübberstedt, Iowa State Univ.; Burton Johnson, North Dakota State Univ.; Erik Sacks, Univ. of Illinois; Michael Stamm, Kansas State Univ.; William Tracy, Univ. of Wisconsin.

Other Participants: Peter Bretting, USDA-ARS-ONP, Beltsville, MD; Terry Isbell, USDA-NCAUR, Peoria, IL; Stephanie Greene, USDA-ARS-NLGRP, Ft. Collins, CO; Gary Kinard, USDA-ARS-NGRL, Beltsville, MD; Candice Gardner, Vivian Bernau, Jeff Carstens, Mark Millard, USDA-ARS-PIRU and NCRPIS, Ames, IA; David Brenner, Laura Marek, and Kathleen Reitsma, Iowa State University and NCRPIS, Ames, IA; Febina Mathew, South Dakota State Univ.;

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After a brief welcome by Drs. Lorenz and Candice Gardner, NC7 Academic Advisor Dr. Joe Colletti, Iowa State University College of Agriculture and Life Sciences, was welcomed. Dr. Colletti thanked the RTAC members, the NCRPIS, its leadership, technicians and curators for their service and dedication to the project. He noted that the off-the-cuff Hatch funding provided by the 12 North Central Regional Landgrant institutions speaks volumes about the value of the NC-007 project, the station and its germplasm. All 12 states are facing one to two year budget cuts ranging from 5-10%. Future budget cuts are anticipated, and a rough ride due to costs associated with Covid19 and its complications. He expressed confidence that NC7 funding will be stable. Ensuring that ISU researchers can conduct essential research is important; field plantings in Ames were accomplished under safe scenarios. A limited number of people can travel by vehicle for local research work. ISU's fall semester will open one week early and end by Thanksgiving, and necessary protections have been instituted.

Peter Bretting, Office of National Programs, USDA-ARS, indicated that international germplasm shipments from the National Plant Germplasm System (NPGS) have temporarily ceased due to access restriction and disruption of international delivery systems. Many genebanks have ceased germplasm shipments, but Ames and a few others have not. The GRIN-Global system is operating normally; remote access has not impacted software development or public website function. Future effects on the budget are unknown; the purchasing power of the budget has steadily reduced since 2010; it peaked in 2003 when distribution of accessions was approximately half of today's. Demand continues to accelerate, especially for expired Plant Variety Protection inbreds. A NIFA Higher Education Challenge grant application for training related to plant genetic resource management and utilization is pending and led by Drs. Pat Byrne of Colorado State University (PI) and Gayle Volk of USDA-ARS (co-PI). This is critical, as 30% of NPGS staff are expected to retire in the next few years.

Candice Gardner gave an NCRPIS update and spoke to its basic mission, the role of the RTAC and of Crop Germplasm Committees. The NC-7 project is one of the oldest Hatch Projects. Covid19 presents many challenges to our personnel and ability to continue efforts. About 83% of the NCRPIS budget (ARS and Hatch) is allocated to personnel costs. Planning for a new -20C cold storage facility is underway; ARS retained a contractor to help develop a plan and a cost basis. Construction could begin in 2021 if funding is allocated. ISU Program Manager Fred Engstrom worked with ISU personnel to fix plugged tile lines and improve field drainage. A new irrigation pit and water delivery system is planned for the south half of

the farm, as old buried lines are deteriorating. Approximately 25% of our nearly 54,000 accessions are distributed annually; in 2019 over 62,000 packets of seed were distributed. About 82% are backed up at the NLGRP. For the first time in seven years there are no ARS or ISU personnel vacancies. Gardner plans to retire at the end of 2020 and replacement recruitment has begun.

Stephanie Greene, Curator at the USDA-ARS National Lab for Genetic Resources Preservation (NLGRP) in Ft. Collins, Colorado reported on the lab's many activities, including development of clonal preservation technologies such as cryopreservation of propagules and in vitro tissue culture, seed preservation and backup collections, and animal and microbial germplasm preservation. Research activities are devoted to understanding factors that impact seed viability and its loss over time. The NPGS holds 532,389 accessions, 81% are backed up at the NLGRP. Of these, 10,359 are seed collections held only at the NLGRP and not at an active site. There are 11,054 PVP varieties deposited. About 500,000 accessions are held in 'black box' security backup for other genebanks. Safety is currently a high priority and most personnel are working from home. Analysis of conservation inventory status for U.S. native crop wild relatives (CWR) focused on 600 native taxa related to important crops or wild food plants. Of these, 7% could be candidates for critically endangered designation, 50% as endangered, 28% as vulnerable, and 15% as near-threatened or of least concern. A high priority is resolution of in situ conservation gaps for 93% of U.S. CWRs. Resources for plant genebank training are being developed by NLGRP personnel and are available at <http://colostate.pressbooks.pub/>.

Gary Kinard, USDA-ARS National Germplasm Research Lab (NGRL) Beltsville, MD, reviewed the mission and status of the Plant Exploration Program, the oldest exploration program. Expeditions were conducted every year except for some during WWI. Many major expeditions were conducted from 1900-1930's. Proposals are due in August for FY2021 collection trips; fewer trips will be completed in 2020 due to the pandemic. GRIN-Global has operated normally during the pandemic. Its new public website with improved interface and functionality will go live in July, pending security review.

NC-7 Regional Technical Representatives Presentations

Amy Iezzoni presented germplasm-related research and breeding conducted at Michigan State University, including the CucCAP efforts on watermelon, phenotyping and identification of QTL for pest resistance, marker development, and breeding; maize research using NC7 germplasm for GWAS and genomic prediction for morphology and compositional traits, and for the Great Lakes Tar Spot initiative; soybean research to improve seed quality, disease resistance, and aphid and cyst nematode resistance; development of a new black bean variety with resistance to anthracnose race 109 from a landrace parent; potato wild relatives to incorporate and map resistance genes for Colorado potato beetle and bacterial wilt; identification of quantitative trait loci for important plant and flower traits in petunia; development of genomic platforms for both cultivated blueberry and strawberry to support research and breeding efforts, such as anthracnose fruit rot in blueberry, and salinity tolerance in strawberry. Iezzoni's research on chilling tolerance and bloom time in *Prunus* has identified two major loci which control bloom time in all *Prunus* crops studied, and breeding has successfully resulted in sour cherry varieties with later bloom time, avoiding freeze risk. Obtaining pollen from Europe for breeding is increasingly difficult.

Aaron Lorenz reported on the use of NPGS germplasm collections by University of Minnesota researchers. Fifty researchers were queried of the 123 unique recipients there during the last five years, and 16 responded. Uses included NPGS potato tissue cultures for studies of potato anthocyanins and consumer preferences; maize for genetic prediction studies and popcorn breeding; soybean nodulation

undergraduate biology studies; a variety of turfgrass species and accessions, important in breeding as current turfgrass cultivar germplasm base is narrow; identification of aphid- and soybean cyst nematode- resistant soybean germplasm; wheat genetic resources to add diversity / specific genes to breeding material and for characterization of alleles; germplasm for use in gene editing, development of transformation protocols for minor crops, development of reference genomes; identification of haplotypes for determining relationships in domesticated apple germplasm; medicinal plant germplasm to better understand genetic contributions to chemical phenotype; alfalfa resources for cropping systems; and education on crop wild relatives and crop domestication.

Bill Tracy shared examples of utilization of sweet corn genetic resources in University of Wisconsin research and variety development programs. They have contributed to trait improvement for ultrahigh eating quality; vegetable corn quality; NCLB, MDMV, and common rust resistance; and understanding the physical, genetic, and chemical basis of corn earworm resistance mechanisms and their inter-relationships, and other traits. Tropical germplasm has been used extensively. Research is also devoted to genomic prediction of hybrids for organic production systems, and performance testing in multiple locations and soil types. Dr. Tracy is a key participant in the Sweet Corn Coordinated Ag Project.

Burton Johnson, North Dakota State University, provided an overview of their agronomic and horticulture research, and efforts to develop best management practices for alternate and new crops, such as those for successful production of field pea and canola. Screening of varieties for adaptation is a key factor. Sorghum is an example of the challenges: adaptation screening of 106 edible white sorghums was conducted in 2015/2016, yield trials were conducted for 21 genotypes in 2016/2017; then four selected PI lines and two commercial hybrids entered advance testing. Open pollinated sources headed earlier than the hybrids, even at later seeding dates, and yielded well, but wet, snowy harvest conditions and high winds took the OPs out. Growers are trying to produce industrial hemp, first grown in ND in 2016. 2019 was the first year for CBD production; many growers haven't sold last year's production yet. Protocols for THC testing and timing need to be well-documented. There is a need to know how hemp grain types perform in various regions. Weed competition and difficulties establishing stands are issues.

Febina Mathew, South Dakota State University, provided an update on screening cultivated sunflower accessions for an economically important fungal disease called Phomopsis stem canker. The incidence of Phomopsis stem canker of sunflower has been increasing since 2010 in the U.S., particularly in Minnesota, North Dakota and South Dakota, where over 75% sunflower production takes place. To date, management options are limited and hence screening sunflower for resistance to the causal fungi of Phomopsis stem canker is underway. Studies from Mathew's lab showed that there is a possible impact of growth stage on the Phomopsis stem canker severity and cultivated accessions with resistance to the causal fungi are identified that can be used to breed and develop disease-resistant hybrids.

Erik Sacks explored the world of *Miscanthus* germplasm research at the University of Illinois, including overwintering trials in Wisconsin, multi-location performance trials, and elucidation of the genetic structure of populations of *Miscanthus sacchariflorus* and *Miscanthus sinensis*. Erik has increased seed of 163 accessions of *M. sacchiflorus* from his 2012 USDA collection trip in eastern Russia and intends to share part of this with the NPGS curator. Southern Japanese germplasm sources tended to be less cold tolerant than Central Japanese sources and were high yielding. Chance Riggins' research with betalain pigments from *Amaranthus* was also discussed; phytochemical diversity among the USDA amaranth collection offers insights on plant stress response, enhanced nutrition, and genetic improvement. Amaranth pigments offer sources of natural food colorants, and amaranth studies offer insights for management of herbicide-resistant weeds.

Terry Isbell, USDA-ARS National Center for Agricultural Product Utilization (NCAUR), Peoria, Illinois, provided an update on use of NIRS data to support commercialization of pennycress, efforts to scan samples for 'CoverCress' and for other crops, including camelina. A CAP grant is devoted to further developing the pennycress crop. Terry plans to retire in August, and Steve Cermak will assume his role as NC7 representative from NCAUR.

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Lori Hoagland, Purdue University, provided insights on research associated with soil and plant microbiomes, and questions associated with the influence of crops on the makeup of the microbiome and the role of endophytes on plant health and function. The Carrot Improvement for Organic Agriculture Project focuses on developing carrot varieties with improved disease and nematode resistance, better competitiveness with weeds, and nutritional quality. It has provided resources for research to understand relationships between carrot genotypes and beneficial microbes in order to introduce selection for beneficial relationships into breeding programs. Results indicate there are endophytes that can suppress *Alternaria dauci*, for example, and improve carrot productivity, and that beneficial activity varies among carrot genotypes.

Sherry Flint-Garcia, USDA, Univ. of Missouri-Columbia, shared insights in the uses and properties of heirloom food corn, and the importance of the nixtamalization process for loosening the starch-protein matrix in maize, making vitamins more bioavailable, and allowing gelatinization of starch. Landrace diversity is being thoroughly explored, and a variety of commercial enterprises are evolving based on their properties and use. A grant proposal has been submitted to NIFA to characterize the landraces of maize from the US, and to create a catalog of haplotypes related to food characteristics and agronomic performance.

Thomas Lübberstedt, Iowa State University, discussed his efforts to understand maize haploid induction and doubling phenomena, and to increase the efficiency of doubling. Genetic variation exists for female donor inducibility, and for genome doubling of haploids. Male haploid fertility and seed set are key traits contributing to spontaneous genome doubling. Of 102 exPVP lines screened, only five had high spontaneous doubling rates, and only three greater than 50%; female fertility is not an issue. A major locus is associated on chromosome 5, which can enable introgression breeding. This has implications for a simplified alternative for doubled haploid production, use of direct seeding of haploids to spontaneously generate doubled haploid lines rather than through artificial doubling procedures.

Michael Stamm, Kansas State University, provided an update on the winter canola industry for the Southern Great Plains. Weather, drought, and depressed commodity prices have slowed industry investment, but expectations are high for the region. Producers want to grow canola if profitable. Winter canola acres have decreased from nearly 330,000 in 2013/2014 to about 25,000 acres in 2019/2020. Kansas had record highest precipitation averages in May 2019 in Kansas in the past 125 years. Recent winter canola variety releases, performance attributes including incorporation of herbicide resistance, and current licensing were discussed. Seed sales of cultivars with KSU genetics have impacted nearly 40,000 winter canola acres in each of the past four years and generated \$550,000 in royalties. Hybrid parent line development utilizes cytoplasmic male sterility and restorer genes developed from radish.

Curator Presentations

NCRPIS Maize Curator Vivian Bernau (ARS) provided updates on maize collection status in Ames. About 1200 accessions from the NLGRP are to be transferred to Ames over time on a schedule, mostly from South America which were regenerated by Major Goodman, and by Wilfredo Salhuana of Pioneer Hi-Bred. Many more are available from CIMMYT; Vivian is transferring passport information pertaining to these from CIMMYT's records. Significant resources are needed to regenerate older collection seed lots; wild relatives are even more of a challenge. Growth regulators are being used to manage teosinte growth in the field in summer prior to transfer to the greenhouse for seed production in winter. Efforts to regrow plant genetic resources previously grown in Mexico in our Puerto Vallarta winter nursery were stymied, as phytosanitary documentation from Mexico at the time it was originally transferred is required for re-import and does not exist. The inviable Mangelsdorf-Galinat collection was deactivated on the advice of the Maize CGC.

NCRPIS Maize Curator Mark Millard (ARS) discussed use of images to document the collection, their use for characterizing accessions, collecting data, and preventing mix ups. He traced the history of image collection and its documentation back to the 1980's, and progress in use of technology. Examples included the Naltel and La Presa stories, and methods used to link race names to pages in the Races of Maize volumes. Historical documents are scanned, text recognized, and records linked to accessions.

NCRPIS Oilseeds Curator Laura Marek's (ISU) major challenge is regeneration of the oilseed Brassica collection; 46% of the collection is less than 50% viable. Some 2020 regeneration plans had to be substantially reduced and postponed due to uncertainty of labor availability this summer. Seedlots with very low viability will be reobtained from the NLGRP backup for regeneration. An accession of Camelina was re-identified to a new species, *C. neglecta*. A collection trip is planned for 2021 in France. Collections in Florida and California for wild sunflowers are planned in cooperation with other scientists; Tom Gulya, retired plant pathologist, has volunteered to collect in California.

NCRPIS Curator David Brenner (ISU) provided an overview of his many crops including amaranth, quinoa, other pseudocereals, and some warm season grasses. Demand for the quinoa collection is high, and some from South America, where some genebanks have lost their collections. The collection has a high level of genetic and phenotypic viability. David is using innovative methods to break dormancy for some of his crops; he is experimenting with use of a sonic agitator to scarify seeds in a tea ball. Some seeds require a knife cut at the micropyle in order to break dormancy, alternative technology is needed.

NCRPIS Ornamentals Curator Jeff Carstens (ARS) described Ames holdings of woody and herbaceous ornamental taxa and medicinal plant germplasm. Challenges are maintaining crop plants when their lifecycle form is unknown, whether biennial or long-lived perennials, there is a lack of established methods for testing viability, and unknown optimum storage methods. From 2003-2020 the collection grew from 2256 to 3871 accessions, of 186 genera. *Fraxinus* collection east of the Mississippi is essentially complete; proposals to collect Western adapted *Fraxinus* are being submitted or were delayed a year due to the pandemic. Well-documented, well-sampled collections of *Fraxinus*, *Cladastris*, *Monarda*, and *Salix* are the current focus. While collecting, seed quantities are very important as well as diversity, and prompt seed handling. *Salix*, for example, requires handling within days in order to ensure its viability. The importance of researchers reporting back results of efforts connected with germplasm use and getting citations in GRIN-Global cannot be overstated, in order to facilitate collection use.

The RTAC discussed adding a representative that would be a resource for the ornamentals curator and whether we should systematically collect feedback on the composition of the RTAC.

NCRPIS Vegetable Curator Kathy Reitsma (ISU) provided statistics for the vegetable crops. Of the 500 *Daucus* accessions collected over the past five years, 95% have been provided by Phil Simon and David Spooner. Regeneration challenges: perennial *Daucus* requires specialized environmental conditions to regenerate; use of beneficial insects is being explored to control whiteflies in cucurbit cages, necessary to provide safety for pollinator insects; and seed-transmitted bacterial fruit blotch of melon seeds received long ago. Major collection evaluations are under way for the carrot and cucurbit collections in conjunctions with the Carrot SCRI and the Cucurbit CucCAP, providing extensive phenotypic evaluation for a number of disease and abiotic threats, important market traits, genomic information and breeding stocks. Resulting tools, databases, and transdisciplinary training opportunities for students and postdocs are extensive and results will facilitate collection utilization for many years.

2021 NC7 RTAC meeting: Will be held at the University of Minnesota, hosted by Chair Aaron Lorenz, with Melanie Caffé serving as Secretary. The 2022 meeting may be held at Kansas State University.

Resolutions:

Sincere thanks are extended to Aaron Lorenz for managing the Zoom meeting and the logistics connected with all presentations, and for serving as recorder.

The NC-007 RTAC recognizes and thanks Candice Gardner for her outstanding 21 years of service as NC7 Project Coordinator.