REPORT OF EXPEDITION

TO KAZAKHSTAN

TO COLLECT GENETIC RESOURCES OF WILD APPLE

August 23-September 16, 1995

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Purpose of Trip:

The main objectives of this expedition were to: 1) collect germplasm of Malus sieversii in its center of diversity, supplementing collections made in 1989 and 1993 by broadening the range of collections and returning to areas that had sparse fruiting in 1993; 2) collect other crop species as found in association with apple and 3) expand contacts with Kazakh scientists to develop plans for further ex situ collections and develop strategies for in situ conservation.

Itinerary:

23-25 August:	Travel from U.S.A to Almaty through Istanbul
25-27 August:	Expeditions in Almaty (formerly Alma-Ata) area
28-29 August:	17 hr bus ride to Tabagatai
29 Aug.-1 Sep.:	Expeditions in Tarbagatai
2 September :	8 hr bus ride to Topelevka
3,4 September:	Expeditions in Topelevka
4 September:	4 hr bus ride to Lepsinsk
5 September:	Expedition in Lepsinsk
6 September:	11 hr bus ride to Almaty
7 September:	Visits with Kazakh Scientists
7,8 September:	15 hr train ride to Chimkent
8 September:	3 hr 4-wheel drive vehicle ride to Karatau
8-10 September:	Expeditions in Karatau
11 September:	3 hr ride back to Chimkent
11,12 September:	15 hr train ride to Almaty
12 September:	Final expedition (Almaty area)
13 September:	Visit ex situ collections of Prof. Djangaliev
14 September:	Participation in Symposium on Genetic resources of Kazakhstan with members of Kazakhstan Academy of Sciences; process plant material for transport
15-16 September:	Travel to U.S.A. through Istanbul

Trip Report:

After arrival, including a day's rest and finalized planning with our cooperator, we took day trips to the five sites near Almaty. (Figure 1, areas C and D and Table 1, Almaty area). Some of these were the same areas observed in 1989 and 1993. The extreme coordinates covered in each area are listed in Table 1. Two populations and 11 wild elite samples were collected in this area. Seed numbers and other data are listed on Table 1. The mean diameter of apples found in random populations (01 and 04) was 34 mm. Elite selections from sites 01-04 and 20 averaged 45 mm. Table 1 provides a summary of other descriptions. Complete data sets on all collections (populations and elites) will be loaded to GRIN. We were able to observe extensive diversity in each site throughout the expedition with 60 to 90% of the trees in the forests fruiting. Forests in Almaty area, Topelevka and Lepsinsk were very similar in habitat and fruit types. Fruit was

not of high quality; therefore fewer elite samples were collected in these general areas. Four samples of related species were collected in sites 01 and 04 (Table 2).

The second phase of our expeditions took us to the Tarbagatai (Fig 1 '95') mountain range which had not been observed in previous collection trips. We arrived at 2:00 a.m. on 29 August and after a meal and four hours of sleep, started a series of expeditions in six sites (05-10) over the next four days through 1 September. The area covered was only 3.5 by 3.0 km, but different valleys and slopes were explored within this area. Much of the habitat here has been destroyed by grazing and this small area is in jeopardy presently as we saw shepherds with flocks in the valleys. This was the most productive four days of our trip as we discovered incredibly high-quality specimens. Three populations (30 trees each) were sampled and 46 wild elites were collected including scions of the very best. Seed and scion numbers are listed in Table 1. The mean diameter of all fruits in the random populations (90 trees) was 43 mm and the mean diameter of the wild-elite selections was 56 mm. The quality of the elite specimens was such that we felt they could be commercial quality (see other data in Table 1). Therefore scions were collected for 10 of the 46 selections. The largest apple among these elites averaged 72 mm in diameter. Most elite selections had aromatic qualities, were extremely firm and had little evidence of disease symptoms. Some red color was present on 61% of the random population and on 96% of the elites. These figures are much higher than those in the forests at 43 and 45° N latitude. Additionally, these apples have evolved in a harsh climate that often reaches -40C. Spur-type trees, which have many horticultural advantages, were also prominent in this area and were seldom seen in the other forests. The trees were much smaller and more widely spaced here also. Four samples of miscellaneous species were collected in sites 5-10 (Table 2).

Topelevka (Figure 1 'A') was the same area as was visited in 1993 but fruiting was heavy this year. Two population samples were collected (Table 1) which included a lower elevation sample (1170-1450 m) and a higher elevation sample from 1450-1690 m. Although the fruit was of similar size from the different elevations, both the random and 14 elites had variable horticultural characters and levels of disease susceptibility depending on elevation (Table 1). One accession each of Ribes and Rubus were also collected here.

The Lepsinsk area ('B' in Fig 1) was also visited in 1993 with minimal collections at that time. Only one population was collected along with eight elites during the current expedition. The diversity in this area was minimal with fruit mainly yellow and on the small side. Firmness and aromatics were also very low and scab infestation was heavy. An additional Rubus accession was

collected here.

After arrival back in Almaty for preparation of samples collected the previous 10 days, we visited the chairman of the Ministry of Forestry, Mr. Amanbayev. Later that day we left by train to the last area of our expedition (Karatau, 'E' in Fig. 1). The first day of expeditions in this area brought us to site 16, upstream from the camp where we stayed. No apples were collected on this day, but along the stream, we collected a population of Vitis vinifera and two elite Vitis vinifera. These grapes were from the same general area as collected in 1993. They were of good quality and diverse in color and other characteristics. In addition, Pistacia and Amygdalus were collected. Over the next two days, sites 17-19 were collected which included a population of apple from along a stream tributary (site 17) along with nine elites. Site 18 was a xerophytic site 300 m above the stream area. There we found and collected a population of apples and 10 wild elites that were completely without scab infection. Because the area is so dry, this may be expected and does not necessarily indicate any scab resistance. However the fruit was also of incredible horticultural quality (Table 1). Fruit from the random population at site 18 had the highest level of firmness and aromatics of any of the populations. It also was the most tenacious of any of the collections (high level of firmness as noted in Table 1, probably relates to this). This is surprising since this area has a very high level of heat units. These apples would likely be late harvest types in most apple-growing districts. They may also be of interest as a drought resistant source for rootstocks. Site 19 was an extension of site 17 downstream where only three elites were collected. At these sites in Karatau, nine additional samples of miscellaneous species were collected (Table 2).

We returned to Almaty for the final three days of our stay. After arrival, we prepared seed samples and made one more expedition to the eastern-most section of the mountains around Almaty (site 20) where three more elite samples of apple were collected, completing our expeditions.

On 13 September, we visited the ex situ collections of Prof. Djangaliev. As evidence of our mutual exchange of germplasm, we observed the collection of 600 apple accessions that he received over the last four years from PGRU in Geneva, NY including 40 accessions that were recently grafted after our carrying them to Kazakhstan three weeks earlier. We also saw other fruit accessions that had been received from NPGS sites in Corvallis, OR and Davis, CA. Finally, we observed other elite commercial types that they maintain as well as 70 wild selected 'forms' of Malus sieversii from the Kazakhstan forests. In 1993, we imported five of these promising 'forms' which remain in quarantine in Beltsville, MD. We continue to monitor the other 65 but feel for now that our efforts are of more value in the

area of seed collections in the wild forests.

On our final day, we participated in a three-hour symposium on the genetic resources of Kazakhstan at the Kazakhstan Academy of Sciences. P. Forsline gave a presentation on the highlights of the 1995 expedition along with some discussion of collections made in previous years. J. Luby discussed his plans for horticultural evaluation of the 1995 collection and E. Dickson discussed strategies for molecular characterization of the population sampling from the 1995 collection.

T. Human and G. Britz of South Africa discussed their intentions for use of the Kazakh apple germplasm. They obtained their support for this expedition solely from the South African Fruit industry which is very eager for progress in developing new varieties to enhance South Africa's economy. They recognize that this material will have immediate benefits in broadening the diversity of the apple gene pool for their country's economic benefit. Mr. Britz and Dr. Human became aware of the wealth of apple germplasm in Kazakhstan through a copy of the report from 1993 that was prepared by the NPGS expedition team. Thus they independently made arrangements for this expedition with our host, Professor Djangaliev. This cooperative effort had synergistic benefits for the U.S.A. team since the Kazakh hosts were provided with a larger resource base to conduct the logistics of the expedition. This was similar to the expedition in 1993 where Americans were joined by New Zealand scientist, Dr. Noiton. We need to encourage other international participation in future expeditions.

As a group of three Americans and two South Africans, we presented Prof. Djangaliev with a jointly written declaration (appendix 1) of the importance of the wild Malus resources in Kazakhstan and some recommendations for in situ conservation of these resources.

We spent the remainder of 14 September participating in a traditional Kazakh hospitality session which included a five-course dinner. This was followed by completion of records and packaging for transporting plant materials into U.S.A.

Table 1

SUMMARY OF APPLE COLLECTIONS

KAZAKHSTAN, 1995

				Populations[1]						Elites						
General area	Sites	Coordinates	Elevation M	#/#seed	Size mm	Size Range mm	%Red	%Firm	%Aromatic	#Scions	#/#seed	Size mm	Size Range mm	%Red	%Firm	%Aromatic	%Scab Free
Tarbagatai '95'	05-10	(47-14-39N)-(47-16-41N) (81-34-14E)-(81-39-59E)	870-1120	3/3630	43	28-62	61	40	29	10	46/14414	56	46-72	96	67	84	71
Lepsinsk 'B'	14-15	(45-30-39N)-(45-31-14N) (80-42-57E)-(80-43-55E)	1190-1360	1/1425	34	28-44	27	0	3	0	8/6065	37	32-51	50	63	25	12
Topolevka 'A'	11-13	(45-23-21N)-(45-24-25N) (80-24-28E)-(80-24-51E)	1170-1690	1/1545	36	27-48	33	3	17	1	10/4444	46	37-56	80	90	50	57
				1/1469	35	27-41	50	57	10	0	4/3174	38	35-46	50	50	50	0
Almaty 'C/D'	01-04, 20	(43-06-33N)-(43-21-43N) (76-47-46E)-(77-40-28E)	1360-1550	2/2121	34	25-49	33	15	12	0	11/7858	45	32-56	91	27	27	43
Karatau 'E'	16-19	(42-52-22N)-(42-53-18N) (69-52-52E)-(69-56-15E)	600-910[2]	1/1476	41	28-54	30	10	23	1	12/4081	39	30-44	50	67	17	100
				1/2177	41	32-48	62	44	44	2	10/6113	42	33-46	80	90	60	100
Total	20			10/13842						14	101/46149						

[1] 30 trees/population, 5-8 fruit/tree

[2] Xerophytic area

Table 2

MISCELLANEOUS SPECIES COLLECTED

KAZAKHSTAN, 1995

Sites	Species	# of collections		# of seed
01,04,17	Prunus armeniaca	4		575
01	Hippophae rhamnoides	1		100
01	Rubus caesius	1		50
04	Ribes meyeri	1		150
05,10	Pyrus heterophylla	3		1125
06	Amygdalus ledebouriana	1		200
13	Ribes turbinatum	1		100
13,14	Rubus idaeus	2		200
16,18	Pistacia vera	2		700
16	Amygdalus spinosissima	1		125
16	Vitis vinifera	1	(population of 31 vines)	3798
16	Vitis vinifera	2		1925
17	Prunus sogdiana	1		30
18	Amygdalus petunikowii	1		200
18	Cerasus tianschanica	1		150
18	Pyrus regelii	1		400
18	Allium sp.	1		30
	Total	25		9808


RUSSIA
AREA SHOWN
Ural'sk
Kokchetav
Pavlodar
Semipalatinsk
Ust-Kamenogorsk
KAZAKHSTAN
Karaganda
95
Caspian Sea
Shevchenko
Dzhezkazgen
Aral Sea
A
B
Lake Balkhash
Alma-Ata
C
E
Chimkent
F
D
UZBEKISTAN
KYRGYZSTAN
TURKMENISTAN
TAJIKISTAN
CHINA

Figure 1.

Appendix 1

Declaration drafted by Forsline, Luby, Dickson
Britz and Human for Prof. Djangaliev
14 September 1995

The preservation of Malus sieversii and other indigenous plant species of Kazakhstan is of great importance, not only to the people of Kazakhstan but to scientists worldwide. In 1989 the first exploration team from the USA arrived to meet Kazakh scientists and to conduct an expedition principally for Malus. Since 1989, Government and private organizations have seen the value of this initial exploration and have provided funding for further germplasm exchange. Through lectures, seminars, national and local media, publications and other forms of communication, other countries became interested and participated in joint expeditions, including New Zealand and South Africa. Each expedition has provided new genetic material and has convinced us that Malus sieversii is the key to the origin of the cultivated apple, Malus domestica. The germplasm is and will be preserved in gene banks, ex situ. More importantly, however, it must also be preserved in natural wild populations, in situ.
We foreign scientists can ensure ex situ preservation in our own countries and can support ex situ efforts in Kazakhstan. For example, the USDA specific cooperative agreement is presently funding, in part, this effort in Kazakhstan. Our observations during the 1995 expedition confirm and support many of the observations made in the publications of Professor Djangaliev. To further the dissemination of these publications to the general public, scientists and funding sources, the USDA is providing financial support for the translation of these works into English.

From our observations, we would like to offer the following recommendations:

1) Continued communication among scientists worldwide in an effort to conserve the genetic resources of Kazakhstan.
2) Ex situ conservation in Kazakhstan:
   - Security is necessary due to economic pressures in Kazakhstan
3) In situ conservation:
   - Total government support is required, both moral and financial
   - Public education to increase awareness is needed
   - Human impact needs to be managed and controlled; such things as:
     . Grazing of cattle, sheep, goats and horses
     . Timber harvesting
     . Suburban dacha developments
     . Other developments including mineral and petroleum explorations

Appendix 1

- Reforestation after careful consideration and monitoring of the natural environment is a last resort
- National Parks or World Heritage sites can act as an attractant for ecotourism which is another source of revenue.

We as representatives of the International Scientific Community offer our support to Professor Djangaliev, his laboratory and the minister of Ecology and Bioresources, The National Academy of Sciences and the People of Kazakhstan to Preserve the important bioresources of this region.

MALUS DATA COLLECTION FORM

1. Scientific name _____ 2. Site no. _____ 3. Collection no. _____
4. Country _____ 5. Province/subdivision _____
6. Village/town _____
7. Directions from _____
_____
8. Latitude _____ N S 9. Longitude _____ E W 10. Elevation _____-meters

COLLECTION SITE HABITAT

11. Soil: Texture _____ Stoniness _____ Drainage _____
12. Slope: Incline _____ Aspect _____ Light _____
13. Landform _____ 14. Rainfall _____
15. Tree species: Dominant _____ Associated _____
16. Shrub species: Dominant _____ Associated _____
17. Herbaceous: Dominant _____ Associated _____
18. Population: Abundance _____ Distribution _____
Area size _____ Tree size uniformity _____ Desease uniformity _____
Sucker propagation _____ % fruiting _____ # trees sampled/(fr/sample) _____
Fruit uniformity _____

ACCESSION INFORMATION

19. Propagule collected _____ Herbarium Y or N / I.D. _____
Wild _____ Selected form / I.D. _____ Nearest M. Domestica _____
20. Tree: Height _____ DBH _____ Habit _____(24)
Vigor _____(25) Crop load _____ General Health _____
21. Leaves: Disease _____ Shape _____
Size _____ Comment _____
22. Fruit: Bloom _____(1) Wax _____(2) Flesh color _____(3)
Firmness _____(4) Flavor _____(5) Ground color _____(6)
Over color _____(7) O.C. intensity _____(8) O.C. patern _____(9)
Russet intensity _____(10) Rus loc _____(11) Rus type _____(12)
Shape _____(13) Stem length _____(14) Stem thickness _____(15)
Stem cavity _____(16) Calyx basin _____(17)
Length _____(18) Width _____(19) Size uniformity _____(20)
Texture _____(21) Tenacity _____(22) Season _____(23)
Disease _____
Insect _____

23. General notes: _____

_____

_____

24. Collectors _____ Date _____

MALUS DESCRIPTOR CHARACTERIZATION DATA

1. Fruit bloom:

Code	Definition
1	ABSENT
2	SLIGHT
3	MODERATE
4	HEAVY

2. Wax: Yes or No

3. Flesh color:

Code	Definition
1+1	WHITE
2+2	CREAM
2+3	CREAM + GREEN
2+4	CREAM + YELLOW
3+3	GREEN
3+4	GREEN + YELLOW
4+4	YELLOW
4+5	YELLOW + ORANGE
4+7	YELLOW + RED
5+5	ORANGE
6+6	PINK
7+7	RED
8+8	ROSE RED

4. Flesh firmness:

Code	Definition
1	SOFT
2	SEMIHARD
3	FIRM
4	HARD

5. Flesh flavor:

Code	Definition
1	AROMATIC
2	SWEET
3	SUBACID
4	ACID
5	ASTRINGENT

6. Ground color:

Code	Definition
1	LIGHT GREEN
2	GREEN
2,4	GREEN YELLOW
3	LIGHT YELLOW
4	YELLOW
5	ORANGE
5,4	ORANGE YELLOW
6	BROWN
7	PINK
8	RED
9	PURPLE

7. Over color:

Code	Definition
1	NONE
2	GREEN
2,5	GREEN BROWN
3	YELLOW
3,2	YELLOW GREEN
4	ORANGE
5	BROWN
5,7	BROWN RED
5,9	BROWN PURPLE
6	PINK
7	RED
7,5	RED BROWN
8	DARK RED
9	PURPLE

8. O.C. Intensity: % over color on fruit 0-100%

9. O.C. Pattern:

Code	Definition
1	BLUSH
2	STRIPED
3	SPLASHED

10. Russet Intensity: % surface with russet 0-100%

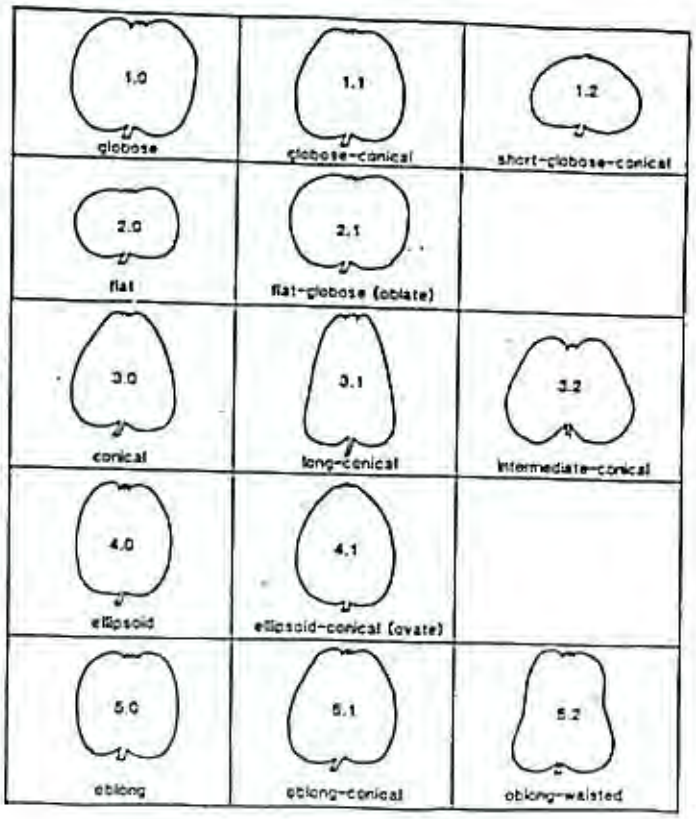
11. Russet location:

Code	Definition
1	PEDICEL END ONLY
2	CALYX END ONLY
3	BOTH PEDICEL AND CALYX END
4	ENTIRE FRUIT

12. Russet type:

Code	Definition
1	EXTREMELY FINE
2	MEDIUM HEAVY
3	SURFACE CRACKS

13. Fruit shape:



14. Stem length: Stem length in mm

15. Stem Thickness:

Code	Definition
1	SLENDER
2	MEDIUM
3	STOUT

16. Stem cavity:

Code	Definition
1	NONE
2	ACUTE SHALLOW
3	ACUTE MEDIUM
4	ACUTE DEEP
5	OBTUSE SHALLOW
6	OBTUSE MEDIUM
7	OBTUSE DEEP

17. Calyx basin:

Code	Definition
1	NONE
2	ACUTE SHALLOW
3	ACUTE MEDIUM
4	ACUTE DEEP
5	OBTUSE SHALLOW
6	OBTUSE MEDIUM
7	OBTUSE DEEP

20. Size uniformity:

Code	Definition
1	UNIFORM
2	VARIABLE

21. Texture:

Code	Definition
1	FINE
2	MEDIUM
3	COARSE

22. Tenacity:

Code	Definition
1	DROPS BEFORE MATURE
2	HOLDS PAST MATURITY
3	PERSISTS WELL INTO WINTER

18. Fruit Length (m.m.)

19. Fruit width (m.m)

23. Harvest season:

Code	Definition
1	EXTREMELY EARLY >60
2	VERY EARLY 50-60
3	EARLY 30-50
4	MED-EARLY 20-30
5	MED 10
6	MED/LATE
7	LATE 10
8	VERY LATE 20-30
9	EXTREMELY LATE >30

24. Bearing Habit:

Code	Definition
1	COLUMNAR
2	TYPE I SPAR
3	TYPE II SEMISPUR
4	TYPE III STANDARD
5	TYPE IV TIP BEARER
6	WEEPING

25. Tree vigor:

Code	Definition
1	SMALL
2	MEDIUM
3	VIGOROUS
4	VERY VIGOROUS