STATE OF UTAH
Annual Report for Calendar Year 2004
to the W-6 Technical Committee
Compiled by Kevin B. Jensen

Germplasm Activities of Mary E. Barkworth (Intermountain Herbarium, Utah State Univ., Logan, UT) - Order number: 163810 - *Achnatherum brachychaetum*.

No Report Submitted

Germplasm Activities of Craig Coleman (Brigham Young Univ., Provo, UT) - Order number: 167417 - *Pennisetum glaucum* (Pearl Millet); **Order number: 167333** - *Zea mays* subsp. *huehuetenangensis, Zea mays* subsp. *mexicana, Zea mays* subsp. *parviglumis*. Research study on seed storage proteins.

We have cloned zein-like genes from *Zea mays* ssp. *parviglumis* and *Pennisetum glaucus* using the USDA germplasm. We are in the process of cloning additional genes and analyzing seed storage protein profiles from the germplasm. As yet we do not have any publications reporting our data.

Germplasm Activities of Craig Dunford (Honeyville Grain Inc., Salt Lake City, UT) - Order number: 162678 - *Triticum monococcum.*

Seed obtained for a customer that wanted a specific type of wheat. When he found it was not being grown anywhere, he changed his mind. The seed was not used.

Germplasm Activities of Tim Ford (Pineview Farms, Huntsville, UT) - Order number: 163496 - *Medicago sativa* subsp. *falcata*; **Order number: 163178** - *Medicago sativa* subsp. *falcata* from Mongolia.

Medicago falacata for breeding.

Germplasm Activities of Dwain Horrocks (Brigham Young Univ., Provo, UT) - Order number: 165818 - *Lycopersicon esculentum*; **Order number: 165158** - *Glycine max*; **Order number: 165130** - *Triticum aestivum.*

Order Number: 165130 (*Triticum aestivum*) and Order Number: 165158 (*Glycine max*)were passed on to Drs. Bruce Smith (Plant and Animal Sciences) and Lee Hansen (Chemistry). They are working on broadening the base understanding of respiration in plants with the idea that they can relate metabolic adaptation to the environment in which a cultivar or line originated. They are continuing to work on this. No publications have resulted from the use of these plant materials, but that is the goal.

Order Number: 165818 (*Lycopersicon esculentum*)- This was used in hybridization studies between tame tomatoes and *L. peruvianum*, a wild type, in which a transfer of viral resistance from the wild type to the tame type was the goal. Luis Gordillo, has nearly completed his PhD dissertation on these hybridization studies. Once the dissertation is completed then a manuscript will be prepared for peer review.

Germplasm Activities of Eric N. Jellen (Brigham Young Univ., Provp, UT) - Order number: 165550 - *Phaseolus acutifolius*, *Phaseolus acutifolius* var. *tenuifolius*. haseolus acutifolius for genetic mapping.

I did not get the *Amaranthus* seed to the flowering stage before they died; I am going to try again this summer.

We have included the *Phaseolus acutifolius* accessions in a phylogenetic analysis of this species which we reported at the last PAG Meeting; we are preparing a manuscript based on these data. It looks like the domesticated material forms a fairly tight cluster within the broader wild materials, as expected, with the greatest genetic diversity for cultivars in the American Southwest. Unfortunately, materials from Mexico and Central America were numerically under-represented in the collection. We will be planting some of the domesticated materials out at the ITA outside of Khenifra, Morocco.

Germplasm Activities of Kevin B. Jensen (USDA/ARS, Logan, UT) - Order number: 165627 - *Bromus marginatus*, *Bromus carinatus*, *Sporobolus airoides*.

Crested Wheatgrass Complex Breeding: An induced tetraploid of *Agropyron cristatum* (I28; PI279802) is currently being tested for possible release as **Hycrest II**. Population (HxB28) is a cross between hexaploid crested wheatgrass (406442) and the cultivar Hycrest, which has combined the improved quality and broad leaves of the hexaploid and the drought tolerance of Hycrest. Siberian wheatgrass (*A. fragile)* from Kazakhstan (W6-13324-13374) is a low growing, pubescent-blue green population that is being tested as an ecological bridge species for restoration projects on sites with 6 to 8 inches of precipitation.

Russian Wildrye Complex Breeding: The cultivar 'Bozoisky-II' was released this year. It has increased seedling vigor over 'Bozoisky-Select' and other commercially available cultivars. The major breeding effort is on the population generated by doubling the cultivar 'Bozoisky' and crossing it onto the natural tetraploid Russian wildrye (PI-565063 to 565072) from Kazakhstan in an attempt to infuse more drought tolerance and increased yield under dryland conditions in the tetraploids. This population is in regional field tests pending release.

Orchardgrass Breeding: A wide leafed population of orchardgrass has been developed from plant introductions from Northwestern Regions of China. Selection emphasis in all populations is on reduced fiber (high quality), regrowth characteristics, increase seedling establishment, disease resistance, and increased persistence. Selections within PI's 237269 (Denmark), 255168, 305498, 311034 (Poland), and 370668, 440275, AR-468 (USSR) were polycrossed and are

currently being evaluated for superior regrowth and quality under repeated defoliation in an early-maturing orchardgrass population.

Bromegrass Breeding: Breeding programs were initiated this year in mountain brome (*Bromus marginatus* and *B. carinatus*). All NPGS meadow bromegrass accessions (*Bromus riparius*) are currently being evaluated for forage yield and quality under repeated defoliation. PI's 315397, 325235, 325236, 297887, and 315391 have significantly higher forage yield after three harvests than the commercially available cultivars.

Snake River and Thickspike wheatgrass: All accessions from the NPGS were evaluated this year for persistence, plant vigor, seed yield, establishment characteristics, and forage yield. Data will be taken 2005 and 2006.

Slender wheatgrass: A composite of collections from Colorado that were selected for seedling vigor under a deep planting depth have shown real promise when compared to the traditional cultivars. At four different locations (Utah, Wyoming, and Washington), this population has expressed significantly better establishment characteristics and is currently being tested for release.

Germplasm Activities of D. A. Johnson (USDA-ARS, Logan, UT)

Germplasm Collection and Evaluation of *Astragalus filipes*: Work is continuing with *Astragalus filipes* (basalt milkvetch or threadstalk milkvetch) for use in restoration and revegetation efforts in the Intermountain West. During the summer of 2004, intensive efforts were again mounted to collect seed of Utah milkvetch (*Astragalus filipes*). Supplemental seed collections were made in a six-state area of the western U.S. In addition, seed collections were made in British Columbia, Canada to represent the furthest north extension of this species. This brings the total seed collections for basalt milkvetch to 83. Detailed passport data (latitude, longitude, elevation, slope, soils data, associated species, etc.) for each of the species were entered into Excel to document each collection. Seed of each of the collections and accompanying passport data will be incorporated into the U.S. National Plant Germplasm System.

Forage samples from each of the new collections made in 2004 were ground, extracted, and analyzed for toxic properties by Dr. Dale Gardner at the USDA-ARS Poisonous Plant Research Laboratory at Logan. As observed in 2003, amounts of nitrotoxins (3-nitropropanol), selenium, and swainsonine (compound that causes loco poisoning in animals and a product of a fungal-endophyte association) were either non-detectable or extremely low for all collections of basalt milkvetch. As a result, these collections of basalt milkvetch do not appear to have any major problems related to livestock or wildlife toxicity.

In cooperation with scientists from the Nitragin Company, six rhizobial strains isolated from root nodules of A. filipes were tested in the greenhouse for their infectiveness and effectiveness at nitrogen fixation. Seedlings were started in large-sized conetainers in the greenhouse and exposed in replicated trials to each of the six rhizobial strains along with check treatments with

no rhizobial inoculation and complete nutrient solution addition. Plants were harvested after two months of growth. Data collected included numbers of nodules, nodule dry weight, aboveground dry weight, root dry weight, and nitrogen content. Data are being analyzed to determine the rhizobial treatment that exhibits the greatest growth enhancement, which the Ntragin Company will make commercially available.

Greenhouse-grown seedlings of each of 83 collections were transplanted in replicated common garden plots at two sites in northern Utah. Plants are currently being evaluated in these common gardens for their morphological, physiological, and ecological attributes. Characteristics that are being examined include: plant morphology, vigor, forage yield/quality, defoliation tolerance, persistence, and seed yield. Collaborations are continuing with Jim Cane at the USDA-ARS Bee Biology and Systematics Lab at Logan to study pollination and seed predation in basalt milkvetch. All 2004 seed collections were treated with pest strips after collection, and collections were examined for seed predator presence. True weevils and seed beetles were found in most samples and are currently being taxonomically verified. In addition, seed from 30 collection sites was sent to Victor Vankus at the USDA-FS National Tree Seed Lab in Dry Branch, Georgia, to develop rules for testing seed of basalt milkvetch. This will aid in commercial marketing of seed of basalt milkvetch.

Germplasm Collection and Evaluation of *Dalea ornata*: Western prairie clover (*Dalea ornata*) is a North American legume that is another promising candidate for use in restoration and revegetation of detiorated rangelands in the western U.S. This species is found in sagebrush steppe and pine forest areas across a five-state area of the western U.S. During 2004, a total of 22 seed collections of western prairie clover were made in Washington, Oregon, and Idaho. Seed collections were examined by Dr. Jim Cane (USDA-ARS Bee Biology and Systematics Lab at Logan) who identified specific seed pests that may be a problem for commercial seed production of this species. Leaf samples also were obtained from plants at each of the collection sites and analyzed for three toxic properties (swainsonine, selenium, and 3-nitropropanol) in cooperation with Dr. Dale Gardner at the USDA-ARS Poisonous Plant Research Laboratory in Logan. No detectable amounts of these toxic compounds were found, indicating that *D. ornata* would likely not be toxic to wildlife and domestic livestock. Consequently, toxicity would not be a major concern in the breeding and selection of this species.

About 150 plants of each of the 2004 collections were started in the greenhouse along with plants of *D. purpurea* and *D. searlsiae* for comparison. Small amounts of soil from soil samples taken from each of the collection sites in 2004 were added to each conetainer to serve as rhizobial inocula for the greenhouse-grown plants. Seedlings were transplanted to two field sites in northern Utah during May 2005 and will be observed for characteristics such as plant morphology, flower color, plant vigor, forage yield/quality, defoliation tolerance, persistence, and seed yield.

Additional seed collections of western prairie clover will be made in 2005 to supplement existing collections. Sites in Nevada and California will be specifically targeted for collection to expand ecotypic diversity of this species. Plans include isolation *of Rhizobium* strains that form infective and effective associations with *D. ornata* plants to maximize nitrogen fixation.

GIS Data Extraction Tool: Cooperative work with Chris McGinty, Doug Ramsey, and Chris Garrard at the GIS/Remote Sensing Lab at Utah State University has led to the development of a GIS data extraction tool for germplasm-related research in a six-state area in the western U.S. The GIS layers developed included: county, land ownership, mean site precipitation, mean minimum temperature, mean maximum temperature, elevation, slope, aspect, Omernik Level III and IV ecoregion designation, and NRCS STATSGO soils and range site description information. By providing latitude and longitude for a specific site, all above information can be extracted for each site. This information will be invaluable to characterize specific collection sites for species that occur in the western U.S. This site information can also be used to develop tools to predict species occurrences at other similar sites. Efforts are currently underway to expand coverage of this tool to all 17 western states and make this information available on a web server at Utah State University.

Germplasm Collection for Low-Maintenace Turf Germplasm in Inner Mongolia, China: A proposal was prepared and submitted to the USDA Germplasm Exploration Fund to collect seeds of low-maintenance turf germplasm in Inner Mongolia, China. This region of northern China has vast semi-arid rangelands, cold deserts, high mountains, saline soils, marshlands, and fertile valleys quite similar to those of the western U.S. Ecotypic diversity in plants that occur there is large, and numerous grass species grow there across a broad range of sites differing in edaphic and climatic characteristics. It was proposed that low-maintenance turf grasses in the genera *Agrostis, Festuca, Koeleria, Poa,* and *Puccinellia* would be targeted by two separate collection teams during 2005. The proposal was selected for funding, and a request for approval to the Chinese Ministry of Agriculture was submitted by our collaborating scientists at China Agricultural University. However, because of strict regulations put in place in 2003 by the Chinese Central Government for germplasm collection, our request was denied. Apparently no germplasm collections trips by foreigners have been approved since these stringent regulations were put in place. We are currently checking on the possibility of having our collection included under a U.S.-China bilateral agreement, which may allow the collection to proceed.

Forage Seed Increase Project in Mongolia: We assisted collaborating scientists at the Research Institute of Animal Husbandry (RIAH) and Mongolia State University of Agriculture to prepare a proposal related to forage seed increase for submission to the U.S. Embassy in Ulaanbaatar, Mongolia (Agriculture Science and Technology Local-Currency Fund Program). The four-year proposal was selected for funding. The main focus of the proposal is to assist Mongolia in meeting its critical need for forage seed to improve forage production, reseed deteriorated rangelands, revegetate abandoned croplands, reclaim disturbed mine lands, and provide plant materials to conserve Mongolia's diverse natural resources. As part of the U.S. Embassy Fellows Program through the USDA-Foregn Agricultural Service, we were invited to travel to Mongolia during March 6-12, 2005 to participate in working discussions and develop work plans for the Forage Seed Increase Project. Detailed discussions were held with the project Principal Investigators concerning the project work plans. We reviewed the overall objectives of the project, oversight responsibilities of key project personnel, needed staffing for the project, project facility and equipment needs, planned project expenditures, and project timetable. A total of ten Mongolian students were selected for pursuing M.S. and Ph.D degrees on the project.

One of the laboratories at RIAH will be refurbished to allow facilities for seed germination testing. After construction, this room will allow testing of germination percentage and seed purity. Plans are to test 100-200 samples of 60 forage species. A small tractor, field equipment, seed harvesters, and seed cleaning equipment will be purchased for the Research Institute of Seed Processing Technology in Huhhot, Inner Mongolia, China. Various Mongolian farmers will be contacted for possible seed contract work in other parts of Mongolia, and the groundwork has been laid to establish the first Mongolian Forage Seed Growers Association. The field portion of the project will be initiated during April-May 2005 at the Bornuur Experiment Station of Mongolian State University of Agriculture. Bornuur is in Tuv Aimag and is located 110 km north of Ulaanbaatar.

While in Ulaanbaatar, we met with Principal Investigators of the Swiss-funded Green-Gold Pasture Ecosystem Management Programme ("Green-Gold Project"). It was agreed that the Forage Seed Increase Project and the Green-Gold Project would work closely together on various aspects of forage and seed production. The Green-Gold Project will provide funding for two Mongolian scientists to travel to the U.S. to receive training in forage seed production and rangeland monitoring. In addition, funding from the Green-Gold Project will be used to train six Mongolian students in the U.S. for graduate training in various aspects of rangeland ecology and management.

Ongoing Research Projects Involving NPGS Germplasm: Ongoing collaborative research projects that involve the use of germplasm from the National Plant Germplasm System include: evaluation of carbon isotope discrimination as a selection tool for enhanced water-use efficiency in cool-season range grasses and evaluation of accessions of squirreltail (*Elymus elymoides*) and bluebunch wheatgrass (*Pseudoroegneria spicata*) for response to a gradient of water application.

Germplasm Activities of T. Jones (USDA-ARS, Logan, UT)

Twenty-three PIs of Idaho fescue (*Festuca idahoensis*) were included in an AFLP genetic study comparing them to accessions of Roemer's fescue (*Festuca roemeri*), a congener of Idaho fescue found west of the Cascade and Sierra Nevada Mountains from southern British Columbia to northern California. These allopatric taxa were found to be closely related but genetically distinct. Two cultivars released as Idaho fescue before Roemer's fescue was described, were found be have roughly equal genetic contributions from the two species. A manuscript has been prepared to be submitted to the American Journal of Botany.

Four pre-variety germplasm releases are being registered: Toe Jam Creek and Fish Creek bottlebrush squirrelail (*Elymus elymoides*), Cucharas green needlegrass (*Nasella viridula*), and Star Lake Indian ricegrass (*Achnatherum hymenoides*).

Germplasm Activities of Boyd Kitchen (Utah State Univ., Logan, UT) - Order number: 167424 - *Triticum aestivum***.**

I requested a variety of wheat on behalf of a citizen that wanted to plant it in her garden. No other source was found, so I requested it from the NPGS. At this time, I have no more information.

Germplasm Activities of Steve Larson (USDA-ARS, Logan, UT)

Bluebunch wheatgrass (*Pseudoroegneria spicata*) is an abundant, cross-pollinating species widely adapted to the temperate, semiarid steppe and open woodland regions of western North America. Highly palatable to livestock and amenable to cultivated seed production, this species has been widely used for rangeland revegetation. Amplified DNA fragment length polymorphism (AFLP) was used to investigate genetic diversity and population structure among 565 *P. spicata* plants grown from 82 source identified seed collections, including 32 NPGS accessions, representing much of the species distribution. Bluebunch wheatgrass genotypes grouped by locality and geographic region based on neighbor-joining cluster analysis of DNA profiles. Significant DNA polymorphism among seed collections (32%) was detected by analysis of molecular variance (AMOVA). Thus, each collection site may represent a genetically distinct deme, the smallest unit of population structure. However, the average total number of DNA polymorphisms (genetic distance) among seed collections was significantly correlated ($r > 0.58$) with geographical distance among corresponding localities. Therefore, genetic isolation among putative demes may have resulted in part from disconnected sampling along a genetic continuum. The optimum Bayesian clustering model included 21 genetic groups, indicating that gene flow and dispersal was not sufficient to group all samples into one population. Significant differentiation among these 21 groups of seed collections was also supported by AMOVA and other nonparametric methods of hypothesis testing based on DNA similarity coefficients. Thus, each one of these 21 hierarchical groups may represent a genetically different metapopulation, a more complex form of population structure comprised of multiple demes. However, the average total number of DNA polymorphisms among Bayesian groups was also correlated ($r = 0.53$) with the average geographic distance among corresponding seed collection sites. Again, genetic isolation among putative metapopulations may have resulted in part from disconnected sampling along a genetic continuum. Nevertheless, approximately 18.3% of the DNA polymorphism was partitioned among the 21 putative metapopulations, 14.9% among putative demes within metapopulations, and 66.8% within demes (seed collection sites). Although demes may be subject to multiple extinctions and recolonizations, metapopulations are expected to persist far longer than their corresponding deme components. Although plant demes are usually the most obvious and recognizable form of population structure, geographically significant metapopulations may be more relevant units for research and development of plant materials used for rangeland revegetation. The results were published in the American Journal of Botany:

Efforts are also underway to characterize genetic diversity and population structure among 384 source identified *Leymus* wildrye accessions, including a large number of NPGS accessions.

Germplasm Activities of Thomas H. McKnight (Leeds, UT) - Order number: 168612 - *Punica granatum***; Order number: 168611 -** *Actinidia chinensis, Actinidia deliciosa, Ficus carica.*

No Report Submitted

Germplasm Activities of Susana Mogensen (Brigham Young Univ., Provo, UT) - <u>Order number:</u> 169745 - *Ribes.*

Plant materials were used to develop testing procedures to identify the presence of weed seeds in topsoil samples. Part of this project is writing a user-friendly guidebook for weed seed identification, to be used by seed labs all over the country. The book will include pictures of a comprehensive list of noxious and invasive weeds (about 1500). These accessions are part of our bulk seed collection. All seeds will be kept in laboratory, in tight containers until used for photography. They will not be used for any other purpose and will be destroyed after the project is concluded, according to an agreement we established with APHIS. Fallopia even though it is low viability.

Germplasm Activities of T. Monaco (USDA/ARS, Logan, UT) -

In 2004 experiments conducted to determine nitrogen uptake potential of perennial grasses used 'CD-II' crested wheatgrass and 'Goldar' bluebunch wheatgrass. These species were also used to evaluate competiton with numerous weed species.

An herbicide study to evaluate injury of sulfosulfuron to numerous perennial grasses was also conducted. This study included the following plant materials: 'Goldar' bluebunch wheatgrass 'Secar' Snake River wheatgrass, 'CD-II' crested wheatgrass, 'Bozoisky' Russian wildrye, 'Rosana' western wheatgrass 'Critana' thickspike wheatgrass,'Greenar' intermediate wheatgrass, 'NewHy' wheatgrass, and 'Manchar' smooth brome.

A study was also published that evaluated revegetation success of numerous perennial grass species on rangelands disturbed by military exercises at Fort Carson, CO. The following plant materials were used: 'Barton' western wheatgrass, 'Vaughan' sideoats grama, 'Nordan' crested wheatgrass, 'Ladak' alfalfa, 'Pryor' slender wheatgrass, 'Critana' thickspike wheatgrass, and 'Nezpar' Indian ricegrass.

Germplasm Activities of Ethan Nielsen (Nielsen Research Group, Provo, UT) - <u>Order number:</u> 169681 - *Fragaria*.

In 2004 I requested and received a number of samples from the U.S. National Plant Germplasm System (NPGS). All samples were of *fragaria* species and hybrids, used in a program to develop other ornamental varieties of strawberries, after the manner of recently successful pink flowered hybrids. The samples requested, mostly not commercially viable for their fruit, were selected for other traits, such as fruit color or flower color. Some were selected for ploidy count, as a measure towards creating hybrids with *fragaria* relatives.

Germplasm Activities of Sal Orlando (Univ. of Utah, Salt Lake City, UT) - Order number: 165009 - *Capsicum annuum, Capsicum baccatum* var. *pendulum.*

No Report Submitted (Discontinued - E-mail and mailing address)

Germplasm Activities of Joseph Romagnano (Utah State Univ., Logan, UT) - Order number: 165056 - *Pisum sativum.*

Currently, we are evaluating *Earligreen* sensitivity to ethylene in controlled environment chambers. If you would like more details, please don't hesitate to contact me. *Pisum* for possible sper dwarf crops on the International Space Station. For information regarding the use of the *pisum sativum* germplasm we requested please see:
http://www.usu.edu/cpl/research_dwarf.htm#pea

Germplasm Activities of Joseph Robins (USDA/ARS, Logan, UT) - Order number: 169505 - *Festuca idahoensis, Poa secunda, Sporobolus airoides*; Order number: 169156 - *Alopecurus arundinaceus, Elymus lanceolatus, Elymus lanceolatus* subsp. *lanceolatus, Elymus lanceolatus* subsp. *yukonensis*.

I requested all available accessions of seven species during the 2004 calendar year. The accessions include the following:

- 51 accessions of *Alopecurus arundinaceus*
- 20 accessions of *Elymus lanceolatus*
- 30 accessions of *Elymus lanceolatus* subsp. *lanceolatus*
- 2 accessions of *Elymus lanceolatus* subsp. *yukonensis*
- 52 accessions of *Festuca idahoensis*
- 17 accessions of *Poa secunda*
- 3 accessions of *Sporobolus airoides*

We planted and began evaluations for all of the *Alopecurus, Festuca,* and *Sporobolus* accessions. We will begin evaluations of the remaining accessions in coming years. In all cases, we use the accessions for identification of promising genotypes for applied breeding and cultivar development purposes. There is no available data on evaluations at this time.

Germplasm Activities of Blair Waldron (USDA/ARS, Logan, UT) - Order number: 169188 - *Pseudoroegneria spicata* (bluebunch wheatgrass).

Order number 169188 – *Pseudoroegneria spicata* (24 Nov 2004)
All (149) *P. spicata* accessions were ordered to initiate breeding program for bluebunch wheatgrass adapted to the Great Basin area. One hundred and thirty of the 149 accessions germinated in sufficient quantity to be transplanted to the field and are listed below. They and approximately 100 collections held by research labs were started in the greenhouse and transplanted in mid-April, 2005 near Wells, NV and Nephi, UT. They will be evaluated for vigor and persistence.

Germplasm Activities of L. J. Watson (Saratoga Springs, Utah 84043) - Order number: 166361 - *Capsicum annuum, Capsicum chinense.*

No Report Submitted

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