PLANT EXPLORATION REPORT

Title: Plant Exploration in the Altai-Gobi and Altai Mountain Regions of Mongolia to Collect Cool-Season Grass and Legume Germplasm for Crop Improvement

Participants:

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Countries visited: Mongolia

Dates of travel: 13 August to 18 September 1996

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

Accomplishments: We were accompanied on our plant exploration trip by agronomists and botanists from the Research Institute of Animal Husbandry in Ulaanbaatar. Two collection teams (five Mongolians and two Americans on each team) traveled to the Altai-Gobi and Altai Mountain Regions of western Mongolia. One team focused its efforts mainly in the southwest, while the other team concentrated on the northwest. The two teams traveled about 10,000 km (6,000 miles) and made a total of 387 collections, which represented 94 genera and 176 species. 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 and is reducing the vegetation diversity of extensive areas. The collected seed was shared equally with the Mongolians, and the U.S. portion was brought back to the U.S. and 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 were sent to the Regional Plant Introduction Station at Pullman, WA for entry into the National Plant Germplasm System where the seed will be made available to scientists in the U.S. and throughout the world. The most promising forage germplasm accessions will be used in ongoing forage breeding and selection programs at Logan to provide improved forage species for western U.S. rangelands.

Recommendation: Because of their isolation, the Hovsgol and Hentei Mountain regions of northern Mongolia have a unique flora that is unlike other regions of Mongolia. These areas are known to contain important forage germplasm that has not been systematically collected. A forage collection trip to northern Mongolia should be undertaken as soon as possible to preserve critical forage germplasm from this floristically diverse area before additional diversity is lost.

Trip Highlights

General Information: Mongolia is a climatic analog of the Intermountain, Northern Rocky Mountain, and Great Plains Regions of the western U.S.A. Variations in temperature and precipitation in Mongolia create seasonally harsh conditions. Winters are generally long, cold, and dry, whereas the spring season is cold, dry, and windy. Most of the precipitation in Mongolia is received between mid-June and the end of August. Extended drought periods and winter snow storms are common features in the Mongolian environment. These dry and temperate climatic conditions have favored the development of extensive grass and shrub steppe grazing lands.

The topography of Mongolia is also similar to that in the western U.S. Mongolia has deserts, high mountains, saline soils and lakes, fertile valleys, forests, and vast expanses of steppe. These lands have supported grazing animals for thousands of years, cover an area of 1.26 million km^2, and have the capacity to support large numbers of grazing animals. These natural pastures are grazed yearlong by pastoral livestock and wild herbivores. Higher-yielding natural pastures are harvested as hay for winter supplemental feed. Mongolian grasses and legumes evolved under sustained grazing pressure and are well adapted to grazing.

Because of their adaptation to grazing and the climatic and topographic similarities between Mongolia and western North America, many of the grasses and legumes found in Mongolia hold potential for use as valuable forage species in pastures and rangelands of the Intermountain, Northern Rocky Mountain, and Northern Great Plains Regions of the western United States. However, germplasm from western Mongolia is poorly represented in the current collections of the National Plant Germplasm System in the U.S. and could only be obtained by collection. In addition, because of changing economic and social conditions in Mongolia, these unique rangeland areas in western Mongolia are potentially threatened by intensive agricultural development and overgrazing. Severe overgrazing is already widespread near population centers throughout Mongolia, and plant communities in these areas are becoming dominated by weedy species that are unpalatable to livestock. This situation threatens the continued existence of diverse forage germplasm in Mongolia. As a result, it is important that this unique forage grass and legume germplasm be collected while the natural grazing lands in western Mongolia remain in relatively high ecological condition.

Mongolia has six major vegetation zones, each having different topography, elevation, temperature, rainfall distribution, soils, and vegetation. Mongolia's major vegetation zones and the percentages of land area occupied by each are: alpine tundra (4.5%), mountain taiga (3.8%), mountain steppe and forest (23.3%), grass steppe (25.9%), desert steppe (21.5%), and desert (15.4%).

High mountain grazing land (alpine tundra) has an annual standing crop yield (dry weight) that ranges between 100 to 850 kg/ha. Lichen grazing land at the highest altitude is used for summer grazing of reindeer. Lichen-Carex grazing land is used for summer grazing of yak. Alpine shrub and meadow grazing land is used for summer and autumn grazing of yak and cattle; swamp grazing land is used for summer grazing of cattle. Bluegrass grazing land is used yearlong by all livestock.

Forest steppe, swamp steppe, and grass steppe grazing land predominate in Mongolia and exhibit the highest forage yields. Forest grazing land has annual standing crop yields ranging from 400 to 600 kg/ha. Birch-pine forest, larch forest, and birch-poplar forest grazing land is used primarily for summer grazing by horses, cattle, and large wild herbivores. Forest with an extensive shrub understory is grazed during the summer by all livestock except camels. Swamp steppe grazing land dominated by grasses and Carex species in association with herbs has annual standing crop yields ranging from 180 to 800 kg/ha. Swamp steppe grazing land is used yearlong and is generally most suited for horses and cattle.

Forest and grass steppe regions have the highest number of livestock. These lands are dominated by grasses and herbs and have annual standing crop yields ranging from 250 to 800 kg/ha. Plant morphological characteristics such as awns on Stipa species may limit use of some grazing land by livestock to certain seasons. Most forest steppe and grass steppe grazing land is grazed yearlong by all livestock except camels. Red deer is the major wild herbivore grazing in forest steppe areas, while gazelles are the most common wild herbivore grazers in grass steppe areas.

Desert steppe and desert grazing land generally exhibit low standing crop yields, but provide the highest diversity of vegetation communities, soils, and land form. The effect of these specialized communities is to create "patch" grazing for livestock and wild herbivores. Desert steppe grazing land is dominated by grasses, herbs, and shrubs with annual standing crop yields ranging from 170 to 400 kg/ha. Desert steppe formerly was the habitat of the Mongolian wild horse (Equus ferris).

Although its yield is low compared to other natural regions, desert grazing land has the highest diversity of plant communities in Mongolia. Annual standing crop yield ranges from 100 to 330 kg/ha. Desert grazing lands are especially suited to grazing by camels, sheep, and goats and provide habitat for a number of wild herbivores.

Trip Details: On August 13 U.S. participants flew from their respective locations to Beijing and arrived in Ulaanbaatar on August 16. One day was spent in Ulaanbaatar finalizing trip arrangements, supplies, and equipment for the exploration. Two collecting teams were assembled to effectively traverse the extensive areas of the Altai-Gobi and Altai Mountains in western Mongolia. Dr. Johnson led the north team, while Dr. Sheehy led the south team. The north team used a four-wheel drive van owned and operated by the Research Institute of Animal Husbandry, whereas the south team rented a four-wheel drive van and hired the owner/driver in Ulaanbaatar. The Research Institute of Animal Husbandry provided a co-leader, taxonomist, agronomist, and an interpreter for each team for the entire collection period. Mr. Thomas Sheehy accompanied the south team, and Mr. Hugh Sheehy accompanied the north team.

The two teams left Ulaanbaatar on August 18 (see attached map). The south team took a route that began in Ulaanbaatar and traversed southwest to Oberhangai Aimag; southwest through Bayanhongor Aimag to Gobi-Altai Aimag; west to Hovd Aimag near the border with the Xinjiang Autonomous Region of the People's Republic of China; north through Hovd Aimag to Ubs Aimag near the border with Russia; east through Ubs and Zavhan Aimags to Hovsgol Aimag; southeast through Hovsgol and Bulgan Aimags to Tov Aimag; and return to Ulaanbaatar. The north team traversed a route that began in Ulaanbaatar and went west through the Tov, Bulgan, and Arhangai Aimags; northwest through Zavhan and Ubs Aimags to near the Russian

border; southwest through Ubs and Bayan-Olgii Aimags to near the border with the Xinjiang Autonomous Region of the People's Republic of China. The team then traveled southeast through the Aimags of Bayan-Olgii, Hovd, and Gobi-Altai; east through Bayanhongor Aimag; and northeast through Oborhangai and Tov Aimags; and return to Ulaanbaatar.

Seed was collected for each accession, and accompanying passport data was obtained for each collection. Voucher herbarium specimens were obtained to taxonomically verify the collections at the Institute herbarium in Ulaanbaatar. Germplasm accessions were collected from the forest steppe, grass steppe, desert steppe, and desert vegetation zones. Collections were made in the Gobi, Altai, and Hangai-Hovsgol Ecological Regions of Mongolia. Characteristics for each of these regions are summarized as follows:

Gobi Region: The Gobi Region includes the semi-arid and southern portion of Mongolia. In this region, moisture availability and arable soils are the major limiting factors to agricultural production. Except in irrigated oases suitable for the production of vegetables and melons, agriculture is limited primarily to using sheep, goats, and camels to harvest grazing land forage. The Gobi Region is the center of a cashmere goat industry. A major limiting factor to livestock production in the Gobi Region is the need for winter supplemental feed for livestock in a region that has little inherent capability to produce supplemental feed. Aimags forming the Gobi Region include Gobi-Altai, Bayanhongor, Oborhangai, Dundgov, Omnogov, and Dorngov. General climatic and physical factors of the Gobi Region include: elevations ranging from 700 to 1400 m; mean annual temperatures ranging from 0.0EC to > 2.5EC with a low temperature of -20EC in January and a high temperature of 23EC in July; average wind velocity of 2 to 8 m/sec; from 90 to > 130 frost-free days; and precipitation of about 100 mm. Lack of snow, which is used as a water source by grazing animals, limits livestock production in the Gobi Region.

Altai Region: The Altai Region is the high mountain region in western Mongolia. Agricultural production in the northern and central part of the region is limited to using cattle, sheep, goats and yaks to harvest grazing land forage with pastoral grazing management strategies. In the southern Altai Region irrigated fruits, berries, and melons are produced and limited fodder production is possible. Aimags forming the Altai Region include Ubs, Bayan-Olgii, Hovd, Zavhan, and Gobi-Altai. Climatic and physical factors influencing biological systems in the Altai Region include elevations between 1500 and 4000 m; mean annual temperature between -2.5EC and 5.0EC with a low temperature of -24EC in January and a high temperature of 22EC in July; 60 to 120 frost-free days; between 400 to 500 mm of annual precipitation; snow depths that range between 5 to > 15 mm; and an average wind speed of between 2 to 6 m/sec.

Hangai-Hovsgol Region: The Hangai-Hovsgol Region is located in northwest Mongolia. As a mountainous region of high elevation and deep valleys with some forest and arid steppe, agricultural production is limited to harvesting forage with grazing animals including yaks, cattle, sheep, and reindeer. Agricultural activities other than pastoral grazing include a limited amount of fodder harvest and grain production in the steppe areas of the region. Aimags forming the region include Arhangai, Hovsgol, Bulgan, and Zavhan. Climatic and physical factors influencing biological systems in the Hangai-Hovsgol Region include elevations between 2000 and 3000 m; mean annual temperatures between -2.5EC and 7.5EC with a low temperature of -24EC in January and a high temperature of 19EC in July; from 60 to 100 frost-free days; and an

annual precipitation of 200 to >400 mm; wind speed that averages from 2 to 4 m/sec; and snow cover that often exceeds 15 mm in depth.

The south team returned to Ulaanbaatar on September 12, and the north team returned on September 13. The two teams traveled about 10,000 km (6,000 miles) and made a total of 387 collections, which represented 94 genera and 176 species. In Ulaanbaatar, herbarium specimens were taxonomically verified, the collections were cataloged and species lists prepared, the seed was equally divided, and necessary export approvals were obtained. All necessary procedures and requirements for collection documentation and inspection required by Mongolian Government officials in Ulaanbaatar were followed. Discussions were held with our Mongolian counterparts to develop a proposal to collect forage germplasm in 1998 in the areas of Hovsgul, Mongolian-Daguur, and the Hentei Mountains in northern Mongolia. These proposed collection areas are well known for their unique floristic composition. It was agreed that Dr. Johnson would take the lead role in finalizing a proposal to collect forage germplasm in northern Mongolia in 1998. U.S. team participants departed Ulaanbaatar on September 17, overnighted in Beijing, and returned to their respective homes on September 18.

1996 Mongolia Germplasm Collections

Achnatherum splendens (2)
Aconitum barbatum (1)
Agriophyllum pungens (1)
Agropyron cristatum (16)
Agropyron desertorum (1)
Agropyron krylovianum (1)
Agropyron michnoi (3)
Agrostis clavata (5)
Agrostis mongolica (1)
Agrostis trinii (4)
Allium altaicum (1)
Allium anisopodium (3)
Allium clathratum (1)
Allium leucocephalum (1)
Allium mongolicum (2)
Allium odorum (4)
Allium polyrhizum (4)
Allium senescens (4)
Allium splendens (2)
Alopecurus arundinaceus (3)
Alopecurus brachystachyus (5)
Alopecurus ventricosus (1)
Amaranthus retroflexus (1)
Amygdalus pedunculata (1)
Arenaria capillaris (1)
Artemisia anethifolia (1)
Artemisia frigida (1)
Artemisia spp. (1)
Aster alpinus (1)
Astragalus adsurgens (12)
Astragalus dahuricus (1)
Astragalus minetus (1)
Astragalus mongholicus (2)
Astragalus patenti-pilosus (3)
Astragalus spp. (4)
Astragalus tibetanus (2)
Beckmannia syzigachne (5)
Brassica juncea (1)
Bromus inermis (8)
Bromus ircutensis (1)
Bromus japonicus (1)
Bromus pumpellianus (3)
Bromus squarrosus (1)
Calamagrostis langsdorffi (1)
Calamagrostis macrolepis (1)
Calamagrostis purpurea (2)
Caragana bungei (1)
Caragana leucophloea (2)
Caragana spinosa (1)
Caragana stenophylla (1)
Carex duriuscula (1)
Carex pseudofoetida (1)
Carum carvi (4)
Ceratoides papposa (1)
Chloris virgata (1)
Cleistogenes songorica (1)
Cleistogenes squarrosa (3)
Convolvulus gortschakovii (1)
Cotoneaster melanocarpa (1)
Elaeagnus moorcroftii (1)
Elymus angustus (2)
Elymus chinensis (10)
Elymus confusus (1)
Elymus dahuricus (9)
Elymus gmelinii (1)
Elymus ovatus (2)
Elymus paboanus (4)
Elymus racemosus (2)
Elymus secalinus (6)
Elymus sibiricus (10)
Elymus spp. (1)
Elymus strigosus (1)
Elytrigia aegilopoides (3)
Elytrigia nevskii (2)
Elytrigia repens (1)
Eragrostis minor (1)
Festuca altaica (3)
Festuca lenensis (6)
Festuca ovina (1)
Festuca sibirica (1)
Galium vaillantii (1)
Galium vernum (1)
Gentiana decumbens (1)
Glycyrrhiza uralensis (2)
Halerpestes salsuginosa (2)
Halimodendron halodendron (1)

Haplophyllum dauricum (1)
Hedysarum fruticosum (4)
Hedysarum inundatum (1)
Helictotrichon pubescens (1)
Helictotrichon schellianum (3)
Hierochloe odorata (1)
Hordeum bogdani (4)
Hordeum brevisubulatum (4)
Iris bungei (2)
Iris lactea (1)
Juncus gerardii (2)
Kochia prostrata (2)
Koeleria altaica (1)
Koeleria glauca (2)
Koeleria gracilis (2)
Koeleria macrantha (2)
Leontopodium leontopodioides (1)
Leymus paboanus (1)
Lilium tenuifolium (1)
Lotus corniculatus (1)
Medicago falcata (11)
Medicago lupulina (2)
Medicago platycarpos (2)
Medicago varia (2)
Melica virgata (1)
Melilotus alba (1)
Melilotus dentata (7)
Nitraria sibirica (2)
Olgaea lomonossowii (1)
Onobrychis sibirica (1)
Orobanche cumana (1)
Oxytropis eriocarpa (1)
Oxytropis microphylla (1)
Oxytropis spp. (1)
Pedicularis flava (1)
Peganum harmala (2)
Peganum nigellastrum (1)
Phalaris arundinacea (2)
Phleum phleoides (1)
Phlomis tuberosa (1)
Plantago depressa (1)
Plantago salsa (1)
Poa altaica (1)
Poa argunensis (1)
Poa attenuata (4)
Poa botryoides (1)
Poa nemoralis (1)
Poa palustris (1)
Poa pratensis (8)
Poa stepposa (1)
Poa subfastigiata (2)
Polygonum aviculare (1)
Potentilla fragarioides (1)
Potentilla gelida (1)
Psathyrostachys juncea (7)
Ptilagrostis mongholica (1)
Reaumuria soongarica (3)
Rosa laxa (2)
Rumex thyrsiflorus (1)
Salsola ruthenica (1)
Sanguisorba officinalis (3)
Schizonepeta annua (2)
Serratula centauroides (1)
Setaria viridis (1)
Silene jenisseensis (1)
Silene parviflora (1)
Spaeropyra salsola (1)
Stipa capillata (3)
Stipa glareosa (3)
Stipa sibirica (5)
Tamarix gracilis (1)
Thalictrum minus (1)
Thalictrum simplex (1)
Thermopsis dahurica (3)
Thermopsis schischkinii (4)
Trifolium lupinaster (2)
Triglochin palustre (1)
Tripogon purpurscens (1)
Trisetum sibiricum (1)
Urtica cannabina (1)
Valeriana officinalis (1)
Veronica incana (1)
Vicia amoena (3)
Vicia costata (2)
Vicia cracca (1)
Vincetoxicum sibiricum (1)
Zygophyllum potanini (1)
Zygophyllum xanthoxylum (2)

TOTAL 387