Minutes of RTAC NC-7 meeting (South Dakota State University, Brookings, SD, June 11 and 12, 2025) by Ravi Mural

<u>Day 1:</u>

8:00 AM: Melanie Caffe, meeting chair (SDSU) started the meeting with an introduction and all attendees introduced themselves.

8:07 AM: A motion to approve the 2024 meeting minutes was requested

- Yu Ma so moved and Burton Johnson seconded. All were in favor.

8:08 AM: Dr. Jon Blanton (Associate Dean for Research, SDSU) Introduced the South Dakota experimental station

- South Dakota has about 950,000 residents and is proud to have the highest percentage of population involved in agriculture of any state (about 6%).
- 43 out of 49 million acres in South Dakota are privately owned and used for agriculture.
- Eastern South Dakota has more row crops (corn, soybean), while western South Dakota is more cattle-focused due to soil and precipitation differences west of the Missouri River.
- SDSU's total annual research budget is ~$55–60 million; about $20–35 million is from federal funding. Commodity groups (e.g., corn, soybeans, sunflowers, nutrient councils) also fund agricultural research at SDSU.
- There are 9 research farms across the state and 7 additional farms on campus, about 16,500 acres. Three farms are owned by farmer boards; farmers invest their own money to support University research, including rapid infrastructure development.
- SDSU has about 174 research FTEs, including 104 PhDs, spread across four colleges and 11 departments. The largest research programs are in agronomy and animal sciences.
- SDSU is not yet R1 but is growing research capacity while maintaining impact on local producers. SDSU is farmer-focused with an agile approach to research infrastructure and delivery.

8:16 AM: Dr. Brent Turnipseed (Department of Agronomy, Horticulture and Plant Science, SDSU) Welcomed everyone

- Number of students in the department: ~133 agronomy undergraduates, ~22 in horticulture, ~73 in precision ag, and ~65–75 graduate students.

8:17 AM: Dr. Kendall Lamkey (Associate Dean Facilities and Operations, College of Agriculture, Iowa State University) interim NC-7 administrative advisor

- NC-7 is a unique multi-state regional project, and although similar germplasm committees exist in other regions (e.g., Northeast), NC-7 NCRPIS funding model is rare and has been sustained due to long-standing support.
- The NCRPIS NC-7 project was established in 1948, making it the first multistate project under the USDA framework to receive such funding. NC-7's origins are linked to key legislation: the Morrill Act (1862), Hatch Act (1887), Research and Marketing Act (1946), and AREERA (1998).
- Annual NC-7 project funding for the NCRPIS remained flat (~$520,000) for 20 years, while costs such as salaries and benefits increased. A ~10% increase in the budget was approved for the 2022-2027 funding cycle.
- Iowa State provides an additional ~$600,000 in-kind support, including land, office space, and infrastructure.
- The approval process for NC-7 involves multiple layers:
  - The project proposal reviewed by department chairs, it is evaluated by the experiment station directors and then reviewed by the North Central regional association board
- RTAC Committee responsibilities include:

    - Organizing and conducting annual meetings, updating project objectives, ensuring broad participation beyond just the North Central region, submitting timely annual reports
- RTAC Participation offers benefits such as:
    - Leadership development and collaboration on large-scale, multi-state projects. It required modest reporting obligations
- Each institution implements NC project funds differently, with some offering internal grants or institutional matches.
- NC-7 currently has ~43 total members, with representation from ~12 states in the associated Technical Advisory Committee (TAC).
- The project must demonstrate true multi-state collaboration, not just individual contributions grouped together and there have been attempts to add research-focused objectives (e.g., germplasm enhancement) to ensure alignment with expectations for regional projects.
- **Project ends in 2027; next proposal renewal is due in 2026, with deadlines for objectives in October 2026 and the full proposal by December 1, 2026. Things to mainly focus on are objectives, outputs, outcomes and project impact.**
- Inactive or non-performing projects are at risk of termination, as happened with a regional corn breeding project that lacked sustained participation.
- **Additional Points from Open Discussion**
    - Participants discussed broad research objectives like trait characterization or phenotyping across species to enhance collaborative value with tangible outcomes.
    - Impact statements must be written in clear, concise language, demonstrating real-world benefits beyond academic research—this is crucial for Congressional communication (Dr. Singh).
    - All listed participants should actively contribute to annual reports, especially with individual impact statements.
    - Margaret Smith emphasized that regional project approvals are done at the regional level, and budgeting proposals should be discussed with station directors in advance.
    - The NC-7 germplasm is widely used, even by non-members, highlighting its broad national relevance and impact.
- Dr. Lamkey introduced Dr. Asheesh (Danny) Singh (Associate Dean for research and discovery, College of Agriculture and Associate Director of Iowa Experiment Station) as the incoming Administrative Advisor for the NC-7 multistate project.

8:40 AM: Dr. Neha Kothari, National Program Leader for the USDA-ARS National Plant Germplasm System, attending remotely

- Joined USDA-ARS in October 2024, career as a plant breeder.
- Emphasized that the germplasm system is the crown jewel of USDA-ARS.
- The NPGS fits within the plant breeding life cycle, from acquisition to regeneration, and back again via PVP expiration or public releases. Germplasm may enter any point in the breeding cycle, reinforcing the system's central role in U.S. agriculture.
- NPGS functions: acquire, document, characterize, and distribute germplasm from 22 centers, covering over 200 crops.
- Over ~200,000 samples are distributed annually, highlighting system demand; about 20% from the NCRPIS.
- Locations at Urbana, IL and Riverside, CA are slated for closure and relocation under the current President's budget. Details are not yet available.
- Some crops are clonally propagated; 7% of collections are living trees, which cannot be backed up by seed storage and require on-site maintenance (e.g., 2,000+ trees at Riverside).
- Microbial collections are also supported, important for seed treatments and soil fertility studies. Currently under-resourced despite high demand.

- Current non-microbial NPGS stats (availability fluctuates due to regeneration needs and seasonal constraints):
  - ~620,000 accessions
  - ~476,000 available for distribution
  - ~16,000 species
  - 77% seed-based collections
- Budget concerns:
  - Inflation-adjusted funding has declined steadily since 1999.
  - Accession numbers increasing while funding declines = resource strain.
  - Some sites added costly new collections (e.g., Geneva), and budget cuts are not equitably distributed.
- Risks of underfunding:
  - Regeneration lag of 30–90 years at some sites (e.g., 30 years at Ames).
  - Seed viability and genetic integrity decline over time, risking permanent genetic loss.
- Requested help from the community to:
  - Share genotyping/sequencing data from curated materials.
  - Partner in identifying diversity sets, prioritizing regeneration, and reducing redundancy.
- Highlighted success stories to showcase ROI (return on investment):
  - Pecan breeding story presented at Ag Outlook Forum.
  - Cotton fusarium wilt resistance story: one accession helped address massive crop losses in California.
  - Success stories are available on the GRIN-U database. Search for "success stories"
- **Discussion and Q&A Highlights**
  - David Baltensperger encouraged including a research objective centered on molecular tools; Neha agreed and highlighted the importance of genomic data for conservation prioritization and the need for collaboration by sequencing the rest of collections already partially genotyped by researchers.
    - Curators and land-grant institutions can help structure research objectives into proposals.
  - Danny: Asked how success stories are collected. Neha responded that researchers reach out to them. USDA prefers researchers to proactively share stories.
  - David: Annual reports are a critical entry point for these stories. Once documented, USDA can trace accessions, build databases, and track return on investment.
  - David: Suggested that annual report leads reach out to members and emphasize the need for impact statements with economic or social metrics. Neha agreed, adding that citations of germplasm use in publications help track usage. More impact reporting is needed to justify the $54.5M annual investment.
  - Danny: Noted that germplasm use is long-term, and 200,000 packets distributed per year underestimates actual impact, highlighting the need for metrics that capture reuse and longevity.
- Neha concluded by stressing:
  - Success stories, collaborations, and genotyping data sharing are all critical to preserving, improving, and justifying the germplasm system.
  - Encouraged all participants to connect with the program for future support and collaboration.

9:04 AM: Hannah Tetreault, Acting Seed Curator, USDA National Laboratory for Genetic Resources Preservation (NLGRP), Fort Collins, CO, attending remotely

- NLGRP is in Fort Collins, CO, at ~1,500 meters elevation, benefiting from a naturally low relative humidity (~35%), ideal for seed drying and storage.
- NLGRP is part of the Agricultural Genetic Resources Preservation Research Unit and hosts both plant and animal germplasm programs.
- NLGRP Core Functions:

    - Specializes in long-term storage of plant genetic resources:
    - Backs up all NPGS seed accessions.
    - Houses special collections: Plant Variety Protection (PVP) and Plant Registration submissions.
    - Stores microbial collections.
- Seed Storage Process:
    - Seeds are dried to optimal moisture (around 25% RH).
    - Packaged in moisture-proof pouches and stored in conventional cold storage (-18°C), or cryogenic storage (liquid nitrogen vapor, ~-176 to -185°C).
- Monitoring & Testing:
    - Seeds are viability tested upon arrival.
    - Retested on a 10–15 year cycle (goal: reduce to 5–10 years depending on species).
- Collection Snapshot (as of this update)
    - Total NPGS accessions (active sites): 622,439
    - Accessions backed up at NLRP: 498,710 (~80%)
- Special Collections:
    - PVP Collection: 9,605 accessions; 20-year retention before integration into NPGS.
    - Black Box Storage: 255,502 accessions (from global & domestic partners; and endangered or sensitive materials).
- Clonal Storage:
    - Across NPGS: 28,800 clonal accessions
    - At NLGRP:
        - 394 in vitro cultures
        - 6,827 accessions (meristems + dormant buds)
        - 297 pollen accessions
- Seed Curation Updates & Successes:
    - Strong viability testing program with six trained seed analysts; half are AOSA certified, rest to complete soon.
    - Viability and germination data now integrated into GRIN, enabling real-time tracking by donors and curators.
    - Meeting turnaround goal that seeds are processed and stored within 3 months
    - Backlog cleared: Seeds of Success materials are now tested and stored.
    - Detailed NLGRP germination assay protocols now viewable on GRIN.
- **Upcoming and Ongoing Initiatives**
    - Relevance-based viability monitoring focus aligned with active site priorities
    - Plan to mark older/unneeded inventories as “discard” to optimize space and efficiency.
    - Storage of non-distributed yet potentially valuable accessions
    - Collaborating with sites like Ames.
    - Offers long-term preservation of unique but currently unused germplasm.
    - Renewing cryogenic storage program building criteria for which accessions should enter cryo such as the initiation of Salix storage for Ames.
- **Q&A Highlights**
    - Dr. Singh asked how "relevant material" is determined. Hannah responded that decisions are made in consultation with active site curators and national program leaders, based on crop importance and stakeholder needs.

9:20 AM: Dr. Gary Kinard, Research Leader, USDA National Germplasm Resources Laboratory (NGRL), Beltsville, MD, attending remotely

NGRL Updates, GRIN Development, and System-wide Support Activities: The NGRL lab supports the entire National Plant Germplasm System. Key areas include:

- Plant Exploration & Exchange Program

        - FY25 explorations are pending USDA approval due to changes in outgoing agreement policies.
        - If ARS site leads exploration, money may be directly transferred. If university leads, agreements are required.
        - FY26 RFP and solicitation are on hold and the timeline will be adjusted based on federal budget clarity.
    - GRIN / GRIN-Global Database Infrastructure Updates
        - Policy & Procedural Changes:
            - As of Jan 1, 2025, for international requests, SMTA only required for requests of propagative materials not for non-propagative materials.
            - For domestic requests, SMTA only required if materials originally received with SMTA.
            - Website now includes FAQ and detailed list of propagative vs. non-propagative plant parts.
        - Search Functionality Enhancements:
            - Users can now exclude GE/GM material from advanced searches.
            - If GE/GM material is requested, a click-to-acknowledge box appears during checkout.
            - Descriptor searches now include images (fruit, flowers, etc.) if images have been loaded to GRIN.
            - Reminder of the three search modes in GRIN: accession, taxonomy-based and descriptor-based
        - Status of GRIN IT Operations:
            - Due to federal voluntary separation programs, 4 of 5 IT positions in the GRIN team are vacant which includes 3 voluntary separations and 1 pre-existing vacancy affected by a USDA hiring freeze.
            - Current focus is maintaining system stability; enhancements and new features are on hold.
            - System functionality remains operational: users can search collections and request materials.
    - Outreach, education, and impact documentation
        - GRIN-U, launched in 2021, is a dedicated training and outreach platform for plant genetic resources. Contains materials such as:
            - eBooks, infographics, training videos, and webinars
            - Materials useful for educators, researchers, and curators
            - Content is both internally developed and externally curated
            - Includes a YouTube channel with high-quality videos from Ames and other gene banks.
            - Infographics are available in handout or poster format, downloadable for outreach.
            - Quarterly newsletter subscription available (~370 items currently on site).
        - Success Stories Initiative:
            - Building a collection of “success stories” demonstrating real-world impact of NPGS accessions. Stories highlight how specific germplasm solved agricultural problems.
            - Templates and intake forms are available on GRIN-U.
            - Strongly encouraged to submit success stories to support documentation of return on investment for NPGS. Feel free to work through an appropriate curator.

9:35 to 9:50 Break

9:52 AM: Steven Cermak, USDA: Oilseed Processing, Product Development, and Support for Breeding Programs, NCAUR, Peoria, IL, attending remotely

- Dr. Cermak is an organic chemist leading two USDA-ARS projects:
    - Project 301: Soybean composition analysis in support of breeders.
        - Soybean Support: We analyze ~6,000 soybean samples/year for moisture, protein, and oil, providing critical compositional data to soybean breeders.

        - Project 306: Development of new products from ag-based materials.
            - Oilseed Processing Program (Pilot-Scale) working with various oilseeds, including newer crops like pennycress. Facility includes:
    - Oil extraction (mechanical pressing and solvent-based methods)
    - Oil refining
    - Product development (lubricants, biofuels, polymers)
    - Highlighted Product: Biobased Motor Oil
        - Developed first biobased motor oil approved by the American Petroleum Institute (API).
        - Created using high oleic soybean oil.
        - API starburst approval ensures manufacturer warranty compliance.
    - Analytical and Processing Equipment
        - Oil composition analysis via NMR.
        - Protein analyzer handles larger samples (3g), improving consistency.
        - Additional equipment includes:
            - GC-MS for fatty acid profiles
            - ICP for elemental analysis
            - Whole grain analyzer
            - French screw press (can press ~1 drum of oil per day)
            - Solvent extraction and thin-film distillation units
            - Wide range of mills and seed conditioning tools
    - Crop-Specific Processing Insights
        - Pressing conditions are seed-specific and must be optimized for each crop.
        - Pressing efficiency affected by oil content and moisture; eg, seeds with very high oil content (like 50% and above) can be harder to press due to slippage.
    - Ongoing Research:
        - *Silphium integrifolium,* a native perennial related to sunflower.
            - Partnered with The Land Institute.
            - Targeted for oilseed and protein uses; also protects from soil erosion and provides pollinator support.
            - Current analysis values: 18% oil in seed, 31% oil in kernel and 54% protein in kernel
            - Developed mechanical methods for hull separation.
        - Industrial Hemp:
            - Must maintain <0.3% THC compliance.
            - Provides composition data and THC testing for breeders and growers.
            - Developing IR libraries for rapid seed screening. IR vs wet chemistry
            - Collaborating with four universities; evaluating ~1,300 samples and 10+ varieties.
            - Challenges:
                - Inconsistent maturity affects oil quality and chlorophyll levels.
                - Cold-pressed oil is very green, which complicates IR calibrations.
                - Pressed oil typically contains less chlorophyll than hexane-extracted oil.
                - Excess chlorophyll acts like audio interference in spectral calibrations
                - Cold-pressed hemp oil appears green and resembles goopy consistency.
                - Collaboration Invitation
        - Lab is open to collaboration; has capacity for proof-of-concept pressing and analyses such as supporting new soybean variety development through small-scale pressing.
        - Open to exploring peanut oil pressing if relevant to collaborators.
    - **Q&A Highlights**
        - Residual oil after pressing varies by seed; high-oil seeds can't always be fully pressed.
        - Follow-up question: pressing + solvent extraction is a common two-step approach.

10:12 AM: Laura Marek, NCRPIS NC-7 project manager: NCRPIS NC-7 Budget

- Reviewed the current budget funded by the NC7 Hatch Project:
  - Approved by Experiment Station Directors in 2022, $572,890 annually. Budget categories include salaries, travel, supplies and maintenance. All Hatch project spending must comply with NIFA expenditure guidelines.
    - Salaries: $42,800/month to support 7 positions: farm manager, three curators, and three technical specialists associated with the curators. One position was eliminated during 2024 to ensure spending was within budget.
    - Travel funds: Support curators' participation in meetings and stakeholder engagement events like this meeting; in FY23, ~$7,500 was spent.
    - Supplies: Covers non-federally purchasable items for NC7 staff; in FY23, less than $1,000 was used.
    - Maintenance: Covers expenses that cannot be covered by federal funds such as under-ground work (because NCRPIS in on ISU land); irrigation work last year cost $1,300
- Reported that three staff resigned or retired in March-April
  - One position was filled in October.
  - The unfilled positions allowed use of NC7 salary money to support student workers and temporary P&S hires from April through December ($105,000), during a federal budget gap allowing operations to continue more smoothly.
- NCRPIS ISU CALS Support more than $600,000 annually:
  - Iowa State contributes via the Experiment Station Hatch system and additionally through the College of Agriculture.
  - CALS pays fringe benefits for personnel
  - They also contribute significant in-kind support including facilities on and off main campus (greenhouse and office space), farmland, and administrative support (HR, accounting)
- Total non-federal support to NCRPIS amounts to approximately $1.2 million/year.
- **Q&A Highlights**
    - David: Congratulated Laura and her team on operating the facility efficiently with limited resources. Laura acknowledged the hard work of the team and appreciated continued stakeholder support.

10:18 AM: Adam Mahan, USDA, NCRPIS RL, attending remotely

- Manages two ARS projects at the station, the germplasm collections (NPGS-related curatorial projects) and the Germplasm Enhancement of Maize (GEM) project.
  - Currently 19 full-time USDA staff positions and a fluctuating number of USDA and student temporary employees. The 7 Hatch-funded staff positions are managed separately.
  - Reported 6 USDA vacancies:
    - 4 curatorial-side vacancies (3 technicians,1 administrative secretary).
    - 2 GEM vacancies; currently, only one full-time person on GEM.
- Some federal budget details:
  - About 12% of the budget goes toward administrative and operational overhead due to Ames location; includes charges for shared USDA services and facility repairs.
  - Pressure from ARS to invest more in aging infrastructure; plan in 2025 was to repair greenhouse coverings damaged by wind and age, but no contracts were finalized.
    - Intends to redirect unused facility funds to hire seasonal students via agreements extending into the next fiscal year.

        - Full-time salaries and related costs for 19 federal positions consume nearly 80% of the total budget, including overtime and performance awards. Including overhead ~91.5% of the total budget is committed before any additional activities.
        - The remaining 8.5% discretionary budget is divided into:
            - 4% for temporary salaries, including Iowa State undergraduates and federal limited appointments to assist with curation seasonally.
            - 4.5% for supplies and equipment, including controlled pollination costs (e.g., bees, flies) and related materials.
        - Limited discretionary funds constrain flexibility, that reflects long-term underfunding across NPGS sites. Urged stakeholders and leadership to recognize that modest additional funding to gene banks can significantly enhance their support for external research.
    - Operational updates:
        - Late seasonal student hiring was recently approved; as many as10–11 new student workers may join the 5–6 continuing students.
        - Planting is mostly complete.
        - Current scale of controlled pollination regeneration is similar to last year but constrained by student labor shortages, compared to years ago when 2–3x as many students worked in the summer.
    - Discussed long-term strategic planning in response to staffing and budget constraints:
        - Re-evaluating collection priorities: may reduce active regeneration of underutilized accessions, send more to Fort Collins for long-term freezer storage.
        - Ames has limited freezer space currently; would benefit from investment in local long-term cold storage.
        - Prioritizing storage improvements and seed regeneration efficiencies ensure productivity remains high while reducing resource burdens.
    - Highlighted shift in international request policy:
        - Moving to one annual shipment per international location to reduce phytosanitary and logistical costs.
        - Aimed to better balance domestic vs. international distribution burdens.
    - Broader NPGS strategy questions:
        - Advocated for improving phenotypic and genotypic characterization over continuous acquisition.
        - Better characterization helps researchers make more informed seed requests.
        - Noted challenges from budget uncertainties and potential USDA reorganization but affirmed that the core gene bank mission remains strong and ongoing.
    - Budget detail clarification:
        - NPGS gene bank budget (without GEM): ~$2.5 million.
        - GEM budget: $1.3–1.4 million (increased in recent years).
        - There is disparity in advocacy: GEM is well-supported by maize stakeholders, while gene bank functions are underfunded despite their interconnected value. Working to encourage maize advocates and GEM stakeholders to also support the gene bank side of operations; all units benefit from shared capacity.
    - Concluded by inviting collaboration:
        - Open to research collaborations, including characterization of regenerated material.
        - Encouraged stakeholders to recognize that gene banks offer both seed and scientific expertise and that small financial inputs to gene banks yield large returns in terms of system-wide research support.
        - Building collaborations may naturally lead to external funding opportunities.

10:35 AM: Jessica Shade, NIFA Update, attending remotely

- Gave a short NIFA update; it is difficult to provide more detailed information or definitive timelines at the moment.
- Noted that due to the federal transition, there are significant delays and changes underway at NIFA. As executive branch employees, NIFA staff are working to align all activities with the current administration's priorities. They appreciate stakeholder patience and flexibility.
- Announced leadership changes at USDA:
  - Dr. Jay Hambley was appointed as NIFA Director on March 20, responsible for driving USDA efforts in agricultural innovation, outreach, and leadership development.
  - Dr. Scott Hutchins is now serving as Under Secretary for the Research, Education, and Economics (REE) mission area.
- Explained that NIFA is currently:
  - Reviewing all RFAs (Requests for Applications) for alignment with administration goals, causing a delay in their release.
  - Working through reviewed proposals from last year; still under internal processing.
  - Slowly issuing awards as decisions move forward.
- Noted that there is a temporary pause on a limited number of ASAP accounts due to administrative appointment implementation.
  - These suspensions occur without direct notification to awardees; only NIFA staff are informed.
  - Encouraged all PIs with active awards to check their ASAP accounts to confirm account status.
- **Q&A Session**
  - Dr. Singh asked about colleagues receiving review packages but no clear funding date; are: these proposals still under consideration? Jessica said yes they are. NIFA issued non-determination emails to provide reviewer comments without indicating funding status. This gives applicants time to improve future proposals, and it does not mean proposals are scrapped. AFRI is not one-year money, so awards are still expected but delayed.
  - Margaret Smith said that Cornell's ASAP accounts have been blocked across all USDA awards without notice, and is there a way to resolve this? Jessica replied that unfortunately, NIFA staff have no control or insight into those suspensions. These decisions occur outside of NIFA, at a higher administrative level.
    - David asked if Dr. Scott Hutchins officially been appointed, or is his nomination still pending? Jessica thought he would be confirmed soon.

First Round, NC-7 Representatives presentations:
10:46 AM: Lori Hoagland, Perdue University, attending remotely

- Soil microbiologist working closely with plant breeders. Her program focuses on understanding plant–microbiome interactions across the phyllosphere, rhizosphere, and endosphere, with implications for stress tolerance and nutrient acquisition. Highlighted her work on heavy metal uptake in plants, specifically cadmium, lead, and arsenic, which are harmful to plants and humans.
- Discussed a collaboration with David Brenner and the quinoa collection, particularly:
  - A project in Peru to address cadmium contamination in quinoa.
  - Identification of high and low cadmium uptake lines across a domestication gradient.
  - A paper currently under review in Science and the Total Environment.
  - Follow-up research by a graduate student on seed-borne endophytes and their roles in cadmium uptake.
- Shared ongoing efforts with carrots and spinach:
  - Collaborating with Phil Simon (ARS, WI) on carrots and Charlie Brummer and Ellen van Deynze (UC Davis) on spinach.
  - Addressing cadmium accumulation in these vegetables due to food safety concerns, particularly in baby food.

        - Utilizing hyperspectral imaging and machine learning to non-destructively screen for heavy metal uptake.
    - Highlighted work on pathogen suppression via microbiomes:
        - Investigating how soil microbes may induce systemic resistance to foliar pathogens.
        - Ongoing work with carrot and the pathogen Alternaria dauci, including a GxE interaction study with a student.
        - In tomato, collaborating with Jim Myers (OSU) to map traits associated with root exudates and microbial-mediated pathogen suppression.
        - Identifying SNPs related to microbiome-responsive traits using mapping populations.
    - Shared updates from other Purdue researchers using germplasm:
        - Diane Wang (Agronomy): Research on rice and soybean diversity panels.
        - Katy Rainey (Soybean Breeder): Long-standing use of germplasm; recent publication on soybean diversity.
        - Mitch Tuinstra (Sorghum and Maize Breeder): Development of three new sorghum parental lines from germplasm accessions.
        - Stephen Scofield (ARS, West Lafayette): Research on fusarium head blight using wheat lines.
        - Tesfaye Mengiste (Botany & Plant Pathology): New project on pearl millet, growing 500 accessions for disease resistance research.
        - Cankui Zhang (Agronomy): New project using ryegrass germplasm.
    - Acknowledged companies in Indiana using germplasm in breeding programs, thanks to a list provided by Laura.
    - Closed with highlights from recent international collaborations in Peru:
        - Visited quinoa collection and Potato Park with over 1,300 accessions of various crops.
        - Emphasized the impressive germplasm conservation work in these facilities despite limited funding.
    - **Q&A Discussions and Comments**
        - Burton shared historical context regarding cadmium in durum wheat affecting European exports.
            - Explained the geographic shift in durum production in North Dakota was due to Fusarium head blight.
            - Mentioned prior research by Rufus Chaney (USDA) on cadmium levels in durum wheat and across multiple crops. Lori said she will follow up with Rufus.
            - Complimented Lori's captivating research program and expressed interest in collaborating on heavy metal screening.
        - Colleen Warfield: Asked about the isolation of endophytes, whether from seeds directly or from plants. Lori explained that they attempt seed isolation, but due to low abundance, they also germinate seeds under sterile conditions to amplify microbes and improve characterization.

11:02 AM: Natalia De Leon, University of Wisconsin, attending remotely

- Natalia opened by acknowledging Laura for helping compile data and providing shipment information from 2020 to 2024, highlighting wide use of diverse genera and species from the NPGS in Wisconsin. Noted Wisconsin is a strong consumer of NPGS resources, reflecting heavy use and integration of the collections into research and breeding.
- Emphasized the importance of the germplasm collection in advancing research.
- Recalled initial involvement with germplasm through the Great Lakes Bioenergy Research Center (GLBRC), a DOE-funded initiative ($375 million) focused on biomass and biofuels, especially using maize.
    - The project benefited from the DOE Joint Genome Institute support for characterizing maize populations.
    - Created the Wisconsin Maize Diversity Panel by requesting all inbred lines with maturity potential for Wisconsin from the NPGS.

    - These lines were genotyped, phenotyped, and formed the foundation of biparental and MAGIC-type populations, including double haploid lines.
- Shared that their team has conducted extensive phenotypic and genotypic evaluations, published widely, and enabled the use of these resources by external groups.
- Noted that in addition to maize-specific studies, several resources and tools developed have cross-species applications, such as computational and phenotyping tools.
- Highlighted work on the recently expired Plant Variety Protection maize lines, maintaining over 600 lines in their in-house collection.
    - These lines have been characterized using standard genotypic protocols and shared via publications.
    - Developed and evaluated hybrids using these lines, with promising combinations competitive with commercial checks.
- Discussed combining germplasm from NPGS, Hanson's germplasm (GEM), and exPVPs in breeding programs. Efforts include both grain and silage-focused breeding.
- Discussed the Genomes to Fields (G2F) initiative:
    - Collaborative effort started in 2014 to integrate genomics, phenomics, and environmental data to improve maize prediction models.
    - By 2024, tested materials across 300+ locations, 190,000 plots, and 6,000 unique hybrids.
    - Populations used are rotated every two years, mostly derived from the NPGS.
    - All data are publicly available, including environmental, phenotypic, and agronomic datasets.
    - This initiative involves numerous institutions, corn grower associations, and consistently acknowledges USDA-NPGS and GEM.
    - Described the recent prediction contest (2024–2025) organized by Jacob Washburn:
        - Used 10 years of G2F data for teams to predict outcomes for 2024.
        - Attracted 370 participants in 205 teams from 42 countries, encouraging public model development and data use.
- Shared cumulative extramural funding and in-kind support received for related efforts, emphasizing that none of these projects would have been possible without germplasm access.
- Concluded by introducing the Maize Circular Economy (Circa) project, led by Ed Buckler, Cynthia Romay, and Sarah Miller (Cornell and USDA-ARS):
    - Focus on improving nutrient recycling, perennial-like traits, and season extension in maize.
    - Her team is working on early-season cold tolerance by screening high-altitude maize accessions from the NPGS.
        - Closed by emphasizing the critical role of continuous germplasm availability in exploring new research directions and crop improvement strategies.

11:17 AM: Sherry Flint Garcia, USDA, Columbia, MO, attending remotely

- Began by introducing her topic: “Corn for the People”. Her work centers around addressing corn’s public perception as just a commodity, associated with high fructose corn syrup, GMOs, and industrial agriculture. Corn has a "PR problem" and emphasized improving public opinion by focusing on corn as food and flavor, noting that everyone eats corn in some form.
    - Described her career’s focus on grain composition and germplasm diversity, particularly beyond typical yellow dent corn.
    - Interest in working with heirloom corn varieties (also called landraces), using the term "heirloom" for its public appeal and branding effect.
    - Outlined her recent projects based on diverse corn germplasm, sourced extensively from the NCRPIS.
- Detailed a NIFA-funded project focused on U.S. heirloom corn:
    - Project led by Sherry, Jim Holland (ARS-NC), Jacob Washburn (ARS-MO), and Joe Gage (NC State).

        - Selected ~1,000 accessions from ~1,300 in the collection, using a partially replicated design across two years and two locations (MO and NC).
        - Noted severe nematode pressure in NC this year, leading to heavy loss in plots.
    - Discussed high-throughput phenotyping:
        - Weekly drone flights for aerial imaging, alongside extensive manual trait collection.
        - Manual pollination and phenotyping of ears, cobs, and kernels.
        - Developing an automated imaging pipeline to extract quantitative ear and kernel traits, particularly color, which is poorly handled by the Wisconsin image pipeline.
        - Working on grain composition via NIR spectroscopy, including color-specific calibrations.
        - Described efforts to understand genetic relationships and phylogeography:
        - Performing genetic analysis to identify genetic relatedness and migration patterns of heirlooms across the U.S.
    - Emphasized work on adaptation and culinary quality:
        - Collaborated with a tortilleria in Kansas City to evaluate heirlooms for flavor and cooking quality.
        - Developed in-lab tortilla-making workflow using a stone mill and conducted IRB-approved human taste panels to evaluate flavor, aroma, and texture.
        - Investigating free asparagine levels in grain due to its role in forming acrylamide (a potential carcinogen) during cooking.
            - Found 20-fold variation in asparagine content across accessions.
            - Created a QTL mapping population from high and low accessions to dissect genetic control.
            - Collaborating on the CIRCA project to explore asparagine and nitrogen-related traits, aiming to reduce nitrogen waste in grain.
        - Developing CRISPR-Cas and mutant lines targeting asparagine pathways, in collaboration, for omics-based investigation (GWAS, transcriptomics, proteomics).
        - Discussed corn whiskey flavor genetics:
            - Initiated a project after request from Wood Hat Spirits, comparing red and blue heirloom corns.
            - Noted significant flavor differences even in clear distillates.
            - Developed a QTL mapping population and working on metabolomics using lab-scale distillation, led by grad student.
    - Described a pigmented corn breeding program:
        - Motivated by food flavor, color, and interest in natural food dyes, particularly red dye alternatives.
        - Collaborating with a food scientist to simulate industrial dry-grind milling and study pigment content.
        - Breeding colorful aleurone and pericarp layers into high-yielding ex-PVP backgrounds, using ~15–20 donors into ~12 ex-PVP lines.
        - Focus on white and yellow endosperm backgrounds with stiff-stalk parentages for hybrid development.
    - Repeated the value of heirloom corn for food, flavor, and public engagement. "All corn is edible—it's just a question of how pleasant it is to eat."

11:31 AM: Thomas Lubberstedt, Iowa State University, Prerecorded Presentation

Dr. Lubberstedt was unable to attend due to travel and prepared a recorded presentation.

- Focused on the use of germplasm by researchers at Iowa State University and outlined several case studies to demonstrate impact.
    - Between 2020 and 2024, 13,879 accessions were shipped to Iowa users. Of these, 2,883 accessions were delivered to ISU researchers
        - Primary users were: Jianming Yu, Pat Schnable, Danny Singh and Thomas Lubberstedt.
        - 2700 accessions were maize

        - Other significant recipients in Iowa included USDA ARS teams and private sector groups like Corteva, which placed multiple large orders (some exceeding 1,000 accessions).
        - Due to the impact of COVID-19, only 285 accessions were shipped in 2020–2021. The remaining ~2,600 accessions were shipped between 2022–2024.
    - Use Case 1: Work from Dr. Jianming Yu's Lab, pioneer in plant genomic selection research
        - 2007: Early foundational paper
        - 2016: Widely cited paper on "turbocharging gene banks" using genomic selection
        - 2019 onward: Studies on optimal design and hybrid prediction using gene bank materials
        - 2020s: Papers on micro-phenotypes, such as meristem cell traits
    - Findings:
        - Genomic selection is applicable for both macrotraits (e.g., yield, flowering time) and microtraits (e.g., cellular-level traits)
        - Integration of marker and trait data can enhance the use of exotic germplasm
        - Selection decisions should consider prediction accuracy and trait improvement while maintaining genetic diversity
    - The Shoot Apical Meristem Diversity Panel was highlighted:
        - Included 369 inbred lines the NCRPIS selected to represent major subpopulations and heterotic groups
        - Focused on early maize inbred lines for genetic mapping and recreating pre-1960s hybrids
        - These materials supported large, multi-location projects funded by USDA-NIFA, and contributed to formation of the AI Institute for Resilient Agriculture (USDA-NSF funded), showcasing how germplasm enabled high-profile initiatives.
        - Results have been published in Nature Communications, Genome Biology, and Plant Physiology.
    - Use Case 2: Schnable Lab Applications
        - Germplasm from the NCRPIS was used to:
            - Develop haploid inducers
            - Investigate male and female fertility
            - Support PhD student projects leading to publications and jobs in plant breeding
    - Use Case 3: Early-Stage Entrepreneurship
        - Highlighted a postdoc, Yu-Jo Chen who used PI germplasm in a project focused on virus resistance and Group 1 resistance traits.
        - Chen is participating in I-Corps entrepreneurship training with the goal of forming a startup. The germplasm supports the development of new varieties with traits valuable for commercial applications.
    - Use Case 4: Dr. Danny Singh's Work with Finger Millet
        - Screened over 600 accessions of finger millet, all from the NCRPIS.
        - Identified 61 promising lines which were used tor further multi-year trials, the selection of elite lines and the development of F_2 populations for breeding.
        - Some lines were exposed to gamma radiation to induce new variation.
        - Overall goal is to develop improved, novel millet germplasm for further breeding efforts.
    - Closing remarks: Dr. Lubberstedt summarized that use of NCRPIS germplasm has resulted in:
        - Funded research projects
        - PhD student training and employment
        - Improved and characterized germplasm
        - Novel breeding methods
        - Potential for startup companies

11:42 AM: The session was concluded by thanking all presenters for highlighting the impact of the NPGS in both public and private sectors.

Lunch Break

12:56 to 6:00 PM: Great tours of the SDSU Seed Testing Lab, several Field Operations (grape, vegetable, native grasses and wheat), Greenhouse work (rice and soybeans) and the Ravan Precision Ag Building

<u>Day 2:</u>
8:00 AM: Meeting opened with NCRPIS NC-7 curator presentations

8:04 AM: Vivian Bernau, USDA, Maize Curator (along with Mark Millard)
- **Efforts focused on:**
  - Removing duplicates and inviable accessions from the collection
  - Identified duplicates using genetic data from Romay et al. 2013
  - Collection has remained same size for the past 6 years; the collection is aging
  - Continued decline in the number of collections available for distribution; 25% are not available for distribution.
  - 50% of the available accessions are >30 years old.
  - Many people in the maize community are regenerating accessions for the NCRPIS including several of the members of this RTAC committee.
  - Typically would increase 100-200 accessions per year; this year are not increasing any in Ames due to decreased temporary workers (budget) GEM project is increasing 25 expired PVPs for Maize.
  - Tropical materials are expensive to regenerate because they do not flower in Ames; must be contracted out to a tropical location.
  - Genotyping and good image analysis were emphasized
  - Benefits of genotyping maize accessions was emphasized because the information leads to identification of redundant materials which can be inactivated
  - Data analysis and data informed decision for better collection management is emphasized

8:25 AM: Laura Marek, Iowa State University, Oilseed Project Curator
- Goal of streamlining field data collection
  - Incorporating use of Field Book, a plant breeding data collection app developed by Trevor Rife when he was in Jesse Poland's lab. Laura first became aware of the software from an OnRamp presentation in early 2023.
  - Developed for use on an Onyx EBoox tablet (no camera), it also now works well Android smartphones, which offer improved portability and have good quality internal cameras. NCRPIS has Pixel 7A devices to use. Beginning in 2024, the Oilseed project has been capturing field images almost exclusively with Field Book including Laura's images of wild sunflower regeneration plots Parlier, CA.
  - Taking field images and managing the data in Parlier so much easier with Pixel 7A than with DSLR.
  - When launching the app:
    - The first screen shows components such as fields (experiments).
    - Users can input detailed information about each experiment.
    - Experimental items are loaded via CSV files, with a required unique identifier column (in this case, PI inventory numbers).
    - Trait entry is recognized by scanning a bar code, promoting streamlined data collection.
  - Loading the data to GRIN involves downloading data from Field Book, checking and reorganizing the data, renaming column headers to required GRIN names. Laura prefers some manual verification versus direct data loads from Field Book to GRIN.

- Ashley Sonner from the seed processing unit has been key to progress with Field Book and she is the NCRPIS contact with the developer.

- **Challenges with the Flax Collection**
  - The cultivated Flax (Linum) collection was transferred to Ames in 1998 when the USDA breeding program in Fargo was closed; over 80% of the distribution lots are still seed received that year. All the seed lots were grown before 1998 and some as early as the 1960's
  - 181 seed distribution lots currently have less than 50% viability. Based on recent testing, we expect at least half of the 2,346 lots due to be tested between 2025 and 2029 to be less than 50% viable.
  - The regeneration capacity is limited for all crops in Ames. 18 flax accessions are being regenerated this year. At this rate, regeneration will span many decades.
  - Some back up seed lots in Fort Collins were originally harvested in the 1960s. They are stored at -18C, compared with 4-5C in Ames. Seeds from several Ft Collins lots used for the 2025 regeneration plots successfully germinated at >95% germination, demonstrating that proper seed storage conditions can maintain seed viability for decades.
  - Flax is grown in isolation cages at Ames to preserve genetic purity, given the possibility to cross-pollinate in windy regions like the Midwest.
  - We hope to develop genome-level assessments to clarify genetic relatedness between original and stored samples and between accessions to work towards identifying a core collection on which to focus regeneration efforts.
- **NCRPIS Annual Report and Documentation Update**
  - Attendees were reminded that updated statistics and distribution details are available in the 2024 Annual Report.
  - The NCRPIS annual report has been streamlined for utility—reduced from over 100 pages in past years to 24 pages this year.
  - Anyone who didn't receive a copy can request one via email.
- **Q&A Discussion**
  - Q: Steve asked about the most requested oilseed species? A: Helianthus is the most frequently requested genus. H. annuus and other wild species are regularly distributed. Brassica accessions also see significant demand.
  - A question was asked about Field Book data file sizes and backup procedures? A: The CSV data files are small, as they only contain file paths to images. Photos are stored separately on the phone. Data and images are backed up to a server at the NCRPIS. Only a few selected images (e.g., 4–5 per accession) are uploaded to GRIN for long-term archival.
  - Comment: This structure prevents data loss, and file naming via barcode scanning is a major improvement, images are already labeled with PI numbers, avoiding manual renaming.
  - Q: Addie asked how do we ensure traits are entered correctly and consistently across team members? A: Trait headers are defined early in the season. While the team is just beginning to use Field Book for traits beyond images, consistency checks and headers facilitate accuracy.
  - Comment: Using histograms to visually inspect trait distributions could help identify outliers early. Code is being developed to compile and validate traits across devices.

8:47 AM: David Brenner, Iowa State University, Emerging Crops Curator, attending remotely

- Emerging Crops Collection Categorization
  - Germplasm at Ames is roughly categorized into two groups:
    - Accessions well-adapted to existing greenhouse environment (e.g., Amaranthus, millets).
    - Difficult accessions, which require outdoor field environments, longer cycles, or involve biennials, monocarpic perennials, and cage pollinations.
  - The Ames greenhouse is not ideal for all crops, but careful curation and long-term adaptation strategies have enabled consistent regeneration cycles:

        - Two greenhouse cycles per year (January and August plantings). Not used in summer due to excessive heat and day length.
        - About 200 accessions can be regenerated annually.
    - Greenhouse and Pollination Innovations:
        - Ongoing efforts to improve greenhouse cage pollination, enabling better control over crosses using insect pollinators within greenhouse cages.
        - Recent success with coriander pollination in greenhouse cages was noted, despite challenges with spider mites at the end of the cycle.
- Amaranth Germplasm Enhancement
    - Highlighted selection efforts for short-season Amaranthus types:
        - Motivation: Farmers face harvest challenges due to late maturity.
        - Goal: Develop varieties that mature earlier, improving harvest timing and reducing risk.
        - Approximately 50 short-season selections planted this year for evaluation.
    - Work on cytoplasmic male sterility (CMS) in Amaranthus:
        - Sufficient CMS materials are now available to facilitate crosses.
        - Observed strong heterosis in hybrid combinations.
        - Efforts continue to identify fertility restorers across species, with eventual plans for molecular tracking.
- Exploratory Work on Cover Crops
    - Investigating Lamium amplexicaule (commonly considered a weed) as a winter cover crop:
        - Naturally occurs across the Midwest, often forming solid stands.
        - Ideal growing window: October–May, matching the off-season of corn.
        - Successful initial seed collection using a leaf blower/vacuum.
        - Planning spring plantings to assess dormancy, emergence, and field compatibility.
- Collection Management and Accessioning
    - Described challenges in regenerating aging seed lots from the 1970s–80s.
    - Leveraging greenhouse to support more regenerations for perennial and difficult crops.
    - Recent accessioning effort: 361 wild Chenopodium accessions (spinach wild relative), collected all over the United States, received from Utah.
        - Time-consuming documentation and naming process, including conversion to PI numbers.
        - Legacy data issues in GRIN make it slow to verify and update records.
    - Emphasized a need to improve:
        - Bibliographic citations in GRIN.
        - Documentation consistency.
        - Accessibility of collections through better metadata.

9:00 AM: Jeffery Carstens, USDA, Horticulture Curator, attending remotely

- Manages woody and herbaceous plant collections. Typically adds ~100 new accessions and regenerates 50–100 annually. In 2025, only 12–15 regenerations due to lack of staff: no technician and only 2 student workers this season.
- Notable Collections & Efforts
    - Kentucky Coffee Tree: Near-complete collection with Brenton Arboretum.
    - Ash Species: Eastern complete and focus shifted to underrepresented southern/southwestern types; collection trips are challenging due to terrain and low seed yields.
    - Monarda: ~100 new accessions including several new species added.
    - Echinacea and Hypericum: Strong collections maintained.
    - Serviceberries (Amelanchier): Endangered or threatened: Working with Iowa DNR and State Nursery targeting rare and endangered species.
        - First time these natives will be mass-produced in-state.

        - Most Iowa herbarium records for Amelanchier pre-date 1980.
        - Recent collection vouchers added to Iowa State's Ada Hayden Herbarium.
    - Climate-Resilient White Pines
        - New accessions from western edges of the range, more drought and heat tolerant.
        - Addresses regional issues with winter burn and temperature fluctuations.
    - Red Mulberry (Morus rubra): Collaborative work with SDSU; first confirmed true red mulberries added to NPGS.
    - Willows (Salix): Two rare species added via University of Minnesota PEO grant.
        - High demand due to lack of prior work and propagation difficulty.
        - Some states now restrict propagation and distribution (e.g., Minnesota).
        - Ames 32848 willow now in Iowa State Forest Nursery's production pipeline with verified genetic origin
    - Regulation Challenges: difficulty acquiring new collecting permits
- Publications and Economic Impact
    - Two new Monarda species descriptions submitted for publication.
    - One NC7 trial oak release led to $671K in wholesale and $2.7M in retail revenue.
- Challenges
    - Labor shortages due to budget issues affect perennial field maintenance and regeneration. 75 accessions across 4.5 acres are currently unmanaged.
    - NC7 Trials: No distributions expected in 2026–2027 due to extensive rabbit damage and production delays.
        - Container production led to root issues, pest pressure, and 120+ extra hours/year for watering.
        - Potential program discontinuation under new administrative policy.
    - Critter Damage causing field reductions:
        - Estimated 50% cut in regenerations; 80% reduction in field acreage.
        - $20K spent on fencing; 10% already needs replacement.
        - Newly planted materials must be protected within 12 hours to avoid loss.
        - Major field trials (Kentucky Coffee Tree, Hydrangea) scheduled for removal due to irreparable damage.
- **Q&A**
    - Question from Yu about Monarda being used in floriculture like cut flower products? Jeff answered that there is strong interest in essential oils and ornamental breeding. Iowa State PhD student studying genetics and oil content. Breeders also interested in disease resistance traits.
    - David from NDSU asked about service berries being evaluated for fruit quality or just landscape traits? Jeff answered that both trait types are of interest. Student collecting fruit size data. Potential collaborations on nutritional profiling.
    - Question about regenerating clonally or from seed? Jeff answered that seed preferred for efficiency and long-term storage. Shrubs/trees are grown in large, screened hoop houses. Long juvenile periods require patience, but larger cages yield more seed.

9:22 AM: Kathleen Reitsma, Iowa State University, Vegetable Project Curator, attending remotely

- Staffing changes: full-time and part-time technicians resigned in spring 2024; new ag specialist, Sarah Couser, joined in October.
- Vegetable crops include:
    - Cichorium (chicory, Belgian endive)
    - Cucumis (cucumber, melon, wild species)
    - Cucurbita pepo (squashes)
    - Carrot, basil, parsnip

- Disease Challenge
  - Bacterial Fruit Blotch is a key issue in the melon collection.
  - Seed-transmitted pathogen; eradication protocols under investigation (Dr. Colleen Warfield).
  - Limited melon regeneration due to uncertainty in infection levels.
- Data & Record Management
  - Long-term cucurbit descriptor data pending upload to GRIN.
  - Improved photo documentation using Field Book with Pixel 7A.
  - Continuing to assign permanent PI numbers to Ames-numbered accessions, especially important for the carrot collection (500+ Ames accessions).
- Special Projects:
  - Cucurbit Coordinated Agricultural Project (CuCAP)
  - Led by Rebecca Grumet (MSU); now in phase two.
    - Aims: Genomic tools for cucurbits, disease resistance breeding, economic analysis.
    - Focused on genotyping all NPGS cucumber, melon, watermelon, and squash germplasm.
    - Results integrated into GRIN and the Cucurbit Genomics Database.
    - ~700 publications produced under CuCAP.
    - CuCAP Impact on Ames:
  - Responsible for managing 3 single-seed descent core collections (~1000 new accessions).
  - Watermelon handled by Griffin, GA.
    - Seed increases done by industry/PI collaborators to meet phytosanitary requirements.
    - Core lines are genetically distinct and homozygous, and linked to original accessions and PI *numbers. They will be distributed from Ames and Griffin with no IP restrictions and can be* selfed/sibbed for increased supply
  - Cucumber Core (384 accessions) arriving summer 2024 from Dr. Yicheng Wang (USDA-ARS).
  - Already used in a salt tolerance evaluation project (2023 NEFA grant).
- 6 tolerant PIs identified.
- Project led by Shaker Kousik (USDA-ARS, Charleston).
  - Germplasm Internship Program
    - 2025 intern sponsored by Dr. Irwin Goldman (University of Wisconsin).
    - PhD student visited Ames (Oct 2023) to design internship.
    - Workflow charts and schedules created for structured training.
    - Monthly Training Breakdown:
  - May: Orientation, transplanting, harvesting, observation plot planting.
  - June: Pre-collection scouting with Jeff Carstens; herbarium visit.
  - July: Focus on plant pathology (lab testing, field scouting, documentation).
  - August: Germination testing (viability, TZ testing, setup).
  - September: Germplasm management (recordkeeping, inventory, GRIN training).
  - Includes job-shadowing with support units (entomology, farm management).
    - Goals:
      - Serve as a template for future internships.
      - Open to more undergrad and grad students via faculty sponsorship.
      - ISU undergrad intern working on germplasm protocols using environmental origin data.
- **Q&A / Comments**
  - Danny praised the internship model and encouraged broader discussion with faculty to replicate the approach. Noted it offers strong experiential learning, tool exposure, and access to NPGS resources.

9:35 AM: Advisory Committee Discussion, questions for NCRPIS:
David Baltensperger asked about the cold storage situation in Ames

- Cold Storage Facility Updates:
  - Cold storage is currently at or near full capacity.
  - Main cold room received a new cooling system with four alternating blowers: colder, more uniformly ventilated, and quieter than before.
  - Lost a bay of storage space due to blower installation; mitigated by using stand-up packs, avoiding glass jars, and splitting shelves.
- Freezer Storage Constraints
  - Freezer space is extremely limited, used mainly for tree seeds or species unsuitable for 4°C.
  - A walk-in -20°C freezer would significantly increase efficiency, reduce regeneration needs, and improve seed longevity.
  - Funding remains a barrier despite relatively modest cost for freezer space expansion.
- Seed drying, processing and interim storage
  - Generally functioning well. Key issue is interim storage post-drying and pre-processing.
  - Soybeans benefit from immediate placement in 4°C storage after harvest.
  - Maize (corn) often stored in non-optimal cool-dry spaces.
  - A second 4°C room is urgently needed as a holding area before processing to preserve viability.
- Labor Limitations & Regeneration Bottlenecks
  - Acceptance of offers of in-kind regenerations are limited by:
    - Lack of secure interim storage
    - Insufficient staffing to handle large incoming batches
    - Especially critical for tropical regeneration of corn, which requires careful handling and significant space.
  - One step to address regeneration bottlenecks: Proposed Long-Term Freezer Strategy
    - Transfer duplicate distribution samples (e.g., 10K of 30K seeds/accession) to Fort Collins -20°C freezer for extended viability.
    - Could reduce regeneration frequency by ~75%; regenerate an accession once in a curator's tenure.
    - May transfer entire collections (e.g., ash, Kentucky coffee tree) to Fort Collins to free up local freezer space.
    - Trade-off: Loss of immediate access to these samples for distribution.
- For corn, labor-Intensive processes includes:
  - Ear and kernel scans (flatbed), cross-sections, color and cob depth evaluation
  - Cleaning, imaging, documenting, and jar packaging
  - Landraces require special care due to genetic diversity and need for complete documentation.
- Delegation of Regeneration Tasks
  - In-kind contributors are unlikely to do final documentation/scanning due to:
  - Need for quality assurance
  - Lack of genetic fingerprinting for cross-verification
  - Until identity can be confirmed through genotyping, final phenotypic documentation remains internal.
- Humidity and Moisture Management: moisture control protcols in place include:
  - Seeds conditioned in breathable bags under low humidity in 4°C room before being jarred.
  - Ensures moisture is reduced before sealing, preventing viability loss.
  - No additional treatments/coatings used.
  - Past issues have been resolved by the current drying and storage workflow.
- Closing Remarks
  - Cold room is functioning well; additional cold storage and freezer capacity is a critical need.
  - Next steps may include seeking funding and shifting backup strategies (expanded Fort Collins storage).

Second round, NC-7 Representatives presentations:

10:07 AM: Dipak Santra, University of Nebraska, Lincoln, attending remotely: Proso Millet Breeding & Genetics Update UNL

- Five advanced breeding lines (PM 11.26-63, PM 11.31-101, and three others) evaluated over 14 to16 site-years show superior performance compared to commercial checks (e.g., Horizon, Sunrise, Earlybird, Huntsman).
  - Planted in production-scale plots by a farmer at Sydney, NE; he and his customers favored lines 63 and 101 for release.
  - Limited seed available in 2024; larger seed quantities expected in 2025.
  - Remaining three lines may be released based on future interest.
- Public Variety Testing Results:
  - Data from 2023–2024 variety trials at Akron, CO and Sidney, NE showed:
  - Lines 93 and 101 ranked in top 4 both years.
  - Line 93 was ranked #1 in 2023 and #2 in 2024.
  - Four of Santra's breeding lines ranked within the top six entries in 2024.
  - Release paperwork for selected lines is currently in progress.
- Newly selected lines trace back to USDA germplasm and older PI lines.
  - Line 101: Earlybird × PI line
  - Line 93: Huntsman × Sanat (Sanat and Huntsman released by predecessor Dr. David Baltensperger)
  - Reinforces value of historic USDA materials in ongoing improvement efforts.
  - 85 lines selected from an original set of ~130–140 PI accessions received from Dr. Baltensperger.
- Phenotype and genotype analyses
  - Phenotypic characterization based on flowering time, plant height, panicle length, seed weight, lodging, and leaf rolling
  - Cluster analysis conducted to identify contrasting trait categories and diverse parents for future crosses.
  - Conducted GWAS using 70 adapted PI lines (others excluded due to poor adaptation).
  - 11,000 SNP markers used to assess associations with key traits (heading date, lodging, 1000-grain weight).
  - Identified 20 significant marker-trait associations, published in Plants (2023).
  - Summary includes Manhattan plots, marker positions, and their phenotypic effects across 18 chromosomes.
- Ongoing Challenges: Proso millet breeding program is unfunded, yet efforts continue through commitment and strategic resource use.
  - Despite the lack of external support, progress continues in variety release, genetic research, and applied breeding.

10:17 AM: Dr. Burton Johnson, North Dakota State University, attending remotely: **Intercropping and Crop Management Strategies**

- B. Johnson, Hatch Projects Overview. Two Hatch projects:
  - NC-7 related germplasm evaluation.
  - BMPs (Best Management Practices) for new/alternative crops (focus on industrial hemp and intercropping).
  - Recent germplasm evaluations include perennial flax, Kernza, and industrial hemp.
- Industrial Hemp
  - Hybrid Varieties: ND has grown hemp since 2016, originally using open-pollinated varieties.
  - Introduction of hybrid hemp is recent and promising:
    - Advantages include better uniformity, seed vigor, and yield (10–15% increase).
    - Hybrids align with improved farm revenue and sustainability.

        - Historical precedent of hybrids in ND crops: sunflower (1970s), canola (1990s).
- Crop Management Teaching & Regeneration Practices: shared seed-to-harvest framework used in teaching and regeneration
    - Seed type, bed prep, planting depth/timing/rate, stand establishment, weed/pest control, harvest method, and tillage.
    - No-till dominates western ND due to moisture limitations and erosion risks.
    - Emphasized rotation diversity: >30 crop options in ND; major crops include wheat, corn, soybean, canola, and sunflower.
- Intercropping Studies: Two crops planted, grown, and harvested together.
    - Three key intercropping combinations studied:
        - Camelina + Canola
        - Camelina + Crambe
        - Canola + Crambe
    - Intercropping methods: Mixed rows (same row), alternating rows (adjacent rows), and comparison with sole crops.
    - Planting and maturity synchronization were easier among cool-season oilseeds.
    - Performance Outcomes (2023):
        - Camelina + Canola: Canola highly competitive; camelina yield reduced. LER > 1.0 (1.12) → 12% overyielding.
        - Camelina + Crambe: Less competitive interaction; LER ~1.02 → marginal benefit.
        - Canola + Crambe: Canola dominated; LER < 1.0 → no overyielding.
    - Economic LER (not just yield), Camelina priced at $30/cwt in 2023 vs. canola at $25/cwt → improves camelina's value proposition despite lower yield.
- Future Considerations
    - Adjusting seeding rates may balance crop dominance (e.g., reduce canola seeding to favor camelina).
    - Additional intercropping trials underway for 2024 and 2025.
    - Intercropping is promising but requires precise management, appropriate equipment and growers with specialized knowledge (e.g., organic producers)
- Industrial Hemp Q&A
    - No incidents of THC exceeding limits reported in Johnson's trials (15 grain/fiber varieties tested yearly).
    - Hemp production in ND peaked at 4,000 acres (2020); <1,000 acres in 2023.
    - Lack of labeled pesticides remains a limiting factor for hemp production and scalability.
    - Hemp-sunflower intercropping previously yielded promising results:
    - LER ~1.25, boosted by hemp's high value ($54/cwt vs. sunflower at $27/cwt).
- Experimental Bucket Study, Buckwheat + Millet intercropping initiated in 2024.
    - Millet was highly dominant in yield.
    - Advantage: both crops short season and easy to separate post-harvest.
    - Weed pressure was minimal, allowing clean harvest.

Closing Notes: Emphasized the complexity of intercropping and the need for targeted support and special grower engagement. Encouraged ongoing research and grower collaboration. Twenty germplasm requests from 12 NDSU/USDA researchers to the NCRPIS included the following nine species groups: wild sunflower, domesticated sunflower, Zea, Brassica, *Camelina*, *Linum*, *Monarda*, dessert willow, and cottonwood**.**

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10:39 AM: Dr. Melanie Caffe, South Dakota State: Presented by PhD student Guilherme Oliveira: Oat Chromosome rearrangements: SDSU Lines characterization and implication for breeding

- Background and Motivation
  - Oat genome is complex: Hexaploid with three genomes (A, B, D), ~10.8 Gb total size across 42 chromosomes.
  - Oat genome is much larger than maize (~2.4 Gb) and even wheat (~16 Gb).
  - Long evolutionary history and frequent structural rearrangements (translocations/inversions) make breeding more complex.
- Relevance to Breeding:
  - Historical introgression of disease resistance (especially crown rust) from wild Avena species has introduced chromosomal rearrangements into elite lines.
  - Example: Line HiFi (from NDSU) shows multiple rearrangements due to past use of synthetic oats and resistant donors like A. magna.
  - Resistance gene of interest: Pc91, introduced ~15 years ago, was effective until ~2014–2015.
- Research Objectives
  - Characterize chromosomal rearrangements (CRs) in the breeding germplasm.
  - Understand implications for:
    - Genetic diversity
    - Population structure
    - Recombination
    - GWAS/marker-trait associations
- Dataset and Approach
  - 1,230 oat lines (F6, breeding lines from different pipelines).
  - 3,000 SNP markers used.
  - Focused on 4 rearrangement regions:
  - Translocation on 1C–1D
  - Inversions on 3C, 4C, and 7D
- Major Findings
  - Detection of Structural Variants:
    - PCA using SNPs from rearranged regions clearly separated lines into distinct clusters, showing that CRs define genetic subgroups.
    - Confirmed by allele profiles—clear visual differences between clusters in 3C, 4C, and 7D.
  - Population Structure:
    - PCA using all genome-wide markers showed two major subpopulations.
    - Rearrangement cluster (especially 1C–1D translocation) aligned closely with overall population structure, suggesting lasting effects from historical introgressions.
  - Recombination Patterns:
    - Very low or no recombination observed in rearranged regions (strong LD).
    - Crosses between lines from different clusters (e.g., different 7D rearrangement types) showed no recombination across affected regions in progeny.
    - These rearrangements may act as recombination barriers.
  - GWAS and Trait Associations:
    - No significant marker-trait associations detected within rearranged regions.
    - Raises concern about GWAS blind spots: potential trait loci in rearranged regions may be missed due to suppressed recombination or marker distortion.
    - Trait associations may be confounded or masked by structural complexity.
- Breeding Implications
  - Presence of CRs can impact genetic diversity, reduce recombination, and create population stratification.

    - Important to consider cluster groupings when designing crosses:
    - Crosses within clusters preserve variability.
    - Crosses between clusters may be limited due to recombination suppression.
    - Historical decisions have long-term effects on breeding materials.
- Recommendations and Next Steps
    - Better characterization of CRs is essential for parental selection, breeding strategy optimization and avoiding unintentional fixation of unfavorable traits
    - Consider use of new genomic tools or approaches (e.g., long-read sequencing or CRISPR/Cas) to investigate or potentially modify rearranged regions.
    - Explore targeted crossing strategies to either maintain or break CR blocks depending on trait goals.

Addendum: *Morus rubra* germplasm from the NCRPIS were utilized in the sequencing of the chloroplast and nuclear genomes of the native *Morus rubra*. The chloroplast genome sequencing has been completed and published. Several accessions of yellow-flowered alfalfa (YFA) (*Medicago falcata*) were evaluated for biomass production near Aurora, SD, from 2022 to 2024. The PI 502441 population yielded the highest biomass. The evaluation and characterization of winter wheat, spring wheat and oat germplasm has led to increasing our understanding of the genetic control of major traits and to the release of new cultivars.

10:54 AM: Addie Thompson, Michigan State University: Michigan State University Germplasm Use, Breeding Outputs, and Outreach Activities

- Germplasm Distribution Trends in Michigan
    - Analysis of NPGS germplasm orders from Michigan shows consistent use (~100 requests/year).
    - Many users including tribal nations, seed companies, non-profits, and hobby breeders.
    - Spikes in requests were linked to targeted projects (e.g., full panel requests by specific labs).
    - Diversity, stress tolerance, heritage lines, and education/outreach were common research themes.
- MSU Breeding and Genomics Outputs
    - Publications and Tools from Germplasm Use:
        - Origin and evolution of bread wheat paper with extensive co-authorship using genome sequencing.
        - Hyperspectral phenotyping study on DON-infected wheat.
        - Soybean disease resistance discovery and mapping population development from USDA accessions.
        - Development of SNP marker subsets from USDA soybean collection to facilitate diversity capture.
        - Phenomics and Engineering Collaboration using breeding populations.
        - Soybean Genomics Strategic Plan highlighted the essential role of germplasm resources.
    - USDA and MSU Breeders:
        - Karen Cichy (USDA), dry bean breeder: Focus on nutrition and specialty traits in dry beans; multiple lines characterized for nutritional profiles.
        - Robin Buell, tepary bean diversity panel → GWAS → Variety release (success story from USDA/PGS-derived lines).
        - David Douches, potato breeder, developing diploid potato breeding platforms, overcoming self-incompatibility; use of bridge species for wild introgressions and working with CIP germplasm on secondary metabolites and SI gene surveys.
- Faculty Using Germplasm in Diverse Contexts
    - Cholani Weebadde: Launched a Global Online Plant Breeding M.S. Program; uses germplasm in education/citizen science projects (e.g., strawberries).

    - Eric Patterson: Active in weed genomics, classification, and herbicide resistance; uses weedy germplasm panels.
    - Jeremy Johnson: Works in tree genomics and breeding, focusing on forest adaptation to climate change (pine, chestnut).
    - Rebecca Grumet (retired): Recent cucumber papers from the CuCAP project, focusing on fruit morphology, cuticle traits, and powdery mildew resistance.
    - Robert VanBuren: Works on drought/desiccation tolerance in grasses; has sequenced genomes of fonio and resurrection plants; collaborative work on sorghum diversity panel.
    - Emily Josephs: Focus on population genetics and ecology, especially Capsella; recent meta-analysis of 112 plant species' genomes.
    - Sue Rhee: Involved in heat/drought resilience studies on desert-adapted species and sorghum diversity panels.
    - David Lowry: Curates the monkeyflower diversity collection; related resources maintained at the MSU PRI and Kellogg Stations. Small NPGS collection at OPGC, Ohio State.
    - Erich Grotewold: Specialized in metabolism and gene regulatory networks in maize, pennycress, camelina; multiple omics-based studies using germplasm.
- Addie Thompson's Lab Output
    - Works with maize and sorghum (Sorghum Association Panel, Wisconsin Maize Panel).
    - Focus on genomics, phenomics, and nitrogen use efficiency.
    - Prioritizing parents from global genebanks to breed climate resilient crops
    - Collaborative project with Michael Kantar and Gil Buol on Higher Education Plant Breeding Curriculum, initially proposed under USDA/NSF funding.
- Outreach and Educational Use of Germplasm
    - Tree Map Project on MSU campus: 22,000 trees mapped with metadata; planned extension to trial and children's gardens.
    - Germplasm used in undergraduate honors research seminars (e.g., G2F data projects).
    - Maize diversity panels used for hands-on experiments, trait screening, and hybrid trials.
    - Outreach workshops with tribal groups (e.g., Menominee Nation): included seed education, germination testing, and seed jewelry activity using colorful germplasm.
- Redistribution and Documentation Challenges
    - Noted concern about unclear rules on redistribution of germplasm with STAs.
    - Clarification needed on domestic redistribution of NPGS accessions.
    - Example: Addie's lab distributed seed to multiple institutions (Nebraska, Missouri, etc.).
    - Emphasis that impact of redistribution is not well tracked—suggests better mechanisms for attribution and reporting.
- There is extensive use of NPGS germplasm at MSU across species, breeding programs, and educational initiatives. There is a need for improved citation guidance, systematic tracking of germplasm flow and recognition of breeding outcomes stemming from these resources.
- The NPGS was represented at the 2024 World Food Prize, meeting in Des Moines in October, including three posters from NCRPIS curators. Genetic resources was a primary theme of the 2024 Food Prize.

11:21 AM: Yu Ma, The Ohio State University: Germplasm Conservation and Research Highlights at Ohio State University and the Ornamental Plant Germplasm Center

Dr. Yu Ma joined OSU in 2023 and currently serves a dual role: faculty at OSU, supporting crop germplasm research and director of the Ornamental Plant Germplasm Center (OPGC) – part of the USDA National Plant Germplasm System (NPGS). Placing an emphasis on expanding access and documentation of germplasm usage.

- Established in 2001, OPGC is the youngest of the 22 NPGS gene banks.
    - Located on OSU's Columbus campus it is a collaborative venture between USDA-ARS and OSU, supported by the Floriculture Nursery Research Initiative.

- Conserve diverse ornamental plant germplasm, conduct research, and facilitate germplasm use in research, breeding, and product development.
- Current Collection Stats:
  - ~8,600 accessions, covering ~400 genera and ~2,000 species.
  - 6 priority genre: Begonia, Phlox, Coreopsis, Rudbeckia, Lilium, and Viola.
  - Added ~1,200 accessions last year, supported by partnerships like the Bureau of Land Management Seeds of Success (SOS) initiative.
  - 73% of collection backed up at NCGRP in Fort Collins, CO.
- OPGC Distribution and Usage:
  - Currently, ~33% of accessions are available for distribution (goal is to double by year-end).
  - In 2024, OPGC fulfilled 72 orders, distributing nearly 500 seed items.
  - Since inception: 1,600+ orders, 13,000+ items distributed.
  - 86% of orders from U.S. researchers and 14% from International researchers.
  - 60% from public sector, 40% from private sector.
- Operational Challenges – Flat USDA budgets and rising costs have led to:
  - Reduced staff capacity: Now at 3.75 FTEs (previously 4 FTEs).
  - No current student labor; previously many student workers.
  - Labor-intensive regeneration due to caging, tissue culture, and normal collections.
  - Aging infrastructure (greenhouses built in 1991) with frequent maintenance needs, especially for environmental control systems.

- Germplasm-Based Research Highlights at OSU: OSU has 7 breeding programs and 11 active crop characterization projects involving a wide range of crops.
  - Pennycress (Dr. Andrea Gschwend):
    - Focus on winter cover crop potential and biofuel applications due to high oil content.
    - Evaluation of 30+ accessions under low oxygen/waterlogging conditions.
    - Identified 2 accessions with strong waterlogging tolerance.
    - Work funded by U.S. Department of Energy; resulted in 2 recent publications.
  - Jerusalem Artichoke (Dr. Florence Sessoms):
    - Native U.S. crop with high insulin (dietary fiber) content (~70% of tuber dry weight).
    - Evaluation of 5 cultivated varieties and expansion to wild relatives from NPGS.
    - Focus on tuber morphology and inulin yield.
  - Maize Nitrogen Fixation (Dr. Kristin Mercer):
    - Study on nitrogen fixation potential in traditional maize landraces.
    - Screened accessions from NC7 and NSGC collections.
    - Identified landraces with enhanced associative nitrogen fixation, reducing fertilizer needs.
    - Recent publication highlighting this discovery.
  - Maize Transposable Elements (Dr. Shujun Ou):
    - Research on transposable elements (TEs) in maize, which make up ~70% of the genome.
    - Developed PenEDTA, an open-source tool for genome-wide TE annotation.
    - Used across 26 maize reference genomes.
    - TE activity linked to kernel pigmentation and other traits.
  - Rubber Dandelion (Dr. Katrina Cornish, now retired):
    - Investigating hydroponic systems for maximizing root biomass and natural rubber content.
    - Used accessions from NPGS/W6.
    - Research supported by $26M NSF grant in collaboration with Tennessee partners.
- OSU faculty also conduct outreach and student training, including master's-level research using germplasm.
- Yu thanked the NC7 community for the opportunity to present and collaborate.

11:37 AM: Candice Hirch, University of Minnesota, pre-recorded presentation

- Dr. Candice Hirsch is a quantitative genetics and genomics researcher at the University of Minnesota. Newly appointed as the NC7 representative for Minnesota, taking over from Dr. Aaron Lorenz, who recently stepped down. Expressed appreciation for joining the committee and regret for not attending in person due to prior commitments. At the University of Minnesota for ~10 years, leading a lab focused on genomic diversity, stress response, and trait prediction in maize and other crops.
- Key Research Areas at University of Minnesota
  - Pan-genome Variation in Maize:
    - Study of presence/absence variation and copy number variation across the maize genome.
    - Examining how these variations contribute to phenotypic traits and environmental adaptation.
  - Transposable Element (TE) Variation:
    - Development of methods to analyze TE variation using short-read sequencing.
    - Investigation of how TEs affect gene regulation and stress responses.
  - Food-Grade Corn & Trait Improvement:
    - Collaborative work with PepsiCo and seed companies on:
    - Moisture uptake during rehydration.
    - Pericarp retention and kernel quality during cooking.
  - High-Throughput Phenotyping:
    - Use of drones to track canopy growth, plant height, and developmental curves.
    - Assessing trait plasticity and environmental responsiveness.
  - Genomic Prediction Enhancement:
    - Leveraging structural variation and gene expression data to improve prediction accuracy across environments.
    - Includes work on transcriptomic response under stress conditions.
  - Grain Durability and Nitrogen Content:
    - Studying grain durability, a key trait for transport logistics.
    - Simultaneously working to reduce grain nitrogen content in the context of circular agricultural economy goals.
  - Importance of Germplasm Access:
    - All major research projects rely on access to diverse germplasm resources:
    - Mutants for starch, protein, and nitrogen traits.
    - Pan-genome lines, XP panels, and NAM lines.
    - Accessions used to explore G×E interactions, plasticity, and trait inheritance.
- Institutional Germplasm Usage: Over 20 research groups at the University of Minnesota have made germplasm requests in the past five years.
  - Dr. Katie Greenham is using pennycress germplasm to improve cold tolerance in this emerging biofuel crop.
  - Dr. Dean. Malvick is a longtime user of germplasm collections for research on key corn diseases, including recent work on tar spot resistance.
  - Dr. Jim Anderson, works on several crops and regularly requests material from the National Small Grains Collection. He has made pennycress germplasm requests, using accessions as parents in breeding programs in Minnesota and internationally as well as accessions of *Camelina sativa* including a newly available herbicide tolerant accession which will positively contribute to his work.
  - Dr. Devanshi Khokhani has used the national germplasm collections as a critical resource to develop their research into the pathogenicity of critical bacterial pathogens of solanaceous crops on Minnesota-native weedy *Solanum* species. This research is helping Minnesota prepare for potential epidemics that could have major economic impacts on the state. The Khokhani lab is

also working with requested corn (*Zea maize*) varieties to study mycorrhization and interactions of mycorrhizal fungi and soil bacteria. They have used accessions from the NCRPIS to study virulence of an economically important disease of corn known as Goss's wilt.

- Materials from NCRPIS have been integral to Dr. Brandon Miller's Resilient Landscape Horticulture research program as well as the living collections of the Minnesota Landscape Arboretum. The unique and well-documented germplasm sources provide much needed species diversity suited to tolerating severe weather events in the Upper Midwest. One project that used NCRPIS germplasm (*Populus* x*canadensis* 'Imperial' UMLA accession 19810229) is in long-term trial at the arboretum for landscape uses. It is a unique example of how NCRPIS germplasm continues to provide value to research, even long after receiving the initial acquisition.

- Dr. Hirsch expressed appreciation for the opportunity to join the committee. She looks forward to participating in future meetings and continuing to support the broader germplasm community.

11:48 AM: Meeting Planning and Final Discussion

- Sincere thanks was extended to Melanie for organizing the meeting, coordinating excellent tours, and facilitating favorable weather.
- General appreciation for the hybrid meeting model (in-person and Zoom) that enabled broad participation.
- Next meeting location planning
  - After discussion the group decided on an in person 2026 meeting with a virtual option in Ames unless another host institution volunteers.
  - Timing will likely avoid early June, since little field data would be available then.
- Future Meeting Hosts: 2027 Meeting: Yu Ma tentatively volunteered to host in Columbus, OH. Yu expressed interest in maintaining the hybrid format (in-person + virtual).
- David Baltensperger shared that the National Association of Plant Breeders (NAPB) will meet June 14–18, 2026, in College Station, Texas and discussed a joint meeting opportunity.
- Broader Discussion on System Vision and Sustainability
  - David emphasized the importance of maintaining a long-term vision for germplasm system success despite budget limitations and current financial challenges.
  - Encouraged the group not to lose focus amid short-term constraints and to support leadership and staffing efforts setting up for future success.

11:52: Closing Business

- No additional business raised from online or in-person attendees.
- Motion to adjourn made by Burton Johnson, seconded by Addie Thompson. Meeting formally adjourned 11:53 AM.

Addendum: Dr. Mike Stamm report for Kansas submitted after the meeting
Diverse germplasm allows for development of canola, soybean, and wheat varieties adaptable to Great Plains environmental conditions. Plant genetic resources and varieties of new crops such as winter canola are made possible through the conservation of and access to National Plant Germplasm System (NPGS) collections.
Clubroot (*Plasmodiophora brassicae*) is a serious, soil-borne disease of canola; however, it is currently not identified in the Great Plains region. To preemptively safeguard against its appearance, resistance to the disease is being introgressed into elite parent lines of winter canola using the *Brassica napus* accession PI 443015 as the donor parent. The second backcross was made in 2025 and backcrossing will

continue to the BC4 stage. Introgression lines will be tested for clubroot resistance in the greenhouse and field studies by project collaborators investigating the disease's impacts.

Interest exists in developing tillage radish types that overwinter and maintain ground cover longer for added soil protection. Four *Raphanus sativus* accessions (PI174936, PI458914, PI458915, PI666198) were identified as potential genetic diversity as winter tillage radish sources. Intercrossing the accessions produced F1 seeds that were harvested in spring 2025. The F2 generation will be grown in the winter 2026 greenhouse and field evaluation may begin in the fall if seed quantities allow.

High day temperatures during seed-fill and drought conditions are negatively impacting soybean yield and grain quality. This project is evaluating accessions from the USDA Soybean Germplasm Collection for response to abiotic stresses. Evaluations have included over several hundred accessions and over 16 phenotypic traits, including seed yield, protein and oil concentrations, canopy wilting and flower abortion. Our evaluations have enabled us to identify genetic regions and candidate genes responsible for heat stress tolerance, drought tolerance and genotypes with lower flower abortion.

The quantitative genetics program will work with the canola, soybean, and wheat breeding programs to characterize, improve, and leverage NPGS collections in breeding for the southern Great Plains. This will include the design of sampling strategies to survey genetic and environmental diversity, development of methods to characterize the response of unique plant introductions to biotic and abiotic stresses, evaluation and application of new phenotyping technologies, and design and evaluation of pre-breeding and breeding strategies. The quantitative genetics program will develop and deploy methods as open-source software. Development goals will include an integrated software ecosystem for the evaluation and exploitation of genetic and environmental diversity and accessibility for different users through graphical user interfaces and application programming interfaces. We will also leverage advances in machine and deep learning to organize and link knowledge about genotype-environment interactions within and across species into tools such as ontologies, knowledge graphs, and databases to facilitate knowledge transfer and use.