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Wild potato (*Solanum* sect. *Petota*) germplasm collecting expedition to Argentina in 1990, and status of Argentinian potato germplasm resources

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Summary

A joint Argentina/United States expedition collected wild potato (*Solanum* sect. *Petota*) germplasm in Argentina between February 4 – 28 and March 28 – April 18, 1990. This was followed by a short expedition between February 27 and March 3, 1991. Collections were made in the Andes Mountains from southern Tucumán Province (27°20′ S), south to southern Rio Negro Province (40°52′ S) and comprised 88 lots of germplasm of ten species, 76 as true-seed and 12 as tubers. The most important new collections included germplasm of *S. brevidens*, *S. maglia*, *S.* × *rechei* and *S. venturii*. By summarizing details of these collections with those of existing collections, we have been able to suggest future collecting in Argentina.

Introduction

Prior to the expedition described in this paper, the Inter-Regional Potato Introduction Project (IR-1) at Sturgeon Bay, Wisconsin, USA, maintained 4460 germplasm accessions (data from Hanneman & Bamberg (1986), including tuber collections, previously unlisted accessions, and new collections from Mexico, 1988, and Chile, 1989; Spooner et al., 1991a,b). Of these, 1243 (28%) were from Argentina (Table 1), a surprisingly high proportion since *Solanum* sect. *Petota* is widely distributed in 16 countries from the southwestern United States to southern Chile (Correll, 1962; Hawkes, 1990). Argentina thus represents one of the best collected countries and the extensive collections from there have largely been made by K.A. Okada and his former colleagues at the Instituto Nacional de Tecnologia Agropecuaria (INTA; the National Institute of Agricultural Technology), in Balcarce, Argentina (Okada, 1976; Okada & Clausen, 1984), together with collections by J.G. Hawkes, J.P. Hjerting, W. Hoffman, E. Petersen, K. Rahn and others (Hawkes & Hjerting, 1969; Hanneman & Bamberg, 1986). For some Argentinian species, however, there were only a few germplasm accessions (Table 1). The focus of this expedition to Argentina was to collect *S. brevidens*, *S. maglia*, *S.* × *rechei*, *S. venturii* (with known localities in Argentina) and to search for *S. etuberosum* which we suspected to occur in Argentina.

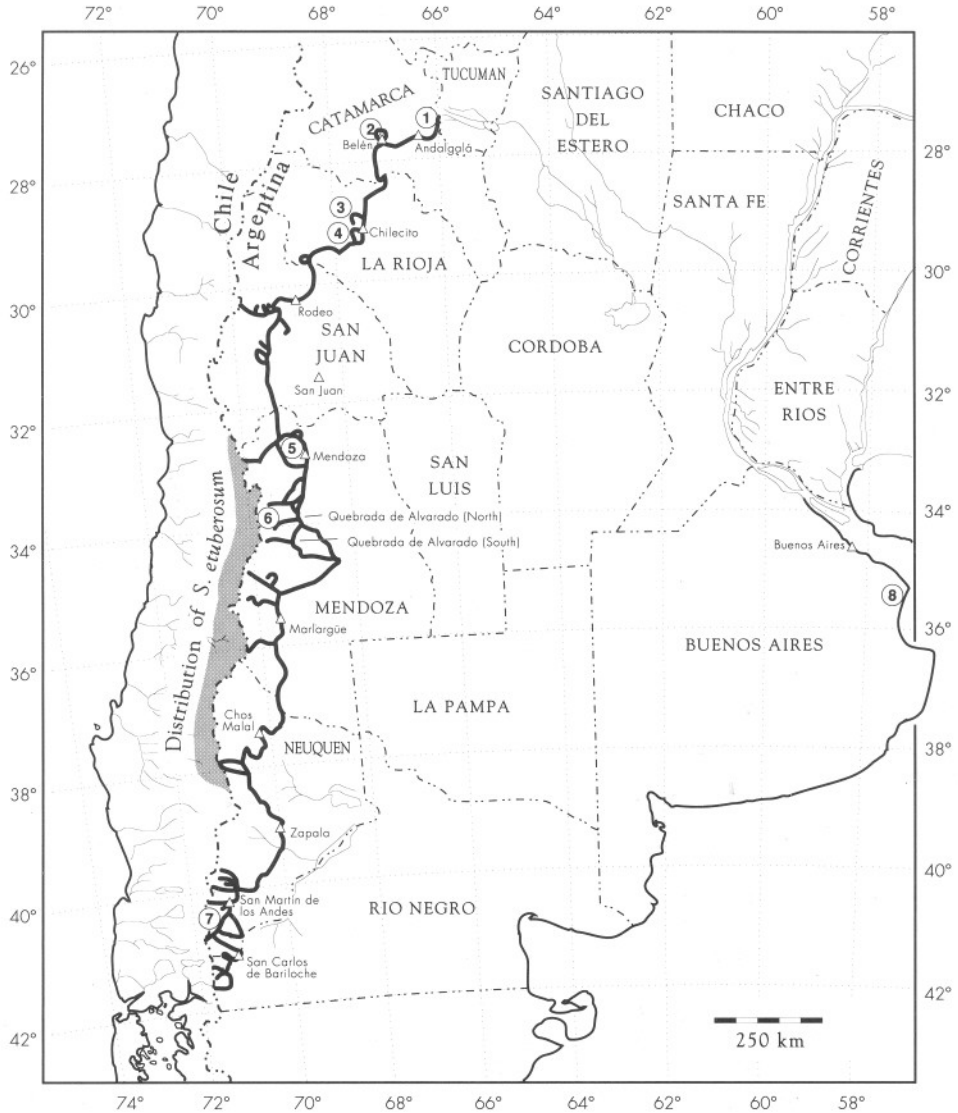

Fig. 1. Map of routes of the 1990 Argentina expedition. The numbers refer to generalized collection sites (see Table 1).

Materials and methods

Although collecting priorities were *S. brevidens* and *S. maglia*, two species collected in Chile in 1989 (Spooner et al., 1991b), we took advantage of our location both to search for *S. etuberosum*, *S.* × *rechei*, and *S. venturii*, and to collect any other

species. We obtained locality data from INTA Balcarce and IR-1, which we supplemented by the localities given by Hawkes & Hjerting (1969) and advice provided by J. Hawkes and K.A. Okada. We purchased all available 1:250 000 and 1:1 000 000 scale topographic maps from the Instituto Geográfico Militar in Argentina and supplemented them by individual province road maps from the Automóvil Club Argentino.

Results

We collected from February 4 – 28 and from March 28 – April 18, 1990, in the Andes Mountains, from southern Tucumán Province (27°20' S) south to Río Negro Province (40°52' S). We also made one collection of *S. chacoense* in Buenos Aires Province (Fig. 1). In the intervening period, Spooner, together with Andrés Contreras (Universidad Austral de Chile, Valdivia) and his colleagues, collected *S. tuberosum* in southern Chile; these collections will be reported separately. Subsequently we learned of another report of *S. maglia* in Argentina by Brücher (1965), so Clausen returned to Mendoza Province between February 27 and March 3, 1991, to collect both this species and *S. kurtzianum*.

We collected 88 germplasm accessions of 10 species, 76 as true seed and 12 as tubers. True seed were unavailable from some populations, so we collected tubers from which Clausen grew plants and later intercrossed them at INTA Balcarce to produce true seeds. Such collections are listed as true seed collections in this account. The most important new collections include *S. brevidens*, *S. maglia*, *S.* × *rechei* and *S. venturii* and details of these are summarized together with those of previous collections to provide a current list of all Argentinian potato germplasm (Table 1). Detailed reports are on file at INTA Balcarce, IR-1, the USDA, ARS Germplasm Services Laboratory in Beltsville, Maryland, the University of Wisconsin Depts. of Botany and Horticulture, and the International Potato Center (CIP). All the new germplasm and herbarium collections were divided equally between INTA, Balcarce and IR-1. Expected dates of germplasm availability from INTA and IR-1 are late 1993 for the germplasm collected as seed, and late 1994 for the tuber collections.

Discussion

Comments on collected species

Solanum acaule ssp. *aemulans*. *S. acaule* was divided into three sub-species by Hawkes (1990) and into two varieties by Ochoa (1990). Both authors accept the *aemulans* taxon. We follow Hawkes (1990) for convenience because his is the latest work to treat all of the Argentinian species.

Solanum acaule ssp. *aemulans* is restricted to two small areas in the Provinces of Jujuy and La Rioja. Of the 17 previous collections of ssp. *aemulans* at INTA Balcarce (Table 1), ten were from Jujuy Province and seven were from La Rioja Province. Our eight new collections cover the entire known distribution in the La Rioja populations, including a topotype collection (*Spooner & Clausen 4594*). The species thrives in highly disturbed areas grazed by cattle (Ugent, 1981) and is common in the area. We easily located mature to rotting berries, but most leaves were withered when we visited on April 6 – 8, and collections for herbarium specimens should be made earlier.

Table 1. Summary of collections of *Solanum* sect. *Petota* from the 1990 Argentina trip[1] and total Argentinian holdings at Balcare, Argentina and Sturgeon Bay, Wisconsin, USA.

Species[2]	1990 Expedition				Elevations (a)	Total accessions	
	Map[3] location	Seeds	Tubers	Hebarium[4] spec.		BAL	IR-1[5]
S. acaule ssp. *aemulans* (Bitter et Wittm.) Hawkes et Hjert	3	8	0	5	2800–3610	217[6]	225[6]
S. boliviense Dunal	–	0	0	0	–	9	0
S. brevidens Philippi	7	23	0	23	675–1180	24	24
S. commersonii Dunal	–	0	0	0	–	40	30
S. chacoense Bitter	4 8	1	0	2	5–1620	87	100
S. gourlayi Hawkes	–	0	0	0	–	255	139[7]
S. incamavoense Okada et Clausen	–	0	0	0	–	9	5
S. infundibuliforme Philippi	–	0	0	0	–	111	108
S. kurtzianum Bitter et Wittm.	4 5 6	29	0	27	1005–2330	117	102
S. maglia Schldl.	6	0	5	5	1630–1820	5	1
S. megistacrolobum Bitter	–	0	0	0	–	103	99
S. microdontum Bitter	1	10	0	10	1650–2505	62	73
S. neorossii Hawkes et Hjert.	–	0	0	0	–	2	4
S. okadae Hawkes et Hjert.	–	0	0	0	–	3	7
S. oplocense Hawkes	–	0	0	0	–	43	28
S. × *rechei* Hawkes et Hjert.	4	1	4	5	1720–1840	9	5
S. sanctae-rosae Hawkes	–	0	0	0	–	9	12
S. spegazzinii Bitter	2	1	1	2	1830–1850	82	62
S. tarijense Hawkes	–	0	0	0	–	48	43
S. tuberosum ssp. *andigena* (Juz. et Buk.) Hawkes	–	0	0	0	–	345	109
S. venturii Hawkes et Hjert.	1	1	0	2	2140–2505	16[8]	4[8]
S. vernei Bitter et Wittm.	1	2	0	0	2200–2350	39	35
Putative interspecific hybrids	–	–	–	–	–	35	26
Not identified	3	0	2	2	1520–2665	16[9]	18[9]

Footnotes to Table 1

[1] The *S. maglia* and *S. kurtzianum* from map location 6 (Fig. 1) were collected in March, 1991.
[2] These include the species accepted in Hawkes (1990).
[3] See Fig. 1.
[4] Specimens deposited at BAL, WIS, and the herbarium at IR-1 (here informally designated at PTIS).
[5] The majority of the IR-1 accessions are duplicates of those at BAL.
[6] These figures are for all accession of *S. acaule*. The figures for ssp. *aemulans* are 25 and 24 respectively.
[7] These include *S. vidaurrei*.
[8] Some of these accessions may be misidentified as the very similar species *S. okadae*.
[9] These accessions include taxa being considered for descriptions as new species and unknown taxa.

Solanum brevidens. Prior to our expedition, there were only two germplasm collections of this species from Argentina, one at IR-1, *Diem s.n.* (seeds given by J. Diem to E. Petersen and J.P. Hjerting and numbered *1890* by them, see Hawkes & Hjerting, 1969, p. 133; Hanneman & Bamberg, 1986) and another at INTA Balcarce, *Delhey s.n.*; the precise locality of this last collection is unknown. A third collection listed in Hanneman & Bamberg (1986), *EBS 388*, has no locality data and may be from Argentina. Our 23 new collections cover the entire distribution of this species as outlined in Hawkes & Hjerting (1969). Efforts to locate new populations to the north, east, and south were unsuccessful. These collections, with 50 new collections made in Chile in 1989 by Spooner and Contreras (Spooner et al., 1991b) increase our germplasm holdings of this species to 77.

Solanum etuberosum. There are no undisputed reports of *S. etuberosum* from Argentina, but we suspected it occurred there for two reasons. First, Hawkes & Hjerting (1969, Appendix III) report a specimen of *S. etuberosum* from Mendoza Province, Cordillera del Atuel (*Kurtz 10081*), deposited in the herbarium of the Universidad Nacional de Córdoba. They discounted this report as a possible confusion with a Chilean locality, because the Cordillera del Atuel is near the border with Chile. *S. etuberosum* was not listed in a subsequent flora of this region (Böcher et al., 1968), but no mention was made of *Kurtz 10081* and it may have been overlooked. Second, *S. etuberosum* was located in 1989 (*Spooner 4490*) in Chile within 3 km (by air) west of the border with Argentina at Paso de Copahue (Spooner et al., 1991b). Eleven days of intensive searches in Argentina, adjacent to the Chilean distributions, including the Cordillera del Atuel and Paso de Copahue (Fig. 1), failed to locate it. The habitats on the eastern slopes of the Andes in Argentina are generally drier than those on the western slopes in Chile, but many streamside habitats occur in Argentina that appear similar to those in Chile where *S. etuberosum* grows. Our failure to locate *S. etuberosum* in the Cordillera del Atuel and elsewhere in Argentina, combined with the lack of a report in Böcher et al. (1968), support Hawkes & Hjerting's (1969) contention that *Kurtz 10081* was mislabelled for Argentina.

Solanum maglia. This species has an interesting distribution. It grows only in isolated moist habitats along the coast of Chile (approximate latitudes 30° S – 33°30′S), and in a single valley in Argentina, Mendoza Province, Quebrada de Alvarado (quebrada = gorge or ravine), at the base of the Andes Mountains (Hawkes & Hjerting, 1969; Contreras, 1987; Spooner et al., 1991b). Efforts by Hawkes & Hjerting (1969) to relocate the species in Argentina were unsuccessful. We located Quebrada de Alvarado on the Automóvil Club Argentino Province of Mendoza road map at approximately 34°15′ S. This valley was prominently labelled at its entrance by a sign. We searched this area intensively on two visits totalling three days (February 11 – 12, March 29) without finding any wild potatoes. A major discrepancy between this locality and that of the prior Argentinian collections was the elevation. The Argentinian collections indicated an elevation of 1500 m, but this "Quebrada de Alvarado", occurred at 2200 – 3000 m. After completion of the expedition, we learned of an earlier report of this species from Argentina (Brücher, 1965). Clausen was unable to contact Brücher but contacted Fidel Roig, a noted botanist from Mendoza Province, who supplied her with an out of print 1:1 000 000 scale Instituto Geográfico Militar topographic map dated 1947 that showed a separate "Quebrada de Alvarado",

about 20 km by air, north (33°59′S, 69°15′W) of the one we had searched. Clausen returned on February 27 – March 3 and made five collections of *S. maglia* along the floor of the gorge, between 1630 and 1820 m, along a distance of 5 km (five new collections of *S. kurtzianum* also were made outside the gorge at this time). This gorge, unlike any other gorge we searched on our expedition, was deep and narrow with habitats shaded throughout the day. *S. maglia* was abundant in many places and it is possible that the species is limited in Argentina to this gorge. The populations flowered freely, but no fruits were found. Mitotic chromosome counts made by Clausen of two of the populations (*Clausen & Masuelli 869, 870*) were diploid ($2n = 24$), in agreement with prior reports from the Argentinian populations. Except for two diploid populations, all of the Chilean populations known cytologically are triploid ($2n = 3x = 36$, Hawkes & Hjerting, 1969).

Solanum × *rechei*. This taxon was originally described as a non-hybrid taxon from the Sierra de Famatina, La Rioja Province (Hawkes, 1963). Later field studies showed that it occurred in association with *S. microdontum* ssp. *gigantophyllum* and *S. kurtzianum*, and that the populations exhibited reduced fertility. *Solanum* × *rechei* was later designated as a natural hybrid (Hawkes & Hjerting, 1969; Okada & Hawkes, 1978; Okada, 1981; Brücher, 1989). We found what we tentatively identify as *S. kurtzianum* and *S.* × *rechei*, occurring sympatrically in the Sierra de Famatina. These two species are remarkably similar and differ mainly in the width of their leaflets (*S.* × *rechei* is wider). We failed to locate *S. microdontum* in this area. Of our five collections of *S.* × *rechei*, one produced fruits with seeds (*Spooner & Clausen 4577*) and the others lacked fruits. Of the seven populations of *S. kurtzianum* found in this area (the other populations were collected in Mendoza Province), three produced fruits with seeds and four lacked fruits. When these populations were later grown at INTA Balcarce in a screenhouse, all of the *S. kurtzianum* were highly fertile (>85% pollen stainability) but the pollen stainability of the *S.* × *rechei* ranged from 0 to 60%. Recent molecular studies in plants (Rieseberg et al., 1988), and in *Solanum* sect. *Petota* in particular (Spooner et al., 1991c), are questioning hypotheses of hybrid speciation. Clausen and Spooner are currently conducting morphological, cytological, and molecular studies on these collections to reinvestigate the hypothesis of hybridogenetic origin of *S.* × *rechei*.

Solanum venturii. This collection in Catamarca Province is the first germplasm collection of this species from the Sierra del Aconquija, as the other collection (*EBS 457*) was found growing just to the north in Tucumán Province. The collections from Jujuy and Salta Provinces listed in Hawkes & Hjerting (1969) were identified as *S. okadae* Hawkes and Hjerting in Hawkes & Hjerting (1983).

Solanum vernei. This species is listed by Hawkes & Hjerting (1969) and Hawkes (1990) as one of the few examples of a phenological isolating mechanism in *Solanum* sect. *Petota*, where it is reproductively isolated from the sympatric *S. microdontum* which flowers later. We located our two collections by chance in the Sierra del Aconquija when rain exposed the orange tubers that are commonly dug up by wild pigs in this area. Collections for fruits would have to be made in February when *S. microdontum* is just beginning to flower.

Table 2. Okada's (1976) list of priority collecting sites for potatoes in Argentina.

Province	Departments, mountain range, etc.
Jujury	1. Humahuaca and Tilcara: eastern slopes of Sierra de Zenta and Tilcara
	2. Valle Grande: Sierra de Calilegua
	3. Capital: Sierra de Chani
	4. Santa Catalina: remote quebradas to collect hexaploid *S. oplocense*
Salta	5. Santa Victoria and Iruya: the main valleys of these remote departments should be explored to collect primitive varieties of *S. tuberosum* subsp. *andigena*..
	6. Rosario de Lerma and La Poma: remote valleys and quebradas to collect diploid cytotypes of *S. gourlayi* and related forms
Catamarca	7. Santa Maria: Sierra de Quilmes
	8. Antofagasta de la Sierra
	9. Ambato: Sierra de Ambato
	10. Ancasti and El Alto: Sierra de Ancasti
La Rioja	11. Sanagasta and Castro Barros: Sierra de Velasco
San Juan	12. Iglesia, Calingasta and Ullún: eastern Andean valleys to collect *S. kurtzianum*
Mendoza	13. Las Heras, Luján, Tunuyán, San Carlos, San Rafael and Malargüe: eastern Andean valeys to collect *S. kurtzianum* and *S. maglia*
Entre Rios, Corrientes and Misiones	14. Several departments to collect *S. commersonii* subsp. *malmeanum* and *S. chacoense*

Ideas for future collecting in Argentina

The most recent list of priority collecting sites for potatoes in Argentina was presented by Okada (1976) who listed 14 areas in need of exploration (Table 2). With reference to this list, our collections of *S. brevidens* were not listed in Okada (1976), but we explored areas 12 and 13. It was a dry year in area 12 and no potatoes were located, but we collected *S. kurtzianum* and *S. maglia* in area 13. Areas 1 and 6 were successfully collected in 1983 (Okada & Clausen, 1984) and areas 2, 5 and 6 in 1989 (Clausen, 1989). Area 2 should be further searched for wild species because native cultigens were the focus there and the wild species generally emerge earlier than the time when Clausen (1989) visited. Area 14 was collected in 1980 by Okada and Clausen. Areas 3, 4, 7, 8, 9, 10, 11 still need to be explored.

In addition, we list the following new areas, based upon the low number of collections of *S. venturii*, *S. okadae*, and *S. sanctae-rosae* (Table 1) or the little-explored nature of these regions. Area 15: the eastern slopes of the Nevados del Aconquija, Sierra del Aconquija, Cumbres Calchaquíes, and Cumbres del Obispo (Provinces of Catamarca, Tucumán, and Salta). Area 16: Parque Nacional Baritú and surrounding areas (Province of Salta, near the Bolivian border).

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