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Potato germplasm collecting expedition to the Guaitecas and chonos Archipelagos, Chile, 1990

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Summary

A joint Chilean, Italian, and United States potato (*Solanum tuberosum*) germplasm collecting expedition was conducted in the Guaitecas and Chonos Archipelagos, south of Chiloé Island, between March 4 – March 21, 1990. The expedition resulted in 30 collections of *Solanum tuberosum* and 1 collection of *Fragaria chiloensis* L. Twenty-three of the potato collections were along the salt-water-swept shores of the islands. These beach populations, unlike the indigenous landraces in southern Chile, are self-perpetuating populations and provide useful new germplasm for researchers interested in the origin of cultivated potatoes and in the origin of *Solanum tuberosum* in Chile.

Introduction

Chiloé Island and the immediate islands to the south in the Guaitecas and Chonos Archipelagos have been considered as the center of origin of the potato (*Solanum tuberosum* subspecies *tuberosum*), the strawberry (*Fragaria chiloensis* L.), and the grass, *Bromus mango* Desv. (Vavilov, 1951). *Solanum tuberosum* is divided by some authors (e.g., Hawkes, 1990; Ochoa, 1990) into two subspecies, subspecies *andigena* and subspecies *tuberosum*. These subspecies are distinguished with difficulty by overlapping character states of number of stems, angle of insertion of leaves, lateral leaflet length/width ratio, day-length adaptation (Hawkes, 1990), nuclear-cytoplasmic interactions (Grun, 1990), and minor differences in chloroplast DNA (Hosaka & Hanneman, 1988).

The origin of these subspecies and application of the names is subject to debate. *Solanum tuberosum* subspecies *andigena* is endemic to the Andes mountains from Venezuela south to Argentina, and subspecies *tuberosum* to Chiloé Island and the immediately surrounding mainland and island areas. The application of taxonomic names is determined by means of nomenclatural types, usually herbarium specimens. A holotype is the 1 specimen used by the author of a name or designated by him as the nomenclatural type. If a holotype was not designated or was later lost, a herbarium specimen or illustration called a lectotype can be selected from original material to serve as the type specimen. Such is the case for subspecies *tuberosum*. Hawkes

(1956) designated a lectotype specimen for subspecies *tuberosum* from a specimen in Linnaeus's herbarium. This possibly originated from introductions into Europe in the 1570's of subspecies *andigena* that evolved in the 200 years before collection of the lectotype specimen into populations with long-day adaptation and change of morphology to a type of subspecies *tuberosum* (Salaman, 1949; Hawkes & Francisco-O., 1992). The name, subspecies *tuberosum*, has been applied to this lectotype specimen, modern derivitive long-day adapted cultivars, and indigenous plants from southern Chile, while the name subspecies *andigena* has been applied to indigenous Andean cultivars that remain adapted to short day lengths. Complicating these problems of the application of names is that cultivars from North America and Europe have incorporated germplasm, through breeding, from 15 of the over 200 tuber-bearing wild species estimated by Hawkes (1990) to be related to the potato (Ross, 1986; Plaisted & Hoopes, 1989). An unanswered question is the origin of the southern Chilean populations of subspecies *tuberosum* (i.e. endemic or introduced from subspecies *andigena* or subspecies *tuberosum*; Spooner et al., 1991).

Despite the controversy surrounding the origin of the first European potato, the importance of indigenous Chilean varieties in potato improvement is well-documented. The indigenous Chilean varieties Rough Purple Chili, Daber, Villaroela, and Chilote Indianer were important in early breeding programs and form the pedigrees of the majority of the world's cultivars (Hougas & Ross, 1956; Plaisted & Hoopes, 1989; Van Ratlef, 1933).

Both subspecies of *Solanum tuberosum* are considered by some (e.g. Hawkes, 1990) to be exclusively tetraploid ($2n = 4x = 48$). Other cultivated potatoes at different ploidy levels (2x, 3x, 5x) are placed by some taxonomists (e.g. Hawkes, 1990; Ochoa, 1990) in different species. Diploid and triploid cultivated potatoes have been collected from Chiloé Island, however (Brücher, 1963, 1975; Sykin, 1971; Contreras, 1987). Their relationship to *S. tuberosum* is unknown.

Early records of potatoes in Chile

The earliest putative potato fossil member of sect. *Petota* is from Chile, and is dated as 13 000 years old, long before the probable origin of agriculture (Ugent et al., 1987). These authors identify this fossil as *S. maglia* (an extant species) but from erroneous or unreliable data (Spooner et al., 1991). The first historical account of potatoes in Chile is that of DeCortes Hojea (1557). He observed potatoes cultivated in 1557 by native peoples from Isla Ascension (at the northern end of the Guaitecas Archipelago, see Fig. 1; also known as Isla Melinka). Pedro de Valdivia observed potato cultivation in the Mapocho Valley (Santiago de Chile) in 1541 (Medina, 1953). Sir Francis Drake later made observations of potatoes in Chile, at Mocha Island (38° S) in 1578 (Drake, 1628). Charles Darwin collected watery purple tubers at Low Bay on the south side of Guaiteca Island in 1845 (Darwin, 1889). Contreras (1987) summarized prior collections to the Guaitecas and Chonos Archipelagos. Surviving samples of these collections are maintained at the germplasm bank of the Universidad Austral de Chile in Valdivia.

Collectors, itinerary

The expedition participants consisted of the authors, three sailors, and two guides. The Guaitecas and Chonos Archipelagos consist of hundreds of islands and thousands of off-shore rocks. The guides were essential to lead us through the maze of

interconnecting channels. They participated in the 1984 expeditions to the Guaitecas and Chonos Archipelagos (Contreras, 1987; Contreras et al., 1986). Because they are native hunters and fishermen with intimate knowledge of these islands, they were able to lead us to the potato populations. Our expedition left Castro at southern Chiloé Island and crossed the Gulf of Corcovado to Guaiteca Island for our first stop, following the route shown in Fig. 1.

Collections

A total of 30 accessions was collected on this expedition (Table 1). Eleven of these accessions were also collected on an expedition in 1984 (Contreras et al., 1986). More complete locality data and details of the expedition are on file at the Universidad

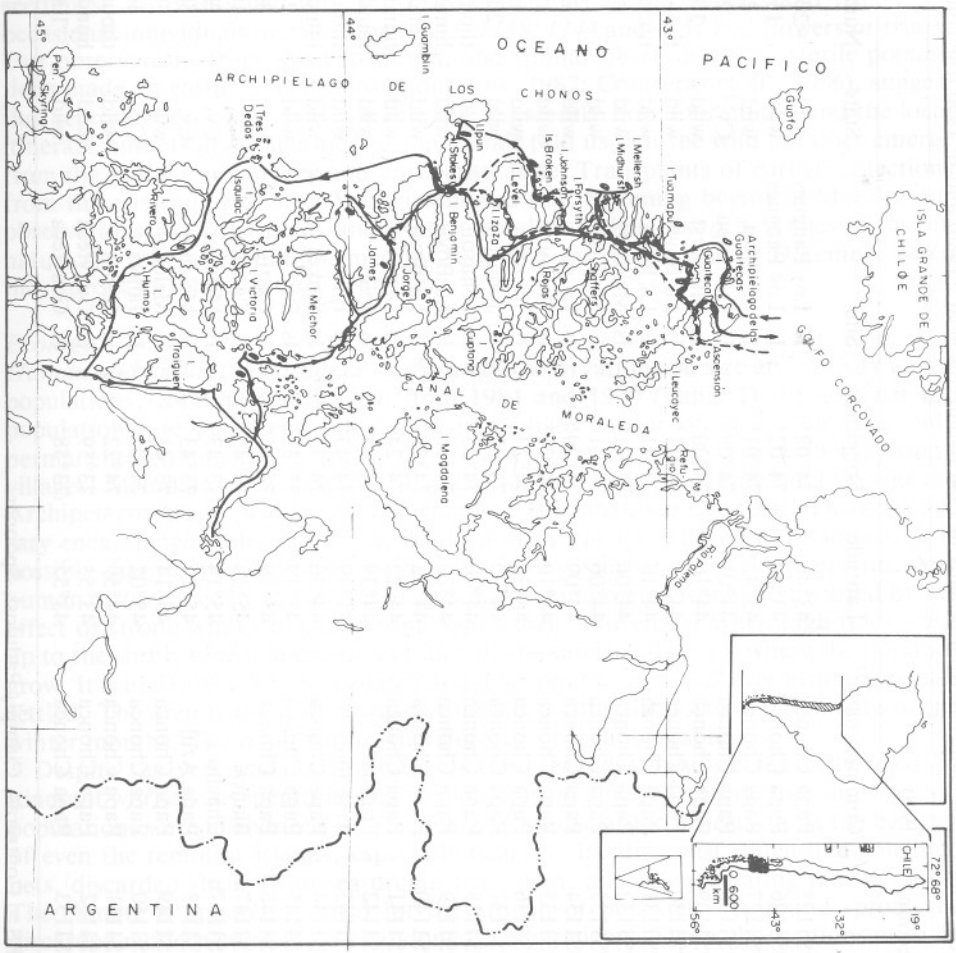

Fig. 1. Routes of the 1984 expedition (dotted lines) and the 1990 expedition (solid lines).

Table 1. Collection number, indigenous common name, location, and observed numbers of collections of *Solanum tuberosum* made in the Chonos and Guaitecas Archipelagos in 1984 (Contreras et al., 1986) and in 1990 (the collections reported in this paper).

Collection [a]	1990						1984	
	Common name [b]	Latitude	Longitude	Site	State	Numbers	Density	Collection [c]
CCPS1125	Papa Chonca	43°46′	74°02′	Is. Los Pangues	wild	+200		
CCPS1126	Papa Chonca	43°46′	74°02′	Is. Los Pangues	wild	150		
CCPS1127	Papa Chonca	43°47′	74°01′	Is. La Boya	wild	25		
CCPS1128	Papa Chonca	44°01′	74°09′	Is. Tuamapu	Cv.[d]	20	ca. 200	CHM 540
CCPS1129	Papa Chonca	44°10′	74°20′	Is. Midhurst	wild	300	ca. 1000	CHM 537
CCPS1130	Papa Chonca	44°10′	74°21′	Is. La Boya	wild	thousands	thousands	CHM 535
CCPS1131	Papa Chonca	44°10′	74°21′	Is. La Boya	wild	hundreds		
CCPS1132	Papa Chonca	44°06′	74°21′	Is. Mellersh	wild	80		
CCPS1133	Papa Chonca	44°06′	74°21′	Is. Mellersh	wild	2		
CCPS1134	Papa Chonca	44°09′	74°20′	Is. Larga	wild	70	50	
CCPS1135	Papa Chonca	44°10′	74°20′	Is. Midhurst	wild	10	10	
CCPS1136	Papa Chonca	44°20′	74°23′	Is. Johnson	wild	10		CHM 534
CCPS1137	Papa Chonca	44°20′	74°23′	Is. Johnson	wild	200		CHM 534
CCPS1138	Papa Chonca	44°20′	74°23′	Is. Johnson	wild	thousands	thousands	CHM 533
CCPS1139	Papa Chonca	44°22′	74°28′	Is. La Boya	wild	hundreds	±300	CHM 530
CCPS1140	Papa Chonca	44°22′	74°28′	Is. La Boya	wild	hundreds	± 30	CHM 531
CCPS1141	Papa Chonca	44°22′	74°24′	Is. Don Vicho	wild	hundreds	thousands	CHM 532
CCPS1142	Frutilla	44°39′	74°43′	Is. Ipun	wild	hundreds		
CCPS1143	Arvejilla	44°39′	74°43′	Is. Ipun	wild	thousands		
CCPS1144	Papa Chonca	44°36′	74°35′	Is. Stokes	wild	hundreds		
CCPS1145	Papa Chonca	45°19′	73°35′	Is. Sur	wild	25		
CCPS1146	Papa Chonca	45°19′	73°45′	Is. Castillo	Cv.	30		
CCPS1147a	Blanca	45°19′	73°45′	Is. Castillo	Cv	10		
CCPS1147b	Chacho	45°14′	73°43′	Is. Melchor	Cv.	30		
CCPS1148	Papa Azul	45°14′	73°43′	Is. Melchor	Cv.	30		
CCPS1149	Papa Chonca	45°14′	73°41′	Is. Melchor	wild	30		
CCPS1150	Papa Chonca	45°02′	74°05′	Is. James	Cv.	10		
CCPS1151	Papa Chonca	44°59′	74°22′	Is. James	wild	thousands		
CCPS1152	Papa Chonca	43°55′	73°59′	Is. Guayteca	wild	hundreds	hundreds	CHM 541
CCPS1153	Papa Chonca	43°55′	73°58′	Is. Guayteca	wild	100	hundreds	CHM 542

[a] CCPS = Contreras, Ciampi, Padulosi, Spooner.
[b] Papa Chonca is the indigeneous common name for the purple-skinned potatoes found on the beaches in the Chonos and Guaitecas Archipelagos.
[c] CHM = Contreras, Huamán, Montaldo.
[d] Cv. refers to an indigeonous cultivar possessing a morphology like one of those found on Chiloé Island.

Austral de Chile, the Instituto de Agronomico per L'Oltremare, Venice, Italy and at the National Research Support Program-6 (NRSP-6, formerly known as the Inter-Regional Potato Introduction Project, IR-1) at Sturgeon Bay, Wisconsin, USA. The collections are maintained at the Universidad Austral de Valdivia, with duplicates being transferred to the Instituto Agronomico per L'Oltremare, and to NRSP-6.

The majority of the wild potatoes in the Chonos Archipelago grow along the western chain of the islands near the Pacific shore. Most of these collections appear uniform in morphology. In the majority of the accessions, the tubers are ovoid, small (up to 3 cm in diameter), with blue to purple to light reddish skin and flesh. All have long stolons, some of which we traced for more than two meters from the base of the plant.

We observed all populations for the mode of reproduction. We never observed seedlings. All plants had tubers. Most populations lacked flowers and fruits, but occasional individuals in collections *1133*, *1138*, *1144* and *1151* had flowers or fruits. Our observations from this expedition, and similar observations of sterile populations made on earlier expeditions (Contreras, 1987; Contreras et al., 1986), suggest that reproduction by seeds is possible but apparently rare. Our guides and the local itinerant hunters and fishermen of the islands told us that the wild potatoes emerge from the ground in January and grow until June. Transplants of earlier collections from these islands grown in Valdivia showed that blooming begins in March. Our observations from the fields and experimental plots lead us to hypothesize that in nature the tubers are fully formed by July, and are dormant until December when they sprout to form the next year's growth.

Ecology

Human and natural disturbance of the area. Observations on size and density of the populations, combined with data from 1984 and 1990 (Table 1) suggest that the populations are persistent and not in immediate danger of extinction. The only permanent settlements on these islands are at Ascensión Island with two small villages, Melinka on the east and Repollal on the south. The only land uses in the Archipelagos are by seal hunters, fishermen, and small-scale loggers. Their temporary encampments along the beaches do not disrupt the wild potato habitats. It is possible that the populations depend on natural disturbance for their survival. Any human disturbance by the scattered seasonal encampments would be dwarfed by the effect of strong winter storms during September – November when high tides wash up to the shrub zone and churn up much of the sands and gravel where the potatoes grow. It is unlikely that these isolated and inhospitable areas will ever be permanently settled. The area is difficult to reach and has a cold and forbidding climate in the winter months. The populations, therefore, are probably stable.

Despite the very isolated location of these islands, they are regularly used by itinerant workers, as mentioned above, and it is possible, therefore, that some potato populations were introduced. We frequently saw discarded objects along the beaches of even the remotest islands, especially near the Pacific coast. Such items include nets, discarded shells from sea-urchin fishermen, and many floating plastic items. The climate is apparently ideal for the growth of potatoes. We found sprouts of discarded modern cultivars at abandoned encampments. These observations must be considered in studies investigating the indigenous nature of these island populations of wild potatoes.

Climate. The climate in the western part of the islands in the Chonos Archipelago is classified as a marine climate, tepid-cold, with much rain (the Cfb classification of Koeppen, 1948). It rains throughout the year, and 3000 – 4000 mm of rain falls, increasing in amount to the south and east. Specific monthly distributions at Melinka, in the northern part of the region are: 18 % from December – February, 26 % from March – May, 34 % from June – August, and 22 % from September – November. Rainfall is more evenly distributed in the southern part of the region. Relative humidity is high throughout the region, especially during February – April, when it averages 85 – 90 %. The highest median temperatures in the island are during November – April, with medium temperatures above 10 °C. January and February are the warmest months, and August is the coldest.

Vegetation. Vegetation is remarkably uniform throughout the islands. There is a thin zone of herbaceous vegetation (growing up to 200 cm tall), behind the open coastline, if present, followed by a thin zone of brushy thickets, growing up to 3 m tall, followed by coast line forest, inland forest, and occasional inland bogs. Elevations on the larger islands can reach 100 m. The forests are extremely dense and impenetrable, and do not to our knowledge harbor populations of wild potatoes. Potatoes grow in open sand and gravel on the beach near the herbaceous zone, in the herbaceous zone, and at the edge of the shrubby zone.

Our collections document the following associated species in this herbaceous zone (vouchers at VALD): *Acaena pinnatifida* R. et P., *Apium australe* Thouars, *Aster vahlii* (Gaud.) Hook. et Arn., *Cerastium arvense* L., *Coronopus didymus* (L.) J. E. Sm., *Cotula scariosa* (Cass.) Franchet, *Festuca* sp., *Galium aparine* L., *Gunnera* sp., *Anthoxanthum utriculatum* (R. et P.) Schouten et Veldk., *Lathyrus magellanicus* Lam., *Libertia chilensis* (Mol.) Gunkel., *Polygononum maritimum* L., *Rumex cuneifolious* Campd., *Sarcocornia fruticosa* (L.) Scott., *Senecio candidans* DC., *Senecio smithii* DC., *Uncinia* sp. and *Vicia bijuga* Gill. ex H. et A.

We collected the following in the shrubby zone: *Berberis buxifolia* Lam., *Escallonia rubra* (R. et P.) Pers., *Fuchsia magellanica* Lam., *Pernettya mucronata* (L. f.) Gaud. ex Spring., and *Ribes magellanicum* Poir.

Conclusions

Our new collections provide a good sampling of the southernmost populations of *Solanum* sect. *Petota*, a group naturally distributed from the southwestern United States to southern Chile in the Guaitecas and Chonos Archipelagos. We make no conclusions here regarding the long-standing questions of the origin of *Solanum tuberosum* in southern Chile or the origin of the European potato. However, our collections provide ample materials for investigations of these questions using new germplasm resources. Most of the germplasm collections of *Solanum tuberosum* from Chile in the world's gene banks are landrace populations and may represent different biotypes from these wild-growing plants. Our collections provide new germplasm for researchers interested in the origin of cultivated potatoes and in the origin of *S. tuberosum* in Chile.

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