COOPERATIVE EVALUATION OF INNER MONGOLIA, PRC, GRASSLAND GERMPLASM IN THE WESTERN USA

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ABSTRACT
Replicated dryland studies were established at three USDA, NRCS, Plant Materials Centers in the USA northern intermountain west by Chinese and American scientists. Forty-six Asian and 16 USA grasses, legumes, and shrubs were included. These plantings were evaluated for vigor, percent stand, and foliage height in 1994 and 1995, and for biomass production in 1995. Generally, USA grasses outperformed Asian grasses, while Inner Mongolian legumes show the highest potential for use in the intermountain west.

KEYWORDS
USA, germplasm, evaluation, Inner Mongolia, intermountain west

INTRODUCTION
The semi-arid and arid grasslands of Inner Mongolia and the western United States are ecologically similar in structure and function (Dewey, 1983). A cooperative project was initiated between the Grassland Research Institute, Inner Mongolia, People's Republic of China and the USDA Natural Resources Conservation Service (NRCS), Bridger Plant Materials Center (PMC), Bridger, Montana, USA in 1988. The major objective of the cooperative program was to evaluate and select plant materials to restore steppe, shrub-steppe, saline bottomlands, and open woodland sites in the arid and semi-arid zones of the two countries.

METHODS AND MATERIALS
The Bridger, Montana PMC received seed of 23 Chinese accessions in 1989, which were planted March 2, 1989. Sixteen additional Chinese accessions were received in 1990, which were out-planted in plots April 27, 1990. These collections were planted in single, 6-meter long rows with 2-meter row spacings. The plots were irrigated and maintained near field capacity throughout the summer. The plots were not replicated due to small seed supplies. Plant vigor, stand density, foliage height and seed head production were evaluated in 1989 and 1990. Seed was eventually harvested from these plots to establish additional studies.

In the spring of 1994, replicated plots featuring Asian plant materials were established on dryland sites at USDA, NRCS, Plant Materials Centers at Bridger, MT, Pullman, WA, and Aberdeen, ID. Each of the accessions and cultivars were planted in four rows, six meters long, and were replicated three times. Row-spacing widths were 30 cm for grasses, 60 cm for legumes, and 120 cm for shrubs. The Bridger plots consist of 46 Asian and 2 USA accessions, while Aberdeen and Pullman sites feature 33 and 2, respectively. Fourteen USA cultivars are included for standards of comparison at Bridger, and 12 USA cultivars at Aberdeen and Pullman. The Bridger site receives 280 mm of mean annual precipitation and has clay loam soils. Pullman receives 500 mm and Aberdeen receives 224 mm of rainfall. Elevation ranges from 762 m at Pullman to 1345 m at Aberdeen. Latitudes vary from 42˚-47˚N at the three locations. These plantings have been evaluated for vigor, percent stand, and foliage height in 1994-1995, and for biomass production in 1995.

RESULTS AND DISUSSION
Bridger 1989 and 1990 Plantings. Overall, *Agropyron cristatum*, *Astragalus adsurgens*, *Caragana korshinshii*, *Caragana microphylla*, and *Ceratoides arborescens* maintained the best stands of the 1989 plantings, ranging from 80 to 100%. *Agropyron cristatum*, *Agropyron desertorum*, *Agropyron sibiricum*, *Elymus dahuricus, Elymus nutans*, and *Hordeum brevisubulatum* had the highest stand ratings of the 1990 planting.

Bridger 1994 Planting. Twelve grass accessions maintained a 60% or greater stand through 1995: 'Rosana' *Pascopyrum smithii* (73%); 'Bozoisky-Select' *Psathyrostachys juncea* (67%); 'Critana' *Elymus lanceolatus* ssp. *lanceolatus* (67%); 9057961 (62%), 9058216 (63%), and 9075989 (67%) *Hordeum brevisubulatum*; 'Pryor' *Elymus trachycaulus* ssp. *trachycaulus* (62%); 'Hycrest' *Agroypron cristatum X desertorum* (60%); 9058214 *Elymus ciliaris (*62%); 9057959 *Elymus tangutorum* (60%); 9075984 (63%) and 9057955 (60%) *Elymus dahuricus;* and 9058217 *Stipa grandis* (63%). Only one accession 9069980 *Leymus racemosa* failed to establish any plants, probably due to poor seed viablity.

The highest forage-producing accessions in 1995 were Hycrest *Agroypron cristatum X desertorum,* 7821 kg ha^{-1}; Rosana *Pascopyrum smithii,* 7415 kg ha^{-1}; 'Bannock' *Elymus lanceolatus* ssp. *lanceolatus*, 7127 kg ha^{-1}; and 9058207 *Agropyron desertorum,* 6789 kg ha^{-1}. The lowest yield was for 540441 *Elymus arenarius*, at 143 kg ha^{-1}.

'Lutana' *Astragalus cicer*, 9057946 and 9075988 *Astragalus adsurgens*, and Spredor III *Medicago sativa* were the highest ranked legume species in 1995, with greater than 48% stand. These three accessions produced more than 4419 kg ha^{-1} air-dry forage.

Aberdeen 1994 Plantings. Nine accessions of grasses had greater than 80% stands in 1995. They were 9058210 (93%) *and 9075984 (85%) Elymus dahuricus:* Rosana *Pascopyrum smithii* (88%); 9075989 *Hordeum brevisubulatum* (85%); 9075983 *Leymus chinensis* (83%); Critana (82%) and Bannock (81%) *Elymus lanceolatus* ssp. *lanceolatus*; 9058212 *Elymus nutans* (81%); 9057959 *Elymus tangutorum* (81%). The best forage-producing accessions were Hycrest *Agroypron cristatum X desertorum,* 9380 kg ha^{-1}; 9058211 *Elymus exelsus,* 8560 kg ha^{-1}; 9058210 *Elymus dahuricus,* 8350 kg ha^{-1}; and Rosana *Pascopyrum smithii,* 8190 kg ha^{-1}. The lowest-producing grass accession was 9058217 *Stipa grandis*, 1180 kg ha^{-1}.

Stand percentages for the legume species ranged from 100% for Spredor III *Medicago sativa* to 47% for 9075986 *Melissitus ruthenicus*. Forage production for the legume accessions were Spredor III *Medicago sativa,* 8760 kg ha^{-1}; Lutana *Astragalus cicer,* 8450kg ha^{-1}; 9057988 and 9057946 *Astraglaus adsurgens* , 6080 kg ha^{-1} and 5650 kg ha^{-1}, respectively; and 9075986 *Melissitus ruthenicus*, 1720 kg ha^{-1}.

Pullman 1994 Planting. Fifteen grass accessions had greater than 70% stands in 1995: Hycrest *Agroypron cristatum X desertorum* (92%); 'Schwendimar' *Elymus lanceolatus* ssp. *lanceolatus* (88%); 9058211 (80%), 9057956 (70%), and 9057957 (77%) *Elymus excelsus;* 9058212 *Elymus nutans* (85%); 9058207 *Agropyron desertorum* (85%); 9058214 *Elymus ciliaris* (77%); 9058209 *Agropyron sibiricum* (87%); Pryor *Elymus trachycaulus* ssp. *trachycaulus* (87%); Rosana *Pascopyrum smithii* (90%); Bannock

Elymus lanceolatus ssp. *lanceolatus* (78%); P-27 *Agropyron fragile* ssp. *sibricum* (73%); 9075984 *Elymus dahuricus* (72%); and 540441 *Elymus arenarius* (73%).

Hycrest *Agroypron cristatum X desertorum* had the highest forage production at 15,993 kg ha^{-1}. An additional four accessions produced more than 9000 kg ha^{-1} of air-dry forage. They were Schwendimar *Elymus lanceolatus* ssp. *lanceolatus* 13,270 kg ha^{-1}; 9058211 *Elymus excelsus,* 11,848 kg ha^{-1}; 9058212 *Elymus nutans,* 10,879 kg ha^{-1}; and 9058207 *Agropyron desertorum,* 9250 kg ha^{-1}.

Percent stand for the legume accessions ranged from 93% for Lutana *Astragalus cicer* to 62% for Spredor III *Medicago sativa*. Forage production varied from 8459 kg ha^{-1} for Spredor III to 4900 kg ha^{-1} for 9057946 *Astragalus adsurgens*.

CONCLUSION

Preliminary results of the Chinese accessions planted at the three USA locations show several Asian species have potential for pasture improvement, reclamation, and sustainable cropping systems in the USA intermountain west. Generally, USA grasses outperformed Asian grasses, while Inner Mongolian legumes show the highest potential for use in the intermountain west. Species which completed much of their active growing period in the spring were able to escape summer drought. Summer drought is characteristic of the intermountain west and could limit long term adaptation of those introduced species exhibiting summer active growth.

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