PLANT GERMPLASM COLLECTION REPORT

USDA-ARS
FORAGE AND RANGE RESEARCH LABORATORY
LOGAN, UTAH

Foreign Travel to:
Mongolia
August 21 - September 26, 1994

Objectives: The objective of our trip was to make joint seed collections of important forage grass, legume, forb, and shrub germplasm in Mongolia for improving deteriorated rangelands in the western U.S. and Mongolia.

U.S. Participants

Dr. Douglas A. Johnson - Plant Physiologist
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GERMPLASM ACCESSIONS

Accomplishments: We were accompanied on our plant exporation trip by agronomists and botanists from the Research Institute of Animal Husbandry in Ulaanbaatar. Two collection teams were organized with one going east and south to the Eastern Steppe and Gobi Desert Regions. The other team went to the north and west to the Selenge-Onon and Hungai Regions. The two teams traveled more than 5,500 km (3,300 miles) and made a total of 412 collections, which represented 97 genera and 152 species. Mongolian scientists indicated this was the best year for seed availability that they had seen in the last 20 years. The rangelands of Mongolia are some of the most diverse and productive of any rangelands in the world. Overgrazing, however, is becoming a serious problem near population centers and is almost certainly reducing the vegetation diversity of these sites. The collected seed was evenly divided with the Mongolians, and the U.S. share was sent to the Plant Germplasm Quarantine Center in Beltsville, Maryland, where it was processed according to quarantine regulations. The seed was cleaned and cataloged at Logan, UT. The cleaned seed and accompanying passport data was sent to the Regional Plant Introduction Station at Pullman, WA for entry into the National Plant Germplasm System.

Future Collaboration: Because of the large distances involved and the slow and difficult travel on dirt tracks in the Mongolian countryside, the collecting route could not traverse the Khuvsgul and Mongolian Altai Regions of the country. Because of their isolation, these regions

have a unique flora that is unlike other regions of Mongolia. Plans for a joint germplasm collection trip to this unique region of Mongolia were discussed with our Mongolian counterparts, and a proposal for another germplasm collection trip to Mongolia was submitted for FY96 funding consideration.

TECHNICAL REPORT AND TRIP DETAILS

21-22 August Doug Johnson departed Logan, Utah and traveled to Vancouver, British Columbia where he applied for and was issued a transit visa for the People's Republic of China from the Chinese Embassy, which the Foreign Agricultural Service neglected to obtain in Washington, DC.

23-26 August Dennis Sheehy departed Wallowa, Oregon and met Doug Johnson at the Vancouver International Airport where they assembled their collecting gear and luggage for departure for Beijing. They caught the first available flight to Ulaanbaatar, Mongolia, and were met at the Ulaanbaatar Airport by Mr. J. Byambadorj, partner in MCS Consulting Services, an agricultural- and energy-related private consulting firm located in Ulaanbaatar. Mr. Byambadorj had previously worked for the Ministry of Agriculture. We were transported to our Ulaanbaatar accommodations. The two hotels in Ulaanbaatar were booked out so we were put up in a two-bedroom apartment located about a mile from the main downtown area of Ulaanbaatar.

27-31 August We went to the U.S. Embassy in Ulaanbaatar where we met with Mr. C. Michael Konner, First Secretary and Consul of the U.S. Embassy in Ulaanbaatar. We informed him of our plans of our plant exploration trip, and he assisted us in cashing U.S. travelers checks into the local currency (405 tugriks per $1). We also met with officials at the Ministry of Agriculture including Mr. Surenjargol (Vice Minister of Agriculture) and Mr. Davadorj (Director of the Crops, Machinery and Irrigation Department in the Ministry). We discussed our plant collection collaboration, and they were very supportive of our efforts. They indicated that Mongolia does not have long-term or short-term storage facilities for their germplasm collections. Because of this, they must re-collect most of their collections every few years. They indicated that animal production (sheep, goats, cattle, horses, and camels) is the main industry in Mongolia; therefore, the Ministry is very interested and supportive of research involving forage collection, breeding, and evaluation.

We met with Dr. B. Minjigdorj, Director of the Research and Teaching Institute of Animal Husbandry. Based upon our desire to make forage collections in both the eastern and west-central steppe regions of Mongolia, there will be two collecting teams. Our main contact for the exploration trip (Mr. S. Jigjidsuren from the Research and Teaching Institute of Animal Husbandry in Ulaanbaatar) had been called out of the country unexpectedly so the logistical arrangements of the trip had not been finalized. We discussed our proposed trip with Dr. Jamiandorj (Head of the Seed Production Section of the Institute). After considerable discussion, the routing and composition of each team was decided. The east team, which focused efforts on the grass steppe and desert steppe regions of eastern Mongolia, consisted of Dennis, Tom Sheehy

(soil scientist), Dr. Jamiandorj (plant specialist), Dr. Bor (plant specialist), Dr. Tsolgon (taxonomist), Dr. Jalhaikav (interpreter and animal nutrition specialist), Mr. Naintai (horticultural specialist), and a driver. The west-central team, which collected germplasm from the forest steppe, grass steppe, desert steppe, and desert ecoregions in central Mongolia, consisted of Doug, Hugh Sheehy (cartographer), Dr. Jigjidsuren (plant specialist), Dr. Erdenchimeg (agronomist), Dr. Nyamdorj (taxonomist), Mr. Biliguun (interpreter), and Mr. Byamsogt (driver). The Institute had one four wheel drive vehicle, which was assigned to the west-central team; the vehicle for the eastern team had to be hired. The Institute had managed to obtain enough petroleum rationing coupons to allow both teams to purchase sufficient diesel fuel for the entire trip. Because very few commercial hotel accommodations are available in the countryside in Mongolia, the teams had to camp for the three-week duration of their trips. Mongolia has recently switched from a centrally-planned economy to a free-market economy so that team members had to spend considerable time and effort in locating and purchasing food, vegetables, and supplies from small shops and markets throughout the city prior to their departure.

1-20 September The eastern and west-central collecting teams departed from Ulaanbaatar on 1 September and proceeded on their separate routings (see attached map). Their respective narratives are as follows:

West Segment #1: The team began germplasm collection in the mountain steppe region located in the Hentii Mountains north of Ulaanbaatar. This is an area of gently rolling hills dominated by grasslands interspersed with patchy woodlands occurring mainly on north-facing slopes (very similar to Montana). This mountain steppe area is very picturesque and is valued for its wildlife habitat and livestock grazing (mainly sheep and horses with a few cattle). The major grass genera include *Stipa, Poa, Festuca, Koeleria,* and *Trisetum,* whereas the dominant tree genera include *Pinus, Larix, Picea, Abies, Betula,* and *Populus.* The lush, productive grasslands have a wide diversity of legumes present including *Vicia amoena, Thermompsis lanceolata, Melilotus dentatus,* and *Medicago falcata*. Some of the broader, flatter areas were being cut for hay for winter feeding of livestock.

West Segment #2: Near Bayangol the team dropped in elevation into a broad, flat area along the Haraa River and north of Darhan along the Orhon River where wheat and oat crops were planted. Mongolia, because of its low precipitation and short growing season, is generally not very suitable for crop and grain production. This north-central area of Mongolia towards Suhbaatar is the main crop growing area of Mongolia. This year had apparently been relatively cold and moist so that the grain crops were fairly marginal. The grain fields are surrounded by grazing lands, and herders closely tend their herds to keep them away from the grain fields. Collection sites in this area were in the grasslands of the mountain steppe areas typically located above or along the margins of the grain fields.

West Segment #3: West of Suhbaatar the team crossed the Selenge River. This is one of the largest rivers in Mongolia and carries a large flow of water. Collection sites in this segment were located mainly along the broad, flat valley bottom of the Selenge River, in moist meadow and riparian areas located along creek tributaries of the Selenge River. Main genera collected included *Elymus, Leymus, Agropyron, Calamagrostis, Melilotus,* and *Medicago.*

West Segment #4: This segment consisted of gradual increases in elevation going to the southwest and above the broad valley areas of the Selenge River. With the increase in elevation, the team traveled out of the moist meadow areas back into mountain steppe areas where promising collections of *Onobrychis sibirica* and *Medicago falcata* were made. Some of these areas had at one time been cultivated for grain production. Because these areas only produced about one crop in every three of four years, they were not economically feasible to farm. As a result, large areas had been abandoned with no effort made to reclaim these areas for productive forage use. These areas were infested with annual weeds and after five or six years were still dominated by annual weeds. *Elymus sibiricus* was one of the few valuable forage species coming back into these abandoned fields. The Research Institute of Animal Husbandry was particularly interested in collecting, evaluating, and making selections of *Elymus sibiricus* for use in possibly enhancing plant succession in these areas.

West Segment #5: As the team proceeded towards Bulgan, overgrazing became a prominent feature of the landscape. The closer we came to Bulgan, the worse the overgrazing became. This was typical around most population centers that the team encountered throughout the trip. The numbers of herds increased dramatically with sparse vegetation and active soil erosion typically occurring around Mongolian cities and towns. Stricter grazing control will be absolutely essential as population numbers increase in Mongolia. This overgrazing will certainly increase genetic erosion of valuable forage species.

West Segment #6: The team proceeded into the Hangai Mountains. Yak and yak-cattle hybrids became more dominant as the team ascended into the higher elevations. Yaks with their long, shaggy coats do better during the harsh winter conditions typical of these areas. The team collected a diversity of important forage grass genera in the alpine areas of the Hangai Mountains including *Poa*, *Elymus*, *Festuca*,*Bromus*, *Koeleria*, and *Helictotrichon.* The lower elevation areas of the Hangai Mountains are used for overwintering sheep herds. Typically, stone and wood shelters were constructed on south-facing slopes to protect livestock from severe winter weather. Most of the areas around these shelters would not be grazed until late fall. Many of the more productive meadow areas were cut for hay and stored in piles on top of the shelters for winter forage use. In these lower elevation areas we made promising collections of *Astragalus adsurgens* and *Onobrychis sibirica.*

West Segment #7: The team traveled south of Arvayheer and descended in elevation (with associated declines in precipitation) into the expansive grass steppe area of Mongolia. This flat, treeless area had a much smaller species diversity than the mountain steppe region and was dominated by *Stipa capillata, Cleistogenes songorica, Agropyron cristatum*, and numerous *Allium* species.

West Segment #8: As the team proceeded further south, the areas became gradually more arid and eventually graded into the northern reaches of the Gobi Desert. The dominant vegetation in this desert steppe area included low caespitose grass (*Stipa gobica* and *Cleistogenes songorica*) and species of shrubs (*Anabasis, Artemisia, Eurotia, Kochia,* and *Salsola). Allium* species were abundant in the desert steppe and served as a reliable forage resource for sheep, goats, and camels, which grazed in this remote, sparsely inhabited area.

West Segment #9: This last segment of the trip involved heading northeast through Erdenedalay towards Ulaanbaatar through the grass steppe. Collections were made of *Medicago ruthenica*, a perennial that is closely related to alfalfa and may have potential as a leguminous forage resource for semiarid areas. *M. ruthenica* typically grows close to the ground, but we found individual plants that had stems that reached 1 m in length. The closer we came to Ulaanbaatar, the more overgrazed the landscape became. Our last collecting site was in the meadow area along the Tuul River.

East Segment #1: Germplasm collection for the east team was initiated in the grass steppe in Hentii Aimag along the Herlen River. The Herlen River is the major river in eastern Mongolia and is unique in that it is the only river system actually draining to the Pacific Ocean from Mongolia. Collections were made between the Tariat Research Station and the provincial capital, Onderkhan City and were in grass steppe and meadow communities along the main channel of the Herlen River and associated tributaries. Most collection sites were being grazed by livestock but apparently on a seasonal basis. During the collection trip, livestock use was most heavily associated with riparian zones along river and stream tributaries and adjacent to sum and brigade centers.

East Segment #2: From Onderkhan City germplasm collection stops followed the general ecological transition from typical grass steppe to desert steppe. Collection sites were located in increasingly drier grass steppe areas in Hentii Aimag and the northern portion of Dorngov Aimag. Collection sites generally had a high level of livestock use.

East Segment #3: After briefly visiting the desert steppe, the collection team traveled through the northern portion of Sukhebaatar Aimag and through Dornod Aimag to the Mongolian border with Inner Mongolia in the People's Republic of China. Eastern Mongolia is essentially a vast, treeless plain in the grass steppe. In this area, both the human and animal populations are low except for areas adjacent to the Herlen River and Khalka River in extreme eastern Mongolia. During one days travel of 160 km, only two Mongolian herders and no livestock were observed. Much of the grass steppe in this area has a pristine appearance and is uniform in its limited plant species composition. Soils are brown chestnut soils developed under grass steppe conditions and, except for one large state farm along the Khalka River, have not been cultivated. Over 60 % of the cultivated land associated with the state farm had been abandoned for economic reasons. Infrequent collection stops were made during this segment because of low species diversity and adverse weather conditions.

East Segment #4: During this segment, collections were made at a research station dedicated to research on tree and shrub species adaptation to the grass steppe. With irrigation, it appeared possible to obtain a fair response from planted trees, especially poplar and sea buckthorn. Germplasm was collected from a variety of species at this location, which was in the typical grass steppe. The grass and forb species growing at this collection site appeared to benefit from the combination of irrigation and wind protection afforded by the tree plantations. Another collection site was located in sand dune areas formed by wind and storm activity associated with

Buur Lake, a fresh water lake located on the border with the People's Republic of China. Collections were also made from an experimental area near Choibalson, which was established for evaluating vegetable production of varieties from countries in East Europe, India, and Asia.

East Segment #5: Collections were made in a moderate elevation hill range that parallels and is located south of the Herlen River between Choibalson and Onderkhan cities. Because of variation in elevation and topography in this area, considerable ecotypic variation within species was evident. Both the human and livestock populations were high in this area because of summer grazing areas, water, and meadow/marshland associated with the Herlen River. Meadows and marshlands are used extensively as summer grazing land for livestock, whereas the higher elevation hills in this area are used as winter grazing land. Collection sites had received little or no grazing from livestock during the previous summer.

East Segment #6: This area was located north of the Herlen River between Onderkhan City and the Tariat Research Station, which was in the transition zone between the mountain steppe of the Hentii Mountains and the grass steppe of eastern Mongolia. This higher rainfall area yielded a large diversity of species not previously collected on the trip. Most collections were made along small streams draining the southern edge of the Hentii Mountains. Elk and wolves were observed in the area.

21-23 September: After returning to Ulaanbaatar, the herbarium voucher specimens were taxonomically verified, and the collections cataloged. The staff at the Research Institute of Animal Husbandry processed the necessary paperwork for obtaining export permits for the seed collections. The seed collections were evenly split with half the collection remaining in Ulaanbaatar and the other half hand-carried back to the U.S. Upon arrival in Vancouver, British Columbia, the seed collections were delivered to airport officials of the USDA-Animal and Plant Health Inspection Service (APHIS). The USDA-APHIS officials forwarded the collections to the Plant Germplasm Quarantine Center in Beltsville, Maryland, where the seed was processed according to quarantine regulations. The seed was eventually shipped to the USDA-ARS Forage and Range Research Laboratory for cleaning and cataloging. The cleaned seed and accompanying passport data were sent to the Regional Plant Introduction Station at Pullman, Washington for seed increase and entry into the National Plant Germplasm System.

The two collection teams traveled a total of about 5,500 km (3,300 miles) and made a total of 412 collections representing 97 genera and 152 species. Our Mongolian collaborators indicated that abundant rain and excellent seed ripening weather made 1994 the best year for germplasm collection during the last 20 years. The long distances traveled by the two teams under slow, difficult road conditions and the necessity of camping at a new location every night during the entire collecting period made the trip particularly demanding. The excellent cooperation, logistical support, and botanical expertise of staff at the Institute were instrumental in the success of the trip.

Future Collaboration: The rangelands of Mongolia are some of the most diverse and productive of any rangelands in the world, and the diversity of important forage species in Mongolia is impressive. Overgrazing, however, is becoming a serious problem near population centers and is undoubtedly reducing the vegetation diversity of these sites. The forage collections

made in Mongolia during 1994 have added important accessions that will now be available to scientists around the world; however, because of the large distances involved and the extreme isolation, the collection route in 1994 could not encompass the remote areas of western Mongolia. As a result, another collaborative germplasm collection trip should be undertaken to collect forage germplasm in the Khuvsgul and Mongolian Altai Regions of western Mongolia. Germplasm collections from this unique, remote area of western Mongolia are not represented at all in the National Plant Germplasm System of the U.S. and are very poorly represented even in Mongolia's own germplasm holdings. Possibilities for a joint collection trip to western Mongolia were discussed with Institute staff before departing from Ulaanbaatar, and a proposal for collecting in western Mongolia has been submitted for FY96 funding consideration.

Addresses and Contacts

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Ministry of Food and Agriculture
Ulaanbaatar, Mongolia

Dr. Ts. Uuld, Minister
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Dr. G. Davaadorj, General Director of Crops, Machinery, and Irrigation

MCS Pty. Ltd.
State Statistics Office
Ulaanbaatar - 11, Mongolia

Mr. J. Odjargal, Director
Mr. J. Byambadorj, Manager Agricultural Division

COLLECTED SPECIES LIST FOR MONGOLIA (1994)

Achnatherum splenens (4)	Carum buriaticum (1)	Leymus chinensis (16)	Stipa baicalensis (3)
Agropyron cristatum (20)	Ceratoides papposa (1)	Lilium tenuifolium (1)	Stipa capillata (9)
Agropyron pectinatum (1)	Chloris virgata (2)	Linum baicalense (2)	Stipa glareosa (1)
Agropyron repens (3)	Cleistogenes songorica (6)	Malba trionum (1)	Stipa sibirica (4)
Agrostis mongolica (6)	Cleistogenes squarrosa (4)	Medicago falcata (13)	Suaeda corniculata (1)
Agrostis trinii (1)	Convolvulus arvensis (1)	Medicago lupulina (2)	Thermopsis lanceolata (1)
Allium altaicum (3)	Cotoneaster melanocarpa (2)	Medicago ruthenica (7)	Trifolium lupinaster (2)
Allium anisopodium (2)	Dianthus versicolor (2)	Medicago sativa (1)	Trisetum spicatum (4)
Allium bidentatum (3)	Elymus dahuricus (11)	Melica turczaninowiana (1)	Urtica cannabina (1)
Allium mongolicum (1)	Elymus exselsus (1)	Melica virgata (3)	Isatis costata (1)
Allium odorum (2)	Elymus secalinus (1)	Melilotus alba (1)	Vincetoxicum sibiricum (1)
Allium polyrhizum (6)	Elymus sibiricus (9)	Melilotus dentata (9)	Veronica incana (1)
Allium schoenoprasum (1)	Eragrostis minor (3)	Nitraria sibirica (2)	Vicia amoena (3)
Allium senescens (6)	Eriogonum mongolicum (1)	Onobrychis sibirica (4)	Vicia costata (1)
Alopecurus arundinaceus (1)	Erodium stephanianum (1)	Oxytropis prostrata (1)	Vicia cracca (2)
Alopecurus brachystachyus (1)	Festuca lenensis (2)	Papaver nudicaule (1)	Vicia multicaulis (2)
Amaranthus retrofelxus (1)	Festuca litvinovii (1)	Patrinia rupestris (1)	Vicia unijaga (1)
Amaranthus spp. (1)	Festcua rubra (1)	Pedicularis myriophylla (1)	Zea mays (1)
Amygdalus pedunculata (2)	Festcua sibirica (3)	Phaseolus vulgaris (1)	
Arachis hypogaea (2)	Festuca venusta (2)	Phleum phleoides (3)	
Artemisia frigida (9)	Ptilagrostis mongholica (1)	Phragmites communis (3)	
Artemisia santolinaefolia (1)	Glycine hispida (1)	Plomis tuberosa (1)	
Asparagus dahuricus (1)	Glycyrrhiza uralensis (4)	Poa attenuata (2)	
Astragalus adsurgens (11)	Haplopyllum dahuricum (1)	Poa botryoides (5)	
Astragalus brevifolius (2)	Hedysarum alpinum (1)	Poa pratensis (5)	
Astragalus dahuricus (4)	Hedysarum fruticosum (1)	Poa subfastigiata (4)	
Astragalus melilotoides (2)	Helictotrichon mongolicum (3)	Polygonum divaricatum (2)	
Astragalus scoberianus (1)	Helictotrichon schellianum (2)	Potentilla multifida (1)	

Astragalus tenuis (9)	Heteropappus hispidus (2)	Potentilla tanacetifolia (3)	
Atragene tangutica (1)	Hordeum brevisubulatum (6)	Ptilotrichum canesens (1)	
Beckmannia syzigachne (1)	Iris bungei (1)	Puccinellia tenuiflora (3)	
Betula fruticosa (1)	Iris dichotoma (1)	Reaumuria soongarica (1)	
Brassica spp. (1)	Iris lactea (1)	Ricinus (1)	
Bromus inermis (11)	Juncus salsuginosus (1)	Rumex acetosella (2)	
Bromus pumpellianus (2)	Juncus filiformus (1)	Salsola collina (3)	
Bupleurum bicaule (1)	Kalidium foliatum (1)	Sanguisorba officianlis (2)	
Calamagrostis epigeios (2)	Klion tatarskii (1)	Schizonepeta multisida (2)	
Calamagrostis purpurea (2)	Kobresia bellardi (1)	Scorzonera divaricata (1)	
Calamagrostis epigios (1)	Kochia prostrata (6)	Sedum aizoon (1)	
Caragana leucophylla (2)	Koeleria cristata (2)	Serratula centauroides (1)	
Caragana microphylla (5)	Koeleria macrantha (5)	Setaria viridis (2)	
Caragana stenophylla (2)	Koeleria mukdenensis (1)	Siliena crissentis (1)	
Carex duriuscula (2)	Lathyrus pratensis (1)	Solanum depilatum (1)	
Carex pediformis (2)	Lespedeza daurica (7)	Spiraea rubescens (1)	
Carthamus tinctorius (1)	Lespedeza hedysaroides (2)	Stellaris dichotoma (1)	