ANNUAL PROGRESS REPORT

For Calendar Year 1992

USDA-ARS
NATIONAL CLONAL GERMPLASM REPOSITORY
33447 Peoria Road
Corvallis, OR 97333

Presented June 24 and 25, 1993
Ft. Collins, Colorado

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Dr. Barbara Reed, Cryopreservation, Plant Physiologist
Dr. Patricia Buckley, Microbiologist (Temporary)
Dr. Henrietta Chambers, Research Horticulturist (Temporary)
Bill Doerner, Agricultural Technician-Integrated Pest Mgmt.
Judith Flynn, Secretary
Ray Gekosky, Agricultural Technician-Field Assistant
Jay Goodwin, Agricultural Technician-Seed Management
Lisa Hunt, Agricultural Technician-Screenhouses & Acquisitions
Dennis Magnello, Agricultural Technician-Greenhouses & Distribution
Carolyn Paynter, Agricultural Technician-Tissue Culture
Joseph Postman, Plant Pathologist
Joe Snead, Agricultural Technician-Field Manager
Dr. Maxine Thompson, Research Horticulturist (Temporary)
Dennis Vandeveer, Facilities Manager

Brian Courtney, Biological Aid (Temporary)
Traci DeWilde, Biological Aid (Temporary)
Aaron Henderson, Biological Aid (Temporary)
Nancy Higgins, Biological Aid (Temporary)
Elizabeth Langham, Biological Aid (Temporary)

Wes Messinger, Graduate Student
Derek Peacock, Graduate Student
Dennis Yeo, Graduate Student
Xiao-Ling Yu, Graduate Student

Dr. Francis Lawrence, Collaborator
Dr. Mel Westwood, Collaborator

Personnel

Ms. Donna Gerten, our Computer Specialist, resigned in August 1992. We were unable to recruit for replacement for the position because of the hiring freeze that was imposed. We decided to terminate the position and establish a co-operative education developmental position. Mr. Brian Courtney was hired for the co-op developmental position. At present he is working at 0.7 FTE and taking a full load of undergraduate courses in the Oregon State University Computer Science Department. Upon graduation he can be considered for a full time position.

Several new Agricultural Science Research Technicians were recruited during 1992. Ms. Lisa Hunt was hired in June as our Screenhouse Manager, and Dennis Magnello was hired in August as our Greenhouse Manager. The plants in the primary screenhouse collections are now under Lisa's watchful eye. She has developed new fertilizing and pruning schedules to increase the vigor and health of these plants. Lisa is also in charge of new acquisitions. Dennis has taken over the responsibility for plant distribution, along with the greenhouse management.

Drs. Maxine Thompson, Henrietta Chambers, and Pat Buckley are continuing part time Research Associate Positions studying Rubus cytology, Mentha cytology, and internal contamination of in vitro cultures. Each of them are making significant contributions to the practical research needs of the repository and we are greatly concerned that these positions cannot continue next year due to funding difficulties and staffing ceilings.

Our unit is now supporting several graduate students. Xiao Ling Yu and Dennis Yeo are studying in vitro culture of *Corylus* and *Pyrus* with Dr. Barbara Reed. Wes Messinger is examining subgeneric differences in *Ribes* taxonomy, from a molecular view. Derek Peacock has just begun an assignment studying *Rubus* seed germination.

Physical Plant

The development of our new acreage, our north farm, as we now call it, is proceeding well. All of the old structures, which were safety hazards, are now removed. The perimeter fencing has been completed. Trash and rubble from the old buildings has been burned or removed.

Our main facility buildings are beginning to show signs of aging, now being 12 years old. The main water heater was replaced. Many valves for the main water supply were replaced. We are contemplating adding a filter to our main water supply. Dennis Vandeveer, Unit Facility Manager, has kept our back-up diesel generator on line. The multizone unit had some quarks early in winter but functioned well in general. Our screenhouse doors are falling apart and are being replaced as needed. The fiberglass roofing and some of the eaves of the screenhouses are deteriorating and will be a large expense within 5 years. The swamp coolers for the greenhouses are under a rotational replacement scheme. The older models seem require many replacement parts.

Our security and fire systems continue to have numerous false alarms. Older rate of rise sensors are being replaced when they begin causing trouble-alarms. Faulty circuits caused several false burglar alarms this past year.

Budget

Our base funding in FY 1992 was $643,505. A slight increase was given for FY 1993 to $663,767. At this level of funding our operating dollars are quite tight, travel and material purchases are minimal. We coordinated about $114,000 additional dollars in FY 1992, including extramural specific cooperative agreements, plant exploration dollars for collecting Chinese *Rubus*, coordinating two meetings to determine the safe movement of small fruit germplasm, fence construction, training of scientists and student apprentices, propagation of hazelnuts by in vitro culture.

With the continuing of base funding level, although our accessions are continuing to increase we are forced to make decisions regarding trade-offs. While virus testing and elimination and back-up in vitro storage of our plant materials are both integral parts of our mission, these tasks are proceeding at a much slower pace than we would prefer due to limited staffing and budget. Maintenance of primary collections is given preference.

New Accessions and Inventory

After much deliberation among the staff we decided to change our local or inventory numbering system. We decided to adopt a system that keeps track of seedlings from a seedlot using increasing decimals from the base seedlot number. We also wanted to link virus tested material with the original accession. While this seems like a small change on the surface - and an important need to keep track of observations on our seedlings - this was a major change in our database management. We use the inventory number as our primary identifier so all of our programming had to be modified to incorporate this change.

We are continuing to increase our collections. We have added 749 new accession records which include more than 1067 inventory items. Our largest increases were *Rubus* and *Fragaria*. Several USDA plant exploration trips provided us with new species of *Rubus* from Chile, Ecuador, China and Russia. The return of Scott Cameron to Chile provided us with additional collections of South American *Fragaria chiloensis* to fill in gaps in the collection.

Corylus scionwood was received from Russia to replace material that did not survive propagation last year. We gratefully acknowledge Dr. L. Burmistrov of Russia, Dr. L.N. Lasareshuili of Tbilisi and Dr. George White for facilitating the entry of this germplasm. We also thank Sophia Golotareva and Natasha Scribanova for sending *Corylus* seed from Russia. We have received new *Coryus* from Manuel Coque Fuertes and Merce Rovira in Spain. Dr. Tom Lumpkin obtained accessions from several different genera from Sachalin Island, Russia for us.

We have been corresponding with Tom Brown who obtained Pears from La Purisima Mission in California for our collection. These pears date back several hundred years to the original establishment of the mission. We also received early ripening pears from Sardinia, Italy, from Professor Aggabio of Sassari, and two recent releases from Professor Belini of Florence. The Italian Pears are being tested at the National Quarantine Center in Beltsville.

We have received many new cranberry accessions from native collections from the southern range of *Vaccinium macrocarpon*, collected by Jeannie Allen. In addition, Dr. Elden Stang has 2provided cranberry selections and propagules of *V. vitis-idaea,* the lingonberry, from his collection in Wisconsin. Several clones of *Sorbus*, said to be bred by Luther Burbank, have been added to our collection.

We have recently assumed responsibility for the species *Juglans cinerea*, the butternuts, at the request of the Davis Repository. Davis could not house this germplasm because of California quarantine regulations. We have 18 selections of butternut now planted at our north farm. The Paw-paw, Assimina triloba, is a native American fruit which had not previously been assigned to a repository. We will be assuming responsibility for this species with new crop potential. This tree has an edible fruit and is native to the Southeastern United States. We will participate with Anita Azerenko of the OSU Horticulture Department and Neil Peterson of the National Paw-paw foundation on a cooperative project evaluating Paw-Paws in 14 states throughout the country.

Plant Distribution

In 1992 the Corvallis Repository distributed a total of 2,634 items as seed, cuttings, runners, scionwood, rooted plants, and tissue cultures to researchers in the United States and abroad. Foreign distribution accounted for 26% of the items shipped. Requests coming into the repository can require as long as 3 years to complete, in some cases. This length of time is needed to coordinate the import permit, phytosanitary certification, and appropriate season for plant propagation. Over the past 5 years as many as 500 items per year were requested that were not in the repository collection or were not yet large enough to propagate. At the end of 1992 more than 900 items remain pending for distribution in 1993.

IPM Activities for 1992

This report is a brief summary of last year's efforts toward providing an integrated pest management (IPM) program for the greenhouses, screenhouses, and field collections at our facility.

Weather Station:

In 1992, we were recording seven meteorological parameters which include: **air temp.** @ 42" in degrees F. and degrees C., **soil temp.** @ 4" and 20", **wind speed, wind direction, solar radiation, relative humidity**, and **precipitation**. We used the data to calculate chilling-units from Oct. 1st to Feb.28 and day-degree units (codling moth development) from March 1st to Sept. 30th. We provided OSU researchers and extension personnel with weekly weather data reports (see attached examples). The beneficiaries included: Dr. Porter Lombard, Dr. Bob Stebbins, Dr. Glenn Fisher, Dr. Les Fuchigami, Ms. Becky McClusky, Mr. Scott Robbins, and Mr. Bob Rackham. We will continue to provide this service during 1993.

A solar panel and lead battery were installed to replace the 8 alkaline D cell batteries previously used to power the system. The lead battery provides a 12 volt power source to the micrologger and the solar panel recharges the lead battery. This gives us an economical and more

dependable power supply. The Campbell model 21 micrologger continued to operate and performed very well in 1992. At some point we will have to purchase a new micrologger, but for now this one is getting the job done.

Codling Moth Mating Disruption Trial:

Working with Dr. Janice Gillespie, Concep Membranes Inc., Bend, OR., and Dr. Glenn Fisher OSU Dept. of Entomology, a mating disruption trial was conducted in our pear orchard. The purpose of this trial was to evaluate the product "CheckMate CM" under our orchard conditions to determine if mating disruption of codling moth as a control strategy could be achieved. The trial consisted of two treatments, a high rate (320 lures/acre) and a low rate (160 lures/acre). The high rate was applied to the northern half (cultivar block) of the orchard and the low rate was applied to the southern half (species and rootstock block). A control block was established using rows 1-10 in the northwest corner and 3-12 in the southwest corner of the orchard (see attached map). Five buffer rows (no treatment) were maintained between the control and treatment areas.

Biofix was established on April 13 and the pheromone lures were applied on the morning of April 14th. Both treatments and the control blocks were monitored with pheromone traps (see attached data). The CheckMate pheromone dispensers were changed every 60 days for a total of four applications. A Guthion 35% WP (1lb./acre) spray was applied to the buffer areas four times throughout the season according to a day-degree model. On July 30, forty fruits were sampled from each row by randomly sampling four fruits/tree (one fruit was sampled from each side of the tree).

The high rate block (320 lures/acre) had 13.6% infested fruit, while the low rate block (160 lures/acre) had 10.8% infested fruit. The data from the low rate block is perhaps misleading at first glance, but remember this is our species collection and much of the fruit is undesirable for codling moth. Also much of this fruit is pea to marble size and we were unable to recover any codling moth from this type of fruit. For this reason, the number of fruits susceptible to codling moth in the low rate block is less than that in the high rate block. This points out one of the difficulties in evaluating mating disruption in an orchard as diverse as ours. The small size of our orchard and the proximity to the Lewis-Brown orchard (no mating disruption) are probably the reasons why this technology does not show better results. Also, I there may have been a problem with the dispensers running out of pheromone before the 60 day period.

Field Insectaries:

We established small field plantings of clovers, herbs, and wild flowers for the purpose of attracting natural occurring beneficial species of insects to our field plant collections. In our *Rubus* and *Fragaria* plantings we continue to experiment with a variety of flowering plants. Our aim is to maintain early, mid, and late season nectar sources.

The adult stage of many important beneficial insects (wasps, flies, beetles, lacewings, etc.) require nectar in their diet. Without nectar, these insects will not reproduce. In order to

accommodate healthy populations of beneficials in our agroecosystem, a sustained source of nectar is critical.

In general, plants with small flowers are important because tiny parasitic wasps and flies have trouble accessing the nectar of large blossoms. Plants we have successfully established include: fennel, dill, caraway, clovers (white, crimson, ladino, red), vetch, sunflower and buckwheat.

In addition to a nectar supply, these plants also help increase the plant diversity which reduces the chance of serious pest outbreaks. Research has shown that crops grown in floristically diverse habitats support fewer herbivorous pests than do related crop species in monocultures. There is great potential for expanding this concept to other areas of our field including the new land.

Greenhouse/Screenhouse:

The pest quarantine area (gh #4, section #5) continues to be the keystone of our pest prevention program. We have been very successful in reducing the number of pests introduced into the greenhouses/screenhouses since we have established this program. Communication between repository staff is improving and we are well on our way to providing acceptable pest control with a minimum of chemical pesticide use.

We continue to experiment with different biological control agents, for control of arthropod pests under our greenhouse/screenhouse conditions. Our most successful biological control agent has been the predatory nematode *Steinernema carpocapsae*. These nematodes are marketed under the name "Exhibit", and sold by Ciba-Geigy Ltd.

The second most successful biocontrol agent has been *Encarsia formosa*, a tiny parasitic wasp for control of greenhouse whitefly. *Encarsia* continues to be the most reliable biocontrol agent against the greenhouse whitefly.

The predatory mite *Phytoseiulus persimilis* provides fair to good control in the greenhouses but poor control in the screenhouses. This is due to the high humidity requirements of this mite which cannot be maintained under our screenhouse conditions.

We have arranged to prepay for biocontrol agents in early February so that they can be shipped monthly to the repository. This has made biocontrol more efficient and easier. Tani has been very cooperative in setting this up.

Summary/Recommendations:

The IPM program for the repository is improving each year. We are now entering our fourth year and I feel we are on schedule with the development of IPM at the repository. When I began this job four years ago, I estimated it would take approximately five years to complete the transition from a conventional spray program to an IPM program. Each year we try to add a new dimension to our program depending on what worked and didn't work the previous year. In order for the IPM program to continue to grow and improve, continued support is critical.

In addition to one full time technician, a part time assistant is necessary. Without continued support staff, the IPM program will decline significantly.

Virus Detection and Virus Elimination

Clonal accessions at NCGR are routinely tested for virus diseases using appropriate bioassay or ELISA. Accessions found to be virus infected are subjected to heat therapy and micropropagation in an effort to produce a healthy plant. At the close of 1992, 48% of all clonal accessions, and 66% of the six major fruit and nut genera were available as virus negative plants (Tables below).

NATIONAL CLONAL GERMPLASM REPOSITORY - CORVALLIS

1992 Virus Status Summary

GENUS	CLONES	PERCENT VIRUS NEGATIVE	PERCENT VIRUS POSITIVE	PERCENT UNTESTED OR INCONCLUSIVE
CORYLUS	413	85.47	3.39	11.14
FRAGARIA	851	54.29	10.22	35.49
HUMULUS	775	7.35	1.29	91.35
MENTHA	470	2.77	3.19	94.04
PYRUS	1497	82.03	13.09	4.88
RIBES	424	37.74	24.53	37.74
RUBUS	716	64.25	11.45	24.30
VACCINIUM	455	50.11	0.66	49.23
TOTAL	5601			

Virus negative includes accessions with virus status F, P and T.

J. D. Postman 05/21/93

National Clonal Germplasm Repository - Corvallis

1992 Summary of Accessions and Virus Status

GENUS	TOTAL ACCESSIONS	UNIQUE CLONES	VIRUS NEGATIVE CLONES	VIRUS INFECTED CLONES	UNTESTED CLONES
CORYLUS	434	413	353	14	46
FRAGARIA	1131	851	462	87	302
HUMULUS	784	775	57	10	708
MENTHA	520	470	13	15	442
PYRUS	1788	1497	1228	196	73
RIBES	797	424	160	104	160
RUBUS	1639	716	460	82	174
VACCINIUM	889	455	228	3	224
*** Total ***	7982	5601	2961	511	2129

Duplicate accessions, clones that have been replaced with heat treated plants, and misidentified accessions are not included in this report. "Virus negative" includes the sum of clones with virus status F, P and T. This includes clones that have tested negative for all important viruses, clones that have provisionally been released following virus therapy, and clones that have tested negative following limited indexing, respectively. "Total accessions" includes seed lots.

J. D. Postman 21 May, 1993

Mentha Collection

The *Mentha* collection received many additions during 1992 including *Mentha australis* from Victoria, Australia, *M. diemenica* from New South Wales, Australia and *M. cunninghamii* from New Zealand. In addition were collections, as yet unidentified from Turkmenia and Sahkalin Island. The Australian and New Zealand plants arrived early enough in the season to obtain flower buds and chromosome counts. The latter will be added to the chromosome survey of *Mentha* that is being submitted for publication in *Taxon* in 1993. Another project, involving chromosome counts in *Pycnanthemum* along with a report on artificial hybrids in that genus, was submitted to *Castanea* and accepted for publication in 1993.

The herbarium study of native Australian and New Zealand *Mentha* was completed in 1992. The Oregon State University herbarium borrowed specimens for us. The locality data of a portion of the 800 specimens that were examined will be put into a data base, distribution maps will be made, and all will be assembled into a packet that USDA plant collectors could take to these countries with the goal of obtaining more of these endemic species for our collection. We currently have 4 accessions of the seven taxa that are endemic to Australia and New Zealand and need a better representation.

Drs. Henrietta Chambers and Kim Hummer prepared an article "*Mentha* genetic resources and the collection at USDA-ARS NCGR-Corvallis" which was published in Diversity.

Seed Collections

Inventories of seven of the eight major genera and of all 15 of the minor genera have been completed and the database updated. The inventory of *Vaccinium* seeds is roughly one-third of the way to completion.

Concurrent with the inventory, the packaging material of each seed lot was inspected and replaced if worn or damaged. Package labels were also improved and now show the genus and species of the seed, the date collected and the date received at NCGR, the weight per 100 seed, and the current quantity and current date. The quantity and date are noted on the package whenever seeds are withdrawn for germination or distribution. A new storage system for the seeds was determined to make more efficient use of our limited storage space. The new system requires slightly less room, but makes it much easier to locate, withdraw, and replace a particular seed packet.

Most seed requests are filled within several days of receipt of the request. However, when shipment requires an import permit and phytosanitary certificate additional time may be required.

We have produced seedlings of *Rubus, Ribes, Fragaria, Vaccinium, Pyrus, Amelanchier, Corylus*, and *Peraphyllum*. *Rubus* is proving difficult to germinate. *Vaccinium* is not difficult to germinate but it is difficult to keep the seedlings alive. Though patience may be required, starting other genera from seed is not particularly problematic.

Cryopreservation, Tissue Culture & Other Laboratory Activities

Cryopreservation:

Most of the experiments this year focused on *Ribes* apical meristems. The first four months of 1992 were spent developing vitrification techniques for *Fragaria*, however these were mostly unsuccessful. Work with *Ribes* was a comparison of three techniques with four or five genotypes. The results were presented at the Cryobiology meeting and the International Congress on Plant Cell, Tissue and Organ Culture. A summary of data from screens of *Rubus, Fragaria* and *Pyrus* were presented to the Spanish Society for Cryobiology.

Cold Storage:

The cold storage collection is holding about steady at 1400 accessions. We have not added many this year due to limited personnel. The collection is also getting large enough to require a lot of time for repropagation. Since most of the collection has been in storage since 1989, many are coming up for recollection from the screenhouse. Next spring and summer we will look at replacing those that have been repropped three times, or discarding them if they are not a high priority for T.C. and adding something that is. We may also plant some in the field for evaluation.

We still have need for one or two small cold rooms to be able to experiment with light and temperature conditions for cold storage. Storage experiments are in progress with both *Pyrus* and *Mentha* cultures.

Tissue Culture:

Pyrus rooting screens have been completed for 49 pear and 1 *Pyronia* accession. Pear cultivars were easier to root than species material. Ten genotypes (mostly species) did not root on any of six treatments. The majority rooted best following a dip in 10 mM IBA and growth on medium with no growth regulators. Some of the more difficult to root accessions were successful with a 10 mM NAA dip or growth on 10 μM IBA for one week in the dark followed by growth on medium with no growth regulators.

Corylus culture is progressing with the fine work of Xiaoling Yu. We have developed improved initiation and multiplication methods for several genotypes and developed an improved medium as well. The use of glucose in the medium as well as sequestrene iron and altered benzyladenine concentrations improved multiplication considerably.

Development of a pear rootstock micropropagation system by Dennis Yeo is focusing on improving multiplication and rooting. We are working on three rootstocks not currently widely used due to lack of availability: two Oregon Pear Rootstocks and one Old Home x Farmingdale cross. Specific genotype differences are apparent among the accessions and each will require a different protocol for successful commercial micropropagation.

Internal Contaminants:

Antibiotic treatments have been developed and successfully used on several *Mentha* accessions. Characterization of the bacterial cultures and preliminary testing for antibiotic susceptibility provided the information needed to do preliminary identification and successfully treat the infected cultures. Combinations of antibiotics were required to eliminate bacteria in some plants, probably due to the presence of several different bacteria or to very resistant bacteria such as *Agrobacterium*. The phytotoxic effects of certain antibiotics were also noted.

Rubus Collection

Maxine Thompson is continuing to make chromosome counts for the *Rubus* species and cultivars at the Repository. When this work is completed a publication, which will include not only all of her counts, but also a compilation of all published counts for the genus, will be prepared. Dr. Thompson will present a paper at the *Rubus/Ribes* Symposium in Poland, July 1993 on chromosome numbers of Chinese *Rubus*, many of which she collected on a *Rubus* plant exploration trip to Guizhou Province in June-July 1992. That trip yielded 81 seed samples of about 25-27 species which have been added to the Repository accessions.

NCGR Visitors

More than 300 individuals visited the Repository from January 1st to December 31st, 1992. People sought information about our 30 genera. These visitors arrived from as close as Boring, OR. or as distant as Mongar, Bhutan. Tours were given to groups and individuals as diverse as Bruce Fry's Rotarians and Dr. He, Shan-An of the Nanjing Botanical Garden in China. We have given tours to classes from Oregon State University and Willamette University. Always we take pride in sharing our information and many experiences with the public.

Computer Interactions

At the end of 1992 there were 7032 total accessions of our 8 major genera at the Germplasm Repository in Corvallis. This includes 469 new accessions. Of the active inventory 4762 were available as clones and 1318 available as seed.

There were 617 total accessions of our minor genera (of which 25 are intergeneric hybrids). This includes 60 new minor genera that we received in 1992. Of the active inventory for the minor genera there were 224 available as clones and 157 available as seed.

The inventory accessions, cooperator and order processing records were uploaded to the GRIN data base on PRIME.ARS-GRIN.GOV at the end of December 1992. We did not keep exact accounts of numbers of records uploaded to GRIN this past year due to change of staff members. We have been interactive with Solborn and the internet. Joseph Postman (postmanj@bcc.orst.edu), Kim Hummer (hummerk@bcc.orst.edu) and Barbara Reed (reedbm@bcc.orst.edu) actively check E-Mail on the local Oregon State network. We can connect through the Oregon State node to PRIME or Sol or other systems on the internet.

December , 1992
New Accessions

Genus	New Accessions
Corylus	33
Fragaria	115
Humulus	5
Mentha	36
Pyrus	13
Ribes	52
Rubus	139
Vaccinium	76
** Subtotal **	469
Amelanchier	5
Arbutus	3
Ceanothus	2
Cydonia	0
Eriobotrya	0
Escallonia	0
Gaultheria	2
Gaylussacia	0
Holodiscus	1
Juglans	0
Mespilus	0
Peraphyllum	0
Pycnanthemum	17
Sambucus	4
Sorbus	7
Intergeneric Hybrid	1
** Subtotal **	60
Total ***	529

December , 1992

National Clonal Germplasm Repository Corvallis
Collection Summaries

Genus	Available Clones	Available Seed	** Unavailable Quarantine	Patented	Other	Active Inventory	Total Accessions
			** MAJOR GENERA				
Corylus	333	0	32	1	45	411	425
Fragaria	628	176	99	26	93	1022	916
Humulus	774		0	1	8	784	782
Mentha	455	38	0	1	20	514	488
Pyrus	1368	68	17	27	221	1701	1608
Ribes	273	149	103	0	123	648	644
Rubus	571	596	24	17	242	1450	1340
Vaccinium	360	290	9	4	221	884	829
** Subtotal **	4762	1318	284	77	973	7414	7032
			** MINOR GENERA **				
Amelanchier	32	20	0	3	35	90	75
Arbutus	2	2	0	0	5	9	11
Ceanothus	0	11	0	0	24	35	35
Cydonia	19	5	0	0	19	43	45
Eriobotrya	3	0	1	0	7	11	13
Escallonia	0	0	0	0	0	0	1
Gaultheria	5	18	0	0	2	25	25
Gaylussacia	0	0	0	0	3	3	3
Holodiscus	0	2	0	0	1	3	3
Juglans	11	0	0	0	0	11	11
Mespilus	16	0	0	0	3	19	23
Peraphyllum	2	4	0	0	2	8	6
Pycnanthemum	35	28	0	0	19	82	80
Sambucus	20	41	0	0	23	84	82
Sorbus	68	26	10	0	89	193	179
** Subtotal **		157	11	3	232	616	592
			IGHYB GENERA **				
Interspec. Hyb.	11	0		0	12	24	
** Subtotal **	11	0		0	12	24	25
*** Total ***	4986	1475	296	80	1217	8054	7649

Publications

Articles:

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