

ANNUAL PROGRESS REPORT  
REGIONAL PROJECT W-6  
CY 1998

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*Pyrus pyrifolia* cv. Kikisui in bloom.

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**John Carter**, Visiting Scientist, MI  
**Henrietta Chambers**, Collaborator  
**Yongjian Chang**, Graduate St., OSU  
**Jinah Choi**, Lab Work Study, OSU  
**Douglas Cook**, Computer Specialist  
**Jeff Darbut**, Biological Science Aid  
**Jeanine DeNoma**, Research Assistant, OSU  
**Michael Dorris**, Plant Work Study, OSU  
**Judith Flynn**, Program Assistant/Secretary  
**Raymond Gekosky**, Ag. Sci. Res. Tech.  
**Jennifer Hiscox**, Saturday Academy Intern  
**Jacki Huddleston**, Office Work Study, OSU  
**Kim Hummer**, Research Leader/Curator  
**Trina Johanson**, High School Volunteer  
**Francis Lawrence**, Collaborator  
**Karen Leger**, Greenhouse Wk St., OSU

**James Oliphant**, Ag. Sci. Res. Tech, Plants  
**Carolyn Paynter**, Bio. Sci. Lab Tech., Plants  
**Stephany Peebler**, Ag. Sci. Aid-Plants  
**Joseph Postman**, Plant Pathologist  
**Tirzah Quigley**, OSU Grad Student  
**Barbara Reed**, Plant Physiologist  
**Alanna Robbins**, Ag. Sci. Aid-Plants  
**Damiens Satori**, Visiting Student-France  
**Rebecca Shala**, Saturday Academy Intern  
**Sara Schwanke**, ARS Research Apprentice  
**Joe Snead**, Ag. Sci. Res. Tech., Plants  
**Scott Thompson**, Field Work Study, OSU  
**Chih-Wei (Valen) Tsao**, OSU Grad St.  
**Dennis Vandever**, Maintenance Technician  
**Liz Vella**, Ag. Sci. Res. Tech., Plants  
**Nan Wang**, OSU Grad Student  
**Amy Wasson**, Office Work Study, OSU

## **PERSONNEL**

By Kim Hummer

### **Staffing Changes**

Over the course of the CY 1998, 31 employees were on the NCGR payroll, including 17 women, 4 Asians, 19 students (graduate, undergraduate, and high school levels). The Repository has 11 permanent full-time federal positions including two Scientists, a Support Scientist, five Technicians, a Program Assistant, a Facilities Maintenance Technician, and a Computer Specialist. In addition, a part-time Research Assistant for the hop tissue culture and virus testing is sponsored through a Research Support Agreement with the Oregon State University, Department of Horticulture. The Repository had a high school volunteer during the year who contributed 24.5 hours toward the Repository mission, and two scientific collaborators. Thank you to Dr. Henrietta Chambers, Dr. Whitey Lawrence, and Trina Johanson for your help.

During calendar year 1998 we had one permanent staff change. In the summer, Liz Vella took maternity leave. In September, she resigned her position as our Greenhouse Manager to take on greater responsibilities with her new baby, Raven. Best wishes and good luck to Liz and her family. Mike Dorris assumed the position of temporary greenhouse manager during the summer and Jim Oliphant took over that responsibility in September. In the new fiscal year, FY 99, we recruited for a permanent Greenhouse Manager replacement. Twenty-two applicants qualified for the position and were forwarded from our personnel office. Five were interviewed and Jim Oliphant was selected. Jim, who has a M. S. in Botany from Oregon State University, was chosen because of his expertise in greenhouse management, his experience in working with our assigned genera, and his training in Horticulture, Botany and Genetics. Welcome aboard, Jim!

Jeanine DeNoma was selected for the Research Assistant position (through OSU) to manage the hop *in vitro* collection. She is also assisting Joseph Postman in virus testing and elimination procedures for this collection.

### **Promotions**

Three Repository staff members were promoted during CY 1998. Carolyn Paynter, Biological Science Research Technician was promoted to GS 8. She is responsible for maintaining the *in vitro* culture collections and overseeing day-to-day laboratory operations. Carolyn has been very helpful in training many students and visiting scientists in tissue culture procedures.

Dennis Vandever, Facilities Maintenance Technician, was promoted to WG 8. Dennis has been responsible for facilities maintenance since 1992. Dennis has overseen the development of the North Farm Building and various repairs to the main facilities complex. Lately he is coordinating roof repair for the main building, screenhouses, and replacement of greenhouse glass with lexan.

Doug Cook, Computer Information Manager, was promoted to GS 7. Doug manages computer hardware, software, and database files for the Repository. Doug keeps local files as well as uploading accession information to the GRIN database.

### **Training**

Bruce Bartlett completed the PNW Agricultural Chemistry & Toxicology Short Course in Eugene, OR, 02/10/98 to 02/11/98.

Douglas Cook attended The Microsoft Windows 95 Users Conference in Portland, OR, 04/09/1998. Ray Gekosky completed the PNW Agricultural Chem. & Toxicology Short Course in Eugene, OR, 2/10 - 2/11/98, the Drinking Water Safety Training Course, Portland, OR, 02/2/98.

Joseph Snead completed the PNW Agricultural Chemistry & Toxicology Short Course in Eugene, OR, 02/10/98 to 02/11/98 and the Train The Trainer Program for Respiratory Certification, Eugene, OR, 06/16/98.

Dennis Vandever took the Drinking Water Safety Training Course, Portland, OR, 02/26/98.

## **BUDGET AND FISCAL**

By Kim E. Hummer

During 1998, The Corvallis Repository base funding remained stable at \$ 756,772. About 78% of this budget was obligated in salaries. As of 1998 the Repository began operating under a single CRIS which has combined two former CRIS units encompassing traditional and alternative technologies for germplasm preservation of temperate fruit, nut, and specialty crops.

In 1998 the USDA, ARS National Program Staff provided \$20,000 of extramural funding for purchase of orchard pruning and greenhouse pest management equipment. The Pacific West Area Administrators provided an additional \$10,000 for computer upgrades. A total of \$35,000 was received from other grants for germplasm research and preservation from the National Seed Storage Laboratory, A. M. Todd Company, Driscoll Strawberry Associates, and state and federal summer apprenticeship programs.

## **SAFETY**

Barbara Reed, our Chemical Hygiene Officer, and I reviewed and revised our unit Chemical Hygiene Plan. This plan, along with Repository SOPs and chemical lists is published in our operations manual. Our unit purchased a person-lift (\$3,500) for safe access. We have also upgraded spray cab for the tractor, purchased signs and miscellaneous safety related equipment (about \$600). Our employees participate in the Occupational Health Monitoring Program. Our unit has hosted fire extinguisher training for the location and cpr/first aid training. We have specific annual pesticide training for agricultural workers on our North Farm. We have periodic fire drills for our main building complex. Two CA-1's were submitted: for back strain and for a spider bite on the left forearm. These injuries were discussed with the staff and our safety officer to prevent or avoid these and other injuries.

## **NEW ACQUISITIONS AND INACTIVATION OF DUPLICATE GERmplasm**

By Kim E. Hummer

During 1998 227 new accessions were added to the NCGR collections. New *Ribes* and *Corylus* accessions topped the list, then *Sambucus*, *Vaccinium*, *Rubus* and *Fragaria*. The core for *Humulus* was tested for viruses and virus infected accessions are undergoing thermotherapy and establishment into tissue culture.

The Repository has 7717 available accessions for distribution to requestors. Repository inventory lists increased by 396. *Humulus* activity was greatest, next *Fragaria*, *Corylus*, *Ribes*, *Rubus*, *Sambucus*, and *Vaccinium*. Seventy-five accessions were "deactivated," either closed through duplication, or extinguished seedlots, during FY 99.

Fig. 1. Funding and staffing at the USDA-ARS National Clonal Germplasm Repository, Corvallis, Oregon

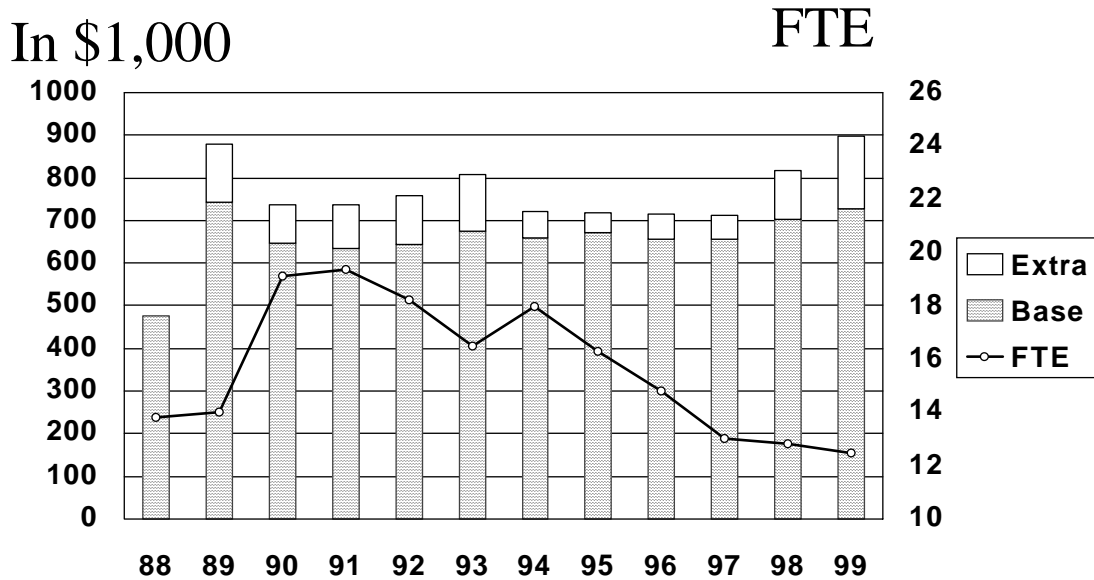
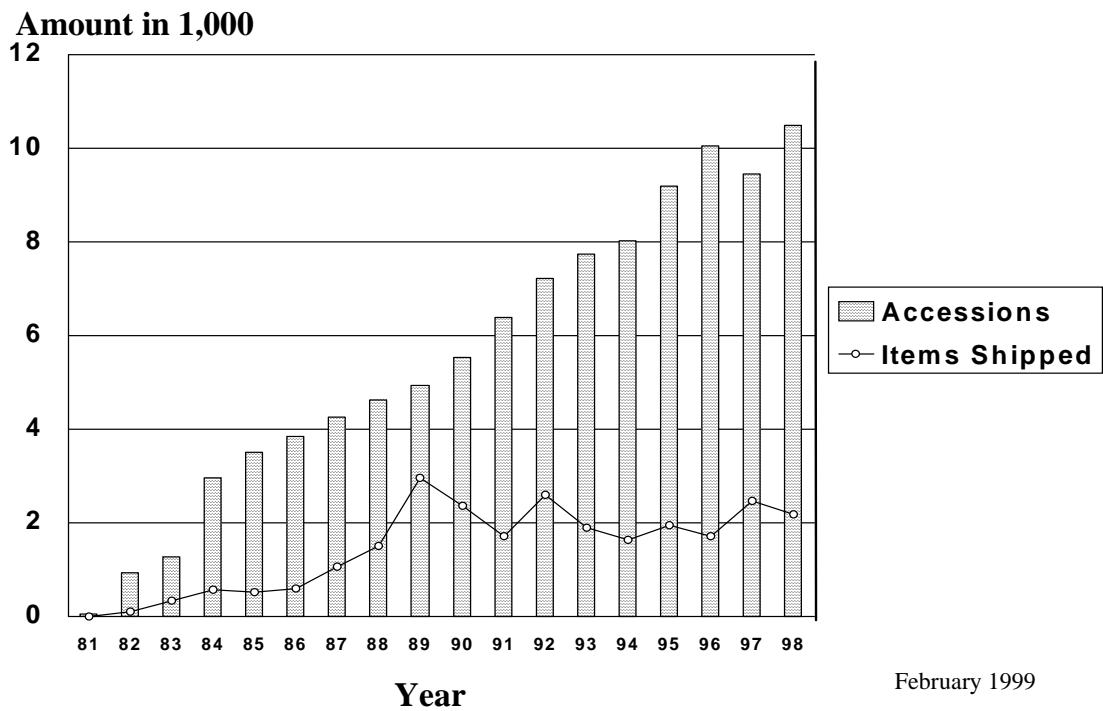


Fig. 2. Total Accessions / Distribution



February 1999

## **Facilities Corner**

By Dennis Vandever and Kim Hummer

The computer based environmental control and alarm system is being expanded to control greenhouse irrigation. We received a new GENI person lift to comply with OSHA standards. New air circulation fans were installed in Screenhouses 8 and 9. These fans will allow better control of powdery mildew. The four swamp coolers on greenhouse 4 were replaced with fiberglass units. An air conditioning system was installed in the headhouse offices and break area. This positive airflow conforms to OSHA standards. The outdoor cranberry beds and numerous shrubs around the landscape were removed. Irrigation control wiring was installed and the existing underground piping system was upgraded. Grass was replanted in the old cranberry beds. Due to several near misses around the parking lot, numerous landscaping trees were removed to increase visibility around driveway corners. Gas leaks were repaired on the gas meter of the main building. Numerous slipped and broken glass panes were replaced in the greenhouses. New American Disabilities Act door openers were installed in the main lobby in accordance with national guidelines. Three propane heaters were purchased to replace existing fan coil units in Screenhouses 8,9 and 10. These units and the heavy overhead hot-water circulation lines will be removed after the heating season.

### **North farm**

A safety shower eyewash was installed. Exterior window trim and a deep sink were installed in the office. A subcontractor installed tile in the office and restroom. A work crew from the Repository completed the interior trim. A new well was drilled and a second larger pressure tank was installed. The existing well was failing with low flow and impurity conditions due to the rusting out of the down pipe. This very old driven well was removed. We spread 150 cubic yards of gravel on the access roads for maintenance.

### **Vehicles, tractors and equipment**

The Repository purchased a new 1998 Dodge Caravan. The Kubota tractor had numerous seals repaired, a new clutch installed and the front tires and wheels were replaced. The electric forklift battery was replaced.

### **Special Awards for 1998**

September	Barbara M. Reed	For outstanding accomplishments in plant physiology related to the in vitro culture and cryogenic preservation of temperate fruit and nut genetic resources.
September	Alanna Robbins	For superior work in maintaining the health of NCGR clonal collections in the absence of a greenhouse/screenhouse manager. For reorganizing and helping to correct irrigation, insect and disease problems as they occur.
December	Kim Hummer	For leadership in evaluating core collections of the Repository and giving special emphasis to preservation of the core collections.

## **Field Collections Management**

By Joe Snead and Kim Hummer

This last year considerable changes took place in the field operations. Previously this report summarized the status of our field collections. Now this report will include activity of our two operating farms.

Since 1979, the Repository has had a memorandum of understanding with Oregon State University, Department of Horticulture, to occupy about 20 acres of ground on the Lewis Brown Farm. The interaction between the OSU Horticulture Farm crew and our own concerned our own needs. When the initial MOU land was occupied, the state had no available land to donate. In 1990 the USDA was able to purchase 40 acres for the Repository through a congressional appropriation. Recently the use farm land and resources both at the Lewis Brown Farm and our North Farm has changed.

On both farms the Repository has land returning that had been loaned out to other projects. Also on both farms Repository ground is being farmed by the Horticulture Farm Crew for other research projects. Cooperative efforts with Oregon State University Department of Horticulture is strong. Now OSU Horticulture has plot users on Repository property. A plan for the North Farm development is being developed. Many researchers from the other location USDA units and from the OSU Departments of Horticulture and Crop Science use plot ground on the North Farm. Plans were initiated for a greenhouses and screenhouses to be built on the North Farm. These buildings will accommodate scientists from the USDA ARS Horticultural Crops Research Unit.

Pesticide issues have been addressed for farm use but these need to be rewritten to include the greenhouse and screenhouse. The irrigation water quality and quantity on the North Farm is poor. With increased use an irrigation development plan will be developed. As North Farm use increases overhead costs will go up. Some agreement needs to take place to meet these demands. On the Lewis Brown Farm our plot land situation is changing also. Two acres loaned out to the Small Fruits Breeding Program is coming back to the Repository this year. Will we have a need for this land in the future? In the past we have given land back to the Horticulture Department when we had no short term plans.

### North Farm Land Use

- 2 acres of *Ribes* Germplasm Collection
- 1 acre of minor genera in three separate irregular blocks
- 0.1 acre of *Pyrus* rootstock trial removed 1/1/99
- 2 acres *Rubus* Species collection in cooperation with Dr. Finn
- 1 acre *Asimina* trial Dr. Hummer and Dr. Azerenko with the Pawpaw Foundation
- 2 acres long term Hops germplasm collection Dr. Henning
- 2 acres *Vaccinium* seedlings second year of seven year planting Dr. Finn
- 3 acres *Rubus* Seedling block final year Dr. Finn
- 4 acres Potato End Blight one year use Dr. Mosley
- 1 acre *Ribes* Research Block Dr. Hummer
- 1.5 acre for Greenhouse, screenhouse and headhouse Dr. Linderman

### North Farm Site Changes

- Large concrete debris was removed and area cleaned up.

- Old concrete silo foundation broken up and removed.
- Concrete dry well in the *Ribes* field broken up and removed. On all three of these projects a jackhammer was required. OSU Horticulture provided a 5 yard dump truck and driver and paid the \$2200.00 dump charges.
- We purchased 2 sets of gates for the perimeter fencing & replacement posts for flood damage.
- A new well was installed for domestic water needs of our tractor building and new greenhouses.
- Three acres of land were worked with soil redistribution to maximize ground in a swale.

#### Lewis Brown Farm Land Use

- 2.5 acres *Corylus* germplasm collection
- 1 acre *Vaccinium* germplasm collection
- 0.5 acre fallow ground, old strawberry ground
- 6 acres *Pyrus* germplasm collection with 1 acre possible hillside expansion
- 2 acres loaned to ARS small fruits research to be returned in the fall of 1999

#### Repository Main Building Site

- The low growing *Vaccinium* planting beds were removed and turf established.
- Landscape bed areas were removed and turf installed to simplify maintenance.
- Manual irrigation system was reworked with all electric valving and a modern timer.
- Cleaned up old shadehouse area and surplus iron and other material recycled.

***Vaccinium:*** These fields have significantly changed this year. The cranberries, lingonberries and other low growing *Vaccinium* species were moved into the screenhouse and planted in deep flats. The former cranberry bed area was turned into landscape turf. The high bush field had problems with flooding washing mulch away and exposing roots. Corn stalks and other debris covered or was stuck in the bushes had to be removed in the spring. The debris filled about 15 pickup-truck loads. The drip lines were washed into the bushes across several rows. A fresh layer of sawdust was put down in the spring. The spring was very wet and *Pseudomonas* strikes were observed on many plants. Fruit set was very poor. Those plants that bloomed late, during a dryer period, had a fair set. Carlo virus is being watched for the second year. Several infected accessions were removed. These plants had been physically close to last year's original infected plant. We hope that we have culled the infected plants. The OSU Horticulture's Turf Management Program headed by Dr. Tom Cook is kindly mowing the grass between the blueberry rows. The field matured into an attractive planting.

***Corylus:*** About 30 new accessions were added to the *Corylus* field this year. Most of these were returned from seedling blocks that Dr. Shawn Mehlenbacher and his staff were evaluating from seed that the Repository had given him. The accessions were well established multi-stemmed and around five years old. The trees were dug with a backhoe in early March just before they broke dormancy. It was a hard transplant but they all survived. The core accessions were marked in the field and received a little additional pruning to induce better scionwood production. The rest of the field had some basic pruning done to open up the turf aisles. Besides better scionwood production, better nut production for

distribution is on the agenda for this coming year. Filbert worm will be controlled along with attempts at bird and squirrel control. The Eastern Filbert Blight remains a big concern with detected orchards being found closer to the repository. Efforts to get more accessions into tissue culture were increased last year with the field crew collecting scionwood and directing grafting operations. Twelve accessions were sent to Parlier, California to establish a remote backup location. Two self rooted layers of each accession were provided by Dave Smith of OSU Dept. of Horticulture Hazelnut Research Program. Only twelve accessions were sent to see if the *Corylus* can survive the summer heat of the region. A larger shipment will be sent next year if the first group do as well.

*Pyrus*: This last year a lot of work has occurred in the *Pyrus* collection. At the start of the year all the core plants were pruned hard to invigorate the trees to encourage more and better scionwood. We hired an extra field worker from a temporary employment service to help with the job. At the end of June \$15,000 was provided from the USDA ARS National Program Staff to purchase a tree hedging machine. This is a double sicklebar mower which can cut up to 4 inch limbs. The machine is able to cut the sides and top of the trees. The cultivar collection was topped at 13 feet. The collection had been previously topped at 12 feet, but the new topper could not cut through the branches at that point. The species collection had to be topped even higher. According to the area of the field some trees were topped at 14', 16', or 18'. The aisles are now opened up. Sunlight reaches the bottom to the trees again. Scionwood production is very good. This was only the first step in bring the trees under control again. Most of the trees need thinning and topping now. The topping will probably require saw work. We will be requesting purchase of an orchard person-lift, i.e., "cherry-picker" that can make tree training more efficient.

After topping and hedging the sides of the trees with the mechanical hedger 1.5 months was needed to clean up the trimmings. For several years we have been removing trees and now with this extensive pruning, the labeling in the field has deteriorated. In the fall material was purchased to create new labels. Clear Avery labels will be attached to pieces of vinyl siding for placement on the tree. As in the *Corylus*, the rodent population rose to a high level and required control measures.

According to OSU weather sources, Corvallis is in a six year wet cycle. For the third year in a row the lower *Pyrus* species field has flooded. The flooded water has remained for extended periods up to five months. Even though the rootstock OH x F 333 is tolerant to wet ground, repeated long term submersion may cause problems for some trees. Disease and some insect damage seems more evident this year and was perhaps brought on by the wetter weather. We are developing a new five year management plan for this collection and are seeking advice from the *Pyrus* Crop Germplasm Committee.

*Ribes*: The new year started out with lots of action in the *Ribes* field with the discovery of an *Eriophyid* mite infestation. To prevent further infestation the planting was cut back to ground level and the tops were burned. JMS Stylet spray oil was used as a miticide. The planting was given weekly crown drenches for the first month and then weekly sprays for another 1.5 months to control the problem. The treatment seemed to work and it helped control powdery mildew. Because the plants were cut back to ground level there was a big flush of growth in the spring. The spring was very wet with some wind and many of the



young weak stems lodged from wind and the weight of water. Red currants and some gooseberries were most affected. Corrective pruning measures will correct the problem.

Irrigation is difficult in this field. The present system has become clogged by iron bacteria and is useless. In 1998, irrigation was applied by aluminum pipe and large impact heads. This irrigation method is labor intensive. A new drip system is needed for this field and others on the North Farm.

Minor Genera : This last growing season the plants have really started to size up well in the minor genera blocks and are providing ample propagation material. Weed control is finally at a good level. Labeling is up to date. In the *Sorbus* several accessions were attacked by shot hole borer. Some accessions are not doing well on the lower slope of this planting. I believe the problem is heavy compacted soils. If the plants do not respond then perhaps this part of the planting should be moved.

Cooperative Field Plantings :The repository has two plantings on the North Farm that are cooperative efforts. The Chinese *Rubus* is a cooperative effort with Dr. Chad Finn of the Small Fruits Breeding Program. This planting has been in over five years the last data and propagation material was taken in the fall. This field will be renovated in 1999 and may be available for planting in the fall of 2000. This has been a worthwhile planting for all concerned.

Asimina: The pawpaws variety trial was in its fourth leaf. This planting is in conjunction with Dr. Hummer of the Repository and Dr. Azarenko of OSU Dept. of Horticulture and The Pawpaw Foundation. This is an interesting trial because these clones have not been grown before in the west. Fertilizer and water requirements are not known for production purposes. The disease problems are new, although they were not an apparent problem this last year. Fruit set seems to be a problem these last two years. Hopefully some of the cultural questions will be answered in time and this can become a productive plot and the different cultivars evaluated.

New Plantings: In the fall a new *Ribes* research block was planted. It is a replicated planting of *Ribes* cultivars. The planting is a little under an acre in size. It is hoped data can be collected in the spring and summer of 1999. A new *Fragaria* cultivar planting is in the planning stages for the spring of 1999. It will be for the accessions that are new and have not been evaluated by the Repository yet. The planting will be about 1/2 acre in size.

### **Screenhouse/Greenhouse Collections**

By Jim Oliphant and Joseph Postman

Elimination of redundancy in the screenhouse collections continued in 1998. Many errors and duplications in the inventory database were identified and removed. New plastic benches were installed in two houses following roof replacement. The decision was made to house the *Ribes* core collection in screenhouse 6. Softwood cuttings of *Ribes* were taken during the summer and are now well established. Only 30 core accessions remain to be collected in 1999.

The cranberries, lingonberries, and other low-growing *Vaccinium* were moved from the field into screenhouse 10. These accessions have been planted in 5" deep trays and are well established. Softwood cuttings of blueberry cultivars and core accessions of other *Vaccinium* species were made from field plantings to fill gaps in the screenhouse collection. This will continue in 1999.

The *Fragaria* collection was re-potted and moved back to screenhouses 8 and 9 after the roof repairs, interior painting, and new bench construction was complete. Propagation is nearly complete to make two pots for each core accession.

A screenhouse collection of core *Humulus* is being established from plants that were maintained in vitro for many years. Explants from the *Humulus* in vitro collection were established and grown out in the greenhouse. In addition, many clones from the field have been re-established from heat-treated meristem cultures.

### **Quarantine Plants**

By Jim Oliphant and Joseph Postman

The Repository has been working with the USDA-APHIS and Oregon State regulations to import plants from foreign countries. At the close of 1998 we had 80 accessions in post-entry and other quarantines. Quarantine plants are tested for viruses and other disease agents and are inspected at least annually by APHIS representatives. In most cases pathogen-free plants may be released after two growing seasons. This table shows the plants in quarantine at the end of 1998, listed by genus code.

#### **Plants in quarantine at NCGR 1998**

<b>Genus</b>	<b>In Quarantine</b>	<b>Released in CY 1998</b>
<i>Corylus</i>	0	0
<i>Fragaria</i>	2	7
<i>Ribes</i>	40	8
<i>Rubus</i>	0	0
<i>Pyrus</i>	18	0
<i>Sorbus</i>	1	0
<i>Vaccinium</i>	0	0

### **Plant Distribution**

By Bruce Bartlett

The NCGR in Corvallis continues to distribute plant germplasm within the United States and internationally. We have distributed a total of 2,485 items as seeds, cuttings, runners, scionwood, rooted plants and tissue culture from 1998 requests (Fig. 4). This represents 69% of the total number of items requested for 1998.

The total number of plant items shipped during the 1998 calendar year was 2,743. Three of the shipped items were requested in 1995, 31 from 1996, 265 from 1997, and 2,444 from 1998. The total postage paid for domestic and international shipping was \$1,037.54 (Table 2). The total cost for Federal Express was \$735.41 and the total paid to the Oregon Department of Agriculture for 41 Phytosanitary Certificates was \$410.00.

**Table 2. Expenditures for Plant Distribution from 1995 - 1998.**

Year	Total items Shipped	Postage	FedEx	PC's	Total	Shipping cost per item
1998	2743	\$1,037.54	\$735.41	\$410.00	\$2,182.95	\$ 0.81
1997	2632	1,622.35	619.73	800.00	3,042.08	1.16
1996	2028	1,656.15	330.06	700.00	2,686.21	1.32
1995	1974	1,523.23	135.78	556.00	2,215.01	1.12

The total number of plant items shipped has increased over the past four years from 1,974 in 1995 to 2,743 in 1998 (Table 2). The amount spent for postage and Phytosanitary Certificates (PC's) decreased in 1998 while the amount spent for Federal Express increased slightly. The amount spent per plant item shipped also decreased in 1998.

The diverse nature of plant accessions at NCGR-Corvallis present an ongoing challenge. Items may be pending for as long as three years. The coordination of foreign import permits (IP), seasonal availability and slow growth of some accessions all contribute to delays in plant shipment. As of February 10, 1999, 27% of the 1998 requested plants are pending, 4% are listed as not available and 1% have been canceled. Shipment records from 1993 to 1997 show that a between 80% and 86% of request plants will eventually be shipped. Total plant shipments from 1998 should be 85% or slightly higher.

In vitro cultures represented less than 10% of the total distributed accessions, however, they were the most requested and shipped form for foreign requestors. A number of factors have contributed to the rise of tissue culture as the favored form by foreign requestors. European and South American IP restrictions are less on plants in the form of tissue culture as opposed to other forms. In situations where *Pyrus* scionwood would be prohibited to import due to the possible presence of fire blight (*Erwinia amylovora*), tissue culture may be accepted. Many accessions in tissue culture are also virus tested and therefore may satisfy IP restrictions. Tissue culture accessions are durable in shipment and may be shipped most any time of the year except during periods of extreme heat and cold. Many countries will restrict the shipment of woody plants to the dormant period while these same plants if in tissue culture could be sent most any time. Some genera of seed (e.g. *Rubus*) now are prohibited from being shipped to New Zealand, France and Germany unless the virus status of the mother plants is known. Since much of our seed collection was gathered on plant explorations, the virus status of the mother plant is unknown and we can not therefore certify that the seed is virus free. All of these factors have contributed to the favor of tissue culture over other forms when shipping to foreign destinations.

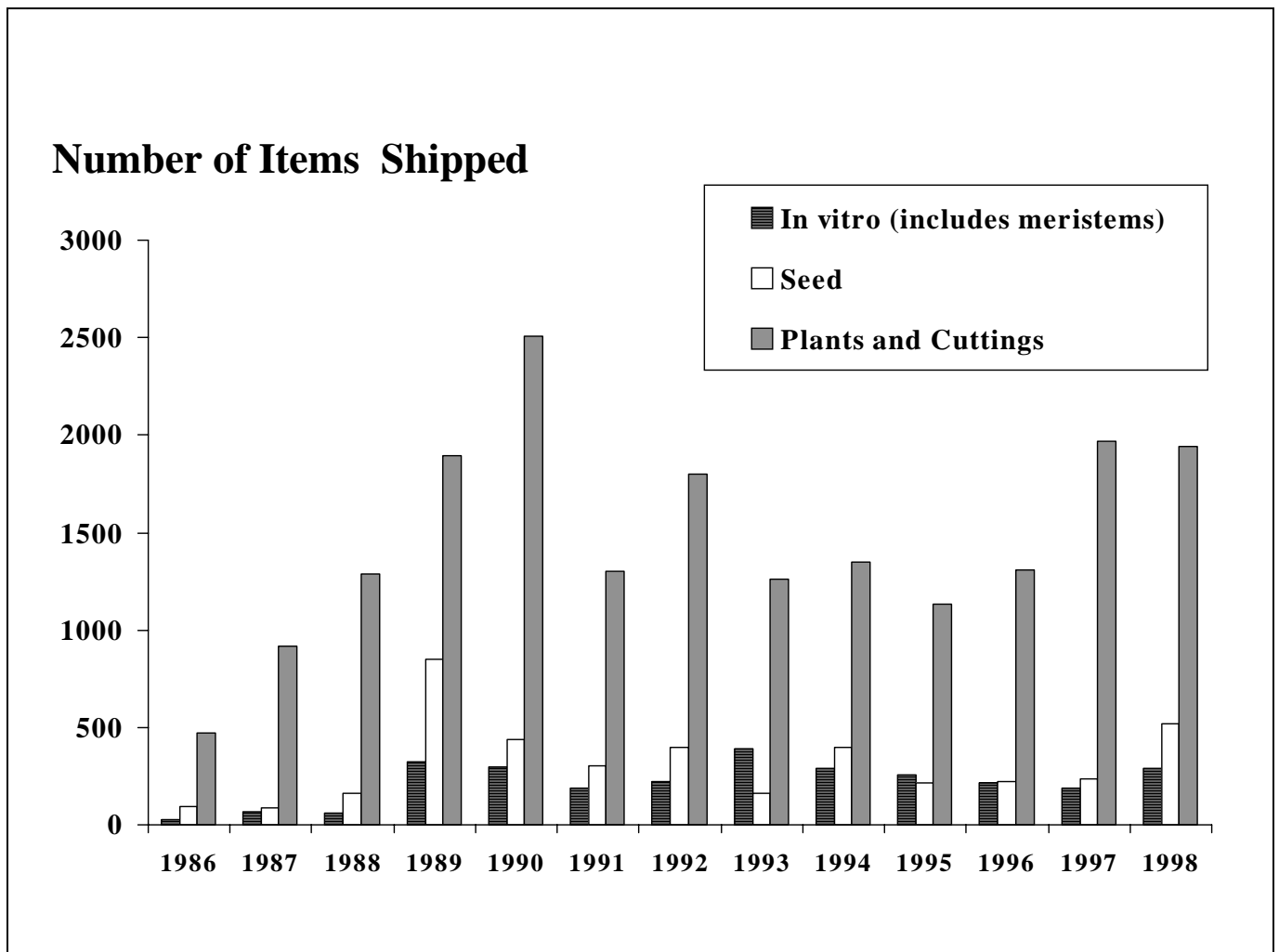
A trend from 1991 to 1993 showed that about 20% of items requested in a given year would not be shipped, primarily due to unavailability or complications associated with IPs. Considerable effort was made beginning with 1994 to more closely work with requestors to select alternative accessions to those not available. Since that time, the number of items **not** shipped has dropped to 15% for 1994 and 95, 16% for 1996 and 14% for 1997

The total number of items requested was stable during 1993 (2,513) and 1994 (2,507), dropped slightly in 1995 to 2,076, rose again to 2,291 in 1996 (domestically shipped *Humulus* have not been added to 1995 or 1996 totals and may represent an additional 150

items for each year) and to 2,983 in 1997. The total number of items requested rose higher yet in 1998 to 3,613. In 1996 and 1995, foreign requestors asked for approximately 40% of all items ordered. This is significantly more than the previous trend of 25% from 1992 to 94. In 1997, foreign requestors asked for 22% (643 items) of all items ordered and 27% (983 items) in 1998.

Over the past seven years (1998-92) *Fragaria* accessions have been the most often requested based (21% of requests). In 1998 accessions *Pyrus* (19%) was requested slightly more than *Fragaria* (18%). *Pyrus* (18%), *Rubus* (16%), and *Ribes* (15%) were the next most often requested in descending order during this seven year period. Over this seven year period *Mentha* has been the fifth most often requested genus but during the past two years (1998, 97) *Mentha* has been third due to recent interest in leaf oil content. Requests for *Vaccinium* accessions have been stable over the last four years but lower relative to other genera requested. Requests for our other major and combined minor genera have varied only slightly.

**Figure 4. Plant Distribution Summary 1986 – 1998**



## **Tissue Culture**

By Barbara Reed

This year Valen Tsao assisted Carolyn Paynter in the laboratory with repropagation, collecting and initiating cultures, and storage of *in vitro* cultures. With the assistance of Saturday Academy Interns Jennifer Hiscox and Rebecca Shala, and French Intern Damiens Sartori, we initiated about 300 new *Corylus*, *Fragaria*, *Mentha*, *Pycnanthum*, *Pyrus*, *Rubus*, *Ribes*, and *Vaccinium* cultures. Joe Snead and Bruce Bartlett collected the *Pyrus* and *Corylus* budwood in January. Carolyn stored it and after a month of additional chilling it was hot water treated before forcing (*Pyrus*) or grafting (*Corylus*).

I finished analyzing *Mentha* cold storage data and presented it at the SIVB meeting in June. It was submitted to HortScience for publication and was accepted with minor revisions in November. In April we initiated our backup cold storage collection in Bob Martin's cold room at the Horticultural Crops Laboratory. This will provide an offsite backup to our culture collection. We will need to have 3 rather than 2 starpacks of *Fragaria*, *Ribes*, and *Humulus*. We outgrew the space available by August and will need to find additional backup cold storage space.

## **Cryopreservation**

By Barbara Reed

Yongjian Chang continued work on *Pyrus* cryopreservation and sent some additional *Pyrus* meristem accessions to NSSL. Elise Palmer and Loren Weisner came to NCGR to get additional training for Elise on our cryopreservation techniques and to discuss additional storage of clonal germplasm.

Sara Schwanke, our ARS Research Apprentice, did preliminary experiments on pear seed cryopreservation. She accomplished the main objective of the study, and learned about the difficulties of working with new techniques. Rebecca Shala is taking up the project for a high school science fair project. She will look at cryopreservation of freshly gathered 'Bosc' pear seeds.

An additional *Corylus* seed accession was stored in liquid nitrogen in January. *Corylus sieboldiana* var. *mandshurica* seeds were stratified and cryopreserved as isolated embryonic axes using the method developed for two other species in 1994-95.

## **Miscellaneous**

Yongjian, Valen, and I presented research at the Society for In Vitro Biology meeting in June. I co-chaired a workshop on "Designing a micropropagation system" and co-edited the resulting publication in *In vitro- Plant* with M.A.L. Smith of the University of Illinois.

I presented two invited talks, two posters, and chaired two discussion sessions at the JIRCUS/IPGRI Joint International Workshop on Cryopreservation of Tropical Crops in Tsukuba, Japan in October.

I continue to be an Associate Editor for HortScience and a Reviewing Editor for *In Vitro-Plant*, a board member for the Society for In Vitro Biology, and treasurer for the Oregon State University Chapter of Sigma Xi.

IN VITRO STORAGE AT NCGR AS OF DECEMBER 1998

Genus	No. of accessions	
	Active <i>in vitro</i>	In storage
<i>Corylus</i>	37	19
<i>Fragaria</i>	309	195
<i>Humulus</i>	100	46
<i>Mentha</i>	255	221
<i>Pycnanthemum</i>	15	15
<i>Pyrus</i>	222	179
<i>Ribes</i>	73	28
<i>Rubus</i>	296	144
<i>Vaccinium</i>	184	120
Total	1491	967

These numbers represent an increase of 340 accessions over those present in 1997.

**Virus Indexing**

By Joseph Postman

At the end of 1998, four of our eight major collections have more than 75% of all clonal accessions available as virus tested plants. These include *Corylus*, *Pyrus*, *Rubus* and *Vaccinium*. A table at the end of this section itemizes the total number of clones in each of these major collections and the number of virus tested, virus infected and untested plants. If we consider only 'CORE' accessions, more than 80% of the clones are available as virus tested for six of our eight major genera.

**Virus Status of NCGR CORE Collections at the end of 1998**

	Core Plants	Percent Tested	Percent Infected	Percent Untested
<i>Corylus</i> :	168	95.8%	1.2%	3.0%
<i>Fragaria</i> :	474	80.8%	14.1%	5.1%
<i>Humulus</i> :	131	80.9%	10.7%	8.4%
<i>Mentha</i> :	49	14.3%	2.0%	83.7%
<i>Pyrus</i> :	200	89.5%	5.0%	5.5%
<i>Ribes</i> :	227	13.2%	15.0%	71.8%
<i>Rubus</i> :	307	85.3%	8.8%	5.9%
<i>Vaccinium</i> :	222	90.5%	0.5%	9.0%

- "Virus Tested" includes plants that have tested negative for several important viruses, and plants that have been produced by heat-therapy and meristem culture.
- These counts may include more than one plant per accession for certain recently heat-treated clones.
- This table DOES NOT include duplicate accessions or misidentified plants.
- This table DOES include accessions that are not available due to intellectual property rights, quarantine, insufficient inventory, or virus infection.

***Corylus*** - No bioassays or ELISAs were performed during 1998. There is only one virus infected clone remaining in the collection in need of heat therapy. COR 205 (Blumberger Zellernuss) was heat treated, and several micrografts were made. Only one micrograft survived, and its condition is dubious. Will be repeated in 1999.

***Fragaria*** - Emphasis in 1998 has been on the core collection. A backlog in bioassays was reduced thanks to a grant from Driscoll Strawberries, which allowed us to hire additional temporary labor.

271 clones were tested by bioassay:

70 by sap inoculation to *Chenopodium quinoa*

129 by graft inoculation to Alpine

69 by graft inoculation to UC-5

51 clones were tested by ELISA for either Tomato Ringspot or Strawberry Mild Yellow Edge

Three clones were newly identified as virus infected by ELISA and two clones by bioassay. At the end of 1998, 60% of the clonal collection is listed as virus 'TESTED'. 41 meristems were cut from 8 clones and survival was very good. June Yellows was observed in a new accession of Ozark Beauty, and phytoplasma symptoms (green flower petals, fruit phylloidy) were observed on a new presumably virus-free accession of Muir.

**Humulus** - A core of 80 genotypes representing the genetic diversity of the collection was identified for long term maintenance *in vitro*. Prior to *in vitro* establishment, core accessions were tested by ELISA for six viruses: apple mosaic ilarvirus (ApMV), arabis mosaic nepovirus (ArMV), hop latent carlavirus (HLV), American hop latent carlavirus (AHLV), hop mosaic carlavirus (HMV), and prunus necrotic ringspot ilarvirus (PNRV). HLV was the virus most commonly detected (71%), followed by HMV (54%), AHLV (54%), and ApMV (29%). ArMV and PNRV were not detected. ArMV is not known to occur in North America but is common in some European hop growing areas. Approximately 70% of accessions were infected with 2 or more viruses. All but 12 clones have been successfully heat treated and re-generated *in vitro* from apical meristems. 93 plants representing 41 genotypes have been established in the green house from these *in vitro* cultures. They will be retested by ELISA early in 1999 to determine the success of therapy.

**Mentha** - No virus testing in 1998.

**Pyrus** - Continued to test about 100 accessions per year for Apple Stem Grooving Virus using the new *Malus micromalus* indicator, and to test new accessions and recently heat treated plants by grafting to *Pyronia veitchii* and *Pyrus communis* 'Nouveau Poiteau'.

166 clones were tested by bioassay during 1998:

98 on *Malus micromalus*

38 on *Pyronia veitchii*

28 on Nouveau Poiteau

Four new accessions were found to be infected with one or more viruses, 39 heat treated plants tested virus negative on one or more indicators, and two heat treated plants were found to be still virus-infected after therapy. To date, 469 virus infected accessions have been put through therapy and are now available as virus tested clones. During 1998,

148 pear meristems were cut from heat treated plants. These meristems came from 63 virus infected clones, half of which were being processed for the National Germplasm Quarantine lab in Beltsville, and the remainder were from the repository collection. The National Quarantine lab has recently hired a heat therapy technician, so I anticipate that they will begin doing their own virus therapy this year. I will finish processing the clones they have sent to Corvallis in previous years.

In addition to the routine virus clean-up, about 100 meristems were cut from two clones infected with Pear Blister Canker Viroid (PBCVd) following different in vitro heat or cold treatments. These cultivars, Nouveau Poiteau and Kalle (Red Clapp Favorite) were found to be viroid infected by colleagues in Beltsville and Prosser. We hope to develop a strategy for cleaning up pear clones infected with this newly characterized viroid. Seedlings are also being grown from these two infected cultivars to assess the seed transmissibility of PBCVd.

At the end of 1998, 85% of the *Pyrus* collection is listed as 'Virus Tested'. This is the largest collection at the repository, and also the collection with the highest percentage of accessions that are available as virus tested plants.

**Ribes** - Final results were collected for 15 black currant clones from graft-inoculated Amos Black currants as the indicator plants bloomed and foliage emerged during their 3rd growing season. None of the indicators produced characteristic symptoms of Reversion Disease. All of the indicator plants that bloomed (5) had normal non-reverted flowers. The foliage symptoms, however, were inconclusive. Both healthy controls as well as inoculated plants had some atypical leaves, and since we have no positive control for Reversion Virus it was impossible to interpret the results. The most likely cause of leaf abnormalities was powdery mildew.

Seven previously quarantined *Ribes* clones were put through heat therapy and 45 meristems were dissected. Several of these meristem plants survived in vitro culture and have been grown out and transferred to the greenhouse. We have begun to resurrect a screenhouse collection for core *Ribes* accessions. This will include any heat-treated clones as well as core accessions from the field to protect them from infestation by the gooseberry bud mite, and to prevent the movement of aphid-transmitted viruses. As resources allow, the screenhouse *Ribes* collection will be indexed for common viruses.

**Rubus** - Nearly 80% of this collection is listed as virus tested. The back-log of bioassays was also reduced for *Rubus* in 1998 thanks to the extra hands provided by the Driscoll Strawberries grant.

168 plants tested by bioassay

72 by sap inoculation of *Chenopodium quinoa* (CQ)

96 by graft inoculation to *Rubus occidentalis* 'Munger' (MUN)

One new infected accession was identified on CQ and two new infected accessions were identified on MUN. About 50 samples were tested by ELISA, primarily to detect RBDV, TSV and TomRSV in new accessions. No new infections were found.

Therapy - 20 virus infected clones were heat treated and 80 meristems were dissected. Only a handful of meristems survived in vitro, and none were successfully transferred to the greenhouse. During 1999, efforts will be devoted to evaluating different



media and growing conditions toward improving the survival of meristems for this difficult genus.

A study was completed with Chihwei Tsao, Barbara Reed's graduate student, looking at the effect of viruses on in vitro multiplication of raspberry. Multiplication of Malling Landmark red raspberry in vitro was found to be affected by Tomato Ringspot, Tobacco Streak and Raspberry Bushy Dwarf viruses, especially with multiple infections.

**Vaccinium** - During the summer of 1997, one clone in our field collection was found to be infected with blueberry shock ilarvirus (BBSIV) and about a dozen plants were found to be infected with blueberry scorch carlavirus (BBSCV). All infected plants were removed from the field. ELISA tests were repeated in 1998 and only two plants were found to be infected with BBSCV. These were in the same rows from which infected plants were removed previously. More than 2000 samples were tested during 1998 in our field and greenhouse collections (541 for BBSCV, 535 for BBSIV, 440 for BBSSV, 530 for TobRSV, 76 for TomRSV).

**Minor Genera** - The *Mespilus* collection was tested using the same graft-inoculated indicator plants that are used for *Pyrus* (*Pyronia veitchii* and Nouveau Poiteau). Out of 19 available Medlar clones, 6 have been found to be infected with Apple Chlorotic Leafspot Virus (= Pear Ringpattern Mosaic). Two of the infected clones have been put through heat therapy plus apical meristem tissue culture, and soon will be large enough to re-index.

Summary of Collections and Virus Status for Accessions Received Through December 1998

<b>GENUS</b>	<b>Total Accessions</b>	<b>Seed Lots</b>	<b>Plants</b>	<b>Virus Tested</b>	<b>Virus Infected</b>	<b>Untested</b>
CORYLUS	476	1				
Virus status:			471	369	3	99
FRAGARIA	1488	326				
Virus status:			1118	674	190	254
HUMULUS	749	13				
Virus status:			735	124	68	543
MENTHA	495	51				
Virus status:			439	13	21	405
PYRUS	1910	303				
Virus status:			1547	1316	127	104
RIBES	898	336				
Virus status:			560	62	91	407
RUBUS	1729	999				
Virus status :			699	555	66	78
VACCINIUM	1075	551				
Virus status:			512	409	2	101

		<b>Percent Tested</b>	<b>Percent Infected</b>	<b>Percent Untested</b>
<i>Corylus:</i>	471	78.3%	0.6%	21.0%
<i>Fragaria:</i>	1118	60.3%	17.0%	22.7%
<i>Humulus:</i>	735	16.9%	9.3%	73.9%
<i>Mentha:</i>	439	3.0%	4.8%	92.3%
<i>Pyrus:</i>	1547	85.1%	8.2%	6.7%
<i>Ribes:</i>	560	11.1%	16.3%	72.7%
<i>Rubus:</i>	699	79.4%	9.4%	11.2%
<i>Vaccinium:</i>	512	79.9%	0.4%	19.7%

"Virus Tested" includes plants that have tested negative for several important viruses, and plants that have been produced by heat-therapy and meristem culture.

This report DOES NOT include duplicate accessions or misidentified plants.

This report DOES include accessions that are not available due to intellectual property right quarantine, insufficient inventory, or virus infection.



## Meetings and Presentations during CY1998

John Carter - Trip to make presentations at The International *Ribes* Association and NASGA meetings, Victoria, British Columbia, February 26-March 1, 1998. Information presented on White Pine Blister Rust and *Ribes* Eryophid Mite.

Judith Flynn – Attended the PWA Secretarial & Support Personnel Advisory Council Meeting as the Council Recorder, Moscow, ID, 31 March – 4 April 1998.

Kim Hummer – To coordinate the panel discussion at the White Pine Blister Rust Conference Planning Meeting and give information on the History of White Pine Blister Rust, Resistance in *Ribes* to White Pine Blister Rust and to moderate a discussion session in Albany, NY, January 9-11, 1998.

Kim Hummer – Invited to present a paper on Mint Genetic Resources at the National Plant Germplasm Repository and the National Plant Germplasm System to the Mint Industry Research Council and present a poster *Mentha* germplasm at the National Clonal Germplasm Repository to their annual meeting on 15-16 January 1998, Las Vegas, NV.

Kim Hummer – Presented information to Eugene Chapter of the Oregon Association of Nurserymen at their 4 February 1998 meeting.

Kim Hummer – Trip to make presentations at The International *Ribes* Association and NASGA meetings, Victoria, British Columbia, February 26-March 1, 1998. Information presented on White Pine Blister Rust and *Ribes* Eryophid Mite.

Kim Hummer – Eighth Annual North American Blueberry Research and Extension Workers Conference, Wilmington, NC, 26-31 May 1998. Gave a presentation on the *Vaccinium* collection at the NCGR.

Kim Hummer – Attended the ASHS 95<sup>th</sup> Annual International Conference in Charlotte, NC, 12-17 July 1998 and presented a poster of *History of white pine blister rust*; attended the Small Fruit CGC, *Pyrus* CGC, American Pomological Society meeting (and advisory board meeting and Associate Editors meeting).

Kim Hummer, Joseph Postman & Barbara Reed – To take active parts in the Plant Genetic Resource Management Meeting, Ames, IA, 19-25 July 1998.

Kim Hummer – Traveled to and provided a final report for an IN-US PL-480 project on the Collection and Maintenance of temperate fruit and nut crops collected from the Himalayan Hills. 24 August to 4 September 1998.

Kim Hummer – Attended the Western Forest Pathologist Meeting in Reno, NV, 28-29 September 1998. Discussed collaborative research possibilities of white pine blister rust – *Ribes* – *Pinus strobus* study.

Kim Hummer – Invited to present a seminar, “clonal Genetic Resource Management” in Wooster and Columbus, Ohio, October 7-9, 1998.

Kim Hummer – Attended and took an active role in all sessions at the NCR-22 Small Fruit and Extension Workers Meeting in Troutdale, OR on 26-27 October 1998.

Kim Hummer – Attended and made a presentation at the Northwest Center for Small Fruits 8<sup>th</sup> Annual Meeting November 30-December 2, 1998, Boise, ID.

Joseph Postman – Presented, “Pests and Diseases in *Ribes*” at the 49<sup>th</sup> Annual Western North American Small Fruit Pest Conference, Stevenson, WA, March 6, 1998.

Joseph Postman – To attend and give a presentation on virus and virus-like diseases of fruit crops at the WCC-20 Meeting of Fruit Virologists, University of California, Davis, CA, May 15-20, 1998.

*Joseph Postman* – To attend and give a presentation at the Hops Research Council Meeting, Yakima, WA, 2-5 Aug. 1998. “Procedures for detection and elimination of pathogens from hop germplasm collection.”

*Dennis Vandaveer* – Training was titled, “ADA/Ergonomic Workshop,” given at PWA, Albany, CA October 27-30, 1998.

*Barbara Reed* – To give oral presentation on mint cold storage and preside over the workshop, “Designing a micropropagation system”, at the Society for In Vitro Biology General and Board Meetings, Las Vegas, NV, 29 May-5 April, 1998

*Barbara Reed* – JIRCAS/IPGRI Joint International Workshop 1998: Cryopreservation of tropical plant germplasm – Current research progress and applications. Tsukuba, Japan, 10/17-10/25/1998. Presented two invited talks, submitted two posters and chaired two discussion sessions.

### **Website Activity**

By Joseph Postman

The repository web page continues to be an important technology transfer tool. Germplasm users and the general public can access information about the repository, download catalogs of our collections, search the GRIN database, and make requests for plant germplasm online. At the present rate of access, we are attracting about 6000 visitors per year to our home page. Web access statistics for a typical month (Summary Period: Jan 1 1999 to Feb 2 1999) show the following repository pages to be the most frequently accessed:

<b><u>Web Page</u></b>	<b><u>Monthly Hits</u></b>
Repository main home page	523
Index of featured plants	97
Index to collection catalogs	101
Featured plant - Ribes Cluster Cup Rust	105
Index to Pear of New York Images	181
Index to Small Fruits of New York Images	556

### **Visitors, Technology Transfer and Community Outreach**

By Judith Flynn

The number of folks visiting NCGR to gain both specific and general information about our collections totaled 495 from January through December 1998 inclusive. During this year visitors represented 13 countries of the world: Austria, Chile, China, Ecuador, Estonia, Germany, Japan, Latvia, New Zealand, Russia, Scotland, Taiwan and the United States.

Private sector groups touring the Repository to obtain knowledge of our extensive collection consisted of: The Nursery Growers and Extension Workers Association, the Retired Oregon State University County Agents, the Hop Commission, the Mint Commission, the Mint Research Council, International Seeds, Inc., Cornell Cooperative Extension, Linn County extension Association, Proctor and Gamble, Xinjiang Academy of Forestry, Fall Creek Farm Nursery, Crop and Food Research.

Classes visiting the NCGR from these institutions: Oregon State University, University of Portland, Linn-Benton Community College, Willamette University, Linfield

College, Shandong Agriculture University, Philomath High School, Corvallis High School, West Albany High School, Willamette Valley Community Elementary School  
Capital Press, Salem, OR, Oregonian, Portland, OR, Gazette-Times, Corvallis, OR, Organic Offerings, Oakland, OR, published articles and photos explaining various aspects of the the NCGR mission.

John Carter, visiting scientist from University of Minnesota, presented a seminar titled, "Black Currants Beset by Frost and Mites: Some of What I did on my Sabbatical" at the Repository March 11, 1998. Folks from ARS and OSU attended.

## **NCGR 1998 PUBLICATIONS**

### **Journal Articles:**

- Davis, R.E., R. Jomantiene, E.L. Dally, J. Maas, D. Legard, and **J. Postman**. Link between the rare plant taxon "*Fragaria multicipita*" in Canada and a disease problem in strawberry in Florida. *Acta Horticulturae* 471:25-30. 1998.
- Hummer, K.**, 'Old Home' and 'Farmingdale,' the Romeo and Juliet of pear rootstocks: An historical perspective. *Fruit Var. J.* 52(1):38-40. 1998.
- Hummer, K.**, Review of: Walnut production manual. D. Ramos, ed. *HortTechnology* 8(2):225. 1998.
- Hummer, K.** and C. Rom. Preserving a healthy fruit crop industry in the United States. *Fruit Var. J.* 52(4):210-214. 1998.
- Jomantiene, R., R.E. Davis, E.L. Dally, J.L. Maas, and **J.D. Postman**. The distinctive morphology of "*Fragaria multicipita*" is due to a phytoplasma. *HortScience* 33(6):1069-1072. 1998.
- Postman, J.D.** Temperate Fruit Germplasm Borne Pathogen Collections at NCGR-Corvallis. *Acta Horticulturae* 471:111-114. 1998.
- Postman, J.D.** and P. Catling. *Fragaria multicipita* - a pathogen induced taxon. *Acta Horticulturae* 471:31-33. 1998.
- Reed, B.M.**, J. Mentzer, P. Tanprasert, and X. Yu. Internal bacterial contamination of micropropagated hazelnut: Identification and antibiotic treatment. *Plant Cell, Tissue, and Organ Culture* 52: 67-70. 1998.
- Reed, B.M.**, J. DeNoma, J. Luo, Y. Chang, and L.E. Towill. Cryopreservation and long-term storage of pear germplasm. *In Vitro-Plant* 34: 256-260. 1998.
- Reed, B.M., C.L. Paynter,** J. DeNoma, and Y. Chang. Techniques for medium and long-term storage of pear (*Pyrus* sp.) genetic resources. *IPGRI Plant Genetic Resources Newsletter.* 115:1-5. 1998.
- Tanprasert, P. and **B.M. Reed**. Detection and identification of bacterial contaminants of strawberry runner explants. *Plant Cell, Tissue, and Organ Culture* 52: 53-55. 1998.

## Abstracts:

- Chang, Y. and **B.M. Reed**. Effects of photoperiod and alternating temperature on cryopreservation and cold hardiness of *in vitro*-grown *Pyrus* meristems. *In Vitro* 34: 61A. 1998.
- Chang, Y. and **B.M. Reed**. Cold acclimatization improves the cryopreservation of *in vitro*-grown *Pyrus* and *Rubus* meristems JIRCUS/IPGRI Joint International Workshop 1998. Tsukuba, Japan October 20-23, 1998.
- Dumet, D., Y. Chang, **B.M. Reed**, and E.E. Benson. Replacement of cold acclimatization with high sucrose pretreatment in black currant cryopreservation. JIRCUS/IPGRI Joint International Workshop 1998. Tsukuba, Japan October 20-23, 1998.
- Hummer, K.** 1998. Horticultural Perspective: History of White Pine Blister Rust. HortScience HortScience 33(3):468.
- Postman, J.D.**, J.S. DeNoma and **B.M. Reed**. Incidence of six viruses in USDA hop (*Humulus*) germplasm, and establishment of virus-tested *in vitro* core collection. APS abstracts. 1998.
- Reed, B.M.** Cold storage of mint germplasm *in vitro*. *In Vitro* 34: 49A. 1998.
- Reed, B.M.** Genotype considerations in temperate fruit crop cryopreservation. JIRCUS/IPGRI Joint International Workshop 1998. Tsukuba, Japan October 20-23, 1998.
- Reed, B.M.**, J. DeNoma and Y. Chang. Application of cryopreservation protocols at a clonal genebank. JIRCUS/IPGRI Joint International Workshop 1998. Tsukuba, Japan October 20-23, 1998.
- Reed, B.M.**, R.M. Brennan, and E.E. Benson. Cryopreservation: an *in vitro* method for conserving *Ribes* germplasm in international genebanks. JIRCUS/IPGRI Joint International Workshop 1998. Tsukuba, Japan October 20-23, 1998.
- Tsao, C-W. V. and **B.M. Reed**. Adventitious shoot regeneration *in vitro* from leaf explants of eight important blackberry cultivars. *In Vitro* 34: 69A. 1998.