USDA SOYBEAN GERMPLASM COLLECTION REPORT -- 2014
February 2015

In 2014, we distributed 29,268 seed lots from 14,973 accessions from the USDA Soybean Germplasm Collection in response to 689 requests from 422 individuals. This is the thirteenth year in a row and 17 of the past 20 years in which we have distributed more seed lots than total accessions in the Collection. There were 613 domestic requests (89% of the total) with a total of 26,613 seed packets representing 14,672 accessions sent to 355 researchers from 46 states. Domestically, public scientists made 440 requests, scientists with commercial companies made 118 requests, and individuals made 55 requests. There were 2,655 seed packets of 2,099 accessions in 77 orders sent to 67 scientists in 25 countries. Thirty-two requests were made for 2,056 seed packets of 927 perennial *Glycine* accessions. We also sent backup seeds of 600 accessions to the National Center for Genetic Resources Preservation (NCGRP) and 2,026 accessions for storage in the Svalbard Arctic Seed Vault. 99% of the collection is backed up at NCGRP and 66% is backed up at the Svalbard Arctic Seed Vault.

We planted 3,012 accessions of *G. max* and 75 *G. soja* for seed replacement in the Collection. These were planted at three locations: 2,065 *G. max* and 14 *G. soja* accessions at Urbana, 836 *G. max* and 61 *G. soja* accessions at Stoneville, and 111 *G. max* in Costa Rica. Seeds of 2 bulk *G. soja* samples of 100 plants collected by Erick Sachs, Univ. of Illinois; Elena Dzyubenko, Larissa Bagmet, and Andrey Sabitov N.I. Vavilov All-Russian Scientific Research in the Khabarovsk and Primorski regions of the Russian Federation were grown and seeds from these plants will be pure lined in 2015. Eleven plant introductions were donated by Dr. Yusran, Tadulako University, Central Sulawesi, Indonesia in 2011 and 2 donated by Tran Thanh Binh, Center Research Legume and Development, Hanoi, Vietnam in 2008 were pure lined.

Seed notes are being taken on accessions grown in Urbana, Stoneville and Rosemont 2011, 2012, and 2013 evaluations.

Some of the *G. soja* accessions evaluated at Urbana in 1998 and 1999 had maturity dates or seed sizes that varied widely between years. Plants from older sources and 1999 sources were compared and in at least 43 cases, plants grown from 1999 seed were different than earlier sources. The seed from the 1998 evaluation years appears to be correct. To be safe, seed orders are not being filled from any *G. soja* seed lot grown in the Urbana 1999 evaluation because there are few phenotypic differences among *G. soja* so there could be more seed lots that are incorrect. There are older backup sources of all the *G. soja* accessions which will be planted to obtain fresh, correct seed for distribution. Seed requests will be surveyed and everyone who potentially received mislabeled seeds will be notified.

The genotyping of 19,652 *G. max* and *G. soja* accessions with 52,041 SNPs was completed by Perry Cregan and Qijian Song in Beltsville, MD. Those data are now available through SoyBase (http://www.soybase.org/dlpages/index.php) and have already been used in several manuscripts. Using these data 6198 *G. max* and 499 *G. soja* accessions were found to be at least 99.9% similar in SNP markers to at least one other accession and some were 100% identical (1908 *G. max* comparison groups with 72 accessions in the largest group, 138 *G. soja* groups with 54 accession in the largest group). Using qualitative, phenotypic data to remove accessions that were obviously different we narrowed this list down to 3413 *G. max* (1151 groups with 42 accessions in the largest group) and 414 *G. soja* accessions (137 groups with 46 accessions in the largest group). Starting with the largest groups of accessions with similar phenotype and SNP markers in maturity groups of 000 - IV, 1276 *G. max* and 214 *G. soja* accessions were planted in comparison plots in Urbana in 2013. The second half was compared in 2014. However, due to rain the *G. max* plots were not planted until June 17 and many plants froze before maturity so these will need to be replanted in 2015. Nevertheless, some accessions being compared are definitely different. Accessions that were 100% alike for SNP markers were found to have up to 8 qualitative differences and accessions with great than 99.99% SNP similarity had as many as 11 qualitative differences. We will be rechecking some of these accessions to make sure that the DNA samples were correctly labeled. These SNP data will be very useful in defining genetic differences among accessions and we are exploring ways that we can use these data in managing the Collection. It is not likely that we will eliminate any

accessions from the Collection based on SNP similarity because the concurrence of this many SNP markers still cannot define two accessions as completely identical.

One germplasm release, 5 genetic types, and 9 private varieties with expired Plant Variety Protection certificates (PVPC) were also added to the Collection. There were 302 new accessions donated from a Vietnamese soybean germplasm collection project funded by the United Soybean Board in collaboration with the Agricultural Genetics Institute (AGl) and the National Center for Soybean Biotechnology, University of Missouri. These will be grown in Stoneville in 2015.

Alyson Steines, the technician who worked with new introductions, tropical accessions, wild soybeans, and managed our greenhouse, resigned in August 2012. Because there had been a hiring freeze in place there was a large backlog of vacancies to be filled. Our request to fill her position was approved in the spring of 2013. An initial set of candidates was forwarded to us in October, but the preselected list had only one candidates with field or greenhouse experience. We decided not to select among those candidates and our search has not yet been reopened. We are hoping that this will happen this summer.

NPGS will be adding transgenic cultivars to our collections when the patents on these cultivars expire. General policies and procedures on how to include these lines into collections and prevent transgenes from contaminating other accessions are in the final stages of approval. The Soybean Collection will have to determine the specific procedures that we will follow.

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 need to begin the process and set priorities for what we can do at a time when the resources for the current USDA Soybean Germplasm Collection are not adequate for the task.

In cooperation with Marcelo Oliveira of Embrapa, all of the soybean accessions in maturity groups IX and X are being evaluated in Sinop in northern Brazil. This test was planted in October of 2014 but because of severe drought and restrictions on irrigation the test was lost. It was replanted again in February but lack of rain is again threatening the test.

NPGS plans to implement the switch from GRIN to GRIN Global in 2015. The public version of GRIN-Global Release 1.9.4 is now available at http://npgsweb.ars-grin.gov/gringlobal .

Jim Heiholtz and Patti Witcher, Dept. of Agricultural Sciences, Texas A&M University-Commerce, continued to screen MG V accessions for tolerance to Redbanded Stink Bug. Louis O'Donoughue et. al. characterized 119 accessions for the allelic status at the GmPhyA3 gene (E3 locus) (Tardivel, A., H. Sonah, F. Belzile, L.S. Donoughue. 2014. Rapid Identification of Alleles at the Soybean Maturity Gene E3 using Genotyping by Sequencing and a Haplotype-Based Approach. Plant Genome. 7:1-9. doi: 10.3835/plantgenome2013.10.0034)

Not counting registration articles in Crop Science and Journal of Plant Registrations there are 93,021 accession linked to 380 citations in GRIN. 19,893 unique accessions are covered by at least one citation not including USDA Tech. Bulletins or Crop Science registration articles. These citations are listed with an accession's information, 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.

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As of December 31, 2013, the Collection contained the following entries:

USDA Soybean Germplasm Collection Inventory

Annual subcollection	**Entries**
Introduced *G. max*	17151
G. soja	1179
Germplasm releases	196
Modern cultivars	546
Old cultivars	208
Private cultivars	585
All isolines	599
Pigment mutants	47
Genetic types	197
Annual subtotal	**20708**

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 21689

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

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

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	Soybean 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

Photos stored in GRIN:

	Number of Photos	Number of Accessions
G. max	12,718	3,809
G. soja	2,051	1,081
Perennial G*lycine*	3,204	991