

**BIOGEOGRAPHIC SURVEY AND COLLECTION
OF TEMPERATE FRUIT AND NUT GENETIC RESOURCES
IN NORTHERN PAKISTAN**

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The trip report was prepared by Maxine Thompson who is responsible for all errors of fact and misspelling of foreign words.

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INTRODUCTION

OBJECTIVES

This multi-species plant exploration project included all temperate fruit and nut species, both cultivated and wild relatives. The objectives were as follows:

- 1) Locate and identify cultivars and species
- 2) Characterize, as much as possible, traits of horticultural interest
- 3) Define the geographical range of each cultivar/species
- 4) Describe, in general terms, the geography of the study areas
- 5) Collect seeds/scions of cultivars and species
- 6) Photograph fruit samples and trees/shrubs in their natural environment
- 7) Prepare herbarium specimens as vouchers for all wild species and for cultivars whose species identity was questionable

An objective of secondary importance was to collect seeds of species which might have potential ornamental value.

JUSTIFICATION

This plant exploration trip, whose purpose was to expand the genetic base for temperate fruit crop species, was justified by 1) the genetic vulnerability of these crops in the Western world, 2) the known diversity that exists in the study region, 3) the threatened status of these fruit genetic resources, and 4) the paucity of fruit germplasm from this region available in the West.

Genetic vulnerability of fruit species, as with most other crop species in the U.S., is of increasing concern as fewer commercially important cultivars are being planted and old cultivar collections are being destroyed. Most fruit crops are dominated by one, or very few, cultivars and typically these few are closely related to each other, having been derived from the same progenitors. Overall, the germplasm base of most important fruit crops was derived from Europe which, because it is not the center of diversity, has provided us with a relatively limited representation of the world gene pool. For Central and East Asian species, there have been even fewer plant introductions because of more limited access to these regions.

Geographically, the mountainous region of No. Pakistan lies between the two major centers of temperate fruit species diversity, the Caucasus

Mountains and China. As ancient trade routes from China to Western Asia passed through this region, fruit species from along the entire route were brought here and have been cultivated for thousands of years. As a consequence of the isolation of the many remote valleys in this rugged mountain area and the long period of time that people have lived there, not only have many diverse human cultures evolved, but many, distinct fruit cultivars have resulted from both human and natural selection.

In regard to the wild species, this region is at the crossroads of two major floristic regions. Here are the eastern limits for several Central or W. Asian species, such as *Crataegus songarica*, *Pistacia khinjuk*, *Pistacia atlantica cabulica*, *Prunus kuramica*, *Prunus bucharica*, *Rubus anatolicus*, and *Sorbus tianshanica*, while it is the western limits for Himalayan and W. Chinese species such as *Pyrus pashia*, *Sorbus lanata*, *Prunus cerasioides*, *Prunus cornuta*, *Pistacia chinensis integerrima*, *Ribes himalense*, *Rubus macilentus*, and *Rubus niveus*.

In No. Pakistan, plant species, both wild and naturalized, are disappearing or their distribution and genetic diversity is being greatly diminished by the increasingly critical over-population. Woody species, in particular, are being decimated by cutting for lumber, fuel, and fodder and by the destruction of the natural habitats as land is cleared for more and more food production. The status of ancient, local fruit cultivars is especially threatened by horticultural development programs which are rapidly introducing western cultivars to replace the old established ones. Until very recently, virtually no fruit germplasm had been collected and introduced to the U.S. or to other western countries from this region. For example, the only fruit germplasm in the U.S. Clonal Repositories from this region were a few apples, grapes, and walnuts that resulted from a recent IBPGR-sponsored exploration in a limited area of northern Pakistan.

GEOGRAPHY

The geographic area surveyed lies between 32° 53' N and 36° 24' N latitude and 71° 30' E and 76° 00' E. longitude. Our trip included parts of the Districts of Chitral, Swat, Peshawar, Hazara, Kohistan, Diamer, Gilgit, Baltistan, and Rawalpindi, and the tehsil of Muzaffarabad in Azad Kashmir. The region appears relatively small on a map as the maximum east-west air, or horizontal, distance is only about 665 km and the north-south is about 500 km. However, because of the extremely precipitous mountains, there is considerable vertical distance to traverse, and the hazardous, very rough roads make traveling very slow and time-consuming. For

example, it may take almost a full day to drive 130 km. We collected over an elevational range of 750m to 3230m.

The topography of the region consists of some of the highest mountains in the world, including K-2 at 8692m, the second highest peak in the world, as well as many more peaks over 7500m. Three ranges of the greater Himalaya Mts., the Hindu Kush, Karakoram, and the main Himalaya converge here. These are among the most recently formed mountains in the world and, as such, they are extremely rugged, precipitous and highly unstable. There are continual landslides, mud flows, avalanches, falling rocks, glacial shifts, and earthquakes. River drainages have cut deep valleys within which people have found occasional spots which are level enough and have sufficient soil to cultivate. The road system where we traveled principally follows these river valleys.

Rainfall patterns in the western Himalaya are influenced by the summer monsoons that arise from the south and by winter precipitation arising from the north. Beginning in June the moisture-laden air from the Indian Ocean first strikes the eastern Himalayan region in India and then moves, with decreasing intensity, northwest to Pakistan where it reaches its western limits on the front ranges in Swat and Dir Dts., Safed Koh Mts. and Kurram Valley in Pakistan and Nuristan in E. Afghanistan. In the winter, the weather pattern is reversed with cold winds bringing periodic snow or rains from Central Asia. Within No. Pakistan, there is decreasing rainfall from the outer foothills in Azad Kashmir, Hazara, and lower Swat where mean precipitation is about 1100-1600mm, to the inner mountain regions of Chitral, Gilgit, and Baltistan which are very arid with mean rainfall 100mm to 150mm. Thus, there are significant differences in precipitation between different regions. Also, there are widely varying annual fluctuations at a given site.

With increasing elevation, the climate varies from sub-tropical in the foothills to warm temperate, temperate, to alpine and arctic. For every 1000m increase in elevation the mean temperature decreases as much as 6 degrees C. Within a relatively limited geographic region, there are widely varying temperature differences due to local site differences in elevation, exposure, slope, vegetation cover, and wind patterns. Generally, temperate fruit crops are grown from about 1000m to 2900m with the less hardy, lower chilling-requiring species such as Oriental plums, Asian pears, and persimmons at the lower elevations and apples, walnuts and apricots to the highest elevations. Walnuts and apricots are grown from about 900m to 2800m, but fruits have better quality at the higher elevations. *Vinifera* grapes and almonds are successful to about

2150m; above this elevation there is insufficient heat to mature fruit satisfactorily. At the elevations where temperate fruits are grown, winter temperatures are cold but not too severe; for example, the minimum recorded at Skardu (2215m) was said to be minus 20 degrees C. and at Gulmit, Hunza at the highest elevation for fruit (about 2900m) the minimum recorded was said to be minus 28 degrees C.

Some fruit species such as *Pyrus pashia*, other local pear cultivars of uncertain species, *Vitis Jacquemontii*, *Diospyros lotus*, *Diospyros kaki*, *Pistacia chinensis*, and *Rubus ellipticus* are well adapted to the summer rains and high humidity on the front ranges. However, most commercially important species such as apple, apricot, peach, almond and grapes are best adapted to the dry inner mountains. The climate of this region is ideally suited for temperate fruit species because there are minimal risks of spring frosts, no hail damage, virtually no rain during fruit development period, very low humidity, and virtually no winter freeze damage.

In some areas there are known to be high pH soils. We began to determine this parameter but had to discontinue because distilled water was unavailable for calibration of our pH meter.

DURATION: May 20 to December 10, 1988

This time frame permitted us to collect seeds from the earliest ripening fruits (strawberry) to the latest ripening, and to remain until scionwood was mature enough for cutting.

OPERATIONAL ASPECTS

ADVANCE PLANNING:

The inspiration for this expedition was born in 1983 when the Team Leader (Maxine Thompson) was engaged by IBPGR to make a brief survey of fruit genetic resources and to prepare a plan for a Fruit Repository System in Pakistan. At that time, the wealth of genetic diversity in fruit and nut species was recognized and plant exploration was highly recommended in the IBPGR Consultancy report. Serious planning for this project was undertaken in 1987 by the team leader after retirement from the University.

Literature consulted included botanical, horticultural, geographical, and general travel guidebooks. (See Appendix II for complete list of references) Topographical maps were obtained from The Library of Congress (US02 Series prepared for the U.S. Army Map Service (now Defense Mapping Agency). Road maps were purchased in Pakistan. Details for routes and specific in-country costs were discussed with Dr. Zahoor

Ahmed while he was at the Clonal Repository in Corvallis, OR. on an IBPGR-sponsored 6-months training course.

Fruit and Nut Crop Advisory Committee chairpersons and other interested fruit specialists were asked to give their input on priorities for collection, (e.g. what traits in each species might have particular value, or what species should be stressed), and they were requested to write letters of support for the proposal in regard to the potential value for their respective crop interests.

Advance preparations were made for introduction to the U.S. of the seeds/scions collected. Plant Quarantine regulations for importing the target genera were obtained and adhered to. George White, Plant Introduction Officer, provided mailing labels and suggestions for the most expeditious methods for transferring the plant materials from Pakistan to the appropriate recipients in the U.S. Curators of Temperate Fruit Repositories and the Director of the Plant Quarantine Center, Glenn Dale, MD, were informed of the project, when to expect shipments of plant materials, and agreements were reached as to how much material they could handle conveniently when it arrived.

HOST COUNTRY COOPERATION

The government of Pakistan approved our plant exploration plans and placed no restrictions on movement of plant materials out of the country. Three scientists from the Plant Genetic Resource Center (PGRC), National Agriculture Research Center, Islamabad, Pakistan (Rashid Anwar, Zahoor Ahmed, and Sadiq Bhatti) cooperated fully. They arranged in advance for Pakistan Agriculture Research Council approval for this joint project and for the required Government security clearance. Each month the three men alternated accompanying us, so that we had one Pakistani scientist with us at all times. They were very helpful in arranging accommodations, helping to plan specific routes, locating and introducing us to local agriculture and forestry officials, and indispensable for contacting local village men and interpreting for us where there would have been an insurmountable language barrier. The PGRC also provided us the use of their Landrover with drivers (Liaqat Ali and M. Asalam). The drivers were valued members of our team; they not only drove the vehicle but serviced and cleaned it and repaired the several problems that arose when we were in remote areas, far from a mechanic shop. They also helped collect fruits, extract seeds, and collect scionwood.

Two taxonomists at The National Herbarium (Yasin Nasir, Director, and Rubina Akhter) provided valuable services both at the beginning of the

trip and at the end. Initial discussions with them and observations of their herbarium specimens helped us to recognize the wild species previously unknown to us and to pinpoint the sites where we could expect to find them. After our trips were completed, they verified the identity of all herbarium specimens that we collected.

MODE OF TRAVEL

Almost all of our travel was by Landrover. In only a few instances did we walk to locations a few miles from the road. On a few occasions we rented a local jeep and driver, either to traverse roads which were too narrow for the Landrover or because our hosts had returned to Islamabad with our vehicle and driver.

ACCOMODATIONS AND MEALS:

There are various accomodations scattered all along the road system; these include local motels/hotels (generally low priced and low quality), tourist motels (reasonably good to good quality), and government rest houses (varying from very primitive to very good). Food in local, non-tourist restaurants was difficult for us Americans due to the combination of hot spices, excessive over-cooking, and liberal use of oil.

LANGUAGE

One advantage in traveling in Pakistan is the widespread use of English. Every person that completes college is fluent in English, and those who attend High School have some competence. I was told that it has been compulsory from the 5th grade, but recently they have begun to teach English in the first grade. It is only among the village people, who have very limited or no education, that we Americans (and sometimes, even our Pakistani hosts) had a communication problem. Unfortunately, it was with these people, who had the most knowledge of local plants, that we required an interpreter. Urdu is the national language and most men know this language, although we did meet a few men that did not. In the limited geographic area that we visited, there is a total of 11 local languages, in addition to Urdu, that people speak in different regions.

COLLECTING PROCEDURES

Seed Collections

Fruits were bought in markets, from peddlers along the roads, or from farmers, and were obtained from Dept. of Agriculture nurseries or research stations or from wild plants. Seeds were extracted by cutting fruit (e.g. apricots), by mashing soft fruits in

water and floating off the pulp (e.g. raspberries) or, in the case of hard fruits, we crushed the fruit by stomping on it and picked out the seeds (e.g. *Pyrus pashia*). Seeds were then placed on blotters on the motel floor to dry. Before departure from the motel, seeds were put into labeled cloth bags. We aimed to obtain a minimum of 400 seeds of each accession (200 for the U.S. and 200 for Pakistan); actual numbers depended on the availability. In only 3 cases we solicited local men to collect seeds for us because we would not be there at fruit-ripening time. All other samples were collected by the team. When seed collections were completed, seeds were fumigated with phostoxene, boxed, import labels attached, and were then posted by the U.S. Agricultural Attache, Robin Tilsworth (via U.S. Pouch) to George White, Plant Introduction Officer in Beltsville, MD.

Scions/Cuttings

Scion/cuttings were collected between Oct. 11 and Nov. 26, by which time most of the wood appeared to be mature enough to survive. Walnut wood was the latest to mature so some scions of this species might have been too immature at the time of collection. In some cases, we returned to the exact same tree from which we had collected seeds. Trees were identified by recording the village and owner's names or, in cases where the owner was not available, by marking the tree with a splotch of paint. Scions were cut either from the ground with a long-handled, collapsible cutter or by climbing the trees. Local men were very adept, and often willing, to climb trees for us (for a few rupees) in order to collect fruit as well as scions. We were also fortunate to have an excellent tree climber on our team--this was one of David Brenner's hidden talents.

Immediately after cutting, scions were placed in polyethylene bags, a few selections per small bag, and then a group of small bags were put into larger poly bags. While traveling, we kept wet cloth towels over the bags of scions to take advantage of evaporative cooling, which was very efficient in the dry atmosphere there. About once a week we sent, or brought, the accumulated scions to the cold storage room at the PGRC in Islamabad. Before boxing for shipping, a third layer of poly bag was put around the bundles. To expedite the transfer of scions to U.S. destinations, I brought the boxed scions, with import labels attached, with me to the U.S. as

excess baggage. Prior to my arrival in Seattle, I had informed Dr. George White, the Plant Introduction Officer, when I would arrive. He had then alerted the Plant Quarantine Officers at the airport so they were prepared to receive the boxes, inspect the plant materials, and ship them directly to the P.I. Officer. Shortly after passing through the Plant Introduction Office, the scions were shipped either to the appropriate Clonal Repository or to the Plant Quarantine Station in Glenn Dale, MD. By using these procedures the scions/cuttings were out of cold storage only about one week and arrived in good condition.

Herbarium Specimens

Voucher herbarium specimens were collected for wild species and for some cultivated fruits where species identification was questionable (e.g. *Pyrus* and *Vitis*). A minimum of 4 samples (2 for each country) were collected from each plant. These dried plant materials were treated with phostoxene just before boxing for shipping. The Agriculture Attache sent these boxes also, via U.S. Embassy pouch, to the U.S. Plant Introduction Officer who, in turn, sent them to the Curator at the Corvallis Clonal Repository who had agreed to forward them to appropriate destinations.

EVALUATION

For each accession, a collection sheet, with site information and miscellaneous notes, was prepared. In addition, evaluation forms for fruit traits, with rating scales consistent with descriptors developed by IBPGR and by the U.S. Crop Advisory Committees, were used to record more detailed information for some cultivars. Some of the information recorded consisted of actual measurements and direct observations by the team and some of it was provided by local village men. In general, it appeared that local informants were very reliable but, in some cases, we were uncertain about the validity of what we were told. We often asked the same questions to different men and used consistent responses as a measure of their validity. Undoubtedly, some errors have been recorded because of the necessity of relying on random village informants and the need to obtain much information through interpreters, a process always subject to misunderstandings or omissions. Both collection and evaluation sheets for each accession of seeds, scions, and/or herbarium specimens were sent to recipients for the plant materials that he/she

received.

DISPOSITION OF PLANT MATERIALS COLLECTED

One half of all seeds, scions, and herbarium specimens collected was retained in Pakistan. Seeds and scions were deposited with our collaborators at the Plant Genetic Resources Lab., National Agriculture Research Center in Islamabad. Herbarium specimens were placed in the National Herbarium, also affiliated with N.A.R.C. The other half of the collections were brought to the U.S. and deposited in the following places:

1. Pome (except *Sorbus*) and stone fruit scions--National Plant Quarantine Center, Glenn Dale, MD.

2. Grape cuttings and apple seeds--National Clonal Repository, Geneva, N.Y.

3. All seeds of *Ampelopsis*, *Diospyros*, *Ficus palmata*, *Juglans*, *Morus*, *Olea*, *Pistacia*, *Prunus*, *Punica*, *Vitis*, and *Zizyphus*, and clones of *Juglans*, *Diospyros*, and *Ficus*--National Clonal Repository, Davis, CA.

4. All seeds of *Corylus*, *Cotoneaster*, *Crataegus*, *Duchesnea*, *Fragaria*, *Pyrus*, *Ribes*, *Rubus*, and *Sorbus*, and cuttings of *Viburnum grandiflorum*, *Ribes orientale*, and *Sorbus lanata*--National Clonal Repository, Corvallis, OR

5. *Morus* scions --Mike McConkey, P.O. Box 77, Afton, VA, 22920 and A.J. Bullard, 103 Smith Chapel Rd., Mt. Olive, NC, 28365

6. All herbarium specimens, and seeds of many, ornamental/misc. species--National Arboretum, Washington, D.C.

7. Seeds of many species of ornamentals/miscellaneous-- Plant Introduction Station, Ames, IA; Hoyt Arboretum, Portland, OR; and John Stewart, Dept. of Horticulture, Oregon State University, Corvallis, OR, 97331

8. *Amaranthus* sp.--Plant Introduction Station in Ames, IA; and Leon Weber, Rodale Research Center, Box 323, R.D. 1, Kutztown, PA, 19530

9. *Solanum pseudocapsicum*--Plant Introduction Station, Griffin, GA

10. *Impatiens* sp.--PanAmerican Seed Co., P.O. Box 438, W. Chicago, IL, 60185; Mikkelsen's, Inc., P.O. Box 1536, Ashtabula, OH, 44004; and Longwood Gardens, Kennett Square, PA., 19348

RESULTS

NUMBER OF ACCESSIONS

Altogether, there was a total of 774 accessions, including seeds, scions, and herbarium specimens. The 52 fruit and nut species, including

cultivars and wild related species, were the primary objectives. Of secondary importance for this trip, 36 possible ornamental/miscellaneous species were collected as we happened upon them. Total numbers of accessions are presented here.

	<u>seeds</u>	<u>scions</u>	<u>herbarium sp.</u>
Fruit and nut sp.	229	273	176
Ornamental/Misc.	<u>56</u>	<u>1</u>	<u>37</u>
Totals	285	274	213

A more detailed summary of plants collected is given in Appendix III, and a complete list of accessions is presented in Appendix IV.

SOURCES OF INFORMATION

The information presented in this report about the species and cultivars collected is partly from our observations, partly obtained from local men, and partly derived from botanical literature. Species designations are primarily those used in the 'Flora of Pakistan' (1972-), although in some cases other authorities have been accepted. In this trip report, only general observations about the species and cultivars will be presented. More detailed reports will be prepared later for certain important crops.

CULTIVAR NOMENCLATURE

The difficulties of obtaining accurate cultivar names cannot be over-emphasized. In some cases, local Department of Agriculture Officers were helpful but, as their main concern is with recently introduced cultivars, some of them are not so knowledgeable about old local cultivars. Since there are no written references to consult about fruit cultivar names or descriptions, most of this information had to be obtained from local village men and, often boys, where men could not be found. When local names were given to us orally, in any one of several languages, there was often a problem of how to spell them in English, especially as our Pakistani hosts heard different sounds than we did. Commonly, there was a different name for the same clone in different villages due to language differences. Also, within a given language there were differences in pronunciation (and thus, spelling) of the same name in different villages. As local informants were chosen simply by their availability, their reliability was often questionable because successive responses to the same questions by different people varied. Frequently, the same name was given to different clones, and different names were applied to the same

clone. Sometimes, when we asked for the name of a fruit tree, we were told the generic name, e.g. apple, or peach, in the local language. General terms translated as, for example, 'black grape' or 'white pear', were used in different language areas and it was not always clear if these terms referred to the same or to different cultivars.

DESCRIPTIONS OF SPECIES COLLECTED

Pome Fruits

Pome fruit species collected included *Pyrus pashia*, *Pyrus sp.* (cultivars), *Malus domestica*, *Cydonia oblonga*, *Sorbus lanata*, *Sorbus tianshanica*, *Crataegus songarica*, *Cotoneaster affinis* var. *bacillaris*, *C. integerrima*, *C. lindleyi*, and *C. nummularia*.

1. *Pyrus pashia* Ham. ex D. Don

No. of collections: seeds(5), scions(3), herbarium specimens (4)

Taxonomy: This is a very distinct species. *Pyrus variolosa* Wall is the only synonym I discovered. In addition to the wild seedlings, there is one, or more, vegetatively-propagated clones that seem to have been derived, at least in part, from this species.

Nomenclature: Depending on the local language, seedlings of this species are called 'batanji', 'tanchi', 'tangay', or 'batangay'. These words mean 'very small-fruited pears' and, at least in the case of 'tanchi', the term was also used for very small-fruited pears that were clearly not *Pyrus pashia*. In Swat Valley, the larger-fruited clonal selections of *P. pashia*, which we observed in 3 locations, were called 'khapa' (meaning "it grabs your mouth", or is astringent before fully ripe) whereas, in Muzaffarabad Dt, they were called 'tanchi'.

Distribution: This species occurs naturally at elevations between 750 and 2500m all along the front slopes of the Himalayan range from N.W. Pakistan (Dir Dt.) to W. China. In Pakistan, it is also found south of Dir in the Safed Koh and Suleiman mountain ranges in regions where the summer monsoon rains reach. This is the only wild pear species in the region we studied. Other target species that were often found in this same general range are *Pistacia chinensis integerrima* and *Diospyros lotus*. Although the natural vegetation in much of the region where this species occurs has been cleared for farming many trees remain, primarily around the edges of farm fields, because the fruit is edible and, because of the tendency to sucker profusely, trees are used for rootstocks for pear

cultivars. *Pyrus pashia* seems to be very well-adapted to this region; in previously cut-over areas that were allowed to regenerate naturally this species was one of the few trees among the many shrubs and herbs returning.

Characteristics: Trees are medium-sized, with glossy, glabrous leaves with acuminate apices. Fruit in wild seedlings is brown with conspicuous white, raised lenticels, and very small in size (1-2cm). It is harvested in November, at which time it is hard and inedible. Before it can be eaten it is stored and allowed to soften and turn dark brown. In fruits that we harvested Oct. 10 and later, seeds appeared to be fully mature, although the flesh was still light colored and very hard. The vegetatively propagated clones had larger fruit (about 3cm diam.) whose lenticels did not seem so obvious, but which had the same need for storage and softening as did the wild seedlings. Leaves were somewhat different, also, in that the apices were not so acuminate. Although these clones appeared to have been selected directly from the wild species, it is possible that some other species also might have been involved. Because we did not have fruit of all 3 accessions together, we could not determine if there is one clone widely distributed or if there are 2 or 3 clones in the different districts where we collected.

2. *Pyrus sp.* (cultivars)

No. of collections: seeds(1), scions(37), herbarium specimens(15)

Taxonomy: The species identification for pear cultivars was not always clear. Whereas some were typical *Pyrus pyrifolia* (e.g. Kharnak and Shoghor) and some were clearly *P. communis* (e.g. Paraow and Bagugosha), there were several which may be interspecific hybrids involving *communis*, *pyrifolia*, *pashia* and/or some other *Pyrus* species. The species identity of all pear cultivars collected needs to be established by pear experts after they are propagated. In Swat Dt., there were several cultivars which had such small fruit that one would expect that they were derived recently from a wild species (e.g. 'Shukar', 'Mamusay', 'Kwaga Maywa', and 'Rash Tangoo'). However, their leaf and fruit traits were quite different from *P. pashia*, the only wild species there now. Although we did not see these fruits at maturity, we were told that the flesh becomes soft and sweet, i.e., not crisp like *P. pyrifolia*. Leaves were variable and not typical of any of the 3 species mentioned above. These cultivars are definitely not recent introductions from Europe or America, and no one to whom we spoke had any idea where they came

from. There were also medium to large-fruited cultivars whose fruit size was more typical of commercial pears in the West. Two of these, 'Kieffer' and 'Le Conte' are known interspecific hybrids introduced from the U.S. in this century. In Gilgit and Baltistan there are some *communis* types that are said to have come from Kashmir. Since the British introduced many European fruits to Kashmir in the last century, it is likely that at least some of these are European pear cultivars that I do not recognize. The origin of most others was not known by any of our informants who merely said that they were "local" cultivars.

Nomenclature: The names of pear cultivars, particularly in Swat, is also very confusing. Several words that seem to be a variant of the word "pear" in Urdu, Pushtoo, or Kohistani languages are used to designate specific clones, and sometimes more than one clone is given the same name, e.g. 'Nashpati' (3 clones), 'Nak' (4), 'Tang' (2), 'Tanga' (1) 'Tangoo' (1), and 'Batang' (1). Since no Pakistani clarified the meaning of all the various pear terms for me, the following interpretation is subject to error because it represents many random comments made by local people. In Pushtoo, the word 'batang' refers to large-fruited pears, 'tanga' to medium-sized pears, and tangay, batangay, or batanji to very small-fruited pears (including, but not exclusively, *P. pashia*). The word 'tangoo' is also used but I do not know its specific meaning. In Urdu, the general term for pear is 'nashpati', and one informant said that this term referred to pears with smooth texture which do not store (presumably *P. communis*). The term 'nak' (which is either Urdu or Pushtoo) is also used, and I was told that it refers to pears that have inferior, hard-textured, gritty flesh (presumably *P. pyrifolia*). Specific cultivar names were applied to different clones at different locations, e.g. 'Kharnak' (=donkey pear, or poor quality pears fit only for donkeys) was applied to at least 2 distinct clones which had hard-textured fruit. One informant told us that 'Kieffer' is also called 'Kharnak'. There were at least 2 clones called 'Bagugosha'. In Balti, pears are called 'neuri' or 'muri'; in Brushuski, 'pesho' or 'fesho'; in Kalashi (or Chitrali), 'ayal'.

Distribution: Pear cultivars are grown both in regions with summer rainfall (Swat, Hazara, and Muzaffarabad) and in the arid interior valleys (Gilgit, Baltistan and Chitral) where there is irrigation. The greatest diversity of pears is in the Swat Valley and adjacent tributary valleys, especially on the eastern side of the Valley. Because cultivars in Swat are not suitable for storage and shipping it is not economic to plant large orchards (as is done on the Valley floor with apples) so trees are widely scattered on the edges of small farms, predominantly in the hills.

In Gilgit and Chitral Dts. there is a very good Asian pear cultivar, 'Shogori' (which means it came from the village of Shoghor in Chitral), which is typical *P. pyrifolia*. In Peshawar Dt., which is the lowest elevation region for pears, (estimated chilling is about 400 hours) 'LeConte' and 'Kieffer' are the main cultivars because of their low chilling requirements. In Muzaffarabad, important cultivars mentioned were 'Nak Batang', said to be "an ancient" cultivar and to have large, juicy fruit, fairly firm texture, and to be a good keeper (few months) and 'Bagugosha' (one type) which has the largest fruit, juicy, sweet, and tender-skinned, ripens in late August, and stores only a few weeks. I believe that both of these are *P. communis*, probably introduced from Kashmir.

Characteristics: Although there are not huge numbers of cultivars, there is a large diversity in the pears found in Pakistan because there are at least 3, and possibly more, species involved in the origin of various cultivars. Fruit size ranged from small, round (2cm diameter) to large, pyriform (8cm width x 11 cm length, or larger). Shapes varied from oblate to long, pyriform. Fruit colors varied from light green, yellow, to brown, and some had a red blush. Fruit texture varied from soft and smooth to very hard and gritty. In relation to fruit size, pedicel length varied from very short to very long (5-25mm). All of the cultivars seem to be well-established. Chance seedlings no doubt occur, especially in Swat where there are summer rains, but we did not encounter any. The same cultivars were found repeatedly in different villages, and we were not made aware of any on-going local selection process. It appears that, long ago, most of these cultivars were either introduced, (from Central Asia or Eastern Asia) or were selected from local segregating populations that no longer exist in this region. European pears have been introduced during the past century. Rootstocks for pears are commonly derived from suckers on established pear trees. In regions where *P. pashia* grows naturally, this species is favored because it suckers profusely. In other regions, suckers from any pear cultivar are used. In general, pear trees looked very healthy in all regions, and the only problem reported was alternate bearing in some cases.

3. *Malus domestica* Borkh

No. of collections: seeds (5), scions (24), herbarium specimens (2)

Taxonomy: The correct terminology for the domestic apple has long been debatable. Synonyms include *Malus pumila* Mill. and *Pyrus malus* L. There is one group of apples here which have green fruit varying

from very small to medium size, poor quality, not sweet, and does not store well. These are widely planted, even on the plains of Pakistan, are said to be mostly seed-propagated and are used for rootstocks as well as for fruit. Generally, fruits mature earlier than in typical western cultivars. They seem to be a different type of apple from domestic apples known in the West, but I am not sure if they are sufficiently different to warrant a different species designation. All the agricultural officers in Pakistan call them crab apples, but they are definitely not *Malus baccata*. We did not find evidence of any truly wild apple species. There is a second group of cultivars, typical of *Malus domestica*, which are grown in all temperate regions (i.e., above about 1200m).

Nomenclature: The only names we heard applied to the local, inferior quality green apples is 'Chotta' (a name which refers to the heavy suckering trait) and 'Shird' (heard only in Kagan where this name was applied to a particularly small-fruited tree.) The term 'Amri', or 'Ambari' is applied to several different clones. Although I could not get a clear definition of this term, I think that it is restricted to types with red fruit which are firmer and store longer than most local apples. For example, on one farm in Keris, Baltistan, we were shown 3 distinct, firm fruit types, all of which were called 'Amri'. Although it appears that 'Amri' is used as a general term, 'Quetta Amri', 'Kashmir Amri', and 'Kachura Amri' are recognized as distinct clones. The lack of written information about the local apple cultivars and the 'general' responses we received from questions directed to local farmers and agriculture officers sometimes made it difficult to discover the names of many cultivars. For example, in one case, we were told that there were only two varieties of local apples, red and green, and then later we observed different types of 'red' apples, which did have specific local names. More in-depth discussions with local village men in different regions is necessary to clarify apple cultivar nomenclature in No. Pakistan. In Urdu, apple is called 'seb'; in Balti, 'kushu'; in Brushuski, 'balt'; and in Wakhi, 'mur'.

Distribution: Commercial production of apples (mostly 'Red' and 'Golden Delicious' but also 'Quetta Amri') is concentrated in Baluchistan and the Swat Valley, both areas with fairly good transport systems to urban markets. Currently, and for the past several years, these 2 introduced cultivars are also the dominant clones propagated and distributed by Horticulture Development Projects in the more remote regions of No. Pakistan. At this time, there still remain many trees of old, local cultivars scattered in the various northern regions, but as these trees die out, or are removed, they will most surely be replaced by newer,

introduced cultivars (mainly, 'Red Delicious'). I offer the following possible origins of the 3 types of local apples. Admittedly, my impressions were based on too limited interviews with local people and no written references. Therefore, I present them only as a tentative explanation for the origin and distribution of the different types of apples found in No. Pakistan. It appears that the local, inferior quality, green-fruited types, which are seed-propagated and widely distributed in No. Pakistan, have been here for a very long period of time. The second type, a group of cultivars which are clonally propagated and have fruit which is red, bland (low acids), medium to large size, and soft texture with poor storage quality, also have most likely been here for a long time. Probably, both these groups were introduced from Central or East Asia many, many years ago. A third type of apples consist of a small number of very firm, good storing apples, e.g. 'Quetta Amri', 'Kachura Amri', and 'Kashmir Amri'. Since these appear to trace back to either Kashmir or Quetta, both areas where the British were very active in fruit introductions in the 19th century, it is possible that these are old European cultivars. To further support this supposition, these firm-fruited types are found principally in either Quetta or Baltistan, an area with the closest links to Kashmir. Apples are grown, to some extent, in all areas where there are sufficient chilling hours (at elevations about 1100-2500m), including the outer Himalayan regions of Swat, Murree Hills, Hazara, and Azad Kashmir where there are summer rains, and the arid, inner mountain valleys of Chitral, Gilgit, and Baltistan which have minimal rainfall during the growing season. In the latter regions, which are relatively inaccessible to urban markets because of inadequate road system, fruit quality and appearance is much superior, disease problems are minimal, and regular fruit production is more reliable (due to the lack of spring frosts and rain, or hail during the growing season) than fruit grown in the more accessible regions.

Characteristics: As compared to the larger red-fruited apples, the local small-fruited, green, sour, seed-propagated apples typically bloom earlier, the fruits mature earlier, and the leaves and fruit are smaller. Although we were told by a local man that trees of this type bloom earlier, we observed very heavy crops on 2 trees located adjacent to trees of recently introduced cultivars which had a total crop failure, reportedly due to spring frosts. Thus, flowers, or very young fruits, of these local types must have superior tolerance to freezing temperatures at, or shortly after, bloom time. Although the fruit quality of these apples is very poor, this possible frost tolerance might be a genetic trait of value

for apple breeding. Another trait that could be valuable is the low chilling requirement of trees growing on the plains. If these apples come true-to-type from seed, as we were told, this could be a source of apomixis for use in breeding rootstocks. We did not see, or collect, seeds or scions from trees on the plains but we were told about them more than once. As they are used for rootstocks in Pakistan and are said to come fairly true-to-type from seed, systematic evaluation for desired rootstock traits may reveal something of value for this purpose. However, the tendency for heavy suckering must be considered.

The old, local, larger, soft, red-fruited types lack the firm texture and higher acids favored by the Western consumer but, with appropriate evaluation, something useful in regard to disease or pest resistance or other adaptive traits may be discovered. The cultivar 'Nurshahbalt' in Hunza, a soft, bland apple of this type, is said to store until March-April in spite of its soft texture at harvest.

The 'Amri' types have a better sugar/acid balance, firmer flesh and better storage ability than the softer, red types. They may offer some desirable fruit quality and storage traits for use in breeding. However, because these may have been introduced by the British in the 19th century, it would be advisable for someone familiar with European apple cultivars to try to identify them. In Ishkoman Valley, two other local cultivars were reported to be good storage apples, namely, 'Dunbalt' and 'Francissi'. As 'Dunbalt' means 'stone apple', presumably it has a hard texture. However, we did not return to this area at the appropriate time to collect scionwood.

4. *Cydonia oblonga* L.

No. of collections: scions (1)

Taxonomy: This is a distinct species with no synonyms.

Nomenclature: The only name we heard applied was the general word for quince. Although some of the trees were budded selections, we were never given a cultivar name. In Shinah, quince is called 'chator'; in Balti, 'charoll'; and in Urdu, 'behi'.

Distribution: It appeared that only a few cultivars of this species have been introduced to No. Pakistan. Quince is not abundant nor is there a great deal of diversity. We saw relatively few trees: in a few cases we saw what were probably seedling trees which had been planted, and in other cases, trees had been clonally propagated. There were said to be many more, and better quality, quinces in Baluchistan and Afghanistan.

Characteristics: According to our local informants, only the

astrigent type of fruit occurs in No. Pakistan. No sweet types, as occur in Iran and probably Afghanistan, were reported. Two uses were mentioned; people cook them and use for medicinal purposes (for coughs, in particular) and they also boil fruits and preserve them in sugar. At the ex-Raja of Shigar's palace we saw old quince trees grafted onto *Crataegus songarica* rootstocks. If there was any use of quince rootstocks for pears (except on recently introduced quince clones at government nurseries /experiment stations) we were not aware of this practice.

5. *Sorbus lanata* (D.Don) S. Schauer

No. of collections: seeds (2), scions (3)

Taxonomy: This is a distinct species. The only synonym found was *Pyrus lanata* D. Don

Nomenclature: The local Kohistani term in Kalam area is 'tameez' for seedling trees, and 'anj' for the clonal selection. We also heard it called 'wild apple' in other areas.

Distribution: This species occurs naturally from N.E. Afghanistan to Nepal in the moist, temperate and sub-alpine forests in the outer Himalayan and Hindu Kush slopes and valleys, at elevations from 2000-3600m. It is also found in the Kurram Valley on the slopes of the Safed Koh range. In mixed coniferous forests in Pakistan it is associated with *Abies pindrow*, *Picea smithiana*, *Cedrus deodara*, *Pinus wallichii*, *Pinus gerardiana*, *Juglans regia*, *Corylus jacquemontii*, *Quercus dillitata*, *Acer* sp., and other broad-leaved species. Although older botanical literature reports that this is a common species, we found relatively few trees. Local botanists in Islamabad knew of only one tree in the Murree Hills. David Brenner found a small group of trees while on an overnight hike up a lateral valley on the north side of Brumboret Valley in Chitral. We saw a few trees in the forests in Kalam area-up the Ushu River Valley on the trail to Lake Mahodan and along the Utrot road to Gabral. In Kalam and nearby tributary valleys this species, both seedling trees and a clonally-propagated selection, is planted for its edible fruit.

Characteristics: Trees are medium to medium-large size; leaves are simple, serrate, ovate to obovate, 8-16mm in length, 4-8mm in width. There is dense, white wooly tomentum on the undersides of leaves and on young shoots. Fruit is roundish, 2-4cm diameter, orange-colored with a heavy red blush. The fruit flesh is edible and sweet when it becomes very soft and mushy. At about 2300m elevation, the fruit is harvested in mid-September and can be kept for about 1 month. As compared to seedlings, the clonal selection, 'Anj', has larger fruit with

more seeds, larger leaves and buds, and more vigorous vegetative growth. In the Kalam area, this species is used as an interstem between *Crataegus songarica* rootstocks and apple cultivars. The clone 'Anj' is preferred over seedlings for this purpose because its vigor is more similar to that of *Crataegus* and overgrowth is avoided. We did not hear of this practice in any other areas.

6. *Sorbus tianshanica* Rupr.

No. of collections: herbarium specimens (1)

Taxonomy: This species has also been included in *Sorbus aucuparia* Hk.f (non Gaert.), or *Pyrus aucuparia* L. but apparently it is distinct enough to be a separate species

Distribution: This is a Central Asian species, reported to occur in Turkestan, the Altai, Tian Shan, Pamir, and Karakoram Mts. In Pakistan, this species is found at elevations of 2460-4000m. Stewart (1972) mentions collections in Gilgit Dt. at Nomai-Naltar Pass and in Hunza Valley; and in Baltistan Dt. at Hushe Valley and Shigar Valley. We found a group of several trees on the slopes above Naltar, at about 3385m, associated with *Betula utilis* and *Juniperus excelsa*.

Characteristics: Plants are shrubs or small trees (to 5m tall). Leaves are pinnately compound with 9-15 leaflets, lanceolate, acuminate. On Sept. 23, leaves were turning yellowish to red. We found no fruit on the only trees that we observed.

7. *Crataegus songarica* C. Koch

No. of collections: seeds (6), herbarium specimens(6)

Taxonomy: According to Stewart (1972) this is the name for the common species in No. Pakistan. Kitamura (1964) mentions as synonyms the following names: *C. oxyacantha* auct. non L., *C. oxyacanthoides* Thuill., *C. fisheri* Schn. and *C. monogyna* auct.

Nomenclature: The local name in Kohistani is 'chochina'. In Kagan, it was called 'sinjuli'; in Chitrali, 'gooni'; and in Pushtoo, 'sinjay'.

Distribution: This is a Central Asian species that ranges from Iran through Afghanistan and Pakistan to Uttar Pradesh in India. It also occurs in adjacent regions of the U.S.S.R. Kitamura (1964) states that it occurs in Iran, Afghanistan, Pamir-Alai Mts., Tianshan, Kashgar, Kuldza, and W. Pakistan. It is not reported as far east as Nepal. It is commonly found in cultivated areas at elevations from 925-2800m. In Pakistan, it is reported to occur in the juniper tracts in upper Baluchistan, in the Kurram Valley, in Chitral, Swat, Astor, Gilgit, Hazara, Murree Hills,

Poonch and Azad Kashmir. We observed it several times in Chitral, in Swat, and in the Kagan Valley, Hazara Dt. Trees are not being eradicated because the fruit is harvested and eaten by local people.

Characteristics: Trees are small (to 9m in height), leaves are pinnately lobed, fruit is globose to short-oval, 1.5 to 2.5cm diameter, and either red or black at maturity. We made our first seed collection on Aug. 12 (at 2230m elevation). Fruit was not mature yet but seeds appeared dark and possibly mature enough. On Sept. 9 (at 1846m elevation) fruit, as well as seeds, appeared to be ripe. Since the mature fruit hangs on the tree for several months one can collect seeds over a fairly long period, beginning in early September. I think that the trees we saw were seedlings. If there are clonal selections being propagated, we were not told of this practice. One local informant told us that trees were propagated by seeds or by suckers. As well as being grown for its fruit this species is also used as a rootstock for quince and, in upper Swat, for apple. We were told that the reason for using this species as a rootstock was that it is resistant to root rot (presumably *Phytophthora* sp). This trait should be verified and, if true, this species may be useful for rootstock breeding. Because the local apples are not graft-compatible with *Crataegus*, an interstem of *Sorbus lanata* is necessary.

8. *Cotoneaster affinis* var. *bacillaris* (Lindl.) Schneider

No. of collections: seeds (5), herbarium specimens (5)

Taxonomy: According to Stewart (1972) this is one member of a species complex which is exceptionally variable. The five specimens that we collected appeared similar, and this is the species name used by Pakistani botanists. Both Stewart (1972) and Hara and Williams (1979) cite this as a synonym of *C. bacillaris* Wall ex Lindl.

Nomenclature: In Kalashi language this species was called 'kabeshoo'; in Chitrali it was 'bedour'. Stewart (1972) states that this species is called 'luni' or 'rauns', presumably in Urdu.

Distribution: This species is found from Afghanistan to Bhutan at elevations of 1100-3000m. In Chitral we found it associated with *Pinus gerardiana*, *Cedrus deodara*, and *Viburnum cotinifolium*. In the Murree Hills it was growing in dense vegetation with *Cornus macrophylla*, *Aesculus indica*, *Ulmus*, *Populus*, and much herbaceous growth. In Swat, we found it with *Pinus wallichii*, *Pyrus pashia*, *Quercus* sp. and *Vitis Jacquemontii*.

Characteristics: Deciduous upright, large shrub, (the largest *Cotoneaster* in Pakistan.) We saw shrubs to 4m tall. Leaves

rather large for this genus (3-5cm long), elliptic. Flowers white, in dense corymbs. Fruit clusters have 2-7 attractive red berries, (5-6mm diam.). Fruit was mature enough to collect seeds by late August to mid-September, but since the fruit hangs on the plant, I would expect that seeds could be collected over a few months period, at least. These shrubs appear to be promising for ornamental use because of attractive foliage, relatively conspicuous white flower clusters, and red berries in fall and winter. We heard of no attempts to graft any other pome fruit on these plants.

9. *Cotoneaster integerrima* Medik.

No. of collections: seeds (1), herbarium specimens (1)

Taxonomy: This is the name given to this taxon by both Stewart (1972) and Rehder (1940). Stewart gives as a synonym *C. vulgaris* sensu Hk.f. This may be the same taxon that Polunin and Stainton (1984) refer to as *C. falconeri* Klotz. as these authors state that synonyms for it are *C. integerrima* Medicus sensu Parker, and *C. vulgaris* Lindley.

Nomenclature: We did not hear of a local name for this species.

Distribution: Apparently, this is a wide-ranging species. Rehder (1940) states that it occurs in Europe and No. Asia to the Altai. Stewart (1972) claims that it is common in Pakistan in Swat, Gilgit, Baltistan, Astor, Hazara, and Kashmir at elevations of 2600-4000m. We found it at 2200m in Chitral Gol National Park growing in association with *Cedrus deodara*.

Characteristics: Plants are upright shrubs to 2m tall. Leaves are ovate or oval, 2-5cm long, bluish green above and grayish below. Fruit, red to black, subglobose, 5-6mm diam., in few-fruited clusters. Possible ornamental use.

10. *Cotoneaster lindleyi* Steud.

No. of collections: seeds (1), herbarium specimens (2)

Taxonomy: There seems to be lack of agreement about the appropriate name for this taxon. Stewart (1972) uses this species name but also mentions 4 synonyms; *C. nummularia* Hk.f., non F. and M., *C. nummularia* Fisch. and Mey. var. *lindleyi*, *C. bacillaris* Aitch. non Willd., and *C. insignis* Pojark. Rehder (1940) considers this to be closely related to *C. racemiflora* (Desf.) K. Koch and gives as synonyms *C. nummularia* Lindl. non Fisch. and Mey. and *C. arborescens* Zabel. Polunin and Stainton (1984) report the occurrence of *C. nummularia* Fischer and Meyer in India

and claim that it is synonymous with *C. insignis* Pojark (and thus, perhaps synonymous with *C. lindleyi* Steud.) It appears that more detailed studies are necessary to clarify this conflicting taxonomic situation.

Nomenclature: No local names were obtained.

Distribution: Rehder states that it is found in the Himalaya. In Pakistan, Stewart (1972) reports this species from Hazara, the Jhelum Valley in Azad Kashmir, in Swat and Astor. Apparently this species does not reach as far east as Nepal as it, or any of its synonyms, does not appear in Hara and William's (1979) list of the plants of Nepal. If this name is synonymous with *C. falconeri*, the term used by Polunin and Stainton (1984), this species ranges as far east as Himachal Pradesh in India. In Pakistan, we found it along the Mastuj Riverbank about 20 km north of Chitral associated with *Cassia*, *Tamarisk*, *Platanus*, and *Salix*.

Characteristics: The shrubs we saw were about 1m tall, with small, broad-oval to broad-ovate leaves. Fruit was large (about 10-11mm diam.), globose, dark blue-black, edible and quite tasty. At 1690m elevation, fruit was ripe on August 31. This species may have value as an edible ornamental because of its large, dark-colored berries in autumn.

11. *Cotoneaster nummularia* Fisch. and Mey.

No. of collections: seeds (5), herbarium specimens (4)

Taxonomy: Stewart (1972) gives 3 synonyms for this species; *C. racemiflora* var. *royleana* Dipp., *C. racemiflora* var. *kotschyi* C.K. Schneider, and *C. minuta* Klotz. Rehder (1940) considers it to be one of the varieties of *C. racemiflora* (Desf.) K. Koch rather than a distinct species.

Nomenclature: This species was called 'undundur' in Kohistani, and 'bedour' in Chitrali (the same common name used for *C. affinis bacillaris*).

Distribution: Polunin and Stainton (1984) mention this as a common species which ranges from Pakistan to Uttar Pradesh in India. Stewart(1972) states that "This is the commonest species at low altitudes (600-3000m) and often in very dry situations." In Pakistan, it has been reported from Baluchistan, Waziristan, Kurram Valley, Chitral, Swat, Gilgit, Astor, Skardu, Hazara, Murree, and Kashmir. We collected it at 2 sites beyond Kalam; at 2530m elevation on a dry, rocky scree slope in association with *Cedrus deodara*, *Ribes orientale*, *Juniperus excelsa* and *Acer* sp. and at about 3000m on another rocky, scree slope. We also collected it at 3 relatively dry, well-drained locations in Chitral; in Shishi Valley (at 2163m), and in Brumboret Valley (at 2280m), where it

was associated with *Quercus baloot*, *Fraxinus xanthoxyloides*, *Prunus prostrata*, and a few *Cedrus deodara* and *Pinus gerardiana*.

Characteristics: The shrubs we saw were 1 to 1 and 1/2m tall and somewhat spreading. Leaves are very small (1 cm. diam.), orbicular-ovate, glabrous above and whitish-tomentose underneath. Fruit is also very small (6-8mm diam.) and black at maturity. This species would be suitable for a low, spreading ornamental shrub in dry sites.

The taxonomy of all the varied *Cotoneasters* in the EurAsian continent seems to be confusing, and in need in serious field studies to clarify the species situation. If this has been done already, I have not discovered the publication.

Stone Fruits

We observed 12 species of stone fruits (not including almonds, which are discussed under the section on nuts) These included 4 wild, naturally occurring cherry species, 3 in subgenus *Cerasus* (*Prunus cerasioides*, *P. jacquemontii*, and *P. prostrata*) and one in subgenus *Padus* (*P. cornuta*). The other 8 species, which were probably introduced at varying time periods by humans, include 4 in the subgenus *Cerasus* (*P. avium*, *P. cerasus*, *P. mahaleb*, and *P. tomentosa*); 3 in the subgenus *Prunophora* (*P. armeniaca*, *P. cerasifera* and *P. salicina*); and one in the subgenus *Amygdalus* (*P. persica*).

1. *Prunus cerasioides* D. Don

No. of collections: scions (1)

Taxonomy: This species was previously called *P. puddum* Roxb. It is in the subgenus *Cerasus*, section *Pseudocerasus*.

Nomenclature: In English this species is called wild cherry or carmine cherry.

Distribution: This species occurs naturally in the outer Himalaya from Pakistan to W. China at elevations as low as 800m in the western edge of its distribution, to a reported 2400m in more southeasterly regions as, for example, in Burma. In Pakistan, botanists at the National Herbarium had records of only 2 locations for this species in the country. One collection was from Murree, and the other from the Margalla Hills at about 800m. We visited this latter site and collected scions from one of the 2 trees that exist there. Although this is a common species farther east in the Indian Himalaya, it is extremely rare in Pakistan which is the western limit of its distribution.

Characteristics: Trees are medium to large in size, leaves

are large (10-20cm), ovate, long-acuminate, sharply serrate and glossy. On the trees that we observed on Nov. 21, at about 800m elevation, old leaves had fallen, new leaves had begun to grow, and flowers were beginning to bloom. Flowers are commonly pink, in few-flowered clusters, and bloom in early winter (Nov.-Dec.). Fruit is small (1-1.5cm long), ovoid, red or yellow, acid flavor, and matures in spring (April-May). Based on the climate where this species grows, as well as its phenology, I would expect that trees would lack cold-hardiness, have low chilling requirements, and possibly, have resistance to some stone fruit diseases that thrive in humid summer regions. In mild climates this tree would provide attractive pink flowers in Nov.-Dec. or might be useful as a rootstock. However, it should be mentioned that S.S. Randhawa in India has found a delayed graft-incompatibility between this species and some *P. avium* cultivars (personal communication).

2. *Prunus jacquemontii* Hk.f.

No. of collections: seeds (2), herbarium specimens (3)

Taxonomy: This is a distinct species in the subgenus *Cerasus*, section *Microcerasus*.

Nomenclature: The local name in Kohistani is "jikhin"; and in Shinah, 'makheen'.

Distribution: This species occurs naturally in semi-arid, temperate regions in Afghanistan and the Pamir-Alai mts., and in the inner, dry Himalayan valleys in Pakistan and N.W. India. In Pakistan, it is found in Baluchistan and the Kurram Valley, as well as in the inner Himalayan semi-arid regions of Chitral, Swat, Gilgit, Astor, and Kagan Valley at elevations of 1250 to 3700m. We saw it in Naltar Valley, Gilgit Dt., at 2400m to 2600m where it was a common shrub associated with *Fraxinus xanthoxyloides*, *Daphne oleoides*, *Hippophae rhamnoides*, *Juniperus excelsa*, *Artemesia*, *Ribes orientale* and *R. alpestre*. It was also common in the Ushu River Valley N.E. of Kalam, Swat Dt. where it grew with *Cotoneaster nummularia*, *Ribes orientale*, *Viburnum cotinifolium*, *Corylus jacquemontii*, *Sorbus lanata*, *Cedrus deodara*, *Pinus wallichii*, *Prunus cornuta*, and *Abies pindrow*. This species was growing on rocky scree slopes in full sun, in open areas near the forest trees. In spite of the shrubs being heavily grazed, plants seem to be fairly common.

Characteristics: Plants are spreading, deciduous shrubs, reported to reach 4m in height, but the ones we saw were 1-2m tall. Leaves are small (2-3cm long), elliptic to obovate-oblong, sharply serrated, and glabrous above and beneath. Due to heavy grazing, shoot

growth is often very stunted and leaves very small. Fruit is bright red, sub-globose, 1 to 1.5mm diameter, juicy and, although tart, is edible. Fruits are borne laterally on the previous seasons growth, either singly or in pairs, on very short pedicels. We were told that the shrubs tend to bear heavily in alternate years and that this was an "off" year, but we did find a few shrubs with good crops. On Aug. 18, (at 2700m) fruit maturity varied on different shrubs from unripe fruits still partly green-colored to old, drying fruits. This shrub would make an attractive ornamental shrub with pink flowers in spring and bright red fruit in summer. Possible value as a dwarfing rootstock for cherries should be considered.

3. *Prunus prostrata* Labill.

No. of collections: herbarium specimens (1)

Taxonomy: According to Browicz and Zielinski (1984), this species is one of a group of closely related species with small leaves and fruits whose ranges do not overlap. It is in the subgenus *Cerasus*, section *Microcerasus*.

Distribution: This species is said to have the widest distribution of any of the related species, ranging from Spain and Algeria through western Asia, Afghanistan, Pakistan, and N.W. India. It is found in mountainous areas at elevations from 1200 to 3700m. It commonly grows scattered on rocky, open, sunny slopes or in shrub communities. In Pakistan it is reported in the dry oak zone, beyond the reach of the monsoon, but where there is some winter precipitation. Although it is reported to be in Chitral, Gilgit, and Swat, we found it in only one region, in Brumboret Valley in Chitral, at 2276m, in association with *Fraxinus xanthoxyloides*, *Quercus baloot*, and *Cotoneaster nummularia*. Although this shrub is also very heavily grazed, I believe it is more common than we observed. Had we walked away from cultivated areas more frequently in the zone where this species occurs, we would probably have seen more plants.

Characteristics: Spreading shrubs 1-2m tall, with very small (1-2cm long), ovate to elliptic leaves with sharp serrations, glabrous above but with white wooly tomentum below. Flowers are red and occur singly or in pairs, laterally on previous season's growth. Fruits are purple-red, very small (6-8mm diam.) with a relatively large stone, and are inedible. On Sept. 7, when we first found the shrubs, fruit was long gone, so we were unable to collect seeds. Browicz and Zielinski (1982) claim that this species is a valuable ornamental, particularly useful for rock gardens, but that it is rarely planted.

4. *Prunus cornuta* (Wall. ex Royle) Steud.

No. of collections: seeds (3), herbarium specimens (3)

Taxonomy: Although early botanists considered this species to be *P. padus* L. (or *P. padus* sensu F.B.I. non L), the European bird cherry, there seems to be general agreement now that this is a distinct species. It is in the subgenus *Padus*.

Nomenclature: The common name in English is 'Himalayan bird cherry'. In Kohistani it is called 'burris', and in an unspecified language in Kagan it was called 'parrt'.

Distribution: It occurs from N.E. Afghanistan all through the Himalayan region to S.W. China, at elevations of 2100 to 3700m. Trees are found in both moist, temperate mixed coniferous and broadleaved forests and, also, in moist sites within dry temperate forests. In Pakistan, this species is commonly associated with *Pinus wallichii*, *Pinus gerardiana*, *Cedrus deodara*, *Abies pindrow*, *Acer*, *Juglans regia*, *Alnus*, *Corylus*, *Aesculus*, *Ulmus*, and *Quercus dilatata*. We observed trees in several regions; in Kalam and adjacent valleys, in Nathiagali, and in the Kagan Valley. It appears to be a common tree but, in most cases, the trees that we saw were heavily lopped for fodder and therefore not reproducing.

Characteristics: Tree medium to large (to 20m). Leaves oblong-ovate to elliptic, 8-20cm long, acuminate, serrulate, and glabrous. Long drooping racemes of many small, white flowers (10 to 25cm in length) are borne both laterally and terminally on previous season's growth. Fruits are soft, globose, 9-12mm diameter, dark red to black at maturity, and are bitter. Although in most areas the trees were lopped, this was not true in the Kagan Valley because there people eat the fruit. Most trees that we saw had relatively light crops, or bore no fruit at all. On one particularly productive tree, there was an average of 9 fruits per cluster (range 2-19). On Aug. 18-19, fruit was ripe and much had fallen already. Fruits are frequently attacked at an early stage by a gall insect, which induces them to grow into long, thin horn-shaped structures. This species might be worthy of rootstock trials for sweet cherry cultivars. In India, S.S. Randhawa has reported good compatibility between rootstocks of this species and *P. avium* cultivars.

5. *Prunus avium* L.

No. of collections: None.

Taxonomy: This is a definite species, in the subgenus *Cerasus*, section *Eucerasus*.

Nomenclature: In English, it is 'sweet cherry'. In Gilgit Dt. it was called 'cheri', with an accent on the last syllable. There are no other common names for this species in local languages.

Distribution: This species is thought to have originated in the region between the Black and Caspian Seas and to have been distributed by humans and animals to Europe long ago, where superior-fruited clones have been selected and cultivated for centuries. It appears that this species has not been introduced into No. Pakistan from the west by way of Iran, Afghanistan, or Central Asia. The only sweet cherries that I saw were 3 European cultivars that were introduced into Kashmir by the British in the 19th century, and subsequently were brought into No. Pakistan. Although there is currently much interest in growing cherries, it appears that they have not been here for very long. I estimated that the oldest trees we saw were about 15 years.

Characteristics: Except for the Horticulture Research Station in Mingora, Swat Dt., where several European and American cultivars have been introduced recently, the only cultivars in the North have been the old European white-fleshed cultivar, 'Napoleon' (locally called 'Gilas') and 2 soft, black British cultivars, one of which I was told was 'Early Winters' and the other was unknown to me, and to local men. None of these 3 cultivars have good enough fruit quality to hold up well in marketing and shipping for fresh use.

6. *Prunus cerasus* L.

No. of collections: seeds (1), herbarium specimens (1)

Taxonomy: This is a distinct species, in the subgenus *Cerasus*, section *Eucerasus*.

Nomenclature: In English, it is called either pie cherry, tart, or sour cherry. In Kagan, Hazara Dt., this species was called 'alucha', the same local name applied to *Prunus cerasifera*. Agriculture officers in Gilgit called it "wild cherry", although it is not a natural species here.

Distribution: This species is considered to have originated in S.E. Europe and W. Asia. and then distributed more widely by humans and animals to Europe where it has been cultivated for many centuries. As with the sweet cherry, it appears that this species did not arrive from its center of origin by way of Iran and Afghanistan, or Central Asia. I believe that this species was introduced to Kashmir by the British in the 19th century, as was the sweet cherry. We saw seedlings of it in Gilgit and Hazara Dts., where it was referred to as 'wild' 'cheri'. It should be noted that the term 'wild' is commonly used for seedling trees of any species

which bear inferior quality fruit, regardless of whether they are introduced species or natural, wild populations. The lack of a specific name in local languages for this species, as well as for *P. avium*, strongly suggests that both these cherry species were introduced in recent history. Since suckers of *P. cerasus* seedlings are commonly used as rootstocks for sweet cherry in No. Pakistan, it is quite possible that it was this usage which resulted in their introduction, along with sweet cherry, from Kashmir (originally from England). Presumably, the sour cherry was brought to these regions as seed primarily for rootstocks rather than for desirable edible fruit.

Characteristics: Since all the fruit that we saw came from seedling trees it was much smaller, and the seeds were relatively larger in relation to the amount of flesh, than commercial cultivars in the U.S. Although local people do eat these small, black, tart fruits we found no evidence of superior selections or of clonal propagation for fruits.

7. *Prunus mahaleb* L.

No. of collections: seeds (1), herbarium specimens (1)

Taxonomy: This is a distinct species, in the subgenus *Cerasus*, section *Mahaleb*.

Nomenclature: The common name is 'mahaleb' cherry or 'St. Lucie' cherry in English.

Distribution: This species originated in Europe and W. Asia, and is now widely distributed in Europe. In "The Flora of the USSR", *P. mahaleb* is reported to occur in Central Asia through the Pamir-Alai Mts. to the western part of the Tian Shan Mts. In Pakistan, it has been introduced in Chitral and in Baluchistan, both areas contiguous to Afghanistan or Central Asia. We found trees in only one location-near an abandoned farm house in Chitral Gol National Park where, presumably, they had been planted. Because *P. mahaleb* does not seem to be in the eastern parts of the Northern Areas in Pakistan which, historically, (until the 1948 partition) had direct links with Kashmir, it is probable that this species has been introduced from the north or northwest, i.e., from Afghanistan or Central Asia.

Characteristics: Trees are medium size (to 10m). Leaves are orbicular to broad-ovate, 3-6cm long, obtusely short-acuminate, rounded or sub-cordate at the base, and serrulate. Flowers white, in 6 to 10-flowered loose clusters 3-4cm long. Fruit very small, 5-7mm diam., black at maturity. We collected seeds on Sept. 2 at about 2200m. The few fruits remaining on the trees were dried, having matured much earlier.

This species has long been used as a rootstock for sweet cherries in Europe and America, especially in dry soils, due to its tolerance of drought, induction of early, heavy bearing of the scion-cultivar, resistance to bacterial canker, tree size control, and tolerance to higher soil pH than other cherry rootstocks.

8. *Prunus tomentosa* Thunb.

Taxonomy: This is a distinct species, in the subgenus *Cerasus*, section *Microcerasus*.

Nomenclature: In English, this is called 'Manchu', 'downy', or 'Korean' cherry; in Shinah, it is called 'shogun'; and in Balti, 'shugun'. (These latter 2 terms may be Urdu)

Distribution: The distribution of this species is Japan, Korea, N. and W. China, through Tibet to Ladakh and other inner valleys in Kashmir, India at elevations from 1400 to 2800m. In the N.W. regions of Pakistan, (Baltistan and Gilgit Dts.) it is a common cultivated plant, grown for both its ornamental value and for its edible fruits. We saw it planted in gardens in Shigar (at 2350m), in Gilgit (1475m), and in the Puniyal Valley (2060m). It is also used as an ornamental plant in Europe and America for both its attractive flowers and fruits.

Characteristics: Plants are shrubs or small trees to 4m tall. Young branchlets are densely tomentose. Leaves are elliptic to obovate, 5-7cm long, abruptly acuminate, and unequally serrate, rugose, dull green above and pubescent. Flowers white or pinkish, borne singly, or in pairs on very short pedicels. Fruit is sub-globose, 1.5-2cm diam., usually scarlet but, in Gilgit we were told that there are both yellow and red-fruited types. Fruits ripen very early, before apricots, and with white mulberry. I would expect that fruits would be mature for seed collection in May or early June. Since we saw our first plants on July 1, we were able to find only a very few seeds in the few remaining, old dried fruits on the ground under one bush.

9. *Prunus armeniaca* L.

No. of collections: seeds (73), scions (102)

Taxonomy: This is a distinct species in the subgenus *Prunophora*, section *Euprunus*.

Nomenclature: In Urdu the superior, sweet-seeded apricot clones are called 'khubani' and old, local seedlings with smaller fruit and bitter seeds are called 'hari'. In Brushuski, apricots are called 'ju'; in Balti, 'chuli'; in Shinah, 'jaroaty'; in Wakhi, 'mamura'; and in Chitrali, 'juli'.

Distribution: The primary center of diversity, and the original home of apricots, is in the arid mountains of north-central and N.W. China. Through the centuries seeds were brought along the trade routes to Central Asia, where there developed a second center of diversity. Subsequently, they were brought to the Near East (Iran, Armenia and Turkey) where there is a third center of diversity, from which European forms were derived. As humans moved from Central Asia south into the high valleys in the Karakoram, Himalaya, and Hindu Kush mountains they brought apricots with them to these regions, now part of Pakistan. In No. Pakistan, apricots are very well adapted and very abundant in all of the arid inner mountain valleys at elevations from about 1200m to 2900m. A few cultivars are also grown at lower elevations (500-1200m) in Swat Valley and Hazara Dt., regions subject to the summer monsoon rains. Here fruit usually ripens before the rainy period begins.

Characteristics: In No. Pakistan, apricot trees are commonly grown from seed. As these trees come in to bearing, the fruit is evaluated and, if inferior, trees are budded to local cultivars. Local men told us that about 70-90% of the trees are budded. However, if a seedling tree bears good quality fruit, it is not budded and is often given a name. Including all the villages, the number of local names must reach into the hundreds. There is an enormous amount of diversity in the overall region because this selection process has been ongoing for many centuries and because it has been carried on in many different, relatively isolated, villages. Very few of the multitude of cultivars are propagated, or known, over a very wide geographic area.

In general, the fruit is relatively small (16-38gms/fruit), most have sweet seeds and the flesh has high soluble solids (we measured up to 34 degrees Brix), the color of fruit ranges from white, cream, light orange, to dark orange, with or without a red blush, and typically, there is scanty pubescence. Fruit flesh ranged from dry, almost mealy to very juicy. There is a range of at least 3 months in time of fruit maturity. Information on the time of bloom was difficult to obtain as we were not there at flowering time. Most people said that they all bloom about the same time, whereas others indicated that there was a span of about 2 weeks between the earliest to the latest blooming cultivar. Apparently, the very late-maturing cultivars such as 'Blochuli', 'Brochuli' and 'Stoonchuli' do bloom later than those whose fruit matures earlier. Certain cultivars are reputed to be superior for drying, e.g. 'Halmon' and 'Alishah Kakas', and others are favored for fresh consumption, e.g. 'Margulam'. Two cultivars had traits that might have great value in breeding for good shipping

cultivars. In 'Kacha', the flesh does not soften at maturity, although it colors and becomes sweet. 'Sharapa Margulam' was said to be late-ripening and that it could be stored in the soil until March without deterioration. Some cultivars are known to be low, and others high, in flatulence compounds. Central Asian apricots are reported to be mostly self-unfruitful, but I was unable to obtain any information about pollination requirements of cultivars in No. Pakistan. Because of the very arid climate which is unfavorable for stone fruit disease development, we obtained no information about disease resistance. Historically, in the mountain valleys, apricots have been one of the few staple foods available for local inhabitants. Apparently, they have been a very reliable food source as the trees bear heavy crops with no care, except for irrigation. The many uses for apricots include fresh and dried fruit, edible kernels, oil extraction from bitter seeds, preparation of 'balay', a mixture of boiled fruit and flour, jam-making, livestock feed, fodder, and firewood.

10. *Prunus cerasifera* Ehr.

No. of collections: seeds (7), herbarium specimens (1).

Taxonomy: This is a distinct species, in the subgenus *Prunophora*, section *Euprunus*. In No. Pakistan, there appeared to be 2 distinct types of plums—old local plums which were typical *P. cerasifera* types, and recently introduced *P. salicina* cultivars from the U.S. In addition, we observed some fruits which appeared to be intermediate, i.e., fruits were a little larger than those of typical *cerasifera*, and somewhat heart-shaped, more like fruit of some *salicina* forms. These may be seedling *salicina* types which were brought into Pakistan long ago from Central Asia, or these intermediate types may represent hybridization and introgression of these 2 species. Our observations were mostly on fruits in markets so we did not observe the trees. Detailed studies of trees, their flowering and bearing habits, as well as fruit types is necessary to clarify the plum species situation here.

Nomenclature: In English, it is called 'myrobalan plum', or 'cherry plum'. In Pakistan, it was usually called 'alucha' in all areas. This species is also referred to by the Russian author, Kostina (1969), as 'alycha'. Whereas, in some instances in Pakistan, the names 'alucha' and 'alubokhara' were used interchangeably for any type of plum, i.e., for *P. cerasifera* or for *P. salicina* cultivars, more commonly, 'alubokhara' was reserved for the larger-fruited *P. salicina* types and 'alucha' for the smaller-fruited *P. cerasifera*. In Shina, the name for fruits of this species is 'dildaru'.

Distribution: This species is thought to have originated in W. Asia, in the Caucasus Mts. but, currently, it has naturalized in parts of Europe and it is reported in 'The Flora of The USSR' to be growing wild from the Caucasus to Central Asia. Its widespread occurrence in No. Pakistan suggests that this species has been here for a very long period. Because of its relatively small fruit size and poor quality (as compared to European plum cultivars) I believe that it was not introduced by the British, but rather, that it was moved with humans from Central Asia at some early time period. The similar common name in both Pakistan and the U.S.S.R. supports this belief. In Pakistan, it is grown in all temperate regions from about 500m to at least 2300m.

Characteristics: Trees are medium size (to 8m tall). Leaves are elliptic or ovate to obovate, 3-6cm long, with fine serrations and acute apex, glabrous, except for some pubescence on the midrib beneath. Flowers usually borne singly in lateral positions on previous season's growth or on spurs. Fruit subglobose, about 2-2.5cm diam., clingstone, green, yellow, bright red to dark purple-red, with a slight bloom, and borne on pedicels 1-1.5cm. Fruit flesh is soft and the skin tough. It is my impression that most of the trees are seedlings. Although in some cases we were told that trees were grafted, we were never given a specific cultivar name, so clonal propagation of selections may not be a widespread practice. Fruit was commonly in the markets during the month of May (from lower elevations) until mid-July (at higher elevations).

11. *Prunus salicina* Lindl.

No. of collections: herbarium specimens (1)

Taxonomy: This is a distinct species, in the subgenus *Prunophora*, section *Euprunus*. One synonym is *P. triflora* Roxb. and, according to Kitamura (1960), *P. bokhariensis* Schneider is another synonym. In 'The Flora of The USSR, the term *P. salicina* Lindl. is used and *P. bokhariensis* C.K. Schn. is said to "presumably represent forms of the basic species *P. salicina*". In Pakistan, I found some confusion among the agricultural scientists about the taxonomic designation of the cultivated plums. All types seem to be called *P. bokhariensis*, including recent introductions from the U.S. which are clearly *P. salicina*. Unfortunately, in "The Flora of Pakistan" Stewart(1972) does not mention *P. salicina* but lumps all cultivated plums into an out-dated, or erroneous concept of *P. bokhariensis*, i.e., that it is a synonym of *P. domestica* L. ssp. *insititia*. We did not see any plums that looked like *P. insititia*, at least not of the blue damson types.

Nomenclature: In English, this type of plum is called 'Oriental', or 'Japanese' plum. In Pakistan, they were called 'alubokhara'. The use of this term, which implies an origin in Bukhara, was puzzling to me at first because all of the typical, large-fruited types in this category were California cultivars introduced from the U.S. However, subsequently I discovered both Kitamura's (1960) reference which mentions the synonymy of *P. bokhariensis* and *P. salicina* and "The Flora of The USSR" which states that *P. bokhariensis* refers to certain forms of *P. salicina* (presumably those which occur in Central Asia in the region of Bukhara). Thus, it appears that the common name, 'alubokhara', which has been used historically for *salicina*-type plums introduced from Central Asia (although fruits are much smaller and inferior quality as compared to those recently introduced) has been transferred to the California cultivars. Although 'alubokhara' is the most commonly used term for *P. salicina* plums, sometimes we also heard them called 'alucha', the term usually applied to *P. cerasifera* fruits. In fact, some of our informants told us that either name could be used. This statement may simply reflect lack of precision in usage of nomenclature by our local informants, or it may be that in Central Asia, the 2 terms originally referred to the 2 distinct species and that the current ambiguity of the nomenclature in Pakistan might be explained by a blurring of previously distinct differences between the 2 fruit types through interspecific hybridization and introgression. More detailed studies of trees, flowers, and fruits is needed to clarify the species designations of local plums in Pakistan.

Distribution: *P. salicina* originated in China and is an ancient cultivated fruit crop in both China and Japan. As with *P. persica*, and *P. armeniaca*, this species was moved long ago along the old trade routes from China into Central Asia where recognizably different forms of the species differentiated, e.g. the type called *P. bokhariensis*. From this region, these plums moved into the inner mountain valleys of the high mountain ranges in No. Pakistan and, subsequently, to the foothills of the outer mountain regions. At present, there is a group of local plums with small to medium-sized fruits which, presumably, are derived either directly from early introductions of *salicina* (or *bokhariensis*) seeds from Central Asia, or from hybridization of these early introductions with *P. cerasifera*. As no cultivar names were given to us, I assumed that these fruits came from seedling trees.

There is another, very distinct, group of large-fruited, high quality *P. salicina* cultivars which are known to have been introduced from the U.S. in the past few decades and have become very popular. These are

grown at elevations from 500 to 2300m. They include 'Santa Rosa' (known locally as 'Fazi-e-Mani', after the man who introduced it), 'Formosa', and 'Wickson'.

Charactersitics: As compared to U.S. cultivars, fruits of the old, local plums in Pakistan (which may be derived, at least in part, from ancient introductions of *salicina* from Central Asia) are smaller and have inferior quality. Fruit color varies from green, yellow, red to dark purple, skin is tough, flesh soft, and clingstone.

12. *Prunus persica* (L.) Batsch.

No. of collections: seeds (19), scions (10)

Taxonomy: This is a distinct species in the subgenus *Amygdalus*, section *Euamygdalus*.

Nomenclature: This species is called 'peach' in English, in Urdu, 'aru'; in Pushtoo, 'gurdalu'; in Chitrali, 'gilgalo'; and in Balti, 'takashu'.

Distribution: This species originated in China. Seeds were undoubtedly brought along the old trade routes from China to Central Asia from whence they were moved south into the high mountain valleys in No. Pakistan. Local peaches are grown in villages throughout the mountainous regions and down the outer slopes to Peshawar and Swat Dts. They are grown as scattered trees, principally for each family's personal use or for local markets, as most of the fruit is too perishable to ship. Although peaches are reported to be wild in the outer Himalayan slopes in Himachal Pradesh, India (Parmar and Kaushal, 1981), we found no evidence of their being wild in Pakistan. Also, Stewart (1972) mentions the peach as a cultivated plant only in Pakistan, where trees are grown from the plains to about 2500m.

Characteristics: The fruit of local peaches is distinctly different from that of recently introduced cultivars from the West. Fruit size is small (from 20-60gms/fruit), and fruit maturity is late (Sept.-Oct) in all local peaches. The flesh is usually very soft and tender, so fruit is very prone to bruising. However, we did see a few clingstones with rather tough, non-melting flesh. They are mostly cream or white-fleshed, although one had orange flesh. Both cling and freestone types occur here. In general, they are very sweet, low in acids and very juicy. Because of this juiciness they are not suitable for drying, and all informants told us that there was no drying of peaches. One had an exceptionally high aroma. In Keris, Skardu Dt., a small group of seedlings had dark green, healthy leaves at a site where most peaches were very

chlorotic (probably lime-induced chlorosis) so they may have tolerance to this problem. Because most trees are never sprayed, in general, they look very poor from being attacked by various diseases and they are short-lived. Most trees are rather small and low in vigor. As local people do not know the peach diseases, nor am I familiar with them, I am not sure what were the problems. I did recognize powdery mildew which was quite severe, particularly in Hunza. A more concentrated study of peaches by one knowledgeable about peach diseases is necessary to identify the diseases in order to locate genetic resistance.

Many of the peach trees are grown from seeds and they are said to come true-to-type. This latter statement is probably true because peach trees, although seed-propagated, had cultivar names. The use of a specific name implies some degree of uniformity among the trees with that name. Local men told us that, although peaches come true-to-type from seed, it is not uncommon to bud trees for the purpose of bringing them into bearing sooner. We collected scions from some cultivars that were said to be budded, but I am not sure if the fact that they were budded meant that they must be vegetatively propagated to maintain their identity, or that they were budded for the purpose of bringing trees into bearing sooner.

Other Tree Fruit Species

Other tree fruit species collected were *Diospyros kaki*, *D. lotus*, *Ficus carica*, *F. palmata*, *Morus alba*, *M. nigra*, *M. serratta*, *Olea glandulifera*, *Punica granatum*, and *Zizyphus* sp.

1. *Diospyros kaki* L.

No. of collections: scions (1)

Taxonomy: This is a distinct species.

Nomenclature: In English, it is called 'persimmon', or 'kaki'.

Distribution: This species originated in China where it has long been a very popular cultivated fruit. In both China and Japan, many very fine cultivars have been selected over thousands of years of human selection. In the past few decades, a few of these have been introduced into the Swat Valley in Pakistan, where they are very successfully grown in commercial orchards.

Characteristics: There appears to be one dominant and a few minor cultivars in No. Pakistan. The most important, and the one we collected, was simply called 'Japani', which referred to its origin. It is probably a Japanese cultivar but I could not discover its Japanese name. The fruit is medium-large, slightly oblate shape, and turns a bright orange

red at maturity. It is astringent until fully ripe, i.e., when the texture becomes soft, sweet and slightly pasty.

2. *Diospyros lotus* L.

No. of collections: seeds (6), herbarium specimens (1)

Taxonomy: This is a distinct species, similar to the E. North American species, *D. virginiana*.

Nomenclature: This species is called 'date plum' in English and 'amluk' in Urdu.

Distribution: According to Browicz and Zielinski (1982) this species occupies 3 disjunct areas. The first is central and southern China; the second is the western Himalaya (E. Afghanistan to Kashmir) and some mountainous areas of Uzbekistan and Tadzhikistan in the USSR, and the third extends from western Iran along the shores of the Caspian Sea, in the Caucasus Mts. and into N.W. Turkey. It is most probable that this species originated in China and was distributed westward by humans traveling the ancient trade routes to W. Asia. In Pakistan, although it is widely cultivated near villages in the hills from about 775m to 2100m, it appears to have naturalized, especially in moist sites near streams. Stewart (1972) considered it to be wild in Poonch and Mirpur, regions subject to rather heavy monsoon rainfall. We collected it at 6 sites; in Murree (2092m), where it was growing with *Pyrus pashia*, *Cornus macrophylla*, *Aesculus*, and *Ulmus*; in Hazara Dt. at 1390m growing with *Pyrus pashia*, *Pistacia chinensis integerrima*, *Ficus palmata*, and pear cvs.; and at 4 sites in Swat between 1385 and 2060m.

Characteristics: Trees are medium to large (to 20m). Leaves are elliptic to broadly lanceolate (8-12 cm long) and glabrous above at maturity. Plants are dichogamous; pistillate flowers borne singly, with very short pedicels, in axillary positions on the current season's growth. Staminate flowers smaller, borne in few-flowered cymes. Fruits are subtended by an enlarged calyx; they are globose to ovoid, small (13-25mm diam.), and light orange, turning to dark purple or black at maturity. Fruit is astringent until fully ripe, at which time it is soft, mushy and sweet. There are 0-10 seeds/fruit; those without seeds being smaller in size. Fruits are harvested in Nov.-Dec., dried, and eaten locally as well as sold throughout Pakistan. Seedlings of this species are used for rootstocks for the recently introduced *D. kaki* cultivars.

3. *Ficus carica* L.

No. of collections: scions (2)

Taxonomy: Kitamura (1960) claims that the cultivated fig in Afghanistan and Pakistan is *Ficus carica* var. *johannis* Boiss. In "The Flora of Pakistan", *Ficus johannis* Boiss. is accepted as a separate species from *F. carica*, and the author agrees that the Pakistani cultivated figs, at least those in Baluchistan, belong in this taxon. According to Browicz in "Flora Iranica", *Ficus carica* and *F. johannis*, along with *F. palmata* consist of a species complex. In No. Pakistan, we saw relatively few cultivated fig trees of the large-fruited, *carica* type, and as we did not study the specific characteristics, I am not sure if the figs we collected were *F. carica* or *F. johannis*. Surely, they were distinct from the *F. palmata* that we saw. Since they resembled the cultivated figs grown in the U.S., I am tentatively calling them *F. carica*.

Nomenclature: The Urdu term for fig is 'anjir'; in Pushtoo, it is 'inzir'.

Distribution: *Ficus carica* is considered to have originated in Asia Minor (in the region between the Black Sea and Saudi Arabia) but very early it was distributed throughout W. Asia into Iraq, Iran, Syria, Turkey, and Afghanistan as well as around the Mediterranean. It is likely that the large-fruited, superior quality clones have come to Pakistan from neighboring countries to the west.

Characteristics: We saw relatively few fruiting trees of the large-fruited *carica* types. The fruits that we did see were large, dark purple, and had very good quality. The scions we collected were from trees said to have large, dark purple fruit, but we did not see it. As there appeared to be relatively little variability in figs we did not spend time on them. In the No. Areas, there were many *Ficus palmata* trees and some people actually said that they preferred these small fruits over the *carica* types.

4. *Ficus palmata* Forssk. subsp. *virgata* (Roxb.) Browicz.

No. of collections: seeds (5), herbarium specimens (1)

Taxonomy: This is a highly variable and wide-ranging species consisting of 2 subspecies, *virgata* and *palmata*. Synonyms include *F. virgata* Roxb. and *F. caricoides* Roxb. It is closely related to *F. johannis* and *F. carica*.

Nomenclature: In English it is called 'wild fig'; in Urdu it is called 'jungli anjir', meaning 'wild fig'.

Distribution: This species extends from Somalia, Sudan, Ethiopia, Egypt, Arabian peninsula, Iran, Afghanistan, Pakistan, No. India, to Nepal. In Pakistan, the subspecies *virgata* is common and widespread

In the hilly regions up to 2200m. It is found in the provinces of Baluchistan, Punjab, and Northwest Frontier, and in Azad Kashmir and the Northern Areas. Trees occur naturally in the front range which is subject to summer monsoon rains and are planted, and irrigated, in the interior, dry valleys.

Characteristics: Trees are medium-sized (to 10m tall). Leaves are broadly ovate to suborbicular or orbicular, base often cordate to truncate, length 8-12 cm and width 4-7cm, serrate to dentate, mostly undivided, although sometimes palmately 3-5-lobed, and pubescent beneath. Fruits are small, roundish but tapering slightly to stem end, about 1.5-3cm wide, with very tender, slightly pubescent, edible skin. Flesh is bland to sweet (we measured 21 degrees Brix in fruit of one tree) and moderately juicy. The fruit we saw was dark purple-black, but yellow fruits are also reported. Fruits mature from early August to the end of September, depending on the elevation. They are harvested and eaten by local people. In contrast to commercial figs, *Ficus carica*, this species is well-adapted to areas with summer rains. Also, trees are said to be resistant to borers that plague *F. carica*. As *F. carica* cultivars are commonly grafted on *F. palmata* trees, this latter species may have some good attributes for rootstocks for commercial figs.

5. *Morus alba* L.

No. of collections: seeds (1), scions (5), herbarium specimens (6)

Taxonomy: Synonyms of this species include *M. indica* L., and *M. atropurpurea* Bureau.

Nomenclature: In English it is called 'white mulberry' (although some trees have black or purple fruit). The local term is 'tut', or, for the seedless clones, 'bidana'. We also heard it called 'shahtut', a term used interchangeably with 'tut' for all mulberries.

Distribution: The species is thought to have originated in China but, long ago was spread westward through Central Asia, to Europe and No. Africa. Over much of this range, it appears to be naturalized. Throughout Pakistan it is a common tree, self-sown or planted, from sea level to about 3000m. It is found on the plains, on the outer mountain slopes, and in the high inner mountain valleys. In the inner mountain valleys, it is one of the most common trees planted around villages.

Characteristics: Trees are medium-large (to about 15-18m tall), monoecious, and deciduous. Leaves are narrow to broad ovate, 5-15cm long and 4-12cm wide, with serrate margins; apex is obtuse, acute or

shortly acuminate; upper surface glabrous, pubescence on main veins on under side only. Fruits are ovoid to cylindrical, about 15-25mm long and 5-8mm wide, and white, purple, or black. They are very sweet and have very low acids. They are the earliest of all fruits to ripen, i.e., in May-June. Fruits of the white, seedless type are eaten both fresh and dried, and the dried fruit is sold in markets all over Pakistan. If the black and purple forms are dried, we did not see them in this form. Most, if not all, of the *M. alba* trees that we saw had seedless fruit, and were clonally propagated, either by cuttings or by grafting to *M. serrata* seedlings. If seedling trees do occur in these regions, they are probably grafted at an early age to the seedless clones because fruit of the latter is very popular. We collected scions of white, seedless clones in 3 locations, and of black, seedless clones in 2 sites. I was unable to discover if these represent one, or more, clones of each fruit color. Trees are very healthy, with dark green leaves, and are very productive with minimal care. Although we did not see *M. alba* trees on the plains (as we did not go there), it is reported that both seedling trees and clones occur there. This is a remarkably wide range of climatic adaptation for a temperate species. The plains are very hot in spring and summer, and so warm in winter as to provide very few chilling hours, whereas winters at 2200m are long and quite cold (one minimum temperature we were given was - 20 degrees C)

6. *Morus nigra* L.

No. of collections: scions (1), herbarium specimens (1)

Taxonomy: This is a distinct species with no synonyms.

Nomenclature: In English, it is called 'black mulberry'. In Urdu, the terms 'tut' and 'shahtut' are used interchangeably by local people for all mulberries.

Distribution: This species is reported to occur, both cultivated and spontaneously, from N.W. India, Pakistan, Central Asia, Afghanistan, through Asia Minor to Central and So. Europe, and No. Africa. A more precise center of origin is not known. In Pakistan, this species is much less common than *M. alba* or *M. serrata*. We found it only as one clone, named 'Kashmiri', and only in relatively few locations. We saw it in Shigar Valley, in Skardu, and in Gilgit and nearby tributary valleys.

Characteristics: Trees are medium-large (to 10m tall) and may be monoecious or dioecious. Leaves are broad-ovate, nearly as long as broad (6-18cm), acute or short-acuminate apex, deeply cordate at the base, coarsely serrate, usually undivided but sometimes 2-3-lobed, upper

surfaces glabrous but rough to the touch, and lower surface pubescent. Fruits of the clone that we saw are ovoid to oblong (15-25mm long) and broader than those of *alba*, dark purple to black-colored, and very acid until mature. At maturity, fruits are very juicy, with red juice, and there is a much more favorable sugar/acid balance than in fruits of *M. alba* (i.e., for the Western palate). Because of their juiciness, fruits of this species are not dried. Rather, they appear to be prime candidates for a fine juice. Fruits mature later than those of *M. alba* and *M. serrata*, and ripening extends over a very long period.

7. *Morus serrata* Roxb.

No. of collections: seeds (3), herbarium specimens (5)

Taxonomy: The one synonym is *M. alba* L. var. *serrata* (Roxb.) Bureau

Nomenclature: The only local name we heard was 'tut'.

Distribution: The natural distribution of this species is confined to the Indo-Pakistan subcontinent, from central Nepal, through No. India to Pakistan, at elevations of 1200-2700m. It is found naturally in mixed forests on the front slopes of the Himalaya in regions of summer rains. Also, it is very commonly planted around villages in the dry inner valleys.

Characteristics: Trees are dioecious and deciduous, very vigorous, reaching a height of 20m. Leaves ovate to broadly ovate, 5-15cm long, 3-10cm broad, usually 3-lobed, apices of lobes acuminate-caudate, margins coarsely toothed or serrate. Fruits are 10-25mm long, 8-14mm wide and are black, white, or reddish-purple, sweet (we measured 20-24 degrees Brix). Fruit size and quality varied more from tree to tree than in the other mulberry species because this species is seed-propagated. A red, seedless clone is reported, but we did not see it. All the *serrata* trees that we saw had seedy fruits which, in general, were less desirable than fruits from the other species, although on some trees it was very good tasting. Fruit-ripening period is very extended; depending on the elevation, fruit matures from May to August. It is commonly planted (or, in moist spots, it probably volunteers) in villages where it is used as a rootstock for the seedless forms. It is also a very important fodder plant due to its high vigor when coppiced.

8. *Olea ferruginea* Royle

No. of collections: seeds (3), herbarium specimens (1)

Taxonomy: A synonym is *Olea cuspidata* Wall. Brandis (1911)

claimed that this species is closely related to *Olea europaea* L.

Nomenclature: In English, it is called 'Indian olive'; in Urdu it is 'kao'.

Distribution: This species ranges from Afghanistan to W. Nepal at elevations from 500-2500m. In Pakistan, it was formerly one of the dominant trees in the lower hills, where it is commonly associated with *Acacia modesta*. Today, even though there has been widespread removal of *Olea* trees, they can be found in sites undisturbed by humans as, for example, in old graveyards where there is a taboo on cutting trees, or in areas where there is an inadequate water supply to support human habitation.

Characteristics: Trees are medium-large (to 15m). Leaves are oblong-lanceolate, 5-10mm long and 1.5-2.0cm wide, tapered at each end, leathery, gray-green above and reddish brown below due to a mat of dense, colored scales. Fruits are small, oval (6-15mm long), and black at maturity. Unlike the European olive, which must have a bitter principle removed before it is edible, the fruits of this species lack this bitterness and can be eaten fresh, although the taste is not particularly good. It is reported that oil can be extracted from them. This species might offer some desirable trait for olive rootstocks, but graft-compatibility is questionable. I was told that some foresters tried unsuccessfully to graft wild trees over to the European olive, but I do not know what cultivars they tried nor what methods they used. Further, this species would make an attractive ornamental tree in dry, sub-tropical areas, e.g. So. California, or Arizona.

9. *Punica granatum* L.

No. of collections: seeds (1)

Taxonomy: This is one of 2 species in the genus, and in the family, Punicaceae.

Nomenclature: In English it is 'pomegranate'; in Urdu, 'anar', in Shina, 'danu'; and in Balti, it is 'shu'.

Distribution: The pomegranate species is thought to have originated in W. Asia, probably in the vicinity of Iran and surrounding regions, and has subsequently been distributed west to the Mediterranean and east to Afghanistan, Pakistan, and India. In Pakistan, it is wild in Baluchistan, the Salt Range, Waziristan, Kurram, Chitral, Dir, Hazara and Azad Kashmir. It is a common wild shrub in sub-tropical to warm temperate regions in the outer hills, at elevations from 900 to 2200m. It occurs in shrub communities with *Dodonea*, *Reptonia*, *Daphne*, *Indigofera*,

and *Berberis* or it may occur in dry subtropical broad-leaved forests with *Olea ferruginea*, *Acacia*, *Pistacia khinjuk*, *Fraxinus xanthoxyloides* and *Ficus palmata*, or in *Pinus roxburghii* communities with *Pyrus pashia*, *Crataegus songarica*, and pines. We saw it abundantly in the Kagan Valley where shrubby re-growth had replaced the former cut-over forests. This fruit is cultivated in Pakistan, principally in Baluchistan, and only to a limited extent in the Northern Areas.

Characteristics: Plants are small trees or large shrubs, with lanceolate leaves 2-6cm long. Flowers are large (4-5cm wide), brilliant red with many yellow stamens. Fruits from wild plants are smaller (5-7cm diam.) and much more sour than those from cultivated plants. We made one collection of seeds from a wild type, which was nearly ripe at the end of September (at 2060m). The skin was greenish with a red tinge and the flesh around the seeds was pale pink and very sour. These fruits are harvested locally, the seeds dried and used as a tart-tasting condiment. We did not observe much genetic variability among the pomegranate cultivars in the local markets. We saw a few different large-fruited cultivars but we did not collect these, nor did we interview local people to obtain information about them. We were told that there is much more pomegranate diversity in Baluchistan, the major producing region. It is most probable that the pomegranates in the mountainous areas were introduced from Baluchistan.

10. *Zizyphus* sp.

No. of collections: seeds (1)

Taxonomy: There are several species of *Zizyphus* in Pakistan, more than one of which has edible fruit. Since we bought from a local market the fruits from which we extracted seeds, I am not sure what species this is.

Nomenclature: Jujube is called 'anab' in Urdu; in Pushtoo, it is 'markhanay'; and in Gujarati, 'singli'.

Distribution: In Pakistan, jujube plants, both wild and cultivated, are common from about 900m to 1800m on the front slopes of the Himalaya. Fresh fruits are found in the markets in September. In Swat Valley, fruits that we saw were not particularly large, being only about 2-3cm in length. There are reported to be some grafted clones in Pakistan, but we did not spend time to obtain information about this species. We did observe trees planted on farms and in some regions, shrubby jujube plants were very common roadside plants. Trees were particularly abundant in the vicinity of Madyan, in Swat Valley.

Tree Nuts

Tree nut species include one hazelnut, *Corylus jacquemontii*; one walnut, *Juglans regia*; 3 pistachio species, *P. atlantica cabulica*, *P. chinensis integerrima*, and *P. khinjuk*; and 3 almond species, *Prunus bucharica*, *Prunus dulcis*, and *P. kuramica*

1. *Corylus jacquemontii* Decne

No. of collections : seeds (3), herbarium specimens (2)

Taxonomy: *C. jacquemontii* is closely related to *Corylus colurna* L. and originally was included in this species. However, subsequently it has been considered to be sufficiently different to be a distinct species. Synonyms include *Corylus colurna* L., and *C. colurna* L. var. *jacquemontii* (Decne) A. DC.

Nomenclature: In Kohistani it is called 'mazeer'. We also heard it called 'jungli badam', the Urdu term for wild almond.

Distribution: This species ranges from Nuristan in N.E. Afghanistan through the mountainous regions of No. Pakistan and No. India to W. Nepal at elevations from 1800-3000m. It occurs primarily on northern slopes in moist temperate forests with both coniferous and deciduous broad-leaved species, including *Pinus wallichii*, *Abies pindrow*, *Picea smithiana*, *Prunus cornuta*, *Juglans regia*, *Ulmus*, *Aesculus indica*, *Acer caesium*, *Viburnum cotinifolium* and *Sorbus lanata*. It also occurs in moist sites in the dry zone deodar forests with *C. deodara*, *Pinus gerardiana*, *Fraxinus* sp., *Prunus cornuta*, and *Ulmus*. The species is gregarious and not widely distributed within its geographic range. In Pakistan, we found it only in upper Swat beyond Kalam, up the Ushu and Utrot River valleys. Nuts that we purchased in a shop in Ushu (the only place we found where hazelnuts were sold) were said to have come from the Shandur region, farther back in the mountains where roads do not extend. Although we inquired in several places about this species, local people seemed to know it only in the vicinity of Kalam, and beyond. Even here, the species is highly threatened. Anywhere near villages trees are not reproducing because they are heavily lopped for the vigorous re-growth which provides abundant fodder, a product which, apparently, is esteemed more than the nuts. Dr. Y. Nasir told us that he had seen a few trees near Changla Gali in Hazara but that it is not a common tree in Pakistan. Its rareness is supported by the fact that the Divisional Forest Officer for the Galis region had never heard of this species.

Characteristics: Trees are deciduous and medium in height, to about 15m. Unlike the shrubby European hazelnut, this is an upright-spreading tree which does not form suckers. Leaves are broadly ovate to sub-ovate, shortly acuminate with a cordate base, serrate, 12-16cm long. The nuts occur in clusters of 1-3 nuts. Each nut is surrounded by a coriaceous, leafy husk (involucre) which is cleft into laciniate lobes which extend beyond the nut. At maturity the drying husks spread open sufficiently to allow the nuts to fall relatively free of the husks. The nuts are small, about 1.5 cm broad, with a very thick shell. The nuts that we purchased did not vary much in size and shape, but I do not know how many trees were represented. We collected a few nuts from a tree on August 19, at which time they were starting to turn brown and would have been mature enough to plant directly. On Oct. 16 when we visited this same tree all nuts were gone. Probably late August or early September would be the best time to obtain fresh nuts from the trees. Local people harvest the nuts from wild trees, and we were told that most of them are shipped to nut dealers in cities on the plains because they command such a good price (we paid U.S.\$ 3.45/kg for in-shell nuts). It was said that there are "on" years and "off" years and that this was a low crop year. We neither saw nor heard of any trees planted near farms so I believe that there has been no selection for "superior" nuts or for productivity.

2. *Juglans regia* L.

No. of collections: seeds (37), scions (9)

Taxonomy: Synonyms are *Juglans fallax* Dode, *J. duclouxiana* Dode., and *J. regia* L. ssp. *fallax* (Dode) Popov. Stewart (1972) and others consider that the forms in Pakistan are simply *Juglans regia* L. Kitamura (1960) mentioned the following *Juglans regia* subspecies, *regia*, *fallax*, *kumaonica*, and *orientis*, and considers *fallax* to be the one in Afghanistan and Pakistan. Rehder (1940) mentions one of the differentiating characters for subspecies *fallax*; i.e., the shells are very thick and there are protruding ridges of shell inside the nut. We saw this characteristic especially pronounced in some walnuts in Brumboret Valley, Chitral, a region contiguous to Nuristan, where this subsp. was first described. However, we observed that the ridging varied from very pronounced to barely discernible, so I question the validity of using this trait to define a subspecies.

Nomenclature: In English, this species is called 'English', or 'Persian' walnut. In Urdu, it is called 'akhrot', or 'jungli akhrot' for the wild forms; in Balti, walnuts are called 'starga'

Distribution: This species has an exceptionally wide natural distribution; it occurs from the Carpathian Mts. of Eastern Europe, all through Western Asia, the Himalayan regions of Pakistan, India, Nepal, and Bhutan, and east into China. In Pakistan, it is cultivated in most villages between 925-3000m, and it also occurs wild. Wild trees are found commonly in mixed deciduous and coniferous forests, from 1550m to 3000m, often associated with *Pinus wallichii*, *Abies pindrow*, *Picea smithii*, *Cedrus deodara*, *Quercus baloot*, *Corylus jacquemontii*, *Prunus cornuta*, *Aesculus indica*, *Ulmus*, and *Acer* sp. We saw wild trees in Hazara (Kagan Valley and Ayubia National Park) and in Swat, especially in the region of Kalam and up the 2 tributaries of the Swat R. beyond Kalam, i.e. along the roads to Ushu and to Utrot. There are also reported to be wild forest trees in the Kurram Valley, in Chitral, in Waziristan above 2450m, and in the Neelum Valley in Azad Kashmir at 2300-2450m elevation.

Characteristics: In some regions walnut trees grow to enormous sizes. The largest one that we saw was in Brumboret Valley; it measured 6.8m in girth. Another large tree, near Ushu in Swat Dt., was 5.7m in girth. The height of the largest trees must have been 40-50m. The nuts of the wild trees are smaller, rounder, and have a much thicker shell than those of cultivated trees. The shell is so thick, and penetrates so tightly into the spaces around the kernels that the kernels cannot be extracted from the shells. Their use seems to be limited to being used as a 'filler' to increase the weight in sacks of edible nuts, and for a boy's marble game.

Cultivated walnuts are undoubtedly derived throughout many centuries of seed selection from the wild species. Local people are not at all familiar with grafting walnuts so all trees are seedlings. In 2 Fruit Research Stations, the practice of grafting has begun recently and introduced cultivars from California are being propagated. In Chitral, a local selection which appears promising is being propagated by the staff of the Fruit and Vegetable Development Board. In Gilgit, the AKRSP staff has selected a thin-shelled nut and is attempting to propagate it. There is an enormous variability in nut traits e.g., nut sizes (small to very large), shapes, shell thickness (very thin to very thick), the degree of shell seal, the color of kernels, and the taste and appearance of kernels. Because walnuts may be knocked off the trees even before the hulls begin to split (and sold as green, fresh nuts) or as soon as the hulls begin to split (for dried nuts), we were unable to get information on time of normal nut fall. In Swat (at 1400m), we saw the first harvesting on August 14. In addition

to knocking the nuts down early, local people often mix the nuts from different trees and sell them very shortly after harvest. These practices make it difficult for a collector to evaluate the dried nuts from specific trees.

Because ours was a multi-species collecting trip, we were unable to spend the time necessary to identify superior walnut trees from among the vast array of genetic variability. The scions that we collected were from trees recommended by local men and, in some cases, we did not see the nuts. The seed collections represent a sampling from different geographic regions and, for the most part, were obtained from farmers or shopkeepers, and chosen on their recommendation as to what was their best nuts. For future walnut collecting trips, I recommend that the collector be there throughout the months of August and September, and possibly October at the higher elevations, to identify desired types. The collection of walnut scionwood often presents another problem; many of the trees are very old and low in vigor so new growth is very weak. Ideally, one should identify a good tree one year, cut it back to induce vigor, and return for scions the following year in December.

3. *Pistacia atlantica* Desf. ssp. *cabulica* (Stocks) Rech.

No. of collections: seeds (6), herbarium specimens (3)

Taxonomy: Synonyms of this species include *P. cabulica* Stocks and *P. mutica* Fisch. and Mey ssp. *cabulica* (Stocks) Engler

Nomenclature: In Chitral, this species was called 'toke'.

Distribution: This species ranges from the Eastern Mediterranean through the Caucasus Mts., Iran, Afghanistan, and Pakistan. In Pakistan, it is found in Baluchistan, the Kurram Valley, Chitral, and Gilgit Dt. It is a common tree at elevations of 1200-3000m in semi-arid areas where precipitation is principally in the winter. It grows in open forests, commonly associated with *Quercus baloot*, *Pistacia khinjuk*, *Cedrus deodara*, *Pinus gerardiana*, *Juniperus excelsa*, and *Fraxinus xanthoxyloides*. At lower elevations, it is one of the most important trees in the dry, subtropical broad-leaved, open forests that include *Olea ferruginea*. Our 5 collections were all in Chitral, where fruiting trees were very common. We did see this species in Gilgit Dt. but, in this region, there was widespread destruction of trees by humans cutting firewood, and consequently seeds were much more difficult to obtain. Trees grow on open, dry, rocky or gravelly slopes.

Characteristics: Trees are dioecious and relatively small, up to 8m. tall. Leaves are imparipinnate, 5-9 leaflets, lanceolate, 26-

70mm long and 8-22mm wide, and petioles are winged. Panicles are extra-axillary, 7-15cm long. On one tree, there was a mean of 37 nuts per cluster (18 clusters). Fruit clusters had one central peduncle which branched farther up than in clusters of *P. khinjuk*, which branch low and have a more spreading appearance due to several peduncles emerging from near the same location on the stem. Individual fruits are short-oval, about 10-13mm long. Fruit skin is yellow with a red blush, embryos are green. We collected seeds between Aug. 30 and Sept. 3 (at elevations between 1340 and 2460m) at which time fruits were mostly still on the trees and appeared to be not quite ripe, although I believe the seeds were mature enough to be viable. There was a very high percentage of aborted seeds (estimated 70-90%) in all the trees from which we collected. We had noticed earlier on trees in Gilgit Dt. that almost all of the seeds were aborted. At one location in Chitral, we observed that people had been harvesting the fruits, presumably for food.

4. *Pistacia chinensis* Bunge ssp. *integerrima* (J.L. Stewart) Rech.

No. of collections: seeds (3), herbarium specimens (3)

Taxonomy: A synonym for this taxon is *P. integerrima* J.L. Stewart ex Brandis.

Nomenclature: In Pushtoo, this species was called 'shinala'; in Hazara Dt., it was called 'kangar' (I'm not sure which language this is)

Distribution: This subspecies ranges from E. Afghanistan to W. Nepal. In Pakistan, it occurs in Baluchistan, in the Suleiman Mts., in the Salt Range, the Siwalik Tract, in the Kurram and Peshawar Valleys, and along the outer Himalayan region between 500 and 2400m. It is scattered in the sub-tropical pine forests (*Pinus roxburghii*) where rainfall is mostly in the summer, and in the subtropical, dry forests associated with *Olea ferruginea*. We observed it most commonly in the areas where *Pyrus pashia* and *Diospyros lotus* occur. We also saw trees surviving in old graveyards with *Olea ferruginea*. Due to the widespread destruction of vegetation in the natural range of this species, we saw relatively few fruiting trees.

Characteristics: Trees are dioecious and larger than the other *Pistacia* species in Pakistan, reaching 18m in height. Leaves are also larger (16-25cm long), with 7-13 leaflets. Leaflets are lanceolate, acuminate, 7-13cm long, and pale green on undersides. Leaves on young shoot growth are brilliant red which makes it very easy to locate trees if they are in the vicinity. Also, leaves commonly have irregularly shaped, often long (to 25cm) reddish-brown galls. Fruit clusters are larger (15-25cm long) than those of the other 2 species. There were 30-178 fruits per cluster in counts that I made. Individual fruits are globose (6-8mm diam.), somewhat compressed, and greyish-brown. Embryos that we saw were green. Fruits mature much earlier than do those in the other *Pistacia* species. On June 23 (at 1160m) we observed that some fruits with full embryos had already fallen, so we made our first collection on this date, although we thought it might be a little too early. Other collections were made on June 28 (at 1400m) and July 6 (at 1385m) from trees where few, if any fruits had fallen as yet. When we returned to the first collection site on August 14, all fruit was gone. Collection of seeds of this species must be done in late June to mid-July, before they are lost to birds or mammals. As the fruit is too small and shells do not split, this species best potential use would be for rootstocks or as an ornamental shade tree.

5. *Pistacia khinjuk* Stocks.

No. of collections: seeds (7), herbarium specimens (12)

Taxonomy: One very old synonym is *P. acuminata* Boiss. and Bunse

Nomenclature: In Chitral it is called 'saveer'; in Gilgit Dt. it was called 'khakaon'.

Distribution: This species occurs naturally from Egypt, through Syria, Turkey, Iraq, Iran, Afghanistan to Pakistan. In Pakistan it is found in dry, rocky areas, from 1500-2450m, in Baluchistan, Khyber, Chitral, and Gilgit. We saw it commonly in several locations in Chitral. Also, it was in Kohistan in the Indus R. gorge, up the Gilgit R. and up the Indus R. almost to the Skardu Valley. In Gilgit Dt. there has been so much destruction of trees that one finds them only on the most inaccessible, rocky cliffs where neither goats nor men can reach them. Along the road to Skardu trees are scattered on the opposite side of the river from the road, in totally inaccessible sites, whereas, on the road side there are virtually no trees remaining. This species is commonly found growing out of rock clefts on cliffs in what appears to be a most inhospitable site for trees. Other plants associated with it are *Pistacia atlantica cabulica*, *Prunus kuramica*, *Quercus baloot*, and *Artemesia*.

Characteristics: Trees are smaller than those of the other *Pistacia* species, reaching only to about 6m. Leaves are imparipinnate, but differ from *P. atlantica cabulica* in having fewer leaflets (3-7) which are broader (ovate-oblong, rather than lanceolate) and leathery in texture. Fruit clusters are larger (14-22cm long) and more low-branched, resulting in a more spreading appearance. Individual fruits are similar to those of *P. atlantica cabulica* but a little smaller (4-6mm long). Also, in our later collection, some of the fruits were blue-black, while others were yellowish. When placed in water to try to separate the many aborted nuts from those with good seeds, only the blue-black seeds sank, while the yellow ones floated. Embryos in the nuts that we examined were yellow. We collected seeds between Aug. 30 and Sept. 26, which appears to be an appropriate season. During this period, nuts seemed to be mature enough for viable seeds but had not yet fallen. At one site (2060m) we were told that the nuts fall in late September and early October. Since nuts are too small, and indehiscent, the potential value of this species would be for rootstocks for *P. vera*.

6. *Prunus bucharica* Korsh.

No. of collections: seeds (1), herbarium specimens (1)

Taxonomy: Synonyms include *Amygdalus bucharica* Korsh., *Prunus amygdalus* Batsch. var. *ovalifolia* Franch. and *Prunus bucharica* (Korsh.) Hand-Mzt.

Nomenclature: In English, this species is called 'wild almond' and in Urdu it is 'jungli badam'.

Distribution: According to the "Flora of the USSR, this species occurs in Central Asia in a fairly restricted area, in the USSR states of Turkmen, Uzbek, and S. Tadzhikistan. It forms extensive thickets in the Pamir-Alai Mts. and is reported to have the most eastern distribution of all species in the section *Amygdalus*. In No. Pakistan, we found it in only one location, along the banks of the Gilgit River and on the slopes above the river beginning just west of the village Hime (at 2000m) and extending up the river valley about 85 km to the village of Chussi (at about 2800m). It was associated with *Pistacia khinjuk*, *P. atlantica cabulica*, and *Fraxinus xanthoxyloides*. We were told that this species also occurs in Astor, but road conditions prevented our going there to verify which of the 2 wild almond species was there. We observed wild almond trees on the slopes in Kohistan on the opposite side of the Indus River from the road (and, therefore, not easily accessible), somewhere between Pattan and Chilas but could not determine which species it was.

Characteristics: Plants are reported to be sometimes shrubby, but those that we saw were medium-small trees to about 8-10m tall and with extremely abundant suckers. They differ from *P. kuramica*, the other wild almond species in No. Pakistan, in having larger trees, many more suckers, larger fruits, thicker pericarps, larger stones (21mm long x 15mm wide) with a very smooth surface, and later fruit maturity. The shell is very thick; one sample cracked yielded 31% kernel. Although the hull is easy to break open and remove, fruits fall without dehiscing. On Sept. 26 (at 2060m) there were still a few fruits on some trees. We were told that these wild almonds mature 20-30 days after the cultivated ones, which mature at the end of August. Therefore, I would expect that early to mid-September would be the best time to collect seeds at this elevation. We were told that the trees are very productive, and that the wild nuts are harvested by local people who extract oil and use it for hair oil. These wild, bitter almonds are used in this region as rootstocks for grafting the sweet, edible types. It is also mentioned in the "Flora of the USSR" that experiments in Tadzhik revealed that this species is suitable as a rootstock for cultivated almond, apricots, plums, and peaches, and that it has exceptional drought-resistance. Thus, it is well worth trying for this purpose, although the heavy suckering that we observed would be

a disadvantage, unless low-suckering individuals could be identified and propagated.

7. *Prunus dulcis* (Mill.) D.A. Webb

No. of collections: seeds (12), scions (2)

Taxonomy: This species is in the subgenus, *Amygdalus*. Over the years, several specific names have been applied to the cultivated almond; these include *Prunus amygdalus* Batsch., *P. amygdalus* Stokes, *P. communis* Arcang. non Huds., *P. communis* Fritsch, and *Amygdalus communis* L.

Nomenclature: In English the name is 'almond' and in Urdu it is called 'badam'.

Distribution: The cultivated forms (now termed *P. dulcis*) are considered to have been derived from the wild species *P. communis* Fritsch (= *Amygdalus communis* L.), which is a very wide-ranging species from Western to Central Asia. The plants grow in arid mountainous regions, often on southern slopes in stony and fine earth rubble. Although wild *P. communis* is reported to occur in Baluchistan, it has not been reported in the Northern Areas, and we did not see it. In Pakistan, almonds are cultivated in Baluchistan, Gilgit, and Baltistan. In the Northern Areas, trees are usually scattered on the small farms, but we did see a few small orchards. Although nuts have a very high value and climatic conditions are suitable for almonds, there did not appear to be a great number of trees in the regions we visited.

Characteristics: Most of the almond trees that we saw were seedling trees, although in some cases local people plant seedlings, allow them to fruit, and then graft over those with bitter seeds and those with very thick shells to a local thin-shelled type. It is my impression that the scions are taken from any local thin-shelled tree as there does not seem to be named clones that are widely used. We did, however, discover one exception to this general practice in Nasirabad, Hunza. Here, local people had selected and propagated fairly extensively a particular clone with long, thin-shelled nuts which they called simply 'khagzi'. Also, at the Department of Agriculture Nursery in Skardu, another long, thin-shelled selection had been identified and was being propagated for distribution to the farmers. The only names for almonds that we heard were 'khagzi', meaning thin-shelled, and 'katta' meaning thick-shelled. As the degree of shell thickness varied continuously from very thick to very thin, the classification into thick and thin for market purposes was highly subjective. Because most trees are seedlings, there is a great deal of

variability, although there is a high proportion of long, narrow nuts because the people prefer this shape and no doubt select this type for planting. There is also a preference for nuts which have a high proportion of twin kernels because people think that they have a higher proportion of kernel. In fact, the Aga Khan Rural Support Program has selected, and was propagating, a clone with virtually all twins. Lack of productivity was a general complaint of the local people about almonds and may be the reason that more trees are not planted. No one could explain the low productivity, but we were told several times that crops were not lost to spring frosts. At some sites, trees were very chlorotic (perhaps N deficiency) and at others were dying at a young age, apparently due to poorly drained soils, whereas, elsewhere trees were very healthy-looking. Although there is currently much interest in planting almonds, probably stimulated by the high prices of these nuts, it appeared that almonds have not been grown in the Northern Areas for a very long period because we did not see any old trees; those that we saw were probably younger than 20 years. One informant told us that almond trees were formerly planted only by the more wealthy people, and were only fairly recently becoming more generally planted.

8. *Prunus kuramica* (Korsh.) Kitam.

No. of collections: seeds (1), herbarium specimens (2)

Taxonomy: This species is in the subgenus *Amygdalus* and the only synonym is *Amygdalus kuramica* Korsh. It is closely related to *P. communis*, differing by having much smaller fruits and thinner, virgate branches. It is reported to hybridize freely with the cultivated almond if the 2 species are growing near each other. Two subspecies have been reported, ssp. *kuramica* and ssp. *aitchisonii* which differ in the size and degree of flattening of the drupes and in the sculpturing of the stone. We saw only one type and I am not sure which subspecies it is.

Nomenclature: Locally, it is called 'jungli badam', meaning 'wild almond'

Distribution: This species has a fairly limited distribution, occurring only in E. Afghanistan and N.W. Pakistan at elevations of 1000-2800m. In Pakistan, it is found in the Kurram Valley and in Chitral. We saw it only in Chitral Dt. -- in Shishi Valley, in Chitral Gol National Park, on the slopes above the valley of Chitral city, and on the slopes above the road as we traveled north from Chitral and into both tributary valleys, the Lutkho R. Valley to Guram Chasma and the Mastuj R. Valley to Mastuj. It commonly grows scattered on rocky or gravelly, dry slopes, often

associated with *Pistacia khinjuk*, *P. atlantica cabulica* and *Quercus baloot*. According to Browicz and Zielinski (1984) this, and *P. bucharica*, are the 2 easternmost representatives of the section *Amygdalus*.

Characteristics: The trees that we saw were relatively small, 4-15m tall, with a rather open, loose growth habit. Leaves were similar to those of cultivated almonds but smaller. Fruits are dehiscent, stones are much smaller (12-14mm by 9-11mm) than cultivated almonds and the shells have a pronounced grooving (scribing), a trait that differentiates this species from others. We noticed relatively little suckering, as compared to *Prunus bucharica*, the other wild almond species that we collected. Also, the fruit matures earlier than the other wild almond species. On August 31, there were no nuts to be found on or under trees, even as high as 2700m. In Mroi village, at 1938m, we were told that these wild almonds mature in late July-early August. For future seed collections, I estimate that one should be there in July. Fortunately, Miraj Khan, an agricultural officer, very kindly gave us some seeds that he had collected for a rootstock trial. Local people harvest these nuts and press them for oil, as they are too bitter to eat. Because of the extreme drought-resistance, low suckering, small tree size, and possible tolerance to high pH, this species might have value for rootstocks.

Small Fruits

Twelve species of small fruits were collected: these included *Duchesnea indica*, *Fragaria nubicola*, *Fragaria* sp., *Ribes alpestre*, *Ribes himalense*, *Ribes orientale*, *Rubus anatolicus*, *Rubus ellipticus*, *Rubus hoffmeisterianus*, *Rubus irritans*, *Rubus macilentus*, and *Rubus niveus*.

1. *Duchesnea indica* Focke

No. of collections: seeds (2), herbarium specimens (2)

Taxonomy: This species is in the sub-family Rosoideae, tribe Potentilleae. Synonyms are *Fragaria indica* Andr., *Duchesnea fragiformis* Smith, *Potentilla denticulosa* et *P. wallichiana* Ser., *Fragaria malayana* Roxb., *F. nilagirica* Zenk. and *Potentilla trifida* Lehm.

Nomenclature: In English, this has been called 'Indian strawberry'. No local names were obtained.

Distribution: This species has a broad geographic range, extending from Afghanistan, through Pakistan, India, Nepal, Bhutan, to China and Japan. It is also reported to be in Malaysia and Indonesia. It occurs in both temperate and sub-tropical zones. In Bhutan, this species

is reported to occur up to 4420m. In Pakistan, it is found from 600-2600m. in Waziristan, Kurram, Dir, Chitral, Swat, Gilgit, Hazara, Murree Hills (Rawalpindi Dt.), Hasan Abdal, Poonch, and Azad Kashmir. We collected it in Nathiagali, Hazara Dt., at about 2600m and in Swat, near Kalam at 2000m. We saw it in forests or on more open slopes, or along road sides, in shady spots (e.g. on the shady side of a large rock or near a tree trunk). It occurred in occasional clumps of about 1m diam., rather than being widely distributed like *Fragaria nubicola*, with which it was commonly associated. Other plants with which it was associated were *Rubus niveus*, *Pinus wallichii*, *Abies pindrow*, *Viburnum grandiflorum*, and *Aesculus indica*.

Characteristics: Plants are low, creeping, and stoloniferous, similar to strawberry. Leaves are usually 3-partite (more rarely 5-partite); leaflets dark-green, elliptic or obovate, 1.5-3cm x 1-1.5cm, margins crenately-serrate, petioles to 10cm. Flowers yellow, solitary, and fruits bright red, globose or conical, with calyx somewhat clasping and the bracts below the calyx reflexed. The many achenes were elevated and very easy to rub off the surface of the fruit. The bright red fruits are attractive against the dark, glossy green foliage. Fruit is soft and the taste is totally bland. At 2000m fruits were ripe in mid-June and at 2600m there were ripe fruits at the end of June. At lower elevations fruit maturity would be in May.

2. *Fragaria nubicola* Lindl. ex Lacaita

No. of collections: seeds (4), herbarium specimens (3)

Taxonomy: This species is in the sub-family Rosoideae, tribe Potentillae. A synonym is *Fragaria vesca* L. var. *nubicola* Hk.f. Since it is very similar to *F. vesca*, it was originally thought to be this species but since Staudt (1959) reported that it is incompatible with *vesca*, it has been considered a distinct species.

Nomenclature: In English it is 'wild strawberry'. In 'Kohistani' it was 'magaroos'.

Distribution: This species occurs throughout the Himalaya from Pakistan through India, Nepal, Bhutan, to S.W. China and Burma. In Pakistan, it also occurs in Waziristan and Kurram at higher elevations which receive enough moisture to support the Himalayan flora. This species is very common in all the temperate and sub-alpine forested areas from about 1800-3800m. Although it is sometimes found on shrubby, more open slopes, it is the dominant species on the forest floor in mixed coniferous forests. It does not seem to be threatened by grazing. We saw

it associated with *Pinus wallichii*, *Abies pindrow*, *Cedrus deodara*, *Aesculus indica*, *Viburnum grandiflorum*, *Parrotiopsis jacquemontii*, *Rubus hoffmeisterianus*, *Rubus macilentus*, *Sorbaria tomentosa* and *Duchesnea indica*.

Characteristics: Plants are hermaphroditic, low, stoloniferous, and seem to be almost continuously distributed over large areas. Leaflets are obovate to elliptic, 1.5-5cm long by 1-3cm wide, margins with sharp serrations. Upper surfaces are medium-light green and undersides have silky, appressed pubescence. Scapes are 2-20cm tall, equal to or often above the leaves, and bear 2-6 white flowers. Fruits are small (8-15mm diam.), globose, soft, with skin color dark red, and flesh color very pale (almost white), very good flavor, and aromatic. Fruits are harvested by local people and commonly sold along roadsides. At lower elevations fruits are mature in May, whereas at higher elevations mature fruits can be found in July. At each site there is considerable range in time of blooming as well as fruit maturity.

3. ~~*Fragaria* sp.~~ *Potentilla nivea* L.

No. of collections: seeds (1), herbarium specimens (1)

Taxonomy: We were not sure about the identity of this species as it does not fit any of the descriptions of *Fragaria* species in this region. There was an herbarium specimen of the same type in the herbarium at The Forestry Institute in Peshawar which was labeled *Fragaria vesca* (the name formerly applied to the native species in Pakistan). However, these herbarium specimens and our accession appear very different from the widespread native species, now called *Fragaria nubicola*. After our arrival back in the U.S., Dr. Royce Bringham observed the herbarium specimens and suggested that this may be a *Potentilla* species. Growing plants from the very few seeds that we collected will be necessary to verify the identity of this species.

Distribution: We collected plants above Naltar (Gilgit Dt.) in an open grassy area within a *Betula utilis* forest at estimated 3350m elevation. The herbarium specimen at the Forestry Institute was collected at Tirah, (in the Khyber Dt. about 130 km west of Peshawar) at an elevation of 1850-2450m. We found no other evidence of this type of strawberry(?) in Pakistan, and there was no herbarium specimen in the National Herbarium in Islamabad.

Characteristics: Leaves were totally covered with a silvery-gray pubescence; in fact, they were so gray as to appear almost dead at first glance. Although the plants were observed late in the season (on

Sept. 23) scapes with floral remnants were still present. They rose well above the leaves (10-20cm tall). The floral remnants consisted of sepals and epicalyx bracts, many dried anthers, and very, very few seeds. Fleshy fruits, if there had been some, were long gone. At this stage the plants appeared to be staminate plants, but it is possible that fruit could have been detached earlier, leaving only dried, shriveled tissue at the point of attachment. On the other hand, if it is *Potentilla*, there would have been no fleshy receptacle

4. *Ribes alpestre* Decne ex Jacq.

No. of collections: seeds (1), herbarium specimens (2)

Taxonomy: This genus is so large and complex that taxonomists have divided it into subgenera and sections. This species is placed in the subgenus *Grossularia*, section *Eugrossularia* which includes the gooseberries. A synonym is *Grossularia alpestris* Berger.

Nomenclature: The English common name is 'Asian gooseberry'.

Distribution: This species occurs from E. Afghanistan through Pakistan, India, Nepal, Bhutan, Tibet, to W. and Central China, at high elevations of 2400-3800m. Plants grow in fairly dry sites on open slopes with other shrubs or at the edge of forests. We collected it in the Naltar Valley at about 3200m, where it was very common. Here it was associated with *Pinus wallichii*, *Picea smithii*, *Juniperus excelsa*, *Hippophae rhamnoides*, *Prunus jacquemontii*, *Berberis*, and *Ribes orientale*. It is also reported to be in the Kagan Valley and in Kashmir.

Characteristics: Shrubs 2-3m tall with 1-3 long (0.5-2.0cm) sharp spines at each node. Leaves suborbicular, about 1.5-3.0cm wide, with 3-5 rounded lobes with blunt teeth, and sparsely pubescent. Fruits oval, 6-11mm long, orange-red to red, with small glandular hairs, and with a good, tart taste. Fruit is borne singly at each node, mostly on 2-year wood. The shrubs that we saw appeared to be moderately productive. On Sept. 21, at about 3200m, fruits were just ripe, or over-ripe and drying, but still hanging on the shrubs long after they had matured. Thus, late August at lower sites and September, at higher sites, would be a good time for future collections.

5. *Ribes himalense* Decne.

No. of collections: seeds (1), herbarium specimens (2)

Taxonomy: This species is in the subgenus *Ribesia*, section *Heritiera*. It is closely related to *R. petraeum* Wulf. Berger(1924)

describes 3 varieties; *glandulosum* Jancz., which occurs in western Szechwan at 1800-3000m; *appendiculatum* Jancz. which occurs in the Western Himalaya at 2000-4000m; and *urceolatum* Jancz., which occurs from Sikkim Himalaya to Yunnan, W. Hubei, and Shanxi. Synonyms include *Ribes emondense* Rehd. and *Ribes rubrum* Clarke non L.

Distribution: This species occurs throughout the Himalayan regions of Pakistan, India, Nepal, Bhutan and east to the mountains in W. China. In Pakistan, this species is found throughout the relatively high elevation areas between about 2200m and 4200m in Kurram, Swat, Gilgit, and Baltistan. We found it near the river in Naltar, Gilgit Dt. where it was associated with *Pinus wallichii*. We were told that it was common around the Naltar Lakes (4675m) about 12 km N.W. of Naltar. It is reported to occur in sub-alpine woodlands with *Betula utilis*, *Sorbus tianshanica* and *Cotoneaster integerrima*.

Characteristics: Erect shrubs 1.5-2m tall, without thorns. Young branchlets glabrous and red. Leaves cordate with 3-5 acute, deeply toothed lobes. Flowers are borne in racemes, 10-15cm long. Fruits are reported to be large (8-10mm diam.), black or red colored, and to be edible, but insipid. At about 3000m, we collected seeds on Sept. 21. This was the very end of the season so we found only a few fruits remaining on the plants, and these were small (5mm diam) and black. I estimate that late August, or early Sept.(at higher elevations) might be a more appropriate time to collect seeds of this species.

6. *Ribes orientale* Desf.

No. of collections: seeds (2), herbarium specimens (6).

Taxonomy: This species is in the subgenus *Berberis*, section *Euberberis*. Synonyms include *Ribes leptostachyum* Dcne., *R. villosum* Wall., and *R. heterotrichum* C.A. Mey. Although some authors consider *R. orientale* to be one highly variable species, Schoenbeck-Temesy who monographed *Ribes* in "Flora Iranica", has split it into 3 species; *R. orientale* Desf., *R. heterotrichum* C.A. Mey., and *R. villosum* Wall.

Distribution: This species, or species complex, is exceptionally wide-ranging, having been reported from E. Europe, W. Asia, Afghanistan and the Himalayan region from Pakistan through India, Nepal, Bhutan, to S.W. China, as well as Siberia. In Pakistan it is very common in dry, mountainous areas at elevations of 2000-4000m. It occurs in Baluchistan juniper zones, in Waziristan, Kurram, Chitral, Swat, Gilgit, Astor, Baltistan, and the Kagan Valley in Hazara. It was by far the most common *Ribes* species that we saw. We collected seeds in Baltistan and

in Swat. This species often occurred in open areas, associated with *Artemesia*, *Hippophae rhamnoides*, *Berberis*, *Salix*, *Ribes alpestre*, *Juniperus*, and *Fraxinus xanthoxyloides*, and sometimes near forests with *Pinus wallichii*, *Cedrus deodara*, *Prunus jacquemontii*, *Cotoneaster*, and *Viburnum cotinifolium*.

Characteristics: Dioecious shrubs 1-2m tall, with glandular-hairy shoots. Leaves small (1.5-3.5cm diam.), with shallow, rounded lobes with crenate margins, and usually covered with sticky glandular hairs. Flowers are in erect racemes (3-5cm long), borne terminally and laterally, mostly on previous year's wood. Fruit clusters, which are more lax, have 5-14 berries which are orange-red to red, mostly about 5-6mm diam. and often hispid. One particularly stout shrub had both larger leaves and larger fruits (10-12mm diam.), neither of which was hispid. Fruit was edible, but bland. Local people did harvest this large-fruited shrub, presumably for food. Although there was a range of ripening time for fruits on the same shrub, there were many ripe berries for our July 18 collection at 2585m elevation and also many ripe on August 19 at a higher site (2700-3200m). However, on Sept. 21, when we collected many ripe fruits of *Ribes alpestre* in Naltar (3200m), fruits on the nearby *R. orientale* shrubs were completely gone. Thus, the best time to collect this species is from mid-July to mid-August. We found these shrubs in some very dry sites so they must have considerable drought resistance.

Two other *Ribes* species are reported to be in the mountains of Pakistan; namely, *Ribes nigrum* L. (at 2600-4300m) and *Ribes glaciale* Wall. (at 3100-4000m). We did not see these species, primarily because we did not spend much time at these higher elevations where they occur.

7. *Rubus anatolicus* (Focke) Focke ex Hausskn.

No. of collections: seeds (5), herbarium specimens (4)

Taxonomy: The species is in the subfamily Rosoideae, tribe Rubeae, subgenus Eubatus. The name *Rubus fruticosus* L. was originally used very broadly by Linnaeus to include all European blackberries. Hooker, in his "Flora of British India" (1875-1897) called the local blackberry in the Himalayan region *Rubus fruticosus* L. var. *discolor* (synonymous with *Rubus discolor* Weihe and Nees). Brandis (1911) and Bamber (1916) both followed this designation. Also, Polunin and Stainton (1984) consider this blackberry to be *R. fruticosus* L., and state that they think that it has been introduced into India from Europe. On the other hand, the term *Rubus ulmifolius* Schott was proposed in 1818, and Focke

(1914), and Kitamura (1960) accepted it as the preferred term, *sensu ampl.*, for the synonyms *R. fruticosus* L. var. *discolor* Hk.f., *Rubus discolor* Weihe and Nees., and *R. fruticosus* var. Aitch. J.L.S. In 1893, *Rubus anatolicus* (Focke) ex Hausskn. was proposed for the forms of this widespread species complex that occur from the Balkan Peninsula, through W. Asia to Kashmir, India. Thus, *R. anatolicus* replaced the previous terms *R. ulmifolius* Schott. ssp. *anatolicus* Focke, *R. ulmifolius* Schott. ssp. *sanctus* Sudre, *R. discolor* Weihe and Nees, and *R. fruticosus* Hk.f. non L. Stewart (1972) questions which of these two most recent terms (*anatolicus* or *ulmifolius*) should be used for the wild blackberry in Pakistan, but prefers *R. ulmifolius*, apparently because it was the latest term accepted by Focke, although Focke's acceptance was for the broadest concept of this species complex. Rechinger, in "Flora Iranica", accepts the term *anatolicus* for the form of wild blackberry that occurs in W. Asia, including Pakistan.

Nomenclature: In English, it is called wild blackberry. It was called 'kanachi' in Hazara Dt. and in Pushtoo, it is 'karwara'.

Distribution: It is difficult to define the exact geographic distribution of this taxon because of the general confusion about the integrity and nomenclature of this EurAsian *Rubus* species, or species complex. Kitamura (1960) states that the *ulmifolius* complex, in a broad sense, is extremely wide-ranging from Europe and No. Africa, through Asia Minor, Iran, Afghanistan, Pakistan, to India. However, the form of this complex termed *R. anatolicus* has a somewhat more restricted range - from the Balkan peninsula through W. Asia, Turkey, Iran, Caucasus Mts., Turkmen, Afghanistan, No. Pakistan to Kashmir, India. In Pakistan, it is a very common roadside plant, in hedges, and at the edges of fields. It occurs at elevations of 300-1800m in Baluchistan, Kurram, Chitral, Lower Swat, Gilgit, Lower Hazara, Murree Hills and in Azad Kashmir. We saw it very commonly in Lower Swat, along the road from Besham to the Swat Valley, in Chitral, in Hazara, on the valley floor near Muzaffarabad in Azad Kashmir, and up the adjacent valleys of the Neelum, Jhelum, and Kunar Rivers. Although it is most common in the outer Himalayan regions where there are summer rains, it is also found in villages in the inner, dry areas, around the edges of irrigated fields.

Characteristics: Plants are spreading shrubs, erect at first, to 1-2m tall. Canes are moderately vigorous, arching, covered with very sharp, strong recurved thorns, and are angular in cross-section. Leaves are 3- or 5-foliate, margins sharply serrate, somewhat dark green above and covered with whitish tomentum below. Terminal leaflets broadly

ovate, with laterals more narrow. Flowers white to dark pink or rosy-red, borne in prominent, long (15-25cm), erect, thyrsoid panicles. Fruits are glossy black, globose, small (9-13mm diam.), and edible, but not particularly good due to their having too few drupelets. In fact, most plants that we saw had very poor fruit set, i.e. few fruits and/or few drupelets per fruit. Plants bloomed and matured fruit over a very extended period; in fact, from the end of June to October we commonly saw all stages, from flower buds to ripe fruits, on the same plants. At the lower elevations, the first fruits begin to mature at the end of June while others on the same plants continue to mature throughout the summer. Our first collection, at 1065m, was made on June 21 and our last, at 1415m, was made on Sept. 14. This species may have value for breeding for extended harvest period in blackberries. Intensive selection should be made in Pakistan for plants that have good fruit set and superior fruit.

8. *Rubus ellipticus* Smith

No. of collections: seeds (1), herbarium specimens (1)

Taxonomy: This species is in the subfamily Rosoideae, tribe Rubeae, and subgenus *Idaeobatus*. Rather old synonyms are *R. flavus* Ham., *R. rotundifolius* Wall., and *R. paniculatus* Moon. However, at present there is no discrepancy about this very distinct species.

Nomenclature: In English, it has been called 'Golden raspberry' and in Hazara Dt., it was called 'guracha'.

Distribution: It occurs in subtropical and warm temperate regions with summer rainfall, ranging from N.W. Pakistan through the Himalaya in India, Nepal, Bhutan, Burma, to Yunnan in S.W. China. It is also found in So. India, Sri Lanka, and S.E. Asian countries of Indonesia, and The Philippines. In Pakistan, it is a common plant in the Himalayan foothills, at elevations of about 700-1800m. We saw it in Swat on the road from Besham to Kwazakhela over the Shangla Pass, along the Karakoram Pass road, in forested areas in Murree Hills where it was associated with *Pinus roxburghii*, *Pinus wallichii*, *Quercus incana* and *Q. dilatata*, and in Azad Kashmir in cut-over, former forested areas, up both the Jhelum and Neelum river valleys. It is commonly found in *Pinus roxburghii* communities.

Characteristics: Plants are very vigorous, erect-sprawling, evergreen shrubs, 2-3m tall. The stout canes are heavily clothed with prominent, rusty brown bristles and scattered reflexed prickles. Leaves are trifoliate 8-20cm long, leaflets elliptic to sub-orbicular or obovate, upper surfaces dark green and undersides lighter-colored due to fine

pubescence, margins slightly serrate. The few-fruited clusters are both axillary and terminal. Fruits are bright yellow, globose, 13-15mm diam., soft, with many drupelets, and rather small seeds. Fruit detaches readily from the receptacle and the taste is quite good. They are harvested locally and are commonly sold along roadsides, but fruits deteriorate rapidly after harvest. Fruits mature throughout the month of May. By May 27, when we made our first, and only, collection (at 1030m), there were only a few old, drying fruits remaining on the shrub. For future collections of this species, early May would be the time to begin.

9. *Rubus hoffmeisterianus* Kunth. and Bouche

No. of collections: seeds (7), herbarium specimens (7)

Taxonomy: This species is in the subfamily Rosoideae, tribe Rubeae, and subgenus *Idaeobatus*. It appears to be a distinct species with only 2 synonyms; *Rubus niveus* Wall. var. *aitchisonii* Hk.f., and *R. pedunculatus* D. Don var. *aitchisonii* (Hk.f.) Kitam.

Nomenclature: In English, it is 'wild raspberry'. In Shinah, it is called 'rumu'.

Distribution: It is reported to range from E. Afghanistan through the Himalayan regions of Pakistan, India, and Nepal. In Pakistan, it has been reported in Kurram Valley, Chitral, Swat, and Gilgit Dts. We saw it frequently at elevations from 1464 to 2770m, and collected in the vicinity of Gilgit (between 1464 and 1775m), near Kalam (at 1970m), in Nathiagali, Hazara Dt. (at 2770m) and in Kagan, Hazara Dt. (at 2000m). It is found both in regions of summer rainfall and in the inner, dry valleys near wet spots, seepages, streams, or irrigation channels.

Characteristics: Plant is a rambling shrub with, sometimes, very vigorous canes, with scattered, strong, recurved thorns. Leaves usually trifoliate, medium green above and white-tomentose below, 8-25cm long. Leaflets generally ovate, sometimes variably lobed, and serrate. Flowers pink, the petals shorter than sepals, borne in several-flowered corymbs, mostly at the end of lateral shoots on main canes. Plants were often very productive, with many fruit clusters having 2-20 fruits per cluster. On one plant with several vigorous canes, we counted 20-33 fruit clusters per cane. Fruits are orange-red to red, with often a bronze tinge on the surface, globose, 9-14mm diam., with good separation from the torus at maturity, fairly firm, with good drupelet adherence, and good tasting, although a little tart. The highest soluble solids that we recorded, on ripe fruit, was 13 degrees Brix. Local people harvest the fruits and sell them along the roadsides. Because of the relatively good

fruit and apparent productivity, a more comprehensive study of this species is recommended to identify outstanding individuals.

10. *Rubus irritans* Focke

No. of collections: seeds (2), herbarium specimens (3)

Taxonomy: This species is in the subfamily Rosoideae, tribe Rubeae, and subgenus *Ideaobatus*. It appears to be a distinct species with only one synonym, *R. purpureus* Hk.f. non Bunge.

Nomenclature: It is a 'wild red raspberry' in English. No local names were obtained.

Distribution: This species has a fairly narrow distribution; it is reported to occur from E. Afghanistan, through No. Pakistan, to Kashmir, India. However, as Polunin and Stainton (1984) do not mention this species, it must not be common in Indian Kashmir. While Hara and Williams (1979) do not report it in Nepal, Grierson and Long (1987) mention it as growing on alpine grassy cliff-ledges in Bhutan at 3960-5200m. In Pakistan, it is reported to be in Kurram, Dir, Chitral, Swat, Astor and Naltar in Gilgit Dt., Satpara Valley in Baltistan, and in Hazara, in the Kagan Valley and from Changla Gali eastward. It is the second highest elevation *Rubus* (after *R. saxatilis*), occurring between 2300 and 3700m. We collected it at 3 sites; the first was along the road to Lake Mahodan, about 25km N.E. of Kalam, at 3230m, where it was associated with *Ribes orientale*, *Viburnum cotinifolium*, and *Juniperus excelsa*. At a second site, in Naltar Valley, Gilgit Dt., at about 3000m, it was associated with *Picea smithii*, *Pinus wallichii*, and *Ribes alpestre*. At the third site, Naran in the Kagan Valley, at 2460m, it was growing with *Pinus wallichii*, *Cedrus deodara*, and *Juglans regia*. It commonly occurs along water channels.

Characteristics: Erect shrubs with only moderate vigor, to one meter tall. Canes covered with many long, thin, straight bristles. Leaves with 3-5 leaflets, variably shaped (broad-ovate to round-cordate), from entire to 3-lobed, with coarse serrations, often doubly serrate, margins, upper surface glabrous and green or sparsely pubescent and lower thinly to heavily pubescent. Flowers borne in short, drooping axillary racemes with 2-5 flowers, or solitary in the lower axils. Petals white and smaller than the long, lanceolate, prickly sepals. Fruits red, globose, tending to be enclosed by the long sepals, detaching from the torus at maturity. We collected only very few seeds because we found plants only at flowering time (July 21 at 2460m) and when fruiting was practically finished, on Aug. 19 at 3230m, and on Sept. 21 at 3000m. There must be a relatively short, condensed period for fruit maturation. End of July to mid-

August is probably the best time to collect seeds of this species. The plants that we saw did not appear to be very productive.

11. *Rubus macilentus* Camb.

No. of collections: seeds (2), herbarium specimens (1)

Taxonomy: This is a distinct species, in the subfamily Rosoideae, tribe Rubeae, and subgenus *Ideaobatus*.

Nomenclature: In English it is 'wild yellow, or orange-red, raspberry'. In Pushtoo it is called 'rutch'.

Distribution: This species occurs from No. Pakistan, through Himalayan India, Nepal, and Bhutan, and So. Tibet to W. China. In Pakistan, it occurs from 1500-2770m. Stewart (1972) reports it in Miandam, Swat Dt., several sites in Hazara, Murree, and in Poonch, Azad Kashmir. We saw it in only 3 locations; 2 near Nathiagali, Hazara Dt. and one near Miandam, Swat Dt. From other collection notes at the National Herbarium, as well as our observations, this species occurs primarily in the moist temperate forest areas on the front slopes, often near streams, and not in the inner dry mountain areas. We found it associated with *Pinus wallichii*, *Abies pindrow*, *Viburnum grandiflorum*, *Acer* sp, *Urtica*, and *Sorbaria tomentosa*.

Characteristics: Plants are the smallest of the *Rubus* sp. that we saw, ranging from 0.2-1.2m tall, and were gregarious. Primocanes are very erect and tend to branch frequently, whereas floricanes are more prostrate. Canes angular, i.e., pentagonal in cross-section, with scattered sharp-pointed, thorns, and without bristles or pubescence. Leaves are smaller than those of the other *Rubus* sp. collected, with 3 leaflets, the terminal leaflet ovate-lanceolate, (1.5-5cm long), lateral leaflets sessile, smaller, roundish to ovate, with slight pubescence, or none, on lower side only. In one patch, the plants were seriously affected by some disease--primocanes had terminal die-back and floricanes had stem cankers. Flowers white, borne singly or in small clusters of 2-3, at or near the end of the canes only. Fruit is bright yellow to orange-red, globose (9-12mm diam.). As the fruits mature, the long, caudate calyx lobes reflex, and the fruit appears to be gradually pushed up and off of the conic to columnar receptacle. Fruits were fairly soft and moderately good taste, although bland. They seem to be low in acids and also low in soluble solids, as ripe fruit measured only 12 degrees Brix. At our 2 collection sites, most fruits were mature on June 24 at 2160m and on June 28 at 2110m elevation. Thus, throughout June is the best time to collect seeds. In general, plants that we saw were small and unproductive, but fruits had an attractive bright yellow color and

acceptable flavor

12. *Rubus niveus* Thunb.

No. of collections: seeds (7), herbarium specimens (¹⁰/₉)

Taxonomy: This species is in the subfamily Rosoideae, tribe Rubeae, and subgenus *Ideaobatus*. Synonyms are *R. lasiocarpus* Sm., *R. distans* D. Don, *R. mysorensis* Heyne, *R. pauciflorus* Wall., and *R. pinnatus* D. Don.

Nomenclature: This is a black, or purple raspberry, which has been called 'Mysore raspberry' in English. In Pushtoo, it is 'buganray' and it was called 'bukaran' in Hazara Dt..

Distribution: This species ranges from N.E. Afghanistan through the temperate Himalayan regions of Pakistan, India, Nepal, and Bhutan, and south into the mountainous regions of Burma, IndoChina, Malaysia, Indonesia, Sri Lanka, So. India, and The Philippines. It also ranges east into W. and Central China. In Pakistan, it is common at elevations of 1100m-2500m., and sometimes occurs higher. It is reported to be in Gilgit and Baltistan Dts., but we saw it only in Swat, Hazara, and Muzaffarabad. Plants were growing in regions with summer rains that were fairly heavily vegetated, and, although there was some overlap, this species occurred at higher elevations than *R. ellipticus* and *R. anatolicus*. Associated plants include *Pinus roxburghii*, *Pinus wallichii*, *Cedrus deodara*, *Pyrus pashia*, *Populus* sp., *Quercus* sp., *Ficus palmata*, *Olea ferruginea*, *Rubus hoffmeisterianus*, *Sorbaria tomentosum*, *Viburnum grandiflorum*, and *Vitis jacquemontii*.

Characteristic: Plants are very vigorous, up to 2m tall, with canes 2-5m long. Primocanes are erect and branch freely the first year; they are often covered with heavy white bloom, and have numerous long, strong, sharp-pointed, recurved thorns. Floricanes are broadly arching, often with varying amounts of purple pigmentation in stems. Leaves are pinnately compound (8-25cm long) with 5-7 leaflets which are elliptic, ovate or lanceolate, 3-6cm long by 1-3.5cm wide, sharply serrate margins, and with heavy white tomentum below. Plants tend to occur scattered as individuals and are not generally gregarious.

Flowers borne in corymbs or corymbose panicles, mostly terminal but also in axillary positions. Flowers are rosy red, with petals smaller than the calyx lobes. The number of flowers per inflorescence varies considerably between different plants, from few to 25. The productivity varied, with some plants appearing very productive; on one plant about half of the lateral shoots terminated in a fruit cluster, and I counted 12-

25 fruits per cluster. At maturity, berries are dark purple-black with a white bloom, and detach easily from the receptacle. The shape is oblate, size is 12mm wide and 8mm high. The flavor is very good as fruits have a desirable sugar-acid balance. We measured 20 degrees Brix on ripe fruit. Plants vary in amount of yield, in size and quality of the fruit, and in number of drupelets per fruit. The time of fruit maturity is principally throughout July. On June 30, when we made our collection at 1540m, only 10-15% of the fruit was mature, and the fruit that we bought from boys on Aug. 8, at 2153m, was the last of the season. Because this species is one of the 2 most likely to be useful, a more comprehensive study of the wild populations in Pakistan, and throughout its range, is recommended to identify superior individuals. Because of its wide geographic distribution as well as its earlier classification as *R. lasiocarpus*, for which 7 varieties were described, I would expect that there is a great deal of variability to be found in this species.

Of the 11 possibly valid *Rubus* species reported to be in Pakistan we failed to collect 5; these are *R. antennifer* (= *caesius*...), *R. biflorus*, *R. paniculatus*, *R. pungens*, and *R. saxatilis*. *R. paniculatus* is said to be rare, and *R. saxatilis* is an alpine species (a region in which we did not spend time). *R. biflorus* and *R. pungens* may be farther off the roads, in forests away from human habitations. *R. antennifer* is reported to be in Chitral and in Kashmir (but, I believe the Kashmir collections were from the Indian-held part of Kashmir). If present in No. Pakistan, it is not very common.

Grapes and Related Species

We collected 2 possible species (or subspecies) of *Ampelopsis*; *Ampelopsis vitifolia vitifolia* and *Ampelopsis* sp., and 3 species and one subspecies of *Vitis*; *Vitis jacquemontii*, *V. jacquemontii glabra*, *V. parvifolia*, and *V. vinifera*.

1. *Ampelopsis vitifolia* (Boiss.) Planch. var. *vitifolia* (orange fruit type)

No. of collections: seeds (4), herbarium specimens (8)

Ampelopsis sp. (black fruit type)

No. of collections: seeds (1), herbarium specimens (1)

Taxonomy: There were two distinct types of plants; one with orange fruit and one with black fruit. I am not certain of the species

designation for these plants. They will need to be grown out and the taxonomy clarified. As described below, the two types did appear to be similar, but yet distinct enough that they may be different species, or subspecies.

Nomenclature: In Darel Valley, the orange-fruited type was called 'kawaki yatch' (which means crow's grape). The black-fruited type that we saw in Chitral was called 'gakuchi'.

Distribution: This species is reported from the Districts of Chitral, Swat, Kohistan, Hazara, Poonch, and Muzaffarabad at elevations of 900-2400m. We saw the orange-fruited type in the lower Swat Valley, in the Indus River gorge between Dasu and Chilas, in the Darel River Valley, and in Hazara Dt. near Kwai up the Kunar R. Valley road. It occurred in two different types of habitats: in Swat and Hazara, it was in a region of substantial summer rainfall, associated with other vegetation, whereas in Kohistan, it was growing in occasional moist gullies in a very arid climate. We collected the black-fruited type about 20 km north of Chitral growing up a slight gully on a rocky, scree slope at 1900m, and associated with *Artemesia* and *Prunus kuramica*.

Characteristics: The orange-fruited plants are 0.5-0.75m tall, with low to moderate vigor, forming large spreading dense patches. Leaves are small (5-7cm broad), thin, palmately lobed, and bright green. These almost luxuriant patches of bright green foliage make a striking contrast to the dry, brown rocky surroundings in the arid regions. Fruits are borne in few-fruited clusters. Berries are bright orange at maturity, globose to slightly oblate, 6-9mm diam., have 1-3 seeds per berry, and are inedible. Fruit flesh contains a white mucilaginous substance that was very irritating to our skin, causing a prolonged itching-stinging sensation. Flowering and blooming is very extended, throughout the summer. Our first seed collection was made on Aug. 15 (at 1900m) and the last was on Oct 3, at 1385m. We were told that goats do not like this plant and, since we saw several un-grazed patches throughout the summer, we assumed that this was true. However, on our last trip up the Indus River gorge in October, a large herd of goats was in the process of totally defoliating one of our collection sites. Perhaps the goats do not prefer this species, but they will eat it if there is nothing else available.

The black-fruited type had a somewhat different aspect; leaves were duller green and thicker, almost leathery, and seemed to be slightly folded up at the midrib, and fruits were blue-black at maturity. Both of these types of *Ampelopsis* may have value as an ornamental ground cover in arid areas. Plants are spreading, but not too vigorous to be invasive,

and form a dark to bright green, dense patch of foliage.

2. *Vitis Jacquemontii* Parker

No. of collections: seeds (9 total), 8 from a cultivated clone(s) and one from a wild pistillate plant; cuttings (11 total), 5 from a cultivated clone(s) that is either hermaphroditic or female, 2 from wild male vines, 1 from a wild female vine, and 3 from wild plants with unknown sex; herbarium specimens (23 total)

Taxonomy: This is a distinct species. The "Flora of Pakistan" gives *Vitis lanata* auct. non Roxb. Decne as a synonym.

Nomenclature: In Pushtoo, the wild grape is called 'gidar kwar' which means 'jackal grape' (i.e., inferior and fit for jackals), or 'zungali kwar' meaning 'wild grape', and the cultivated form is called 'Tor Kwar' which means 'black grape'. In Urdu, it is 'jungli angur' which means 'wild grape'. In Muzaffarabad, the cultivated form was called 'Kali Dakh', a general term for black grapes. In no region did we discover a specific name for the cultivated *Vitis Jacquemontii* clones.

Distribution: This species occurs from 600-2400m on the front slopes of the Himalaya from N.W. Pakistan through the Indian Himalaya to Assam and Bengal, and in Nepal. In Pakistan, it is reported to occur in Swat, Hazara, and Azad Kashmir. We found it in tributary valleys of the Swat River drainage- near Marguzar, along the Karakar Pass Rd., and along the roads to Miandam and to Malam Jabba; in the river valley that the road follows west from Besham to Shangla Pass; along the road going S.W. from Besham to Batgram in Hazara Dt.; in the Murree Hills; and in the Neelum and Jhelum River valleys in Muzaffarabad Dt. It commonly grows along streams or river banks in regions of relatively high summer rainfall. Plants associated with it include *Olea ferruginea*, *Punica granatum*, *Pinus roxburghii*, *Dodonea*, *Diospyros lotus*, *Ficus palmata*, *Pyrus pashia*, *Rubus ellipticus*, and *Rubus anatolicus*. We saw several plants that were obviously wild but, on several occasions, local people told us that the species used to be much more common and that now one has to walk way up in the mountains to find it. We saw plants on several farms in both Swat and Muzaffarabad and discovered that these were clonally propagated. Because the fruit from the cultivated clone(s) is much preferred over that of wild vines, there is no reason for people to protect or maintain the wild species. Clearly, the population is greatly reduced as compared to its former abundance, and the wild species appears to be threatened.

Characteristics: Vines are very vigorous, climbing up into

trees or hanging over riverbanks. Shoot tips and young leaves have heavy pubescence which ranges from white to rusty brown. Leaves are broadly ovate-cordate, 10-15cm long, with dentate-serrate margins, and may be entire to deeply lobed. The amount of lobing varies considerably in different plants, so much so that it appeared, at first, that this species was hybridizing with *Vitis vinifera*. However, later we found a vigorous plant growing in the shade whose leaves varied greatly in the amount of lobing, which indicates much intra-plant, and probably intra-specific, variability for this trait. The amount and color of pubescence on the under surface of leaves also varies: some plants have heavy pubescence which is, typically, rusty brown, but may be lighter colored, while others have sparse pubescence which also varies from light-colored to rusty. Unfortunately, we did not see enough fruiting vines so we could compare the fruit from vines with different types of leaves. Critical observations of both leaves and fruits from many different vines are necessary to determine if interspecific hybridization with *V. vinifera* has been occurring.

Fruits from the cultivated clones are commonly seen in local markets. These were said to have larger clusters of superior quality fruits than the wild vines. Clusters are 15-30cm long, with 50-100 berries per cluster. Berries are black, globose (10-13mm diam.), juicy, with a tough, slip-skin and 2-3 seeds per berry. The flesh has a pleasing, mild flavor, with a good sugar-acid balance. We measured 15-20 degrees Brix on 4 different samples (although they may have been the same clone). There was an estimated 20% shot berries in the clusters that we saw. Fruits mature early. On August 8, fruits were already harvested at lower elevations but were still coming to the markets from the higher elevations. On Aug. 15 we harvested mature fruit at elevations of 1700m and 1846m. As we were not there at bloom time, and no one informed us, I do not know if the clone(s) is hermaphroditic or pistillate. This species, and its clone(s), is well adapted to high summer rainfall and plants are grown where *V. vinifera* would be devastated with fungal diseases. Because of its disease resistance (or tolerance) and acceptable fruit quality, this could have great value for breeding grapes adapted to warm, wet summers and mild winters. It no doubt lacks cold-hardiness and plants are quite delayed in entering dormancy. On Nov. 19, at 525m elevation, vines of this species showed no sign of leaf senescence, as compared to adjacent *V. vinifera* vines whose leaves were senescing and falling.

We did not see fruit on wild plants because we arrived in the grape region too late in the season. By Aug. 8, when we saw the first wild

plants at the lower elevations, the fruit was already gone. At the higher elevations where we traveled, the native vegetation had largely been replaced by farming activities. We were told that it would be necessary to walk several miles to find some wild plants, and we did not do this. The fruit is said to be smaller, in smaller clusters, not so black-colored, and to be somewhat bitter and not nearly as good as the clone that is cultivated. Plants of the wild species are dioecious and both male and female vines can be found. In order to collect seeds from this wild species one should be there during July to early August.

3. *Vitis jacquemontii glabra* Lawson

No. of collections: scions (1), herbarium specimens

Taxonomy: Stewart (1972) agrees with Parker that what appears to be a glabrous form of *Vitis jacquemontii* is actually a hybrid between *V. jacquemontii* and *V. parvifolia*. The plant that we saw, and collected, was as vigorous as other *jacquemontii* vines and appeared to be similar to this species except that it had glabrous leaves. It did not appear to have any traits, other than the glabrous leaves, that resembled the much weaker growing *Vitis parvifolia*. As there did seem to be variation in the amount of leaf pubescence among different *jacquemontii* plants, it may be that the plant we collected was at the extreme end of a continuum of varying amounts of pubescence. As we saw only old shriveled, dried fruits we could not determine their characteristics. A more critical study of this plant will be necessary to classify it accurately.

Nomenclature: We obtained no local name for this glabrous plant.

Distribution: In Pakistan, a glabrous form has been reported from Dir-Gujar, the Neelum River Valley, and the Jhelum R. Valley. We found one plant in the Kunhar R. Valley about 3km west of Kwai, at 1420m elevation. The vines were climbing up in a dense patch of *Ailanthus* beside the road. Associated dense vegetation included *Pinus wallichii*, *Cedrus deodara*, *Cornus*, *Viburnum grandiflorum*, *Juglans regia*, and *Ficus palmata*.

Characteristics: As mentioned above, the vines were similar to those of the usual *V. jacquemontii* except the leaves were glabrous. There were dried fruit clusters remaining on the vine on Oct. 12, but we could not determine the fruit characteristics at this late date, except to note that there were several fruits per cluster. The presence of fruit indicated that the vine is pistillate (or hermaphroditic ?)

4) *Vitis parvifolia* Roxb.

No. of collections: scions (2), one pistillate and one staminate plant

Taxonomy: One synonym is *V. flexuosa* Thunb. var. *parvifolia* (Roxb.) Planch.

Nomenclature: No common names were obtained.

Distribution: This species occurs on the front slopes of the Himalayan region from No. Pakistan through India, Nepal, Indo-China to W. and Central China. It is also reported in Japan and Malaysia. In Pakistan, it is reported to occur in Swat, Hazara, and Azad Kashmir at elevations of 1200-2150m. We found it at only two sites, both near Chikar in the Jhelum River Valley, in Azad Kashmir, at 1400m and 1477m. Plants were growing in small gullies beside the road, and were associated with *Pinus wallichii*, *Quercus*, *Ailanthus*, and *Berberis*.

Characteristics: Plants are trailing climbers, much less vigorous than *V. vinifera*, and both stems and leaves are glabrous. Leaves are small (4-8 by 3-6cm), ovate-cordate and long-acuminate, either entire or 3-5 lobed, with crenate-serrate margins. Plants are dioecious. Fruit is borne in small clusters of small, globose (5-7mm diam.), inedible black berries. I do not know when the fruit ripens because it was Oct. 25 when we collected seeds from a few shriveled, dry clusters still hanging on the vine. Local men told us that the plants are used for fodder. This practice, and the fact that plants are not valued for their fruit, no doubt accounts for the relative rarity of this species and eventually will lead to its decimation. Since this species occurs in regions of high summer rainfall it is likely to contain resistance to grape diseases.

5. *Vitis vinifera* L.

No. of collections: scions (69), herbarium specimens (4)

Taxonomy: This is a distinct species with no synonyms.

Nomenclature: In Urdu, *vinifera* grapes are called 'angur'; in Pushtoo the name is 'kwar'; in Kohistani it is 'yatch'; in Balti it is 'argoon'.

Distribution: This species originated in W. Asia, in the region between and to the south of the Caspian and Black Seas. It was first brought into cultivation in this region at a very early period in human history, and has subsequently been distributed throughout the world and has become the most important world fruit crop. In No. Pakistan, we found no evidence of this species occurring wild nor of seedlings being planted. Apparently, all grapes were brought into this region as clones, along with

the human migrations from the West, North and Northeast. They are cultivated principally in Baluchistan and in the inner, dry mountain valleys in Chitral, in Gilgit, especially in the Punial Valley, Hunza, and Nagar and in Baltistan, especially in Rondu Valley. Grapes are very insignificant in the outer Himalayan regions of Swat, Hazara, and Azad Kashmir, where only a very few cultivars can withstand the summer rains.

Characteristics: There are many, many grape cultivars in No. Pakistan, and a great deal of genetic diversity. All types can be found; colors range from green-white, pink, red, dark purple-red, to black; fruits are mostly seeded, but there are a few seedless clones; berry size ranges from small to very large; texture is from soft and very juicy to very firm; some have a short post-harvest life and some are said to store well. In some regions, e.g. the Kalash Valleys, Punial Valley, and Hunza, where there was a tradition of wine-making, there had been selection of cultivars suitable for wine. We were told that some of these are excellent wine grapes. However, since 1972 alcoholic drinks have been outlawed and there are severe penalties for selling them. As a consequence, many wine grapes, which are not at all suitable for the fresh market, are currently flooding the local markets. In other regions, e.g. Baltistan, there has been selection primarily for table grapes. Overall, there is relatively little drying of grapes for raisins. We heard about raisin-making in only 2 regions. In the Darel River Valley, raisins are made from a cultivar called 'Phater'. In Baltistan, there is a minor production of dried 'Black Corinth' (known as 'Zerish' here). Although the major raisin grape of California, 'Thompson Seedless', is grown here (under the name of 'Kishmish') we did not hear of its being used for raisins.

There are a large number of grape cultivars in No. Pakistan which are in need of more intensive study. The many synonymies that I believe exist there need to be clarified with thorough descriptions and photographs. Mr. A. K. Bulghari, Deputy Director of Agriculture for Baltistan, has established in the Rondu Valley a collection of about 70 grape cultivars from the Baltistan Dt. This germplasm collection, now in its early years, will provide an excellent base for identification, evaluation and selection of the grapes in this District. Depending on the elevation and cultivar, grapes ripen from July to early October, so one should be there during that period in order to study all the cultivars.

CONSTRAINTS TO PLANT EXPLORATION IN NO. PAKISTAN

The following factors contributed to our inability to make as comprehensive a study and collection as had been anticipated.

1. Communication with local people.

The fact that educated people speak fluent English was a real asset when interviewing agriculture and forestry officials. However, my inability to speak Urdu, the national language, was an important limiting factor for conversations with local, village farmers, who were a primary resource for information about old local fruit cultivars. Too often, in response to my question a lengthy answer from a villager was translated with a few brief words, or sometimes not at all. Certainly, I missed a great deal of information about fruit cultivars due to this lack of direct verbal interaction.

2. Cultural taboos.

The social restriction on men i.e., our male hosts, to speak to local women and girls often prohibited our interaction with the very people who were working with the fruit, and who, presumably, would have been an excellent source of information. In some villages, it was difficult to locate men because they often leave the area for work, so we either failed to interview anyone, or else obtained our information from little boys.

3. Social or political unrest.

Because of social or political unrest we were unable to collect in certain areas. For example, we were told not to get off the road when we passed through the District of Dir because there had been some recent inter-tribal feuding. We were unable to go to the Kurram Valley because of the Afghan hostilities. A few other incidents, although not prohibiting us from collecting, made us uneasy. When we first arrived in Gilgit the town was virtually closed down and tourists had been evacuated because of a very recent Moslem inter-sect armed dispute which resulted in villages being burned out, crops destroyed, and at least a few hundred people killed. While we were in Chitral Dt., Afghan bombs were dropped on a city 20 miles from where we were. In Upper Swat, we were required to hire an armed guard to accompany us because there had been some attacks on tourists recently. Before we arrived in Peshawar there had been random bombs planted in the city.

4. Unexpected delays and schedule interruptions

The first was a 2-week delay in departure from the U.S. due to waiting for government security clearance. After arriving in Islamabad, we had to wait another 10 days for my bank draft to clear before we could begin traveling. Our hosts had two long holidays (10 and 11 days) during some fruit harvest periods, which left us without an interpreter to interview village people and to collect. Several times, roads were closed to areas we wanted to visit due to snow blockage, or landslides/falling rocks which blocked the road, or washouts which caused roads to cave in, or rather 'off' the cliffs. Road construction or maintenance is a continual process in these highly unstable, exceedingly steep mountain slopes/cliffs, and one never knows when a particular road will be closed, often for extended periods. Therefore, travel plans must be very flexible. Even when roads are open, they are often of such poor standards that it is not possible to average more than 16 km/hour. With this slow speed, combined with long stretches of arid, uninhabited areas which have none of the target plants, many hours are consumed with no interviews and no plant collecting accomplished.

5. Lack of taxonomic references The lack of a complete Flora of Pakistan, with a key to species, seriously limited our identification of species associated with the wild species that we collected. Botanists at the National Herbarium, N.A.R.C. and at the University of Karachi have been working on a complete Flora, family by family, for several years with grants through the U.S. PL 480 program but, unfortunately, this money will no longer be available after this year for this valuable project.

6. Lack of supplies

The unavailability of reliable distilled water with which to calibrate our pH meter prevented us from collecting this data. For example, the water in one bottle of distilled(?) water that we bought had a pH of 8.5.

7. Scope of the project

The broad scope of this project prevented us from studying any one group of plants in depth. Although we collected representatives of almost all target species (plus 36 miscellaneous sp.), it was not possible to study, and collect, a wide range of variability in each species. This breadth was a serious deficiency and a source of frustration because we could not get as detailed information as I would have liked for all the species. We obtained a broad over-view of the fruit and nut genetic resources in No. Pakistan but we, undoubtedly, missed some valuable, specific germplasm for each of the many species.

RECOMMENDATIONS FOR FUTURE PLANT EXPLORATIONS

1. Budget considerations

a.) Project the costs of purchasing fruits/seeds and scions from local farmers, nurserymen, and markets. We failed to provide for this cost, which was not insignificant, in our budget.

b) Make a written agreement, in advance, with local collaborators as to how much financial responsibility one has toward the vehicle that they provide. I agreed to pay for the vehicle costs of repairs, gasoline, tires, and regular maintenance enroute. However, when we had an accident there were unanticipated repair costs which, fortunately, were not excessive in our case. Had the damage to the vehicle been far greater, it was not made clear to me how much I would have been expected to pay. The N.A.R.C. vehicle in which we were riding was not insured. I am not sure if it is the usual policy of N.A.R.C. to not have vehicle insurance, but surely a future foreign collaborator should consider this factor before setting out. The combination of extremely poor road conditions and completely uncontrolled driving makes road travel the most hazardous aspects of the entire trip. The accident rate in Pakistan must be horrendous.

2. Supplies and equipment.

a) When planning an extended trip to regions, such as No. Pakistan, where the water quality is suspect, I highly recommend taking a water filter. We found that our Swiss-made Katadyn pocket filter was very satisfactory and gave us confidence in having clean water wherever we went.

b) It would be very convenient to have two cameras- an Instamatic as well as a 35mm for color slides. The Instamatic would be valuable for two reasons. As village people appreciate very much having their, and their children's, pictures taken, this courtesy would provide an excellent opportunity to become acquainted and to gain their appreciation and cooperation. The other value of an Instamatic would be to help identify and to remember fruit cultivars. One could detect synonomies by comparing pictures taken in different villages, and one could elicit information from local men by showing them pictures of the fruits.

c) Be sure to take everything that is needed, including labels, heavy gauge polyethylene bags for shipping scions, cloth bags for seeds, collection forms (although xerox machines are available, the paper quality is inferior and the paper size is larger), plant presses, blotters, clippers for cutting scions, etc. as these items may be difficult to obtain.

d) In order to expedite shipping of scionwood to recipients, try to arrive at the U.S. port of entry during week days when Plant Quarantine Inspectors are on duty. Otherwise, the packages remain at the airport for 1-2 days awaiting inspection.

3. Host Country Participants

For future plant explorations in Pakistan, it is highly recommended that a Pakistani scientist who is working with the target crops be included as a member of the team. For example, on our exploration trip, including a local temperate fruit horticulturist would have been a great asset. Such a person should have the background and motivation to diligently seek out plant materials and information about them, and he could make a real contribution to the knowledge of fruit germplasm in his own country. While being a valuable learning experience for him, I would expect that, also, he would be an excellent resource person for the foreign team members.

4. Additional fruit and nuts to collect on future exploration trips.

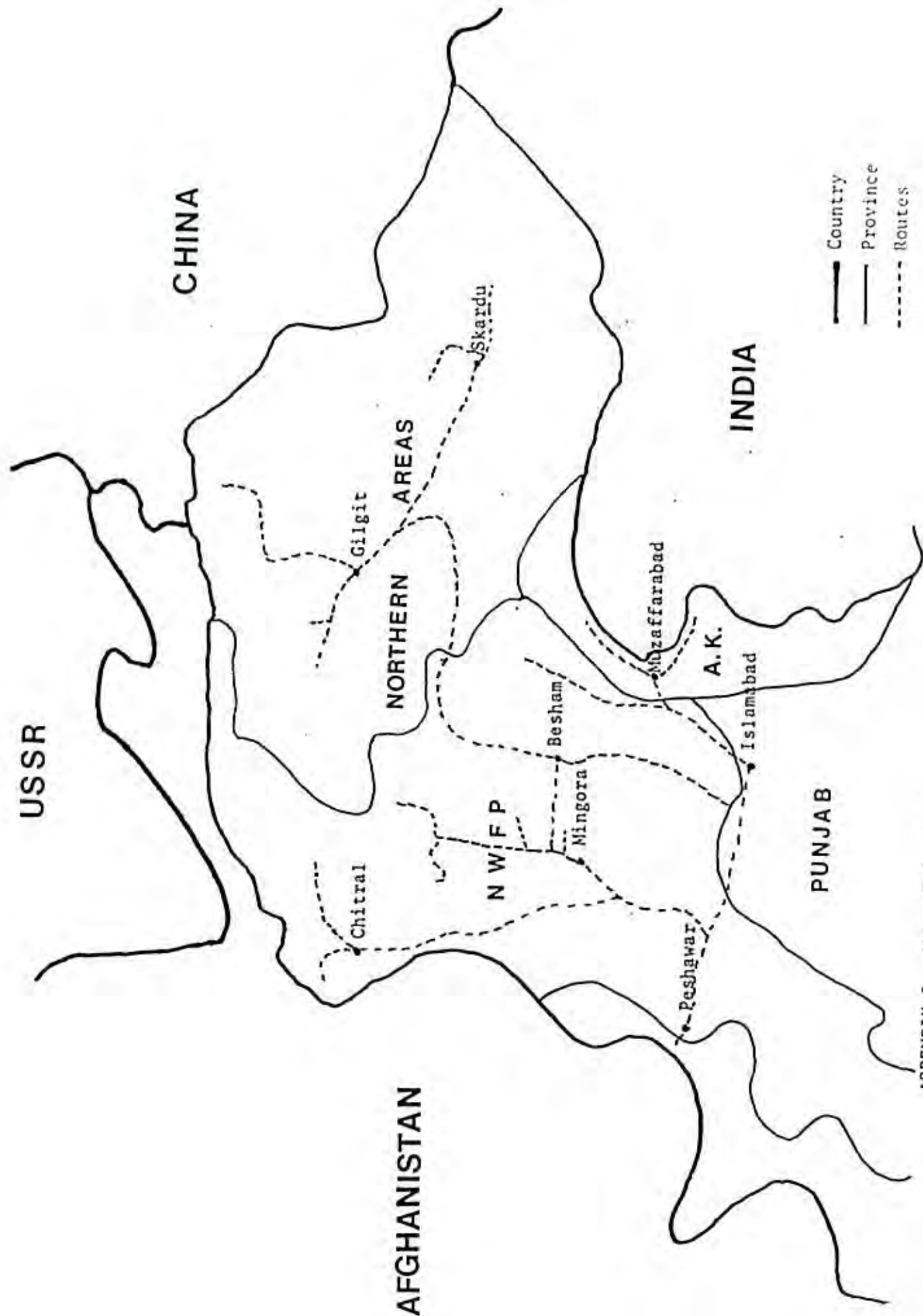
a.) Wild Species

Of the total temperate fruit and nut species present in Pakistan, we failed to collect seeds or scions of a few that occur in the northern mountainous regions. Also, because we could not go to the Kurram Valley nor did we have time to visit Baluchistan we missed several wild species. Other regions that we did not study or were inadequately surveyed include the Kalash Valleys in Chitral, Dir Dt., the Gupis-Yasin region in Gilgit Dt., Astor, and Poonch tehsil in Azad Kashmir. We also failed to collect in every District at higher elevations or areas which are accessible only by trail. Species yet to be collected are listed in Appendix IV.

b.) Cultivated Species

In the northern mountains, the greatest diversity occurs in walnut, apricot, and grape. Certainly, walnut warrants a special in-depth study and collection. Although we did collect many apricot and grape clones, there are many more that we did not collect. While the diversity in apples, pears and peaches did not seem to be as great, there were also more cultivars mentioned that we did not collect, and which may include some interesting germplasm. As we did not return to Chitral for collection of scions, we failed to collect

cultivars specific to this region for all fruit crop species. Getting to Chitral after the Lowari Pass (3240m) is closed with the first snowfall, usually in November, is inconvenient and very time-consuming. Although there are year-round flights to Chitral, one must make the reservations in Peshawar, well in advance. And, since flights are subject to weather conditions and are heavily in demand one never knows when he will actually get on the plane. It is necessary to wait in Peshawar and check with the airport each day. Collection of dormant scionwood in Chitral requires special preparations, and time. In Baluchistan, there are many fruit and nut cultivars that differ from those grown in the North. In addition to commercial production of apple, pear, grape, peach, and apricot, there is also a much greater diversity, of pistachio, almond, pomegranate, fig and quince. A special collection trip to this region is recommended for all fruit and nut crops grown there.



APPENDIX I. Map of No. Pakistan Showing the Routes Traveled

APPENDIX II.

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APPENDIX III Summary of Plants Collected

	<u>seeds</u>	<u>scions</u>	<u>herb. spec.</u>
Acer sp.	1		
Alnus nitida	1		1
Amaranthus sp.	3		
Ampelopsis vitifolia vitifolia	4		8
Ampelopsis sp.	1		1
Berberis orthobotrys	1		1
Cedrus deodara	1		
Celtis caucasica	1		1
Coix lachryma-jobi	1		
Cornus macrophylla	1		1
Corylus jacquemontii	3		2
Cotoneaster affinis bacillaris	5		5
Cotoneaster integerrima	1		1
Cotoneaster lindleyi	1		2
Cotoneaster nummularia	5		4
Cotoneaster sp.	1		1
Crataegus songarica	6		6
Cydonia oblonga	1		
Diospyros kaki		1	
Diospyros lotus	6		1
Duchesnea indica	2		2
Eleagnus angustifolia	2		2
Eleagnus umbellata	2		2
Ephedra gerardiana	1		1
Ephedra intermedia	1		
Ficus carica		2	1
Ficus palmata virgata	5		1
Ficus sarmentosa	2		1
Fragaria nubicola	4		3
Fragaria sp. Potentilla nivea	1		1
Fraxinus raibocarpa	1		1
Fraxinus xanthoxylodes	2		1
Hippophae rhamnoides			1
Impatiens brachycentra	1		1
Impatiens edgeworthii	1		1

	<u>seed</u>	<u>scions</u>	<u>herb spec</u>
<i>Impatiens glandulifera</i>	5		2
<i>Juglans regia</i>	37	9	
<i>Juniperus communis saxatilis</i>	2		2
<i>Juniperus excelsa</i>	4		3
<i>Kydia calycina</i>	1		
<i>Malus domestica</i>	5	24	2
<i>Morus alba</i>	1	5	6
<i>Morus serrata</i>	3		5
<i>Morus nigra</i>		1	1
<i>Olea ferruginea</i>	3		1
<i>Parrotiopsis jacquemontii</i>	1		2
<i>Pinus gerardiana</i>	1		
<i>Platanus orientalis</i>	1		
<i>Podophyllum emodi</i>	1		
<i>Pistacia atlantica cabulica</i>	6		3
<i>Pistacia chinensis integerrima</i>	3		3
<i>Pistacia khinjuk</i>	7		12
<i>Prunus armeniaca</i>	73	102	
<i>Prunus bucharica</i>	1		1
<i>Prunus cerasifera</i>	7		1
<i>Prunus cerasioides</i>		1	
<i>Prunus cerasus</i>	1		1
<i>Prunus cornuta</i>	3		3
<i>Prunus dulcis</i>	12	2	
<i>Prunus jacquemontii</i>	2		3
<i>Prunus kuramica</i>	1		2
<i>Prunus mahaleb</i>	1		1
<i>Prunus persica</i>	19		10
<i>Prunus prostrata</i>			1
<i>Prunus salicina</i>			1
<i>Prunus tomentosa</i>	1		1
<i>Punica granatum</i>	1		
<i>Pyrus pashia</i>	5	3	4
<i>Pyrus sp. (cvs)</i>	1	37	15
<i>Quercus baloot</i>	1		1
<i>Rhamnus prostrata</i>	1		1
<i>Rhamnus virgata</i>	1		1
<i>Ribes alpestre</i>	1		2
<i>Ribes himalense</i>	1		2

	<u>seeds</u>	<u>scions</u>	<u>herb spec</u>
Ribes orientale	2	1	6
Robinia pseudoacacia			1
Rosa macrophylla	1		1
Rosa sp.	2		
Rubus anatolicus	5		4
Rubus ellipticus	1		1
Rubus hoffmeisterianus	7		7
Rubus irritans	2		3
Rubus macilentus	2		1
Rubus niveus	7		8 10
Rubus pungens			2 1
Sambucus wightiana	2		1
Solanum pseudocapsicum	3		2
Sorbaria tomentosa	1		1
Sorbus lanata	2	3	2
Sorbus tianshanica			1
Viburnum cotinifolium	1		1
Viburnum grandiflorum	3	1	3
Vitis Jacquemontii	9	10	23
Vitis Jacquemontii glabra		1	1
Vitis parvifolia		2	2
Vitis vinifera		69	4
Zizyphus nummularia	1		
Zizyphus oxyphylla	1		
Zizyphus spina-christi	1		
Zizyphus sp.	1		

APPENDIX IV. Complete List of Accessions

No.	Genus	Species	Cultivar	Seeds	Scions	Herb	Photo
880320	Acer	sp.		x			
880421	Alnus	nitida (Spach.) Endl.		x			
880459	Amaranthus	sp.		x		x	
880403	Amaranthus	sp.		x			
880362	Amaranthus	sp.		x			x
880290	Ampelopsis	sp.		x			
880248	Ampelopsis	vitifolia (Boiss.) Planch.		x		x	x
		vitifolia		x		x	x
880385	Ampelopsis	vitifolia (Boiss.) Planch.				x	x
		vitifolia					
880381	Ampelopsis	vitifolia (Boiss.) Planch.		x		x	x
		vitifolia					
880049	Ampelopsis	vitifolia (Boiss.) Planch.		x			x
		vitifolia					
880222	Ampelopsis	vitifolia (Boiss.) Planch.				x	
		vitifolia					
880335	Ampelopsis	vitifolia (Boiss.) Planch.		x		x	x
		vitifolia					
880077	Ampelopsis	vitifolia (Boiss.) Planch.				x	
		vitifolia					
880005	Ampelopsis	vitifolia (Boiss.) Planch.				x	
		vitifolia					
880353	Berberis	orthobotrys Bien. ex Aitch.		x		x	x
880429	Cedrus	deodara (Roxb. ex Lamb.) G. Don		x			
880307	Celtis	caucasica Willd.		x		x	
889749	Coix	lachryma L.		x			x
880391	Cornus	macrophylla Wall. ex Roxb.		x		x	
880066	Corylus	jacquemontii Decne.				x	x
880253	Corylus	jacquemontii Decne.				x	x
880430	Corylus	jacquemontii Decne.		x			
880423	Corylus	jacquemontii Parker		x			
880235	Cotoneaster	affinis bacillaris Lindl.		x		x	x
880317	Cotoneaster	affinis bacillaris Lindl.		x		x	x
880390	Cotoneaster	affinis bacillaris Lindl.		x		x	
880452	Cotoneaster	affinis bacillaris Lindl.		x		x	
880328	Cotoneaster	affinis bacillaris Lindl.		x		x	x
880309	Cotoneaster	integerrima Medik.				x	
880455	Cotoneaster	lindleyi Steud.				x	
880284	Cotoneaster	lindleyi Steud.				x	
880251	Cotoneaster	nummularia Fisch. and Mey.		x		x	x
880269	Cotoneaster	nummularia Fisch. and Mey.		x		x	x
880304	Cotoneaster	nummularia Fisch. and Mey.		x		x	
880319	Cotoneaster	nummularia Fisch. and Mey.		x		x	
880322	Cotoneaster	nummularia Fisch. and Mey.		x		x	
880278	Cotoneaster	sp.		x		x	x
880061	Crataegus	songarica C. Koch				x	
880105	Crataegus	songarica C. Koch				x	
880327	Crataegus	songarica C. Koch				x	x
880250	Crataegus	songarica C. Koch		x		x	x
880289	Crataegus	songarica C. Koch		x		x	x
880237	Crataegus	songarica C. Koch		x		x	x

APPENDIX IV (cont.)

No.	Genus	Species	Cultivar	Seeds	Scions	Herb	Photo
880299	Crataegus	songarica C. Koch		x			
880438	Crataegus	songarica C. Koch		x			x
880612	Cydonia	oblonga Mill.			x		
880734	Diospyros	kaki L.	Japani		x		
880449	Diospyros	lotus L.					
880451	Diospyros	lotus L.		x			
880422	Diospyros	lotus L.		x			
880446	Diospyros	lotus L.		x		x	
880406	Diospyros	lotus L.		x			
880392	Diospyrus	lotus L.		x			x
880059	Duchesnea	indica (Andr.) Focke		x			x
880082	Duchesnea	indica (Andr.) Focke		x		x	
880071	Elaeagnus	angustifolia L.		x		x	x
880384	Eleagnus	angustifolia L.		x			
880331	Eleagnus	angustifolia L.		x			x
880211	Eleagnus	umbellata Thunb.				x	
880238	Eleagnus	umbellata Thunb.		x		x	
880268	Ephedra	gerardiana Wall. ex Stapf.		x		x	x
880036	Ephedra	intermedia tibetica Stapf.		x		x	x
880524	Ficus	carica L.	Black Fig 1		x		
880574	Ficus	carica L.	Skardu Black		x		
880053	Ficus	palmata Forssk. virgata (Roxb.) Browicz				x	
880287	Ficus	palmata Forssk. virgata (Roxb.) Browicz		x			
880463	Ficus	palmata Forssk. virgata (Roxb.) Browicz				x	
880213	Ficus	palmata Forssk. virgata (Roxb.) Browicz		x			
880306	Ficus	palmata Forssk. virgata (Roxb.) Browicz		x			
880361	Ficus	palmata Forssk. virgata (Roxb.) Browicz		x			
880076	Ficus	palmata Forssk. virgata (Roxb.) Browicz		x			
880748	Ficus	sarmentosa Buch-Ham. ex J. E. Smith		x			
880462	Ficus	sarmentosa Buch-Ham. ex J. E. Smith		x			
880054	Ficus	sarmentosa Buch.-Ham ex J. E. Smith				x	
880117	Fragaria	nubicola Lindl. ex Lacaita		x			
880001	Fragaria	nubicola Lindl. ex Lacaita		x			
880065	Fragaria	nubicola Lindl. ex Lacaita				x	
880083	Fragaria	nubicola Lindl. ex Lacaita				x	
880070	Fragaria	nubicola Lindl. ex Lacaita		x		x	x
880359	Fragaria	sp. <i>Potentilla niven</i> L.		x		x	x
880321	Fraxinus	raibocarpa Rgl.		x		x	
880323	Fraxinus	xanthoxyloides Wall.		x		x	x
880298	Fraxinus	xanthoxyloides Wall.		x			
880019	Hippophae	rhamnoides L.				x	
880263	Impatiens	brachycentra Kar. and Kir.				x	
880272	Impatiens	brachycentra Kar. and Kir.		x			
880259	Impatiens	edgeworthii Hk.		x		x	

APPENDIX IV (cont.)

No.	Genus	Species	Cultivar	Seeds	Scions	Herb	Photo
880267	Impatiens	glandulifera	Royle	x			
880208	Impatiens	glandulifera	Royle	x		x	x
880258	Impatiens	glandulifera	Royle	x		x	
880318	Impatiens	glandulifera	Royle	x			
880273	Impatiens	glandulifera	Royle	x			x
880064	Juglans	regia	L.	x		x	
880340	Juglans	regia	L.	x			x
880325	Juglans	regia	L.	x			
880345	Juglans	regia	L.	x			
880348	Juglans	regia	L.	x			
880344	Juglans	regia	L.	x			
880315	Juglans	regia	L.	x			
880346	Juglans	regia	L.	x			
880465	Juglans	regia	L.	x			
880368	Juglans	regia	L.	x			
880474	Juglans	regia	L.	x			
880439	Juglans	regia	L.	x			
880473	Juglans	regia	L.	x			
880343	Juglans	regia	L.	x			
880458	Juglans	regia	L.	x			
880434	Juglans	regia	L.	x			
880412	Juglans	regia	L.	x			
880432	Juglans	regia	L.	x			
880246	Juglans	regia	L.	x			
880301	Juglans	regia	L.	x			
880424	Juglans	regia	L.	x			
880466	Juglans	regia	L.	x			
880341	Juglans	regia	L.	x			
880483	Juglans	regia	L.	x			
880427	Juglans	regia	L.		x		x
880478	Juglans	regia	L.	x			
880431	Juglans	regia	L.	x			
880425	Juglans	regia	L.	x			
880457	Juglans	regia	L.	x			
880408	Juglans	regia	L.				
880743	Juglans	regia	L.		x		
880468	Juglans	regia	L.	x			
880426	Juglans	regia	L.	x			
880404	Juglans	regia	L.	x			
880405	Juglans	regia	L.	x			
880545	Juglans	regia	L.	x			
880638	Juglans	regia	L.	x			
880464	Juglans	regia	L.	x			
880591	Juglans	regia	L.				
880698	Juglans	regia	L.		x		
880700	Juglans	regia	L.		x		
880710	Juglans	regia	L.		x		
880711	Juglans	regia	L.		x		
880467	Juglans	regia	L.		x		
880717	Juglans	regia	L.	x			
880548	Juglans	regia	L.		x		
			Byaroke Starga				
			Culapore		x		
			Henzal		x		
			Janduhl I		x		
			Janduhl II		x		
			Meng Phali	x			
			Navakalay		x		
			Tile		x		

APPENDIX IV (cont.)

No.	Genus	Species	Cultivar	Seeds	Scions	Herb	Photo
880354	Juniperus	communis L. saxatilis Pall.		x		x	x
880270	Juniperus	communis L. saxatilis Pall.		x		x	
880279	Juniperus	excelsa M.B.		x		x	
880280	Juniperus	excelsa M.B.		x		x	
880355	Juniperus	excelsa M.B.		x		x	
880311	Juniperus	excelsa M.B.		x		x	
880744	Kydia	calycina Roxb.		x		x	
880045	Malus	domestica Borkh.		x			
880046	Malus	domestica Borkh.		x			x
880044	Malus	domestica Borkh.		x			x
880626	Malus	domestica Borkh.	Bongkushu		x		
880713	Malus	domestica Borkh.	Chikboy		x		
880444	Malus	domestica Borkh.	Chitralli		x		
880116	Malus	domestica Borkh.	Chotta			x	x
880487	Malus	domestica Borkh.	Chulam Nur		x		
880549	Malus	domestica Borkh.	Goharaman		x		
880709	Malus	domestica Borkh.	Googbubay		x		
880563	Malus	domestica Borkh.	Kachura		x		
880582	Malus	domestica Borkh.	Karfokushu		x		
880469	Malus	domestica Borkh.	Kashmiri Ambri		x		
880625	Malus	domestica Borkh.	Keris Amri		x		
880544	Malus	domestica Borkh.	Khosbui		x		
880567	Malus	domestica Borkh.	Local Ambri		x		
880528	Malus	domestica Borkh.	Mamubalt		x		
880590	Malus	domestica Borkh.	Naskushu		x		
880488	Malus	domestica Borkh.	Nurshah		x		
880570	Malus	domestica Borkh.	Quetta Ambri		x		
880668	Malus	domestica Borkh.	Sari		x		
880139	Malus	domestica Borkh.	Shakri	x			x
880550	Malus	domestica Borkh.	Sherumbalt		x		
880523	Malus	domestica Borkh.	Shikumbalt		x		
880492	Malus	domestica Borkh.	Shinibalt I		x		
880522	Malus	domestica Borkh.	Shinibalt II		x		
880118	Malus	domestica Borkh.	Shirr			x	x
880413	Malus	domestica Borkh.	Shirr	x			
880600	Malus	domestica Borkh.	Shukar		x		
880624	Malus	domestica Borkh.	Shukarkushu		x		
880609	Malus	domestica Borkh.	Skieurkushu		x		
880027	Morus	alba L.		x		x	
880013	Morus	alba L.				x	
880021	Morus	alba L.				x	x
880025	Morus	alba L.				x	
880022	Morus	alba L.				x	x
880018	Morus	alba L.				x	
880498	Morus	alba L.	Black Seedless I		x		
880613	Morus	alba L.	Black Seedless II		x		
880497	Morus	alba L.	White Seedless I		x		
880543	Morus	alba L.	White Seedless II		x		
880614	Morus	alba L.	White Seedless III		x		
880033	Morus	nigra L.	Kashmiri			x	
880569	Morus	nigra L.	Kashmiri		x		

APPENDIX IV (cont.)

No.	Genus	Species	Cultivar	Seeds	Scions	Herb	Photo
880026	Morus	serrata Roxb.		x		x	
880023	Morus	serrata Roxb.		x		x	x
880007	Morus	serrata Roxb.		x		x	x
880031	Morus	serrata Roxb.		x		x	x
880333	Olea	ferruginea Royle		x		x	x
880336	Olea	ferruginea Royle		x			
880394	Olea	ferruginea Royle		x			
880060	Parrotiopsis	jacquemontiana (Decne) Rehder				x	
880274	Parrotiopsis	jacquemontiana (Decne) Rehder		x		x	
880435	Pinus	gerardiana Wall. ex Lamb		x			x
880296	Pistacia	atlantica Desf. cabulica (Stocks) Rech.		x		x	
880297	Pistacia	atlantica Desf. cabulica (Stocks) Rech.		x		x	x
880281	Pistacia	atlantica Desf. cabulica (Stocks) Rech.		x		x	x
880308	Pistacia	atlantica Desf. cabulica (Stocks) Rech.		x			
880303	Pistacia	atlantica Desf. cabulica (Stocks) Rech.		x			
880305	Pistacia	atlantica Desf. cabulica (Stocks) Rech.		x			x
880088	Pistacia	chinensis integerrima J.L. Stewart ex Brandis		x		x	x
880120	Pistacia	chinensis integerrima J.L. Stewart ex Brandis		x			x
880080	Pistacia	chinensis integerrima J.L. Stewart ex Brandis		x		x	
880075	Pistacia	chinensis integerrima J.L. Stewart ex Brandis				x	
880052	Pistacia	khinjuk Stocks				x	
880050	Pistacia	khinjuk Stocks				x	
880035	Pistacia	khinjuk Stocks				x	
880364	Pistacia	khinjuk Stocks		x		x	x
880365	Pistacia	khinjuk Stocks		x		x	x
880282	Pistacia	khinjuk Stocks		x		x	
880285	Pistacia	khinjuk Stocks		x		x	
880034	Pistacia	khinjuk Stocks				x	
880163	Pistacia	khinjuk Stocks				x	x
880294	Pistacia	khinjuk Stocks		x		x	
880132	Pistacia	khinjuk Stocks		x		x	
880286	Pistacia	khinjuk Stocks		x		x	x
880450	Platanus	orientalis L.		x			
880265	Podophyllum	emodi Wall. ex Royle		x			
880048	Prunus	armeniaca L.		x			x
880029	Prunus	armeniaca L.		x			
880010	Prunus	armeniaca L.		x			
880100	Prunus	armeniaca L.		x			x
880040	Prunus	armeniaca L.		x			
880011	Prunus	armeniaca L.		x			x
880276	Prunus	armeniaca L.		x			x

APPENDIX IV (cont.)

No.	Genus	Species	Cultivar	Seeds	Scions	Herb	Photo
880123	Prunus	armeniaca L.		x			
880008	Prunus	armeniaca L.		x			
880292	Prunus	armeniaca L.		x			
880009	Prunus	armeniaca L.		x			x
880041	Prunus	armeniaca L.		x			x
880133	Prunus	armeniaca L.		x			
881031	Prunus	armeniaca L.		x			x
880475	Prunus	armeniaca L.		x			
880742	Prunus	armeniaca L.	Abdullah Khani		x		
880126	Prunus	armeniaca L.	Alishah Kakas	x			x
880147	Prunus	armeniaca L.	Alishah Kakas	x			x
880489	Prunus	armeniaca L.	Alishah Kakas I		x		
880506	Prunus	armeniaca L.	Alishah Kakas II		x		
880504	Prunus	armeniaca L.	Almon		x		
880592	Prunus	armeniaca L.	Amba		x		
880606	Prunus	armeniaca L.	Andur		x		
880507	Prunus	armeniaca L.	Argoon		x		
880162	Prunus	armeniaca L.	Argoon Ju	x			x
880628	Prunus	armeniaca L.	Azischuli		x		
880143	Prunus	armeniaca L.	Badam Kakas	x			x
880178	Prunus	armeniaca L.	Badamchuli	x			x
880568	Prunus	armeniaca L.	Badamchuli		x		
880537	Prunus	armeniaca L.	Balansju		x		
880520	Prunus	armeniaca L.	Bibaju		x		
880603	Prunus	armeniaca L.	Blochuli I		x		
880604	Prunus	armeniaca L.	Blochuli II		x		
880618	Prunus	armeniaca L.	Blochuli III		x		
880635	Prunus	armeniaca L.	Blochuli IV		x		
880707	Prunus	armeniaca L.	Boi		x		
880559	Prunus	armeniaca L.	Brochuli I		x		
880581	Prunus	armeniaca L.	Brochuli II		x		
880144	Prunus	armeniaca L.	Bulbul-e-Shikanda	x			x
880142	Prunus	armeniaca L.	Burum Kakas	x			x
880161	Prunus	armeniaca L.	Burum Ju	x			x
880494	Prunus	armeniaca L.	Burumju		x		
880180	Prunus	armeniaca L.	Chaksachuli	x			
880150	Prunus	armeniaca L.	Dail Mesh	x			x
880184	Prunus	armeniaca L.	Dolpa	x			x
880637	Prunus	armeniaca L.	Dolpa		x		
880596	Prunus	armeniaca L.	Dosopa		x		
880517	Prunus	armeniaca L.	Doulato		x		
880508	Prunus	armeniaca L.	Dudasen-e-Ju		x		
880138	Prunus	armeniaca L.	Dudour	x			x
880500	Prunus	armeniaca L.	Dudour		x		
880152	Prunus	armeniaca L.	Dulatoju	x			x
880540	Prunus	armeniaca L.	Kakas		x		
880136	Prunus	armeniaca L.	Galserin	x			x
880738	Prunus	armeniaca L.	Gambir		x		
880141	Prunus	armeniaca L.	Gaqai Shikanda	x			x
880157	Prunus	armeniaca L.	Gaqai Tinani	x			x
880155	Prunus	armeniaca L.	Garkmish	x			x

APPENDIX IV (cont.)

No.	Genus	Species	Cultivar	Seeds	Scions	Herb	Photo
880608	Prunus	armeniaca L.	Chonchuli		x		
880502	Prunus	armeniaca L.	Chulamju		x		
880542	Prunus	armeniaca L.	Green Dudour		x		
880586	Prunus	armeniaca L.	Gurdaluchuli		x		
880495	Prunus	armeniaca L.	Gurman Chili		x		
880160	Prunus	armeniaca L.	Gurman Chili	x			x
880129	Prunus	armeniaca L.	Habiju	x			x
880148	Prunus	armeniaca L.	Habiju	x			x
880185	Prunus	armeniaca L.	Habiju	x			x
880125	Prunus	armeniaca L.	Habiju	x			x
880124	Prunus	armeniaca L.	Habiju	x			x
880135	Prunus	armeniaca L.	Habiju	x			x
880511	Prunus	armeniaca L.	Habiju I		x		
880521	Prunus	armeniaca L.	Habiju II		x		
880169	Prunus	armeniaca L.	Halmon	x			x
880561	Prunus	armeniaca L.	Halmon I		x		
880564	Prunus	armeniaca L.	Halmon II		x		
880416	Prunus	armeniaca L.	Hari	x			
880182	Prunus	armeniaca L.	Hashimpa	x			x
880634	Prunus	armeniaca L.	Hashimpa		x		
880665	Prunus	armeniaca L.	Hotar		x		
880496	Prunus	armeniaca L.	Huratum Ju		x		
880153	Prunus	armeniaca L.	Jamal Kutzay Ju	x			x
880536	Prunus	armeniaca L.	Janjir		x		
880127	Prunus	armeniaca L.	Janjir seedling	x			x
880099	Prunus	armeniaca L.	Kabuli	x			x
880546	Prunus	armeniaca L.	Kabuli		x		
880177	Prunus	armeniaca L.	Kachachuli	x			x
880602	Prunus	armeniaca L.	Kachachuli		x		
880183	Prunus	armeniaca L.	Kakas	x			x
880667	Prunus	armeniaca L.	Kandas		x		
880578	Prunus	armeniaca L.	Kapuke		x		
880666	Prunus	armeniaca L.	Karasho		x		
880175	Prunus	armeniaca L.	Karfochuli	x			x
880171	Prunus	armeniaca L.	Karfochuli	x			x
880565	Prunus	armeniaca L.	Karfochuli		x		
880598	Prunus	armeniaca L.	Kartaksha I		x		
880636	Prunus	armeniaca L.	Kartaksha II		x		
880146	Prunus	armeniaca L.	Kartashi	x			x
880145	Prunus	armeniaca L.	Khan-e-Ju	x			x
880503	Prunus	armeniaca L.	Khan-e-Ju		x		
880172	Prunus	armeniaca L.	Khapuke	x			
880131	Prunus	armeniaca L.	Khoban	x			x
880552	Prunus	armeniaca L.	Khoban I		x		
880589	Prunus	armeniaca L.	Khoban II		x		
880605	Prunus	armeniaca L.	Khoban III		x		
880585	Prunus	armeniaca L.	Khochuli		x		
880541	Prunus	armeniaca L.	Khojaijui		x		
880165	Prunus	armeniaca L.	Khoshenda	x			x
880555	Prunus	armeniaca L.	Khoshenda		x		
880579	Prunus	armeniaca L.	Khostar		x		

APPENDIX IV (cont.)

No.	Genus	Species	Cultivar	Seeds	Scions	Herb	Photo
880704	Prunus	armeniaca L.	Khubani		x		
880173	Prunus	armeniaca L.	Korkumchuli	x			x
880607	Prunus	armeniaca L.	Korkumchuli		x		
880518	Prunus	armeniaca L.	Kundu		x		
880151	Prunus	armeniaca L.	Lakesh	x			x
880706	Prunus	armeniaca L.	Lala		x		
880619	Prunus	armeniaca L.	Late Karfochuli		x		
880620	Prunus	armeniaca L.	Late Sdlg. #1		x		
880621	Prunus	armeniaca L.	Late Sdlg. #2		x		
880610	Prunus	armeniaca L.	Luonapochuli		x		
880736	Prunus	armeniaca L.	Mahmudi		x		
880516	Prunus	armeniaca L.	Maiunju		x		
880594	Prunus	armeniaca L.	Mamur		x		
880167	Prunus	armeniaca L.	Margulam	x			x
880560	Prunus	armeniaca L.	Margulam I		x		
880562	Prunus	armeniaca L.	Margulam II		x		
880380	Prunus	armeniaca L.	Mindilakhs	x			
880491	Prunus	armeniaca L.	Mindilakhs		x		
880137	Prunus	armeniaca L.	Mir Mamudi I	x			x
880554	Prunus	armeniaca L.	Mir Mamudi I		x		
880130	Prunus	armeniaca L.	Mir Mamudi II	x			x
880553	Prunus	armeniaca L.	Mir Mamudi II		x		
880510	Prunus	armeniaca L.	Nabatahahi		x		
880156	Prunus	armeniaca L.	Nagarum Shikanda	x			x
880158	Prunus	armeniaca L.	Nazarali Kutzay Tinani	x			x
880140	Prunus	armeniaca L.	Neeli	x			x
880701	Prunus	armeniaca L.	Neeli		x		
880705	Prunus	armeniaca L.	Nukap		x		
880379	Prunus	armeniaca L.	Paiwand	x			
880490	Prunus	armeniaca L.	Paiwand		x		
880485	Prunus	armeniaca L.	Paw Mamur		x		
880509	Prunus	armeniaca L.	Pushkish		x		
880154	Prunus	armeniaca L.	Pushkish Ju	x			x
880575	Prunus	armeniaca L.	Quetta #1		x		
880176	Prunus	armeniaca L.	Quetta #2	x			x
880576	Prunus	armeniaca L.	Quetta #2		x		
880149	Prunus	armeniaca L.	Quropo	x			x
880515	Prunus	armeniaca L.	Quropo		x		
880588	Prunus	armeniaca L.	Rahinchuli		x		
880164	Prunus	armeniaca L.	Rangbuon	x			x
880556	Prunus	armeniaca L.	Rangbuon		x		
880708	Prunus	armeniaca L.	Safeda		x		
880166	Prunus	armeniaca L.	Sarakarpo	x			x
880557	Prunus	armeniaca L.	Sarakarpo		x		
880535	Prunus	armeniaca L.	Shabeck		x		
880170	Prunus	armeniaca L.	Shaganda	x			x
880580	Prunus	armeniaca L.	Shaganda		x		
880159	Prunus	armeniaca L.	Shai Kutzay Ju	x			x
880597	Prunus	armeniaca L.	Shaksa		x		
880587	Prunus	armeniaca L.	Sharapa Margulam		x		
880539	Prunus	armeniaca L.	Shayjui		x		

APPENDIX IV (cont.)

No.	Genus	Species	Cultivar	Seeds	Scions	Herb	Photo
880192	Prunus	armeniaca L.	Shikanda	x			x
880484	Prunus	armeniaca L.	Shikanda I		x		
880505	Prunus	armeniaca L.	Shikanda II		x		
880538	Prunus	armeniaca L.	Shirini jui		x		
880378	Prunus	armeniaca L.	Shobaig	x			
880611	Prunus	armeniaca L.	Shuruckchuli		x		
880377	Prunus	armeniaca L.	Sorus	x			
880593	Prunus	armeniaca L.	Stoonchuli		x		
880530	Prunus	armeniaca L.	Sumalbeck		x		
880519	Prunus	armeniaca L.	Suriasunju		x		
880737	Prunus	armeniaca L.	Svat #2		x		
880599	Prunus	armeniaca L.	Tachuli		x		
880534	Prunus	armeniaca L.	Unchi jui		x		
880558	Prunus	armeniaca L.	Wafochuli		x		
880584	Prunus	armeniaca L.	Yakar		x		
880595	Prunus	armeniaca L.	Yarkimpa		x		
880367	Prunus	bucharica Korsh.		x		x	x
880015	Prunus	cerasifera Ehr.				x	
880081	Prunus	cerasifera Ehr.		x			
880024	Prunus	cerasifera Ehr.		x			x
880004	Prunus	cerasifera Ehr.		x			
880103	Prunus	cerasifera Ehr.		x			x
880042	Prunus	cerasifera Ehr.		x			x
880043	Prunus	cerasifera Ehr.		x			x
880101	Prunus	cerasifera Ehr.		x			x
880747	Prunus	cerasioides D. Don			x		x
880114	Prunus	cerasus L.		x		x	x
880062	Prunus	cornuta (Wall. ex Royle) Steud.				x	
880255	Prunus	cornuta (Wall. ex Royle) Steud.		x			
880260	Prunus	cornuta (Wall. ex Royle) Steud.		x		x	x
880262	Prunus	cornuta (Wall. ex Royle) Steud.		x			
880119	Prunus	cornuta (Wall. ex Royle) Steud.				x	
880349	Prunus	dulcis (Mill.) D. A. Webb		x			
880472	Prunus	dulcis (Mill.) D. A. Webb		x			
880639	Prunus	dulcis (Mill.) D. A. Webb		x			
880601	Prunus	dulcis (Mill.) D. A. Webb		x			
880482	Prunus	dulcis (Mill.) D. A. Webb		x			
880350	Prunus	dulcis (Mill.) D. A. Webb		x			
880739	Prunus	dulcis (Mill.) D. A. Webb		x			
880347	Prunus	dulcis (Mill.) D. A. Webb		x			
880360	Prunus	dulcis (Mill.) D. A. Webb		x			
880479	Prunus	dulcis (Mill.) D. A. Webb		x			
880740	Prunus	dulcis (Mill.) D. A. Webb	Abdul Wahdi	x			
880533	Prunus	dulcis (Mill.) D. A. Webb	Nasirabad Khagzi		x		
880532	Prunus	dulcis (Mill.) D. A. Webb	Nasirabad Khagzi	x			
880741	Prunus	dulcis (Mill.) D. A. Webb	Shakh-i-Bugz	x			
880573	Prunus	dulcis (Mill.) D. A. Webb	Skardu Khagzi		x		
880038	Prunus	jacquemontii Hk.f				x	
880069	Prunus	jacquemontii Hk.f				x	x
880264	Prunus	jacquemontii Hk.f		x			
880252	Prunus	jacquemontii Hk.f		x		x	x

APPENDIX IV (cont.)

No.	Genus	Species	Cultivar	Seeds	Scions	Herb	Photo
880295	Prunus	kuramica (Korsh.) Kitam.					x
880293	Prunus	kuramica (Korsh.) Kitam.					x
880326	Prunus	kuramica (Korsh.) Kitam.					x
880310	Prunus	mahaleb L.		x			x
880342	Prunus	persica (L.) Batsch.		x			x
880332	Prunus	persica (L.) Batsch.		x			x
880329	Prunus	persica (L.) Batsch.		x			x
880330	Prunus	persica (L.) Batsch.		x			x
880314	Prunus	persica (L.) Batsch.		x			x
880366	Prunus	persica (L.) Batsch.		x			x
880369	Prunus	persica (L.) Batsch.		x			x
880471	Prunus	persica (L.) Batsch.		x			x
880291	Prunus	persica (L.) Batsch.		x			x
880277	Prunus	persica (L.) Batsch.		x			x
880370	Prunus	persica (L.) Batsch.	Chalpachu	x			
880572	Prunus	persica (L.) Batsch.	Charmaghz		x		
880193	Prunus	persica (L.) Batsch.	Chitar	x			x
880551	Prunus	persica (L.) Batsch.	Chugdar		x		
880371	Prunus	persica (L.) Batsch.	Churko	x			
880527	Prunus	persica (L.) Batsch.	Habijibika Chugdar		x		
880372	Prunus	persica (L.) Batsch.	Hunshu	x			
880629	Prunus	persica (L.) Batsch.	Keris #1		x		
880630	Prunus	persica (L.) Batsch.	Keris #2		x		
880631	Prunus	persica (L.) Batsch.	Keris #3		x		
880632	Prunus	persica (L.) Batsch.	Keris #4		x		
880633	Prunus	persica (L.) Batsch.	Keris #5		x		
880373	Prunus	persica (L.) Batsch.	Khanda	x			
880374	Prunus	persica (L.) Batsch.	Loimari	x			
880375	Prunus	persica (L.) Batsch.	Lutkoo	x			
880616	Prunus	persica (L.) Batsch.	Takaahu I	x			
880615	Prunus	persica (L.) Batsch.	Takashu I		x		
880617	Prunus	persica (L.) Batsch.	Takashu II		x		
880376	Prunus	persica (L.) Batsch.	Thulu	x			
880324	Prunus	prostrata Labill.					x
880016	Prunus	salicina Lindl.					x
880179	Prunus	tomentosa Thunb.					x
880363	Punica	granatum L.		x			x
880230	Pyrus	pashia Ham. ex D. Don		x			x
880393	Pyrus	pashia Ham. ex D. Don					x
880389	Pyrus	pashia Ham. ex D. Don		x			x
880454	Pyrus	pashia Ham. ex D. Don		x			x
880395	Pyrus	pashia Ham. ex D. Don		x			x
880453	Pyrus	pashia Ham. ex D. Don		x			x
880275	Pyrus	pashia Ham. ex D. Don		x			x
880398	Pyrus	pashia Ham. ex D. Don	Khapa		x		x
880525	Pyrus	sp.	Tanchi I		x		x
880571	Pyrus	sp.	Atagar		x		
880623	Pyrus	sp.	Bagugosha I		x		
880722	Pyrus	sp.	Bagugosha II		x		
880234	Pyrus	sp.	Bap Tangoo		x		
880418	Pyrus	sp.	Batang			x	x
			Batang			x	

APPENDIX IV (cont.)

No.	Genus	Species	Cultivar	Seeds	Scions	Herb	Photo
880725	Pyrus	sp.	Batang I	x			
880735	Pyrus	sp.	Batang II	x			
880115	Pyrus	sp.	Batanji			x	
880529	Pyrus	sp.	Dutkinas	x			
880400	Pyrus	sp.	Frashishi	x		x	
880627	Pyrus	sp.	Gha	x			
880566	Pyrus	sp.	Gompapa	x			
880513	Pyrus	sp.	Joghoso I	x			
880017	Pyrus	sp.	Jogoso			x	
880526	Pyrus	sp.	Jogoso II	x			
880501	Pyrus	sp.	Jujukutzay	x			
880232	Pyrus	sp.	Khan			x	x
880719	Pyrus	sp.	Khan Tangoo I	x			
880732	Pyrus	sp.	Khan Tangoo II	x			
880716	Pyrus	sp.	Khapa	x			
880226	Pyrus	sp.	Kharnak			x	x
880723	Pyrus	sp.	Kharnak I	x			
880729	Pyrus	sp.	Kharnak II	x			
880731	Pyrus	sp.	Kharnak III	x			
880622	Pyrus	sp.	Kusuk	x			
880231	Pyrus	sp.	Mamusay			x	x
880726	Pyrus	sp.	Mamusay	x			
880223	Pyrus	sp.	Nak			x	x
880399	Pyrus	sp.	Nak Batang	x			
880712	Pyrus	sp.	Nak I	x			
880727	Pyrus	sp.	Nak II	x			
880714	Pyrus	sp.	Nashpati I	x			
880730	Pyrus	sp.	Nashpati II	x			
880224	Pyrus	sp.	Parao			x	x
880715	Pyrus	sp.	Paraov	x			
880486	Pyrus	sp.	Poot Pesho	x			
880225	Pyrus	sp.	Rootstock sprout			x	x
880728	Pyrus	sp.	Shinkwalay	x			
880531	Pyrus	sp.	Shoghoi II				
880227	Pyrus	sp.	Shukar			x	x
880228	Pyrus	sp.	Shukar			x	x
880718	Pyrus	sp.	Shukar I	x			
880724	Pyrus	sp.	Shukar II	x			
880493	Pyrus	sp.	Soghoi I	x			
880721	Pyrus	sp.	Spin Tangoo	x			
880720	Pyrus	sp.	Sur Tangoo	x			
880402	Pyrus	sp.	Tanchi II	x		x	x
880733	Pyrus	sp.	Tanga	x			
880240	Pyrus	sp.	Tangoo			x	x
880547	Pyrus	sp.	Unknown cv.				
880433	Quercus	baloot Griff.		x		x	
880312	Rhamnus	prostrata Jacq. ex Parker		x		x	
880250	Rhamnus	virgata Roxb.		x		x	
880351	Ribes	alpestre Decne ex Jacq.		x		x	x
880039	Ribes	alpestre Decne ex Jacq.				x	
880107	Ribes	himalense Decne				x	

APPENDIX IV (cont.)

No.	Genus	Species	Cultivar	Seeds	Scions	Herb	Photo
880352	Ribes	himalense Decne		x		x	x
880266	Ribes	orientale Desf.		x			
880068	Ribes	orientale Desf.				x	
880174	Ribes	orientale Desf.		x		x	
880037	Ribes	orientale Desf.				x	
880106	Ribes	orientale Desf.				x	
880168	Ribes	orientale Desf.				x	
880577	Ribes	orientale Desf.	Satpara		x	x	x
880339	Robinia	pseudoacacia L.				x	
880358	Rosa	macrophylla Lindl.		x		x	
880300	Rosa	sp.		x			
880436	Rosa	sp.		x			
880288	Rubus	anatolicus (Focke) Focke ex Hausskn.		x			x
880051	Rubus	anatolicus (Focke) Focke ex Hausskn.				x	
880334	Rubus	anatolicus (Focke) Focke ex Hausskn.		x			x
880073	Rubus	anatolicus (Focke) Focke ex Hausskn.				x	
880074	Rubus	anatolicus (Focke) Focke ex Hausskn.		x			
880057	Rubus	anatolicus (Focke) Focke ex Hausskn.				x	x
880089	Rubus	anatolicus (Focke) Focke ex Hausskn.		x		x	
880207	Rubus	anatolicus (Focke) Focke ex Hausskn.		x			
880003	Rubus	ellipticus Smith		x			
880056	Rubus	ellipticus Smith				x	
880030	Rubus	hoffmeisterianus Kunth and Bouche		x		x	
880086	Rubus	hoffmeisterianus Kunth and Bouche		x			
880067	Rubus	hoffmeisterianus Kunth and Bouche				x	
880012	Rubus	hoffmeisterianus Kunth and Bouche		x		x	
880014	Rubus	hoffmeisterianus Kunth and Bouche		x			x
880313	Rubus	hoffmeisterianus Kunth and Bouche				x	
880112	Rubus	hoffmeisterianus Kunth and Bouche		x			x
880111	Rubus	hoffmeisterianus Kunth and Bouche				x	
880006	Rubus	hoffmeisterianus Kunth and Bouche		x		x	x
880072	Rubus	hoffmeisterianus Kunth and Bouche		x		x	x
880356	Rubus	irritans Focke		x		x	
880108	Rubus	irritans Focke				x	x
880261	Rubus	irritans Focke		x		x	
880085	Rubus	macilentus Camb.		x		x	x
880087	Rubus	macilentus Camb.		x			
880058	Rubus	niveus Thunb.				x	
880090	Rubus	niveus Thunb.				x	
880121	Rubus	niveus Thunb.		x			
880055	Rubus	niveus Thunb.				x	
880079	Rubus	niveus Thunb.		x			
880113	Rubus	niveus Thunb.				x	x

APPENDIX IV (cont.)

No.	Genus	Species	Cultivar	Seeds	Scions	Herb	Photo
880028	Rubus	niveus Thunb.				x	
880214	Rubus	niveus Thunb.		x		x	
880096	Rubus	niveus Thunb.		x			
880236	Rubus	niveus Thunb.				x	
880092	Rubus	niveus Thunb.		x		x	
880094	Rubus	niveus Thunb.		x		x	
880414	Rubus	niveus Thunb.		x			
880110	Rubus	pungens Camb.				x	
880084	Rubus	pungens Camb. <i>niveus Thunb.</i>				x	
880257	Sambucus	wightiana Wall. ex Wight and Arn.		x			
880256	Sambucus	wightiana Wall. ex Wight and Arn.		x		x	
880097	Solanum	pseudocapsicum L.		x		x	x
880212	Solanum	pseudocapsicum L.		x		x	x
880417	Solanum	pseudocapsicum L.		x			x
880428	Sorbaria	tomentosa (Lindl.) Rehder		x		x	
880442	Sorbus	lanata (D. Don) S. Schauer		x			
880316	Sorbus	lanata (D. Don) S. Schauer		x		x	
880441	Sorbus	lanata (D. Don) S. Schauer			x		x
880271	Sorbus	lanata (D. Don) S. Schauer				x	
880443	Sorbus	lanata (D. Don) S. Schauer			x		
880440	Sorbus	lanata (D. Don) S. Schauer			x		
880357	Sorbus	tianshanica Rupr.				x	x
880254	Viburnum	cotinifolium D. Don		x		x	x
880063	Viburnum	grandiflorum Wall. ex D.C.		x		x	x
880109	Viburnum	grandiflorum Wall. ex D.C.		x		x	
880411	Viburnum	grandiflorum Wall. ex D.C.			x		
880217	Vitis	jacquemontii Parker				x	
880104	Vitis	jacquemontii Parker				x	
880419	Vitis	jacquemontii Parker			x	x	
880102	Vitis	jacquemontii Parker				x	
880420	Vitis	jacquemontii Parker		x	x	x	
880249	Vitis	jacquemontii Parker		x		x	
880387	Vitis	jacquemontii Parker			x	x	x
880078	Vitis	jacquemontii Parker				x	x
880401	Vitis	jacquemontii Parker			x	x	
880247	Vitis	jacquemontii Parker		x			x
880221	Vitis	jacquemontii Parker				x	
880122	Vitis	jacquemontii Parker				x	
880098	Vitis	jacquemontii Parker				x	x
880460	Vitis	jacquemontii Parker			x	x	
880093	Vitis	jacquemontii Parker				x	
880209	Vitis	jacquemontii Parker		x			
880206	Vitis	jacquemontii Parker		x			x
880216	Vitis	jacquemontii Parker				x	
880218	Vitis	jacquemontii Parker				x	
880215	Vitis	jacquemontii Parker		x			
880220	Vitis	jacquemontii Parker				x	
880219	Vitis	jacquemontii Parker		x			
880229	Vitis	jacquemontii Parker				x	
880470	Vitis	jacquemontii Parker			x	x	
880210	Vitis	jacquemontii Parker		x			

APPENDIX IV (cont.)

No.	Genus	Species	Cultivar	Seeds	Scions	Herb	Photo
880447	Vitis	jacquemontii Parker	Cidar Kwar	x			
880396	Vitis	jacquemontii Parker	Kali Dakh I	x		x	
880409	Vitis	jacquemontii Parker	Kali Dakh II	x		x	
880702	Vitis	jacquemontii Parker	Kwar I	x			
880461	Vitis	jacquemontii Parker	kali Dakh	x			
880407	Vitis	jacquemontii glabra Lawson		x	x	x	
880456	Vitis	parvifolia Roxb.		x		x	
880095	Vitis	parvifolia Roxb.		x		x	
880653	Vitis	vinifera L.	Aliagar	x			
880641	Vitis	vinifera L.	Auodirang	x			
880660	Vitis	vinifera L.	Badadargoon	x			
880644	Vitis	vinifera L.	Bargoon	x			
880669	Vitis	vinifera L.	Barkilay	x			
880656	Vitis	vinifera L.	Berurargoon	x			
880640	Vitis	vinifera L.	Bohmochan	x			
880652	Vitis	vinifera L.	Borargoon	x			
880388	Vitis	vinifera L.	Boyalsing I	x			x
880671	Vitis	vinifera L.	Boyalsing II	x			
880383	Vitis	vinifera L.	Broom	x			
880672	Vitis	vinifera L.	Budrilay	x			
880693	Vitis	vinifera L.	Buraburi	x			
880649	Vitis	vinifera L.	Burgoon	x			
880657	Vitis	vinifera L.	Chamo	x			
880646	Vitis	vinifera L.	Chargoon	x			
880648	Vitis	vinifera L.	Churgoon	x			
880410	Vitis	vinifera L.	Dakh				x
880397	Vitis	vinifera L.	Dakh	x			x
880689	Vitis	vinifera L.	Dalnato I	x			
880691	Vitis	vinifera L.	Dalnato II	x			
880686	Vitis	vinifera L.	Dardari	x			
880690	Vitis	vinifera L.	Fatai	x			
880687	Vitis	vinifera L.	Gashochi	x			
880659	Vitis	vinifera L.	Gubistan	x			
880499	Vitis	vinifera L.	Guduri	x			
880650	Vitis	vinifera L.	Gungargoon	x			
880662	Vitis	vinifera L.	Himali	x			
880663	Vitis	vinifera L.	Hosargoon	x			
880658	Vitis	vinifera L.	Hussaini	x			
880688	Vitis	vinifera L.	Ishkin	x			
880678	Vitis	vinifera L.	Junjali	x			
880477	Vitis	vinifera L.	Kabuli	x			
880675	Vitis	vinifera L.	Kala Kostan	x			
880645	Vitis	vinifera L.	Kargoon	x			
880697	Vitis	vinifera L.	Kashiri	x			
880674	Vitis	vinifera L.	Kashrilay	x			
880699	Vitis	vinifera L.	Khorestini	x			
880382	Vitis	vinifera L.	Kini Yatch I	x			
880386	Vitis	vinifera L.	Kini Yatch II	x		x	x
880476	Vitis	vinifera L.	Kini Yatch III	x		x	
880684	Vitis	vinifera L.	Kostan	x			
880703	Vitis	vinifera L.	Kwar II	x			

APPENDIX IV (cont.)

No.	Genus	Species	Cultivar	Seeds	Scions	Herb	Photo
880481	Vitis	vinifera L.	Luthuri		x		x
880670	Vitis	vinifera L.	Margoan	x			
880480	Vitis	vinifera L.	Matsumshun I	x			x
880512	Vitis	vinifera L.	Matum Margoan	x			
880682	Vitis	vinifera L.	Matum Shilshun Chraing I	x			
880683	Vitis	vinifera L.	Matum Shilshun Chraing II	x			
880681	Vitis	vinifera L.	Matumshun II	x			
880514	Vitis	vinifera L.	Millishun	x			
880679	Vitis	vinifera L.	Muscalochi	x			
880642	Vitis	vinifera L.	Nakpoghangargoan	x			
880692	Vitis	vinifera L.	Namonia	x			
880696	Vitis	vinifera L.	Neeli	x			
880673	Vitis	vinifera L.	Neelilay	x			
880664	Vitis	vinifera L.	Nilok	x			
880654	Vitis	vinifera L.	Nosargoan	x			
880680	Vitis	vinifera L.	Palziji	x			
880661	Vitis	vinifera L.	Parargoan	x			
880677	Vitis	vinifera L.	Schwin	x			
880685	Vitis	vinifera L.	Shikumshun	x			
880651	Vitis	vinifera L.	Shingargoan	x			
880655	Vitis	vinifera L.	Shoklo	x			
880695	Vitis	vinifera L.	Shuwarti	x			
880694	Vitis	vinifera L.	Soniahawi	x			
880445	Vitis	vinifera L.	Spin Kvar	x			
880448	Vitis	vinifera L.	Spin Ugad	x		x	
880643	Vitis	vinifera L.	Sunourargoan	x			
880647	Vitis	vinifera L.	Torgoon	x			
880745	Zizyphus	nummularia (Burm. f) Wight		x			
880746	Zizyphus	oxyphylla Edgew.		x			
880337	Zizyphus	sp.		x			
880091	Zizyphus	spina-christi (L.) Willd.					x
***	Total	***					

APPENDIX V

Fruit and Nut Species Remaining to be Collected

Northern mountainous regions

Crataegus wattiana Hemsl. and Lace
Prunus griffithii (Boiss.) C.K. Schneid.
Prunus prostrata Labill.
Ribes glaciale Wall.
Ribes nigrum L.
Rubus antennifer Hk.f. (= *R. caesius* L.)
Rubus biflorus Ham. ex Sm.
Rubus paniculatus Sm.
Rubus pungens Camb.
Rubus saxatilis L.
Sorbus tianshanica Rupr.

Baluchistan and /or Kurram Valley

Crataegus wattiana Hemsl. and Lace
Pistacia vera L. (cultivars)
Prunus aitchisonii (Korsh.) Kitam.
Prunus brahuica (Boiss.) Aitch. and Hemsl.
Prunus microcarpa C.A. Mey.
Prunus rechingeri (Browicz) R.R.S. n. comb.