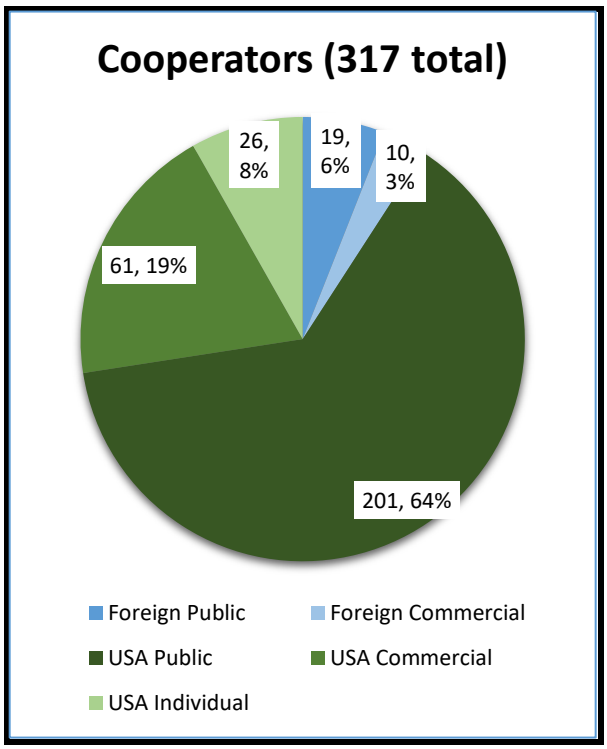
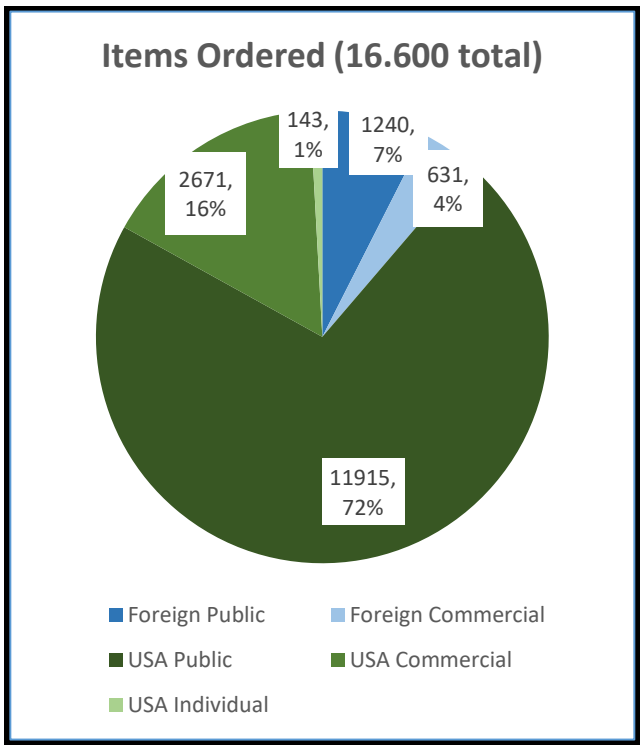
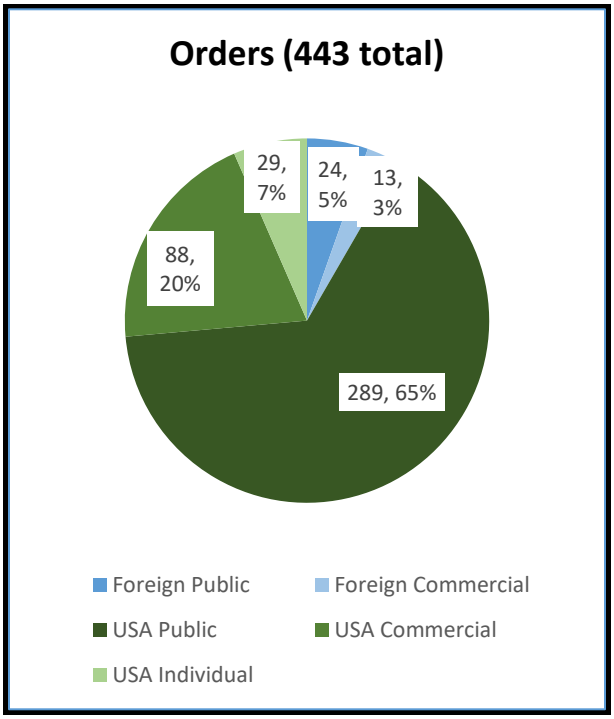
USDA SOYBEAN GERMPLASM COLLECTION REPORT -- 2019

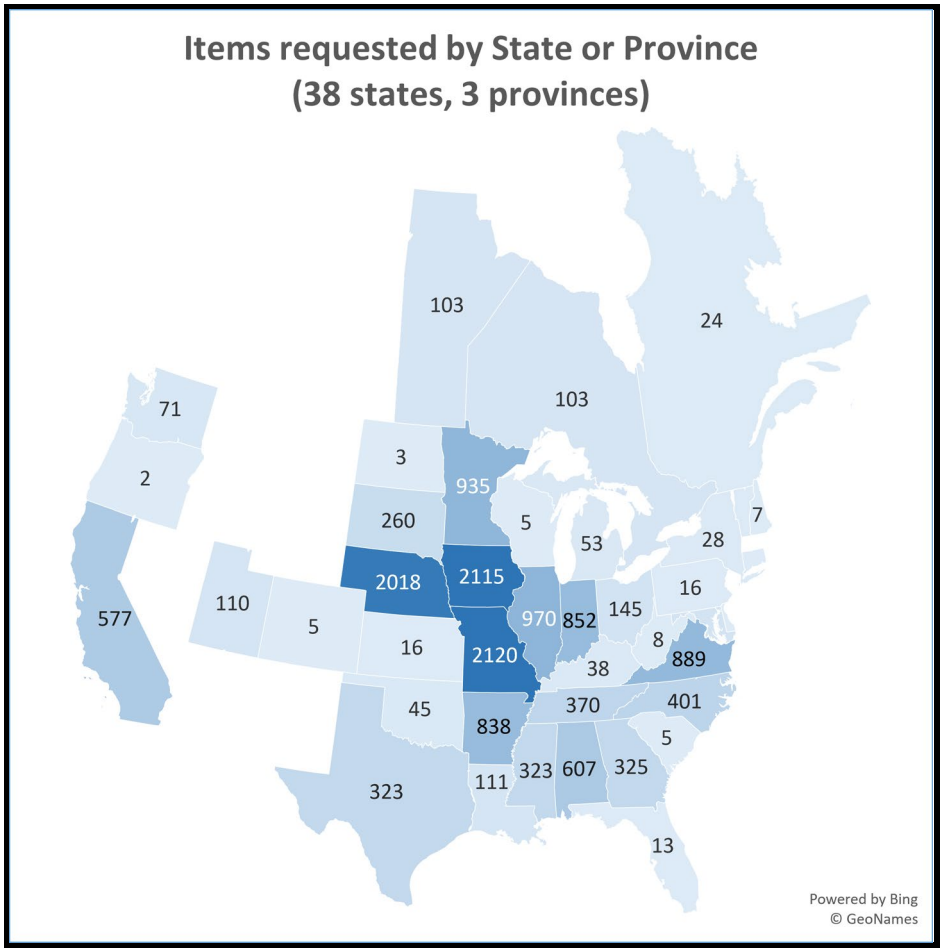
March 2020

In 2019, we distributed 16,600 seed lots from 9,174 accessions from the USDA Soybean Germplasm Collection in response to 443 requests from 317 individuals in the United States and 14 countries. This included 25 requests for 579 seed packets of 370 perennial *Glycine* accessions. We also sent backup seeds of 207 accessions to the National Center for Genetic Resources Preservation (NCGRP) and 73 accessions for storage in the Svalbard Arctic Seed Vault. Over 99% of the collection is backed up at NCGRP and 89% is backed up at the Svalbard Arctic Seed Vault.








Items requested by State or Province
(38 states, 3 provinces)
103
24
103
71
2
3
935
260
5
53
28
7
2018
2115
16
110
5
970
852
145
577
16
2120
8
889
38
45
370
401
838
5
323
111
323
607
325
13
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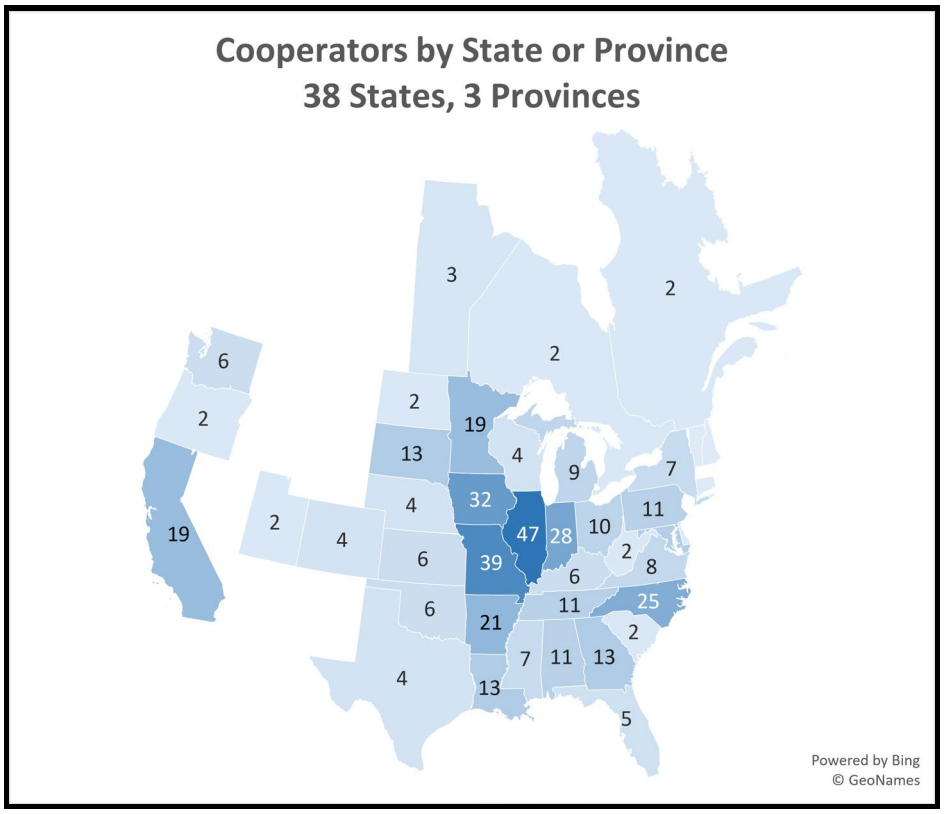
Cooperators by State or Province
38 States, 3 Provinces
3
2
2
6
2
2
19
13
4
9
7
32
4
11
19
2
4
47
28
10
2
6
39
8
6
6
11
25
21
2
7
11
13
4
13
5
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We grew 2,355 accessions of *G. max* for seed replacement in the Collection: 1,348 accessions at Urbana, Illinois, 1,007 accessions at Stoneville, Mississippi. There were also 400 accessions sent for increasing in Upala, Costa Rica planted in January, 2020.

Twenty-nine germplasm releases, three modern cultivars, seven private varieties with expired Plant Variety Protection certificates, and 3 isolines were added to the collection. Seed has been increased from 141 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 1.10.6.1 is now available at https://npgsweb.ars-grin.gov. Users can create accounts to request seed online, view their order history, or receive email updates about GRIN-Global. The shopping cart feature was utilized for 79% of the total seed requests made. The software for adding new images to GRIN Global was recently improved, and 6,898 new images including seeds, flowers, leaves, pods, and plants were uploaded.

Candidates for a new curator were recently interviewed and we are awaiting word from the MWA office on which candidate they selected. A candidate for the vacant technician position has been selected and is in the process of being hired. Some of the Randy Nelson's breeding research has been reassigned to David Walker. The current staff assigned to the Urbana soybean germplasm CRIS project are:

Vacant curator, Research Geneticist (plants)	100%
Steve Clough, Research Geneticist (plants)	50%
Esther Peregrine, Agronomist	100%
Clint Heimann, Agricultural Scientist Research Technician (plants)	100%
Todd Bedford, Program Support Assistant	100%
Vacant, Agricultural Scientist Research Technician (plants)	100%
David Neece, Molecular Biologist	50%
David Walker, Research Geneticist (plants)	50%
Gad Yousef, Biological Science Technician	50%
Nancy Sanders, Program Support Assistant OA	26%

Ram Singh retired in 2017 but returned to work part-time under an RSA. He has counted chromosomes for 88 *G. tomentella* in the collection that previously had unknown chromosome numbers.

Susan Sherman-Broyles and Jeffery Doyle, Cornell University, have offered to conduct GBS on some of the perennial Glycine accessions to help clarify taxonomic classifications. Starting with plants already growing the greenhouse, DNA from 66 accessions was collected. This will be helpful, especially for those accessions that were received simply as "Glycine" with no species specified, and also in determining isozyme groups for the *Glycine tomentella* species.

David Neece has extracted DNA from 1349 accessions that will be sent to Qijian Song, USDA, Beltsville, MD, for genotyping with the Illumina 50K SNP chip. Additional supplies have been ordered to enable more testing whenever new accessions are received, so that all will be genotyped using the same Illumina 50K SNP platform as the rest of the collection.

David Hyten has begun screening the collection with a different set of 50K SNPs under a USB grant at the University of Nebraska. The first set of 2000 accessions were sent to him in October.

Prakash Arelli, USDA, Jackson, TN, is continuing to screen the collection for resistance to soybean cyst nematode (SCN). Results for the reaction to SCN races 1 and 2 of 200 accessions were added to GRIN.

The National Plant Germplasm System will be adding transgenic cultivars to the active collection when the patents and PVPs on these cultivars expire. There are at least 5 Roundup Ready varieties off-patent with expired PVPs. General policies and procedures on how to handle such material have been established but specific procedures are still being finalized for approval by the NPGS.

Related to this, we have begun having the Illinois Crop Improvement Association test the rest of the collection for the adventitious presence of either version 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. Out of 13,672 seed lots screened, 41 tested positive. We stopped distributing these accessions and notified all cooperators who had received any of these seeds. Seven of these were 100% glyphosate tolerant and were removed from the collection. These included a germplasm line released in 2007 by the University of Georgia and six accessions received in 2014 from Vietnam and pure lined in Stoneville in 2016. One seed lot of PI 567428 tested 100% tolerant, but a backup sample from 1993 tested negative and will be used to increase this accession in 2020. The remainder of the accessions had low levels of contamination (less than 10%). Of these, 7 were grown in Urbana and 10 in Stoneville and seed harvested from plants that tested negative. Prakash Arelli sent a replacement sample of a germplasm release that had been found to be <0.35% tolerant. The remaining samples with low levels of contamination will be purified in 2020. Sampling is continuing with the goal to test all distributable seed lots but are limited by available personnel and funding. Tests for other genetically engineered traits may be needed in the future.

A seed germination chamber has been installed and germination tests were made on 942 seed lots. 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 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. The seed separator has proven useful cleaning the rounder, modern-type varieties, but it does not work very well for accessions with flat or oblong seeds. The electronics on the Almaco combines were updated to be compatible with Microsoft Windows 10.

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. Plans are to give us seeds of 400 lines in April, 2020. The Collection will provide storage and distribution services until the seed supply is exhausted.

Esther Peregrine
USDA Soybean Germplasm Collection
1101 W. Peabody Drive, Urbana, Illinois 61801

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

USDA Soybean Germplasm Collection Inventory

Annual subcollection	**Entries**
Introduced *G. max*	17545
G. soja	1179
Germplasm releases	241
Modern cultivars	556
Old cultivars	208
Private cultivars	701
All isolines	604
Pigment mutants	47
Genetic types	197
Annual subtotal	**21278**

Perennial species	**Entries**
G. *arenaria*	5
G. *argyrea*	14
G. *canescens*	151
G. *clandestina*	112
G. *curvata*	9
G. *cyrtoloba*	49
G. dolichocarpa	13
G. *falcata*	30
G. *latifolia*	53
G. *latrobeana*	7
G. *microphylla*	35
G. peratosa	7
G. *pescadrensis*	68
G. *pindanica*	4
G. *rubiginosa*	37
G. *stenophita*	27
G. syndetika	6
G. *tabacina*	184
G. *tomentella*	353
G. unknown species	48
Perennial subtotal	**1212**

Collection total 22490

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

Glycine max		
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

Glycine max		
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	18874
Insect	Beet armyworm	5
Insect	Corn Ear Worm	26
Insect	Defoliation	339
Insect	Leaf hopper injury	784
Insect	Mexican Bean Beetle damage	5046

Glycine max		
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	18965
Morphology	Hilum color	19858
Morphology	Late shattering score	12334
Morphology	Lodging	16546
Morphology	Lower leaflet ratio	15
Morphology	Mottling score	13488
Morphology	Other leaf traits	1089
Morphology	Other plant traits	343
Morphology	Other seed traits	3887
Morphology	Pod color	20052
Morphology	Pod length	15
Morphology	Pubescence color	18972
Morphology	Pubescence density	19332
Morphology	Pubescence form	18388
Morphology	Seed coat color	19904
Morphology	Seed coat luster	18617
Morphology	Seed quality	16652
Morphology	Seed shape of G. soja	15
Morphology	Seed Shape of Glycine max	8561

Glycine max		
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	758
Nematode	Cyst Nematode Race 14	2548
Nematode	Cyst Nematode Race 2	234
Nematode	Cyst Nematode Race 3	12805
Nematode	Cyst Nematode Race 4	7404
Nematode	Cyst Nematode Race 5	11627
Nematode	Reniform Nematode	125
Other	Core Subset	1685
Other	Image	4120
Phenology	Flowering	17481
Phenology	Maturity date	17473
Phenology	Maturity group	18191
Phenology	Twining date	14
Production	Yield	16511
Root	Root Fluorescence	795
Stress	Chlorosis score	4617
Stress	High temperature	520
Stress	Salt reaction	564

Glycine soja		
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

Glycine soja		
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

Glycine soja		
type	**descriptor**	**Obs**
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 G. soja	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

Glycine soja		
type	**descriptor**	**Obs**
Nematode	Cyst Nematode Race 5	547
Other	Image	1847
Phenology	Flowering	1246
Phenology	Maturity date	1245
Phenology	Maturity group	185
Phenology	Twining date	182
Stress	Chlorosis score	21

Perennial *Glycine*		
Type	**Descriptor**	**Accessions screened**
	Core subset	115
	Image	3008
Chemical	Bowman-Birk Inhibitor	560
Cytologic	Chromosome number	861
Disease	Sclerotinia stem rot	777
Disease	Sudden death syndrome	754
Morphology	Adventitious roots	319

Perennial *Glycine*		
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
G. max	18,382	5,723
G. soja	3735	1,171
Perennial G*lycine*	3,819	1,125

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	15	4	107	75	9	420	0	0	8	9	9	6	662
DAV	6	2	73	61	16	95	0	0	3	0	5	1	262
GEN	10	2	35	40	13	359	0	0	4	0	3	17	483
GSOR	30	1	64	13	1	7	0	0	0	1	14	0	131
HILO	4	0	17	6	0	45	1	0	2	1	5	2	83
MAY	7	3	14	10	0	30	0	0	0	0	0	0	64
MIA	4	5	15	28	7	72	0	0	3	1	2	0	137
NA	0	0	15	6	1	12	0	0	0	0	1	0	35
NC7	60	10	420	269	49	172	0	2	3	127	158	22	1292
NE9	7	6	67	42	10	40	0	0	4	30	24	8	238
NR6	26	0	60	29	0	66	0	1	1	0	11	2	196
NSGC	59	8	198	78	15	107	0	3	9	47	129	10	663
NSSL	14	0	4	2	2	0	0	0	0	0	0	0	22
NTSL	1	0	0	0	0	0	0	0	0	0	0	0	1
OPGC	2	1	24	15	5	9	0	0	0	5	0	0	61
PARL	0	0	12	3	0	2	0	0	0	1	3	0	21
PVPO	1	0	0	0	0	0	0	0	0	0	0	0	1
S9	66	4	287	95	38	217	0	0	10	45	99	12	873
SOY	58	1	227	88	3	29	0	0	1	13	23	0	443
TOB	6	2	37	15	0	4	0	0	0	4	4	1	73
W6	79	11	336	179	43	277	0	0	5	38	75	31	1074

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	108	29	2269	1299	125	3119	0	0	335	595	653	43	8575
DAV	624	115	4383	785	168	727	0	0	40	0	42	2	6886
GEN	1265	3	1314	412	197	4543	0	0	123	0	34	68	7959
GSOR	1197	1	3239	230	1	39	0	0	0	14	79	0	4800
HILO	8	0	45	16	0	102	4	0	9	10	34	7	235
MAY	28	6	43	53	0	66	0	0	0	0	0	0	196
MIA	15	8	86	238	20	261	0	0	73	13	17	0	731
NA	0	0	43	18	5	22	0	0	0	0	1	0	89
NC7	1822	45	19583	6400	613	3099	0	43	20	14705	6763	823	53916
NE9	439	479	2132	1193	61	693	0	0	30	3908	1259	47	10241
NR6	1053	0	1538	1288	0	659	0	112	7	0	558	29	5244
NSGC	3848	68	6358	3610	145	2272	0	264	849	1054	10593	2257	31318
NSSL	67	0	91	15	668	0	0	0	0	0	0	0	841
NTSL	150	0	0	0	0	0	0	0	0	0	0	0	150
OPGC	3	1	169	132	55	34	0	0	0	30	0	0	424
PARL	0	0	132	37	0	5	0	0	0	6	201	0	381
PVPO	32	0	0	0	0	0	0	0	0	0	0	0	32
S9	3734	27	11406	4359	3760	2505	0	0	233	2003	6253	374	34654
SOY	1579	2	10327	2671	7	143	0	0	30	631	1210	0	16600
TOB	9	2	97	34	0	27	0	0	0	51	24	20	264
W6	3977	50	13304	5253	2438	2570	0	0	67	4624	3869	879	37031