2022 NC7 RTAC Meeting

June 27-28, 2022
Hybrid meeting; Ames

NC7 Representatives: Thomas Lubberstedt, Iowa State University (ISU), Meeting Chair; Carolyn Lawrence-Dill, ISU, Administrative Advisor; Kendall Lamkey, ISU; David Peters, USDA-ARS, NCRPIS, NC7 Coordinator; Jonathan Fresnedo Ramirez, The Ohio State University (OSU); Burton Johnson, North Dakota State University (NDSU); Lori Hoagland, Purdue University; Erik Sacks, University of Illinois; Bill Tracy, University of Wisconsin; Addie Thompson, Michigan State University; John Park, Clemson University; Nithya Subramanian, Texas A&M University; Melanie Caffe, South Dakota State University (SDSU)

Other Participants: Vivian Bernau, Jeff Carstens, Mark Millard, Colleen Warfield, Lisa Pfiffner, Ashley Sonner, Lisa Burke, and Pete Cyr, USDA-ARS, NCRPIS, Ames, IA; David Brenner, Laura Marek, and Kathleen Reitsma, ISU, NCRPIS, Ames, IA; Christian Tobias, USDA-NIFA; Peter Bretting, USDA-ARS-ONP, Beltsville, MD; Gary Kinard, USDA-ARS-NGRL, Beltsville, MD; Steve Cermak USDA-ARS, Peoria, IL; Stephanie Greene, USDA-ARS, Fort Collins, CO; Candice Gardner, retired; Sherry Flint-Garcia, USDA-ARS, Columbia, MO.

June 27, 2022

After a brief welcome by David Peters (assumed role of chairman; Thomas Lubberstedt taking minutes), 2021 minutes were approved (Bill Tracy moved to approve; Burton Johnson second; no discussion).

The NC7 Academic Advisor, Dr. Carolyn Lawrence-Dill (ISU College of Agriculture and Life Sciences) gave a perspective presentation (history/future). History of NC7, funds off-the-top. More $ for NC7 (NCRA). Budget FY23-27: Federal and regional funding have been flat ($2.3M and $520k per year, respectively). In-kind from ISU has increased from $500k to $591k over last 5 years + acreage. Abundance mindset (as opposed to scarcity mindset/survival mode) is strongly encouraged with expansive visions. Today: try to apply abundance mentality in NC7. Biweekly meetings were held between Carolyn and David to strengthen interaction between PI station and Ames and ISU researchers on campus.

Dr. Peter Bretting (USDA-ARS-ONP) provided an update on the National Plant Germplasm System (NPGS). Number of NPGS accessions has continuously increased to >600k in 2021. Demand is ca. 250k/year but was lower during COVID (219k in 2021). Biggest user: Land Grant Universities. 2/3-3/4 of distributions are domestic. In 2021, 38% of distribution was international. ARS NPGS budget increased from $42 million in 2013 to $49.7 million in 2021. However, taking purchasing power into consideration, the real budget decreased from a peak in 2003 to 2018. Personnel changes: good and bad (new hires, loss of long-term experience). Also: filling positions is a lengthy process at USDA, can take up to 5 years. Crop wild relative acquisition, cryopreservation, GMO, gene edited products provide challenges and opportunities. David Spooner passed away, he made important contributions to NPGS (potato, carrot). Plant Genetic Resources (PGR) Training initiative created online course hosted by Colorado State University (involves ISU faculty). Budgetary increases at Aberdeen, ID (small grains); Corvallis, OR (Vaccinium); Geneva, NY (hemp); College Station, TX (Pecan). New germplasm facility to be established in West Madison, WI, more next year.

Dr. Gary Kinard (USDA-ARS-NGRL) provided an update on the Plant Exploration Program and GRIN-Global (Germplasm Resources Information Network). Dr. Anne Francis joined NGRL 8/21 (Plant Exchange Office project). Two years of backlog for plant explorations, can resume, need to be prioritized. GRIN applications functioned normally during COVID period. New features introduced, including GRIN-U. More telework, was productive. GRIN-Global: sortable tabular display; multiple form types can be used in requests; new taxonomy regulations added to GRIN Taxonomy menu; tool to filter incoming web-orders (e.g., research vs. home gardeners). Helped to remove >50% of requests and focus on legitimate requests. Dealing with private plant breeders and Native Americans (Bill Tracy) –> Gary: make them cooperators; Mark Millard: trying to accommodate in direct communication. Christian Tobias: GRIN for Impact reports to congress.

Gary: numbers, but also GRIN-U (https://grin-u.org/) delivering success stories. Carolyn Lawrence-Dill, Erik Sacks: make seed ordering inclusive rather and exclusive (help those, that are not eligible).

Dr. Stephanie Greene (USDA-ARS-NLGRP) reported on the lab's many activities. Role: safety duplication storage. NLGRP – Plants has 5 scientists (2 for animals). In addition, 41 scientists, technicians, etc. In total >1 million. accessions, in plants >500k accessions (86% of primary seed collections backed up). NPGS clonal collections only 14% backed up. Requires protocol development for cryopreservation etc. Holding of IPR/PVP germplasm, until protection expires. Also accessions (470k) from international collections ("blackbox"). Microbes: >100k. Svalbard used as tertiary storage location (delivery 1x/year, 150k accessions in 2022). NLGRP project plan: Obj. 1 preservation technologies (e.g., pollen storage); Obj. 2 sampling procedures; Obj. 3 improve information system. Outreach: publications on crop wild relatives in the U.S. (both books, article: https://doi.org/10.1073/pnas.2007029117, website). Education: GRIN-U (https://grin-u.org/).

Field tour Ames PI station, 10 am -12 pm.

Dr. Jianming Yu, ISU (guest speaker) – Thoughts for the future of germplasm use. If genes/alleles are known, modern varieties can be "retrofitted" with optimal alleles. Various marker applications, diversity analysis, mapping, GWAS, etc. Reference to article "Turbocharging gene banks" by genomic prediction, demonstrated in sorghum. U value used to construct validation populations – evaluated on meristem volume in maize and demonstrated to be successful using a subset of the Ames panel (Yu et al. 2020; Plant Biotech J). Extension to agronomic traits (Dzievit et al. 2021, The Plant Genome), using both Goodman and Ames panel subsets. Ames panel to BGEM prediction: low accuracies. Optimal design for GS in hybrid crops: when merging populations, have common training populations, will increase prediction to the different populations involved. Use of environmental index to incorporate environmental descriptors to evaluate genotypes in different environments and adjust genotype evaluation across different environments. In terms of adding value to gene banks: add more information (genotype, phenotype, etc.) and methods to analyzed respective data. Bill: most important information, where gene bank accessions come from. Christian Tobias – how to do quick adaptation based on knowledge about genes affecting flowering time? Jianming: long way to know these genes in maize.

Dr. David Peters presented the NCRPIS update. COVID restrictions continued to challenge NCRPIS operations. Labor availability: student labor recruitment is a significant challenge. Budget challenges – infrastructure aging (cold storage cooling units; greenhouses). 19 federal and 9 ISU staff. Increased ISU Ag Exp station support, positive collaboration. Involvement in maintaining collections, research on PGRs, development of software applications. Two CRIS projects at $2.4 million and $1.6 million (Collection, GEM); NC-7 Hatch funds, net to location $522k including 9.5% budget increase NC7 staff benefits & facilities $500k (estimated). Maintenance projects: cold room cooling units by 2023; Building project requests: -18C cold storage extension; 200 m^2 facility requested; Storage building; greenhouse update, space. Staffing changes: 4 persons left; new: Brandyn Chapman (vegetable curation), Tracie Hennen-Bierwagen, James McNellie, Adam Vanous (all GEM); 5 vacancies. Currently 54k accessions available; 41k units distributed of 21k accessions in 2021, which was due to a decline during COVID period. 2021 255 new accessions added. Phytosanitary certification standard changes – EU requires increased Stewart's Wilt testing, affecting seed production of accessions at PI station. Possible public-private partnership in Cucumis melo to address Bacterial fruit blotch. GRIN-Global: pre-testing by experts (Lisa Burke), other USDA units involved in workflow design, etc.

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Curators:

Maize: Dr. Vivian Bernau (USDA-ARS-PIRU), Mark Millard, Sami Armintrout. 20k accessions in 2022, 15.5k available, 16.5k backed up. 11k with viability data. 31k images of 14k accessions loaded to GRIN-Global in 2021. 161 accessions processed in 2021. Mostly inbreds and PVPs in high demand, also wild relatives (though small part of collection). New accessions: Illinois Foundation Seed inbreds; 88 expiring PVPs; Brewbaker inbreds; Wilkes wild Zea collections (not germinating seed) – is georeferenced.

Oilseed: Dr. Laura Marek (ISU), Grace Welke, Jeff Schwartz. Update on the oilseed collection. Sunflower, other Asteraceae oil seed species (40 genera), Brassica species, Cuphea, flax. 2021 and 2022 ca. 300 accessions regenerated each. Priority setting: seed number, viability. -18C facility will help to have extended storage. Main focus to renew Brassica napus winter types, requiring vernalization. Once done, flaxes are next (and easier: self-pollinating, summer annual). Maintenance of sunflower from Southern Spain. Other projects: white sunflower with collaborator; crop-specific conservation strategies with Crop Trust.

Horticulture: Andy (USDA-ARS-PIRU) provided an update on the Horticulture collection, which is approaching 4,000 accessions in 207 genera. The curation team continued active collections in 2021: Monarda fistulosa, Echinacea laevigata, Sassafras albidum. Activities: collection of Monarda observation data; Dirca decipens germination protocol development; Salix seed longevity evaluation. Challenges: deer, labor, large-long-lived plants. T. Lubberstedt: use of grafting to speed up seed multiplication? Not tried yet, could be of interest.

Vegetables: Kathy Reitsma (ISU) provided an update on the vegetable collection. 8,000 accessions. Stable with regard to handling accessions. 2022 regeneration of 168 accessions. Challenges: vernalization in "cave", conditions not stable (temperature, humidity). Need for alternatives.

NC7 representatives

Dr. William Tracy (University of Wisconsin) – sweet corn. Sugary 1 (su1) codes for non-catalytic isoamylase 1, sugar 10-15%, 25% of phytoglycen (creamy texture). Sugary enhancer (se1) increases sugar in su1 genotypes. Increases tenderness. Se1 decreases content of important carotinoids. Supersweet shrunken 2 (sh2) knocks out subunit of AGPase. Excellent properties replaced su1 in U.S. fresh market. Intermediate sh1 allele (sh2-i) in combination with su1 gives high sugar content and creamy/juicy/crispy structure. Better stability of sh2-i. Currently evaluation, if sh2-i can be combined with wx1. sh2-i is earlier in the pathway, allows limited starch to be produced (in contrast to sh2), as prerequisite for phytoglycen production mediated by wx1. New inbreds were derived from tropical by high quality crosses – using GEM lines.

Dr. Addie Thompson (Michigan State University) started her program with seed order from GRIN (started with Wisconsin Diversity panel). Tar spot – new disease (cool humid conditions – spread in upper midwest). GWAS, GS applied, supported by USDA grant. B73- and LH244-DH line populations created, genotyped, and phenotyped this year. Phenotyping initiative – with engineers, statisticians, etc. Canopy characterization: hand measurements to determine ground truth, combined with lidar and UAV-hyperspectral data (7 scans/season). Sorghum – DOE project to capture components in order to predict biomass. USDA-NIFA project on TEFF. Educational efforts to integrate plant sciences and informatics.

Dr. Lori Hoagland (Purdue University). Overview over activities related to germplasm at Purdue: Katy Reiney (soybean): use of ex-PVPs, soybean NAMs to study/map various agronomic traits; Jianxin Ma

(soybean): evolutionary traits, root nodulation; Mohsen Mohammadi (wheat, small grains): dwarfing, root traits; Diane Wang (rice, cotton): rice ecophysiological traits, GxE – uses phenotyping facility; Lori Hoagland (tomatoes, carrot): tomato induced systemic resistance, impact of domestication; carrot root microbiomes; Arequipa NEXUS Institute – collaboration between Peruvian institution UNSA and Purdue: projects garlic (Cangkui Zhang); Quinoa (Mohsen Mohammadi, Lori Hoagland) – ordered accessions from PI station in Ames, work on phenotyping, heavy metals, endophytes.

June 28

Amaranth Curator David Brenner (ISU). Activities: deteriorating seed in parsley. 116 accessions with below 70% viability. New imaging microscope – to study seed coat in Chenopodium, seed characterizing system needed. GRIN-U videos created, among others on scarifying seed. Taxonomic classification of unidentified accessions. Male sterile Amaranth registered as genetic stock (J Plant Registration). Looks for commercial partner to develop hybrids. Thomas Lubberstedt: possible collaborator – Videometer/Michael Carstensen (digital twins) for Chenopodium seed. Carolyn: connect with Herbarium for classification, further characterization.

Dr. Erik Sacks (University of Illinois) provided an overview of three projects. Miscanthus: study of dormancy, under controlled and field conditions, with mini core collections in M. sinensis and M. sacchariflorus. Development of fluidigm-based marker assays to differentiate Msi and Msa, and for hybrid detection. Extended to Saccharum. Seed increase of Msi accessions collected in Eastern Russia in 2012. Corn colorants, Jack Juvick: anthycanin-based natural colorants (red to purple). Water soluble colorants made available to Kraft. Value-addition in crop production. Three counties in Illinois would suffice to replace Red 40 colorant. Approach extended to bioenergy grasses. Amaranthus (Patrick Tranel): dioecious Amaranth as genetic control strategy.

Dr. Burton Johnson (NDSU) presented updates on two Hatch projects. ND01502 is working to define and improve best management practices for sunflower, alternative, and new agronomic and horticultural crops in North Dakota. Johnson has explored industrial hemp, sorghum, Ethiopian mustard, sunflower, and canola. Johnson also screens germplasm for adaptation in ND. ND01530 (NC7) – among others on adaptation to ND. 60 crops have been screened at NDSU as potential new crop in last 60 years. Various crops evaluated in NC7 partnership, such as canola, amaranth, teff, coriander. Perennial flax: evaluation of accessions from Canada to Mx. Agronomy research studies with existing cultivar “Maple Growth”. Fall and dormant seeding promising, shallow seeding, with oat companion. For crops to make it, maturity, shattering, grain moisture levels were main limitations, stalk strength, harvestability. Pests often no initial problem.

Dr. Melanie Caffe (SDSU) presented research on drone-based phenotyping of oats for biomass (forage) yield. In 2021, only 26% of oat planted was harvested for grain because of drought. Remainder was used as forage. UAV-based phenotyping non-destructive, plots can still be used for seed production, also lower cost compared to harvest. High prediction accuracies of biomass yield were obtained. Other NC7 projects by Dr. Karki (soybean glyceollin production), Dr. Ameen (winter barley), Dr. Xu Lan (alfalfa).

Dr. Jonathan Fresnedo Ramirez (OSU) provided updates on the Ornamental Plant Germplasm Center (OPGC). OPGC is joint effort of USDA-ARS and OSU. Focus on herbaceous plants. Dr. Joe Schierens is acting director, Susan Stieve is curator. Search of OPGC director is ongoing. OPGC has 8000 accessions, ca. 300

genera, priority: Begonia, Viola, etc. Active breeding programs in barley, chile peppers, soybean, tomato, wheat. Active germplasm characterization / use: almond, apple, black raspberry, grapevine, pawpaw. Examples for using germplasm: purple tomato (David Francis), pest and drought tolerant tomatoes. Jonathan: rubber dandelion – goal: increase general agronomic performance. Jonathan and Diane Miller re-start the apple breeding program to produce high quality parents for other breeding programs, using an early flowering transgenic genotype from JKI in Germany to accelerate breeding. Jonathan with other researchers: sugar maple – identification of super sweet sugar maples. Establishment of new plantation at OSU. Received USDA-NNF project (-omics for nutrition), recruiting graduate students.

Dr. Sherry Flint-Garcia (USDA-ARS, MO). Maize projects (involving other scientists) on adaptation to environment, climate, stressors, human uses. Sherry's focus on human uses: work on maize heirlooms. In Mx, particular local varieties are used for particular applications. Ongoing activies: culinary corn project; low asparagine corn; "One a day corn"; pigments for value addition; corn for whiskey; evaluation for tortilla production; combination of landraces to be evaluated for various quality traits; low protein materials; Missouri Heritage Corn project; Characterization of maize landraces – phenotyping and genotyping – collaboration with Vivian and Mark.

Dr. Thomas Lubberstedt (ISU) presented on the current status of maize haploid inducer development, as important tool to extract DH lines from accessions of interest.

The 2023 NC7 RTAC Meeting will be held in Scott's Bluff, NE in August. The 2024 and 2025 meetings may be hosted by South Dakota and Minnesota, respectively.

The following resolutions were respectfully submitted by the Resolutions Committee for approval on June 28, 2022.

i. Whereas be it resolved that the NC7-RTAC committee extends our appreciation to David Peters for hosting and chairing, and Thomas Lubberstedt for volunteering to serves as meeting secretary for conducting an excellent face-to-face and virtual NC7-RTAC meeting, and

ii. Whereas be it resolved that the NC7-RTAC committee extends our most sincere thanks to Carolyn Lawrence-Dill Administrative Advisor and Associate Dean Iowa State Univ. regarding dedication, experience, insights, and guidance in formulating the current 5-year NCPRIS project and ongoing support, and

iii. Whereas be it resolved that the NC7-RTAC committee is grateful for support from Expt. Station Directors and most appreciative to additional Hatch funding to the NCRPIS to meet current and future staffing and seed request needs more adequately, and

iv. Whereas be it resolved that the NC7 RTAC committee encourages expediting the funding for the minus 20 degree Centigrade cold storage facility, as it is critical to the mission of the station.

Sacks moved to accept resolutions, and Caffe seconded. There was no discussion. The resolutions were approved with a verbal vote.