Grasslands on Different Continents Share Roots

GU ANLIN, LARRY K. HOLZWORTH AND JODY K. HOLZWORTH

Two countries over half a world apart practice different customs, different religions and have different life styles. But the United States and China may in fact share similar roots, that is, grass roots of our prairies.

Several scientists are finding many similarities between the two country's grassland plant communities. After several treks into China, the U.S. researchers discovered many of the same native grass, forb, sedge and legume species as they work with in the Northern Great Plains of the United States.

USDA Natural Resources Conservation Service (NRCS) agronomists Larry Holzworth, Mark Majerus, John Scheetz and Chinese scientist Gu Anlin began scientific and technical exchanges between the United States and China eight years ago. Through the exchanges, they have planted and evaluated different U.S. plant species in China as well as collected seed from Chinese native plant communities and planted them into U.S. trials. Both countries hope to find plant species to address similar concerns, such as for saline soil reclamation and reseeding overgrazed areas.

The four exchanges were sponsored by the NRCS and the Chinese Ministry of Agriculture. The cooperative project was initiated between the Grassland Research Institute, Inner Mongolia, People's Republic of China and the USDA-NRCS, Bridger Plant Materials Center (PMC), Bridger, Montana, USA in 1988.

Plant Similarities Grounded in Climatic, Topographic Likenesses

During four visits between the U.S. and China, these scientists identified several perennial bunch grasses, sod-forming grasses, shrubs and forbs similar in both areas. Many of the common species are not only physiologically and ecologically similar, but some are genetically related, and some are even identical between the two continents. For example, genetically similar species of needlegrass grow in both countries. The USDA Agricultural Research Service helped the scientists determine the similarities of the plants by using a molecular biology technique that finds chromosome associations, called genomes, between the species.

The similarities between plants are rooted in the climatic and topographic likeness of the two countries' grasslands. The researcher's studies focused on the Northern Mixed Prairie of North America and the True Steppe of North China, which are both situated in temperate inland regions of the Northern Hemisphere (Figure 1). The Northern Mixed

Fig. 1. T*he location of the Temperate-true Stepp of northern China.*

Prairie of North America occupies a broad north-south belt in the Great Plains and is generally defined as the area bordered on the east by the Tallgrass Prairie (eastern Nebraska) and on the west by the foothills of the Rocky Mountains. It includes parts of North Dakota, South Dakota, Nebraska, Montana, Wyoming and south-central Canada (Fig 2). The True-Steppe in China occupies the central-

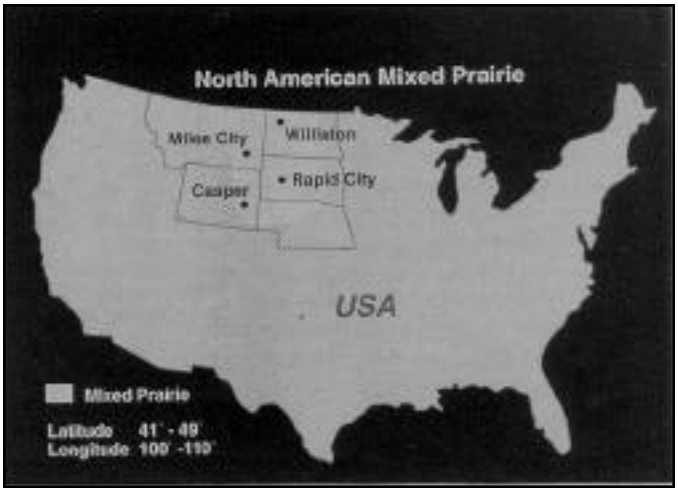

Fig. 2.T*he location of the Northern Mixed Prairie in north-central part of the US.*

eastern area of the Inner Mongolia Plateau (Figure 1). It is bordered by the Meadow Steppe in the east and by the Desert-Steppe in the west.

Central Inner Mongolia, PRC, Temperate-True Steppe showing sod-forming grass,* Leymus chinensis*, and leguminous shrub* Caragana microphylla*. 1991.

The Inner Mongolia Plateau has long, smooth slopes which are mostly gently rolling, but with low stony hills. Elevation ranges from 2,000 to 4,000 feet (600 to 1,200 m) in the hills and as high as 4,900 to 5,900 ft. (1,500 to 1,800 m) near the mountains. The U.S. Northern Mixed Prairie is also dominated by gently rolling topography with elevations ranging from 1,600 to 3,600 ft. (500 to 1,100 m). Unlike Inner Mongolia, the presence of sandy soils allows tallgrass species to dominate the Northern Great Plains. In other areas, the glacial retreat left depressions that filled with water and, subsequently, became the prairie potholes. Local soil drainage patterns also gave rise to "badlands," which result in distinct plant communities.

Grazing has played a large part in the evolution of both of these grasslands. Domestic livestock grazing has only occurred in the Northern Mixed Prairie for 200 years. Domestic grazing has probably occurred in Inner Mongolia for over 1000 years, and possibly as many as 2,000 years. Both countries grasslands evolved with fire and wild ungulate grazing. However, the Inner Mongolian Steppe grasses appear to be more resistant to prolonged heavy grazing than those of North America.

The dry climate of both areas has considerable daily and yearly variations. The winter temperatures are very low with minimums about –40F (–40 degrees Celsius) in both regions. The summer is longer and hotter in the Northern Great Plains than in central Inner Mongolia. The average annual precipitation for both is 10–18 inches (250 to 450 mm). Evaporative demand is much higher than precipitation in both regions.

In Inner Mongolia, snowfall is infrequent and only 30% of the total annual precipitation is received in spring and early summer. Most of the region is characterized by drought until the middle of June and rainfall is more plentiful from July to September. The maximum temperature occurs in mid-summer. More snowfall occurs in the Northern Great Plains than in Inner Mongolia and about 50% of the annual precipitation occurs in spring and early summer. Rainfall peaks during May and June and decreases abruptly in July and August, the warmest period in the year, resulting in a long drought from midsummer to autumn.

The same soil types occur in both areas. Dark brown and moderately thick surface soils, and brown soils, which are lighter-colored soils, are both found in China and the U.S. The similar soil types may also contribute to the likeness of the vegetation.

Same Grasses Growing A World Apart

The researcher's findings demonstrate how grasslands, half a world apart, can be quite similar. In both regions, the predominate grassland vegetation is perennial grasses. Bunch grasses predominate in Inner Mongolia, whereas bunch and sod-forming grasses occur together in the U.S. Perennial forb abundance is secondary to grasses on both continents. The occurrence of sedges and shrubs varies with habitat. Shrubs appear usually only on sheltered hillsides in the Northern Great Plains while they form a major vegetation type in Inner Mongolia. Annuals appear in both areas on disturbed areas.

Needlegrasses are dominant perennial bunchgrasses in both regions and are found in association with other warm-season and cool-season bunchgrasses. In the Northern Great Plains, green needlegrass is found in association with prairie junegrass, Sandberg bluegrass and the warm-season grasses blue grama and little bluestem. In Inner Mongolia, the needlegrasses are found with a warm-season grass, *Cleistogens* sp., similar to the US bluegrama. Bluegrass, fescues and prairie junegrass, same species as in the US, are also found (Table 1.). *Cleistogens* occurs in the True Steppe as blue grama occurs in the Northern

Table 1. The major typical plant communities of the Inner Mongolian Temperate True Steppe and the Northern Mixed Prairie of the Northern Great Plains.

PLANT ASSOCIATIONS	INNER MONGOLIA	NORTHERN GREAT PLAINS
Bunchgrass	needlegrasses, *Cleistogens*, prairie junegrass, bluegrass and fescue	needlegrasses, little bluestem, bluegrama, prairie junegrass, bluegrass
bunchgrass--sod-formers	needlegrasses, Chinese *Leymus*,*Cleistogens*	needlegrasses, western and thickspike wheatgrass, blue grama, little bluestem
	needlegrass, Chinese *Leymus*, crested wheatgrass, prairie junegrass	needlegrasses, western & bluebunch wheatgrass, prairie junegrass
bunchgrass–sod former–shrub	needlegrasses, Chinese *Leymus*, fringed sage	needlegrass, western wheatgrass, fringed sage
bunchgrass—shrub	needlegrass, *Cleistogens*, fringed sage	needlegrass, blue grama & sage brushes
sod-former—bunchgrass	Chinese *Leymus*, needlegrass, *Cleistogens*, prairie junegrass	western and bluebunch wheatgrass needlegrass, prairie junegrass, bluegrass
	Chinese *Leymus*, crested wheatgrass, needlegrass	western and bluebunch wheatgrass, needlegrass
sod former—bunchgrass—shrub	Chinese *Leymus*, needlegrass, fringed sage	western wheatgrass, needlegrass, fringed sage

Mixed Prairie, and both increase with grazing. The bluegrasses are common to both regions and are relatively sensitive to moisture regimes. Sheep fescue (*Festuca ovina*) is a widely distributed species in the Mongolian steppe, but is absent in the Great Plains.

The bunchgrass, sod-former communities in Inner Mongolia are dominated by crested wheatgrasses, (*Agropyron*) needlegrasses, prairie junegrass, and Chinese *Leymus*, which looks like the U.S. western wheatgrass. Western and thickspike wheatgrasses, blue grama, little bluestem, prairie junegrass and bluebunch wheatgrass fill a similar niche in U.S. bunchgrass, sod-former plant communities.

Of the perennial sod-forming grasses, Chinese *Leymus* is the dominant rhizomatous grass in Inner Mongolia. Its counterparts in the Northern Great Plains include western wheatgrass on clayey soils and thickspike wheatgrass and prairie sandreed on sandy soils. Both Chinese *Leymus* and western wheatgrass are tolerant of a wide range of environmental conditions and dominate lowland plant communities where soils are saline or alkaline.

In the True Steppe, perennial forb species are more diverse and more abundant than in the Northern Great Plains. About 10–12% of the forbs are legumes, most of which are usable as forage and some are very palatable. Inner Mongolian species compositions in both the bunchgrass and rhizomatous grass communities include various companion forbs like wild onion, aster and iris, and several leguminous plants such as, pointvetch, milkvetch, sweetvetch, *Caragana*, *Lespedeza* and *Melissitus*. In comparison, the forbs distributed in the Northern Mixed Prairie are less diverse in species composition and have fewer legumes. Roughly, legumes comprise 5% or less of the total prairie species. Relatively common species are scurfpea, milkvetch, pointvetch, prairieclovers and lupines. Several of the species have low palatability, with several considered poisonous to livestock.

The companion sub-shrubs of fringed sage *Artimesia frigida*, the same species on both continents, and cinquefoil, also occur within plant communities on both continents. These sage and cinquefoil genera contain several species important to both the True Steppe and the Northern Great Plains. Another shrub important to the Temperate True Steppe is forage kochia (*Kochia prostrata*), a major companion species occurring in the more arid western portion.

Research Far From Over

Chinese and U.S. scientists are continuing to evaluate grasses, forbs, legumes and shrubs from each others countries in comparison to their own, at test locations in both countries. The preliminary results of these studies reveal that Chinese grasses and legumes out perform the U.S. plant materials in Inner Mongolia. However, results indicate U.S. salt tolerant species have potential to assist the Chinese with saline soil reclamation. U.S. cultivars of tall and slender wheatgrasses (*Thinopyrum ponticum* and *Elymus trachycaulum* respectively) have been successfully established in salinized soils. Results of Chinese species planted at three different locations in the U.S. show several Asian legumes such as milkvetch (*Astragalus*), sweetvetch (*Hedysarum*), *Lezpedeza* and *Melissitus* (a relative of alfalfa) with potential for range improvement, reclamation and sustainable cropping systems in the U.S.

North-central Montana, USA, Northern Mixed Prairie showing sod-forming* Pascopyron smithiim *and two bunch grasses* Nasella virdula *and* Schizachyrium scoparium*, and the shrub* Artemisia frigida*. 1997.

These studies have validated plant performance and adaptation and the next step is to initiate seed production studies to provide seed for additional research. Some of the plant materials will be used in breeding programs of both countries and will become important sources of germplasm for the conservation and forage improvement in both countries.

Plants to Solve Problems

This comparison of the True Steppe of Inner Mongolia and the Northern Mixed Grass Prairie has attempted to reveal some of the important similarities and differences between the areas. The topography, climate and soils of these two regions are similar and support a similar complement of plant species, growth forms and communities. The major differences occur with the richness of legumes in Inner Mongolia compared with a limited number of legume species in the USA, and with the abundance of warm season grass species in the USA compared with few in Inner Mongolia. It is probably surprising that these areas have many of the same species, and certainly many related species with similar characteristics, even though they are on different continents and have evolved under different environments and selection pressures.

The closeness of the Northern Hemisphere's climates, soils, geography and plants allows for germplasm and technology exchanges between the two countries. The evaluation of germplasm by each respective country will eventually make additional plants available to Chinese and American landowners when solving natural resource concerns.

Scientist, Grassland Research Institute, Chinese Academy of Sciences, Wulanchabu East Street, Huhehot, Inner Mongolia 010010, People's Republic of China; Plant Materials Specialist, NRCS, 10 East Babcock St., Bozeman, Mont, 59715; and Communications Manager, The Nature Conservancy of Idaho, P.O. Box 165, Sun Valley, Ida. 83353.