

USDA SOYBEAN GERMPLASM COLLECTION REPORT -- 2018

February 2019

In 2018, we distributed 21,254 seed lots from 9,582 accessions from the USDA Soybean Germplasm Collection in response to 518 requests from 325 individuals. There were 458 domestic requests (88% of the total) with a total of 16,099 seed packets representing 8,072 accessions sent to 273 researchers from 40 states. Domestically, public scientists made 365 requests, scientists with commercial companies made 63 requests, and individuals made 30 requests. There were 5,155 seed packets of 4,202 accessions in 60 orders sent to 52 scientists in 28 countries. Twenty-three requests were made for 219 seed packets of 163 perennial *Glycine* accessions. We also sent backup seeds of 197 accessions to the National Center for Genetic Resources Preservation (NCGRP) and 408 accessions for storage in the Svalbard Arctic Seed Vault. 99% of the collection is backed up at NCGRP and 89% is backed up at the Svalbard Arctic Seed Vault.

We grew 2,480 accessions of *G. max* for seed replacement in the Collection. These were grown in three locations: 1123 accessions at Urbana, Illinois, 967 accessions at Stoneville, Mississippi, and 390 accessions in Upala, Costa Rica. There were also 60 accessions pure lined in Upala. With the addition of these pure lined accessions, all of the accessions received from Vietnam in 2014 have been pure lined except for a few that are still being compared for possible sublining.

Twenty-one germplasm releases, one modern cultivar, 13 private varieties with expired Plant Variety Protection certificates (PVPC), and 42 newly pure lined plant introductions from Vietnam were added to the active collection. Seed was increased from 71 of the 208 perennial *Glycine* accessions received in 2017 through Steve Hughes from the Australian Pastures Genebank at the South Australian Research and Development Institute in Adelaide covered by the Standard Material Transfer Agreement adopted by the FAO.

The public version of GRIN-Global Release 1.10.3.6 is now available at <https://npgsweb.ars-grin.gov>. Users can create accounts to make seed requests online, view their order history and receive email updates about GRIN-Global. The shopping cart feature was utilized for 75% of the total seed requests made. The software for adding news images to GRIN Global was recently developed and 368 new images were uploaded. There are over 8,000 accession images that are not in GRIN. Some of these are of discarded seed lots or similar to other images already uploaded but the majority will be uploaded as time permits. We have begun scanning the original passport documents as pdf files so that these can be stored in GRIN Global. Most of these documents would be for internal use only and not be visible on the public web.

David Neece has been extracting DNA from accessions that still need genotyping with 50K SNP chip and sending them to Qijian Song, USDA, Beltsville.

The National Plant Germplasm System will be adding transgenic cultivars to the active collection when the patents and PVPs on these cultivars expire. General policies and procedures on how to handle such material have been established but specific procedures for the Soybean Collection are still being finalized. One variety, 92B51, is off-patent and already has an expired PVP. Four varieties have PVP expiring in 2019. Looking to the future, there are 1540 transgenic varieties with valid PVPs, so if all of these are eventually added to the active collection additional storage and funding to maintain these will be needed.

Related to this, we have begun having the Illinois Crop Improvement Association test the rest of the collection for the adventitious presence of the Roundup Ready gene. Seed lots were initially screened with lateral flow strip test immunoassays on bulk samples of several accessions, and then with greenhouse tests of 200 plants/accession if a strip test was positive. The U.S. public and private cultivars, germplasm releases, northern maturity groups of *Glycine soja*, and seed lots that had not yet been put away were sampled first. Out of 5,411 seed lots, four tested positive. These were three germplasm lines released in 2007 by the University of Georgia and one 2018 Costa Rica seed lot of an accession received in 2014 from Vietnam and pure lined in Stoneville in 2016: G04-

Ben229IR-G (100% positive), G04-Ben2119IR-MGH (37.6% positive), G04-Ben229IR-M (1.1% positive), and PI 675898 (100% positive). The original backup samples of the germplasm releases from NCGRP also tested positive. We stopped distributing these accessions and notified all cooperators who had received any of these seeds. Zenglu Li was checking on the seed lots at the University of Georgia to see if they were also contaminated. The 2016 seed lot and a few original seeds of PI 675898 from Vietnam will be tested to make sure that seed didn't get mixed after we received it. Sampling is continuing, and we hope to test all distributable seed lots but are limited by available personnel and funding.

A seed germination chamber was purchased so that germination tests can be conducted on the inventory seed lots. It is still being set up and staff needs to be trained to use it. Testing the seed viability is necessary to make informed decisions about when a particular seed lot should be regenerated. A request has also been made for CPRL funds to convert the portion of cold room space that contains the distributable seed lots to from 10C to -18C. With colder storage, most seed can be kept longer before needing regeneration as evident from the backup samples now stored at -18C at NCGRP. This is becoming more important as the collection increases and personnel decreases. Extending the time needed before regenerating seed also lessens the chances for errors and contamination which can occur during packaging, planting, growing, and harvesting.

A dust collection system has been installed at Urbana in the room which houses a stationary belt thresher and seed cleaners. A spiral seed separator was also purchased. It doesn't work very well for accessions with flat or oblong seeds but has proven useful cleaning the rounder, modern-type varieties.

For some time there has been a discussion within the soybean research community about the need for a soybean genetic stocks collection to preserve the many lines that are being developed by various mutagens or with transgenic procedures. The initial collection could range from a few hundred to tens of thousands of accessions depending on the criteria for inclusion. For this purpose, we received an increase in our budget in 2014. This funding was not nearly sufficient for a new collection but we agreed to take several hundred fast neutron mutants that have been characterized from the University of Minnesota but we have yet to receive the seeds. The Type Collection currently functions as a genetic stock collection. These mutants could be integrated into the Type Collection but the T numbers may have outlived their usefulness. An option to consider for transgenic lines and uncharacterized mutants is that the Collection would provide storage and distribution services until the seed supply was exhausted. The originator could then resupply seeds or at that point the line would no longer be available.

Ram Singh retired in 2017 but returned to work part-time. He has been counting chromosomes for the *G. tomentella* in the collection with unknown chromosome numbers. The plant PI 604495 looks like *G. tomentella* but appears to have 148 chromosomes. He plans to continue his work on wide hybridization between *G. tomentella* and *G. max*, using disease tolerant accessions screened by Glen Hartman.

The position for a new curator was advertised last fall. The federal shutdown has delayed the process. This will be a Category 4 (service scientist) position. Category 4 scientists can do original research but they are not required to publish. Some of the Randy Nelson's breeding research has been reassigned to David Walker, which will allow the new curator to focus on research dealing with curatorial issues. Doug Trimble, one of the two technicians for the germplasm unit in Urbana retired in March, 2018. The research agronomist positions vacated by Ed Johnson over 2 years ago is still vacant as well.

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As of December 31, 2018, the Collection contained the following entries:

USDA Soybean Germplasm Collection Inventory

Annual subcollection	Entries	Perennial species	Entries
Introduced <i>G. max</i>	17555	<i>G. arenaria</i>	5
<i>G. soja</i>	1179	<i>G. argyrea</i>	14
Germplasm releases	233	<i>G. canescens</i>	149
Modern cultivars	553	<i>G. clandestina</i>	112
Old cultivars	208	<i>G. curvata</i>	9
Private cultivars	689	<i>G. cyrtoloba</i>	49
All isolines	600	<i>G. dolichocarpa</i>	13
Pigment mutants	47	<i>G. falcata</i>	30
<u>Genetic types</u>	<u>197</u>	<i>G. latifolia</i>	52
Annual subtotal	21261	<i>G. latrobeana</i>	7
		<i>G. microphylla</i>	33
		<i>G. peratosa</i>	7
		<i>G. pescadrensis</i>	68
		<i>G. pindanica</i>	4
		<i>G. rubiginosa</i>	38
		<i>G. stenophita</i>	27
		<i>G. syndetika</i>	6
		<i>G. tabacina</i>	183
		<i>G. tomentella</i>	347
		<u><i>G. unknown species</i></u>	<u>60</u>
		Perennial subtotal	1213

Collection total 22474

Number of accessions screened for which data is entered in GRIN:

<i>Glycine max</i>		
type	descriptor	Accessions screened
Chemical	ARGININE	5530
Chemical	CYSTEINE	5530
Chemical	human allergen P34	13304
Chemical	Iodine number	2820
Chemical	ISOLEUCINE	5530
Chemical	LEUCINE	5530
Chemical	Linoleic	22073
Chemical	Linolenic	22072
Chemical	LYSINE	5530
Chemical	METHIONINE	7515
Chemical	Oil	22165
Chemical	Oleic	21061
Chemical	Other fatty acid composition	5762
Chemical	Palmitic	21061
Chemical	Petiole Ureide	2497
Chemical	Protein	22165
Chemical	Stachyose	5522
Chemical	Stearic	21061
Chemical	Sucrose	5483
Chemical	THREONINE	5530
Chemical	TRYPTOPHAN	5530
Chemical	VALINE	5530
Disease	Bacterial pustule	3394
Disease	Bean Pod Mottle Virus	427
Disease	Brown stem rot	4031
Disease	Frogeye C-32 Isolate	1678
Disease	FROGEYE RACE 11	108
Disease	Frogeye race 2	2652
Disease	Frogeye, unspecified race	115
Disease	Northern Stem Canker	1467
Disease	Peanut Mottle Virus	2150
Disease	Phytophthora Rot Race 1	9950
Disease	Phytophthora Rot Race 10	623
Disease	Phytophthora Rot Race 12	640
Disease	Phytophthora Rot Race 17	2227
Disease	Phytophthora Rot Race 2	432
Disease	Phytophthora Rot Race 20	652
Disease	Phytophthora Rot Race 25	2834

<i>Glycine max</i>		
type	descriptor	Accessions screened
Disease	Phytophthora Rot Race 3	2816
Disease	Phytophthora Rot Race 30	115
Disease	Phytophthora Rot Race 30T	263
Disease	Phytophthora Rot Race 31	145
Disease	Phytophthora Rot Race 33	113
Disease	Phytophthora Rot Race 38	65
Disease	Phytophthora Rot Race 4	1472
Disease	Phytophthora Rot Race 5	791
Disease	Phytophthora Rot Race 6	139
Disease	Phytophthora Rot Race 7	2991
Disease	Phytophthora Rot Race 8	149
Disease	Phytophthora Rot Race 9	96
Disease	Pythium ultimum	1289
Disease	Southern Stem Canker	119
Disease	Soybean mosaic virus	15
Disease	Soybean mosaic virus Strain G1	236
Disease	Soybean mosaic virus Strain G2	107
Disease	Soybean mosaic virus Strain G3	236
Disease	Soybean mosaic virus Strain G4	26
Disease	Soybean mosaic virus Strain G5	107
Disease	Soybean mosaic virus Strain G6	236
Disease	Soybean mosaic virus Strain G7	236
Disease	Soybean Rust Mixed	434
Disease	Soybean Rust Red-Brown	102
Disease	Soybean Rust Tan	3084
Disease	Soybean Sudden Death Syndrome	6861
Growth	Height	16666
Growth	Stem termination type	18108
Insect	Beet armyworm	5
Insect	Corn Ear Worm	26
Insect	Defoliation	339
Insect	Leaf hopper injury	784
Insect	Mexican Bean Beetle damage	5046

<i>Glycine max</i>		
type	descriptor	Accessions screened
Insect	Soybean Aphid Resistance	4061
Insect	Soybean Looper	2278
Insect	Velvetbean caterpillar	126
Molecular	Maturity Locus E3	119
Morphology	Branching	2153
Morphology	Early shattering score	15131
Morphology	Flower color	18168
Morphology	Hilum color	19382
Morphology	Late shattering score	12334
Morphology	Lodging	16546
Morphology	Lower leaflet ratio	15
Morphology	Mottling score	13488
Morphology	Other leaf traits	1060
Morphology	Other plant traits	282
Morphology	Other seed traits	3814
Morphology	Pod color	19269
Morphology	Pod length	15
Morphology	Pubescence color	18172
Morphology	Pubescence density	18697
Morphology	Pubescence form	17758
Morphology	Seed coat color	19428
Morphology	Seed coat luster	18136
Morphology	Seed quality	16652
Morphology	Seed shape of G. soja	15
Morphology	Seed Shape of Glycine max	8561

<i>Glycine max</i>		
type	descriptor	Accessions screened
Morphology	Seed weight	16695
Morphology	Stem termination score	11556
Morphology	Upper leaflet length	15
Morphology	Upper leaflet shape	15
Nematode	Cyst Nematode Race 1	504
Nematode	Cyst Nematode Race 14	2516
Nematode	Cyst Nematode Race 2	219
Nematode	Cyst Nematode Race 3	12533
Nematode	Cyst Nematode Race 4	7378
Nematode	Cyst Nematode Race 5	11620
Nematode	Reniform Nematode	120
Other	Core Subset	1685
Other	Image	4120
Phenology	Flowering	16686
Phenology	Maturity date	16681
Phenology	Maturity group	18186
Phenology	Twining date	14
Production	Yield	16511
Root	Root Fluorescence	795
Stress	Chlorosis score	4617
Stress	High temperature	520
Stress	Salt reaction	564

<i>Glycine soja</i>		
type	descriptor	Obs
Chemical	human allergen P34	1118
Chemical	Linoleic	1243
Chemical	Chemical	1243
Chemical	Oil	1243
Chemical	Oleic	1243
Chemical	Other fatty acid composition	182
Chemical	Palmitic	1243
Chemical	Protein	1243
Chemical	Stearic	1243
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

<i>Glycine soja</i>		
type	descriptor	Obs
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	1060
Morphology	Leaflet size of Glycine soja	1060
Morphology	Lower Leaflet Area	1036
Morphology	Lower Leaflet Aspect	1049
Morphology	Lower Leaflet ratio	182
Morphology	Other leaf traits	38
Morphology	Other plant traits	3
Morphology	Other seed traits	299
Morphology	Pod color	1003

<i>Glycine soja</i>		
<u>type</u>	<u>descriptor</u>	<u>Obs</u>
Morphology	Pod length	182
Morphology	Pubescence color	185
Morphology	Pubescence density	1001
Morphology	Pubescence form	270
Morphology	Seed coat color	1040
Morphology	Seed coat luster	185
Morphology	Seed shape of <i>G. soja</i>	185
Morphology	Seed weight	182
Morphology	Upper leaflet length	182
Morphology	Upper leaflet shape	182
Nematode	Cyst Nematode Race 1	1078
Nematode	Cyst Nematode Race 3	545
Nematode	Cyst Nematode Race 4	1

<i>Glycine soja</i>		
<u>type</u>	<u>descriptor</u>	<u>Obs</u>
Nematode	Cyst Nematode Race 5	547
Other	Image	1847
Phenology	Flowering	1246
Phenology	Maturity date	1246
Phenology	Maturity group	185
Phenology	Twining date	182
Stress	Chlorosis score	21

<i>Perennial Glycine</i>		
Type	Descriptor	Accessions screened
	Core subset	115
	Image	3008
Chemical	Bowman-Birk Inhibitor	560
Cytologic	Chromosome number	836
Disease	Sclerotinia stem rot	777
Disease	Sudden death syndrome	754
Morphology	Adventitious roots	319

<i>Perennial Glycine</i>		
Type	Descriptor	Accessions screened
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

Photos stored in GRIN:

	Number of Photos	Number of Accessions
<i>G. max</i>	14282	4161
<i>G. soja</i>	1558	956
<i>Perennial Glycine</i>	3,204	976

Total orders for all sites in the National Plant Germplasm System

site	UARS	UFED	STA	UCOM	UPRU	UIND	UAID	INT	FGEN	FCOM	FPRU	IND	TOTAL
COR	23	8	136	119	13	460	0	0	9	7	13	2	790
DAV	8	2	63	57	17	149	0	0	4	0	8	2	310
GEN	8	7	65	49	11	374	0	0	1	1	3	22	541
GSOR	46	0	81	8	4	5	0	0	1	6	24	0	175
HILO	3	3	19	4	0	5	0	0	1	1	0	0	36
MAY	8	4	15	8	0	41	0	0	0	1	0	0	77
MIA	8	1	39	14	13	44	0	0	0	2	5	1	127
NA	4	1	28	14	7	27	0	0	0	0	4	0	85
NC7	75	7	466	295	57	147	0	2	8	146	197	17	1417
NE9	3	1	78	45	6	33	0	0	4	29	37	5	241
NR6	30	1	71	22	5	52	0	0	2	7	14	1	205
NSGC	56	1	209	97	12	73	0	2	13	38	144	13	658
NSSL	28	1	8	5	4	0	0	0	0	0	0	0	46
OPGC	1	1	52	15	2	18	0	0	0	6	3	0	98
PARL	1	0	24	9	0	3	0	0	0	3	4	0	44
PVPO	1	0	0	0	0	0	0	0	0	0	0	0	1
RIV	1	0	0	0	0	0	0	0	0	0	0	0	1
S9	47	5	350	96	38	154	0	0	14	45	125	18	892
SOY	81	1	278	63	5	30	0	0	2	18	38	2	518
TOB	1	1	34	13	1	5	0	0	0	6	8	1	70
W6	60	6	379	143	33	263	0	0	7	40	131	52	1114
TOTAL	493	51	2395	1076	228	1883	0	4	66	356	758	136	7457

Total orders items for all sites in the National Plant Germplasm System:

site	UARS	UFED	STA	UCOM	UPRU	UIND	UAID	INT	FGEN	FCOM	FPRU	IND	TOTAL
COR	471	36	1485	1093	229	3198	0	0	50	193	259	7	7021
DAV	22	22	1009	586	178	907	0	0	9	0	144	20	2897
GEN	135	205	1912	684	209	4783	0	0	1	7	16	132	8084
GSOR	1138	0	10799	5312	7	32	0	0	1	1946	1659	0	20894
HILO	8	21	98	8	0	9	0	0	8	18	0	0	170
MAY	9	21	21	25	0	86	0	0	0	9	0	0	171
MIA	16	1	258	73	37	228	0	0	0	30	38	1	682
NA	43	1	108	66	20	44	0	0	0	0	7	0	289
NC7	2617	86	15219	10518	906	2125	0	21	87	17538	12273	107	61497
NE9	32	132	1750	1988	614	263	0	0	6	5379	2687	767	13618
NR6	964	3	2725	2006	32	458	0	0	8	125	522	3	6846
NSGC	2090	40	5346	3158	412	3227	0	99	107	408	9928	4255	29070
NSSL	185	1	550	7	146	0	0	0	0	0	0	0	889
OPGC	7	4	326	168	4	52	0	0	0	80	10	0	651
PARL	20	0	298	55	0	19	0	0	0	58	59	0	509
PVPO	4	0	0	0	0	0	0	0	0	0	0	0	4
RIV	10	0	0	0	0	0	0	0	0	0	0	0	10
S9	2545	115	14913	2323	4383	2743	0	0	862	9073	11918	190	49065
SOY	3391	3	10575	1657	40	433	0	0	1714	936	2496	9	21254
TOB	1	2	84	32	2	9	0	0	0	46	22	20	218
W6	6632	32	11407	3776	587	1634	0	0	264	5726	8664	5771	44493
TOTAL	20340	725	78883	33535	7806	20250	0	120	3117	41572	50702	11282	269159