

NCCC215 Potato Breeding and Genetics Technical Committee Meeting

Called to order at 3:30 pm, Dec. 5, 2023

Attendees list at the end of the document.

1. Introductions
2. 2022 minutes approved (M/S: Laura Shannon, Dave Douches)
3. Report by administrative advisor Ray Hammerschmidt
 - a. Need to prepare our midpoint report.
 - b. Need to identify new administrator.
4. Report by NIFA program leader Christian Tobias
 - a. Agency Overview
 - b. Funding Overview
 - c. Accomplishments - Dashboard, modernization, Potato Research Program
 - d. Upcoming RFAs
5. Research presentations
 - a. Wisconsin
 - i. John Oscar Enriquez: Genomic Prediction using Environmental Covariates in Potatoes
 - ii. Michaela Erickson: Cytoplasm Type as a Consideration During Selection
 - iii. Chelang'at Sitonik: High Throughput Phenotyping for Potato Breeding
 - iv. Johan Aparicio: Impact of a Multi-Trait Approach on Improving the Accuracy of Genomic Prediction for Yield
 - v. Kenji Asano: Development of KASP markers for PVY Resistance Gene, *Ryhc*
6. Scheduling 2024 meeting: Dec. 10-11
7. Elections
 - a. Cari Schmitz Carley (Aardevo) nominated & elected for 2024 Secretary.
8. Research presentations
 - a. USDA-ARS-VCRU
 - i. Dennis Halterman: WiDiPo – A Collection of Wild Diploid Potato for Enhancement of Breeding Germplasm
 - ii. Andy Hamernik: Diploid Seed Multiplication Project Update
 - b. New York
 - i. Pia Spychalla: Towards Cloning Ryadg – A Resistance Gene Against Potato Virus Y
 - c. Minnesota
 - i. Sapphire Coronejo: Genetic Diversity of Dihaploid Potatoes from US Cultivars
 - ii. Muyidee Yusuf: Genomic Selection for Quality Related Traits Measured From Image-Based Analysis in Potato
 - iii. Thomas Stefaniak: MN13142: A New Dual-Purpose, Potato Variety with Excellent Yield Profile, and Low External and Internal Defects
 - iv. Heather Tuttle: Potato Soup: Analysis of Cultivated Potato Genebank Populations reveals High Diversity and Little Structure
 - d. Michigan

- i. Madison Whyte: Dihaploid Potato Production at Michigan State University
 - ii. Dave Douches/Jess Norling: Mining the Wild Species *Solanum microdontum* for Improvement of Cultivated Potato
 - iii. CK Pathirana: Screening *Solanum* Species for Abiotic Heat and Water Stress Tolerance
 - iv. Kaela Panicucci: Examining the Self-Compatibility Properties of a Diploid Potato Population
 - e. Aardevo
 - i. Cari Schmitz Carley: Experiences with Seedling Transplants
9. Breeder presentations
- a. Wisconsin – Jeff Endelman
 - b. North Dakota – Susie Thompson
 - c. Minnesota – Laura Shannon
 - d. Michigan – Dave Douches

Accomplishments

Breeding: Scab resistance, late blight resistance, Verticillium wilt resistance, and PVY resistance is being introgressed into advanced breeding lines for the chip processing, frozen processing, and table (red, yellow and white skins) markets. The majority of the MSU advanced breeding lines have scab resistance. Over 50% have PVY resistance. Late blight resistance is found in about 10% of the lines.

Genome sequencing: the doubled monoploid, DM1S1 was sequenced mostly by Nanopore long read sequencing. See publication. We have sequenced a panel of 100 dihaploid potatoes with ~20X Illumina short read coverage and ~3X long read coverage.

Diploid potato breeding: the genetics of self-compatibility is being studied; EBN1 wild species are being accessed using bridge crossing; dihaploids are being extracted by all the breeding programs to establish a diploid cultivated gene pool. Over 100 dihaploids are female fertile and are being crossed to self-compatibility donors. These form the foundation for a diploid breeding program.

Genetic engineering: potatoes have been engineered to be drought tolerant, late blight resistant, or cold sweetening resistance.

Genomic selection: Genomic selection was used for parent selection in 2023 in the UW chip program based on a multi-trait index for total yield, specific gravity, fry color, and maturity. At UMN, genomic selection was used for yield, specific gravity, tuber shape, and tuber color in fresh market and chipping potatoes.

Multi-institution grants have been obtained (see below).

Impacts

MSZ242-13 was released as Dundee. It is a scab resistant, high solids chip processor.

MN04844 was released as Polaris Gold. It is a late season fresh market yellow potato with low internal defects.

The commercial acreage for Mackinaw, a PVY, scab and late blight resistant chipper, is expanding in the US. Petoskey, Huron Chipper and Blackberry seed acreage is increasing.

Certified seed potato production for Dakota Russet, a dual-purpose russet with frozen processing potential (approved for McDonald's French fry production in 2022) with resistance to the sugar end disorder, cold sweetening, pink rot and southern rot, and moderate resistance to Verticillium wilt and Pythium leak, moved into the top 10 cultivars grown in North America. Certified seed production and grower/industry evaluation of several advancing selections including ND7799c-1 (130+ acres), ND113207-1R (15+ acres), ND1241-1Y (50+ acres), and ND13220C-3 continued to expand.

A PVP certificate was issued for 'Plover Russet' (No. 20200152), and a new application was filed for Lakeview Russet. Portage Russet was released as a processing variety. PVP application (PV2000389) was submitted for Dakota Dawn.

Outreach

National Outreach Activities: Shannon shared "Potato 2.0- Update on Breeding, Agronomics, and Industry Impacts" at the Potato Expo in Denver CO. Endelman, Shannon, and Thompson participate in the National Fry Processing Trial and associated meetings. All four PIs participate in the National Chip Processing Trial and associated meetings. Douches and Shannon have served on panels about sustainability for the steering committees for both trials in 2023.

Michigan Outreach activities for Dave Douches: Montcalm Research Center Field Day, August 2023; Variety Trial Field Day, Montcalm County, August 2023; Potato Variety Day, MI, February 2023. Diploid potato breeding was the one of the topics of the Michigan Winter Potato Conference in February 2023.

Minnesota/North Dakota Outreach activities for Laura Shannon & Asunta Thompson: Minnesota Fruit and Vegetable Growers Conference, St. Paul, MN January 2023 (Shannon); Northland Potato Growers Association Research Reporting Conference, Grand Forks ND February 2023; Minnesota Area II Short Course, St. Cloud, MN March 2023; Sand Plains Research Farm Area II Potato Field Day, Becker, MN, July 2023; Oakes Research Extension Center Field Day (Thompson) August 2023; Northland Potato Growers Association Field Day, Larimore, Inkster, & Hoople ND (August 2023); North Dakota Nutrition Council, Dickinson, ND, August 2023 (Thompson).

Wisconsin Outreach Activities: Endelman presented at the Wisconsin Fresh Fruit & Vegetable Conference (Jan. 31, 2023), the WPVGA Grower Education Conference (Feb. 9, 2023), and field days at the UW-Madison Hancock Research Station and Elite Foundation Seed Farm (July 2023).

Publications

Lee, S., Enciso-Rodriguez, F.E., Behling, W., Jayakody, T., Panicucci, K., Zarka, D., Nadakuduti, S.S., Buell, C.R., Manrique-Carpintero, N.C. and Douches, D.S., 2023. HT-B and

S-RNase CRISPR-Cas9 double knockouts show enhanced self-fertility in diploid *Solanum tuberosum*. *Frontiers in Plant Science*, 14, p.1151347.

Jayakody, T. B., Hamilton, J. P., Jensen, J., Sikora, S., Wood, J. C., Douches, D. S., & Buell, C. R. (2023). Genome Report: Genome sequence of 1S1, a transformable and highly regenerable diploid potato for use as a model for gene editing and genetic engineering. *G3: Genes, Genomes, Genetics*, 13(4), jkad036.

Behling, W. L., & Douches, D. S. (2023). The Effect of Self-Compatibility Factors on Interspecific Compatibility in *Solanum* Section *Petota*. *Plants*, 12(8), 1709.

Agha HI, Endelman JB, Chittwood-Brown J, Clough M, Coombs J, De Jong WS, Douches DS, Higgins C, Holm D, Novy R, Resende MFR, Sathuvalli V, Thompson AL, Yencho GC, Zotarelli L, Shannon LM. (In Review). Genotype-by-Environment interactions and local adaptation shape selection in the United States National Chip Processing Trial. *Theoretical and Applied Genetics*.

Feldman MJ, Park J, Miller N, Wakholi C, Greene K, Abbasi A, Rippner D, Navarre D, Schmitz Carley CA, Shannon LM, Novy R. (In Press). A scalable, low-cost phenotyping strategy to assess tuber size, shape, and the colorimetric features of tuber skin and flesh in potato breeding populations. *The Plant Phenome Journal*.

Agha HI, Shannon LM, Morell, P. (2023). Unloading potatoes: Potato breeding moves forward with only half the genome. *Cell Genomics*. 3 (6)

Miller MD, Schmitz Carley CA, Figueroa RA, Feldman MJ, Haagenson D, Shannon LM (2023). TubAR: an R package for quantifying tuber shape and skin traits from images. *American Journal of Potato Research*. 100(1): 52-62

Stefaniak TR, Miller J, Jones CR, Miller M, Yusuf M, Harder MA, Larsen J, Schmitz Carely CA, Haagenson D, Thompson A, Michaels TE, Thill C, Shannon LM. (2023). Polaris Gold: An Attractive, Yellow-fleshed Tablestock Cultivar with Chipping Potential. *American Journal of Potato Research*. 100(1):71-78

Agha HI, Schroeder L, Eikholt D, Schmitz Carely CA, Cavender-Bares J, Shannon LM (2023). Assessing the Effectiveness of Reflectance Spectroscopy Analysis to Determine Ploidy in Potato. *American Journal of Potato Research*. 100: 135-141

Endelman JB (2023) Fully efficient, two-stage analysis of multi-environment trials with directional dominance and multi-trait genomic selection. *Theoretical & Applied Genetics* 136:65. doi:10.1007/s00122-023-04298-x

Song L, Endelman JB (2023) Using haplotype and QTL analysis to fix favorable alleles in diploid potato breeding. *Plant Genome* e20339. doi:10.1002/tpg2.20339

Sorensen PL, Christensen G, Karki HS, Endelman JB (2023) A KASP Marker for the Potato Late Blight Resistance Gene *RB/Rpi-blb1*. *American Journal of Potato Research* 100:240–246. doi:10.1007/s12230-023-09914-6

Popular Articles

Thompson, A. 2023. Larimore Processing Trial - 2022 Summary. *Valley Potato Grower* 88(301):16-22.

Thompson, S. 2023. Crystal Fresh Market Trial – 2022 Summary. *Valley Potato Grower* 88(302):16-21.

Proceedings and Reports

Thompson, S. 2023. Potato breeding and cultivar development for the Northern Plains Region – 2022 Summary. Minnesota Area II Potato Research and Promotion Council and Northland Potato Growers Association 2022 Research Reports. On-line.

Current collaborative grants awarded

NAME (List/PD #1 first)	SUPPORTING AGENCY AND AGENCY ACTIVE AWARD/PENDING PROPOSAL NUMBER	TOTAL \$ AMOUNT	EFFECTIVE AND EXPIRATION DATES	TITLE OF PROJECT
Douches, Endelman, Thompson, Shannon	USDA/NIFA	\$2,280,000	09/01/23 - 08/31/25	Potato Breeding and Variety Development in the North Central US: Enhancing Yield, Quality and Resilience with New Technologies, 2023-25
Endelman, Bethke, Buell, Douches, Shannon	USDA SCRI	\$3M	9/1/19 – 8/31/23	Creating a new paradigm for potato breeding and seed production based on true potato seed
Byrne, Endelman, Riera- Lizarazu, Zhang, ... Shannon...	USDA SCRI	\$3M	9/1/20- 8/31/24	Tools for Polyploids: Development of a Community Resource Mining the soil and host genetics

Pasche, Thompson, Shannon	North Dakota Department of Ag	\$176,720	10/1/21- 9/30/24	for sustainable answers to Verticillium wilt in potato
Thompson, Pasche, Shannon	North Dakota Department of Ag	\$186,338	10/1/21- 9/30/23	New technology to fight an old foe: characterizing resistance to potato powdery scab
Anderson, Pasche, Thompson, Shannon	North Dakota Department of Ag	\$298,581	Pending	Exploring the Impact of Potato Genetic Variability on Rhizosphere Microbiome Dynamics
Shannon, Ranjan, Pasche, Thompson	USDA SCBG	\$1 M	Pending	Towards sustainable management of <i>Verticillium</i> wilt of potato: a comprehensive study on genetics of host resistance and pathogenicity of <i>Verticillium</i> races

Attendees:

Zoom attendees:

Hemant Kardile

David DeKoeyer

Mercedes Ames

Margaret Halsted

Dave Holm

Christian Tobias

Helen Tai

Sagar Sathuvalli

In person attendees

Name	Organization
Alfonso Del Rio	USDA-ARS Genebank
Amina Abed	Potato Consortium Quebec
Andy Hammernik	USDA-ARS Madison
Becky Eddy	UW-Madison

Benoit Bizimmungu	AAFC-Frederickton
Cari Schmitz Carley	Aardevo
Carloline Gray	CSU
Charlie Higgins	Potatoes USA
Chelangat Sitonik	UW-Madison
Chelanyat Sitonik	UW-Madison
Craig Yencho	NCSU
Dave Douches	MSU
David DeKoeyer	AAFC
David Holm	CSU, retired
Dennis Halterman	USDA-ARS Madison
Douglas Scheuring	TAMU
Dylan Larkin	Aardevo
Erica Favae	AAFC
Ericka Knoeck	Pepsico
Erin Harmelink	Pepsico
Grace Christensen	UW-Madison
Greg Kornelis	USDA-ARS Prosser
Greg Steere	MSU
Han Tan	U Maine
Heather Tuttle	UMN
Helen Tai	AAFC
Husain Agha	UMN
Isabel Vales	TAMU
Jaebum Park	USDA-ARS Aberdeen
James Busse	USDA-ARS Madison
Jeewan Pandey	TAMU
Jeff Endelman	UW-Madison
Jeff Koym	TAMU
Jesse Huege	UMN
Jessica Chitwood-Brown	CSU
Jessica Norling	MSU
João Bitor Normura	UMN
Joe Coombs	MSU
Johan Steven Apancio	UW-Madison
John Bamberg	USDA/US Potato Genebank

John Enriquez	UW-Madison
Joshua Parsons	Pepsico
Julie Pasche	NDSU
Kaela Panicucci	MSU
Kate Shaw	MSU
Katelynn Kaiser	Aardevo
Kenji Asano	UW-Madison
Laura Shannon	UMN
Lauren Sexton	UW-Madison
Lin Song	UW-Madison
Madison Whyte	MSU
Maria Caraza-Harter	UW-Madison
Mark Clough	NCSU
Matt Falise	Cornell
Matt Zuehlke	MSU
Max Feldman	USDA-ARS Prosser
Meng-Yang Lin	Pepsico
Micah Long	MSU
Michael Miller	UMN
Michaela Erickson	UW-Madison
Morgan	AAFC
Muyideen Yusuf	UMN
Pat Quimet	Pepsico
Paul Collins	USDA-ARS Maine
Peyton Sorenson	UW-Madison
Pia Spychalla	Cornell
Raul Guerra	Pepsico
Ray Hammerschmidt	MSU
Rich Novy	USDA-ARS Aberdeen
Sapphire Coronejo	UMN
Stephany Toinga	TAMU
Susie Thompson	NDSU
Thilani Jayakody	MSU
Thomas Stefanik	UMN
Timileyin Sunmonu	UMN
Walter DeJong	Cornell
William Behling	MSU
Xiaoxi Meng	UMN

