The United States Potato Introduction Station Herbarium

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John B. Bamberg[1] & David M. Spooner[2]

Summary

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The United States Potato Introduction Station Herbarium at Sturgeon Bay, Wisconsin, serves the National Research Support Program-6 (NRSP-6; formerly known as the Inter-Regional Potato Introduction Project IR-1). NRSP-6 is part of the United States germplasm system and is the sole genebank for wild and cultivated potatoes in the United States. The genebank and herbarium are devoted entirely to wild and cultivated potatoes (*Solanum* sect. *Petota*). NRSP-6 is charged with the introduction, preservation, classification, evaluation, and distribution of potato germplasm worldwide. Recent expeditions and grants for upgrading the herbarium and associated facilities have provided a valuable new international resource for researchers in *S.* sect. *Petota*.

Introduction

Solanum tuberosum (Solanaceae) is one species of a group of seven cultivated and 216 additional tuber-bearing plus nine non-tuber-bearing wild relatives, classified by Hawkes (1990) in *S.* sect. *Petota*. An alternate classification (Child, 1990) separates the non-tuber-bearing species into *S.* sect. *Etuberosa* (Bukasov & Kameraz) A. Child, sect. *Juglandifolia* (Rydb.) A. Child, and sect. *Lycopersicum* (Mill.) Wettst. This separation is supported by morphology and chloroplast DNA (Child, 1990; Spooner & al., 1993a). *S.* sect. *Petota* is distributed from the southwestern United States to southern Chile. In total, 72 taxonomists have described 531 taxa as new in *S.* sect. *Petota* (Spooner & Van den Berg, 1992).

The taxonomy and distribution of types and other herbarium material of *Solanum* sect. *Petota* are outlined in a comprehensive treatment (Correll, 1962), regional treatments (e.g., Hawkes & Hjerting, 1969, 1989; Ochoa, 1990), or individual taxonomic studies (e.g., Spooner & al., 1993b; Van den Berg & Spooner, 1992). Although types and other specimens are distributed world-wide, they are concentrated in herbaria of taxonomists of the group, including Friedrich A. G. Bitter at W; Donovan Correll at LL; John "Jack" G. Hawkes in his personal herbarium (soon to be transferred to K [personal letter from Hawkes]); Carlos Ochoa in his personal herbarium in Lima, Peru, and in the herbarium of the International Potato Center (Centro Internacional de la Papa) in Lima, Peru, and Andrea Clausen and Katsuo A. Okada at BAL. Few herbaria are devoted almost entirely to collections in *S.* sect. *Petota*. Exceptions include BAL, the International Potato Center, the personal herbaria of Hawkes and Ochoa, and the newly upgraded herbarium described here, the United States Potato Introduction Station Herbarium at Sturgeon Bay, Wisconsin (PTIS [acronym approved for publication in next edition of *Index herbariorum*]).

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PTIS serves the National Research Support Program-6 (NRSP-6), formerly known as the Inter-Regional Potato Introduction Project (IR-1). NRSP-6 is responsible for the introduction, preservation, classification, distribution, and preliminary evaluation of the germplasm of *Solanum* sect. *Petota*. NRSP-6 is part of the United States germplasm system and is the sole genebank for wild and cultivated potatoes in the United States. It complements genebanks in other countries devoted partially or primarily to wild and cultivated potatoes, including the Instituto Nacional de Tecnología y Agropecuaria, Balcarce, Argentina; the Universidad Austral de Chile, Valdivia, Chile; the Colección Central Colombiana, Bogotá, Colombia; the Institut für Pflanzenbau, Landwirtschaftswissenschaften, Gross-Lüsewitz, Germany; the Centro Internacional de Papa, Lima, Peru; the Commonwealth Potato Collection, Dundee, Scotland, United Kingdom; and the N. I. Vavilov Institute of Plant Industry, St. Petersburg, Russia (Hawkes, 1990). These germplasm collections are maintained because of the proven and potential disease resistances and other important agronomic traits present in the cultivated landraces and wild species of potato (Ross, 1986; Hanneman, 1989; Plaisted & Hoopes, 1989). They are being actively used in breeding and many other studies world-wide. Since 1950, NRSP-6 has distributed 150,000 samples of germplasm, but demand has increased so rapidly that orders within the past ten years account for nearly half this total. NRSP-6 germplasm has been used in more than 1,765 published research papers and 190 masters or Ph.D. theses (Spooner & Bamberg, 1991).

NRSP-6 currently maintains 4,308 accessions of 146 (160 taxa, including subspecies) of the 232 species listed in Hawkes (1990). The collection has many accessions for some species (e.g., *Solanum acaule* with 403 accessions, and *S. tuberosum* subsp. *andigena* with 803 accessions). Forty-three percent of the species in the collection have only one to five accessions. Some collections cover only a fraction of their entire range. NRSP-6 maintains an active collecting and research program related to these species.

Herbarium facilities

The herbarium cabinet room contains nine new full-height steel herbarium cabinets and a table for specimen preparation and examination. It is vented outside of the building to allow periodic fumigation of the entire room. In addition, there are two full-height steel herbarium cabinets in the offices of the NRSP-6 taxonomist at the Department of Horticulture, University of Wisconsin, Madison. Both locations also have quarter-height sealed wooden cabinets to accommodate oversize herbarium sheets. The herbarium office includes a computer, and all germplasm and herbarium holdings are entered on a DBASE IV file, freely available upon request. The work room contains a modern stereoscopic microscope with fiber optic ring light illumination and a boom stand, and a modern optical microscope with oil immersion objectives and a camera adaptor.

The topographic and road maps are a valuable component of the herbarium and essential for field planning and exploration. They were purchased from domestic sources and in-country, during recent germplasm collecting expeditions to Mexico, 1988; Chile, 1989; Argentina and Chile, 1990; Ecuador, 1991; Colombia and Venezuela, 1992; and Bolivia, 1993. 1994. This collection incorporates nearly complete coverage for Mexico, Central America, and Chile, and coverage for Andean South

Table 1. Germplasm accessions (Acc.) and herbarium vouchers (HV) maintained at the National Research Support Program-6.

Taxon	Acc.	Acc. with HV	Sheets[1]
Solanum abancayense Ochoa	3	3	28
S. acaule Bitter subsp. *acaule*	362	331	1206
S. acaule subsp. *aemulans* (Bitter & Wittm.) Hawkes & Hjert.	16	12	58
S. acaule subsp. *punae* (Juz.) Hawkes & Hjert.	25	23	80
S. achacachense Cárdenas	1	1	6
S. acroglossum Juz.	2	2	12
S. acroscopicum Ochoa	3	3	13
S. agrimonifolium Rydb.	12	10	47
S. ajanhuiri Juz. & Bukasov	1	1	1
S. alandiae Hawkes & Hjert.	13	11	47
S. albicans (Ochoa) Ochoa	13	11	58
S. albornozii Correll	5	4	11
S. ambosinum Ochoa	14	11	59
S. amabile Vargas	1	1	1
S. andreanum Baker	22	3	19
S. arnezii Cárdenas	5	4	18
S. *astleyi* Hawkes & Hjert.	2	2	16
S. avilesii Hawkes & Hjert.	3	3	10
S. berthaultii Hawkes	58	54	221
S. blanco-galdosii Ochoa	4	4	11
S. boliviense Dunal	13	12	75
S. brachistotrichum (Bitter) Rydb.	26	22	76
S. brachycarpum Correll	34	32	141
S. brevicaule Bitter	15	15	101
S. brevidens Phil.	72	70	274
S. buesii Vargas	1	0	0
S. bukasovii Juz.	81	36	154
S. bulbocastanum Dunal subsp. *bulbocastanum*	39	37	145
S. bulbocastanum subsp. *dolichophyllum* (Bitter) Hawkes	6	6	33
S. bulbocastanum subsp. *partitum* (Correll) Hawkes	2	2	7
S. cacetanum Ochoa	2	2	2
S. cajamarquense Ochoa	2	2	5
S. canasense Hawkes	28	28	151
S. candolleanum P. Berthault	6	5	26
S. capsicibaccatum Cárdenas	4	4	29
S. cardiophyllum Lindl. subsp. *cardiophyllum*	13	6	21
S. cardiophyllum subsp. *ehrenbergii* Bitter	25	19	50
S. chacoënse Bitter	138	120	468
S. chancayense Ochoa	2	2	22
S. chilliasense Ochoa	1	1	1
S. chiquidenum Ochoa	7	3	10
S. chomatophilum Bitter	19	10	68
S. circaeifolium Bitter subsp. *circaeifolium*	4	3	28

[1] This number does not include the many originally collected duplicates or specimens later grown from the germplasm collection and deposited outside of PTIS, either in various herbaria in countries in which they were collected or at the International Potato Center in Lima, Peru, LL, WAG, WIS, and the personal herbaria of J. G. Hawkes and C. Ochoa.

Table 1 (continued).

Taxon	Acc.	Acc. with HV	Sheets
S. circaeifolium subsp. *quimense* Hawkes & Hjert.	4	4	22
S. clarum Correll	6	4	15
S. colombianum Dunal	52	18	61
S. commersonii Dunal subsp. *commersonii*	20	17	78
S. commersonii subsp. *malmeanum* (Bitter) Hawkes & Hjert.	25	24	85
S. contumazaënse Ochoa	1	0	0
S. curtilobum Juz. & Bukasov	7	7	28
S. demissum Lindl.	144	143	593
S. doddsii Correll	11	11	51
S. dolichocremastrum Bitter	4	4	23
S. donachui (Ochoa) Ochoa	0	0	1
S. edinense P. Berthault	1	0	0
S. etuberosum Lindl.	30	30	133
S. fendleri A. Gray subsp. *fendleri*	67	55	184
S. fendleri subsp. *arizonicum* Hawkes	7	7	35
S. fernandezianum Phil.	7	2	13
S. flahaultii Bitter	2	0	11
S. gandarillasii Cárdenas	6	5	30
S. garcia-barrigae Ochoa	2	0	3
S. gourlayi Hawkes subsp. *gourlayi*	165	149	580
S. gourlayi subsp. *pachytrichum* Hawkes (Hawkes & Hjert.)	7	7	35
S. gourlayi subsp. *vidaurrei* (Cárdenas) Hawkes & Hjert.	16	16	74
S. guerreroënse Correll	2	2	12
S. hastiforme Correll	1	0	0
S. hjertingii Hawkes	11	11	70
S. hondelmannii Hawkes & Hjert.	17	17	84
S. hoopesii Hawkes & K. A. Okada	2	2	12
S. hougasii Correll	12	11	52
S. huancabambense Ochoa	5	5	31
S. hypacrarthrum Bitter	1	1	3
S. immite Dunal	4	2	5
S. incamayoënse K. A. Okada & A. M. Clausen	8	8	35
S. infundibuliforme Phil.	125	103	352
S. iopetalum (Bitter) Hawkes	11	11	60
S. irosinum Ochoa	1	0	0
S. jamesii Torr.	34	22	69
S. juglandifolium Dunal	8	0	4
S. juzepczukii Bukasov	1	1	1
S. kurtzianum Bitter & Wittm.	90	82	303
S. laxissimum Bitter	2	2	10
S. leptophyes Bitter	26	26	151
S. lesteri Hawkes & Hjert.	3	3	9
S. lignicaule Vargas	4	4	22
S. limbaniense Ochoa	1	1	10
S. lobbianum Bitter	3	0	2
S. longeconicum Bitter	2	1	6
S. lycopersicoides Dunal	5	2	10
S. maglia Schltdl.	2	2	6

Table 1 continued.

Taxon	Acc.	Acc. with HV	HV Sheets
S. marinasense Vargas	13	13	42
S. matehualae Hjert. & T. R. Tarn	2	1	6
S. medians Bitter	9	9	34
S. megistacrolobum Bitter	136	130	566
S. michoacanum (Bitter) Rydb.	1	1	4
S. microdontum Bitter subsp. *microdontum*	38	36	233
S. microdontum subsp. *gigantophyllum* (Bitter) Hawkes & Hjert.	49	47	313
S. mochiquense Ochoa	4	4	24
S. morelliforme Bitter & G. Muench	18	7	9
S. moscopanum Hawkes	18	6	47
S. multidissectum Hawkes	12	11	47
S. multiinterruptum Bitter	9	9	26
S. nayaritense (Bitter) Rydb.	6	3	7
S. neocardenasii Hawkes & Hjert.	2	2	14
S. neorosii Hawkes & Hjert.	5	5	23
S. nubicola Ochoa	1	1	2
S. ochranthum Dunal	12	3	8
S. okadae Hawkes & Hjert.	16	16	50
S. oplocense Hawkes	58	44	177
S. orocense Ochoa	1	0	3
S. otites Dunal	2	0	0
S. oxycarpum Schiede	11	9	29
S. pampasense Hawkes	5	5	25
S. pamplonense L. E. López	2	2	2
S. papita Rydb.	29	28	143
S. paramoënse Bitter	1	0	9
S. pascoënse Ochoa	1	1	4
S. paucijugum Bitter	8	6	13
S. paucisectum Ochoa	2	2	12
S. phureja Juz. & Bukasov subsp. *phureja*	130	119	404
S. pinnatisectum Dunal	16	16	65
S. piurae Bitter	3	3	8
S. polyadenium Greenm.	21	21	99
S. polytrichon Rydb.	37	35	149
S. raphanifolium Cárdenas & Hawkes	36	34	168
S. rechei Hawkes & Hjert.	3	2	3
S. regularifolium Correll	1	1	1
S. sanctae-rosae Hawkes	12	9	38
S. santolallae Vargas	2	2	22
S. scabrifolium Ochoa	1	1	5
S. schenckii Bitter	12	11	63
S. sitiens I. M. Johnst.	7	0	0
S. soestii Hawkes & Hjert.	0	4	4
S. sogarandinum Ochoa	2	2	13
S. solisii Hawkes	1	1	6
S. sparsipilum (Bitter) Juz. & Bukasov	65	64	309
S. spegazzinii Bitter	62	56	192
S. stenotomum Juz. & Bukasov subsp. *stenotomum*	18	16	60

Table 1 continued.

Taxon	Acc.	Acc. with HV	HV Sheets
S. stenotomum subsp. *goniocalyx* (Juz. & Bukasov) Hawkes	5	5	17
S. stoloniferum Schltdl. & Bouchet	122	120	488
S. subpanduratum Ochoa	1	0	0
S. sucrense Hawkes	37	30	103
S. sucubunense Ochoa	1	1	1
S. tarijense Hawkes	64	62	305
S. tarnii Hawkes & Hjert.	11	8	46
S. toralapanum Cárdenas & Hawkes	35	33	160
S. trifidum Correll	14	13	47
S. tuberosum L. subsp. *tuberosum*	42	11	32
S. tuberosum subsp. *andigena* Hawkes	803	589	1769
S. tuquerrense Hawkes	13	9	44
S. tundalomense Ochoa	4	2	11
S. ugentii Hawkes & K. A. Okada	3	3	9
S. venturii Hawkes & Hjert.	4	3	13
S. vernei Bitter & Wittm. subsp. *vernei*	29	22	85
S. vernei subsp. balsii (Hawkes) Hawkes & Hjert.	9	9	37
S. verrucosum Schltdl.	38	33	149
S. violaceomarmoratum Bitter	7	7	33
S. weberbaueri Bitter	2	2	15
S. yungasense Hawkes	3	3	3
Unidentified	91	66	239
Total: 146 species (160 taxa)	4,308	3,582	14,270

America. Most topographic maps are at a scale of 1 : 250,000, except Ecuador at 1 : 50,000, or Venezuela and Colombia at 1 : 100,000-scale and 1 : 250,000-scale. Most topographic maps are bound into separate books for each country and filed in a map cabinet.

The herbarium also includes all of the United States Department of Interior gazetteers of place names for all of the above countries, and various other gazetteers and atlases purchased in foreign countries. It also has a collection of all regional and comprehensive taxonomic treatments of *Solanum* sect. *Petota* and all original descriptions of its 531 named taxa. The map, gazetteer, and atlas coverage is expanded as field trips progress.

Herbarium holdings

Table 1 lists current holdings at PTIS. All collections are of *Solanum* sect. *Petota* (sensu Hawkes, 1990). While there are many disagreements regarding species boundaries and affiliations of species to series in *S.* sect. *Petota* (Spooner & Van den Berg, 1992), the list in Table 1 largely follows the latest comprehensive taxonomic treatment (Hawkes, 1990), but does not assign species to series. Some species merged into synonymy by Hawkes (1990) are nevertheless listed if contributed by

Carlos Ochoa under a synonymized name. When there is disagreement regarding identification of a NRSP-6 collection between different taxonomists, we use the name provided by the donor. We think that as taxonomic studies continue, there will be changes in identification and fewer recognized species in *S.* sect. *Petota.*

Most specimens are vouchers of the germplasm collection. The major contributors of the collections are listed in Bamberg & Martin (1993), Hanneman (1989), and Spooner & Bamberg (1991). The herbarium maintains two classes of herbarium specimens: (1) original specimens collected in the field on germplasm collecting expeditions, and (2) grow-outs of the germplasm collections grown in the experimental plots at Sturgeon Bay. Additionally, it serves as a temporary depository for specimens on loan for taxonomic studies. Photographs are made of all type material before it is returned from loan for taxonomic studies (e.g., Spooner & al., 1993b; Van den Berg & Spooner, 1992). The herbarium currently has photographs of 105 holotype or isotype specimens of 85 names of taxa in *Solanum* sect. *Petota.* Long-term plans are to expand this photographic collection to all available nomenclatural types. In total, PTIS currently maintains 14,270 specimens of 3,582 accessions (many accessions are collected more than once), 300 additional voucher specimens of interspecific crosses conducted at NRSP-6, and 313 additional herbarium specimens of *S. sect. Petota* not represented by germplasm collections.

Herbarium policies

The herbarium and all associated facilities are open year-round during normal working hours and accessible to all interested researchers. The herbarium is staffed full-time by John Bamberg, the Director of NRSP-6 [Tel.: (+1-414) 743-5406; Fax: (+1-414) 743-1080; email: nr6jb@sol.ars-grin.gov], and, during four-six weeks each year (August and September), by David Spooner, the NRSP-6 taxonomist [Tel.: (+1-608) 262-0159; Fax: (+1-608) 262-4743; email: dspooner@macc.wisc.edu). Contact Bamberg regarding requests for the catalog of germplasm (Bamberg & Martin, 1993) or for germplasm samples. Both are available free. Also contact Bamberg regarding regulations for donations of potato germplasm, which must first pass through United States quarantine. Contact Spooner regarding herbarium loans. Specimens of *Solanum* sect. *Petota* as gifts for determination are welcome. While one herbarium voucher must remain at NRSP-6 to serve the daily needs of the genebank, duplicate herbarium specimens are available for short-term loan.

Acknowledgements

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