2023 USDA SOYBEAN GERMPLASM COLLECTION ANNUAL REPORT

Soybean Breeder's Workshop - February 2024

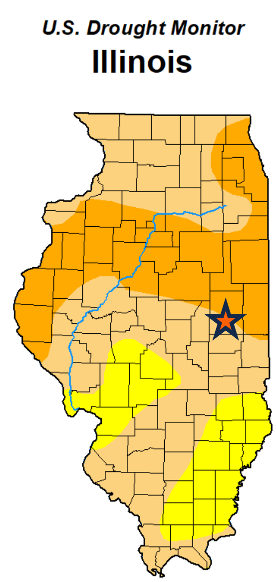
The USDA National Soybean Germplasm Collection's mission is to be the most diverse and well-documented soybean germplasm collection in the world. We are the largest collection which freely distributes seed packets to individuals and organizations around the world as part of its responsibility to conserve and make available a wide range of soybean genetic resources for research, breeding, and educational purposes.

Summary

- Hard rain immediately after planting followed by extended drought conditions led to crust problems with poor emergence and low vigor for many accessions
  - Charcoal rot on several plots from extended dry period
- Vacancy at Agricultural Scientist Research Technician since July, 2023
- Vacancy at Research Geneticist (David Walker retired)
- Purchased, installed, and trained on an NIR for seed composition analysis
- Management strategy for increasing and distributing GE accessions is ongoing
- Tentative -18C cold room upgrade would greatly increase the efficiency of the collection

Below is a summary table for the USDA Soybean Germplasm Collection:

Distribution		**Maintenance**	
Packets	16,687	Seed increases	2,193
Accessions	9,536	New accessions	46
Individuals	232	Germinations	2,232
Countries	17	Photos	1,000+
NSSL	693	Seed stored	1,500+



Distribution

In 2023, the Collection staff distributed 16,687 seed packets encompassing 9,536 accessions from the Collection in response to 380 requests from 232 individuals in the United States and 17 countries. This high demand indicates the value of this collection and the ability of the staff to fulfill orders. The Soybean Collection ranked 5th in 2023 for the total number of seed packets distributed across the entire National Germplasm System; behind only the Small Grains Collection and Plant Introduction Stations which each manage multiple distinct crop species.

The Collection includes many different types of soybean germplasm, such as landraces, wild relatives, and modern cultivars, and it is updated with new materials when the opportunity presents itself. Crop wild relatives are an important part of the Collection, as they can serve as a source of genetic diversity and novel traits that can be used to improve soybean breeding and genetics research. Most requests (16,483) come from *Glycine max* (soybean) and/or *G. soja* (wild soybean) every year. However, 9 requests for 204 seed packets of 166 *Glycine spp.* (perennial *Glycine*) accessions were also distributed in 2023. Backup seed samples for 693 accessions were sent to Ft. Collins NLGRP early in 2024.

Staff – Urbana, IL

Lezlie Furr joined the Research Unit in December and will support the Collection as the Program Support Assistant, just as Nancy Sanders had done prior to her retirement in April 2023. Jessica Fowler departed from the Collection staff in July this year, leaving a vacant Agricultural Scientist Research Technician. Interviews for this vacancy should occur in March of 2024. For David Walker's Geneticist vacancy, interviews have been conducted and the selection and offer process is ongoing.

Adam Mahan, Geneticist	100%
Benjamin Bartlett, Agronomist	100%
Vacant, Agricultural Science Research Technician	100%
Todd Bedford, Germplasm Support Assistant	100%
Eric Moody, Agricultural Science Research Technician	100%
Vacant, Research Geneticist	100%
Gad Yousef, Biological Science Technician	100%
Lezlie Furr, Program Support Assistant OA	33%

Staff – Stoneville, MS

Rusty Smith, Research Geneticist	30%
Philip Handly, Agronomist	70%
Robert (Matt) Kersh, Biological Science Technician	90%
Hans Hinrichsen, Biological Science Lab Technician	20%

Seed increases

The germplasm seed increases at the Urbana location faced difficult conditions when they were planted in early May. A significant rain event shortly after planting saturated the soybean seeds in the ground, causing crust formation before seedling emergence. To address this issue, staff and student workers manually broke up the crust using modified hoes along the two harvest rows for the entire germplasm collection, covering an extensive 5-acre area. The manual process took several days, prompting consideration for the purchase of a rotary tiller to streamline future efforts. Following the late emergence, the situation was further exacerbated by a long period of drought in June and well into July. The region continued to face abnormally dry conditions throughout the remainder of the growing season, posing additional challenges for soybean during critical growth stages and potentially impacting overall yield and seed quality.

In response to the drought conditions and to better manage irrigation in the future, a water reel was purchased. The water reel is equipped with 580 feet of 2-inch hose, a 5-horsepower booster pump, and sprinkler. The Maize Genetic Stocks Center, also located in Urbana, relies on water reels nearly every growing season. We will have local expertise available to begin integrating this form of irrigation into our operations. Additionally, the prolonged dry conditions facilitated the development of Charcoal Rot, caused by the soilborne fungus *Macrophomina phaseolina*. This disease was identified in several plots, leading to the loss or reduced yield of several accessions.

The integrity and availability of the Collection is an ongoing process that is ensured by replacing the seed in storage either due to low inventory or an inventory that is 10 or more years old. The Collection staff grew 2,193 accessions for seed replacement in 2023: 1,086 accessions at Urbana, Illinois; 657 accessions at Stoneville, Mississippi; 294 accessions at Costa Rica; and 56 accessions at Puerto Rico. For the earliest maturing accessions grown in Urbana, we also had a duplicate increase this year in Fargo, ND, thanks to the cooperation of Carrie Miranda and NDSU. A total of 1,962 accessions of *G. max*, 133 of *G. soja*, and 98 of perennial *Glycine* were grown for seed replenishment in 2023.

In Stoneville, 106 accessions of *G. soja* were planted for increase. Accessions of wild soybean (27) and perennial *Glycine* (98) were increased in a leased University of Illinois greenhouse space. Wild soybeans were grown inside an in-ground greenhouse room. This method has been used for several growing seasons now and replaces the insect-proof screen cage that is assembled in the field. Growing wild soybean plants in this manner prevents many insects and diseases that are common under field conditions, especially Potato Leafhopper in Central Illinois. Potato Leafhopper is not an issue in Stoneville, thus G. *soja* increases do not require screen cage protection. Perennial *Glycine* accessions are grown in a greenhouse room with blackout curtains that manipulate the photoperiod (daylight hours) received by the plants. Reducing the photoperiod is intended to induce flowering. Perennial *Glycine* species flower at anywhere between 10-18 daylight hours, and this is an ongoing trial and error across the 19 species of perennial *Glycine* that are curated by the Collection.

New accessions

In 2023, the collection expanded with the addition of 37 new accessions, comprised of 6 germplasm releases, 11 public cultivars, and 20 private varieties with expired plant variety protection certificates. Since 2019, the collection has incorporated a total of 43 germplasm releases, highlighting the emphasis on utilizing genetic diversity to release novel varieties. Within this subset of germplasm releases, 53 Plant Introduction (PI) accessions are present in the pedigrees (see table below).

Soybean Germplasm Pedigree from New Accessions since 2019		
PI 68600	‘Chuu Teppou’ (PI 506636)	'Hutcheson' (PI 518664)
Pl 88788	‘Souga Zairai’ (PI 507299)	'Hyuuga' (PI 506764)
PI 189930	'Ankur' (PI 462312)	'Lee' (PI 548656)
PI 200456	'Asgrow A4715' (PI 539936)	'Loda' (PI 614088)
PI 227687	'Benning' (PI 595645)	'Majos' (PI 458697)
PI 229358	'Blue-Side' (PI 632950)	'Manokin' (PI 559932)
PI 230970	'Brim' (PI 548986)	'Osage' (PI 648270)
Pl 290126B	'Clifford' (PI 596414)	Pearl' (PI 583367)
PI 361064	'Columbia' (Pl 22897 or Pl 548317)	Ransom' (PI 548989)
Pl 366122	'Cook' (PI 553045)	'Ripley' (PI 536636)
PI 407710	'Dillon' (PI 592756)	'Savoy' (PI 597381)
PI 459025B	'Essex' (PI 548667)	'Tamahikari' (PI 423897)
PI 462312	'Fowler' (PI 613195)	'USDA-N7002' (PI 647085)
PI 471904	'Gardensoy 24' (PI 662957)	'Vance' (PI 553048)
PI 547875	'Gardensoy 41' (PI 662960)	'Williams 82' (PI 518671)
PI 567516C	'GaSoy 17' (PI 553046)	
PI 587982A	'Hampton' (PI 614156)	
PI 594208	'Holladay' (PI 572239)	
PI 594538A	'Houjaku Kuwazu' (PI 416937)	

This underscores the importance of leveraging diverse genetic resources to enhance the overall quality and resilience of the soybean collection. The continuous incorporation of new accessions, especially germplasm releases, reflects a commitment to the use of genetic diversity and increases the adaptability and utilization of the collection for future research and breeding efforts.

Testing new accessions for glyphosate resistance in the field serves as a rapid method to identify plants capable of withstanding the herbicide, while also screening conventional seed lots for the presence of genetically engineered (GE) traits. In 2023, newly received accessions were initially planted in 4-row, 10ft long plots, with a single row designated for glyphosate treatment. However, adverse early drought conditions led to poor emergence and low vigor, preventing glyphosate treatment. Seed collection took place from these plots where possible, and the evaluation process is set to recommence in the upcoming season.

Genetically Engineered (GE) Accessions

The National Plant Germplasm System (NPGS) has been working with USDA, EPA, and relevant germplasm curators to draft the necessary protocols for the safe maintenance and distribution of genetically engineered (GE) cultivars. Accessions containing tolerance to Roundup Ready herbicide have recently been granted the ability to be distributed to seed requestors. The collection is working on receiving these accessions from the NLGRP in Ft. Collins and making the ex-PVP lines with this herbicide trait available for distribution.

Over 800 GE cultivars will become available to the Collection through expired ex-PVPs in the next ten years. The large number of GE ex-PVPs will put a strain on the operational protocols and cold-room storage capabilities. The NPGS representative leading the committee on GE germplasm was originally Stephanie Greene. After her retirement, Adam Mahan was appointed as the chair of the committee overseeing guidance for GE cultivars within the NPGS. The committee continues to provide guidance and draft protocols on GE traits involving herbicide resistance in the relevant germplasm collections. Insect resistant GE traits required EPA registration when sold commercially. Discussions between NPGS and EPA have not reached a conclusion on how to treat ex-PVP cultivars with expired GE insecticide traits.

The soybean research community needs to consider the increasing number of accessions with GE traits and the growing strain on resources this will present to the Collection. Particularly, does the Collection need to maintain (grow for replenishment) every accession with the same GE trait, or can the Collection maintain one (or few) accessions for every maturity group with the same GE trait, and simply distribute the rest until seed inventories are exhausted? In this scenario GE accessions would remain at the NLGRP in Ft. Collins, even if they were no longer distributed as part of the active collection.

Germinations

By conducting germination tests on recently harvested seed, the collection staff can also prevent poor quality backup seed from being sent to other seed banks or distributed for research or breeding purposes. Germination tests assess the seed on three criteria; whether the seed germinates, is rotten, or is hard (i.e. didn't imbibe water).

In 2023, germination tests were conducted on 2,232 accessions. Germination tests for the remaining accessions grown in 2020, 2021, and 2022 were completed. Of the 2020 accessions, there was an average of 91% good seed that germinated, with an average of 3% rotten seed, and 6% hard seed. Of the 2021 accessions, there was an average of 93% good seed that germinated, with an average of 3% rotten seed, and 5% hard seed. Of the 2022 accessions, there was an average of 92% good seed that germinated, with an average of 4% rotten seed, and 4% hard seed. Seed received from Costa Rica in 2023, there was an average of 84% good seed that germinated, with an average of 3% rotten seed, and 10% hard seed.

Database

GRIN-Global is a web-based software system developed by the USDA Agricultural Research Service (ARS) to manage germplasm operations. Data from the Collection is available in GRIN-Global to provide easy access to information about the collection. GRIN-Global provides a wide range of tools that can help users find the information and resources they need, including a "shopping cart" feature that allows users to easily request samples of the seeds they need for their research. This popular feature was used by seed requestors for 86% of the orders filled by Collection staff. This tool allows Collection staff to manage the request and ordering process in an efficient manner and is the preferred method to receive requests.

Beginning on or about January 1, 2024, the U.S. National Plant Germplasm System (NPGS) will distribute all germplasm to international requestors (outside the U.S. states and territories) with the Standard Material Transfer Agreement (SMTA) of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

Processing Harvested Seed

An optical color sorter is a tool used to more efficiently separate moldy, diseased, and poor-quality seeds from good quality seed. This is done by using sensors that detect variations in color, shape, and size of seeds. The color sorter then uses a blast of air to separate the good seeds from the bad. A 'Analytical Color Sorter' was installed, and Collection staff were trained on its operation. Previously, Collection staff would visually inspect and manually clean seed lots. This process can be time-consuming and in cases of highly diseased seed, it can take up to two hours to clean seed from a single lot. The operation of the color sorter has already improved the efficiency of the seed cleaning process and reduced the amount of time required to separate good quality seeds from bad quality seeds. Despite being down one technician for part of 2023, Collection staff still processed approximately 1,500 harvested seed lots this year. There is still a critical backlog of seed cleaning that needs to be done. Seed lots from 2020, 2021, 2022, and 2023 Urbana production (approx. 4,000) remain to be processed and quality controlled.

Fatty Acid Evaluation

Fatty acid analysis is an important tool for evaluating the nutritional quality of soybean seeds, as it provides information about the types and levels of fatty acids present in the seeds. We have historically collected fatty acid compositional information on all accessions as part of our evaluation process. This information is then added to the GRIN database, making it easily accessible to seed requestors. Currently we have a backlog of several thousand seed samples that require fatty acid analysis to finish up phenotypic evaluation of those accessions. Unfortunately, we have not yet found a suitable collaborator to finish up this work.

Related to seed composition, the Collection did acquire an NIR which will primarily be used for oil and protein analysis. However, fatty acid data can be collected, and will be used at times to screen for the presence of fatty acid mutant alleles in a small oleic acid breeding project. Fatty acid data collected via NIR on any germplasm accessions will not be used to replace traditional laboratory methods due to a lack of accuracy.

Cold Room Seed Storage

The Collection needs a -18˚C cold room, in addition to 4˚C cold room, to meet current guidelines (FAO. 2013. *Genebank Standards for Plant Genetic Resources for Food and Agriculture*. Rome) for optimal long-term seed storage. Currently, we have a cold room designed for 4˚C (maintains closer to 8 ˚C), and access to a -18˚C storage at the NLGRP in Ft. Collins.

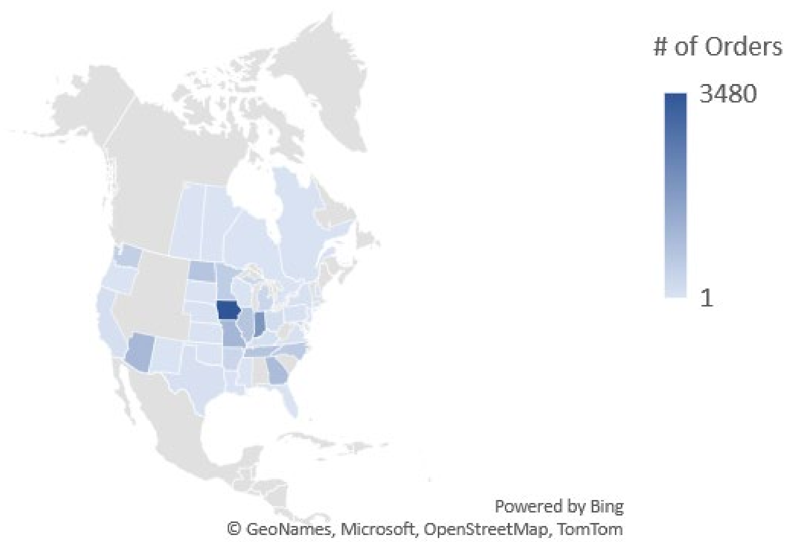
Soybean seed, like most seed, can maintain high germination rates for many years when stored at -18˚C. This is evident from many of the backup samples that are stored at -18˚C at the National Center for Genetic Resources Preservation (NCGRP) and continues to test over 80% germination rate after more than 30 years of storage. By having a proper -18˚C cold room, it can help to reduce the chances of errors and contamination that can occur during packaging, planting, growing, and harvesting. Current procedures select accessions for seed replenishment when an accession becomes 10 years old. This is based on the germination rate of the seed and the perceived degradation of seed germination in the current storage conditions. In 2023 at Urbana, roughly 81% of the accessions were selected for seed increases due to being 10 years old (79% at Costa Rica, 89% at Puerto Rico, and 69% at Stoneville), and not because of low seed quantities.

To address these needs, Adam Mahan, working with Midwest Area staff has tentatively secured capital investment to install a dedicated -18˚C cold room. The funding is due to the cold-room needs of the collection being added to the High Priority project list that is annually updated by the Midwest Area administration, reflecting a strategic commitment to safeguarding the integrity and longevity of the Collection's seed inventories. This investment will also replace the refrigeration and dehumidification equipment for the primary cold-room which routinely maintains seed at 8-10 ˚C and 35-40% humidity. When the project is complete, the primary cold-room will maintain a 4˚C and 28% humidity environment.

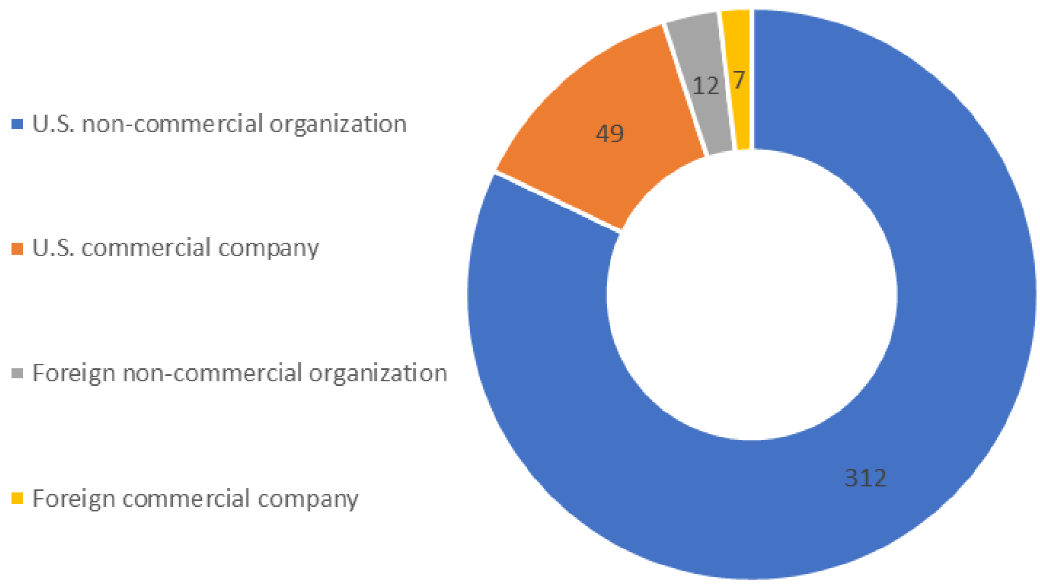
In addition to the cold-room repairs and upgrades, Congress has increased the number of one-year one-time appropriations towards the maintenance and repair of the aging buildings utilized by USDA researchers. To that end, our Urbana location received funds to address the multiple federal buildings here. It is anticipated that roof and gutter repair to our building will be completed with a portion of these funds soon, which will improve the relative safety of our seed storage.

Number of Seed Requests from the U.S. Soybean Collection

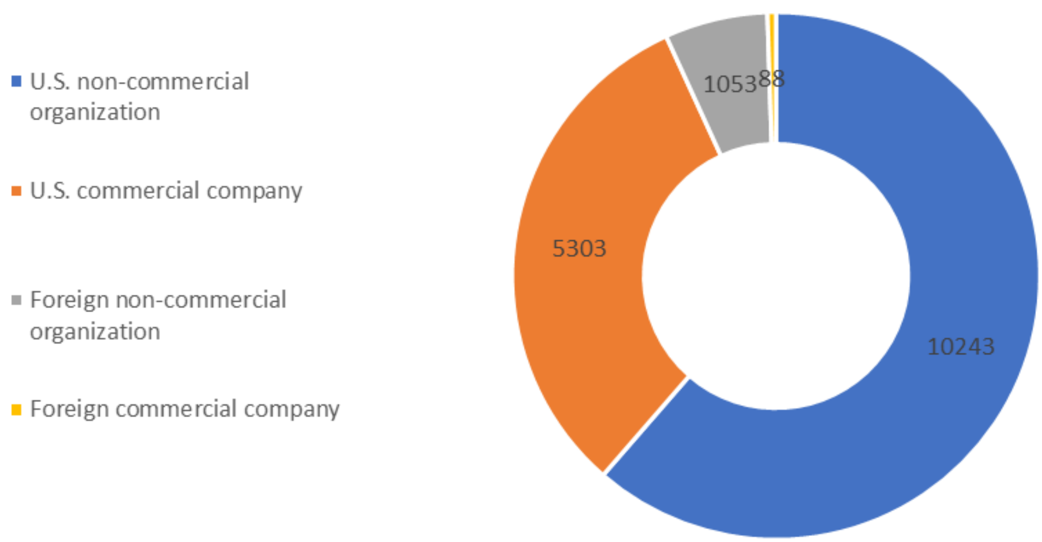
Iowa	3480
Indiana	1873
Missouri	1100
Arizona	1046
Georgia	957
North Dakota	763
Tennessee	763
Illinois	742
North Carolina	608
Minnesota	549
Washington	495
Arkansas	319
Michigan	310
Maryland	295
Ohio	137
Kentucky	108
California	106



Number of Orders from U.S. Soybean Collection (380 total)



Number of Seed Packets from U.S. Soybean Collection (16,687 total)



Summary inventory tables for each sub-collection in the USDA Soybean Germplasm Collection.

USDA Soybean Germplasm Collection Inventory	
Glycine max	17,553
Perennial species	1,213
Glycine soja	1,179
Private cultivars	783
Modern cultivars	565
Germplasm releases	311
Isoline - Clark	295
Old cultivars	208
Genetic types	197
Isoline - Harosoy	141
Isoline - Williams	102
Isoline - Other	66
Pigment mutants	47
Total	22,660

Glycine max	
Maturity Group	**# of accessions**
MG 000	144
MG 00	526
MG 0	1,162
MG I	1,776
MG II	2,279
MG III	2,221
MG IV	4,471
MG V	2,924
MG VI	1,642
MG VII	1,021
MG VIII	964
MG IX	874
MG X	109

Glycine soja	
Maturity Group	**# of accessions**
MG 000	165
MG 00	52
MG 0	54
MG I	61
MG II	95
MG III	50
MG IV	85
MG V	344
MG VI	172
MG VII	90
MG VIII	5
MG IX	2
MG X	4

Perennial species	
G. tomentella	348
G. tabacina	184
G. canescens	151
G. clandestina	112
G. pescadrensis	68
G. latifolia	53
G. cyrtoloba	50
Glycine spp.	55
G. rubiginosa	37
G. microphylla	35
G. falcata	30
G. stenophita	27
G. argyrea	14
G. dolichocarpa	13
G. curvata	9
G. latrobeana	7
G. peratosa	7
G. syndetika	6
G. arenaria	5
G. pindanica	4
Total	1,215

There is a significant amount of publicly available data for *Glycine max*, encompassing 180 traits and nearly 1 million observations. This data, compiled through the efforts of the Collection staff along with observations provided by seed requestors and through collaborations with public and industry partners, is summarized in the tables below.

Total observations for soybeans (*Glycine max*)

category_code	title	obs	category_code	title	obs	category_code	title	obs
CHEMICAL	ARGININE	5,530	DISEASE	Phytophthora Rot Race 30T	263	MORPHOLOGY	Lodging	17,556
CHEMICAL	CYSTEINE	5,530	DISEASE	Phytophthora Rot Race 31	145	MORPHOLOGY	LOWER LEAFLET RATIO	15
CHEMICAL	human allergen P34	13,304	DISEASE	Phytophthora Rot Race 33	113	MORPHOLOGY	Mottling score	14,411
CHEMICAL	Iodine number	2,820	DISEASE	Phytophthora Rot Race 38	65	MORPHOLOGY	Other leaf traits	1,060
CHEMICAL	ISOLEUCINE	5,530	DISEASE	Phytophthora Rot Race 4	1,472	MORPHOLOGY	Other plant traits	308
CHEMICAL	LEUCINE	5,530	DISEASE	Phytophthora Rot Race 5	791	MORPHOLOGY	Other seed traits	3,816
CHEMICAL	Linoleic	22,073	DISEASE	Phytophthora Rot Race 6	139	MORPHOLOGY	Pod color	19,352
CHEMICAL	Linolenic	22,072	DISEASE	Phytophthora Rot Race 7	2,991	MORPHOLOGY	Pod length	15
CHEMICAL	LYSINE	5,530	DISEASE	Phytophthora Rot Race 8	149	MORPHOLOGY	Pubescence color	18,259
CHEMICAL	METHIONINE	7,515	DISEASE	Phytophthora Rot Race 9	96	MORPHOLOGY	Pubescence density	18,697
CHEMICAL	Oil	22,165	DISEASE	Pythium ultimum	1,289	MORPHOLOGY	Pubescence form	17,758
CHEMICAL	Oleic	21,061	DISEASE	SOUTHERN STEM CANKER	119	MORPHOLOGY	Seed coat color	19,514
CHEMICAL	Other fatty acid composition	5,762	DISEASE	Soybean mosaic virus	15	MORPHOLOGY	Seed coat luster	18,224
CHEMICAL	Palmitic	21,061	DISEASE	SOYBEAN MOSAIC VIRUS STRAIN G1	236	MORPHOLOGY	Seed quality	17,662
CHEMICAL	Petiole Ureide	2,497	DISEASE	SOYBEAN MOSAIC VIRUS STRAIN G2	107	MORPHOLOGY	Seed shape of G. soja	15
CHEMICAL	Protein	22,165	DISEASE	SOYBEAN MOSAIC VIRUS STRAIN G3	236	MORPHOLOGY	Seed Shape of Glycine max	9,571
CHEMICAL	Stachyose	5,522	DISEASE	SOYBEAN MOSAIC VIRUS STRAIN G4	26	MORPHOLOGY	Seed weight	17,705
CHEMICAL	Stearic	21,061	DISEASE	SOYBEAN MOSAIC VIRUS STRAIN G5	107	MORPHOLOGY	Stem termination score	12,566
CHEMICAL	Sucrose	5,483	DISEASE	SOYBEAN MOSAIC VIRUS STRAIN G6	236	MORPHOLOGY	Upper leaflet length	15
CHEMICAL	THREONINE	5,530	DISEASE	SOYBEAN MOSAIC VIRUS STRAIN G7	236	MORPHOLOGY	Upper leaflet shape	15
CHEMICAL	TRYPTOPHAN	5,530	DISEASE	Soybean Rust Mixed	434	NEMATODE	Cyst Nematode Race 1	758
CHEMICAL	VALINE	5,530	DISEASE	Soybean Rust Red-Brown	102	NEMATODE	Cyst Nematode Race 14	2,548
DISEASE	Bacterial pustule	3,394	DISEASE	Soybean Rust Tan	3,084	NEMATODE	Cyst Nematode Race 2	234
DISEASE	Bean Pod Mottle Virus	427	DISEASE	Soybean Sudden Death Syndrome	6,861	NEMATODE	Cyst Nematode Race 3	12,805
DISEASE	Brown stem rot	4,031	GROWTH	Height	17,676	NEMATODE	Cyst Nematode Race 4	7,404
DISEASE	Frogeye C-32 Isolate	1,678	GROWTH	Stem termination type	18,195	NEMATODE	Cyst Nematode Race 5	11,627
DISEASE	FROGEYE RACE 11	108	INSECT	Beet armyworm	5	NEMATODE	RENIFORM NEMATODE	125
DISEASE	Frogeye race 2	2,652	INSECT	Corn Ear Worm	26	OTHER	Core Subset	3,102
DISEASE	Frogeye, unspecified race	115	INSECT	DEFOLIATION	339	OTHER	Image	4,119
DISEASE	NORTHERN STEM CANKER	1,467	INSECT	Leaf hopper injury	784	PHENOLOGY	Flowering	17,696
DISEASE	Peanut Mottle Virus	2,150	INSECT	Mexican Bean Beetle damage	5,046	PHENOLOGY	Maturity date	17,688
DISEASE	Phytophthora Rot Race 1	9,950	INSECT	Soybean Aphid Resistance	4,061	PHENOLOGY	Maturity group	18,259
DISEASE	Phytophthora Rot Race 10	623	INSECT	Soybean Looper	2,278	PHENOLOGY	Twining date	14
DISEASE	Phytophthora Rot Race 12	640	INSECT	Velvetbean caterpillar	126	PRODUCTION	Yield	17,521
DISEASE	Phytophthora Rot Race 17	2,227	MOLECULAR	MATURITY LOCUS E3	119	ROOT	ROOT FLUORESCENCE	795
DISEASE	Phytophthora Rot Race 2	432	MORPHOLOGY	Branching	2,153	STRESS	Chlorosis score	4,617
DISEASE	Phytophthora Rot Race 20	652	MORPHOLOGY	Early shattering score	16,063	STRESS	HIGH TEMPERATURE	520
DISEASE	Phytophthora Rot Race 25	2,834	MORPHOLOGY	Flower color	18,255	STRESS	Salt reaction	564
DISEASE	Phytophthora Rot Race 3	2,816	MORPHOLOGY	Hilum color	19,468			
DISEASE	Phytophthora Rot Race 30	115	MORPHOLOGY	Late shattering score	13,266			

Total observations for wild soybeans (*Glycine soja*)		
category_code	**title**	**obs**
CHEMICAL	human allergen P34	1,118
CHEMICAL	Linoleic	1,243
CHEMICAL	Linolenic	1,243
CHEMICAL	Oil	1,243
CHEMICAL	Oleic	1,243
CHEMICAL	Other fatty acid composition	182
CHEMICAL	Palmitic	1,243
CHEMICAL	Protein	1,243
CHEMICAL	Stearic	1,243
DISEASE	Bean Pod Mottle Virus	117
DISEASE	Phytophthora Rot Race 3	448
DISEASE	Soybean mosaic virus	182
GROWTH	Height	182
GROWTH	Stem termination type	1
INSECT	Beet armyworm	425
INSECT	Soybean Looper	379
INSECT	Velvetbean caterpillar	408
MORPHOLOGY	Flower color	185
MORPHOLOGY	Hilum color	939
MORPHOLOGY	LEAFLET SHAPE OF GLYCINE SOJA	1,060
MORPHOLOGY	LEAFLET SIZE OF GLYCINE SOJA	1,060
MORPHOLOGY	Lower Leaflet Area	1,036
MORPHOLOGY	Lower Leaflet Aspect	1,049
MORPHOLOGY	LOWER LEAFLET RATIO	182
MORPHOLOGY	Other leaf traits	38
MORPHOLOGY	Other plant traits	3
MORPHOLOGY	Other seed traits	299
MORPHOLOGY	Pod color	1,003
MORPHOLOGY	Pod length	182
MORPHOLOGY	Pubescence color	185
MORPHOLOGY	Pubescence density	1,001
MORPHOLOGY	Pubescence form	270
MORPHOLOGY	Seed coat color	1,040
MORPHOLOGY	Seed coat luster	185
MORPHOLOGY	Seed shape of G. soja	185
MORPHOLOGY	Seed weight	182
MORPHOLOGY	Upper leaflet length	182
MORPHOLOGY	Upper leaflet shape	182
NEMATODE	Cyst Nematode Race 1	1,078
NEMATODE	Cyst Nematode Race 3	545
NEMATODE	Cyst Nematode Race 4	1
NEMATODE	Cyst Nematode Race 5	547
OTHER	Core Subset	81
OTHER	Image	1,847
PHENOLOGY	Flowering	1,246
PHENOLOGY	Maturity date	1,245
PHENOLOGY	Maturity group	185
PHENOLOGY	Twining date	182
STRESS	Chlorosis score	21

Total observations for perennial *Glycine*		
category_code	**title**	**obs**
CHEMICAL	Bowman-Birk Inhibitor	560
CYTOLOGIC	Chromosome number	861
DISEASE	SCLEROTINIA STEM ROT	777
DISEASE	SUDDEN DEATH SYNDROME	754
MORPHOLOGY	Adventitious roots	319
MORPHOLOGY	Leaflet arrangement	291
MORPHOLOGY	Upper pubescence type	290
MORPHOLOGY	Upper terminal leaflet length	265
MORPHOLOGY	Upper terminal leaflet shape	292
MORPHOLOGY	Upper terminal leaflet width	293
NEMATODE	Soybean Cyst Nematode Race 3	490
OTHER	CORE SUBSET	115
OTHER	IMAGE	3,008