PLANT GERMPLASM COLLECTION REPORT

USDA-ARS
FORAGE AND RANGE RESEARCH LABORATORY
LOGAN, UTAH

Foreign Travel to:
Morocco
July 1-August 14, 1983

U.S. Participants

Melvin D. Rumbaugh, Research Geneticist (retired)

Forage and Range Research
Logan, UT 84322-6300 U.S.A.

Walter L. Graves, Farm Advisor
University of California
San Diego, CA 92123

GERMPLASM ACCESSIONS

Purpose of Trip:

1) To collect seeds of cultivated forage legumes, especially strains of alfalfa (Medicago sativa L.).
2) To collect seeds of forage legumes, grasses, and shrubs suited for arid and semiarid rangelands.
3) To collect nodules of all legumes for subsequent isolation and culture of their nitrogen fixing Rhizobium bacteria.

Rabat	July 2-6
El Jadida	July 7
Rabat	July 8-10
Souk el Arba du Gharb	July 11
Chefchaouen	July 12-14
Al Hoceima	July 15
Oujda	July 16
Taza	July 17
Azrou	July 18-21
Midelt	July 22-24
Rabat	July 25

Errachidia	July 26-29
Ouarzazate	July 30- August 2
Taroudant	August 3-4
Marrakech	August 5
Rabat	August 6-7
Tanger	August 8-9
Rabat	August 10-13

SUMMARY

The 6-week-long plant collecting trip to Morocco by M. D. Rumbaugh and W. L. Graves resulted in the acquisition of 855 accessions which will be added to USDA plant germplasm resources. More than 60 genera and 130 identified species are represented in the collection. These consist primarily of forage plants but seeds of barley, corn, millet, sorghum, and wheat also were obtained.

The geographic, edaphic, climatic, and vegetation regions of Morocco are extremely diverse. Elevation varies from sea level to more than 4,000 m in the interior mountains. While much of the country is dominated by a Mediterranean type climate, the higher elevations are colder and accumulate considerable snow in the winter. The 400 mm (16 inches) precipitation isohyet corresponds roughly with the limit between the Mediterranean and Steppe regions, while the 100 mm (4 inches) isohyet is the best approximation to the boundary of the Sahara. All cultivation without irrigation requires more than 200 mm (8 inches) of precipitation. Semi-nomadic pastoralism is the major form of land resource utilization throughout the steppe lands and a large part of the mountains as well.

The annual legume species within Morocco are now adequately represented in USDA germplasm holdings. This is also true of the indigenous perennial grasses and legumes. The alfalfa collection is very complete except for the extreme southeastern and southwestern parts of the country where military activity precluded travel. Some of these ecotypes may have immediate use in pasture and rangelands of the western United States. Other accessions will be used in breeding programs to incorporate desirable attributes such as salt tolerance into improved cultivars.

TRAVEL DETAILS

July 1-10: The first 10 days were spent in traveling from our duty stations to Rabat, visiting a herbarium, location and meeting contacts, and in making local collections in the vicinity of Rabat and adjoining coastal areas. Many people were helpful during this initial phase of the collection as well as at later times. These included the following persons:

Mr. Hamidou Bouyayachen, Assistant to the Agricultural Attache, U.S.A. Embassy. Mr. Bouyayachen if fluent in Arabic, Berber, English, and French. He has extensive contacts throughout Morocco and was most cordial and helpful throughout our stay in that country. His assistance was highly valued.

Dr. Günter Jaritz, Research Leader, Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ). A very competent Senior Scientists who is keenly aware of the importance of germplasm exchange and preservation. His team of scientists works closely with those of the Institute National de la Recherche Agronomic (INRA) in the development of superior forage crop cultivars and management systems. Team members provided significant help to us at several times.

Dr. Albrecht Glatzle, a GTZ team member who is experienced in rhizobiology. He collected with us on the route from Rabat to Oulmes via Tiflet.

Mr. Mustapha Bounjemate, a forage agronomist and head of the INRA forage research program who generously share both his seeds and a technician.

Mr. Abodelkaer Qazi, a technician for INRA who traveled with us for two weeks. Mr. Qazi speaks Arabic, Berber, and French, and was very influential in obtaining alfalfa seeds in the souther part of the country.

Dr. Richard S. Aro, Acting Chief-of-Party, U.S. AID Range Management Project. Dr. Aro provided information and suggested certain modification of our preliminary travel plans. He also actively assisted with the collection effort in the areas of Azrou and Timahdite.

Mr. John Harding, U.S. AID Range Management Project. Mr. Harding is the manager of a seed farm southeast of El Jadida and helped us collect in that vicinity as well as around Chefchaoven at a later date.

Mr. Pierre Roumet, Plant Breeder, Institute Agronomique et Veterinaire, Hassan II University. Mr. Roumet works on an alfalfa breeding project directed by Mr. Birouk who was in France during this time.

Like much of Morocco, the region extending from Kenitra north of Rabat to El Jadida south of Casablance and east to Oulmes has a Mediterranean climate. However, summer temperatures are moderated by proximity to the Atlantic Ocean. Irrigated truck farms under intensive management are very productive. Small grain, corn, and grapes are important dryland crops. Extensive pasturage supports sheep production and some areas have large cork-oak (Quercus subra) forests. The part of Morocco north of the mountains generally has deeper and more fertile soils than that part of the country south of the mountains. Annual precipitation exceeds 300 mm and supports a luxuriant annual vegetation during the rainy period. Legume species constitute an important component of the vegetation on most sites. We were able to collect samples of the following legume genera: Astragalus, Biserrula, Cicer, Coronilla, Medicago, Ornithopus, Scorpiurus, Trifolium, and Vicia. The Medicago and Trifolium genera were especially well represented in these ecosystems with 13 and 15 species, respectively, included in the collection. The grasses on which we could find seeds included several species of Agropyron, Dactylis, Hyparrhenia, and Phalaris.

At most sites it was impossible to obtain large quantities of seeds. The preceding three rainy seasons had been much below the normal precipitation and this extended drought had drastically reduced both the numbers of plants and the amount of seed per plant. The intense grazing of all available vegetation also made the task of locating pods and seed heads very time consuming. The problem was encountered throughout our travels in Morocco and even affected the collection of irrigated crops such as alfalfa (Medicago sativa). Established stands were being used for forage rather than seed production because of the shortage of irrigation water and consequently livestock feed.

July 11-17: Our route in the second major segment of the collection extended from Souk-el-Arba-du-Rharb northward through the Rif mountains to Chefchaouen, eastward through the

coastal plains and foothills to Al Hoceima and Oujda, southerly to the high plateau region near Ain-Beni-Mather, and then back to the west to Taza, and through the Moyen Atlas to Azrou. Many natural ecosystems and types of agriculture were observed in these areas.

Again, drought was severe throughout the country and greatly restricted the kinds of sites in which we could find seeds. Nevertheless, in this region we obtained 122 accessions representing 12 genera and 37 species of forage legumes, 13 genera and 15 species of grasses, and 5 genera of trees, shrubs, and forbs. Many of these are of very desirable forage species growing in unusually arid habitats. The Dactylis glomerata collections, for example, were from sites that were much drier than the regions in which this species is habitually used for forage in the United States. We believe that the germplasm collected in Morocco can be used in breeding programs to considerably extend the range of Dactylis. Several of the subterraneum clover (Trifolium subterraneum) accessions were obtained from relatively high elevations. Such germplasm may be of value in extending the range of this useful species further into the mountains of California and Oregon, and in the southeastern United States.

July 18-25: The very productive week was spent collecting in the Moyen Atlas mountains around Azrou and in the Plain de l'Arid in the vicinity of the city of Midelt. In addition to several accessions of cultivated alfalfa (Medicago sativa) we obtained seeds of M. glomerata and M. suffrutiocsa. M. glomerata has not previously been reported form this region and, if the identification is substantiated, this collection represents a significant extension of the range of the species. We also made several collections of M. suffructicosa in the high elevation cedar forests south of Azrou. This is a perennial species which has not previously been available to scientists in the United States. While it has many traits of agronomic interest as an intact species, perhaps its greatest value will be realized through interspecific crosses with M. sativa.

The Moroccan Forest Service (Eaux et Forets) has extensive reforestation planting in the Moyen Atlas and other regions of the country. These are excellent sites in which to collect plant germplasm since they are usually protected from grazing during establishment. At one such site near Azrou, we obtained seeds of 11 forage grasses and legumes while adjacent areas had been so heavily pastured that few seeds were available. A similar situation was encountered on the Plain de l'Arid. Drought combined with intensive utilization of the forage resource made seed collection very difficult. However, at a hillside site which had received some protection from grazing, Coronilla minima, Hippocrepis scabra, Lotus creticus, and Onobrychis argentea plants and seeds were plentiful. This location had received only 140 mm precipitation since September 1982. It is our opinion that these drought resistant legumes should be included in seed production

projects in Morocco and then used for range reseeding and improvement. Only grasses and a few shrubs have been included in the few range plantings that have been attempted in Morocco.

Scientists who assisted in the collection of the Timahdite Perimeter and the Plain de l'Arid were the following:

Mr. Mohammed Atigi, Range Scientists, Direction Privinciale de l'Agriculture, Meknes.

Dr. Alan Gray, Range Scientists, U. S. AID Range Management Project, Midelt.

July 26-August 6: The major emphasis during this segment of the collection was to obtain seeds of local indigenous populations of alfalfa (Medicago sativa). Alfalfa was brought to Morocco from the east by Arabs during the expansion of Islam in the 8th Century. This germplasm resource is now being diluted and threatened by the introduction of modern cultivars, primarily those from the southwestern United States. We believe that our collection of the local Moroccan landraces of alfalfa was very timely and that much of this material would otherwise have been lost within the next 10 years.

Mr. Abodelkader Qazi accompanied us during this time period. His knowledge of the Berber language and culture was essential in many of the villages and oases. Throughout our travel in the southern part of Morocco, we solicited assistance from local scientists and officials. Persons who were especially helpful and who might be contacted in preparation for any future germplasm collections included the following:

Mr. El-Mostafa Darfaoui, Range Management Specialist, Errachidia. Mr. Darfaoui speaks English and assisted us in the Tafilalt area.

Mr. Hajjaji, Agronomist, O.R.M.V.A. du Tafilalt, Errachidia. He is responsible for many aspects of the management of a large irrigation project. Mr. Hajjaji does not speak English but wants to exchange information and germplasm and also would like to participated in cooperative research programs.

Mr. Abdelaziz Maghroaui, Agricultural Officer and Range Management Specialist, Livestock Service, Ouarzazate. Mr. Maghroaui speaks English, is a range scientists, and impressed us with his managerial skills as well as his scientific expertise.

Approximately 150 accessions of alfalfa were collected from southern Morocco. We attempted to obtain seeds from more than one farmer within each village of each oasis and to sample all oases along the major rivers. Because of political unrest, border disputes, and military activity, we were not able to collect in the southeastern and southwestern parts of Morocco. We were permitted to pass through a military blockade to collect south of Zagora to M'Hamid in the Draa River valley oases. Because the time required would have been excessive, we did not attempt to reach many of the smaller and more isolated oases although the alfalfas in these villages would be of great interest to plant breeders. During our mountain collection trip we found Agropyron elongatum, not previously know to exist in this region.

At the present time we recognize five broad classes of Moroccan alfalfas. These are designated by the geographic areas in which they are grown.

Draa: Primarily grown in the drainage of the Draa River in the south central Morocco but extending northward to the Anti Atlas, eastward to the divide with the Tafilalt area, and westward toward a merger with the Sous drainage. The boundary between the Sous and the Draa areas is not well defined and we were not able to adequately sample the alfalfas from these oases.

Tafilalt: The Oued Ziz is the most important river in this area. The Tafilalt extends eastward from the Draa toward the Algerian border. The northern limit is not sharply defined but meets the mountain type materials south of Errachidia (El-Ksar-es-Souk). Many of the alfalfa fields showed a high proportion of plants that were stunted, had viral symptoms, physiological problems, or were infected with witches-broom. "Black aphid" is the major insect pest on alfalfa in these oases.

Sous: The Sous alfalfas extend along the watershed between the Haut- and Anti-Atlas mountains to and along the coast west of the mountains. At the higher elevations this germplasm may merge with the mountain type as exemplified by the Demnate populations. Near the coast, the type location may be Massa. Mature plants are 1-2 m tall with thick, hollow stems, large leaflets, and abundant seed. It may be possible to differentiate two subtypes within the Sous based on whether or not the stems are hollow or solid and other morphological characteristics.

Mountain: These alfalfas are less robust than those from lower elevations and usually have solid stems. Well know seed sources are the regions around Demnate east of Marrakech and around Rich north of Errachidia. Since this is a very large geographic region including all of the Rif and Atlas chains, a major detailed examination of these accessions should permit further subdivision of these types into germplasm pools with a greater degree of homogeneity.

Haouz: These alfalfas come from the region north and west of the mountains centered around Marrakech. They are grown on the steppes as well as the coastal plains along the Atlantic Ocean.

August 7-9: This 3-day period was used to extend our collection of Medicago marina and Hedysarum coronarium. We traveled a circuitous route from Rabat to Tanger and back to Rabat. Mr. Qazi accompanied us as a guide. Thirty-one accessions, which included both target species, were obtained.

August 10-13: All accessions of all species in which INRA or Hassan II University staff had expressed an interest were divided and aliquots shared with those scientists. The seeds were then packaged and shipped to quarantine in the United States with the assistance of Mr. Bouyaychen

and Mr. Geerken at the Embassy. We completed our business and financial arrangements and left Morocco.

Table 1. A summary of plant germplasm accessions collected in Morocco in 1983.

Plant Species		**No. of Accessions**
Acacia	sp.	1
Adenocarpus	sp.	1
Agropyron	cristatum	2
	elongatum	2
	intermedium	2
	junceum	2
Anthyllis	sp.	1
	tetraphylla	3
	vulneraria	2
Artemisia	herba-alba	1
Astragalus	cruciatus	1
	hamosus	4
	sp.	4
Atriplex	halimus	2
	nummularia	1
Avena	bromoides	2
Biserrula	pelecinus	3
Brachypodium	phoenicoides	3
	sp.	2
Calycotoma	villosa	1
Cenchrus	ciliaris	2
Plant Species		**No. of Accessions**
Cicer	arietinum	2
Coronilla	minima	1
	sp.	2

Cymbopogon	schoenanthus	2
Cytisus	triflorus	1
	sp.	1
Dactylis	glomerata	21
	sp.	2
Dasypyrum	hordeaceum	1
Ebenus	pinnata	3
Ehrharta	calycina	1
Festuca	arundinacea	10
	elatior	4
	ovina	1
	rubra	1
	sp.	2
Genista	pseudopilosa	1
Hedysarum	coronarium	10
Hippocrepis	scabra	5
	sp.	2
Hordeum	bulbosum	1
	vulgare	1
Plant Species		**No. of Accessions**
Hyparrhenia	hirta	6
	sp.	1
Koelaria	splendens	1
	sp.	1
Lavendula	stoechas	2
Lolium	perenne	2
	sp.	2
Lotus	corniculatus	4
	creticus	10
	major	1
	ornithopodiodes	2
	prostratus	3
	sp.	3

Lupinus	albus	9
	leteus	8
	sp.	1
Medicago	arborea	2
	ciliaris	4
	constricta	1
	glomerata	2
	intertexta	5
Medicago	laciniata	38
	littoralis	28
	lupulina	10
	marina	6
	minima	17
Plant Species		**No. of Accessions**
	murex	2
	orbicularis	6
	polymorpha	12
	rigidula	19
	sativa	155
	scutellata	2
	sp.	10
	suffruticosa	4
	tornata	14
	trunc.X litt.	8
	truncatula	40
	turbinata var. aculeata	31
Melica	ciliata	7
	sp.	1
Melilotus	sp.	1
Moricandia	suffrutiocosa	1
Onobrychis	argentea	5
	perenne	1
	sp.	4
Ononis	natrix	2
	sp.	1

Ornithopus	compressus	9
	iosthmocarpus	2
	pinnatus	1
	sp.	1
Oryzopsis	caerulescens	4
	miliacea	12
Plant Species		**No. of Accessions**
Panicum	mileaceum	4
	sp.	1
Pennisetum	dichotomum	1
	typhoides	3
Periploca	laevigata	1
Phalaris	sp.	2
	truncata	1
	tuberosa	2
Phleum	sp.	1
Poa	bulbosa	1
	ligulata	1
Poterium	sp.	3
Psoralea	bitumenosa	1
Retama	monosperma	1
Sanguisorba	minor	4
	sp.	2
Scorpiurus	muricatus	5
	sulcata	1
	vermiculatus	5
Setaria	italica	1
Sorghum	vulgare	2
Stipa	sp.	1
	tenacissima	1
Plant Species		**No. of Accessions**
Tetragonolubus	silliguosus	1
Trifolium	alexandrinum	15

	angustifolium	6
	arvense	2
	bocconei	1
	campestre	4
	cherleri	5
	dubium	1
	fragiferum	2
	glomeratum	3
	isthmocarpum	5
	lappaceum	3
	ochroleucum	5
	phleoides	1
	physodes	1
	pratense	4
	repens	7
	resupinatum	15
	scabrum	1
	spumosum	1
	sp.	7
	stellatum	2
	subterraneum	27
	tomentosum	5
Trigonella	anguina	1
	sp.	2
Triticum	sp.	1
	vulgare	1
Vicia	faba	1
	monanthus	1
	sp.	3
Zea	mays	1
Unidentified	accessions	12
	TOTAL	852*
*Three additional accessions (GR 99, 212, 243) were lost in transit.		

Table 2. A summary of nodules obtained from leguminous plants collected in Morocco in 1983.

Macrosymbiont species		No. of accessions
Lotus	creticus	1
	corniculatus	1
	major	1
	sp.	1
Medicago	lupulina	2
Trifolium	dubium	1
	fragiferum	5
	pratense	1
	repens	2
	TOTAL	15