PLANT GERMPLASM COLLECTION REPORT

USDA-ARS
FORAGE AND RANGE RESEARCH LABORATORY
LOGAN, UTAH

Foreign Travel to:

Russia and Kazakhstan
October 2 - October 28, 1999

TITLE: FORAGE KOCHIA GERMPLASM COLLECTION EXPEDITION TO RUSSIA AND KAZAKHSTAN *U.S. Participants*

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Russia and Kazakhstan Participants

Nicolai Dzyubenko - Vice Director of Science and Head of Forage Crops Research,
Sergey Alexanian - Director of Foreign Relations, and
Sergey Shuvalov - Assist. Director and Interpreter, Foreign Relations Department
N. I. Vavilov Research Institute of Plant Industry
St. Petersburg, Russia

Auskhan Khusainov - Director
Aral Sea Experiment Station for Plant Genetic Resources
Chelkar, Kazakhstan

Germplasm Accessions:

GERMPLASM COLLECTION ITINERARY:

Travel Logan, UT to Moscow, Russia ... Oct. 2-3
Moscow, Russia ... Oct 3
Travel Moscow, Russia to Chelkar, Kazakhstan ... Oct 4-6
Collection - Chelkar northward to Karabutak, Kazakhstan; Karabutak southeast to Irghiz, Kazakhstan; Irghiz southwest to Chelkar, Kazakhstan ... Oct 7-17
Collection - Sandy desert south of Chelkar ... Oct 19
Travel Chelkar, Kazakhstan to St. Petersburg, Russia ... Oct 20-23

St. Petersburg, Russia (N.I. Vavilov Research Institute) ... Oct 24-27
Travel St. Petersburg, Russia to Logan, UT ... Oct 28

INSTITUTIONS VISITED:

Aral Sea Experiment Station for Plant Genetic Resources, 27 Biyekenov Street, Aktyubinsk Region, Chelkar Town, Republic of Kazakhstan, 464760,

N.I. Vavilov Institute of Plant Industry, 42 Bolshaya Morskaya Street, 190000, St. Petersburg, Russia

PURPOSE OF TRIP:

1. To expand the U. S. germplasm base of forage kochia (*Kochia prostrata*).

2. To make a collection of forage kochia ecotypes which would have the potential to be used in the development of a valuable summer, fall and winter forage. Private landowners have recently taken an interest in utilizing forage kochia for livestock forage, however, Immigrant, the only North American forage kochia cultivar, is restrictive for winter use because of its low stature.

3. To continue to develop contacts and to expand upon interactions for germplasm exchange and related agricultural research with scientists and administrators associated with the N. I. Vavilov Institute of Plant Industry at St Petersburg, Russia and the Aral Sea Experiment Station for Plant Genetic Resources at Chelkar, Kazakhstan.

SUMMARY

We consider the expedition to have been very successful. We collected 246 accessions representing 11 species. The majority of the accessions, 192, were forage kochia (*Kochia prostrata*). In addition, we received 30 forage kochia accessions collected prior to our arrival in what we called the first leg of the germplasm expedition which covered the area southeast of Chelkar, Kazakhstan. Also, the N.I. Vavilov Institute of Plant Industry (VIR) is currently preparing to send us 58 accessions of forage kochia collected after our departure during the third leg of the expedition to the area northwest of Chelkar towards Aktyubinsk, Kazakhstan.

Those leading the expedition told us that we were the third U.S. collection team to visit the Aral Sea Experiment for Plant Genetic Resources in Chelkar, Kazakhstan. The two previous teams were the Westover-Enlow expedition in 1934 (N.I. Vavilov personally accompanied this expedition) and the Asay-Johnson expedition in 1992 (Asay, K.H. and D.A. Johnson. 1992. Plant germplasm collection report [Online]. Available at http://www.usu.edu/%7Eforage/russia92.htm (verified 09 Nov. 1999). According to the accompanying Kazakhstan and Russian scientists, our expedition route did not overlap with Asay and Johnson's, but unfortunately it was too late in the year to make a broad collection of the grass species in the area. We were also told that we were the first Americans to target forage kochia for germplasm collection.

As experienced by Asay and Johnson in 1992, the Foreign Relations Department (Sergey Alexanian and Sergey Shuvalov) and other staff at VIR in St. Petersburg were extremely cooperative, and did an excellent job of facilitating the expedition. Dr. Nicolai Dzyubenko (Vice director of Science and Head of Forage Crops) and Sergey Shuvalov were primarily responsible for organizing our expedition and accompanying us throughout the trip. Dr. Dzyubenko had been director of the Aral Sea Experiment Station for nine years and was familiar with the collection routes and native vegetation. Mr. Shuvalov was fluent in English and acted as interpreter as well as biologist on the collection expedition. In addition, he was responsible for picking us up at our arrival, accompanying us throughout all our travels in Russia and Kazakhstan, and safekeeping and administering the funds allocated for this expedition. Excellent support was also provided through the Aral Sea Experiment Station of Plant Genetic Resources in Chelkar, which provided facilities and arranged for hiring vehicles and drivers for the expedition. This experiment station was previously under the direction of VIR, but is now administered through the National Academic Center for Agricultural Research of the Ministry of Science and Higher Education of the Republic of Kazakhstan (NACAR). However, close cooperation between VIR and the experiment station is evident. Auskhan Khusainov, director of the Aral Sea Experiment Station for Genetic Resources, provided excellent planning and organizational assistance for the trip. He was directly responsible for the logistics of our travel in Kazakhstan and accompanied us in the field, providing taxonomic expertise on the vegetation.

As mentioned earlier, this collection mission consisted of three legs. The second leg was the expedition involving us, the American team, and is that which we have described in this report. Collections were made by Dr. Dzyubenko and Mr. Khusainov during legs 1 and 3.

Asay and Johnson noted severe budget restraints at both VIR and the Aral Sea Experiment Station during their visit in 1992. We are quite sure that the financial well-being of both of these institutes is worse now than in 1992. The staff at the Aral Sea Experiment Station have been reduced to the director, Mr. Khusainov, and a few maintenance employees. There were no evaluated experimental plots still in existence. The Vavilov Institute also continues to operate under severe budget restraints, but fortunately appears to have stabilized and hopefully can rebuild its staff and research activities during the next decade. A recent grant from USAID has allowed them to modernize their long-term seed storage. With the current budget restraints they appear to be mainly focused on germplasm collection and preservation, and have greatly reduced their germplasm evaluation programs. Consideration should be given for financial assistance for these two institutes. We hope to submit a proposal for a joint germplasm evaluation program which would allow us to investigate how selection in the U.S. has changed the genetics of forage kochia and several wheatgrass species, and would include joint scientific papers as well as the opportunity for the Russian and Kazakhstan scientists to visit our research facilities.

TECHNICAL REPORT AND DETAILS

October 2-3 Team members left Logan, Utah and traveled to Moscow, Russia. We were met at the Sheremetyevo II International airport in Moscow by Sergey Shuvalov from VIR and Konstantin Plotnikov from the Centre for International Cooperation Agrointerservice. We were taken to the Hotel Minsk where we discussed financial details of the expedition.

October 4-6 Accompanied by Sergey Shuvalov we traveled by train to Chelkar, Kazakhstan. We were met in Chelkar by Dr. Nicolai Dzyubenko and Auskhan Khusainov. Dr. Dzyubenko had went to Chelkar two weeks earlier to make final arrangements and to carry out the first leg of the collection expedition.

October 7-17 A collection expedition was conducted to the north of Chelkar. The route went as far north as Karabutak, Kazakhstan (a few miles south of the Russian border) and east to Irghiz, Kazakhstan. To our knowledge we were the first Americans to make plant collections in this area. The area had experienced a drought and many plants appeared to be stunted. Livestock numbers were reported to be 10 times less than a decade ago, but we found grazing wherever we went, with concentrated grazing around villages. Environmental and species details of the collection are listed below under the subheading "Collection Details".

October 18-19 Seed samples were cleaned and organized, and accessions were collected from extremely sandy sites within 20 km south of Chelkar.

October 20-23 U.S. team members, accompanied by Sergey Shuvalov, traveled by train to St. Petersburg, Russia. We were taken to the Hotel Sovietskaya.

October 24-27 We visited staff and toured projects at the N.I. Vavilov Institute of Plant Industry in St. Petersburg. Members of the staff visited included Prof. Victor A. Dragavtsev, Director General of the Institute; Dr. Sergey Alexanian, Head of Foreign Relations; Dr. Alexandr Afonin, Climatology; Dr. Vadim Molodkin, Head of Plant Genetic Resources Long-Term Storage Laboratory; Dr. Tamara Smekalova, Herbarium; Andrew Omelchenko, Chief of Computer-Aided Information Systems; Leonid Malyshev, Senior Scientific Researcher of the Fodder Crops Dept.; and Antone Krylov from the Foreign Relations office. Seed was processed and prepared to be brought to the U.S. We discussed with Dr. Alexanian the possibilities of future joint collection missions and germplasm evaluation.

October 28 We traveled from St. Petersburg to Moscow via Aeroflot airlines. Konstantin Plotnikov met us at Sheremetyevo I Domestic airport in Moscow and transported us to Sheremetyevo II International airport. From there we traveled via Delta airlines to JFK airport in New York. We went through customs and turned over the collected seed to APHIS for quarantine inspection. We boarded another Delta flight and flew to Salt Lake City, Utah.

December 17 After being lost for 45 days in the mail, en route from the quarantine office in Beltsville, Maryland, the collected seed arrived in Logan, Utah.

Collection Details

Forage kochia germplasm was collected on 64 sites in Kazakhstan. The collection area included the area from Chelkar in the south to Karabutak in the north and Irghiz in the east. These areas are in the Clay and Sand Deserts which included the Brown Desert Steppe, Light Chestnut

Steppe, Degraded Solonetz, and Solonetz (Atlas of Agriculture of the USSR. 1960. Chief management for geodesy and cartography. Moscow, Russia (In Russian)). According to scientists from the N. I. Vavilov Institute of Plant Industry these areas have the highest concentration of forage kochia in the former Soviet Union. Plant associations include the following: *Agropyron - Stipa - Artemisia; Artemisia terrae-albae; Artemisia terrae-albae - Krascheninnikovia (Ceratoides); Artemisia - Salsola - Kochia; Atriplex- Anabasis -Artemisia; Artemisia - Anabasis; and Anabasis*. Soil surface textures found included sands, fine sands, sandy loam, sandy clay loam, silt loam, clay loam, clay, and gravelly and cobbley. Most soils in the Clay Desert had a clay loam or clay subsoil and were saline and alkaline. The Solonetz sites had extremely high concentrations of alkali and salt. The subsoil in the Sandy Desert was mainly sand to fine sand. Elevations ranged from 250 feet near the city of Irghiz to 1000 feet above sea level north of Karabutak. Annual precipitation, averaged over 14 to 43 years, list Chelkar receiving 6 to 9 inches, Irghiz receiving 6 to 8 inches, and Karabutak receiving 10 to 12 inches (Climate of the U.S.S.R. 1968. No. 18. Part H. Kazakhstan SSR. Air humidity, precipitation, snow cover. Leningrad, Russia (In Russian); Agricultural management in the Aktyubinsk region. 1958. Kazgosizdat. Alma-Ata, Kazakhstan (In Russian)). Average air and soil surface temperatures at Chelkar are 41.9 F and 46.4 F, respectively; at Irghiz 41.5 F and 44.6 F, respectively; and at Karabutak 37.3 F and 41.0 F, respectively (Climate of the U.S.S.R. 1968. No. 18. Part H. Kazakhstan SSR. Air humidity, precipitation, snow cover. Leningrad, Russia (In Russian).

Two hundred and forty-six germplasm collections were made of which 192 were forage kochia. Collections are listed by species in Table 1.

Species associated with forage kochia included:

FORBS - Yarrow (*Achillea micrantha*), annual chenopod, annual kochia (*Kochia laniflora* and *Kochia scoparia*), knapweed (*Centaurea picris* and other spp., knotweed (*Polygonum spp.*), buckwheat (*Eriogonum sp.*), fisheye (*Ceratocarpus arenarius*), russian thistle (*Salsola iberica*), locoweed (*Astragalus sp.*), and yellow flower alfalfa (*Medicago falcata*);

SHRUBS - *Artemisia austriaca*, *Artemisia arenaria*, *Artemisia terrae-albae*, *Salsola orientalis*, winterfat (*Krascheninnikovia [Ceratoides] ewersmanniana* and *Krascheninnikovia [Ceratoides] papposa*), saltbush (*Atriplex cana*), camphorosma (*Camphorosma lessingii*), Anabasis (*Anabasis salsa*), *Ephreda spp.*, and *Haloxylon aphyllum*;

GRASSES - siberian wheatgrass (*Agropyron fragile*), crested wheatgrass (*Agropyron desertorum*), needlegrass (*Stipa sareptana*), giant wildrye (*Leymus* [*Elymus*] *giganta*), spreading wildrye (*Elymus angustifolius*), *Bromus inermis*, *Poa spp.*, *Festuca ovina* and other *Festuca spp.*, *Stipa capillata*, reedgrass (*Calamagrostis sp.*), redtop (*Agrostis sp.*), orchardgrass (*Dactylis glomerata*), saltgrass (*Distichlis sp.*), tall wheatgrass (*Thinopyrum ponticum*), *Elymus spp.*, *Leymus spp.*, quackgrass (*Elytrigia repens*), foxtail (*Hordeum sp.)*, and junegrass (*Koeleria sp.*).

Forage kochia on average made up 6% of the perennial plant composition on native steppe sites ranging from 1 to 20%. The percentage of composition depended on the site and associated species. For example lower percentages of forage kochia was found on the *Agropyron - Stipa -*

Artemisia, Artemisia terrae- albae, and *Artemisia - Kraschenninnikovia (Ceratoides*) sites while higher percentages were found in the *Artemisia - Salsola - Kochia,* and *Atriplex - Anabasis - Artemisia* sites. Overall, Artemisia terrae-albae was the dominant species throughout the native steppe area. Forage kochia made up a higher percentage of the plant composition in disturbed areas along road shoulders, abandoned fields, and farmsteads where a high percent of annuals were growing. On these sites forage kochia ranged from 15 to 60%, and averaged 32% of the plant composition.

As indicated above forage kochia made up a smaller percentage of the perennial plant communities. No where on the Kazakhstan steppes did we observe forage kochia becoming dominant in communities comprised of sagebrush, winterfat, saltbush, *Anabasis,* crested and siberian wheatgrass, and needlegrass. Instead, forage kochia complimented the biodiversity of such communities. In addition, we did not observe forage kochia invading from disturbed sites into the surrounding perennial plant communities.

The forage kochia germplasm collected was mainly the glabrous and red-green stem forage kochia (*Kochia prostrata* ssp. *virescens*), however, some of the forms were gray with heavy pubescence on the leaves and stems and were classified as ssp. *grisea*. Other forms were in-between the red-green stem and the gray stem subspecies which indicated that the two subspecies may hybridize with each other. This was confirmed in our discussions with Dr. Dzyubenko and Mr. Khusainov whose combined experience with forage kochia expands over 20 years. Seed was collected by bulking seed from plants with similar morphological characteristics found at the same site. The morphological characteristics included: Height - one to three feet; Seeds - small and large, and few to numerous; Branches or tillers - few to numerous, and basal or high on the stem; Leaves - mostly basal or throughout the stems and branches; stem diameters - fine (about 1/16 in.) or thick stems (about 1\4 in.); stem color - red, yellowish-green, or gray; leaves, branches and stem - glabrous or pubescent.

Our colleagues said they were not aware of any forage kochia genetics or breeding programs in Russia or Kazakhstan. Earlier cytogenetics work in the former U.S.S.R. had documented diploid, tetraploid, hexaploid, and octoploid forage kochia types, and naturally occurring aneuploids resulting from hybridization between ploidy levels. In addition, these scientists suggested that the two subspecies of *virescens* and *grisea,* which are frequently recognized in North American literature, are not well defined and in their native habitat readily hybridize with each other resulting in morphological types intermediate between the subspecies. The possibility of inter-ploidy and inter-subspecies hybridization may partially explain why we observed a large amount of variation within forage kochia populations at many collection sites.

Through our observations and discussions with the accompanying Russians and Kazakhstans we gathered some notes concerning the use and value of forage kochia in Kazakhstan. Forage kochia is an important part of the plant composition throughout the northern Kazakhstan steppe and had been heavily to moderately grazed in most of the collection sites. It was often selectively grazed indicating high palatability and/or high nutritional content. It is estimated that the number of

grazing animals on the steppe had dropped by 10 fold since the breakup of the Soviet Union, thus greatly reducing grazing pressure allowing us to collect seed even in grazed areas. The grazing/browsing animals in order of their magnitude were cattle, sheep and goats, horses, camels, and Saiga (antelope). We observed utilization of forage kochia by cattle, sheep and goats, and horses, and assumed that camels and Saiga were also grazing the forage kochia. We observed large areas of the native steppe that had been mowed and hayed for winter feed. Forage kochia comprised 1 to 20% of that feed (as indicated above in the discussion on species composition) with *Artemisia terrae-alba* being the major component and *Stipa sp.* and *Agropyron fragile* making up lesser components. Even though forage kochia made up a low percentage of the overall biomass in the hay, we assumed that its high nutritional value made it an important component in overwintering livestock. We did not observe solid stands of forage kochia or areas where it had been seeded, and in fact we only saw one attempt to improve the steppe by seeding of any improved forage species - in which case crested wheatgrass was planted. However, Dr. Dzyubenko and Mr. Khusainov told us that 20,000 ha of forage kochia had been planted in southern Kazakhstan. That area was used for grazing sheep in late fall and early spring to flush the ewes and increase the number of live births.

Table 1. Species collected during expedition to Kazakhstan in 1999[1].

Species	Number of Collections	Species	Number of Collections
Kochia prostrata	192	*Leymus* [*Elymus*] *giganta*	2
Krascheninnikovia [*Ceratoides*] *papposa*	13	*Elymus angustifolius*	7
Atriplex cana	8	*Agropyron fragile*	7
Camphorosma lessingii	10	*Agropyron desertorum*	2
Anabasis salsa	1	*Stipa sareptana*	1
Medicago falcata	3		

[1]In addition, 30 collections of *Kochia prostrata* from the first leg of the expedition were brought to the U.S. An additional 58 collections of *Kochia prostrata* from the third leg of the expedition will be sent from VIR after the seed is processed. Additional species collected on the first and third legs that may be sent include; *Haloxylon ammondendron* - 98 collections, *Camphorosma lessingii* - 49 collections, and *Salsola orientalis* - 92 collections.