Sorghum and Millet Germplasm Committee

Sheraton Hotel, Oklahoma City, Oklahoma

April 2, 2024

Minutes

The Sorghum and Millet CGC meeting convened at 5:00 p.m. at the Sheraton Hotel in Oklahoma City, Oklahoma during the SICNA conference hosted by Chairman Hugo E. Cuevas. A total of 36 members were present and Gary Kinard, Gayle Volk, David Brenner and Joe Knoll were connected via telephone (Appendix 1). After the introductions, the meeting convened with an introduction by Hugo Cuevas that included a summary from the last meeting and the agenda for this meeting.

First, a presentation by Gayle Volk (National Program Leader at Fort Collins, Colorado) provided an overview of the importance and work of the National Program Germplasm Systems (NPGS). She highlighted that the creation of a committee to evaluate NPGS germplasm request has been very effective identifying unauthorized requests. Consequently, the number of germplasms requests over the last few years have been reduced while improving its conservation and adequate use. The importance of submitting success stories associated with the NPGS germplasm collection is necessary to ensure funds for the germplasm collection. These types of stories highlight the importance and impact of NPGS germplasm collections in our agriculture and economy.

Melanie Harrison, the sorghum curator at USDA-ARS Griffin, GA, provided an update of the status of the NPGS sorghum germplasm collection (Appendix 2). Currently, 96% and 92% of the sorghum and millet accessions, respectively, are available for distribution. Germination tests have been completed for 97% of accessions within the past 20 years. The sorghum association panel (SAP) is still a high germplasm request,but the inventory is still adequate for distribution. The regeneration process of sorghum and millet continue in collaboration with USDA-ARS Tropical Agriculture Research Station in Puerto Rico. The federal budget restriction and increasing labor costs might be affecting the cleaning, processing and distribution of sorghum germplasm in the near future. Stephanie Green provides an update of the sorghum and millet germplasm in pre-quarantine (Appendix 3). This report was presented by the chairman, Hugo Cuevas. The inventory of pre-quarantine germplasm has been reduced by half since the previous CGC meeting in 2022, but the materials that completed the pre-quarantine process were finger and pearl millet. A genetic stock of 142 accessions from K.F. Schertz (1968) is being rescued by Dr. Gloria Burrow, USDA-ARS at Lubbock, Texas.

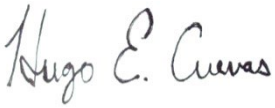
David Brenner, the germplasm curator of millet at Iowa State University, provided a presentation of his work with millet. Since most of the community work is with sorghum, this presentation gave an excellent overview of the diversity and germplasm resources available in millet. Later, Gary Kinard from the National Germplasm Resources Laboratory at Beltsville, Maryland, presented a summary report of its research unit that is comprised by the Plant Exchange Office (PEO), the Database Management Unit (DBMU), and the Plant Disease Research Unit (PDRU).

He commented that currently sorghum accessions are the most requested germplasm from NPGS and encouraged the sorghum and millet community to keep their participation in the CGC meeting. The GRIN database has improved in the last few years and emphasized that is very important that scientist using NPGS germplasm provide the phenotypic or genotypic information after publications.

The last Sorghum and Millet vulnerability statement dates to 2020. Therefore, the chairman suggested that we begin to prepare a new vulnerability statement with the input from private and public breeding programs. In this regard, the chairman will be sending emails to CGC members for suggestions and recommendations, likewise, members could send their comments to the chairman.

The establishment of a sorghum community genotyping service together with an agreement with a private service provider was suggested in the previous CGC meeting. Firstly, Dr. Hugo E. Cuevas showed that most of the 3,011 accessions that constitute the sorghum core collection have been genetically characterized using genotype-by-sequencing (GBS). Currently, this GBS analysis is being used to establish a mini-core collection of ~500 accessions that could be used for extensive phenotyping analysis (Appendix 4). Vivek Kumar, from USDA-ARS, Cold Spring Harbor Laboratory (Sorghumbase) provided an update of the KASP marker platform that is being developed for the sorghum community with the private company Agriplex. A total of 3,496 KASP markers were developed, of which 2,392 were validated for an average of 239 KASP markers per chromosome (Appendix 5). However, the distribution of the markers showed that multiple genomic regions need to be covered with new KASP markers. Currently, these markers are being evaluated and validated using 259 sorghum landraces strategically selected based on its geographical collection site.

Respectfully submitted,



Hugo E. Cuevas

CGC Sorghum and Millet Chairman

Appendix 1. Attendance list Sorghum and Millet Germplasm Committee meeting

Name	Affiliation	Name	Affiliation
Andrew Olson	USDA-ARS; Cold harbor Spring, NY	Laura Mayor	Corteva Agriscience
Breat Bean	USCP	Logan Hopper	Scott Seeds
Carolina Ballen	Clemson University	Marcela Tello	USDA-ARS; Cold harbor Spring, NY
Chuck Cielencki	Scott Seeds	Matthew McClallen	Corteva Agriscience
*David Brenner	Iowa State University	Md Abdullah Al Bari	K-State
Deanna Funnell-Harris	USDA-ARS; Lincol, NA	Melanie Harrison	USDA-ARS; Griffing, GA
Dinesh Kr. Saini	Texas Tech University	Nadia Shakoor	Danforth Plant Science Center
Diriba Chere	K-State	Naqeebullai Kakar	K-State
Dorren Ware	USDA-ARS; Cold harbor Spring, NY	Neway Mengistu	Corteva Agriscience
Gabriel Krishnamoorthy	Richardson Seeds	Nick Glodmore	USDA-ARS; Cold harbor Spring, NY
*Gary Kinard	USDA-ARS; Beltsville, Maryland	Raghu Srpath	Warners Seeds
*Gayle Volk	USDA-ARS; Fort Collins, CO	Sandeep Marla	K-State
Giovanni Melandri	University of Arizona	Scott Sattler	USDA-ARS; Lincol, NA
Gloria Burrow	USDA-ARS; Lubbock, TX	Tyler Reese	Corteva Agriscience
Hugo Cuevas	USDA-ARS; Mayaguez, PR	Vivek Kumar	USDA-ARS; Cold harbor Spring, NY
Jake Sanchez	USDA-ARS; Lubbock, TX	Yinping Jiao	Texas Tech University
*Joe Knoll	USDA-ARS; Tifton, GA	Yves Emendack	USDA-ARS; Lubbock, TX
Karen Harris-Shultz	USDA-ARS; Tifton, GA	Zhanguo Xin	USDA-ARS; Lubbock, TX

* virtual participation

Appendix 2

REPORT TO THE SORGHUM and MILLET CROP GERMPLASM COMMITTEE
April 2024
Melanie L. Harrison, Sorghum & S9 Millet Curator

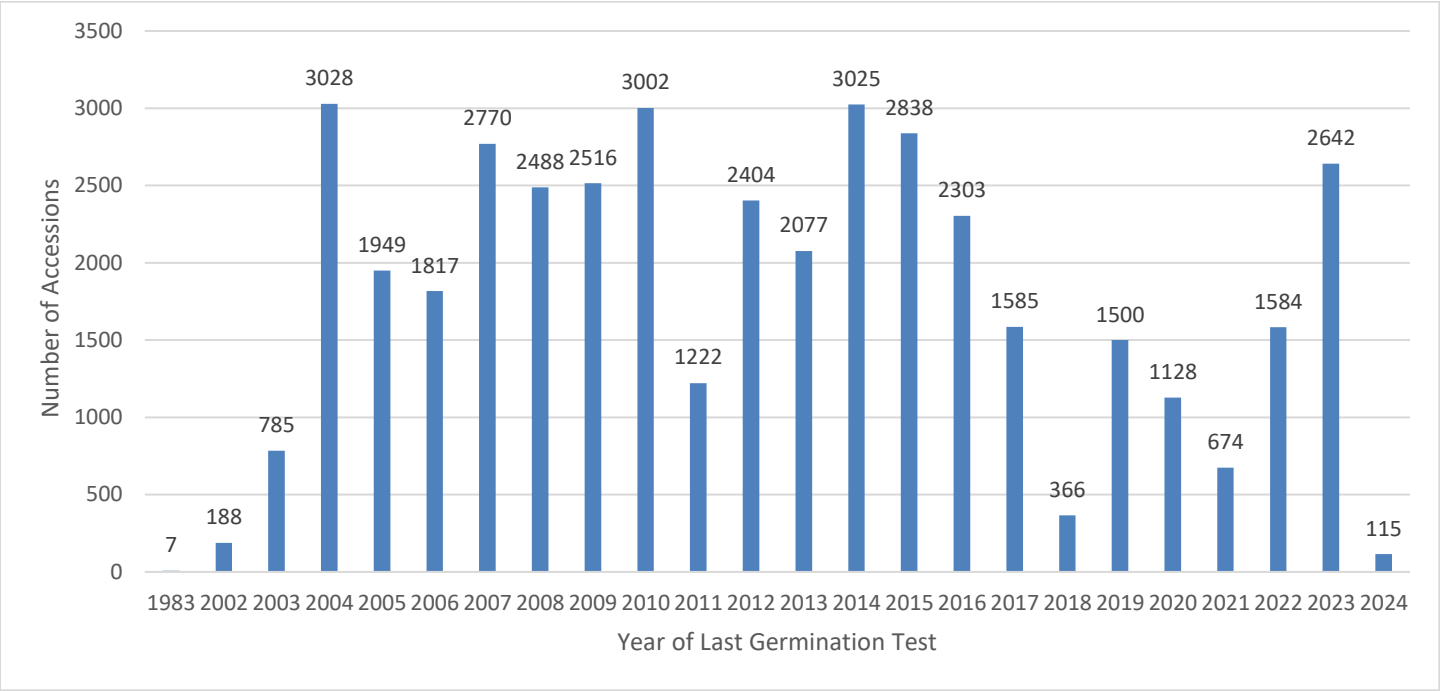
STATUS OF THE COLLECTION

There are 17 taxa included in the S9 millet collection with 2,439 total accessions (Table 1). These include pearl millet, finger millet, and kodo millet. The sorghum collection continues to be the largest crop collection maintained at the Griffin, GA location with 48,213 accessions. Currently, 96% of the sorghum accessions and 92% of the S9 millet accessions are available for distribution. Ninety-three percent of the sorghum germplasm and 98% of the S9 millet germplasm is backed up at the National Laboratory for Genetic Resources Preservation (NLGRP) in Fort Collins, CO. For *Sorghum bicolor* accessions that have a least one germination test, 42% of those have had a germination test conducted in the past ten years and 97% within the past 20 years (Figure 1).

Table 1. Status of the USDA Sorghum and S9 Millet Germplasm Collection as of March 19, 2024.

	Sorghum	Sorghum wild species	S9 Millets
Total Number of Taxa	4	20	17
Total Number of Accessions	48213	313	2505
Number of Available Accessions	46463	253	2314
Number of Unavailable Accessions	1750	60	191
Number of Accessions Backed Up	45035	310	2445
Svalbard Back Up	9724	47	1000
Number of Accessions at -18C	44742	312	2505
Number of Viability Tests	44167	286	2439

Figure 1. Status of germination testing on sorghum accessions. Sorghum genetic stocks and wild sorghum accessions are not included.



DISTRIBUTIONS

For the 2023 calendar year, 16,399 accessions of sorghum germplasm, including genetic stocks, were distributed. A total of 4007 accessions of S9 millets were distributed (Table 2). Most accessions were domestic distributions with 74% for sorghum, 81% for S9 millets, and 57% for sorghum genetic stocks.

Table 2. Distributions of sorghum and S9 millet germplasm during the 2023 calendar year.

Cooperator Affiliation	Number of Accessions Sorghum	Number of Accessions S9 Millets	Number of Accessions Sorghum Genetic Stocks
Foreign commercial company	592	0	24
Foreign genebank	0	0	0
Foreign individual no affiliation	0	0	0
Foreign non-commercial organization	2299	769	2177
U.S. state agencies and all universities	4737	2928	2038
Agricultural Research Service	583	2	214
U.S. commercial company	1040	15	271
U.S. individual no affiliation	304	1	20
U.S. non-profit organizations	1696	292	403
U.S. federal agency (not AID or ARS)	1	0	0
Total Distributions	**11252**	**4007**	**5147**

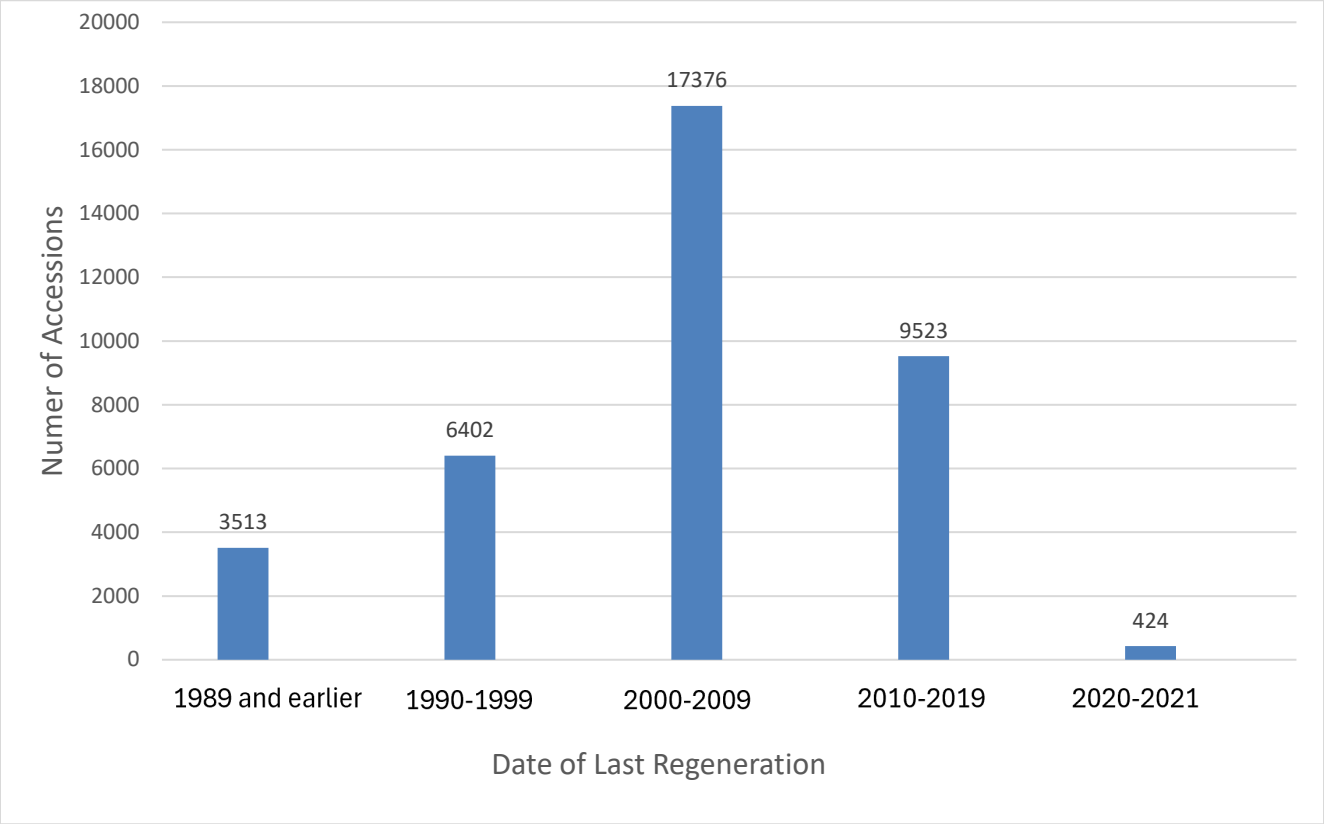
ACQUISITIONS

PGRCU seed storage personnel completed the processing of ~5,000 accessions of sorghum that had originally been preserved at Fort Collins, CO only without a distribution sample in the active collection in Griffin, GA. This material is now available for distribution. Dr. Zhanguo Xin, USDA-ARS Plant Stress & Germplasm Development Unit, Cropping Systems Research Laboratory in Lubbock, Texas donated 252 accessions of the ARS EMS population to the collection. The populations are defined by the descriptor "subset of a population" and can therefore be found using the descriptor search feature on GRIN-Global (https://npgsweb.ars-grin.gov/gringlobal/descriptors). Accessions of these populations are maintained at 4°C only and do not have an additional sample at -18°C. Seed will be distributed until the sample is exhausted and not regenerated.

REGENERATION AND MAINTENANCE

Regenerations of sorghum and pearl millet continue to be performed in Puerto Rico in collaboration with the USDA, ARS, Tropical Agriculture Research Station. Regenerated seeds are sent back to Griffin, GA for processing into the collection. Each regeneration sample has a germination test prior to storage. All newly regenerated accessions are split into two inventories - a 500 seed sample for long term -18°C storage and the remaining seed at 4°C for distributions. If the current backup inventory at Fort Collins, CO has low germination or seed quantity, a new backup inventory is sent from the newly regenerated seed. A greenhouse regeneration for wild sorghum accessions was conducted last year in Griffin, GA. Goals of this regeneration are to increase seed supply, verify taxa, and collect and upload basic descriptor data and images on GRIN-Global. Using last harvest date as a measure to determine year of last regeneration, 90% or 33,725 accessions with a harvest date in GRIN have been regenerated within the last 35 years and 27% or 9,947 accessions in the past 14 years (Figure 2). This does not include recent regenerations performed in 2022 and 2023.

Figure 2. For *Sorghum bicolor* accessions that have a harvest date listed in GRIN (37,238), the number of accessions harvested within a particular time frame are shown.



PERSONNEL

Our seed germination technician, Phiffie Vankus, retired in December 2023. It is through her efforts that there is such a large portion of the sorghum collection that has been germination tested. Due to budget limitations, the vacant germination technician position is not expected to be filled but will most likely be abolished. Seasonal labor used to clean and process newly regenerated sorghum accessions into the collection was eliminated in FY24 and FY25 due to budget limitations. The federal supply budget is severely restricted and may affect future seed cleaning, processing, and distribution activities at the location.

ACKOWLEDGEMENTS

Thanks to Nick Stigura (USDA-ARS, IT Specialist) for providing the data for this report and to Tiffany Fields (USDA-ARS, Seed Storage Manager) for oversight of the sorghum seed cleaning, processing, and distribution activities at the Griffin, GA location. Thanks also to the PGRCU seed storage team (Jill Cunningham, Sylvia Jones, Cassa Munroe, and Phiffie Vankus) for their assistance in sorghum distributions, germinations, and -seed processing.

Appendix 3

Sorghum and Millet CGC

National Laboratory for Genetic Resource Preservation (NLGRP) Report 2024

Stephanie L. Greene, New Solutions Contractor (stephanie.greene@usda.gov)

NLGRP plays a unique role in the NPGS. The laboratory houses the world's largest collection of plant genetic resources (PGR), which are stored in freezers or cryotanks. Seeds, shoot tips, dormant buds, and pollen, come from NPGS sites to back-up USDA's PGR collections in a centralized facility dedicated to keeping germplasm alive for decades, even centuries. In 2022, Dr. Greene retired as seed curator at NLGRP, but is continuing as a contractor until August 2024. We are currently interviewing for a new seed curator.

Sorghum and millet activities at NLGRP

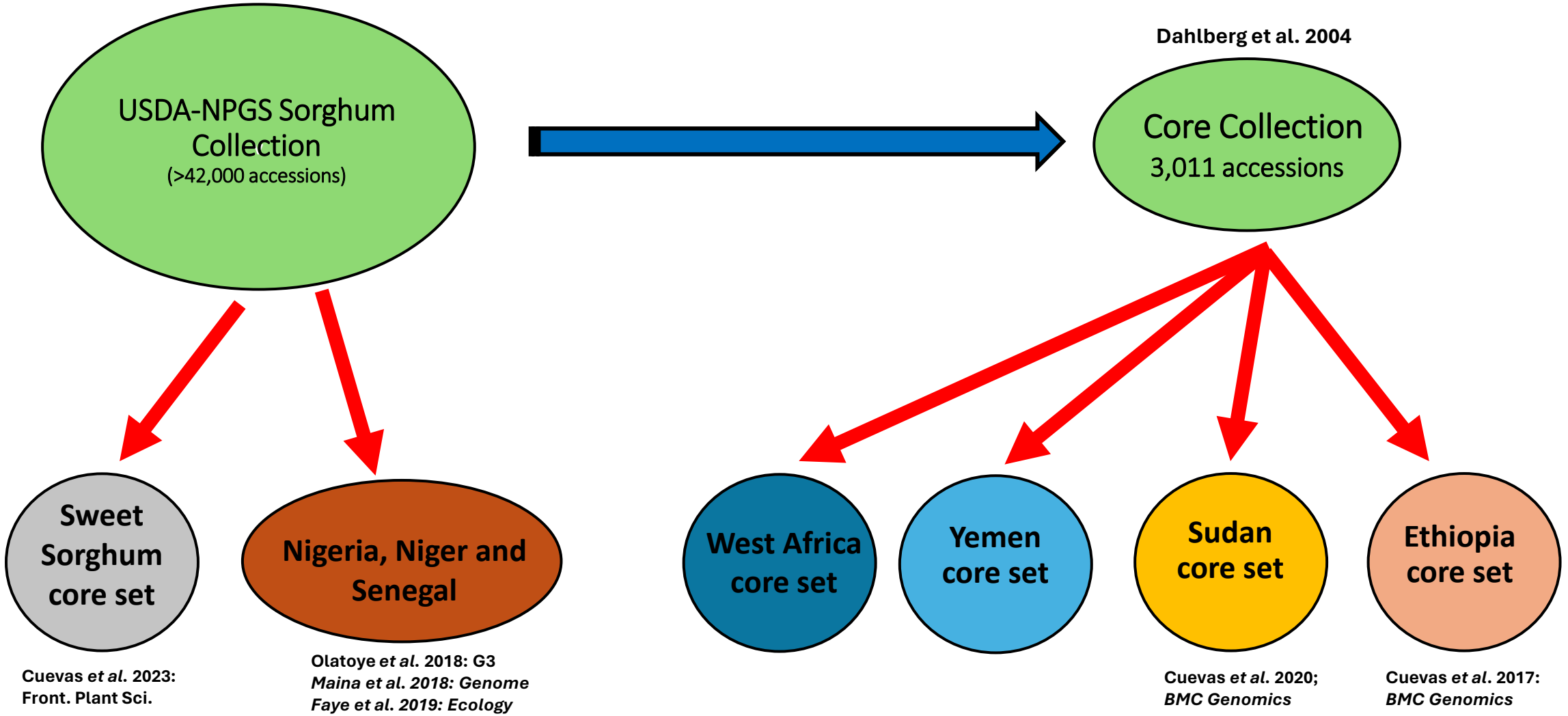
- In 2023, NLGRP sent 259 Kenyan accessions of *Eleucine coracana* to St. Croix, for grow out. Once released from quarantine, this material will be sent to the NPGS site in Griffin, GA where it will be available for distribution. Table 1 summarizes the remining sorghum and millet accessions that require grow out.
- Ninety-two percent of the NPGS sorghum and millet collection is duplicated at NLGRP. Material is stored at -18° C.
- The K.F. Schertz genetic stocks collection (142 accessions) was received by NLGRP in 1968. In 2023, we shipped the collection to Dr. Gloria Burow, USDA, ARS PSGDU, Cropping Systems Research Lab, Lubbock, TX, where it will be rescued and submitted to the NPGS active collection.

Table 1. Millet and sorghum accessions in pre-quarantine storage at NLGRP

Taxon	N	Country
Cenchrus americanus	25	Algeria (1), India (3), Malawi (14), Oman (3), Senegal (1), Sudan (1), Zimbabwe (2)
Cenchrus flaccidus	2	China (2)
Cenchrus geniculatus	1	Zimbabwe (1)
Cenchrus lanatus	1	Pakistan (1)
Cenchrus orientalis	1	Turkmenistan (1)
Cenchrus polystachios	7	Burundi (6), DR Congo (1)
Cenchrus purpureus	8	Burundi (1), Oman (1), Zimbabwe (6)
Cenchrus sieberianus	19	Mali (10), Niger (9)
Cenchrus sphacelatus	1	Lesotho (1)
Cenchrus spp.	24	Botswana (1), Burundi (1), Sudan (22)
Cenchrus trachyphyllus	1	DR Congo (1)
Cenchrus violaceus	14	Mali (2), Niger (12)
Eleusine coracana	20	DR Congo (7), Kenya (2), Nepal (4), Nigeria (1), Saudi Arabia (1), Taiwan (1), Yemen (4)
Panicum miliaceum	6	Kazakhstan (1), Kenya (1), Nepal (3), Russia (1)
Sorghum bicolor	24	China (1), Liberia (1), Malawi (2), Nigeria (1), Somalia (6), South Africa (1), Sudan (2), Tanzania (1), Zambia (5), Zimbabwe (4)
Sorghum hybr.	1	Niger (1)
Sorghum plumosum	12	Australia (12)
Sorghum purpureosericeum	2	Chad (2)
Sorghum spp.	3	Burundi (2), Tajikistan (1)
Sorghum stipoideum	15	Australia (15)
Sorghum timorense	15	Australia (15)
Sorghum versicolor	1	Zimbabwe (1)
TOTAL	203	

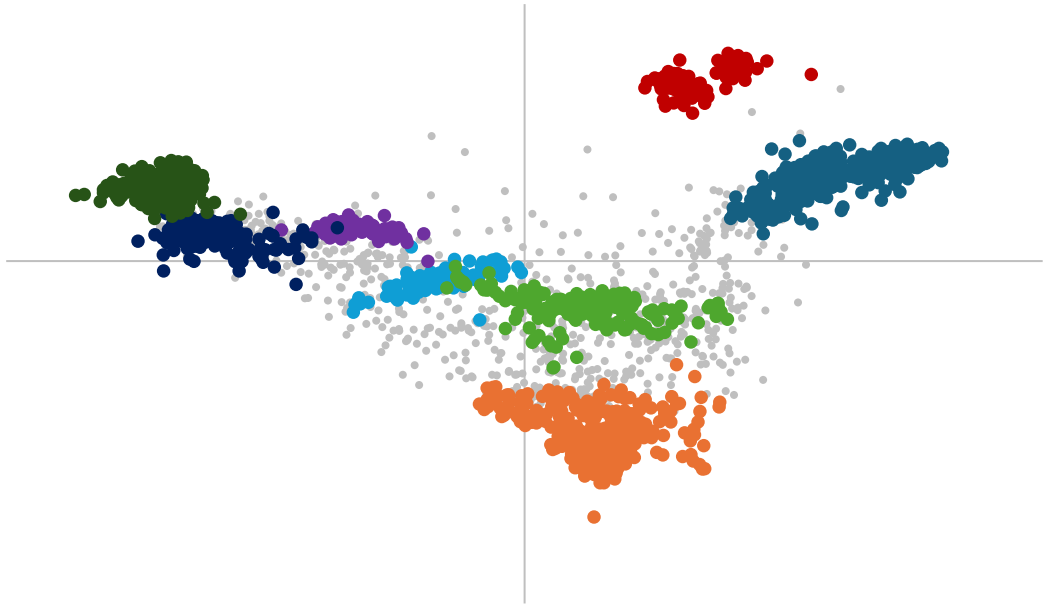
Appendix 4

Genomic resources available in NPGS sorghum germplasm



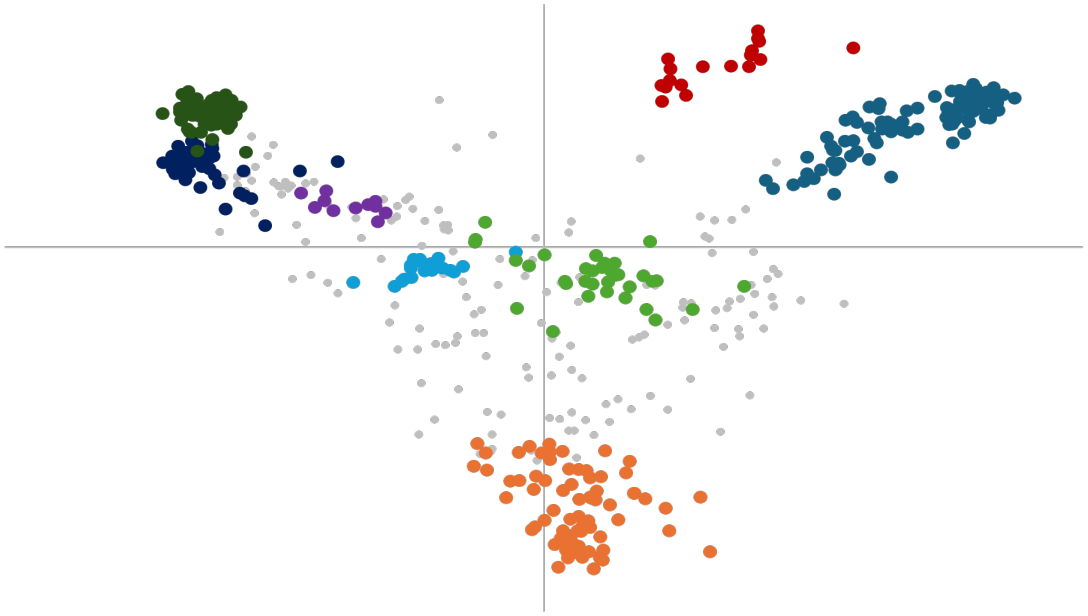
Genomic resources available in NPGS sorghum germplasm

2,600 accessions



Core Collection

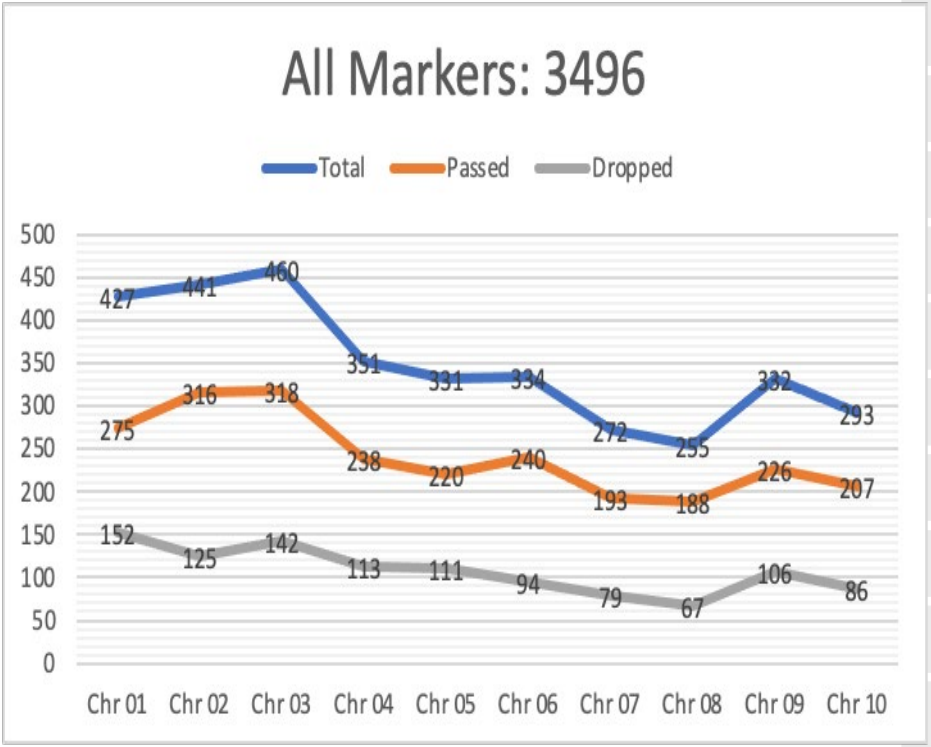
515 accessions (20%)

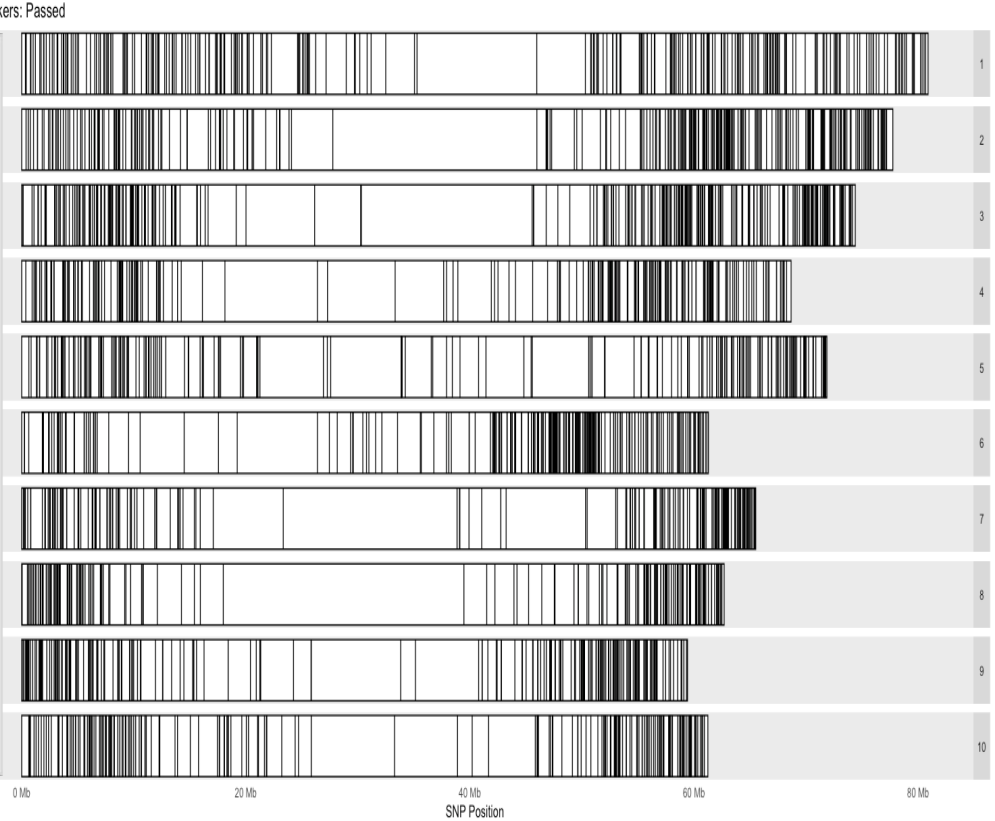


Mini-Core Collection

Appendix 5

Sorghum CMP: Total, Passed, Dropped





Cold Spring Harbor Laboratory

USDA Agricultural Research Service

CMP Validation using Select Landraces: Geo Map

SORGHUM BASE

https://sorghumbase.org/

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