Exploration for *Rubus, Vaccinium, Ribes,* and *Fragaria* Germplasm in N.E. China

Heilongjiang and Jilin Provinces

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A USA-China Collaborative Project

USDA-ARS
National Clonal Germplasm Repository
Corvallis, Oregon, USA

USDA-ARS
Horticulture Crops Research Lab
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cover photo: fruit vendors at Songhua Reservoir near Jilin

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We want to thank **Mr. Xu Deying** for providing the administrative support in China and for approval of Zhang Qinghua's participation in this exploration trip. We are especially grateful to **Xi Shengke** and **Zhang Qinghua** who not only accompanied us the entire time but, also, must have spent many hours in planning the itinerary and making extensive advance arrangements. Their organization of our itinerary, making the contacts, and arranging accommodations was excellent. They also were invaluable for their services as interpreters at locations where there were no English-speaking people. Xi Shengke skillfully provided interpretation for lectures presented by Joseph Postman and Chad Finn at several Institutions.

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Du Feng Guo, from the Department of Forest Resources, Jilin College of Forestry, joined us for the excursions in Jilin Province. We were very pleased to draw upon his taxonomic expertise. As he teaches a class in the native flora, he knew the Latin names for virtually all the woody plants as well as many herbaceous plants. As he also speaks English quite well, we had good communication with him.

Gao Wei Ge, Deputy Director, Yabuli Forestry Bureau, very kindly hosted us in Yabuli, providing accommodations and vehicles, and guided us around to see the fruits, both wild and cultivated, in this region. A special treat here was the visit to the recently developed winter resort, the ride up a long ski chair lift (from which we had a bird's eye view of *Actinidia kolomikta* and *Vitis amurensis* plants among the trees) and the thrilling ride down a 2806 m-long, winding metal toboggan slide. Thanks to Mr. Gao for a unique experience, one we will never forget.

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INTRODUCTION

Our objectives were to explore for small fruit species (the genera *Rubus*, *Vaccinium*, *Ribes*, and *Fragaria*) in the Provinces of Heilongjiang and Jilin in Northeast China, not because of the great diversity of species there but rather to sample the genetic diversity in the few species that have potential value for direct use in breeding programs. The target species were either not present in the U.S.D.A. Plant Germplasm System or were under-represented, and none had been collected from this part of the world. We especially wanted to obtain an increased spectrum of genetic variation within some species, e.g. *Rubus crataegifolius* and *Rubus sachalinensis*, because they are known to have valuable traits for raspberry breeding. The severe climate in that region indicates that all species are particularly cold-hardy and would be especially adaptable in northern regions in the United States. We also wanted to make contacts and to discover the locations of other fruit and nut genera known to occur there (*Actinidia*, *Vitis*, *Malus*, *Pyrus*, *Juglans* and *Corylus*) for future plant collectors who might visit later in the year when the season is more appropriate for collecting seeds or scions. Incidentally, we also collected seeds of other woody genera that might have value as cold-hardy ornamentals. Herbarium specimens of all species were prepared for verification of their identity.

GEOGRAPHY AND CLIMATE

Heilongjiang and Jilin Provinces are in the most northeastern part of China, with Heilongjiang the most northern. We collected in these two provinces between about 41° 55′ and 53° 37′ N latitude and between 122° 16′ and 127° 15′ E. longitude. The elevation ranged from 154 m to 1769 m. Collecting sites were in the Xiao Xing An Ling, a low range of north-south mountains east of Harbin, in the Da Xing An Ling, a somewhat higher elevation range of north-south mountains northwest of Harbin, and in the Changbai Mountains southwest of Jilin City. The northeastern part of China where we visited is divided into three floristic regions: the central part, known as the Song Liao plains, is a vast agricultural plain with principally corn and soybeans. The eastern region is the Bai Shan zone which includes the Xiao Xing An Ling range in the north and the Changbai Mtns. in the south, both heavily forested regions. In the western and northwestern part is the Xing An zone, which includes the Da Xing An Ling range which rises to somewhat higher elevation and is also largely forested. In fact, a large proportion of China's forests are in these two Provinces of Jilin and Heilongjiang.

In the north and west, the climate is severely cold in winter, reaching as low as minus 53°C in the coldest regions, with relatively little precipitation and strong winds. In summer, it is warm with frequent rains. The northernmost regions have boreal forests consisting of birch (*Betula* sp.), larch (*Larix* sp.), pines (*Pinus* sp.), and spruce (*Picea* sp.) with extensive undergrowth of *Vaccinium vitis-idaea* and vast fields of *Vaccinium uliginosum* in open areas. The sparse human population is concentrated in widely scattered forestry-based towns along the train lines. Farther south and east, in the Changbai mountains and vicinity, there is clearly higher precipitation and somewhat milder climate as there is lush undergrowth and much greater variety of herbs and shrubs as well as a very diverse mixture of deciduous and coniferous tree

species. Overall, there is far greater diversity of plant species in this region than in Heilongjiang. Also, one sees more agricultural activities in this region.

ORGANIZATIONAL ASPECTS

The initial concept for the exploration trip was provided by Maxine Thompson and the proposal was developed with the cooperation of Xi Shengke and Zhang Qinghua in China and Joseph Postman in Oregon. The third American team member, Chad Finn, was included shortly before we departed for China. Once the target species were identified, our Chinese collaborators prepared the itinerary and made all the necessary contacts in China. As our collaborators are affiliated with the Chinese Academy of Forestry and wild fruits are considered to be in the domain of Forestry Bureaus, these were the agencies that hosted and assisted us as we traveled around in Heilongjiang and Jilin Provinces. In this part of China, the Forestry Bureau officials are also the administrators for virtually all economic activities, including hotels as well as managing all forestry-based operations. Therefore, for the most part, we were guests in their hotels and they also provided us with local guides and vehicles. Some of our long distance travel was by train or plane so, at each major train or plane destination, our collaborators had arranged with Forestry Bureau officials to meet us and to take charge of our meals, accommodations, and guiding local plant explorations.

The exploration grant funds were handled as follows. We prepared a letter stating that we were handing over the entire amount to be spent in China to the Director of the Institute of Forest Ecology and Environment in the Chinese Academy of Forestry and that he has agreed that his staff (namely Zhang Qinghua) would take care of all in-country costs throughout our one-month period in China. This letter with his signature served as a single receipt for the USDA funds. This is a very satisfactory arrangement as it would be too complicated to try to obtain receipts (in Chinese) for every expenditure by every person on the trip.

Overall, we traveled long distances and visited regions with diverse types of vegetation, and in so doing we obtained a fairly good idea of where wild fruit and nut species can be found. We would liked to have spent more time in the field, but because of the large area we covered and the relatively short time we were there, our field observations were necessarily limited. The last 5 days in China we spent in Beijing for exposure to their marvelous tourist attractions. A day-by-day summary of our trip schedule is given in Appendix 2, and a map of the itinerary is presented in Appendix 3.

SUMMARY OF PLANT COLLECTIONS

Much of our collecting was done along the roadside. Because of the long distances we traveled and frequent heavy rains our collection forays out into the woods or fields was more limited than we would have preferred. As a consequence, the relative numbers of each species collected is biased towards roadside plants. The list of species collected includes the target genera, other fruit and nut genera, and miscellaneous shrubs and trees with potential ornamental use (Appendix 4). Collection numbers 96001 to 96096B represent plants that we collected, whereas numbers 96097 to 96134 refer to seed samples that were very kindly given to us by our

collaborator, Zhang Qinghua, who had collected them the previous year.

The Target Genera - Rubus, Fragaria, Vaccinium, and Ribes

Rubus Species

The most common *Rubus* species were *Rubus crataegifolius* Bunge and *Rubus sachalinensis*. Lev. We found *R. crataegifolius* near Harbin (obtained from peddlers in the city), northeast of Harbin in the Dailing region, east of Harbin in the Yabuli region, and abundantly along the roadside southeast from Jilin in the Changbai Mtns. However, it was not seen near Jiagedaqi or northward from there. This species had mature fruit, so several samples were collected. Fruits are extensively harvested from wild plants and this is the most important *Rubus* species sold fresh in local markets. One of our collections (96050), a pooled sample bought from peddlers at Songhua Lake, had exceptionally large fruit (2.5-3 cm wide and 2 cm high), and may be our most important accession for direct use in breeding. This accession has already been distributed to raspberry breeders in N. America, New Zealand and Scotland. All other collections had considerably smaller fruits, about 1.2-1.5 cm wide and 0.7 to 1.0 cm high). There was no evidence of any genetic selection or cultivation nor did we hear of any processing.

Rubus sachalinensis is very widespread in these two Provinces; it is commonly found in thickets along the roads or other disturbed sites. We saw it in Dailing region, near Jiagedaqi and all the way to the northern border near the Heilongjiang River, along the road to Songjianghe, and in the Changbai Mtns., but not in Yabuli region. Our observations, and the opinion of local botanists, is that this, along with *R. crataegifolius*, are the only two species of red raspberry native to this region. Some taxonomists have separated out *R. komarovi* Nakai on the basis of its having green, or non-tomentose, undersides of leaves as compared to the white, tomentose undersides of *R. sachalinensis*. We saw plants of both types of leaves and, unless there are some other distinguishing traits, we do not believe that this is an important enough trait in itself for a species designation. However, in the Herbarium of the Chinese Academy of Sciences in Beijing there were specimens of both types labeled as *R. komarovi* and *R. sachalinensis*. There did seem to be great variation in the amount of bristles and thorns, variation that seemed to be continuous rather than distinct types. Mostly, plants were flowering or in early stages of fruit development and, only rarely did we find mature fruits with seeds. Fruits were relatively small (about 1.0 cm diam.) and often somewhat crumbly. Herbarium specimens from all *Rubus* samples were tested for raspberry bushy dwarf virus (RBDV) by ELISA upon return to the US. This virus is associated with crumbly fruit in cultivated red-raspberries, however all samples tested negative. Throughout the regions we visited, although plants were abundantly flowering, flowers were often browning and drying and were not forming fruits. Fruits were very sparse and ripe fruit tended to have a very small number of drupelets. While we suspect this may be a characteristic of this species, environmental conditions during the current year may have been a factor. The only explanation we got from local people for this apparent sterility was that there had been a late frost (about the time of flower buds or flowering). Mr. Liu Xin Tan told us that plants are very productive in some years. Normally, in the more northern regions, peak

maturity for fruit is in mid-August, about 2-3 weeks after we were there. Fruits are harvested from wild plants and used primarily at home. Apparently, berries are too soft to sell even on local markets.

Rubus arcticus L. was collected in the Dailing region, near Jiagedaqi and northwards in the Huzhong Nature Preserve and near Xin Ling, where it was very abundant. At all locations, plants were mostly flowering, although we did find a few fruits. The relatively infrequent sightings as compared to the previous two species is no doubt due to their low, inconspicuous growth habit.

Rubus saxatilis L. Only two seed samples were collected, both in the most northern regions that we visited; one north of Mo He and the other along the roadside about 16 km south of Ta He town on the way from Mo He to Xin Lin. Our infrequent sightings were probably due to the fact that much of our collecting was done along disturbed roadsides rather than exploring forest floor understory vegetation where this species occurs.

The *Rubus ideaus* L. plants and seeds collected were from cultivated, or escaped, plants introduced by the Russian settlers in Yabuli, east of Harbin, many years previously. This species does not occur naturally in the regions we explored.

Both *Rubus multibracteatus* Levl. & Vant. and *Rubus niveus* Thunb. seeds were collected in other Provinces in a previous year by Zhang Qinghua, and presented to us at the end of our trip. These species are not found this far north.

Fragaria Species

Fragaria orientalis Lozinsk was observed in most regions where we collected. Except for the collections at higher elevations on Changbai Mtn., one at 1514 m (96059) and the other at 1769 m (96058), both of which had abundant fruit on 2 August, most plants seen were well past the fruiting season, so only few seeds could be obtained from them. This is a common species in all regions where we visited, from the Changbai Mts in the southeast to the Da Xing An Ling in the northwest and as far north as the Heilongjiang River. Local botanists told us that this is the only *Fragaria* species in Jilin and Heilongjiang. We were also told that it is more abundant in the Da Xing An Ling than in the Dailing region. In Mo He, and no doubt in other regions, fruit of this species is harvested from wild plants and, although very small (1 cm long) and soft, is thought to have better taste than cultivated strawberries.

Fragaria nilgerrensis Schldl. ex Gay seeds were collected by Zhang Qinghua in another Province in a previous year and were given to us at the end of our trip. This species does not occur in the northeastern Provinces.

Vaccinium Species

Vaccinium uliginosum L. is a very widespread and common blueberry species in northeast China. In the northern part of Heilongjiang, where there was an extensive forest fire in 1978, the opened-up flat land, which tends to be boggy, provides an ideal habitat for *Vaccinium uliginosum* so that this has become a dominant feature of the vegetation for thousands of hectares. As it was fruiting when we were there, we made many collections. Considerable fruit is harvested from wild plants and sold by local peddlers. There is a processing plant in Heilongjiang at Jiagedaqi and in Mo He,

primarily for juice production for this species and for *V. vitis-idaea*. It is apparent that there is a vast fruit resource here which is undoubtedly underexploited, partly due to underdeveloped processing methods, promotion, and marketing systems. We observed a great deal of genetic variability for traits such as fruit size and shape and productivity in the wild plants, but there has been no selection program nor cultivation of this species. Seed samples were also collected southeast of Jilin in the Changbai Mtns. although this species is not so common there because most of the region is forested and there are fewer open areas suitable for it. There are, however, four regions where this species can be found; they are all above 900 m elevation where there is wet soil. There are also factories for juice and wine in this region but not enough production to supply the factories.

The var. *alpinum* was seen only on Changbai Mtn. Plants are miniature and fruits were small and, although they were not quite mature, we collected a few seeds.

Vaccinium vitis-idaea L., the lingonberry, is another very common species in northern Heilongjiang where it grows as an understory plant in forests, and in open fields. Mo He is the the most important center of lingonberry production, and these berries as well as *Vaccinium uliginosum* are processed as juice here. Although we did collect four seed samples, most of the berries were not ripe yet when we were there, 23-25 July. We were told that they harvest them from 10 August to September. Because of the high value of lingonberry products on the world market and the abundance of plants there, this, also, appears to be an underexploited natural resource.

Vaccinium koreanum Nakai. Seeds were collected at 1800 m elevation in the mountains in Liaoning Province in September 1996 by a friend of our collaborator, Zhang Qinghua, and given to us in Corvallis when she visited here in late September.

Ribes species

We found relatively few plants each of possibly 6 *Ribes* species and collected seeds from 5 of them. Plants were found more sporadically than *Rubus* species, with small patches widely separated from each other. The fact that they tend to occur in the forest and are not easily observable along the roadside may account for our relatively few observations and collections. There was some uncertainty about the species identification in some cases.

Non-target Fruit and Nut Species

Corylus heterophylla Fisch. ex Trautv. was very common in open, disturbed sites south of 51°N latitude. We were told that this was as far north as this species occurs. We observed it in the Da Xing An Ling, the Xiao Xing An Ling and southeast of Jilin in the Changbai Mts. It grows in extensive thickets of shrubs to about 1.5m high, and is found only in disturbed soils such as along roads, railroads, or after "burns". Unfortunately, most of the nuts were too immature to collect. However, on 4 August we found shrubs whose nut shells were not yet turning brown but whose kernels were full size, so we collected these in hopes that seeds would be germinable (96074). The other nut sample had been collected the year before and was given to us by Zhang Qinghua. In Dalian, Liaoning Province, where we did not visit, there is a selection program where interspecific hybrids (with *C. avellana*) have been made and

some evaluations of these plants have been made in Jilin. However, there has been no selection nor cultivation of this species in Jilin and Heilongjiang Provinces. Nuts are harvested from wild plants and we saw them for sale in the Beijing markets. It appears that there is good potential to develop this species as a commercial crop in N.E. China. We saw much variation in nut size and, particularly, in productivity of plants. One nut sample, collected in the Botanical Garden in Beijing on Aug. 12, was probably mature enough. Based on the large size of these shrubs (3-4 m tall), they were probably the subspecies *yunnanesis*.

Actinidia species were found only in the eastern regions where there is higher rainfall and the dense, forest vegetation provides an ideal habitat. We observed three species on this trip.

Actinidia polygama (Sieb. & Zucc.) Maxim. was observed only in the Dailing region on 18 July, at which time fruit was nowhere near ripe enough to collect seeds. We were told that fruits mature in September.

Actinidia arguta (Sieb. & Zicc.) Planch. ex Miq. was very common in forests in the eastern regions we visited- i.e., the Xiao Xing An Ling and in the Changbai Mts. We collected immature seeds at two sites and cuttings at one, although we were not optimistic about their survival. The third sample(96116) had been collected the previous year and was given to us. At the Research Institute of the Chinese Academy of Agriculture, located several kilometers north of Jilin City, there is a selection program for the following native species: *Actinidia arguta* and *A. kolomikta*, *Crataegus pinnatifida* Bunge., *Pyrus ussuriensis* Maxim., *Vitis amurensis* Maxim., and *Schizandra chinensis* (Turcz.) Bail., a medicinal plant. 'Qui', a large-fruited (40 gms) selection of *Actinidia arguta* was named and released to farmers last year.

Actinidia kolomikta (Maxim. & Rupr.) Maxim. was also very common and, no doubt, because of its variegated leaves, was more easily observable than *A. arguta* as we drove along the road. It was especially abundant in the forests in the Changbai Mts. southeast of Jilin, in the Xiao Xing An Ling near Dailing, and in the Yabuli region east of Jilin. We collected immature seeds from two plants and cuttings of two other plants, although we did not have satisfactory storage for cuttings. We were told that fruit matures in September.

Actinidia chinensis Planch. seeds were collected in a different region in the previous year and were given to us in Beijing at the end of our trip.

Lonicera caerulea edulis Regel. is found throughout the northern region. It is a small shrub which grows as an understory in the forests and produces small (12-20 mm long), elongated, semi-tart dark blue fruits that mature very early, in June, and before strawberry season. We obtained several seed samples, some from fruits stored for a few weeks in the refrigerator and a few late-ripening fruits from plants at higher elevations. The fruit is harvested from wild plants and sold on local markets. We did not hear of any attempts to make selections from the wild plants nor to cultivate them. Fruit keeps well under refrigeration for one month and it was said that fruits have a natural fungicide so they do not mold in storage.

Malus baccata (L.) Borkh. is common near Yabuli, east of Jilin. In fact, the name of this town is derived from the Russian word for apples, as Yabuli was originally

settled by Russian people and they observed the abundance of wild apples in this vicinity. Fruits were not yet ripe when we were there on 9 August, but we collected seeds from one sample (96095). Fruits were small, 8 x 9 mm and immature. The other two seed samples had been collected the previous year and were given to us at the end of our trip.

Malus sieversii does not occur in Northeast China; it is native to the Tian Shan Mts., a range which extends from Central Asia into Xinjiang Province. The seed sample reported here was collected the previous year in Xinjiang and given to us at the end of our trip.

Prunus davidiana (Carriere) Franch. seeds were collected on 5 August in the garden at Jilin Forestry University. Fruits were dry and dehiscent or easily broken along the suture. We were told that this tree was probably introduced from Hebei or Shansi Province. It is very cold-hardy and the earliest blooming tree in the Garden, so our hosts were quite sure that the seeds were pure species rather than interspecific hybrids. Seeds are used for medicinal purposes and are not edible. The other seed sample (96120) was collected in the previous year in Dailing region (where it was probably introduced because I do not think that this species is native to Heilongjiang or Jilin) and given to us by our collaborator.

Prunus manshurica Koehne seeds were also collected from the Gardens of Jilin Forestry University in Jilin City. Fruit was over-mature and mostly on the ground on August 5. We made no observations on wild trees of this native species although it is surely native to northeast China.

Prunus padus L. seeds (96052) were collected on 1 August from a wild tree along the road about 300 km SE of Jilin City on the way to Songjianghe. Fruits were mature but are not edible.

Prunus tomentosa Thunb. seeds were obtained from mature fruits. Although not native to the Northeast, this species was introduced to the Dailing region about 40-50 years ago when people moved into the region. It is so well-adapted here that it has naturalized and is commonly planted in home gardens. Fruit was ripe on 18 July and was being sold in local markets.

Pyrus calleryana Decne. does not occur in Jilin and Heilongjiang. The one seed sample was collected in Liaoning Province in 1995 by our collaborator and given to us in Beijing at the end of our trip.

Pyrus ussuriensis Maxim. is native to the Northeast, but we did not seek it in the forests because we were there too early in the season. There is a collection of cultivars and wild forms being evaluated at the Research Institute of the Chinese Academy of Agriculture, several kilometers west of Jilin City. We collected seeds from immature fruits from one wild-type tree in this collection. We were told that fruit size on wild trees varies from about 2 to 5 cm in diameter.

Vitis amurensis Maxim. was not collected because we were there too early in the season to obtain seeds or dormant cuttings, but we observed an abundance of plants. It grows in the forested regions of the eastern mountains. We saw it in the Dailing region of the Xiao Xing An Ling and plants are especially common in the Changbai Mtns. southeast of Jilin City. There seems to be considerable potential for

making selections from wild populations. At the Research Institute of the Chinese Academy of Agriculture near Jilin City, Mr. Shen Yujie has an active selection and breeding program. The *Vitis* collection there consisted of over 400 selections from the wild, and he plants out about 1,000 seedlings from controlled crosses per year. Mr. Shen has also made interspecific hybrids between *V. amurensis* and *V. vinifera*, but these plants lack cold-hardiness so must be buried in the winter to protect them against cold temperatures which reach minus 39° C.

Miscellaneous Cold-hardy Woody Plant Species

We obtained seeds of several other cold-hardy, woody species which may have value as ornamentals. These are included in the list of species collected (Appendix 4) but are not discussed in this report. Information on these species is given on collection sheets which are available, as for all plants collected, from either the site where seeds were deposited or from us, the collectors, and should also be available electronically from GRIN (The USDA-ARS Germplasm Resources Information Network).

Dispositon of Seeds and Herbarium Specimens

Because we obtained seeds of such a variety of plant species, we necessarily distributed them variously to the most appropriate USDA-ARS Germplasm Repository or, in a few cases, to active centers of research on specific species. Seeds of all species of our target genera, *Rubus, Fragaria, Vaccinium*, and *Ribes*, as well as those of *Pyrus, Sambucus, Sorbus* and *Lonicera caerulea* were placed in the National Clonal Germplasm Repository in Corvallis, Oregon. A complete list of the destination of all seeds is given in Appendix 5.

Herbarium specimens for *Rubus, Fragaria, Vaccinium, Ribes, Pyrus, Sambucus*, and *Sorbus* were placed at the NCGR in Corvallis. Herbarium specimens for other miscellaneous plant species were sent to the U.S. National Arboretum in Washington, D.C.

Future Potential Collaboration with Chinese Scientists

At each Institution where we visited, the Chinese scientists received us with great hospitality and extended their services generously for anything that we requested. In all cases, the scientists emphasized their strong interest in future collaboration. They were quite willing to share with us their wild berry germplasm resources which, as mentioned above, are considerable. They realize that they have a great potential to develop the berry industry, particularly blueberry and lingonberry, and they would like to have information about Western cultivars and cultivation methods, especially about the management of the wild fields of lowbush blueberry in northeastern North America. There is also strong interest in more information about different berry products, processing, and marketing systems.

Raspberries might also be a valuable crop for them but the wild species, *Rubus sachalinensis*, does not seem to be reliably productive enough and fruit is soft and small. We observed raspberry culture only in the vicinity of Yabuli, about 210 km east of Harbin. Many years ago the Russian settlers introduced strawberry, raspberry and

black currant cultivars all of which have been successfully grown here. Forestry Bureau officials expressed interest in trying to expand this culture and to do so, they would like new cultivars and information about modern cultivation practices.

In previous years, the Forestry Bureaus had guaranteed government support for all their various enterprises but, recently, they have been informed that henceforth they must be self-supporting. This change in economic policy has stimulated a greater interest in developing berries into a profit-generating industry. Some examples of specific cooperative programs are as follows:

1) Recently Wu Banghua at Jilin Forestry University has received a special grant for blueberry research. He was interested in purchasing blueberry cultivars and obtaining information on culture from the U.S. He plans to establish trial plots to determine which cultivars perform the best for them. Also, he mentioned inviting Chad Finn to return to Jilin University to give some lectures on berry cultivars and cultivation, and he would like to send one of his scientists to the U.S. to see and learn more about blueberry culture, both the highbush cultivars as well as the managed wild lowbush stands. They are also interested in processing methods and new products.

2) Mr. Dai Wanchun, Deputy Director of the Da Xing An Ling Forest Bureau and Mr. Liu Xin Tian, Research fellow, who is in charge of blueberries and hazelnuts, were also interested in future collaboration. They would like to obtain cold-hardy cultivars and cultural information for blueberry and lingonberry. They were interested particularly in our lowbush blueberry and methods of management. There is a processing plant in Jiagedaqi but they make only juice from the berries, and an herbal tea out of the leaves of *Vaccinium vitis-idaea*. They would like to expand the range of processed products made from berries.

3) Mr. Wu Xiaochun, Director of Forest Resources at the Heilongjiang Forest Science Institute, is interested in developing berry culture in Heilongjiang and would very much like more information on our berry production and cultivars. He accompanied us on the entire trip in Jilin and Heilongjiang, showed the greatest interest and was very enthusiastic and energetic in collecting germplasm. It was he with whom we shared all seed samples that were collected because of his interest and because he already has some berry plots established. If funds became available, he would like to visit berry research and production centers in the USA. If we wanted more germplasm from his general region, I feel confident that he would be a responsible person to contact. He also has good command of English language.

4) Mr. Shen Yujie, Vice Director, Institute of Special Economic Wild Animal and Plant Resources, Chinese Academy of Agricultural Sciences, is very active in evaluating selections from wild populations of *Actinidia arguta* and *A. kolomikta*, *Crataegus*, *Vitis amurensis*, and *Pyrus ussuriensis* and in breeding *Vitis amurensis*. He would be a good contact for anyone interested in these crops. He also speaks English moderately well.

5) Mr. Gao Wei Ge, Deputy Director, Yabuli Forestry Bureau, indicated an interest in expanding the raspberry, strawberry and black currant industry in the Yabuli region in Heilongjiang. Production has been declining in recent years because of an inadequate marketing and distribution system for the fruit, and also because the planned processing plant was never opened. They need new cultivars because those that they have are very old, having been introduced some 40-50 years ago. Chad agreed to send them the names and addresses of U.S. nurseries where they could buy new cultivars and Joseph said he would send them a few starts of some cultivars that might survive the low temperatures there. They also are interested in information on berry cultural methods. Here, in the Chang Quang Chei Ling, a branch of the Chang Bai Mts., would be a good region to obtain more germplasm of *Rubus crataegifolius, Corylus heterophylla, Actinidia kolomikta*, possibly, *A. arguta, Malus baccata*, and *Vitis amurensis*.

6) Mrs. Zhang Qinghua is interested in future plant explorations. She is familiar with diverse forested regions throughout the northern part of China and has many professional contact who would be useful collaborators for those interested in many different woody plant species.

An Elusive Strawberry at Changbai Shan

APPENDIX 1. Names and Addresses of Chinese Contacts

Hebei Province

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Heilongjiang Province

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APPENDIX 1. Names and Addresses of Chinese Contacts

Yichun City (Dailing Region)

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Mo He

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Xin Ling

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Yabuli

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Liu Jia Min, Director
Forestation Department
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Gao De Pei (retired)
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Jilin Province

Jilin City

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APPENDIX 1. Names and Addresses of Chinese Contacts

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Songjianghe

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Hunjiang City
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Sun Zhigang
Manager, Liason Dept.
SongjiangheTianchi Travel Service
of Jilin Province
Songjianghe, Baishan City
Jilin, 134504

APPENDIX 2. Summary of Trip Itinerary

Sunday, 14 July - Depart Corvallis 9:00 am.
Anthony's Limousine to Portland
Delta Flight 518 - leave Portland 1:20 pm,

Monday, 15 July
Arrive Tokyo 3:25 pm
United Flight 853 - depart Tokyo 6:15 pm, arrive Beijing 9:00 pm
Forestry institute van to Hotel near Xiang Shan west of Beijing.

All transportation, food, and lodging in China was arranged by our hosts, financed by $12,000 from USDA/ARS plant exploration grant, and $4500 from USDA/ARS Hort. Crops Lab.

Tuesday, 16 July
Meet with officials at Beijing Academy of Forestry. Fly China Air to Harbin, Van to East Hotel.

Wednesday, 17 July
Train from Harbin to Longshiang - 5 hours. Transported by official cars to Dailing Hotel

Thursday, 18 July
Van to Forestry Preserve, about 30 km NE of Dailing. Collect near Forestry Preserve Headquarters - Fire Tower trail in am, Mosquito trail in pm, stay in Forest Academy housing.

Friday, 19 July
Return to Dailing by van, collect en route. Return to Harbin by train, taxi to East Hotel

Saturday, 20 July
Spend day in Harbin, depart 6:30 pm by train to Jiagedaqi.

Sunday, 21 July
Arrive Jiagedaqi 6:30 am, buy blueberries in market, taxi to Bai Shan (North Hill) Hotel

Monday, 22 July
Collect am, visit juice/tea factory pm, stay at Bai Shan Hotel.

Tuesday, 23 July
Jeep caravan to Huzhong, collect en route, stay at Huzhong Forest Bureau Hotel.

Wednesday, 24 July
Collect am, Jeep caravan to Mohe pm, stay at Mohe Forest Bureau Hotel.

APPENDIX 2. Summary of Trip Itinerary

Thursday, 25 July

Visit Baijiechun (North Pole Village), stay at Mohe Forest Bureau Hotel.

Friday, 26 July

Jeep caravan south, lunch at Tahe, stay at XinLin Forest Bureau Hotel.

Saturday, 27 July

Collect north of XinLin on foot in am, get soaked. Visit exhibits, give lectures in pm.

Sunday, 28 July

Jeep caravan south to Jiagedaqi, farewell banquet at Bai Shan Hotel, visit Mr. Dai's home, depart 6:30 pm by train to Harbin.

Monday, 29 July

Arrive Harbin 6:30 am, rainy day, rest at East Hotel.

Tuesday, 30 July

Give lectures at Harbin Forest Academy in am, depart by train for Jilin pm, arrive 8:30 pm, University van to Dong Guan Hotel.

Wednesday, 31 July

Visit Songhua Reservoir and collect in am, view Chang Bai Shan video and discuss expedition plans in pm, stay at Dong Guan Hotel.

Thursday, 1 August

Depart 5:00 am by van, 12 hour drive to Songjianghe, stay at Forestry Bureau Hotel.

Friday, 2 August

Collect at Chang Bai Shan, picnic lunch near the mountain, visit the Lava Forest in pm, stay at Songjianghe Forestry Bureau Hotel.

Saturday, 3 August

Two vans with local forestry official to collect blueberries in swamp am, small group with Jilin driver in pm, stay at Songjianghe Forestry Bureau Hotel.

Sunday, 4 August

Depart Songjianghe 5:00 am, 12 hour drive back to Jilin, stay at Dong Guan Hotel.

Monday, 5 August

Present lectures at Jilin Forestry University am, travel about 50 km west to visit the Institute for Special Economic Wild Animal and Plant Sciences pm, stay at Dong Guan Hotel in Jilin.

APPENDIX 2. Summary of Trip Itinerary

Tuesday, 6 August

Depart Jilin by train 7:30 am, arrive Harbin 12:30 pm, rest and process samples pm, stay at East Hotel.

Wednesday, 7 August

Visit Harbin Arboretum am, shopping downtown pm, stay at East Hotel.

Thursday, 8 August

Travel east to Yabuli in rented van, about 4 hour drive, visit commercial farms to see small fruit culture pm, stay at Yabuli Forest Bureau Hotel.

Friday, 9 August

Collect am, go skiing pm, stay at Yabuli Forest Bureau Hotel.

Saturday, 10 August

Debrief with local officials then depart for Harbin, stay at East Hotel.

Sunday, 11 August

Organize and pack am, farewell lunch with Forest Academy officials, van to airpo rt, depart 2:00 pm China Air, arrive Beijing 4:30 pm, institute van to Xiang Shan Hotel.

Monday, 12 August

Visit Summer Palace am, Beijing Botanic Garden pm, dinner at Shengke's home, stay at Xiang Shan Hotel.

Tuesday, 13 August

Visit Great Wall am, visit Emperor's Tombs pm, stay at Xiang Shan Hotel.

Wednesday, 14 August

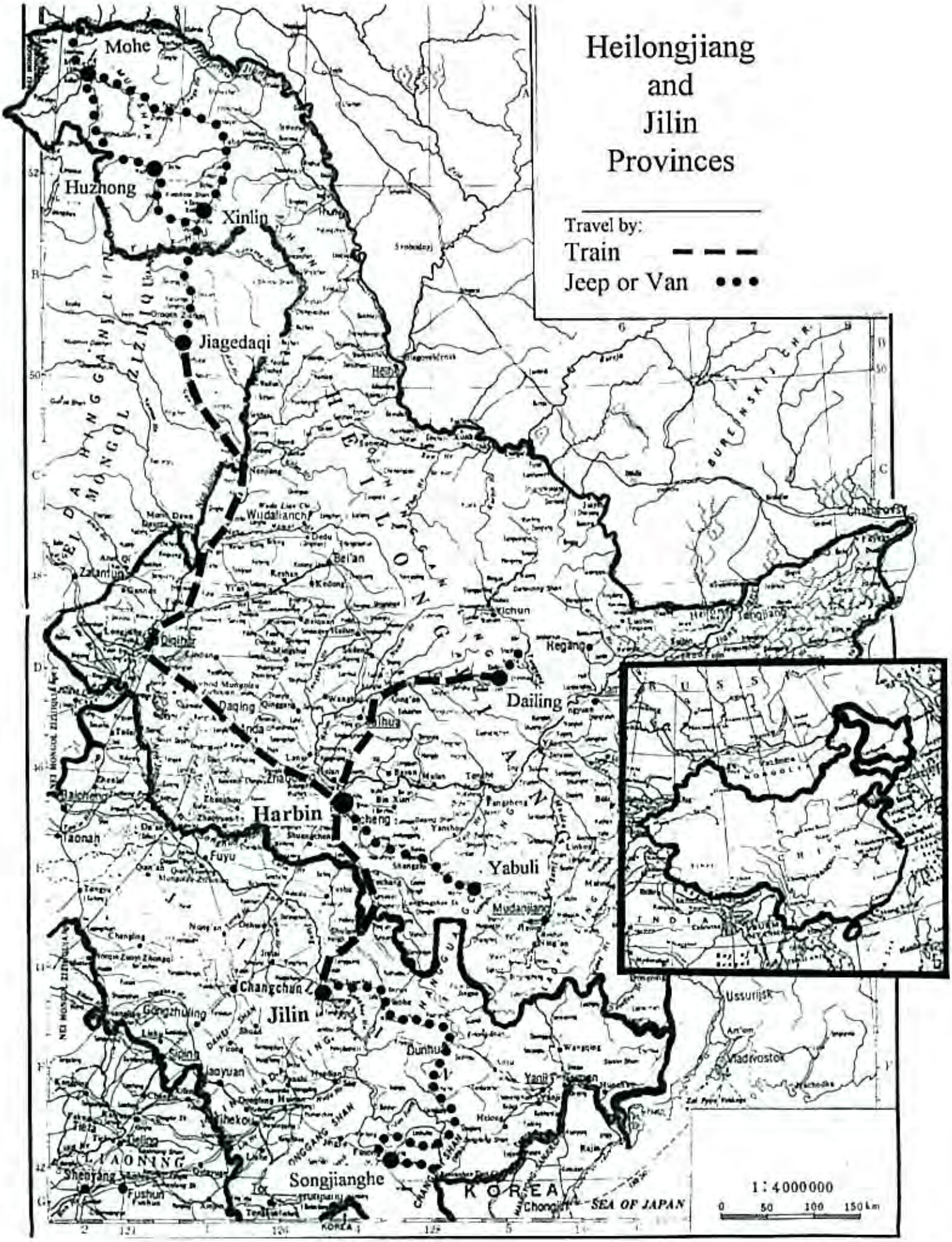
Shopping in downtown Beijing, walk across Tienanmien Square stay at Xiang Shan Hotel.

Thursday, 15 August

Visit Palace Museum pm, stay at Xiang Shan Hotel.

Friday, 16 August

Institute van to airport,
United Flight 828, depart Beijing 10:30 am, arrive Tokyo 3:00 pm.
Delta Flight 528 depart Tokyo 5:30 pm, arrive Portland 10:00 am.
Process plant material with APHIS officials, depart Portland 11:30 am.


Heilongjiang
and
Jilin
Provinces
Travel by:
Train
Jeep or Van
Mohe
Huzhong
Xinlin
Jiagedaqi
Wudalianchi
Bei'an
Zalantun
Qiqihar
Daqing
Harbin
Dailing
Kegang
Yichun
Yabuli
Mudanjiang
Fuyu
Changchun
Jilin
Dunhua
Yanji
Songjianghe
Ussurijsk
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KOREA
SEA OF JAPAN
LIAONING
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0 50 100 150 km

APPENDIX 4. Species Collected

No.	Species	Seeds	Cuttings	Herbarium
96073	Actinidia arguta var. arguta (Sieb. & Zucc.) Planch. ex		X	
96080B	Actinidia arguta var. arguta (Sieb. & Zucc.) Planch. ex	X		
96109	Actinidia arguta var. arguta (Sieb. & Zucc.) Planch. ex	X		
96116	Actinidia arguta var. arguta (Sieb. & Zucc.) Planch. ex	X		
96106	Actinidia chinensis Planch.	X		
96130	Actinidia chinensis Planch.	X		
96053	Actinidia kolomikta (Maxim. & Rupr.) Maxim.	X		X
96007	Actinidia kolomikta (Maxim. & Rupr.) Maxim.	X	X	
96072	Actinidia kolomikta (Maxim. & Rupr.) Maxim.		X	
96115	Broussonetia papyrifera (L.) Vent.	X		
96110	Calycanthus chinensis Cheng & S.Y. Chang	X		
96114	Celastrus orbiculata Thunb.	X		
96029	Cornus alba L.	X		
96066B	Cornus alba L.	X		X
96097	Cornus officinalis Sieb. & Zucc.	X		
96096B	Corylus heterophylla var. heterophylla Fisch. ex	X		
96014	Corylus heterophylla var. heterophylla Fisch. ex			X
96048	Corylus heterophylla var. heterophylla Fisch. ex		X	X
96074	Corylus heterophylla var. heterophylla Fisch. ex	X		
96102	Corylus heterophylla var. yunnanensis Franch.	X		
96006	Corylus sieboldiana var. mandshurica (Maxim.)			X
96131	Crataegus maximowiczii Schneid.	X		
96112	Diospyros tsangii Mer.	X		
96125	Fragaria nilgerrensis Schldl. ex Gay	X		
96013	Fragaria orientalis Lozinsk	X		X
96047	Fragaria orientalis Lozinsk		X	X
96011	Fragaria orientalis Lozinsk	X		X
96026	Fragaria orientalis Lozinsk	X		X
96059	Fragaria orientalis Lozinsk	X		X
96128	Fragaria orientalis Lozinsk	X		

APPENDIX 4. Species Collected

No.	Species	Seeds	Cuttings	Herbarium
96058	Fragaria orientalis Lozinsk	X		X
96108	Indigofera pseudotinctoria Matsum.	X		
96060	Lonicera caerulea var. edulis Turcz. ex Herder	X		
96008	Lonicera caerulea var. edulis Turcz. ex Herder	X		
96057	Lonicera caerulea var. edulis Turcz. ex Herder	X		X
96103	Lonicera caerulea var. edulis Turcz. ex Herder	X		
96044	Lonicera caerulea var. edulis Turcz. ex Herder	X		X
96025	Lonicera caerulea var. edulis Turcz. ex Herder	X		X
96082	Lonicera ferdinandi Franch	X		
96117	Lonicera ruprechtiana Regel.	X		
96071	Lonicera ruprechtiana Regel.	X		
96084	Lonicera tatarica L.	X		
96132	Magnolia officinalis var. biloba	X		
96122	Malus baccata (L.) Borkh.	X		
96111	Malus baccata (L.) Borkh.	X		
96095	Malus baccata (L.) Borkh.	X		
96099	Malus sieversii (Ledeb.) Roem.	X		
96098	Myrica nana	X		
96104	Nandina domestica Thunb.	X		
96080A	Pinus koraiensis Sieb. & Zucc.	X		
96081	Prinsepia sinensis (Oliv.) Oliv.	X		
96078	Prunus davidiana (Carriere) Franch.	X		
96120	Prunus davidiana (Carriere) Franch.	X		
96077	Prunus manshurica Koehne	X		
96052	Prunus padus L.	X		X
96134	Prunus pseudocerasus (see Chin. Flora)	X		
96118	Prunus salicina Lindl.	X		
96009	Prunus tomentosa Thunb.	X		
96001	Prunus tomentosa Thunb.	X		
96119	Prunus tomentosa Thunb.	X		

APPENDIX 4. Species Collected

No.	Species	Seeds	Cuttings	Herbarium
96113	Prunus triloba Lindl.	X		
96123	Pyrus betulifolia Bunge	X		
96107	Pyrus calleryana Decne.	X		
96079	Pyrus ussuriensis Maxim.	X		
96100	Rhus punyabensis var. sinica (Diels) Rehd. & Wils.	X		
96121	Ribes burejense Fr. Schmidt	X		
96005	Ribes burejense Fr. Schmidt	X		X
96055	Ribes komarovii A. Pojark (?)			X
96070	Ribes mandshuricum (Maxim.) Komarov	X		X
96004	Ribes mandshuricum (Maxim.) Komarov	X		X
96127	Ribes meyeri var. tangenticum Maxim.	X		
96030	Ribes pauciflorum Turcz. ex Pojark (?)	X		X
96036	Ribes procumbens Pallas	X		X
96028	Ribes procumbens Pallas			
96045	Ribes procumbens Pallas	X		X
96019	Ribes procumbens Pallas	X		X
96021	Ribes procumbens Pallas	X		X
96010	Rubus arcticus L.	X		X
96023	Rubus arcticus L.			X
96015	Rubus arcticus L.	X		X
96042	Rubus arcticus L.	X		X
96089	Rubus crataegifolius Bunge	X		
96087	Rubus crataegifolius Bunge	X		
96086	Rubus crataegifolius Bunge	X		
96054	Rubus crataegifolius Bunge	X		X
96050	Rubus crataegifolius Bunge	X		
96091	Rubus crataegifolius Bunge	X		
96093	Rubus crataegifolius Bunge	X		
96064	Rubus crataegifolius Bunge	X		X
96012A	Rubus crataegifolius Bunge	X		

APPENDIX 4. Species Collected

No.	Species	Seeds	Cuttings	Herbarium
96063	Rubus crataegifolius Bunge	X		X
96068	Rubus crataegifolius Bunge	X		X
96090	Rubus idaeus L.	X		
96094	Rubus idaeus L.	X		X
96105	Rubus multibracteatus Levl. & Vant.	X		
96126	Rubus niveus Thunb.	X		
96124	Rubus pungens Camb. (?)	X		
96069	Rubus sachalinensis Lev.	X		
96018	Rubus sachalinensis Lev.	X		X
96049	Rubus sachalinensis Lev.	X		X
96035	Rubus sachalinensis Lev.	X		
96002	Rubus sachalinensis Lev.			X
96065	Rubus sachalinensis Lev.	X		X
96024	Rubus sachalinensis Lev.	X		X
96061	Rubus sachalinensis Lev.	X		X
96062	Rubus sachalinensis Lev.	X		X
96067	Rubus sachalinensis Lev.	X		
96040	Rubus saxatilis L.	X		
96034	Rubus saxatilis L.	X		X
96003	Sambucus buergeriana Blume ex Nakai	X		X
96051	Sambucus mandshurica Kitag.	X		X
96046	Sambucus sp.	X		X
96076	Sambucus williamsii Hanue	X		
96133	Schizandra chinensis (Turcz.) Bail.	X		
96092	Schizandra chinensis (Turcz.) Bail.	X		X
96096A	Sorbus pohuashanensis (Hance) Hedl.	X		
96129	Vaccinium koreanum Nakai	X		
96056	Vaccinium uliginosum alpinum E. Busch.	X		X
96032	Vaccinium uliginosum L.	X		
96031	Vaccinium uliginosum L.	X		X

APPENDIX 4. Species Collected

No.	Species	Seeds	Cuttings	Herbarium
96017A	Vaccinium uliginosum L.	X		X
96016	Vaccinium uliginosum L.	X		X
96027	Vaccinium uliginosum L.	X		X
96066A	Vaccinium uliginosum L.	X		X
96033A	Vaccinium uliginosum L.	X		
96038	Vaccinium uliginosum L.	X		
96037B	Vaccinium uliginosum L.	X		
96039	Vaccinium uliginosum L.	X		
96043	Vaccinium uliginosum L.	X		
96041	Vaccinium uliginosum L.	X		
96037A	Vaccinium uliginosum L.	X		
96012B	Vaccinium uliginosum L.	X		
96022	Vaccinium vitis-idaea L.	X		
96017B	Vaccinium vitis-idaea L.	X		X
96033B	Vaccinium vitis-idaea L.	X		
96020	Vaccinium vitis-idaea L.	X		X
96085	Viburnum burejaeticum Regel. & Herder.	X		
96083	Viburnum sargentii Koehne	X		
96088	Viburnum sargentii Koehne	X		X
96075	Viburnum sargentii Koehne	X		
96101	Xanthoceras sorbifolium Bunge	X		

APPENDIX 5. Disposition of Seed Accessions

To: National Clonal Germplasm Repository, Corvallis, Oregon

Fragaria orientalis Lozinsk
Fragaria nilgerrensis Schldl. ex Gay
Lonicera caerulea var. *edulis* Turcz. ex Herder
Pyrus betulifolia Bunge
Pyrus calleryana Decne.
Pyrus ussuriensis Maxim.
Ribes burejense Fr. Schmidt
Ribes komarovii A. Pojark
Ribes mandshuricum (Maxim.) Komarov
Ribes meyeri tangenticum Maxim.
Ribes pauciflorum Turcz. ex Pojark
Ribes procumbens Pallas
Rubus arcticus L.
Rubus crataegifolius Bunge
Rubus idaeus L.
Rubus multibracteatus Levl. & Vant.
Rubus niveus Thunb.
Rubus sachalinensis Lev.
Rubus saxatilis L.
Sambucus buergeriana Blume ex Nakai
Sambucus mandshurica Kitag.
Sambucus sp.
Sambucus williamsii Hanue
Sorbus pohuashanensis (Hance) Hedl.
Vaccinium koreanum Nakai
Vaccinium uliginosum L.
Vaccinium uliginosum alpinum E. Busch.
Vaccinium vitis-idaea L.

To: Shawn Mehlenbacher, Hazelnut Breeding Program, Oregon State University, Corvallis, Oregon

Corylus heterophylla var. heterophylla Fisch. ex Trautv.
Corylus sieboldiana var. mandshurica (Maxim.) Schneid.

To: National Clonal Germplasm Repository, Davis, California

Actinidia arguta var. arguta (Sieb. & Zucc.) Planch. ex Miq.
Actinidia chinensis Planch.
Actinidia kolomikta (Maxim. & Rupr.) Maxim.
Diospyros tsangii Merr.

APPENDIX 5. Disposition of Seed Accessions

To: National Plant Germplasm Quarantine Center, Beltsville, Maryland
Final Destination - National Clonal Germplasm Repository, Davis, California
Prunus davidiana (Carriere) Franch.
Prunus manshurica Koehne
Prunus padus L.
Prunus salicina Lindl.
Prunus sp. (*Cerasus pseudocerasus*)
Prunus tomentosa Thunb.
Prunus triloba Lindl.

To: National Clonal Germplasm Repository, Geneva, New York
Malus baccata (L.) Borkh.
Malus sieversii (Ledeb.) Roem.

To: Southern Regional Plant Introduction Station (S-9), Griffin, Georgia
Indigofera pseudotinctoria Matsum.

To: North Central Regional Plant Introduction Station (NC-7), Ames, Iowa
Cornus alba L.
Cornus officinalis Sieb. & Zucc.
Rhus punyabensis sinica
Xanthoceras sorbifolium Bunge

To: National Arboretum, Washington, D.C.
Broussonetia papyrifera (L.) Vent.
Calycanthus chinensis Cheng & S.Y. Chang
Celastrus orbiculata Thunb.
Crataegus Maximowiczii Schneid.
Lonicera ferdinandi Franch
Lonicera ruprechtiana Regel.
Lonicera tatarica L.
Magnolia officinalis biloba
Myrica nana
Nandina domestica Thunb.
Pinus koraiensis Sieb. & Zucc.
Prinsepia sinensis (Oliv.) Oliv.
Schizandra chinensis (Turcz.) Baill.
Viburnum burejaeticum Regel. & Herder.
Viburnum sargentii Koehne