USDA SOYBEAN GERMPLASM COLLECTION REPORT -- 2016

February 2017

In 2016, we distributed 23,031 seed lots from 11,931 accessions from the USDA Soybean Germplasm Collection in response to 541 requests from 330 individuals. This is the fifteenth year in a row and 19 of the past 22 years in which we have distributed more seed lots than total accessions in the Collection. There were 481 domestic requests (89% of the total) with a total of 17,104 seed packets representing 10,542 accessions sent to 280 researchers from 42 states. Domestically, public scientists made 324 requests, scientists with commercial companies made 113 requests, and individuals made 43 requests. There were 5,927 seed packets of 4,475 accessions in 60 orders sent to 50 scientists in 30 countries. Twenty-two requests were made for 667 seed packets of 552 perennial *Glycine* accessions. We also sent backup seeds of 461 accessions to the National Center for Genetic Resources Preservation (NCGRP) and 1,840 accessions for storage in the Svalbard Arctic Seed Vault. 99% of the collection is backed up at NCGRP and 83% is backed up at the Svalbard Arctic Seed Vault.

The public version of GRIN-Global Release 1.9.8.2 is now available at http://npgsweb.ars-grin.gov/gringlobal . 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 65% of the total seed requests made. The software for adding news images to GRIN Global is still being developed. When it is finished, there are approximately 2,500 images that are ready to be uploaded.

We planted 2,696 accessions of *G. max* and 287 *G. soja* for seed replacement in the Collection. These were planted at three locations: 1,653 *G. max* and 286 *G. soja* accessions at Urbana and 593 *G. max* and 1 *G. soja* accession at Stoneville, and 450 *G. max* at Upala, Costa Rica. Based on the maturity dates of the new accessions donated by Le Huy Ham, Ministry of Agriculture and Rural Development, Institute of Agricultural Genetics, Pham Van Dong Rd, Tuliem, Hanoi, Vietnam and by Can Tho University, Vietnam, which were planted in Stoneville in 2015, 108 accessions were planted for pure lining in Urbana, and 231 accessions were planted in Stoneville. Some of these accessions were very late maturing and will need to be grown in Costa Rica.

Evaluation of accessions that were found to be very similar by genotyping with the 50K SNP chip by Perry Cregan and Qijian Song in Beltsville, MD is continuing. Rusty Smith planted 165 accessions in Stoneville. In these tests we are comparing phenotypes of accessions with greater than 99.9% similarity based on the SNP data which were not obviously different based on recorded phenotypic traits. Tests in previous years have shown qualitative differences among accessions with greater than 99.9% SNP similarity. Using the 6K chip we re-genotyped 24 accessions that were genotypically at least 99.9% alike but had as many as 11 qualitative differences. The 6K SNP profile of those accessions that were phenotypically very different did not match the 50K SNP profile. This indicates that there are some accessions that have the incorrect SNP data in SoyBase. We will continue to work with Qijian Song to correct these data. There were 66 *G. soja* accessions that had 1999 Urbana seed genotyped. Earlier seed sources of these accessions will be genotyped with 50K SNPs to make sure that we have data on the correct accession. We were able to acquire additional 50K SNP chips that will allow us to genotype at least some of the accessions added to the Collection since the genotyping project was completed. The priority will be to genotype introduced accessions before we genotype domestic accessions.

One germplasm release, five cultivars, and 60 private varieties with expired Plant Variety Protection certificates (PVPC), one isoline, and 48 newly pure lined plant introductions were added to the Collection.

After two failed searched to fill the vacancy created when Alyson Steines, the technician who worked with new introductions, tropical accessions, wild soybeans, and managed our greenhouse, resigned in August 2012, we decided to abolish the position. We have largely eliminated the backlog of processing new seed lots into the Collection that had existed since the Collections were consolidated in 1990; we have completed the general evaluations of the current accessions; and we have been unsuccessful in acquiring new accessions from the major Asian sources. With this reduction in work load, we converted the position into a support scientist position to continue the work on wide hybridization that was begun by Ram Singh, who will be retiring at the end of June. A person has been selected for that position but that appointment is being delayed because of the federal hiring freeze.

The National Plant Germplasm System will be adding transgenic cultivars to our collections when the patents on these cultivars expire. General policies and procedures on how to handle such material have been established. The Soybean Collection will have to determine the specific procedures that we will follow and what accessions will be added.

We are in the process of obtaining 208 perennial *Glycine* accessions through Steve Hughes from the Australian Pastures Genebank at the South Australian Research and Development Institute in Adelaide. They had 317 accessions that they offered to us but by comparing Australian accession numbers we determined that we already had 109 of their accession. We will be receiving accessions in *G. canescens, G. clandestina, G. cyrtoloba, G. falacta, G. latifolia, G. latrobeana, G. tabacina, G. tomentella,* and 60 accessions of unknown species.

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.

Our policy has been to pure line all introduced accessions but to add domestic accessions as they are received. When we receive international cultivars that have been recently released by established breeding programs, we are considering adding them to Collection without pure lining. In the database, they could be added to the subcollection of modern cultivars, which is now exclusively U.S and Canadian cultivars, or we could create a separate subcollection for other international cultivars.

In cooperation with Marcelo Oliveira of Embrapa, all of the soybean accessions in maturity groups IX and X were scheduled to be evaluated in Sinope in northern Brazil. This test has been planted three

times since October of 2014 and each time adverse weather conditions has prevented the successful completion of the research. The material is currently being increased in a greenhouse to plant in Mato Grosso.

Patti Witcher, Dept. of Agricultural Sciences, Texas A&M University-Commerce, finished the initial screening of MG V accessions for tolerance to red banded stink bug and is in the process of retesting potentially resistant lines.

Not counting registration articles in Crop Science and Journal of Plant Registrations there are 93,526 accessions linked to 413 citations in GRIN-Global. 19,909 unique accessions are covered by at least one citation not including USDA Technical Bulletins or Crop Science registration articles. These citations are listed on the accession's information page, and a complete list of all of the publications referencing accessions for soybeans with number of accessions cited can be found on the general crop information page.

On February 3, 2017, Randall Nelson retired from ARS. Without consulting anyone directly involved with Collection or any of the clientele, ARS administration decided to abolish the Category 1 (research scientist) position that the curator of the Soybean Collection has always held and replace it with a Category 4 (service scientist) position. Category 4 scientist can do original research but they are not required to publish. The current federal hiring freeze will prevent any immediate action to fill this position

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As of December 31, 2016, the Collection contained the following entries:

USDA Soybean Germplasm Collection Inventory

Annual subcollection	**Entries**
Introduced *G. max*	17200
G. soja	1179
Germplasm releases	211
Modern cultivars	552
Old cultivars	208
Private cultivars	648
All isolines	600
Pigment mutants	47
Genetic types	197
Annual subtotal	**20842**

Perennial species	**Entries**
G. *arenaria*	5
G. *argyrea*	14
G. *canescens*	123
G. *clandestina*	90
G. *curvata*	9
G. *cyrtoloba*	48
G. dolichocarpa	13
G. *falcata*	29
G. *latifolia*	44
G. *latrobeana*	6
G. *microphylla*	33
G. peratosa	7
G. *pescadrensis*	68
G. *pindanica*	4
G. *rubiginosa*	38
G. *stenophita*	27
G. syndetika	6
G. *tabacina*	142
G. *tomentella*	299
Perennial subtotal	**1005**

Collection total 21847

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

Glycine max		
Type	**Descriptor**	**accessions screened**
	Core Subset	1685
Chemical	Arginine	5530
Chemical	Cysteine	5530
Chemical	human allergen P34	13267
Chemical	Iodine number	2817
Chemical	Isoleucine	5530
Chemical	Leucine	5530
Chemical	Linoleic	16521
Chemical	Linolenic	16520
Chemical	Lysine	5530
Chemical	Methionine	7069
Chemical	Oil	16625
Chemical	Oleic	15803
Chemical	Other fatty acid composition	5720
Chemical	Palmitic	15803
Chemical	Petiole ureide	2499
Chemical	Protein	16625
Chemical	Stachyose	5522
Chemical	Stearic	15803
Chemical	Sucrose	5483
Chemical	Threonine	5530
Chemical	Tryptophan	5530
Chemical	Valine	5530
Disease	Bacterial pustule	3438
Disease	Bean pod mottle virus	424
Disease	Brown stem rot	4027
Disease	Frogeye C-32 isolate	1688
Disease	Frogeye race 2	2665
Disease	Frogeye race 11	109
Disease	Frogeye, unspecified race	115
Disease	Northern stem canker	1489
Disease	Peanut mottle virus	2150
Disease	Phytophthora rot, race 1	9988
Disease	Phytophthora rot, race 10	629
Disease	Phytophthora rot, race 12	646
Disease	Phytophthora rot, race 17	2235
Disease	Phytophthora rot, race 2	433
Disease	Phytophthora rot, race 20	659
Disease	Phytophthora rot, race 25	2844
Disease	Phytophthora rot, race 3	2826
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	1478
Disease	Phytophthora rot, race 5	798
Disease	Phytophthora rot, race 6	139
Disease	Phytophthora rot, race 7	2980
Disease	Phytophthora rot, race 8	149
Disease	Phytophthora rot, race 9	96
Disease	Pythium ultimum	1290
Disease	Southern stem canker	120
Disease	Soybean mosaic virus	236
Disease	Soybean rust, mixed	437

Glycine max		
Type	**Descriptor**	**accessions screened**
Disease	Soybean rust, red-brown	103
Disease	Soybean rust, tan	3099
Disease	Sudden death syndrome	6859
Growth	Height	16195
Growth	Stem termination type	17441
Insect	Beet armyworm	5
Insect	Corn ear worm	27
Insect	Leaf hopper injury	784
Insect	Mexican bean beetle damage	5049
Insect	Soybean aphid resistance	3315
Insect	Soybean looper	2335
Insect	Velvetbean caterpillar	133
Defoliation	Defoliation by chewing insects	339
Molecular	Maturity Locus E3	119
Morphology	Branching	2151
Morphology	Early shattering score	14779
Morphology	Flower color	17711
Morphology	Hilum color	17744
Morphology	Image	2033
Morphology	Late shattering score	12243
Morphology	Lodging	16040
Morphology	Lower leaflet ration	15
Morphology	Mottling score	13016
Morphology	Other leaf traits	950
Morphology	Other plant traits	257
Morphology	Other seed traits	3462
Morphology	Pod color	17649
Morphology	Pod length	15
Morphology	Pubescence color	17711
Morphology	Pubescence density	17654
Morphology	Pubescence form	17196
Morphology	Seed coat color	17784
Morphology	Seed coat luster	17550
Morphology	Seed quality	16198
Morphology	Seed shape	8159
Morphology	Seed weight	16202
Morphology	Stem termination score	11145
Morphology	Upper leaflet length	15
Morphology	Upper leaflet shape	15
Nematode	Cyst nematode, race 1	496
Nematode	Cyst nematode, race 14	2493
Nematode	Cyst nematode, race 2	214
Nematode	Cyst nematode, race 3	12097
Nematode	Cyst nematode, race 4	7379
Nematode	Cyst nematode, race 5	11227
Nematode	Reniform nematode	120
Phenology	Flowering	16204
Phenology	Maturity date	16378
Phenology	Maturity group	17790
Phenology	Twining date	14
Production	Yield	16021
Root	Root fluorescence	796
Stress	Chlorosis score	1974
Stress	High temperature	520
Stress	Salt reaction	564

Glycine soja		
Type	**Descriptor**	**Accessions screened**
Chemical	Human allergen P34	1116
Chemical	Linoleic	1075
Chemical	Linolenic	1075
Chemical	Oil	1075
Chemical	Oleic	1075
Chemical	Other fatty acid composition	182
Chemical	Palmitic	1075
Chemical	Protein	1075
Chemical	Stearic	1075
Disease	Bean pod mottle virus	116
Disease	Phytophthora rot, race 3	448
Disease	Soybean mosaic virus	182
Disease	Height	182
Disease	Stem termination type	258
Insect	Beet armyworm	425
Insect	Soybean looper	379
Insect	Velvetbean caterpillar	408
Morphology	Flower color	1004
Morphology	Hilum color	1035
Morphology	Image	1073
Morphology	Leaflet shape	1060
Morphology	Leaflet size	1060
Morphology	Lower leaflet area	1041
Morphology	Lower leaflet aspect	1049

Glycine soja		
Type	**Descriptor**	**Accessions screened**
Morphology	Lower leaflet ratio	182
Morphology	Other leaf traits	38
Morphology	Other plant traits	3
Morphology	Other seed traits	299
Morphology	Pod color	1001
Morphology	Pod length	182
Morphology	Pubescence color	1003
Morphology	Pubescence density	1002
Morphology	Pubescence form	450
Morphology	Seed coat color	1038
Morphology	Seed coat luster	569
Morphology	Seed shape	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
Nematode	Cyst nematode, race 5	547
Phenology	Flowering	1076
Phenology	Maturity date	1076
Phenology	Maturity group	1003
Phenology	Twining date	182
Stress	Chlorosis score	19

Perennial *Glycine*		
Type	**Descriptor**	**Accessions screened**
	Core subset	115
	Image	957
CHEMICAL	Bowman-Birk Inhibitor	560
CYTOLOGIC	Chromosome number	774
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

Photos stored in GRIN:

	Number of Photos	Number of Accessions
G. max	13,559	3,815
G. soja	2,051	1,081
Perennial G*lycine*	3,204	997

Total orders for all sites in the National Plant Germplasm System

site	UARS	UFED	STA	UCOM	UPRU	UIND	UAID	INT	FGEN	FCOM	FPRU	FIND	Total
COR	20	2	108	72	15	365		3	8	6	10	8	617
DAV	9	3	57	39	11	95			3	1	10	1	229
GEN	19		34	39	16	263			1		4	8	384
GSOR	65		68	14	6	9				1	18	1	182
GSPI			3	1							1		5
HILO	5		10	3	3	8				3	4		36
MAY	12	3	30	52	12	116					6	2	233
MIA	4		19	12	13	7			1	2	3		61
NA	9	1	24	20	12	56					3		125
NC7	62	8	435	242	51	92		1	9	107	203	8	1218
NE9	10		80	34	16	33	1		3	21	42		240
NR6	46		83	30	6	51				5	9		230
NSGC	76	4	233	77	26	106		4	14	23	155	13	731
NSSL	34	3	13	4	2	1				1	2		60
OPGC	1		23	7	4	9				3	5	2	54
PARL	2		4	2	4	16			1	3	3		35
PVPO	1												1
RIV	1												1
S9	69	6	295	102	54	255		1	6	64	108	7	967
SOY	**50**	**1**	**269**	**113**	**5**	**43**		**1**	**11**	**10**	**38**		**541**
TOB	4		31	15	3	3							56
W6	63	10	339	157	61	510		1	8	51	147	17	1364

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

Site	UARS	UFED	STA	UCOM	UPRU	UIND	UAID	INT	FGEN	FCOM	FPRU	FIND	Total
COR	537	5	1599	519	53	1300		87	92	108	35	28	4363
DAV	50	10	380	589	116	945			212	10	211	1	2524
GEN	1079		428	583	276	3511			16		45	38	5976
GSOR	2400		5207	54	449	13				2	927	6	9058
GSPI			86	1							2		89
HILO	100		54	12	7	22				10	41		246
MAY	48	28	109	132	13	350					9	13	702
MIA	5		46	36	165	21			9	148	3		433
NA	72	2	69	51	69	145					17		425
NC7	5009	213	10296	4092	594	759		27	1398	5170	10678	236	38472
NE9	551		1081	294	787	180	3		105	2488	2736		8225
NR6	1730		1504	1955	128	523				56	4377		10273
NSGC	14412	160	7218	3869	617	1411		3603	369	795	17037	146	49637
NSSL	2991	44	181	18	38	2				2	64		3340
OPGC	4		177	91	33	58				47	19	104	533
PARL	11		4	3	69	135			4	56	10		292
PVPO	40												40
RIV	8												8
S9	4036	335	10663	6304	9513	804		140	353	4401	6908	30	43487
SOY	**1336**	**432**	**11210**	**3807**	**125**	**194**		**222**	**142**	**1156**	**4407**		**23031**
TOB	9		236	59	44	8							356
W6	2710	116	13879	3668	1415	3187		31	117	1835	6007	300	33265