PLANT GERMPLASM COLLECTION REPORT

Foreign Travel to:

PATAGONIAN REGION OF CHILE AND ARGENTINA

February 8 - March 12, 1996

Plant Exploration in the Southern Patagonian Region of Chile and Argentina to Collect Cool-SeasonGrass and Legume Germplasm for Forage and Turf Improvement

U.S. Participants

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Germplasm Accessions

Objectives: Objective of this trip was to make joint seed collections of important forage grass and legume germplasm in the southern Patagonian Region of Chile and Argentina for improving deteriorated rangelands and for low maintenance turf in Chile, Argentina, and the U.S.

Accomplishments: I was invited to join this third in a series of three plant exploration trips conducted jointly by Argentina and Chile to collect forage germplasm in southern Patagonia. All three collection trips have been funded by PROCISUR (Programa Cooperativo para el Desarrollo Tecnologico Agropecuario del Cono Sur, Subprograma Recursos Geneticos), which is an Inter-South American organization that promotes cooperative germplasm activities of its six member countries. Our five-member team (myself and two scientists each from Argentina and Chile) collected germplasm in Region XII of Chile, Santa Cruz Province of Argentina, and both the Argentine and Chilean portions of Tierra del Fuego. Our team traveled more than 3,500 km (2,100 miles) and made a total of 99 collections representing 41 species (Table 1), most of which were endemic to Patagonia.

The low precipitation, cold winter temperatures, and strong winds in this area have likely exerted strong selective pressures so that germplasm from this area is well adapted to cold, droughty conditions. A wide diversity of Bromus and Festuca species collected from this area may have potential for low maintenance turf and dryland forage applications in the western U.S. The collected seed was evenly divided with one-third going to each of Argentina, Chile, and the U.S. The U.S. share of the seeds was processed according to U.S. plant quarantine procedures and will be sent to the Regional Plant Introduction Station at Pullman, WA, for entry into the National Plant Germplasm System.

Future Collaboration: Most of the rangelands of southern Patagonia have been overgrazed since sheep grazing was introduced to this area in the early 1900s, and productivity on these rangelands has been greatly reduced. Genetic erosion of plant species native to southern Patagonia has undoubtedly taken place and is likely continuing to occur. The drier arid and semiarid areas in Patagonia where desertification is most prevalent have certainly lost considerable genetic diversity. Additional collection trips should be undertaken to preserve as much germplasm as possible from this unique area of the world. The U.S. should take an active role in funding and participating in additional collection trips to Patagonia. Chile, Argentina, and the U.S. could benefit by closer collaboration among their germplasm resources programs.

TECHNICAL REPORT AND TRIP DETAILS

8-11 February I departed Logan, Utah and traveled through Salt Lake City, Denver, and Miami enroute to Santiago, Chile. In Chile, my main interaction was with staff of INIA (Instituto de Investigaciones Agropecuarias), Chile's national agricultural research organization. I visited INIA's La Platina Research Center (located about 25 km south of downtown Santiago). My main contact there was Dr. Alberto Cubillos, National Curator of Plant Genetic Resources. He is responsible for overseeing and coordinating the genetic resources program in Chile and has been involved with the program since its inception. Chiles' long-term storage bank is located at Campo Experimental Vicuna, which is located about 400 km north of Santiago (east of La Serena). This is a state-of-the-art, semi-underground facility that has a capacity for storing 380,000 accessions at a relative humidity of 30 % and -14 C temperature. It has backup electric generation and refrigeration capacity. The main locations for genetic resources research in Chile are La Platina (Santiago), Cauquenes, Quilamapu (Chillan), Carillanca (Temuco), and Remehue (Orsono). The active bank for forages is located at Temuco. Range-related research is being conducted primarily at Tamel Aike (Coihaique) and Kampenaike (Punta Arenas).

I visited with Dr. Giorgio Castellaro, who is a range scientist at La Platina. He is working on plant-herbivore interactions in the Altiplano Zone in northern Chile. The main animals being researched include the alpaca and llama in Festuca and Stipa grasslands. Dr. Castellaro is working with computer simulation models of the Altiplano grasslands. I also met with Dr. Fernando Squella, who is conducting forage evaluation trials with Harding grass, subclover, annual medic species, and various Atriplex species. There are apparently 22 native Atriplex species in Chile, and Atriplex repanda is one of the best. Of the introduced Atriplex species, Atriplex nummularia is best adapted to Chilean conditions.

12-15 February I traveled by plane to Temuco, bus to Puerto Montt, and plane to Punta Arenas. Upon arriving in Punta Arenas, I learned that my visa for Chile was only good for one entry into Chile. Prior to my departure from the U.S., I had been assured by staff of the Foreign Agricultural Service that my Chilean visa was good for multiple entries, but this was not true. We spent about four hours going to various government offices in Punta Arenas to obtain a special pass that allowed me multiple crossings of the Chilean border. This was an unnecessary waste of time and an imposition on my hosts that should not have happened; my travel request specifically documented my need for multiple entry visas for both Chile and Argentina.

Members of the collecting team met at INIA Kampenaike headquarters in Punta Arenas to discuss collecting route, logistics, and collecting procedures. Members included Ing. Agr. Raul Lira from INIA Kampenaike in Punta Arenas, Chile; Ing. Agr. Gabriel Oliva and Ing. Agr. Mercedes Masco from INTA in Rio Gallegos, Argentina; and Ing. Agr. Alicia Massa from the University of Comahue in Cinco Saltos in Argentina. INTA (Instituto Nacional de Tecnologia Agropecuaria) is Argentina's national agricultural research organization. Because of other commitments, Ing. Agr. Mercedes Masco had to return to Rio Gallegos on 18 Feb., and she was replaced by Ing. Agr. Ivette Seguel from INIA Carillanca in Temuco, Chile, who joined our team in Puerto Natales. Collecting supplies and equipment were assembled and packed in our Toyota and Isuzu four-wheel drive vehicles. Our expedition was divided into two segments with the northern segment covering the area from Calafate, Argentina to Punta Arenas, Chile and the southern segment covering the area from Punta Arenas, Chile to Ushuaia, Argentina.

<u>16-24 February</u> We departed Punta Arenas, Chile and drove to Calafate, Argentina in one day. In Argentina, we made collections in the vicinities of Tapi Aike, Perito Moreno Glacier, Calafate, and Rio Turbio. In Chile collections were made in the vicinities of Puerto Natales, Cerro Castillo, Rio Grey, Posada Serrano, Hosteria Petrol, Estancia Laso, and Laguna Parrillar. Although a few of the major roads in this area were asphalt, most of the roads we drove on were rough gravel roads. Elevations of the collecting sites in this northern segment of our trip ranged from 20 to 900 m, whereas the latitude varied from South 50 to 53 degrees. The Andes mountains are spectacular in southern Patagonia, and some of the most spectacular scenery in the world is within Torres de Paine National Park near Puerto Natales, Chile.

The moist west winds from the Pacific Ocean lose their precipitation with increasing elevation on the west slope of the Andes Mountains. On the eastern slope of the Andes there is a dramatic increase in aridity with declines in precipitation from about 4,000 mm on the Andean Divide to less than 300 mm just 120 km to the east of the Divide. This increased aridity to the east is reflected in vegetation changes. The higher rainfall areas in the upper elevations of the Andes have a rich diversity of species dominated by southern beech trees (<u>Nothofagus</u> spp.). Eastward from the Andes with lower elevation and lower precipitation, the beech forests are replaced by dry coniferous forests dominated by <u>Austrocedrus</u> species. These dry forests resemble Ponderosa pine forests in the western U.S. Further east with lower elevation and lower precipitation, the vegetation changes to that of the Patagonian steppe dominated by tussock grasses (<u>Festuca</u> and <u>Stipa</u> species) and finally to semi-desert vegetation dominated by cushion plant growth forms. Although we made some collections in <u>Nothofagus</u> forests during this northern portion of our trip, most of our collections were obtained from Patagonian steppe communities.

All of Patagonia is characterized by strong, prevailing west winds, which cause high evaporation rates. The mean annual temperature is about 8 C with no month being frost-free. The cold season lasts for four or five months in Patagonia with the lowest temperatures about -3 C. Although deep snows are relatively uncommon in southern Patagonia, the winter of 1995 was one of the worst years on record for heavy snow accumulation and subsequent livestock death.

Sheep grazing was introduced into southern Patagonia in the late 1800s and early 1900s. Although some ranchers have fencing that allows them to divide their summer and winter ranges, many ranchers still continuously graze their rangelands. Sheep bands are mainly Merino and Corriedale breeds for wool production and are generally not herded and allowed to freely graze in extensive paddocks. Grazing pressure was extremely high when sheep were first introduced in Patagonia, and declining availability of palatable, nutritious forage have forced reductions in stocking rates, which typically range from 20 to 60 animals per km^2. Stocking rates still appear to be too high on most ranches. Continuous, heavy grazing is causing desertification in Central Patagonia, and many ranches in this area are being abandoned because of their non-sustainability. The cold, winter months generally result in animals losing 30-40 % of their body weight. Winter feeding of stored forages and supplementation are not widely practiced.

Because of the windy Patagonian conditions and subsequent seed shattering in many species, seed collecting was usually quite tedious. Collecting enough seed to divide among the three participating countries was a real challenge. Of a total of 65 seed collections made in this northern portion of the collection trip, only eight collections were legumes (Trifolium, Adesmia, and Lathyrus). Collections of Trifolium hybridum were interesting, purportedly a hybrid species between T. repens x T. pratense. This hybrid clover had variegated white-red flowers and stem node lengths intermediate between red and white clover. The bulk of the collections consisted of grass species in the genera Agrostis, Bromus, Deschampsia, Elymus, Festuca, Hordeum, Poa, Rytidosperma, and Stipa. The various native Bromus species may have particular potential as forage species for semiarid rangelands of the western U.S. with apparently high nutritive value and good establishment characteristics. Potentially important low-maintenance turf species include Festuca magellanica, Rytidosperma virescens, and Deschampsia spp., all of which had soft leaf characteristics and were growing in droughty, low-fertility sites. We arrived back in Punta Arenas on 23 Feb., and we used 24 Feb. to dry and divide our seed collections and process our herbarium voucher specimens.

25 February - 2 March This second segment of our collecting trip covered the Chilean and Argentine portions of Tierra del Fuego ("Island of Fire") from South latitude 53 to 55 degrees. We crossed the Straits of Magellan by ferry near Punta Delgada, which took about 20 minutes. Our collection route took us to Porvenir, Onaisin, Cameron, Pampa Guanacos, and San Sebastian in Chile. Our route in the Argentine portion of Tierra del Fuego went through Rio Grande, Tolhuin, Ushuaia (furthest city south in the world), Puerto Harberton, and Moat.

We collected in two main community types on Tierra del Fuego including the southern Magellanic steppe and the Patagonian Andean forests. The southern Magellanic steppe has a cold, oceanic climate with annual precipitation ranging from 150 to 300 mm. Average annual wind velocity is more than 25 km/h. The steppe soil typically has about a 10-cm layer of sand with a high organic matter content and a hard clay layer below. The vegetation is dominated by the tussock grass Festuca gracillima but also includes Poa spp., Elymus spp., and Hordeum spp. The Patagonian Andean forests receive 400 to 600 mm annual precipitaion and are dominated by trees (Nothofagus spp.) with associated grasses in the genera Festuca, Deschampsia, and Holcus.

We made a total of 34 collections on Tierra del Fuego including collections in the genera Agrostis, Alopecurus, Bromus, Deschampsia, Elymus, Festuca, Hordeum, Phleum, Poa, Trifolium, and Trisetum. As we found in the northern segment of our trip, native Bromus species have potential for use as a forage in semiarid rangelands of the western U.S. Species of Festuca and Deschampsia hold promise in the U.S. for low-maintenance turf. We dried and divided our seed collections and processed our herbarium voucher specimens at the INTA office in Ushuaia. Ing. Agr. Raul Lira and Ing. Agr. Ivette Seguel returned to Punta Arenas and Ing. Agr. Gabriel Oliva returned to Rio Gallegos with their four-wheel drive vehicles.

3-9 March Ing. Agr. Alicia Massa and I flew to Bariloche, Argentina in northern Patagonia via Buenos Aires. We were met in Bariloche by Ing. Agr. Alberto Zappe (Curator of INTA's Regional Genebank in General Roca) and Ing. Agr. Guillermo Becker (Range Scientist from INTA Bariloche). Bariloche (or its full name San Carlos de Bariloche) is in a spectacular setting situated adjacent to Nahuel Haupi National Park and near the Andean Divide, a setting similar to Jackson Hole, Wyoming or somewhere in the Swiss Alps. I visited INTA's Agricultural Experimental Station in Bariloche, which is the regional research center for northern Patagonia. The research station was established in 1967 and has a staff of 48 agricultural professionals and 46 supporting staff. Research at the station is divided into three main areas: 1) natural resources, 2) animal production, and 3) rural development. The main objective of the natural resources group is to understand, evaluate, improve, and conserve water, soil, vegetation, and wildlife resources. The primary focus of the animal production research is to improve the production of sheep, goats, cattle, and wildlife species through genetic improvement, application of artificial insemination and embryo transfer techniques, improved animal fiber production, and developing control measures for animal diseases. The rural development group is primarily responsible for the extension of the research results to farmers and ranchers in Rio Negro and Neuquen Provinces of northern Patagonia.

Most of my time at Bariloche was spent with the natural resources group, which has projects involving rangeland dynamics, use, and improvement; ecology and genetics of native forest species; and wildlife ecology and management. Researchers I visited with at Bariloche included Ing. Agr. Guillermo Becker, Griselda Luz Bonvissuto, Maria Luisa Lanciotti, Roberto Somlo, Carlos Robles, and Dr. Leonardo Gallo. I gave two lectures at Bariloche, one covering our forage breeding and selection work for semiarid rangelands, and the other on our work with carbon isotope discrimination for improving water-use efficiency. We also were taken on a field trip to INTA's main field station at Pilcaniyeu (about 70 km east of Bariloche) to observe adaptation trials of a wide range of native and introduced species. Hycrest crested wheatgrass outperformed most other species at each of the sites. We also visited a ranch owned by Mr. Bernardo Benroth where water spreading techniques were being used to raise forages in a unique marshland (malline) for short duration, high intensity grazing by sheep.

While at Bariloche, we received a fax message that we would not be able to transport our Chilean seeds back to the U.S. This news was very disappointing! Recent regulations now require that permission must be obtained from the Comision Nacional de Recursos Geneticos (National Committee for Genetic Resources) in Santiago before germplasm can be taken out of Chile. As a result, we left our Chilean collections at INTA Bariloche with Ing. Agr. Guillermo Becker until official approval is received.

10-12 March I visited INTA's Institute of Biological Resources at Castelar, one of the suburbs of Buenos Aires. The Institute is located on beautifully spacious grounds that used to be a large ranch. The Institute has a staff of 12 scientists and 24 support staff; the Director of the Institute is Dr. Enrique Suarez, a cereal geneticist. My main host was Dr. Miguel Elechosa, who was the leader of the section that dealt with the preservation and storage of plant genetic resources. Dr. Elechosa is the Argentine coordinator of a large genetic resources project (five years and $5 million from NSF and AID) for evaluating arid and semiarid plants for pharmaceutical potential. Dr. Barbara Timmermann from the Department of Pharmacoloy at the University of Arizona is the Principal Investigator of the project, which is being done cooperatively with Mexico, Chile, and Argentina. The number of plants being provided from arid and semiarid areas each year for evaluation is 250 for Mexico, 200 for Chile, and 100 for Argentina. Five kilogram samples of each species are used to obtain extracts that are evaluated for medicinal properties by Cyanamid Corporation and Purdue University. This project has agreed to provide royalties both to the host country and the particular locality if any of the plants prove to be economically important.

Ing. Agr. Noga Zelener, curator of Argentina's base gene bank for long-term storage, gave us a tour of the seed storage facilities. Construction of the bank began in 1993 with financial assistance (about $1 million) from the Italian Development Agency (IAO). The facilities consist of six large chambers, which maintain a -20 C temperature; three chambers are currently in operation. Seed samples are stored in individual sealed aluminum packets with seeds brought to 4-6 % water content before storage. They also have controlled-temperature chambers for periodically testing seed germination. A total of 8,000 accessions are currently being stored in the base bank, including seeds of maize, soybeans, sunflower, wheat, peanuts, sorghum, cotton, and flax. They are in the process of adding additional species to the base bank. INTA has a total of nine active banks throughout Argentina, and these active banks store their seeds at about 5 C. The numbers of accessions of each crop species being stored at each active bank are contained in Table 2. Ing Agr. Julio Tilleria is in charge of the genebank database, but INTA's genebank computers currently have limited capacity. They are hoping for additional funding to obtain a better computer support system and Internet capability. Only accessions stored in the base bank have been entered into the database.

Other laboratories and their scientific staff that I visited at Castelar included: physiology of seed storage (Ing. Agr. Horacio Luis Maroder, Gabriela Facciuto, and Imelda Pregio), tissue culture and in vitro storage (Ing. Agr. Boris Piterbarg and Norma Hompenera), herbarium (Ing. Agr. Renee H. Fortunato), and Triticeae cytogenetics (Dr. Jorge Dubcovsky). I returned to Logan from Buenos Aires via Miami, Denver, and Salt Lake City.

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Table 1. Number of collections of each species made during our 1996 collecting trip to southern Chile and Argentina.

Species	*Number*	*Species*	*Number*
Adesmia boronioides	*1*	*Festuca magellanica*	*4*
Agropyron antarcticum	*2*	*Festuca pallescens*	*2*
Agropyron fuegianum	*1*	*Festuca purpurescens*	*1*
Agropyron magellanicum	*3*	*Festuca rubra*	*3*

Agropyron patagonicum	*1*	*Hierochloe spp.*	*1*
Agrostis spp.	*2*	*Hordeum comosum*	*3*
Alopecurus magellanicum	*1*	*Hordeum spp.*	*4*
Alopecurus spp.	*2*	*Lathyrus magellanicus*	*2*
Bromus catharticus	*3*	*Phleum commutatum*	*2*
Bromus coloratus	*6*	*Poa poecila*	*1*
Bromus setifolius	*4*	*Poa pratensis*	*3*
Bromus spp.	*8*	*Poa spp.*	*2*
Dactylis glomerata	*1*	*Rytidosperma virescens*	*3*
Deschampsia flexulosa	*3*	*Sisyrinchium spp.*	*1*
Deschampsia spp.	*4*	*Stipa brevipes*	*2*
Elymus arenarius	*1*	*Trifolium hybridum*	*2*
Elymus andinus	*1*	*Trifolium repens*	*2*
Elymus antarcticus	*5*	*Trifolium spadiceum*	*3*
Elymus gayanus	*1*	*Trifolium spp.*	*1*
Elymus spp.	*3*	*Trisetum spp.*	*2*
Festuca gracillima	*2*		
		TOTAL	*99*

Table 2. The nine active genebanks in Argentina and the number of accessions of each crop species being stored at each location.

Location	*Species*	*Accessions*
Pergamino	*Corn*	*2, 360*
	Sunflower	*70*

	Forages	*1,100*
Balcarce	*Potato* *Sunflower* *Forages*	*1,731* *37* *1,190*
Manfredi	*Peanut* *Sorghum* *Sunflower* *Alfalfa*	*3,700* *4,000* *800* *180*
Marcos Juárez	*Wheat* *Soybean*	*671* *350*
Sáenz Peña	*Cotton* *Forages*	*650* *1,100*
La Consulta	*Vegetables* *Garlic* *Fruit trees* *Olive trees* *Vines*	*1,878* *57* *643* *77* *772*
Alto Valle	*Squash* *Forages*	*378* *771*
Cerrillos	*Beans* *Tobacco* *Sugarcane* *Grain legumes* *Forage legumes*	*461* *218* *631* *17* *18*
Anguil	*Forages*	*935*