NCRPIS Annual Report - 2006
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NORTH CENTRAL REGIONAL PLANT INTRODUCTION STATION
NC-7 ANNUAL REPORT, JANUARY 1 - DECEMBER 31, 2006

I. PROJECT TITLE:

NC-7 "Plant Germplasm and Information Management and Utilization."

II. COOPERATING AGENCIES AND PRINCIPAL LEADERS (current):

A. Administrative Advisor

*W. Wintersteen, Iowa

B. Regional Coordinator

*C. Gardner, ARS, Iowa

C. State Experiment Stations Representatives

1.	Illinois	*T. Hymowitz	7. Missouri	*P. Beuselinck
2.	Indiana	*J. Janick	8. Nebraska	*D. Baltensperger
3.	Iowa	*C. Brummer	9. N. Dakota	*B. Johnson
4.	Kansas	*M. Stamm	10. Ohio	*D. Francis
5.	Michigan	*A. Iezzoni	11. S. Dakota	*K. Glover
6.	Minnesota	*S. Hokanson	12. Wisconsin	*W. Tracy

*Voting members

D. U. S. Department of Agriculture

1. ARS National Program Staff, Plant Germplasm	*P. Bretting
2. ARS Plant Exchange Office	*E. Garvey
3. ARS Area Director, Midwest Area	S. Shafer
4. Cooperative State Research, Education and Extension Service	A. Thro
5. Natural Resources Conservation Service	*Vacant
6. National Center for Agric. Util. Research	*T. Isbell
7. National Center for Genetic Resources Preservation	*H. Shands

E. North Central Regional Plant Introduction Station, Ames, Iowa

See organizational chart, Figure 1 in the Appendix.

III. PROGRESS OF WORK AND PRINCIPAL ACCOMPLISHMENTS:

Our mission continues to focus on acquisition, documentation, regeneration, characterization, evaluation, and distribution of germplasm and associated information. The world's biological diversity and plant genetic resources (PGR) continue to be threatened by climatic, social, political and environmental pressures. Demand for genetic diversity and development of supporting technologies to increase the availability of well-documented PGR continues to increase.

The quality of the collections, associated information, and service provided to the research and educational communities continues to build upon the work of generations of plant scientists,

implementing new technologies and new learning. Quality information delivery systems are critical to successful use of plant genetic resources and realizing the potential they offer.

Available resources (approximately $2.2 M from ARS and $0.53 M from NC7 funds) were devoted to this mission, in order to secure and maintain our plant genetic resources, staff, support equipment, laboratory and field activities, and research designed to provide information to improve the quality, value and utility of the collections.

The revision of the NC-7 Project was completed and submitted in December, 2006. Following its review, the NC-7 project was approved and has been extended for the period September 1, 2007 – August 31, 2012.

The NCRPIS Operations Manual has become a dynamic document, providing guidance and documentation on SOPs and best practices. Changes reflects improved practices while providing relevant reference materials used to guide and train our staff on all aspects of curatorial operations and procedures, ensuring high standards and quality of operations. NCRPIS Staff contributed to the revision of the Acquisition and Distribution Policies for the NPGS, to the Active Site section of the revised NPGS Operations Manual, and to the development of geo-referencing standards for documentation of accession origins.

Personnel changes - June, 2006 – May, 2007:
Departures:
Mr. Philip Biggs, USDA-ARS Student Computer Intern, December, 2006.

New Hires:
Ms. Rachael Beyer, USDA-ARS Germplasm Program Assistant, November, 2006.
Mr. Jesse Perret, Term half-time USDA-ARS Computer Assistant, May, 2007.

Promotions:
Kathy Reitsma, to ISU Curator III, March, 2007.

Management of Federal STEP (Student Temporary Employees):
Approximately 41 ISU students were hired to fill 20 FTE positions which supported curatorial projects, viability testing, IT support and development, and farm and facilities operation. Students were interviewed and selected by ISU Program Manager Larry Lockhart or ARS IT Specialist Peter Cyr. Marci Bushman and Rachael Beyer managed the administrative aspects of all STEP hires, with support and guidance by Ames ARS HR Specialist Lynnette Richey.

Construction and Facilities:
Highlights included construction of additional climate-controlled dry storage for harvested material prior to processing, addition of digital temperature and RH monitoring of cold seed storage rooms, installation of a new underground fiber optic cable to the newest machine shed, and repair of deteriorating posts in Greenhouse #3. The neighboring Organic Student Farm was relocated and its land made available by the ISU Agricultural Experiment Station for NCRPIS use. Station staff expended considerable effort preparing the land for NCRPIS use, including squaring field borders and installing permanent benchmarks in the former organic farm and swine farm areas. Availability of Agricultural Experiment Station land on the north side of Mortensen Road for NCRPIS use may not be permanent. Headquarters building restroom areas were remodeled, and new informational displays prepared for the 2006 national germplasm meetings that were hosted by the NCRPIS.

Equipment:
Farm staff designed and constructed a new cage furrow opener that is more durable than the former model. They also constructed two flatbed racks used for organizing and moving plants and cages. New equipment acquisitions in 2006 included a track-type skid steer, a John Deere Gator utility vehicle, 120 new 7x7x20 cage frames and covers, a MIG welder, two field cultivators, two new Conviron™ germinators, and a sidewinder edger for the horticulture project. The new machine shed and flatbed racks have been very helpful in the organization of over $3 M worth of inventory of various types of pollinating cage frames and screens. A thermal gradient table was purchased to support viability methods development research from Seed Processing, the Netherlands.

Twelve new PC workstations were deployed to permanent staff based on prioritized needs. Additional barcode scanners and handheld PCS were purchased to support curatorial needs. See Computers and Telecommunications Section for software upgrade details.

IV. PROGRESS IN GERMPLASM AND INFORMATION MANAGEMENT, RESEARCH, AND EDUCATION (C.A. GARDNER):

(Part IV. summarizes the accomplishments and progress presented in greater detail in the individual staff reports in the document.)

Acquisition and Documentation Highlights:
Total acquisitions in 2006 numbered 658 accessions, compared to 282 in 2005 and 450 in 2004. These included 37 *Chenopodium* accessions donated by Eric Jellen (Brigham Young University) or collected by David Brenner, 44 wild sunflowers, 13 cultivated sunflowers, 36 asters, 70 medicinals, 285 maize accessions, 27 chicory, 36 carrots, 14 mints and 49 woody ornamentals. The sunflower and medicinal plant acquisitions resulted from collection trips conducted by Drs. Laura Marek, Joe-Ann McCoy and their colleagues, and from transfer of *Helianthus* accessions collected by OPGC colleagues. A collection trip to the southeastern US focused on obtaining populations of *Helianthus resinosus* to evaluate for disease resistance characteristics; this was funded by the NPGS ARS-PEO office and a Sclerotinia research grant. A population of *Helianthus argophyllus* was re-collected from the sandy edges of Daytona Beach, FL. This population, originally collected in 1980, is the source of the PIArg gene for resistance to downy mildew, and had become unavailable. Joe-Ann's collaboration with Palmer, AK personnel resulted in collection of three populations of *Oplopanax horridus*. W6 Curator Barbara Hellier provided eight accessions collected in Tajikistan of cultivated umbels, *Panicum*, *Melilotus* and *Amaranthus*. Native Seeds/SEARCH donated an accession of *Panicum hirticaule*, a cultivated millet that is nearly extinct from Sonora, Mexico. The new maize accessions include 88 wild *Zea* transferred from the Univ. of Wisconsin (John Doebley teosinte collection) and 32 inbreds with expired PVP certificates. See Table 1 for additional details.

Dr. McCoy completed a medicinal Plant Database to categorize the current status of medicinal taxa available from the NPGS. The database is a compilation of taxa and purported usage from 27 compendia; 26% of these taxa are currently available from the NPGS. The information will be used to assist in identifying priority species for collection and acquisition. Following resolution of taxonomic-name discrepancies (Dr. John Wiersema, NGRL), the database will be made publicly accessible via GRIN.

Regeneration and Maintenance Highlights:
In 2006, 1184 accessions were grown for regeneration and 1354 were harvested, including those established in past years. Over 1400 were made available to the public. About 880 were backed up at the NCGRP in Ft. Collins; 77% of our collections are backed up and 72% are available. The slight decline (1%) in availability from 2005 reflects incorporation of many new accessions, including part of the exotic maize collection received from Major Goodman in 2004. Substantial progress is recognized for increased availability of wild *Helianthus*, a result of the curatorial team's focused

efforts. Propagation of ornamental woody accessions was facilitated by the collaborative efforts of Horticulture Project and Farm Support Staff to integrate new equipment and methods. A large harvest was obtained from successful greenhouse regeneration of the only accession of *Zea nicaraguensis* in the US. Goss' wilt was diagnosed for the first time in Ames on several populations in the 2006 maize field nursery. Stewart's wilt was widespread, necessitating ELISA testing on all 2006 increases to meet phytosanitary requirements for distribution.

Cooperative *Helianthus* regeneration efforts with the National Arid Land Genetic Resources Unit in Parlier, CA continue to be successful. Curator Maria Jenderek, USDA-ARS, transferred to the NCGRP. We sincerely thank Maria for her efforts that enabled this program to be successful, and to USDA-ARS technician Jerry Serimian for his continuing high-quality support.

In addition to Parlier, CA efforts, assistance for *Cucurbita* regeneration was provided by Dr. G. Whiteaker (Sakata Seed America, CA), and for *Daucus* by R. Maxwell (Seminis Vegetable Seeds, ID) and R. Freeman (Nunhems, OR) for *Daucus*.

See Table 2 for additional details.

Distribution:
2006 distributions included 26,100 items of 13,789 unique accessions in response to 1,183 external orders from 797 individuals, a new record for the NCRPIS. Of these, approximately 54% were distributed domestically and 46% internationally. Historically, approximately 33% have been distributed internationally. Large international distributions were made of oilseed *Brassica*, *Linum*, *Cucumis*, and *Amaranthus*. EMBRAPA (Brazil) requested the oilseed *Brassica* and *Linum* collections. The profile of distributions corresponds well to availability of comprehensive trait screening data. Interest has been renewed in *Linum* for oil and fiber characteristics. Within the NCRPIS, 9,654 accessions were utilized for regeneration, viability testing, characterization and evaluation, and phytosanitary testing (Table 3B). Order information by crop is presented in Table 5. CSREES regional distribution history is presented in Table 6.

Seed orders continue to increase for a number of crops. Interest continues to be high in expired maize PVP lines that are newly available (see Maize Curation project report for specific details) and requests from home gardeners for many popular species and cultivars, and large requests from both domestic and international sources to conduct disease response evaluation trials. Demand for *Cucumis* and *Cucurbita* continues to increase. Although our resources cannot support maintaining and distributing the collections to home gardeners, we have tried to use this development to educate the public about plant genetic resource conservation and encourage interested individuals to save seeds, conserve and share germplasm and associated information, and to pursue their own research interests with the materials. Home gardeners are redirected to other sources of commercially available materials.

We distributed 311 plants of five accessions to 22 sites for evaluation in the Regional NC-7 woody ornamental trial evaluations across the Midwestern U.S, with an additional 79 plants of these accessions provided to 10 public gardens. In the process, J. Carstens met with cooperators in Kansas, Colorado and Nebraska.

Leaf samples of *Hypericum* and *Echinacea* grown under greenhouse conditions continue to be distributed to Drs. Jonathan Wendel and Eve Wurtele of ISU for molecular-marker analysis and associated HPLC analysis, respectively. Vegetative and rhizome samples of new *Hypericum* and *Prunella* accessions were made available to ISU/NIH research partners for chemical and genetic analyses.

Evaluation and Characterization:
Over 1,530 accessions were observed, evaluated and characterized for a wide array of descriptor information; over 38,586 observations were transferred to the GRIN database (http://www.ars-grin.gov/npgs/) in 2006 (Table 4). Digital images were taken of 2,672 accessions.
The chicory, vegetable, maize and medicinal plant projects contributed the bulk of the descriptive data entered in 2005. An extensive collection of evaluation data received from NC-7 trial-site cooperators was loaded into a local Access database and prepared for posting on the Internet.

Hypericum descriptors were approved by the New Crops CGC; data were collected for 53 morphological features from 31 flowering field accessions. Large maize disease screening nurseries were supplied to university and industry collaborators in 2006 for evaluation of resistance to *Aspergillus flavus*, northern corn leaf blight, diplodia ear rot, and Stewart's wilt. The entire chicory collection was grown and 13 descriptors evaluated to complete a comprehensive dataset; digital images of plants and flowers, and foliage scans were also captured.

Information technology and telecommunications:
Cybersecurity improvements continue as an on-going, routine activity. The backup and recovery software/hardware system was upgraded to enhance disaster recovery capabilities. A comprehensive patch management system was implemented to update security patches on all networked computers.

Pilot use of a web-based pollinator request form led to more comprehensive development efforts to supply an application that would track curator pollinator requests, insect delivery, and link them to lot code information in GRIN. This information can be mined long-term to address research and service aspects of pollinator efficacy for various crops.

See full IT team report for more detail.

Germplasm's Viability and Health:
Over 3,570 were tested for viability, or approximately 7% of collection holdings were tested for viability in 2006; this included 18% of the oilseeds collection, 9% of the maize collection, 5% of the vegetable collection, and 12% of the ornamental and mint collection (Table 2). Germination tests were also conducted on a number of vegetable accessions as part of a study to determine pollinator insect efficacy.

Progress was made in development of methods for germination of *Cuphea viscosissima* and for *Melilotus; C. viscosissima* is a parent of a fertile hybrid being developed by the national *Cuphea* consortium as a plant source of mid-chain fatty acids.

Pathologist C. Block, with ISU Seed Science's A. Fessehaie and L. Shepperd, continued collaboration on development of real-time PCR assays for detection of *Pantoea stewartii* and *Stenocarpella (Diplodia) maydis* from maize seed, and on identification of optimal seed pre-treatments and incubation conditions for detecting *Phoma lingam* from *Brassica* seed, utilizing a freezing-blotter protocol. Dr. Block was the principal investigator on a grant from the USDA Sclerotinia Initiative for evaluation of wild *Helianthus* species for resistance to Sclerotinia stalk rot.

The first occurrence of Goss' wilt (*Clavibacter michiganensis* subsp. *nebraskensis*) on maize plants was observed at the Plant Introduction farm. Maize seed increase plots were surveyed for a variety of foliar diseases. Sunflower increase plots inspections revealed no occurrences of downy mildew, viruses, or aster yellows. ELISA testing of cucurbit seedlings for seed-borne squash mosaic virus continued. Black rot (*Xanthomonas campestris* pv. *campestris*) of *Brassica* was commonly identified.

Insect management:
Entomologists Hanlin and McClurg supplied 1,165 cages with six different pollinator insect species in 2006. They continue to develop thoughtful insights which help manage and utilize alfalfa leaf cutter (ALC) bees, *Megachile rotundata*, in our regeneration programs, and to improve ALC handling and incubation protocols. ALCs have proven most useful with plants with small to medium size flowers of a flat nature, under warm (26 C or 80 F or above), mostly sunny, dry growing conditions. ALCs seem unwilling to compete with other pollinator insects for pollen or nectar sources. These bees are preferred by our staff because they do not sting and require less management on the part of Entomology staff members. Pollinating activity of a combination of ALC and *Osmia* pollinators was highly effective on many of the oilseed *Brassica* taxa tested. ALC did not work some genera well; when introduced on five different species of *Hypericum* in the greenhouse, the ALCs died within 24-48 hours of release. Activity of hypericin, an active component believed to have insecticidal properties, is hypothesized as the cause. When introduced to *Matricaria*, which give off a strong odor, the ALC bees avoided these plants.

Please see Entomology research and service report sections for a great deal of fascinating, detailed information.

The pollinator 'tip of the month' feature, developed and communicated to staff members to help them educate their support staff on how to understand insect behavior in order to more effectively perform plant-related tasks such as watering and chemical applications so that the least harm is done to the pollinator insects, has been received well.

A web-based pollinator request form was implemented for use in managing pollinator insect use in regeneration activities.

Enhancement:
Curator D. Brenner continues to cooperate to develop new proso millet cultivars that are genetically broadly based. Eighteen adapted exotic maize lines were released by GEM Project Cooperators in 2006.

Outreach and Scholarship:
The NCRPIS hosted the 2006 joint meetings of the Plant Germplasm Operations Committee (PGOC), the Crop Germplasm Committee Chairs, the Regional Technical Advisory Committees of the four Plant Introduction Stations, and NRSP-6. This was attended by nearly 150 people who also had the opportunity to spend several hours touring the NCRPIS. About 285 other visitors toured the NCRPIS during 2006. Our staff participated in teaching students from the grade K to postgraduate level, provided outreach events to civic and other organizations about germplasm conservation and management, and the work done at the NCRPIS. Scientific and technical staff members continue to publish scholarly journal articles, make presentations at scientific meetings, and supervise graduate research programs.

Current and future foci:
Horticulturist M. Widrlechner serves as chair of a national Technical Review Team that provides technical direction and oversight to an ARS project to update the USDA Plant Hardiness Zone Map using the best available technologies and data sets, and make it accessible via the Internet. Project completion is anticipated in 2006. In addition, he serves as an investigator on an NIH grant to develop collections of medicinal plants and elucidate the basis of the phytopharmaceutical activity.

Efforts to characterize the Southwestern U.S. maize landraces continue; completion of this project is anticipated in 2007.

Real-time PCR analytic methods will continue to be evaluated and modified by Pathologist Block's team for routine detection and identification of multiple pathogens from seeds. Efforts continue to identify vectors of cucurbit viruses that may infest plants through screen cages.

Software development efforts will be pursued to help the Entomology Team and curators manage the production and introduction of pollinator insects into cages in a timely, efficient manner, and also support data capture on handheld PCs and transfer to GRIN. Our Accession Performance Reporting effort is undergoing revision and will be made available to requestors via a web-delivery format. This is part of an effort to improve our ability to capture and assess the impact of use of germplasm. This information may be important in determining the future focus and structure of germplasm conservation and utilization programs.

We anticipate increased involvement in activities to improve GRIN database content, and the interfaces that serve public and internal users of GRIN.

Continued emphasis will be placed on communicating with research stakeholders to identify and address collection development needs. Crop collections for biofuels and medicinal/nutriceutical applications must be enhanced; wise selection of targets for these efforts requires use of complex and varied sources of information.

In 2007, Iowa State University and USDA-ARS will host the 9th International Pollination Symposium on Plant - Pollinator Relationships – Diversity in Action. This will be the second time in 60 years that the Symposium has been held in the USA.

V. IMPACTS OF GERMPLASM USE BY NORTH CENTRAL REGIONAL RESEARCHERS:

Impacts of germplasm use by the researchers at the NCR institutions:
A detailed list of examples of germplasm use in research being conducted at NCR institutions was not requested of the RTAC members this year. Please see Table 6 for a summary of the various CSREES regions order history. Requests for germplasm continue to increase for research as well as non-research use. Requests become increasingly better targeted as the quantity and quality of information associated with the collection improves.

Tables 7 and 8 were prepared to summarize the collective distributions of NPGS germplasm across CSREES regions, and to illustrate the demand for plant genetic resources from the individual sites to support research and educational activities.

The linkage of the GEM Project, the maize curation project, and public and private collaborators throughout the U.S. is resulting in synergy which is facilitating the use of exotic maize germplasm by public and private sector maize researchers. This unique partnership offers great potential for diversifying the genetic base of U.S. maize production, the purpose of the GEM Project.

Linkages among project participants and with other projects/agencies and contributions of the Regional Technical Advisory Committee:
Linkages are driven primarily by common research interests and objectives and by the heritage of the germplasm material utilized for research and education. All states utilize germplasm provided by the NCRPIS and many of the other 20 sites involved in the NPGS; the states have a complex array of collaborative research efforts between their institutions, and with the plant genetic resource curators at the NPGS sites.

The regional technical advisory committee (RTAC) has provided valuable direction in the following areas:

- requesting and suggesting organizational structure of information needed to determine project impact and provide accountability. This includes advice on useful formats for analyzing and evaluating the nature of distributions, whom they benefit, and how benefits are realized, which are essential for determining the impact and value of the project
- identifying needed improvements to the public GRIN interface
- providing input from their respective AES Directors to curators, genebank and other administrators
- providing guidance to increase the NCRPIS program's relevance to NCR stakeholders
- providing technical expertise, particularly in the areas of diversity assessment and taxonomy
- providing added breadth in understanding issues at genebanks beyond the NCRPIS
- understanding challenges faced by public researchers partnering with other public institutions' researchers, both governmental and non-governmental. This has provided useful insights for ARS and NCR administrators to guide programmatic decision-making, as well as operational guidance; this function is key because of its direct impact on the public interest as well as the specific research interests of more directly involved stakeholders.

The technical committee gatherings provide an opportunity for the AES Directors' representatives to learn about and understand strategic issues which impact how their institutions operate and how they can cooperate more effectively to address their mission in today's environment, and then provide this information to their Directors.

Some of the NC-7 RTAC's specific suggestions and contributions from their 2006 Annual Meeting include the following:

- Crop Germplasm Committees must be encouraged by the leader of the National Genetics Resource Lab and Data Management Unit to ensure that CGC annual reports are made current and that they fulfill their obligations.
- Instructions should be developed and posted on the NPGS website on how to appropriately credit curators and other NPGS entities for their contributions to the success of research efforts.
- The public GRIN interface should be significantly improved for ease of use and information delivery
- Imaging methods used for herbarium specimens should be studied and implemented as appropriate by the NCRPIS.

VI. SUPPORT TEAM REPORTS:

A. Farm (L. Lockhart, L. Crim, B. Buzzell)

We supervised and coordinated daily operations at the NCRPIS farm, including management of all facilities, fields, and greenhouse space. We supervised or conducted pesticide applications in the field and campus greenhouses. We responded to maintenance requests from staff members at the farm and the campus location. We selected, coordinated and scheduled the student labor force of 20.0 FTE's. We coordinated and completed facility construction and upgrades.

Labor:
During 2006, 78 applications for hourly employment were received and reviewed. There were 54 interviews, resulting in 41 new hourly employees hired. Currently there are 39 Biological Science Aides (15.9. FTE) working at the NCRPIS.

NCRPIS FARM CREW Personnel:
Larry Lockhart (Program manager II) has been on staff since 1985.
Lloyd Crim (Equipment Operator III) joined the staff in March 1998.
Brian Buzzell (Farm Mechanic) joined the staff in May 2002.

Maintenance projects:
During the past year the farm staff initiated and completed several projects which enhanced the efficiency and safety of the station operations:

1. Constructed an additional climate controlled dry storage room.
2. Constructed loft in dryer shed.
3. Added "bumper" boards to new machine storage building
4. Designed and constructed a new cage furrow opener.
5. Repaired deteriorating posts in Greenhouse 3.
6. Trenched new fiber optic line to new machine storage.
7. Added digital temperature and RH monitoring to cold storage rooms.
8. Remodeled restrooms in HQ building.
9. Created a timeline of historically significant dates at the NCRPIS.
10. Replaced shop doors.
11. Constructed two flatbed racks for moving plants and cages.
12. Squared fields and installed benchmarks in organic farm area and former swine farm.

Purchasing:
Larry Lockhart coordinated purchasing for the NCRPIS farm: this task included gathering and summarizing requests, writing specifications, and obtaining supplies for the farm. Major purchases included the following:

1. Track-type skid-steer
2. John Deere Gator Utility Vehicle
3. 120 7x7x20 cage frames and covers.
4. MIG Welder
5. Two Field Cultivators
6. Two Conviron Germinators
7. Sidewinder Edger for Horticulture Project
8. Replacement Lawn Tractor
9. Road Grader
10. Two Wagon Running Gears

Tours:
This past year, we organized and conducted 15 tours. There were approximately 285 visitors to the NCRPIS during 2006.

Staff Training:
We conducted two Tractor Safety training sessions and a Worker Protection Standard training sessions for the new student employees and existing staff.

Plans for 2007:

1. Coordinate design of irrigation system for Plant Introduction Farm.
2. Update orientation program for new students.
3. Update maintenance shop and entomology shop to meet OSHA training and operation codes.

B. Information Technology and Telecommunications (P. Cyr)

Pete Cyr was assisted in IT duties by one part-time student. The following list outlines the progress made by the IT team during FY 2006 at NCRPIS.

Cybersecurity:
The perimeter defense hardware firewall was upgraded to keep ahead of new, more sophisticated intrusion security threats. The antivirus client software (and the server-based administration/deployment software used to distribute new virus definitions on a daily basis to the clients) was upgraded to minimize the threat of virus/Trojans/spyware security threats. The backup and recovery software/hardware system was upgraded to enhance disaster recovery capabilities. A comprehensive path management system was implemented as part of an ARS cyber-security initiative to standardize the rollout of security patches for desktop computers and server systems and track the progress of new deployments.

Equipment:
As of December 2006, the NCRPIS has 75 workstations installed for use by permanent staff members and part-time temporary student help. There were 12 new workstations deployed in 2006 to permanent staff based on prioritized needs. Where possible, the displaced computers were re-commissioned for light duty work in other areas of NCRPIS and/or donated to local community school systems. Additional Socket™ barcode scanners were purchased for use in data capture and transfer to GRIN.

Work was completed with CI3 (door-access security system vendor) to enable the NCRPIS sites security system to call out to a pager when an intrusion (forced entry) is detected at the Farm.

Software:
All of the workstations at NCRPIS are standardized on Windows XP with Service Pack 2 installed for increased security and reliability. Daily updates to anti-virus and periodic updates to anti spy-ware definitions help to ensure that these workstations stay healthy and productive.

Software was developed and deployed to automate the task of mass uploading accession images to the GRIN database. In FY07, the software used for image loading to GRIN will be enhanced to allow all NPGS sites to use the software for automated mass uploading of accession images. The Accession Performance Report (APR) process used at the PIR MU will be automated and deployed on a publicly facing web server. This will make the task of filling out the performance report easier for the germplasm requestor and create a database for storing/retrieving accession usage information in the GRIN system. This information will be used to document results and impacts of accession items which will support efforts to measure the impacts associated with PGR use over time.

Plans for 2007:
Continue to replace NCRPIS workstations on an as needed basis (targeting a 3-5 year lifespan for daily use workstations).

Migrate all NCRPIS email users to the new ARS Exchange email server.

Perform the annual upgrade of the Symantec anti-virus software used to protect the servers and workstations at NCRPIS.

Complete software development of 'Pocket Pollinator,' a suite of programs to facilitate and track pollinator insect use in regenerations, and to capture action in GRIN for future research applications.

Software development for automation of field note capture on handheld PDA and tablet PCs and transfer to GRIN will continue through FY07. The maize curator, M. Millard, IT Specialist P. Cyr and other PI and MaizeGDB staff members will assist with NPGS community efforts to automate the transfer and linkage of accession information from GRIN with information contained in genomic databases (such as MaizeGDB). This will enhance the utilization of information content of the GRIN and provide phenotypic context to users of the genomics information databases.

Continue to develop, test and deploy applications to be installed and used on the Compaq iPaq PocketPCs. These applications, 'Pocket Actions,' will be designed to assist curators in collecting and analyzing field and laboratory data. These field solutions will leverage the use of barcode technology wherever possible. The target date for initial use of these PDA based field solutions is the end of second quarter of 2006.

Develop a DVD version of the Races of Maize compendium.

C. Seed Research and Computer Application Development (D. Kovach and M. Erickson)

Seed Research:
In 2006, David Kovach and Mark Widrlechner held meetings with curatorial teams to assess seed-physiology research needs. Based on the results of these meetings, a plan was devised and prioritized for the coming years. In 2006, David designed and conducted experiments on *Echinochloa* seed. The seed was subjected to cold temperatures and different light qualities (fluorescent versus incandescent). He also conducted a literature search on *Daucus* seed development and germination. Based on the literature review, David conducted germination tests on *Daucus* seed (obtained from Kathy Reitsma and Cindy Clark) from primary, secondary, and tertiary umbels.

In 2006, David investigated different thermal gradient table manufacturers. Only two were found. He obtained product and price information from Seed Processing, the Netherlands, and successfully negotiated a price within Federal purchasing guidelines. The order was placed and expected in February, 2007.

With co-authors Sharon McClurg, Mark Widrlechner, David Brenner, and Candice Gardner, David submitted a paper (*Liquid nitrogen controls seed-borne chalcids without reducing germination in coriander seeds*) to the journal Seed Science & Technology in January. The revised manuscript was accepted and published in October 2006: Seed Science & Technology, 34, 669-679. This study showed that Chalcid-infestation of coriander seeds can be eliminated by placing the seeds above LN2 overnight. Seed viability is not affected. This treatment was applied by the curator to all coriander seeds harvested in 2005 and 2006, thus ensuring safe storage and distribution of pest-free germplasm.

Germination Testing:
During 2006, Maria Erickson and her crew continued to fill seed germination orders, conducted germination tests on over 3,500 accessions (see Table 2), and helped curators germinate seeds for regeneration. The number of accessions tested in 2006 increased for maize (+338) and the oilseed crops (+554) from that of 2005. The number of accessions tested for the Amaranth group was down from the previous year (-1099). These fluctuations are not uncommon. The total number of accessions tested decreased by 560 from the number tested in 2005, reflecting a reduction in student assistance.

In addition to routine germination tests conducted for curators, Maria also carried out a germination test for the GEM project. This test was on a lot of questionable quality for which

viability needed to be determined before planning to use it as a pollen source. Germination tests were also conducted on *Cucumis, Cucurbita, Daucus, Brassica* and *Ocimum* for a pollinator study. The results of these tests will be used as part of a determination of which pollinators are the most efficacious for each crop.

Maria performed Tetrazolium tests to help determine the seed viability of questionable samples of two accessions of *Celosia* and three accessions of *Cuphea*. The *Celosia* proved to be mostly dead (2% viable), and the two accessions of *Cuphea* tested had viabilities of 40%-55%. She also tested experimental Tetrazolium protocols for *Euonymus* in 2006. The protocol that worked best consisted of removal of the aril encapsulating the seeds, cutting the seeds without soaking and placing the cut seeds into a 1% Tetrazolium solution in Petri dishes at 4 °C overnight with no light. This treatment was followed by placing the Petri dishes in an oven (33 °C) overnight and then placing them in a germinator set at 22 °C with no light for 48 hours. This protocol resulted in a viability score of 74%.

Two new Conviron germination chambers were purchased to accommodate the specific needs for seed regeneration, as well as to meet our ongoing requirements for periodic viability monitoring.

Computer Application Development:
In 2006, David Kovach initially developed and demonstrated a proof-of-concept application to capture user information and search orders with Java Studio Creator IDE (Integrated Development Environment). The creation and management of the user account, as well as enhancement of the search engine, proved difficult in this IDE. Therefore, David looked for a new IDE environment and decided upon MS Visual Studio 2005, after consulting with Pete Cyr. By the end of the year, this project progressed to the point of having a fairly good infrastructure (user account creation and editing, password reminder support, and initial user-information capture). The project was placed in 'delay' status in December until broader, system-wide issues can be resolved.

David attended training at a Visual Studio Conference in New York in September, 2006. He initially used a trial version and then arranged for the Station to purchase a Visual Studio 2005 license in November. David also read books on ASP.NET 2.0 (related to the new Visual Studio 2005 IDE).

In 2006, David modified the Oracle-based Germination Data Entry form to eliminate the need for Crop Specific Number tags. Previously, germination crews had to wash these tags after each use. The modified form utilizes the order number and order-item number and prints lid-sized labels which are not reused.

Internet website related:
In 2006, David Kovach enhanced the USDA Consolidated Website (http://www.ars.usda.gov/mwa/ames/ncrpis) by reformatting our Unit's pages to new USDA guidelines and adding several insect pollination pages, a page on how we store and protect seeds, several navigation items and a sitemap navigation page. An organizational chart was added that mapped to individual biographies. After the June 2006 PGOC meetings, David converted project posters to PDF format and posted them on the Station's website. He posted a Medicinal Plant Spreadsheet (compiled by McCoy and Widrlechner, with additional formatting by Pete Cyr) to our website to help cooperators identify priority species for future collection development. David also reformatted pages on the Ames Area Civil Rights website to accommodate USDA guidelines (http://www.ars.usda.gov//Main/site_main.htm?docid=8446).

Cooperative efforts:
In 2006, David Kovach created or modified Architectural Desktop / AutoCAD drawings to help

meet station needs. This included working with the staff to create and modify field and cage drawings. He created AutoCAD drawings for floor plans for Larry Lockhart and harvest bags for Cindy Clark, altered facility plans for the door security and sensiphone systems, and converted AutoCAD drawings (geographic/collection related) to PDF format for Joe-Ann McCoy. He attended a free training seminar on AutoCAD in Johnston, IA in May.

David supported large-format printing for professional posters and for local use, many for the PGOC Meeting held in Ames and additional posters and conference announcements for conferences that PI personnel and colleagues attended (Block, McCoy, Widrlechner, Blanco, Brenner, Gardner, and Palmer), and posters for a NSF Tribal Outreach Project (Gardner and Lawrence). He modified a US map of germplasm facilities from DBMU (Sharon Stern) for hallway display by Lisa Burke. David also made specialty labels as requested by the staff (Lockhart, Buzzell, and McCoy). He created an UML drawing on the GRIN database schema for Pete Cyr and Mark Millard. In addition, the Ames Area Civil Rights website was regularly updated in association with Steve Hanlin, the station's civil rights representative.

In 2006, David worked with curators and technicians to assess the label needs of proposed pot stake and harvest tags made from a new Valeron material. He worked with a salesperson and designers from Peak Technologies to develop new Valeron tag types requiring new dies.

In 2006, Maria Erickson worked with S. McClurg and K. Reitsma on an Alfalfa Leaf Cutter Bee – Honey Bee Pollinator study. The study involved *Ocimum*, *Brassica*, *Daucus*, *Cucurbita* and *Cucumis*.

Supervision:
This past year, Maria Erickson, Agricultural Biological Science Technician, continued to oversee a crew of three part-time students for help in conducting germination tests. David supervised Maria Erickson

Training:
David Kovach attended training at a Visual Studio Conference in New York in September, 2006.

Maria Erickson tested for certification through the *Association of Official Seed Analysts* and received her *Certified Seed Analyst* title in May 2006. She also attended the *International Seed Testing Association* Biotech Trait Detection Workshop in May 2006.

David Kovach and Maria Erickson completed all required Federal training:

No Fear Act – November 2006
Privacy – September 2006
Security Literacy and Basics – April 2006

Plans for 2007:
Following the recommendation of Horticulturist Mark Widrlechner, and Research Leader Candy Gardner, David Kovach continues to transition from a focus on computer applications towards seed research.

Seed research projects are planned for the coming year based on consultation with Mark Widrlechner and the curatorial staff. The priority list is being updated to include recent feedback and experimental results. A timeline for planned experiments will also be developed.

Maria Erickson will attend two seed technology events in 2007: the AOSA Seed Purity Short Course at ISU held April 16-19 and the AOSA-SCST Annual Meeting from June 4-11 in Cody,

Wyoming. Two workshops at the annual meeting, the Native Species Seed Quality Symposium and the Tetrazolium Testing workshop, will provide Maria with additional Seed Analyst training and techniques.

D. Information Management-Germplasm Collections (R. Stebbins and Rachael Beyer)

Germplasm Collections

Acquisition:
The North Central Regional Plant Introduction Station (NCRPIS) acquired 623 new accessions in 2006. Of these new accessions, 302 were received from within the National Plant Germplasm System (NPGS). This included 96 various accessions transferred from the Ornamental Plant Germplasm Center (OPGC), 26 accessions of wild *Helianthus* and 37 accessions of medicinals from collection trips conducted by NCRPIS personnel, 35 accessions of *Zea* transferred from the National Center for Genetic Resources Preservation (NCGRP), 29 accessions of *Daucus*, and 27 accessions of *Cichorium*.

The remaining 321 accessions, received from outside the NPGS, included 88 accessions of wild *Zea* from the University of Wisconsin and 33 accessions of *Chenopodium* donated by Brigham Young University.

As new accessions are recorded in the Germplasm Resources Information Network (GRIN), an effort is made to include as much passport information as possible. Typical passport information would include a source history, cooperator records, collection-site description, pedigree, secondary identifiers, and any other pertinent information provided by the donor.

Maintenance:
Robert Stebbins provided assistance with curatorial management by processing requests for taxonomic re-identifications and nominations of accessions to the inactive file. In total, 106 accessions received taxonomic re-identifications. Among these were 32 accessions of *Helianthus* and 20 accessions of *Amaranthus*. Also, 412 accessions were nominated for inactivation, including 326 accessions of *Helianthus* and 67 accessions of ornamentals.

Additionally, 79 accessions were assigned PI numbers. Included in this group were 54 accessions of *Amaranthus* and 14 accessions of *Daucus*.

Rachael Beyer began processing the Major Goodman maize racial collection in 2006, with 804 inventory lots completed. Actions to this collection included adding inventory information, secondary identifiers and accession actions, and placing them into storage in the -20° C freezer. Lisa Burke has continued to mentor Rachael throughout this project.

Finally, 9 accessions were inactivated due to duplication. The inventory lots of these accessions were combined with the lots of their respective duplicates.

Projects:
Robert served on the selection committee for the new Germplasm Program Assistant, Rachael Beyer. Since she was hired on 31 October 2006, Robert has assisted in her mentoring.

Late in 2006, Rachael brought many office files, forms, and functions up to date. The 'cnass' public folder was sorted: all out-of-date documents were left in the folder as archival materials and all current-date documents transferred into the 'rabeyer' public folder. All current documents were assessed for accuracy and updated where needed. All farm office paper files were reorganized, to include procurement request records, permanent staff training records, safety information, vehicle

fuel logs, and office forms. Office supplies were manually inventoried and the tracking spreadsheet updated.

The student hiring and separation processes were revamped to accommodate a smoother transition for students beginning or ending federal employment. The Student Hiring SOP and the Student Resignation SOP were written in clear language with examples selected to eliminate extra steps. Clear instructions facilitated communication between Rachael and student supervisors and decreased the time required of them for student staffing issues.

Rachael also completed two short-term projects for Candice Gardner. She modified and updated the NCRPIS crop-assignment pie graph and spreadsheet, and also compiled all FY 2006 expenditures from CATS for a budget review.

Conclusions:
Compared to 2005, new accessions received at NCRPIS were up by 340 in 2006. In maintenance areas, re-identifications were down by 27%, nominations to the inactive file were up by 2475%, PI number assignments were up by 139%, and identified duplications were up by 350% compared to 2005 levels.

All figures for acquisitions and maintenance were below the ten-year average with the exception of nominations to the inactive file which were above average.

In 2007, increased time and effort will be given to assigning permanent PI numbers to all worthy accessions in the NCRPIS collection. 2007 looks to be a record-setting year for PI number assignment.

E. Order processing (R. Stebbins)

During 2006, there were 1,658 orders entered into GRIN; a new record for the NCRPIS. These orders led to the external distribution of 26,100 items (primarily seed packets, but also vegetative samples) (Table 3A). Of these, 14,143 items (54%) were distributed within the United States, and 11,957 (46%) were sent to foreign requestors. Additionally, 8,227 items (Table 3B) were distributed within the NCRPIS, for such uses as regeneration, evaluation, and germination and pathological testing.

The number of orders entered into GRIN in 2006 was 22% greater than that of 2005; also, the number of items distributed was up by 3,800 or 17%. The number of requests received electronically this year was 1,247, an increase of 24% over 2005.

Robert mentored Rachael in all aspects of order processing, including the public GRIN request system and GRIN order-processing functions, methods used to communicate with the curators and plant pathologist, methods for US Mail and FedEx shipping, internal filing, and processing international requests.

F. Seed Storage (L. Burke, L. Pfiffner)

Two full-time, permanent federal employees (Lisa Burke and Lisa Pfiffner), and one part-time, temporary student staffed the seed storage area.

In 2006, all types of seed storage processes saw increased activity. We stored 2738 inventory lots, including 722 original seed lots, 925 non-Ames increase lots, 941 Ames increase lots and 150 check lots. During storage, 334 lots were bulked with previously regenerated samples to create 161 new bulked lots. Of those, 155 became available for distribution. Of the stored lots, 877 lots were made

available for distribution. We split 169 original lots to make them available for distribution in limited quantities. We reviewed 4762 inventory lots were reviewed for seed quantity and any discrepancies corrected in the GRIN database. 1663 samples were prepared for transfer into the long-term storage freezer. Of these, were 1146 maize inventory lots donated to the station by Major Goodman in 2004. We prepared the initial section of this material (342 lots), and Rachel Beyer will complete this project in 2007.

In 2006, 133 accessions received taxonomic re-identification. We re-labeled all affected seed samples, and completed and filed the pertinent documentation. In addition, seed samples of 373 inactivated lots were removed from the active collection and placed in inactive storage. We also re-labeled all seed lots associated with the assignment of 79 new PI numbers, and then corrected cold-storage locations to reflect the change in numbering.

We filled 1230 seed orders in 2006, including those for distribution, observation, germination, transfer and backup. There were 948 lots (879 accessions) sent to the National Center for Genetic Resources Preservation (NCGRP) for backup, involving both accessions new to NCGRP and supplemental lots for previously supplied accessions. NCRPIS distributed 28035 packets to meet distribution and observation requests. Of these, 15996 were distributed domestically and 12039 outside of the US. We transferred 33 inventory lots to other NPGS sites. To fill gaps in viability data, we initiated 11 germination orders.

2006 saw the continuation of the prepacking program. 2243 inventory lots were prepacked (27869 packets) with the aid of our student worker. By using a form that David Kovach developed, we were able to identify accessions with heavy customer demand and prepack those for more effective seed order filling.

As noted earlier in this section, we are continuing work on the material donated by Major Goodman. The material was divided into three groups by the curator. The first two groups, consisting of 1801 lots (869 accessions), existed as accessions on GRIN prior to the donation of the material by Major Goodman. The third group, consisting of 882 lots (487 accessions), have been assigned new Ames numbers. 260 accessions have been re-activated in the process.

In 2005, we imaged and inventoried all the packets. With the addition of a new Germplasm Program Assistant (Rachael Beyer), progress is being made in moving the material into long-term storage. 1146 lots have now completed the journey to the freezer. Prior to completion, samples are entered into GRIN. The inventory information includes the inventory amount, location, additional information on the packet, inventory status, inventory actions and inventory group assignment (where appropriate). Accession information includes secondary plant names for each packet and accession actions. Work will continue in 2007 to complete this project.

We processed a set (88) of teosinte accessions received from John Doebley. They were inventoried, scanned and prepacked for distribution.

Seed storage personnel continued to maintain the germplasm distribution display in the farm facility hallway. New maps were printed at the start of 2006, and national and international distribution destinations were noted.

Scanning of original samples continues to grow. In 2006, 770 scans were taken mostly of original samples. Some of the samples were new to the station while others were of samples that were being pulled for regeneration where the entire sample was needed. Imaging samples that are being used up creates a visual reference for future comparisons.

In the summer of 2006, the station hosted several Native American interns as part of the USF Tribal Outreach training program. The students were each assigned to different NCRPIS project during their time here. In seed storage, the students worked on two projects. One involved taking ear measurements on Native American maize lots for a project comparing the effects of open-pollination versus hand-pollination on ear morphology. The second project had the students looking at material from the Oscar Will Seed Company. The material in the NCRPIS collection attributed to Will also appears in Corn Among The Indians of The Upper Missouri and in an unpublished list of seed catalogues from the seed company. The students were asked to look for accession names in the material and compare them with GRIN information.

VII. CURATORIAL AND SCIENTIFIC TEAM REPORTS

A. Controlled Insect Pollination Service Program (S. Hanlin, S. McClurg)

Progress:

Caged pollination:

Bee pollinators (minus the experimental alfalfa leafcutting bee) were supplied to 692 cages for controlled pollination of 697 accessions.

Honey bee pollination (Hanlin):

Honey bees were used to pollinate 591 accessions in the field and 27 accessions in the greenhouse. Bees pollinated 155 accessions of *Helianthus*, 26 accessions of *Cuphea*, 64 accessions of *Cucumis* (54 accessions in the field and ten accessions in the greenhouse), 17 accessions of *Daucus* (16 accessions in the field and one accession in the greenhouse), 25 accessions of Cucurbita, nine accessions of *Ocimum* (eight in the field and one in the greenhouse), 19 accessions of *Brassica*, 11 accessions of *Linum*; six accessions of *Eruca*, nine accessions of miscellaneous Brassicaceae, 37 accessions of *Potentilla*, 30 accessions of *Echinacea*, 15 accessions of *Hypericum*, 12 accessions of *Actaea*, 11 accessions of *Alcea*, 82 miscellaneous ornamentals/medicinals, 20 accessions of *Melilotus*, eight accessions of *Carum*, 29 miscellaneous umbels.

Honey bees were over-wintered in the indoor wintering facility with a survival rate of 86% for the parent colonies and 52% for the nucleus colonies. We left 48 strong three-story parent colonies in the field, placing them into groups of four and wrapping each group with tar paper (30 pound). The survival rate for the outdoor colonies hives was 90%. The survival rate for the nucleus hives was higher than last year's 37%, with the parent colony survival rate being slightly lower than the 95% in 2005. This winter, we placed 130 two-story parent colonies, 218 double-story nucleus colonies and 25 single story nucleus colonies into the over-wintering facility. Thirteen strong three-story parent colonies were left outside in a well protected area at the station. The colonies were placed in groups of two and each group was wrapped with tar paper. All queens to be used for queen rearing will be selected in the spring of 2007 from resilient parent colonies.

In the fall of 2005, ISU sold a parcel of land containing one of our "beeyards". In the spring of 2006 two new beeyards were established, one at an alternative ISU farm location and one at a private orchard near Nevada, IA.

Queen rearing throughout the summer produced an average of 65 queens per week. Nucleus hives were produced until early August, with hives not used in cages for pollination being fed and strengthened for over-wintering.

To prepare for spring cage pollination, we purchased 51 "Buckfast" queens. We made 51 two frame nucleus hives with brood and adhering bees. In each nuc, a caged queen was placed so that by mid-May we had productive nucs to place into cages. This allowed us to have a limited supply of hives prior to the start of queen grafting to fill our early spring pollination requests.

Twenty-five "Italian" three pound packages were purchased and nineteen of the packages were placed into full size hives. Five of the packages arrived in very weak condition and were placed into nucleus equipment and "nursed" through most of the summer. We collected four local swarms, two were made into colonies and two were made into double story nucleus hives. These colonies were included in our nucleus hive production or placed into cages for pollination once they became established.

In late August, 58 strong double story nucleus hives were made into colonies and all strong single story nucleus hives were doubled in the fall to prepare them for over-wintering.

Because of higher mite counts in the fall, all parent colonies and nucleus hives intended for over-wintering were treated. Mite populations were determined using three separate methods of sampling. We used the "powder sugar roll" in which 1 tablespoon of powdered sugar is placed into a jar with 100 bees that are randomly sampled from the hive as our main sampling technique. A second sampling method used this year involved uncapping approximately 25 drone cells per hive, removal of the larvae and examination of the larvae and cell for mites. We also examined for mites on a weekly basis throughout the summer. This fall, a new treatment method was used. The treatment is called Apiguard® an organic based Thymol mitecide.

All parent colonies and nucleus hives to be over-wintered were fed a total of two feedings of Fumidil-B syrup during the fall. This treatment is for prevention of dysentery in the bees while in the over-wintering room.

For wax moth control during the winter/summer of 2006, stacks of supers containing empty frames were treated with paradichlorobenzene (Para-moth®) crystals on a bimonthly basis to fumigate for moth larvae. Because of the warmer temperatures during the winter, we could not use environmental control methods which consist of opening outside doors on colder days and allowing the room to drop in temperature.

We continued to use our present syrup feeding system of two 1000 gallon polypropylene tanks (one inside the shop and one outside), a 30 gallon "mixing" tank and a dish washer with good success. Minor problems of "crystallization" or crystal formation in the bottom of the inside tank continued throughout the summer of 2006. To prevent the blockage of the pipes, an immersable heater was used for four hours daily and the syrup circulated once daily.

Bombus pollination (Hanlin):
Seventeen "research" colonies of *Bombus impatiens* and a single drone hive were ordered throughout the spring/summer of 2006 from a commercial supplier. *Bombus* colonies were used to pollinate twenty-six field accessions and two greenhouse accessions. One *Bombus* colony can be used for pollinating more than one cage with a minimum lapse of 48 hours between the two locations to prevent contamination. Bees pollinated 22 accessions of ornamentals and medicinal plants (*Alcea, Althaea, Calendula, Caragana, Diervilla, Hyssopus, Matricaria, Monarda, Potentilla, Staphylea, Symphytum,* and *Tanacetum*); three accessions of *Cucurbita* and single accessions of *Ocimum* (greenhouse), *Helianthus* and *Matthiola* (greenhouse).

I began using sixty quart protective plastic containers to house and protect hives while in field and greenhouse cages. This system appeared to allow the cardboard box hives to last better throughout the summer. However, we found that in order to prevent the wind from blowing the container and the hive off of the stand two water-filled quart containers needed to be placed on either side of the hive in the tub. This system is comparable to what has been used by the Ornamental Plant Germplasm Center (Columbus, OH) for the protection of *Bombus* hives for the last two years.

Osmia cornifrons/*O. lignaria* pollination (Hanlin):
Osmia was used to pollinate a total of 98 field cages and 27 greenhouse cages. Bees pollinated 39 accessions of *Brasscia*, 13 accessions of *Camelina*, 24 accessions of *Linum* (13 in field and 11 in greenhouse); 11 accessions of *Eruca*, one accession of *Cucumis* (greenhouse), 31 miscellaneous Brassicaceae, four miscellaneous ornamentals and two miscellaneous umbels (greenhouse).

Approximately 4,582 bees were used to fill 115 domiciles in 2006. The total number of domiciles used in 2006 was 223. We collected approximately 1,683 bees last year for use in the spring of 2007. The lower increase numbers in 2006 possibly were due to a drier spring and having approximately 70 domiciles which were never placed into the field and thus did not have bee emergence or increase. We will need to purchase approximately 6000 bees in 2007.

For the second year, a handheld GPS unit was used in the spring when placing out the "increase" domiciles; the coordinates for each domicile were recorded and in the summer the hand held was used again to accurately locate each domicile. All domiciles were located this year; however since less precise coordinates were used in the spring time than the more exact setting utilized in the summertime we could not locate all domiciles immediately.

For the Des Moines Water Works Park "increase" location, a standardized aerial map was used to plot all domicile locations and to locate the domiciles for retrieval in the summer. This was a great improvement from the hand drawn maps which were made in the past while placing out domiciles. In the future, we will make a photocopy of this map each spring and plot the sites while placing the domiciles in the field.

Fly pollination (McClurg):
Houseflies (*Musca domestica*) and blue bottle flies (*Calliphora* sp.) were requested by five of the six curatorial projects that utilize insect pollinators, for a total of 156 greenhouse and field cages containing 140 accessions of 32 genera in all of 2006. Flies were used to pollinate: 41 accessions of 12 genera in 51 cages (4 greenhouse and 47 field) of miscellaneous umbels including *Astrodaucus, Angelica, Chaerophyllum, Carum, Coriandrum, Cuminum, Eryngium, Levisticum, Pimpinella, Petroselinium, Sium, Zizia*; 20 accessions of 9 genera in 10 cages (8 greenhouse and 2 field) of miscellaneous oilseeds including *Aurinia, Biscutella, Brassica, Crambe, Erysimum, Isatis, Linum, Lepidium, Matthiola*; 21 accessions of 7 genera in 24 cages (18 greenhouse and 6 field) of ornamentals including *Ampelopsis, Brunnichia, Calendula, Euonymus, Hyoscyamus, Matricaria, Schiasandra*; 31 accessions of two genera in 34 greenhouse cages of the medicinals *Hypericum* (6 species) and *Triadenum*; 27 accessions of two genera in 37 cages (14 greenhouse and 23 field) of the vegetables *Daucus* and *Chicorium*.

Fly pollinations started 4 January, 2006 and ended 28 December, 2006 with only a three week break in deliveries from late September to mid-October. The first field delivery was 24 April 2006 and ended 8 September 2006; the remainder of the fly pollinations occurred in greenhouse cages.

Flies are usually supplied to cages twice weekly during the winter-spring season (January – May) due to variable greenhouse conditions and cooler field weather, and once weekly during the summer through late fall seasons (June – December); the grand total fly deliveries in 2006 was 1322. During the very early and very late parts of the year, there were ca 5 cages supplied weekly with flies. The average number of cages increased to 15-20 per week in late-winter to spring, and the peak number of cages for summer deliveries was 83 cages during the first week of July.

Both blue bottle flies and houseflies were delivered to greenhouse and field cages from 4 January through 26 May. From 29 May through 28 December only blue bottle flies were utilized in most cages.

Alfalfa leafcutting bee (ALC) pollination (McClurg):
ALC bees (*Megachile rotundata*) were supplied to five of the six curatorial projects that utilize insect pollinators, for a total of 208 greenhouse and field cages containing 217 accessions of 37 genera in all of 2006. ALC were used to pollinate: 2 accessions of 2 genera in 2 cages (2 greenhouse and 0 field) of *Chaerophyllum* and *Melilotus*; 90 accessions of 15 genera in 86 cages (6 greenhouse and 80 field) of miscellaneous oilseeds, including *Alyssum*, *Aurinia, Biscutella, Brassica, Camelina, Crambe, Eruca, Erucastrum, Erysimum, Hesperis, Isatis, Linum, Lepidium, Matthiola, Sinapis*; 32 accessions of 13 genera in 21 cages (12 greenhouse and 9 field) of ornamentals and mints, including *Agastache, Brunnichia, Calendula, Glebionis, Hyoscyamus, Malva, Matricaria, Monarda, Originum, Phacelia, Potentilla, Schisandra, Tanacetum*; 17 accessions of 2 genera in 15 cages (11 greenhouse and 4 field) of the medicinals, *Hypericum* and *Echinacea*; 76 accessions of 5 genera in 84 cages (25 greenhouse and 59 field) of vegetables, including *Cichorium, Cucumis, Daucus, Ocimum, Oreosyce*.

ALC pollinations started 17 January, 2006 and ended 8 December, 2006 with a break in deliveries from the end of April to mid-May. Bees were unavailable during the late spring due to delay in processing the purchase request for the spring-summer supply of ALC. The first field delivery of ALC was 1 June 2006 and the field season ended for ALC 28 September 2006; the remainder of the ALC pollinations occurred in greenhouse cages. Stopping field pollinations at the end of September allowed us to clean and store equipment in a timely way.

ALC can be introduced to cages any week day. ALC are re-supplied to cages anywhere from twice weekly to once every several weeks depending on the cage location, its contents and bee "satisfaction level". The need to re-supply is determined by monitoring bee population present in the cage preferably during warm, sunny weather. The grand total number of ALC deliveries in 2006 was 1376. During the very early and very late parts of the year, there were 5 to 20 cages supplied weekly with ALC; the peak number of cages for summer deliveries was 114 cages the first week of August 2006.

B. Controlled Pollinator Insect Research Program (S. Hanlin, S. McClurg)

Alfalfa leafcutting bees:
We continued to make improvements in our ALC handling and incubation protocols. One change we made for summer 2006 bees was to incubate varying amounts of cells/week rather than a standard number every week all summer as for 2005. Our plans were to provide bees for ca 30 cages weekly in May-June and September-October, and 60-80 cages weekly in July-August, based on 2005 use/demands. Because we purchased a larger number of cells requiring refrigerated storage throughout summer 2006, several additional screen trays were constructed in spring 2006.

In order to accommodate the larger number of cells to be incubated weekly, we designed and constructed larger emergence boxes which held twice as many cells as the original boxes we designed in 2004. We also modified additional collection dish lids to supply these larger boxes as each new large box supports two dishes at a time when needed. We purchased additional Binderboards^{R} (Pollinator Paradise, Parma, ID) in order to supply the additional collection dishes. As in 2005, we provided sucrose-soaked cotton wicks along with the wood Binderboards^{R} to assist in keeping the bees quiet in the collection dishes until they are dispensed to cages.

It was necessary for us to locate the larger emergence boxes in a different rearing area than the incubator used for the original small emergence boxes. We fitted one of our larger rearing rooms with a supplemental heater to maintain a desired temperature of ca 30° C and purchased and hung additional black lights to trap parasitic wasps in this room. A lighting timer allows us to limit the light period ca 6 hours daily to draw bees from the emergence boxes into the collection dishes.

We found that we could obtain more even emergence of bees from their leaf cells on a daily basis if each weekly pre-incubation group was divided in half. The first half of the pre-incubation group was moved to 30 C dark chamber on a Friday and the second half on the following Monday.

Another major change in handling of ALC was the method of distributing bees to the field cages during summer 2006. Rather than dividing bees into individual 120 ml cups for transport to the field, we simply combined the contents of several collection dishes into a single 28-cm diameter plastic container. Once in the field plots, the entire container of bees was placed inside the opening of a cage. The dish lid opened, and warmed-up bees flew out into the cage. Bees were counted as they exited the dish and the lid replaced when the desired number of bees had entered the cage. This method saves handling time and reduces potential for injury to bees in the lab.

In 2005, we discovered that adding domiciles to cages where ALC were placed appeared to extend bee life. In 2006, we constructed ca 100 pine wood frames (19 cm long x 14 cm wide x 4.5 cm deep). The top of the frame extends out over an interior Styrofoam nest block to provide protection from the elements. The commercial Styrofoam nest block has pre-drilled holes of 0.635 cm diameter and 6.75 cm depth (the size preferred by ALC bees, purchased through Northstar Seed Ltd, Neepawa, Manitoba). We cut the large nest blocks into 24 pieces, each ca 14 cm long x 9 cm wide. The wood frames have a plastic-coated wire handle ca 75 cm long which is wrapped around metal cage frames so the block faces to the S-SE for rapid warm-up in the morning sun. Active ALC domiciles were removed from cages when pollination was no longer required and hung on an exterior metal frame (1.4 m tall x 1.4 m wide x 1 m deep) for several days prior to placement in other germplasm cages to avoid introducing pests or foreign pollen to other accessions. Late-removed domiciles were left hanging on this same frame at the end of the pollination season until hard frost; bees were allowed to continue to forage in the open until they died naturally. Any leaf cells formed in the Styrofoam nest blocks were dislodged and the cells and frames were cleaned prior to storage in the late fall.

We tried adding ALC to new genera again this year; our primary focus was trying them on accessions regenerated by the Brassica Oilseeds curation team in summer 2006 field cages, along with requested *Osmia* and honeybee pollinators. Genera pollinated included *Alyssum*, *Aurinia, Biscutella, Brassica, Camelina, Crambe, Eruca, Erucastrum, Erysimum, Hesperis, Isatis, Linum, Lepidium, Matthiola,* and *Sinapis.* The Brassica staff was pleased with the results of using the ALC bee. It appeared that the ALC bee was complementary in its' pollination activity where *Osmia* were present in the same cages; the *Osmia* were observed working the crop early in the cool morning and during overcast conditions, while the ALC were observed working the crop later in the hot afternoons. We also noted that the ALC did some nesting in the *Osmia* straws even though they were provided their own domiciles in most *Brassica* cages.

The ALC bee that did not work well with some genera. Due to the small, flat flower structure, the Medicinals curator asked to try ALC bees on *Hypericum* in greenhouse cages. Bees were supplied from 18 April to 14 June to a total of 11 different accessions of 5 different species of *Hypericum* in the greenhouse, but the bees died within 24 to 48 hours of each of thirty-six releases. It is possible the chemical components of this genus may have played a part in the lack of pollination success; the active component hypericin, prominent in some *Hypericum* species, is said to have some insecticidal properties. ALC bees were provided to four accessions of *Matricaria* in field cages beginning 1 June. *Matricaria* plants have small "globe-shaped" flowers without obvious petals; the plants also give off a strong odor. The ALC bees were not observed pollinating these target plants, but instead spent their time on other genera included in the same cages. We found that blue bottle flies successfully pollinated these two genera that the ALC avoided or could not tolerate.

It appears that we may be more successful using ALC bees on new genera in cages which contain an accession which is known to be an "ALC-preferred" genus. With the favored plants available,

the bees live longer and may be more likely to start working other genera in which they have less interest initially.

It is important to assess other conditions in the cages where it appears the ALC bees are dying off quickly. In some cases, the bee may wish to work the accessions within the cage, but they are subject to predation by spiders or other insects such as robber flies. We must take time to remove predators before introducing the ALC bees so they have a chance to pollinate. Screens must be tightly secured on frames to prevent bees escape. Personnel watering plants must use less desirable methods and avoid drowning the ALC.

Because of increased demand to provide a small number of pollinators for late-blooming accessions in greenhouse cages into the late fall, we again tried to extend the emergence of ALC bees from cells purchased for use for summer 2006. We were successful in obtaining some bees into mid-December 2006 from cells incubated in November. There was reduced percent emergence compared to that of cells incubated during their normal range of use, but the bees that emerged did successfully pollinate plants including *Daucus*, wild *Helianthus*, and buckwheat (*Fagopyrum*). Primary observations and conclusions from this test include:

1. ALC bees work only when full natural sunlight or greenhouse lights are available; natural light encourages more activity than artificial light.
2. ALC bees live at most for one week during this time period, thus bees need to be replaced at least 1 - 2 times weekly in fall greenhouse cages.
3. Having the cage located in a warmer "zone" of the greenhouse did not appear to extend bee longevity.

Pollination Improvement:

Pollinator Requests:
The entomology staff met early in 2006 with all projects which make use of pollinators to discuss concerns or improvements in the delivery and quality of pollinators being used. From these meetings, came two main improvements: a standard "flagging system" and a revised electronic "pollination request" form.

Cage flagging system:
We assisted curatorial staff in creating a color-coded cage flagging system to indicate to all farm staff desired pollinators and actions. This appeared to work well in the summer 2006 field plots; there was less compliance with greenhouse cages.

Web-based pollinator request form:
During spring and early summer 2006, we assisted P.Cyr and the Vegetable project staff with initial trials of a new web-based pollinator request form intended to replace the current Excel request form developed by P. Cyr. The web form imports GRIN data from the local inventory database for currently growing lots, as entered by curatorial staff, and exports these data to a GRIN "pollinator database" on the local server. When entomologists access the pollinator database, they are provided with correct cage location (field or greenhouse), accession identification (prefix and number) and genus/species, as well as the desired pollinator, date, and action for all newly submitted requests. This web form should increase accuracy of pollinator requests, reduce time entomologists need to confer with curatorial staff before supplying or removing pollinators, and should reduce hand data entry for entomologists' record-keeping, thus increasing efficiency and accuracy. This web request form will be used by all curatorial staff in 2007.

The above-mentioned pollinator database was used in an initial trial of "Pocket Pollinator" - a handheld program developed for entomologists by P.Cyr. The program aids in verifying insect delivery to correct locations and assists in record keeping in the field. This system was still in

development when introduced to entomologists in summer 2006; limited equipment and functions made it difficult to test thoroughly (barcode reading was not active within the Pocket Pollinator program, bar-coded exterior cage labels were not utilized by curatorial staff, and only one Socket^R barcode scanner and one IPAQ^R were furnished to Entomology). Improvements are being made by P. Cyr and will be implemented in 2007.

In the interim, entomologists generated some bar-coded maps and inventory lists to support immediate, accurate record-keeping needs. Both the Symbol^R (on desktop computer) and Socket^R (on IPAQ^R handheld) barcode scanners were utilized for this data collection.

Honey bees:
For the second year, an electric fence was installed at the NADC beeyard location prior to moving bees into the beeyard. The fence was set up as a deterrent for raccoon's knocking off feed buckets and opening weaker nucleus hives and feeding on honey frames in a 50' x 25' area.

To possibly improve the pollination of extensive vining *Cucurbita* sp in large cages, we compared use of *Bombus* to alternate honey bee arrangements. In three cages, commercial *Bombus* hives were placed at the south end of the cages and were elevated above the ground. In two cages, two single story nucleus hives of honey bees were placed at opposite ends of the cage (north and south ends). Several times during the summer, observations were made by either the vegetable or the entomology staff to determine if bees where seen flying throughout the cage and if fruit was being produced throughout the cage.

Houseflies:
We had some difficulties obtaining the desired number of housefly pupae from the local source in March – April during 2006 and previous years. We investigated alternate sources of these insects and found a laboratory in California (Beneficial Insects) with a similar product at much reduced cost. We made a trial purchase of these housefly pupae for six weeks during a portion of the summer 2006 field cage season. The shipments arrived in good condition and fly emergence was high. A 10,000 pupa shipment easily supplied 25 cages with an adequate number of houseflies per cage weekly. Another attractive factor was the reduced cost per cage of $2.55 for California flies in the summer vs. the cost per cage of $11.25 for locally-produced flies in the winter-spring. Curatorial staff were pleased with the seed production in the cages with the California-supplied flies. A winter shipping trial of the California flies during the early 2007 fly pollination season will be used to determine if we can utilize this lower-cost source for effective pollinations year round.

Alternate Pollinators:
In March, 15 black cutworm *Agrotis ipsilon* (Hufnagel) adults and pupae were introduced as alternate pollinators into a greenhouse cage containing a night-blooming accession of *Matthiola* sp. which were not setting seed with our "traditional" insect pollinators. Although moths were observed in the cage, their pollination efficacy is unknown.

Pollinator Protocols:

Operations manual:
The "pollinator section" of the NCRPIS operations manual was reviewed and updated to reflect revised/improved methods of rearing or emergence of pollinator insects. The section was also updated with explanations of additional insects now used as pollinators such as fly species and the ALC bees.

NCRPIS internet website:
The "pollinator links" for the internet website were updated with recent pictures taken by the entomology staff, revised information of how the pollinator are used at NCRPIS and updated methods for rearing and emergence of the insects being presently used.

Contacts/Cooperation:
In January, the entomology staff assisted Mark Smith, ISU forage breeding project, with recommendations, placement and emergence of greenhouse pollinators. Mr. Smith was shown several of the cage designs used to hold greenhouse pollinators used at the station and then designed a cage for his project. We also provided information on *Bombus* suppliers and assisted with placement of hives in his cages. A single story nucleus hive was supplied for his use in pollination of alfalfa in a greenhouse cage. More recently, alfalfa leaf-cutter bees were emerged and supplied to Mr. Smith for use in pollination of birdsfoot trefoil over several weeks. Mr. Smith quit using ALC because his greenhouse could not maintain the preferred temperature for ALC bees, and resumed use of *Bombus*.

On March 16, S. Hanlin visited with Dean Peterson (ARS in Morris MN) on the use of honey bees under caged pollination and gave D. Peterson a prototype nuc to take back with him. Several times throughout the summer and fall, D. Peterson contacted the entomology staff on advice on how to manage the honey bees under several different conditions.

In April, NCRPIS staff was contacted by Maria Jenderek of the Parlier, CA station. She was searching for a less costly alternate pollinator for *Helianthus* in place of honey bees as hives in that region were scarce and costly ($145/hive). Blue bottle flies had been recommended as a potential pollinator to Jenderek by other parties. The entomologists advised Jenderek that it would be better to pursue another bee pollinator rather than trying flies on sunflowers. Flies will move pollen around the flower heads, but they will not effect as much cross-pollination as a bee would.

This summer the entomology staff advised and assisted Evelyn Ortiz Perez (R. Palmer's graduate student) with the pollination section for several research publications she was submitting. The research was a culmination of the past cooperative work done with R. Palmer and the pollination of male sterile lines of soybeans using alfalfa leafcutting bees and honey bees.

On November 2, the entomology staff was visited by Pam Ponsness of Forked Tree Ranch in Idaho – the supplier of our blue bottle flies. Mrs. Ponsness came to observe our use of flies and discuss with us possible improvements to some of our protocols. She encouraged NCRPIS staff to consider using flies for pollination of *Brassica* as she has had success with this.

In November, the entomology staff was asked by Nathan Brockman (Entomologist at Reiman Gardens, Ames, IA) to produce a poster titled "History of Insect Pollination at NCRPIS" for the 2007 summer display at Reiman Gardens. A new version of the pollination poster in 2006 for the RTAC/PGOC station tour was made.

Presentations:
On March 23, S. Hanlin spoke at the Des Moines Botanical Center in Des Moines, IA on honey bees and beekeeping. The garden was having family day with a focus on beneficial insects and how they help you. S. Hanlin spoke to approximately 250 children and their parents at five separate presentations.

On April 3, S. Hanlin spoke at the "Glow and Grow Garden Club" in Indianola, IA on the history and purpose of the germplasm system, and provided an informative discussion on the pollinators used at the station and comparable beneficial garden pollinators. Approximately 25 individuals participated in this presentation.

Publications/Posters:
Insect-mediated Seed-Set Evaluation of 21 Soybean Lines Segregating For Male Sterility at 10 Different Loci. E. Ortiz-Perez; H. T. Horner; S. J. Hanlin; & R. G. Palmer. (2006) Euphytica. 152:351-360

Seed-Set Evaluation of Four Male-Sterile, Female-Fertile Soybean Lines Using Alfalfa Leafcutter Bees and Honey Bees as Pollinators. E. Ortiz-Perez; M. R. Main; R. L. Cooper; T. Mandiola; J. Tew; H. T. Horner; S. J. Hanlin; & R. G. Palmer. (2006) Journal of Economic Entomology. (submitted)

Liquid Nitrogen Controls Seed-borne Chalcids Without Reducing Germination in Coriander Seeds, Kovach, D.A., McClurg, S.G., Widrlechner, M.P., Brenner, D.M., and Gardner, C.A.C. (2006), Seed Sci. & Technol., 34, 669-679

NCRPIS Controlled Pollination Project, Hanlin, S.J., McClurg, S.G., poster presented at the RTAC/PGOC tour of the NCRPIS station June 2006.

Research Plans for 2007:
In the *Osmia* removal/replacement study done in the spring of 2005, we observed adult bees in approximately half of the cages which had domiciles reintroduced into them. A possible problem was that the field fringe, where domiciles were placed in the interim during spray applications, was mowed on one occasion and several domiciles were knocked over by field vehicle traffic. The bees appeared to be disoriented because of few landmarks and thus were lost. We will remove the domiciles in spring/early summer 2007 for spraying and relocate them to one of two locations, either near the fence line near the woods on the north side of Mortensen Rd. or just north of highway 30 along the fence on the southern part of the station.

In a continuing study to encourage pollinator activity throughout the large *Cucurbita* cages, we will use a single *Bombus* colony or two double-story honey bee nucs per cage. In the two nuc treatment cages, one nuc will be placed at the north end of the cage and a second nuc at the south end. The *Bombus* colony will be placed at the south end of the cage in a protective plastic box. In the summer of 2007, we will also raise all bee hives off of the ground/mulch to allow the bees to fly more easily through large quantities of vegetation in order to pollinate.

We will provide feedback on the development and implementation of the "Pocket Pollinator" PDA program which is intended to record pollinator actions as the work is performed. This program is designed to result in more accurate delivery of pollinators for curatorial regenerations and to allow for more precise and immediate access of entomologists' work records. It will facilitate development of long-term pollination records that can be utilized to address research questions related to plant genetic resource management.

Summary of Pollinators supplied to regeneration cages in 2006

Number of Unique ACCESSIONS per pollinator

	Honeybee	Bombus	Osmia	Flies	ALC	TOTAL
Amaranth/Mis Umb	57	0	2	41	2	102
Brassica	58	1	118	20	90	287
Horticulture	125	22	4	21	32	204
Medicinals	62	0	0	31	17	110
Sunflower	181	1	0	0	0	182
Vegetable	135	4	1	27	76	243
OVERALL	618	28	125	140	217	1128

Number of TOTAL CAGES per pollinator

	Honeybee	Bombus	Osmia	Flies	ALC	TOTAL
Amaranth/Mis Umb	81	0	2	51	2	136
Brassica	53	1	124	10	86	274
Horticulture	125	22	4	24	21	196
Medicinals	62	0	0	34	15	111
Sunflower	183	1	0	0	0	184
Vegetable	137	5	1	37	84	264
OVERALL	641	29	131	156	208	1165

C. Plant Host-Insect Resistance and Control of Seed Infestation Research (S. McClurg)

Progress:

Sunflower resistance to sunflower moth:

I completed data analyses for 379 total accessions tested in the field from 1994 through 2003. 167 unique accessions rated resistant to sunflower moth larval feeding. Data were summarized in March 2006; discussion with sunflower curator Laura Marek is needed prior to entry into GRIN.

Brassica resistance to aphids:

In November 2006, I reviewed the work done with former research entomologist R.L. Wilson, former Brassica curator R.L. Luhman, and cooperator G. Reed of Hermiston, Oregon at the request of the current Oilseeds curator L. Marek in her quest to make available NC-7 generated aphid evaluation data on GRIN. In summary, 1415 accessions were tested in Ames greenhouses for green peach aphid resistance from 1993 -1997 with aphids obtained from a laboratory colony maintained at NCRPIS; twelve accessions were identified as resistant (rated 2 or less) on a 5 point rating scale developed by R.L. Wilson. 1638 accessions were evaluated in Oregon field plots for cabbage aphid resistance from 1997 – 2002 with natural populations of aphids; 178 accessions rated a 1 or 2 (resistant) on a 5 point rating scale developed by Wilson and Reed.

Sunflower seed weevils:

Sunflower technician I. Larsen requested assistance with identification of larvae found in summer 2005 increase seeds of several accessions of wild perennial sunflowers. These were identified as red or gray seed weevil larvae. I investigated the biology of these weevils and strategies for

scouting and field management techniques; this information was presented to the Sunflower Oilseeds staff in spring 2006.

Biological control of aphids:
Because of ongoing aphid problems in regeneration cages and apparent curatorial staff misinformation about the use of biological control methods, I developed a written guide on biological control and some photos taken of common agents (lady beetles and parasitic wasps) found in NCRPIS field cages. This was made available to all staff in June 2006.

Contacts:
October 2006: Responded to Joe Louis, MS Entomology student at Kansas State (KSU), regarding voucher information he needed for green peach aphids I had supplied to Dr. Jyoti Shah, KSU Department of Biology, from the laboratory colony maintained at NCRPIS prior to 2000.

Plans for 2007:
I will continue to support activities for the NCRPIS insect pollinator program, assisting in the incubation and placement of bees and flies, as well as providing cooperation in pollinator studies proposed by S. Hanlin and NCRPIS curators. Continued investigation of the alfalfa leafcutter bee is a priority.

I will continue to work with the sunflower curatorial team to determine extent of sunflower seed weevil infestation in perennial wild-type sunflower plots and assist in the investigation of control alternatives. I will also continue to offer support to all NCRPIS and GEM project personnel when insect pest identification/information is needed.

I will continue to process, archive and make data publicly available from past host plant resistance evaluations as requested by curators.

I will work with other NCRPIS staff in development and implementation of barcodes on field and greenhouse cage labels to make pollinator delivery data entry more accurate and efficient.

I will also continue work on indexing past Entomology project slides and photos to make them accessible to other NCRPIS staff.

D. Plant Pathology (C. Block, B. Van Roekel)

Research Notes:
Maize (*Zea mays)*:
Five hundred and twenty (520) maize accessions were evaluated for Stewart's wilt (*Pantoea stewartii*) resistance. The five most-resistant accessions, with average scores of 1.2 or lower on a 1-9 scale, were Ames 25559 (H60), Ames 26121 (CI 28), Ames 26791 (H55), Ames 27193 (VA85), and PI 558533 (Mo21R).

We continued a collaborative research project with scientists at the ISU State Seed Science Center on development of real-time PCR assays for the detection of *Pantoea stewartii* and *Stenocarpella* (*Diplodia*) *maydis* from maize seed.

Sunflower:
C. Block was the principal investigator on a grant for $33,800 from the USDA Sclerotinia Initiative for "Evaluation of wild *Helianthus* species for resistance to Sclerotinia stalk rot." We made substantial progress on the development of a greenhouse resistance screening protocol. The project is being done in conjunction with co-investigators Dr. Tom Gulya at Fargo, ND and Dr. Laura Marek at Ames.

Brassica:
We collaborated with scientists at the ISU State Seed Science Center to evaluate the freezing-blotter protocol for detecting *Phoma lingam* from *Brassica* seed. Optimal seed pre-treatments and incubation conditions were identified. The blotter method was found to be equal in sensitivity to the ISTA 2,4-D method.

Disease observations on seed increase crops:
Field observations for plant diseases were made in the seed increase plots of maize, cucurbits, sunflower, and brassicas.

Corn (*Zea mays*):
The maize seed increase plots were surveyed during August and early September for the presence of Stewart's wilt, common rust, common smut, gray leaf spot, and northern leaf blight. Stewart's wilt was widespread in 2006. We identified and confirmed Goss' wilt, caused by *Clavibacter michiganensis* subsp. *nebraskensis*, on a few plants in late August. This is the first known occurrence at the PI Station. Lab tests were run on 430 maize seed lots for Stewart's wilt; 152 seed lots for Goss' wilt, and 104 seed lots for crazy top or sorghum downy mildew.

Cucumber and melon (*Cucumis sativus* and *C. melo*):
The melon greenhouse management plan (vertical barriers, bottom watering, and frequent plant inspection) was successful in preventing bacterial fruit blotch (BFB) spread for the second consecutive year. Four infected seedlings were identified and removed. Accessions were monitored regularly in the field between planting and harvest and no BFB occurred.

Cucurbit virus-testing:
Greenhouse-grown cucurbit seedlings were tested by ELISA for seed-borne squash mosaic virus to prevent spread in the field planting. No infection was found among the melon and cucumber accessions. Ten *Cucurbita pepo* accessions had infected seedlings, with five accessions from original seed. Infected plants were immediately removed. Results are summarized in the following table.

Species	Accessions tested	Accessions with infected plants	Plants tested	# of SqMV infected plants	% infected plants
C. sativus	10	0	381	0	0%
C. melo	44	0	1595	0	0%
C. pepo	31	10	1000	25	2.5%
Total	85	10	2976	25	0.84%

Sunflower (*Helianthus annuus*):
The main disease of phytosanitary interest in sunflower is downy mildew, caused by *Plasmopara halstedii*. Field inspections were conducted for downy mildew, viruses, and aster yellows. None of these diseases were found in 2006.

Brassica and related *Brassicaceae* genera:
Seed increase plots were surveyed for diseases in mid-June, near the peak of flowering. Diseases of interest included black rot (*Xanthomonas campestris* pv. *campestris*), blackleg (*Leptosphaeria maculans*), powdery mildew (*Erysiphe cruciferarum*), Alternaria diseases (*Alternaria* spp.), downy mildew (*Peronospora parasitica*) and white rust (*Albugo*). Absent in 2006 were blackleg, downy mildew, white rust and *Alternaria* diseases. Powdery mildew was present at low levels. The most common disease was black rot.

Miscellaneous:
Several unusual diseases were observed at the Station in 2006, including Agastache downy mildew, Potentilla rust, Potentilla leaf blisters (*Taphrina* fungus), and Cercospora leaf spot on *Chenopodium*.

Publications:
Menelas, B., Block, C. C., Esker, P. D., and Nutter, F. W., Jr. 2006. Quantifying the feeding periods required by corn flea beetles to acquire and transmit *Pantoea stewartii*. Plant Dis. 90:319-324.

Fessehaie, A., Block, C.C. and Shepherd, L.M. 2006. A diagnostic real-time TaqMan PCR assay for the detection of *Pantoea stewartii* subsp. *stewartii*. Phytopathology 96:S35;

Shepherd, L.M. and Block, C.C. 2006. Optimization of blotter test protocol for blackleg detection in *Brassica* seed. Phytopathology 96:S107

E. ***Amaranthus, Celosia, Chenopodium, Coronilla, Dalea, Echinochloa, Galega, Marina, Melilotus, Panicum, Perilla, Setaria, Spinacia* and miscellaneous Umbelliferae and Poaceae (David Brenner and Sam Flomo)**

Acquisition and inactivation (Table 1):
Sixty-two accessions were acquired. The majority were 37 wild United States collections of *Chenopodium* donated by Eric Jellen, or collected by David Brenner. Two *Echinochloa* accessions were collected in central Iowa, one of which (Ames 28347) is our first typical *E. muricata* var. *muricata*. Eight Umbelliferae accessions were donated, six of them were native prairie species transferred from the Ornamentals Station in Ohio, and two were spice seed species collected in Tajikistan. Eight accessions came from Tajikistan collected by Barbara Hellier, comprised of two cultivated umbels, one *Panicum*, four *Melilotus*, and one ornamental *Amaranthus*. Two additional *Amaranthus* were accessions of wild germplasm from the United States. Native Seeds/Search donated an accession (Ames 28194) of *Panicum hirticaule*, a nearly extinct cultivated millet from Sonora, Mexico.

Maintenance and distribution (Tables 2, 3A, and 3B):
Eighty-one accessions were planted for observation, primarily to resolve taxonomic and duplication issues. Two-hundred-ten accessions were planted for regeneration.

In general the field and greenhouse seasons went well and harvests were adequate.

Amaranthus and *Chenopodium*:
The 22 accessions ordered for observation were primarily for taxonomic determinations in greenhouse plantings at the NCRPIS. The regenerations were grown in the fall greenhouse.

The surge in distribution to 3234 items (Table 5) is mostly due to an order for 2308 *Amaranthus* accessions from EMBRAPA-CENARGEN in Brazil, to build their genebank.

Echinochloa, Panicum, *Setaria,* miscellaneous Poaceae:
We are developing a new regeneration protocol for *Setaria sphacelata* since some of the perennial grasses have been difficult to regenerate in the field. *Setaria sphacelata* seeds harvested in the campus greenhouse had less than 5% viability whereas seeds produced in isolation in or near the farm greenhouse had greater than 80% viability. There are too many variables to ascertain the reasons for this difference but a thrips infestation in the campus greenhouse may be a factor. The current preferred protocol: start the perennial grasses on campus in September, take them to the farm greenhouse in December, provide a quiescent winter period in cool night (4 ^{0}C) conditions, then pollinate in isolation, harvesting in summer after a spring flush of growth and flowering.

The following paper, which I found in 2006, demonstrates that *S. sphacelata* is an outcrossing species. Therefore flowering populations should be carefully isolated.

Hacker, J.B. 1967. The maintenance of strain purity in the *Setaria sphacelata* complex. The Journal of the Australian Institute of Agricultural Science 33:265-267.

Melilotus and other legumes:
Customarily, we separate annual and biennial individuals within accessions in the greenhouse in February. In 2006, annual and biennial individuals of Ames 23793 were kept together and given the same 4 °C short day treatment that the biennials need for vernalizing. Growth of the annual plants was delayed enough that entire accessions could be transplanted together into the field at the same time. Substantial effort was saved. We will try to repeat this successful method.

The field plantings of *Melilotus* were threatened by aphid infestations which were controlled with soapy water and hand crushing rather than traditional pesticides in order to avoid negatively impacting pollinator health.

A *Melilotus* accession (Ames 21596) has small irregular pits on the seed coats. This rare trait is associated with non-dormancy. Forage breeders worked with this trait in the 1950's. In 2006, we achieved a first successful seed increase of this accession carrying this trait from an old seed lot.

Spinacia:
The experiments with seed dormancy breaking in wild *Spinacia* were continued. As before, seeds kept in sand-filled flats through the summer in a warm greenhouse germinated in the fall. A manuscript about this method is in progress.

The surge in distribution to 1619 items from 399 items (Table 5) is mostly due to four large orders for disease screening and breeding.

Miscellaneous Umbelliferae:
We had excellent harvests of two species of *Eryngium* in field cages. Four other field cages with annual umbels were severely damaged by gophers (*Geomys bursarius*). One accession of *Astrodaucus littoralis* (PI 277064) and two accessions of *Angelica* (Ames 25403, and Ames 27293) were found to be winter-hardy; the plants over-wintered in the field and matured a good seed crops in their second summer.

Characterization/taxonomy/evaluation (Table 4):
This was a very successful year for entering old *Amaranthus* observations, such as greenhouse notes on stem colors, into the GRIN database. Now 3,234 accessions have data compared to 297 accessions in 2005. The data loading was a major accomplishment for the year and provides additional information which can facilitate collection utilization. Large blocks of data remain to be loaded into GRIN, including many years of *Melilotus* grow-out observations and passport data for hundreds of millet accessions donated from the University of Illinois.

In collaboration with Dr. Michael Own, ISU, an amaranth line, PI 538327, was found to have no outcrossing with weedy species under field conditions in one Iowa planting, as determined by observations of progeny grow-outs for hybrid individuals. Three other lines did appear to outcross with weeds. The non-outcrossing trait is a potential aid to seed maintenance of commercial grain cultivars. The preliminary data was presented in a poster at the 2006 American Society of Agronomy meeting, and was later added to the NCRPIS www site. The biological mechanism for this crossing-incompatibility is unknown, and could become an interesting area for continued research.

Two new *Setaria* descriptors, BUNCH STRUCTURE, and VEGETATIVE STRUCTURE were developed and deployed in GRIN.
I made 39 taxonomic changes in 2006 for my combined crops. The majority of these (20) were in *Amaranthus*. The remaining changes were in *Echinochloa, Melilotus, Panicum, and Setaria.*

Enhancement and/or utilization:
Development of diverse Proso cultivars
Some wide crosses between proso millet accessions, (*Panicum miliaceum* L. subsp. *miliaceum*) were made with the intention of widening the diversity in commercial cultivars. A plan is needed to advance and release these segregating lines in cooperation with a soon-to-be-hired proso millet breeder at the University of Nebraska, Panhandle Experiment Station.

Amaranthus:
In 2006, I recovered the first segregates with chlorophyll deficient ornamental leaf spots (DB 2005106) from crosses between PI 462129 and *Phomopsis amaranthicola*-disease resistant PI 608761. Their late season disease resistance will be field tested in 2007.

Eight breeding lines with improved stems from my enhancement breeding project were grown this year by cooperators: David Baltensberger in Nebraska, Burton Johnson in North Dakota, and Mike Bachman with Rob Myers in Missouri. Mike Bachman plans to use some of the lines in his breeding program. We need to select improved germplasm lines for release by Iowa State.

An unusual trait was observed in one of the dwarf breeding lines, DB 2003878; small branches emerged from the midribs of leaf blades. An extreme example was selected and sub-lined as DB 2006346 for further evaluation.

Publications and presentations:
David M. Brenner, Bohumil Muchna, and Micheal Owen. Research with Amaranth Germplasm. Oral presentation. American Society of Agronomy meeting November 12-16, 2006. Indianapolis, IN.

David M. Brenner, and Micheal Owen. 2006. Cross-Compatibility of Cultivated *Amaranthus* Grain Lines with Wild *Amaranthus* Species. *In* 2006 Agronomy Abstracts. ASA, Madison, WI. Poster presentation at the American Society of Agronomy meeting November 12-16, 2006. Indianapolis, IN.

Costea, M., D. M. Brenner, F. J. Tardif, Y. F. Tan, and M. Sun 2006. Delimitation of *Amaranthus cruentus* L. and *Amaranthus caudatus* L. using micromorphology and AFLP analysis: an application in germplasm identification. Genetic Resources and Crop Evolution 53:1625-1633.

Kovach, D.A., S.G. McClurg. M.P. Widrlechner, D.M. Brenner, and C.A.C. Gardner. 2006. Liquid nitrogen controls seed-borne chalcids without reducing germination in coriander seeds. Seed Science and Technology 34:669-679.

Written Progress Reports for the Crop Germplasm Committees: Clover and Special Purpose Legumes, Forage and Turf Grass, Leafy Vegetable, and New Crops.

I helped organize a continuing education tour of the Holub Greenhouse facilities for NCRPIS staff on March 2, 2006.

Plans for 2007:

I am conducting and organizing research in cooperation with Mike Owen of ISU and eleven cooperators in other states. The cooperators grow plants from seeds we provide and return the seed harvests for evaluation of the frequency of outcrossing of some accessions with weedy *Amaranthu*s plants. PI 538327, suspected to be a low-frequency outcrossing line, will be compared with PI 558499, suspected to be a higher-frequency outcrossing line.

There are substantial taxonomic issues associated with the millet collections. I plan to develop my taxonomic expertise for the millets and conduct a series of taxonomic comparison grow-outs, utilizing expertise from collaborators.

There is considerable interest in new biomass production crops. Among my crops, both *Amaranthus* and *Melilotus* are of potential value. I collaborate with researchers by providing germplasm, and demonstrating with small observation plots. We need to determine trait evaluation needs to support selection of cultivars suitable for biomass production and end use.

Acknowledgments:
Adam Conzemius, Alex Fales, Meghan Hermiston, Nathan Johnson, Andrew Martin, and Krista Sheldhl worked with us as part time student help.

Mr. Samuel Flomo continues to expand in his role as the Technician. He gives me opportunity to concentrate on problem areas in the germplasm collection.

Thanks to Sam Flomo for loading many images into GRIN in early 2007. Thanks also to all who prepared the image loading software and SOPs including Lucida Clark, Pete Cyr, and Mark Millard.

Some research publications derived directly from use of our germplasm and associated information:

Baranski, R., M. Baranska, H. Schulz, P.W. Simon, and T. Nothnagel. 2006. Single seed ramen measurements allow taxonomical discrimination of Apiaceae accessions collected in gene banks. Biopolymers 81:497-505

Doust, Andrew S. and Elizabeth A. Kellogg. 2006. Effect of genotype and ecology on branching in weedy green millet (*Setaria viridis*) and domesticated foxtail millet (*Setaria italica*) (Poaceae). Molecular Ecology 15:1335-1349.

Jank, L., K.H. Quesenberry, A.R.S. Blount, P. Mislevy. 2002. Selection in *Setaria sphacelata* for winter survival. New Zealand Journal of Agricultural Research 45:273-281.

Rosskopf, E.N., C.B. Yandoc, R. Charudattan. 2006. Genus-specific host range of *Phomopsis amaranthicola* (Sphaeropsidales), a bioherbicide agent for *Amaranthus* spp. Biocontrol Science and Technology 16:27-35.

Research indirectly about our germplasm:

Austin, Daniel F. 2006. Fox-tail millets (Setaria: Poaceae)-abandoned food in two hemispheres. Economic Botany 60:143-158.

National Research Council. 2006. Lost crops of Africa. Volume II: Vegetables. The National Academies Press, Washington, D.C.

Ortiz-Ribbing, Loretta, and Martin M. Williams. 2006 Potential of *Phomopsis amaranthicola* and *Microsphaeropsis amaranthi*, as bioherbicides for several weedy *Amaranthus* species. Crop Protection 25:39-46.

Spalik, Krzysztof, and Stephen R. Downie. 2006. The evolutionary history of *Sium* sensu lato (Apiaceae): dispersal, vicariance, and domestication as inferred from ITS RDNA phylogeny. American Journal of Botany 93:747-761.

F. Horticulture (M.P. Widrlechner, J. Carstens)

Germplasm Collections

Acquisition:
During 2006, we entered information about 63 new accessions of ornamentals and mint-family plants into the GRIN database (Table 1). The largest groups of new acquisitions included collections made by the Ornamental Plant Germplasm Center (OPGC, Columbus, OH) from wild populations of herbaceous ornamentals and mints in Ohio, tree and shrub collections made in Michigan, exchanges from the Republic of Georgia, as well as various tree and shrub populations that we obtained for possible testing in the NC7 Ornamental Trials. In addition, we were able to re-obtain samples of 11 accessions that were pending inactivation due to past losses.

Plans for the acquisition of *Fraxinus* germplasm from both North America and northeastern Asia moved forward with some urgency in the face of the destruction of native ash populations by the introduction and spread of Emerald Ash Borer.

Maintenance:
Field plantings of trees and shrubs continued to receive special attention for maintenance and rejuvenation in 2006, with the establishment of an additional, clean-cultivated nursery field in preparation for the establishment of a new cage field for shrubs in 2007. In 2006, we obtained a field-bed opener, which will be used to create clean strips (rows) for long-term plantings.

Availability:
During 2006, approximately 44% of the ornamental collections and 62% of the mint-family plants were available for distribution (Table 1), figures slightly above those reported in 2005 (43 and 56%).

Back-up:
Approximately 34% of the ornamental collections and 64% of the mint-family plants are duplicated at NCGRP (Table 2), figures slightly above those reported in 2005 (32% and 59%).

Regeneration:
Regeneration efforts intensified somewhat in 2006, with the largest number of regenerated seedlots produced since 2000. The harvests listed in Table 2 include 91 successful cage increases and 53 woody-ornamental seed increases. There were also 22 accessions of woody plants established from seeds and 18 accessions vegetatively re-propagated.

Viability Testing:
In 2006, 202 ornamental and 74 (or slightly more than half the entire collection) mint-family accessions were tested for germination (Table 2). Viability tests for 2006 regeneration lots began in 2006, but continue into 2007. Only those completed in 2006 are included in the statistics for this Annual Report.

Mark Widrlechner also analyzed historical germination-test records that documented slow after-ripening of Calendula germplasm at 4 degrees C, 25% RH and presented his results at the 2006 Annual Meeting of the Eastern Region of the International Plant Propagators' Society.

Distribution:

As summarized below (and in Table 3), requests for accessions of ornamental germplasm rebounded significantly in 2006, after a "lull" in 2005, both in relation to the number of recipients and the number of items shipped**.** The 436 "order items" included all the distributions for the NC7 Trials (described in the following section), along with 46 plants, 553 cuttings, 32 budwood sticks, 1 root sample, 170 leaf samples for DNA extraction, and 328 seed packets, distributed to fulfill external requests for ornamental plant germplasm. This group encompassed 47 genera; those most in demand were *Salix* (437 cuttings, 44 leaf samples, 23 plants, 1 root sample, and 1 seed packet), *Fraxinus* (37 leaf samples, 32 budwood sticks, and 1 seed packet), *Betula* (47 packets and 7 leaf samples), *Malva* (33 packets) and *Aronia* (25 packets and 8 plants).

Demand for mint-family germplasm remained relatively constant in 2006, nearly meeting the high number of packets distributed in the previous year.

Historical Summary of Distribution Activity:
Note: In the summer of 2004, about 240 accessions of *Echinacea* and *Hypericum* were transferred to Joe-Ann McCoy for curation. In addition, about 500 accessions of herbaceous ornamental germplasm representing 23 genera once part of this project were transferred to the Ornamental Plant Germplasm Center (OPGC) in Columbus, Ohio for maintenance in 2002. Statistics presented in the summary tables at the end of this Annual Report exclude activity in the transferred accessions. However, for comparative purposes, statistics reported in the historical distribution table (below) do include activity related to the transferred accessions conducted prior to their transfer.

Crop	Year	No. of Orders	No. of Recipients	No. of Items Distributed	No. of Accessions Distributed
Ornamentals	02	103	89	779	361
	03	108	91	883	320
	04[1]	87	81	361	297
	05[1]	58	53	241	187
	06[1]	89	76	436	322
Mint Family	02	4	4	22	19
	03	9	9	45	39
	04[1]	17	16	45	37
	05[1]	17	16	59	38
	06[1]	19	19	55	37

[1] Includes external distributions only.

Characterization/taxonomy:
All the herbaceous ornamentals in the cage fields and many of the tree and shrub accessions being regenerated were checked to verify identifications. In all, 16 ornamental and 2 mint-family accessions were re-identified. During 2006, Jeff Carstens captured images of 122 ornamental and mint-family accessions for our local database (Table 4). These are named following our standard

protocol and those from past years were loaded to GRIN early in 2006, by using the new mass-loading system for images, developed by Pete Cyr.

Evaluation:
An extensive collection of evaluation data was received from NC-7 trial-site cooperators. Ten-year evaluation data from 2006 were summarized and prepared for loading to our Internet database (described further in the section "Coordination of the NC-7 Regional Ornamental Trials"). To this end, we began work on a specialized descriptor list that will allow NC-7 Trial data to be added to GRIN observations.

Draft descriptor lists were also prepared for *Calendula* and *Potentilla* during 2006.

Enhancement:
There was no major progress to report with enhancement activities in 2006.

Coordination of the NC-7 Regional Ornamental Trials:
Plant Distribution - In 2006, Mark Widrlechner and Jeff Carstens distributed 311 plants of five accessions to 22 sites for long-term evaluation, with an additional 79 plants of these accessions provided to 10 public gardens. As part of that process, during April, Jeff Carstens delivered plants and met with cooperators in Kansas, Colorado, and Nebraska.

Computer-generated, "One-, Five-, and Ten-year Performance Report" forms were distributed to trial-site cooperators this summer. Evaluation data submitted by the cooperators covering distributions made from 1954 through 1993 will be summarized and eventually posted in Public GRIN in a new format utilizing Accession Actions. Currently, all active NC7 or NA site priority accessions (333 accessions) have newly-loaded Accession Actions indicating that these accessions have been trialed through the program.

An extensive collection of reports on the evaluation of NC7 Trial plants was published from the 1960s until about 1980. These reports are not widely available. During 2002, Kyle Cavanaugh scanned these reports and created .pdf files. These reports have been indexed and will be linked to accession records in GRIN.

Two updates were emailed or sent to trial cooperators in 2006 to inform them about recent developments in the testing program, plans for future distributions, and ongoing efforts to regenerate *Physocarpus* germplasm.

Germplasm activities in crops other than those curated:
Throughout 2006, Mark Widrlechner actively participated in a university-industry-ARS collaboration to guide the development of the Ornamental Plant Germplasm Center (OPGC), in Columbus, OH, and facilitate its integration within the National Plant Germplasm System. He serves as the Agency's representative to administer a Specific Cooperative Agreement (SCA) between ARS and The Ohio State University to fund the OPGC. In 2006, he helped coordinate an external team, which conducted a Project Planning Session at the OPGC in March 2006. This team made recommendations about operations and future plans for the Center, which are being implemented.

In 2002, Iowa State University and the University of Iowa were awarded a five-year grant from the National Institutes of Health (NIH) establishing a Center for Research on Botanical Dietary Supplements to study variation and bioactivity in *Echinacea* and *Hypericum*. Mark Widrlechner has continued his involvement with the Center by overseeing a subcontract to ARS, which supports the curation of the Station's *Echinacea* and *Hypericum* germplasm collections by Joe-Ann McCoy and the distribution of that germplasm so it can be evaluated for chemical composition, genetic

diversity, and bioactivity. He assisted Center researchers in interpreting secondary-metabolite and passport data for *Echinacea*. And in September, 2006, he helped prepare a proposal which was submitted to NIH to request funding to extend Center activities for the period, 2007-2010.

During 2006, Mark Widrlechner was involved with a number of other collaborative germplasm activities including:

1. a project with Pedro Lopez, Colegio de Postgraduados, Puebla, Mexico, to describe patterns of genetic diversity in *Coriandrum* germplasm, that resulted in a poster presented at the 6th National New Crops Symposium and the submission of three papers to Genetic Resources & Crop Evolution, which provide an overview of patterns of genetic, biochemical, and morphological variation;
2. projects with collaborators at the Center for Research on Botanical Dietary Supplements to document the effects of *Echinacea* extracts on prostaglandin production in mouse cells and on cytokine-modulating capability in a human model of influenza vaccination;
3. the description of a potentially undescribed species of *Cucumis* from Zambia, with Kathy Reitsma, Cindy Clark and Joseph Kirkbride (USDA-ARS, Beltsville);
4. service on the organizing committee for the International Pollination Symposium to be held in Ames next June, chairing a session on the use of pollinating insects for germplasm conservation;
5. participation in the ARS National Program 301 Research Planning & Coordination Workshop in St. Louis, co-chairing a break-out session on "Filling Gaps in Genebank Collections" with Ned Garvey (USDA-ARS, Beltsville); and
6. program planning for the combined Plant Germplasm Operations Committee (PGOC), Regional Technical Advisory Committee (RTAC), and Crop Germplasm Committee (CGC) Chairs meeting in June, and assisting Candice Gardner with a new Project Plan for Multi-state Research Project NC-7 and a concept paper for our CRIS Project for the National Program 301 Workshop.

Research products:
The project to evaluate variation in *Coriandrum* (point 1 above) resulted in a practical poster that assists breeders and other germplasm requestors who are searching for accessions with valuable traits, such as large seeds, high essential-oil and fatty-acid contents, and leafy plant types. This information will also be shared through the published proceedings of the 6th National New Crops Symposium.

The *Echinacea* projects (point 2 above) are helping to document specific bioactive components and accessions in these widely-used botanical dietary supplements. Our results contribute to the more effective use of these supplements and to understanding their modes of action.

Mark Widrlechner's other research and training activities:
Collaboration continued with George Yatskievych of the Missouri Botanical Garden, which will ultimately result in the development of keys and descriptions for *Rubus* species for an updated Flora of Missouri.

Collaborations also continued on the development of models to predict the risk of naturalization of non-native woody plants. In 2006, Mark Widrlechner presented a poster describing this work to the Second USDA-ARS Floral and Nursery Crops Researchers Workshop, Portland, OR. During 2006, significant progress was made on the assembly of data describing an extensive set of naturalizing and non-naturalizing woody plants from the Chicago region, in an effort to validate risk-assessment models developed from data collected in Iowa. This work is being conducted in

concert with Galen Gates, Peter Bristol and Kristen Kordecki at the Chicago Botanic Garden, funded through a Specific Cooperative Agreement.

In 2006, Mark Widrlechner continued his service as chair of a national Technical Review Committee that provides technical direction and oversight to an ARS project to update the USDA Plant Hardiness Zone Map by using the best available technologies and to make the next version of the map accessible via the Internet. As part of that service, he helped negotiate an agreement with the PRISM group at Oregon State University to provide climatic data analyses to USDA-ARS.

During the summer, Mark Widrlechner assisted in mentoring six Native American interns as part of a special summer genomics program funded by NSF and coordinated by Carolyn Lawrence (USDA-ARS, Ames). In October, he presented a talk reviewing current trends influencing the introduction of new nursery crops at the 6th National New Crops Symposium in San Diego.

Other Horticultural project-training and staff-development activities:
In 2006, Mark Widrlechner and Jeff Carstens attended the Eastern Region Annual Meeting of the International Plant Propagators' Society.

Communications Activities:
Manuscript and Proposal Review:
Mark Widrlechner continued his service on the Editorial Review Boards of Genetic Resources and Crop Evolution and the Journal of the American Rhododendron Society. He also served as a peer reviewer for manuscripts submitted to Journal of the American Society for Horticultural Science, Plant Breeding, Plant Genetic Resources Characterization and Utilization, and Plant Systematics and Evolution, and as an internal reviewer for two papers prior to journal submission. He reviewed NPGS Plant Exploration proposals and Germplasm Evaluation proposals as a member of the Woody Landscape Plant and Herbaceous Ornamental CGCs.

Posters, Presentations and Seminars:
Kordecki, K., M. Widrlechner, and P. Bristol. 2006. Predicting the risk of naturalization for non-native woody plants in the Chicago Region. Poster presented to the Second USDA-ARS Floral and Nursery Crops Researchers Workshop, Portland, OR, 12-15 June.

Lawrence, C.J., V.M. Cruz, C.A. Gardner, M.P. Widrlechner, M.J. Millard, T.E. Seigfried, D.A. Campbell, and V. Brendel. 2006. Summer research internships in plant genome research for American Indians at Iowa State University. Presented by the senior author at the Collaborative Plant Biology in the Rocky Mountain/Midwest Region: Impacts and Future Prospects for Plant Genomics, Laramie, WY, 1-3 June.

Lawrence, C.J., C.A. Gardner, M.P. Widrlechner, and V. Brendel. 2006. The NSF Plant Genome Research Outreach Program for American Indians at Iowa State University. Presented by the senior author at the Plant Genome Research Program - 9th Annual Awardee Meeting, Arlington, VA, 7-8 Sept.

López, Pedro A., Mark P. Widrlechner, Theodore B. Bailey, and Candice A. Gardner. 2006. Efecto de años y fechas de siembra sobre características fenológicas y morfológicas en poblaciones de cilantro (*Coriandrum sativum* L.) Presented by the senior author to the XXI Congreso Nacional y Primero Internacional de Fitogenética, Tuxtla Gutiérrez, Chiapas, Mexico, 3-8 September.

López, P.A., M.P. Widrlechner, P.W. Simon, S. Rai, T.B. Bailey, and C.A. Gardner. 2006. Screening the gene pool for special uses in coriander. Poster presented to the 6th National Symposium "Creating Markets for Economic Development of New Crops and New Uses," San Diego, CA, 14-18 October.

McCoy, Joe-Ann H. and Mark P. Widrlechner. 2006. Utilizing the NPGS (National Plant Germplasm System) for medicinal plant research. Invited presentation by the senior author to the American Society for Horticultural Science Annual Conference, New Orleans, 26 July.

Widrlechner, Mark P. 2006. Old and new trends influencing the introduction of new nursery crops. Invited presentation to the 6th National Symposium "Creating Markets for Economic Development of New Crops and New Uses," San Diego, CA, 14-18 October.

Publications which appeared in print in 2006:
Day Rubenstein, Kelly, Melinda Smale, and Mark P. Widrlechner. 2006. Demand for genetic resources and the U.S. National Plant Germplasm System. Crop Science 46: 1021-1031.

Kovach, D.A., S.G. McClurg, M.P. Widrlechner, D.M. Brenner, and C.A.C. Gardner. 2006. Liquid nitrogen controls seed-borne chalcids without reducing germination in coriander seeds. Seed Science & Technology 34: 669-679.

Lebeda, A., M.P. Widrlechner, and J. Urban. 2006. Individual and population aspects of interactions between cucurbits and *Pseudoperonospora cubensis*: Pathotypes and races. Presented to Cucurbitaceae 2006 by senior author. Pp. 453-467 in: Proceedings of Cucurbitaceae 2006. (G.J. Holmes, ed.) Universal Press, Raleigh, NC.

Senchina, David S., Lankun Wu, Gina N. Flinn, Del N. Konopka, Joe-Ann McCoy, Mark P. Widrelechner (sic), Eve Syrkin Wurtele, and Marian L. Kohut. 2006. Year-and-a-half old, dried *Echinacea* roots retain cytokine-modulating capabilities in an *in vitro* human older adult model of influenza vaccination. Planta Medica 72: 1207-1215, also published online doi 10.1055/s-2006-947254.

Departmental Activities:
Mark Widrlechner continued as an active member of the Crop Seeds Committee and the Plant Breeding and Genetics Advisory Panel of the Agronomy Department at Iowa State University. He also served on Agronomy Department's Greenhouse & Growth Chamber Committee and the faculty of the Horticulture Department. He completed service as Co-major Professor for Pedro Lopez, who received his Ph.D. in Plant Breeding, and on the Program of Study (POS) Committees for three graduating Ph.D. students, two in Plant Breeding and the other in Horticulture. He continued to serve as a member of the POS Committee for a Ph.D. candidate in the Interdepartmental Plant Physiology Program.

Conclusions and Plans for 2007:
Curation
Curation efforts in 2006 focused on increasing levels of activity in caged seed multiplication and increasing the efficiency of our handling of longer-term tree and shrub plantings, which lead to significant increased in the number of accessions regenerated.

Looking ahead to 2007, one of the first activities after storage of the 2006 crop will be to proof passport data for the designation of a large cohort of accessions the will receive PI numbers. In addition, we now have large numbers of shrub and small-tree seedlings ready for a significant expansion of our caged-seed regeneration effort, beyond the completion of regenerations from our existing woody and herbaceous perennial cage fields. This process should be aided through use of our new field-bed opener.

With the development of a workable protocol for the cryopreservation of Salix germplasm as dormant cuttings, we will begin the routine back-up of our clonal collections at the National Center

for Genetic Resources Preservation. And for the tree genera, *Alnus, Betula*, and *Fraxinus*, Jeff Carstens continues to learn more about the development of controlled-pollination systems for seed production. Given the serious threat caused by the introduction of Emerald Ash Borer to the North Central Region, we will continue to collaborate with Kevin Conrad, Ned Garvey, Dave Ellis, Kris Bachtell (Morton Arboretum), and Bob Karrfelt (USDA Forest Service) to refine and execute plans to conserve North American ash (*Fraxinus*) germplasm (and acquire Chinese germplasm).

To help capture valuable information about our accessions, we have drafted descriptor lists for *Calendula*, a crop with ornamental, medicinal, and industrial uses, and *Potentilla*, and for transferring data from the NC7 Ornamental Trials to GRIN. Given sufficient resources, we plan to test the Calendula list with an evaluation planting in 2007. The draft NC7 list will be presented to the Woody Landscape Plant CGC for its approval.

Research

Considerable progress was made on a wide range of research projects during the past year as outlined above.

Research efforts for the coming year will focus on:

1. validating recently developed risk-assessment models for the invasiveness of non-native woody plants in the Midwest with data being collected from the Chicago region through the support of a Specific Cooperative Agreement with the Chicago Botanic Garden (attempts are also underway to secure additional external support for this project);
2. coordinating technical advice and relaying appropriate research information from the PRISM group at Oregon State University as they supply climatological data and analyses in support of efforts to revise the USDA Plant Hardiness Zone Map;
3. completing and submitting a study for publication that uses long-term germplasm viability records and distribution histories to estimate target quantities for seed regeneration;
4. studying historical viability data to search for additional examples that may document the phenomenon of slow after-ripening in cold, dry storage, beyond data already analyzed for *Calendula*. This phenomenon is not well described in the seed-physiology literature, but it could explain otherwise unexpected results related to increases in germination tests during storage;
5. completing and submitting a study for publication (with Lankun Wu, Philip M. Dixon, Basil J. Nikolau, George A. Kraus, and Eve Syrkin Wurtele), that tests the use of metabolic profiles in comparing two different taxonomic treatments of *Echinacea*; and
6. providing guidance to Pedro Lopez as he completes his publications on patterns of genetic and phenotypic diversity in *Coriandrum*.

Staff Development

Plans for staff development for 2007 will focus on training experiences for Jeff Carstens, which are likely to include attendance at the Iowa Shade Tree Short Course and an ISU Genecology course (tentatively offered for Fall Semester), visits to NC7 Ornamental Trial sites, local nurseries, and safety training.

G. Maize Curation (M. Millard, M. Lively, D. Losure)

Equipment:

A new seed counter was purchased for use by the maize curation project.

Personnel:

Increased funding prospects at this time appear to be stagnant and increase staffing for maize may have to wait for some time. Staffing remains at levels which were first achieved in 1998. New challenges for the program will need to be met with the current staff.

Research Progress:
The thesis project on the races of maize in the Southwestern U.S. continues. Ms. Lindsay Werth is studying the landraces of maize native to the U.S. Southwest with the aim at describing the races found there. The late, Dr. Debra Muenchrath was the major professor for both studies. Dr. Candice Gardner the NCRPIS RL is assisting in the project.

Acquisition:
Statistics show a 285 accession increase in accessions in 2006 as seen in Table 1. Thirty-three of these were Plant Variety Protected (PVP) accessions. Twelve are teosinte inbred lines from Dr. John Doebley. Eighty-eight are remnant seed of teosinte populations with low seed quantities to be used for molecular studies in small quantities only. Fifty-one of the accessions received were CSR inbreds from Nigeria which were regenerated in quarantine on St. Croix.

The NCRPIS has imaged all of the Goodman Racial Collection of Maize received in June, 2004. The collection consisted of about 1,800 accessions. There were 2,110 images of seed taken. Cross-checking with the collection began in 2005, but was delayed due to staff transitions until the end of 2006. Approximately 50% of the final incorporation was completed by the end of 2006.

Regeneration:
There were 439 accessions regenerated during the summer of 2006. This compares favorably with 130 accessions in 2005 and 317 in 2004. Ninety-six inbreds were grown and 343 populations. In order not to overwhelm new staff and to make more accessions available faster, 217 50-plant increases were performed on accessions from Uruguay. These accessions had not been grown before in Ames and therefore needed to be evaluated for appropriateness for an Ames increase. Indications are that they can successfully be grown in Ames. There was one lone dry period forcing a single irrigation of the inbreds at the beginning of the pollination period. Later rains were spaced in such a way that irrigation wasn't required. This was a much better situation than other parts of Iowa experienced in 2006. This type of season usually gives good increases because many diseases are reduced, and this season was no exception. Stewart's Wilt appeared early and was fairly widespread throughout the nursery. This will necessitate ELISA testing on all 2006 increases to meet phytosanitary requirements. Also, Goss's Wilt was diagnosed on half a dozen populations. This disease has not appeared in the Ames plots before. There was one wind event, but it only affected a small percentage of the nursery.

A very good increase of almost 130,000 cupules of *Zea nicaraguensis* was made during January and February of 2006 from a greenhouse stand started during November 2004. This is the only accession of *Zea nicaraguensis* in the NPGS. The accession failed to flower under short day conditions in the greenhouse of less then 12 hours of light. The plants continued to grow into the rafters at 15 feet or more. We took cuttings during the next spring and summer of 2005 from the tops of the main stalk and from tillers. The cutting is made below the first node that is below the topmost fully extended internode. These plant tops rooted without assistance in a gallon of water and were transplanted to soil.

Very small seed harvests from four accessions of *Zea diploperennis* were harvested from their propagation in the Ames greenhouse during 2005-6. These accessions can be maintained clonally indefinitely. The plants were divided and increased in number during the summer of 2006. They are currently flowering for a second harvest during the 2006-7 winter greenhouse season.

Five maize accessions were grown in the GH during the winter of 2005-6. Two of these were very early populations, Tom Thumb (PI 217412) and Petite Mic Mac (PI 340832). These were grown in isolation in the 1950s and 60s and had shown possible contamination by sweet corn in later increases. They were self pollinated, selected for plant and kernel type and now will go through a sib-mating regeneration. The inbred WD is part of the Buckler-Goodman diversity set and shows a genetic lesion that is usually fatal to most plants before reaching maturity. It was grown in the greenhouse to manipulate the environment to overcome this lesion. The inbreds Mp701 and H21W were grown as rescue regenerations of samples that were very low in quantity.

One group of 50 accessions was regenerated by Carlos Hernandez with CH Farm Services, Inc., (Ponce, Puerto Rico) and received for processing in 2006 from an FY '05 planting. This nursery has been processed and stored. A second nursery group of 50 accessions was sent in 2006 and processed.

Fifty-six inbred line accessions were sent to St. Croix for quarantine increase in 2006. Twelve of these were waxy inbred lines from Australia and 44 were TZ inbreds from the Nigerian program that were recently registered in Crop Science. Fifty-four accessions from the 2005 St. Croix Nursery was stored.

Dr. Matthew Krakowsky, USDA-ARS at Tifton, Georgia, increased four old Georgia inbreds and one Georgia sweet corn population. He tried a couple of dozen other Georgia accessions from his holdings this year and commented that these lines didn't look too good even though they should be adapted to the Georgia environment. He will try again in 2007. This work is greatly appreciated as regeneration of many of these old Southeastern U.S. lines is difficult.

Maintenance:
Table 1 indicates that accession availability decreased from 66% to 63% at the end of 2006. This was due mainly to the incorporation of a portion of the Goodman racial collection which will initially be unavailable due to low seed supplies. This will mean that the percent of the collection available will go down again next year as the remainder of the collection is incorporated into the station statistics. A total of 332 accessions previously unavailable were made available in 2006.

In 2006, 1670 accessions or 8% of the collection were tested for viability compared to 1332 or 7% in 2005. The 2006 number represents 13% of the number of available accessions.

Distribution:
Table 5 shows that maize packet distributions, orders, and requestors were significantly higher than the previous year. This required a much greater amount of time to be devoted by the curator to orders than in previous years. The expired PVP inbred lines continued to be a popular distribution.

Crop	Calendar Year	No. of Orders	No. of Recipients	No. of Items Distributed	No. of Accessions Distributed
Maize relatives	2002	5	5	16	7

	2003	7	7	22	8
	2004	8	8	11	6
	2005	7	7	11	6
	2006	16	14	34	6
Average		**7**	**7**	**15**	**7**

Maize	2002	399	279	4714	2511
	2003	226	178	2298	1475
	2004	335	241	4973	2617
	2005	380	274	4422	1826
	2006	585	356	7927	2477
Average		**322**	**234**	**3809**	**2007**

Characterization:
There were 9,330 data points relating to 14 ear descriptors on 476 accessions loaded into GRIN in 2006, compared with 8,310 data points relating to 14 ear descriptors on 478.

We imaged 1,559 accessions in 2006 compared to 3,556 accessions in 2005. The reduction is due to most imaging being associated with regenerations rather than to accessions already in cold storage that had never been imaged before. Almost all accessions in the collection now have an image.

PDA program development to capture maize plant measurements in the field for direct loading into GRIN was started in 2006.

Evaluation:
There were three large disease screening nurseries sent out in 2006. Dr. Steve Moore at Louisiana State University received 500 accessions for top crosses that will be screened for Aspergillus resistance screening. Dr. Bill Dolezal with Pioneer Hi-Bred DuPont screened 250 accessions for northern leaf blight resistance and diplodia ear rot screening. Dr. Charles Block, USDA-ARS at the NCRPIS, screened 552 accessions for Stewart's wilt resistance. All three pathologists reported good conditions for their screenings (lots of disease!).

Communication:
The NCRPIS hosted a large June 2006 meeting of the Plant Germplasm Operating Committee (PGOC), CGC Chairs, and all Regional Technical Committees (RTACS) for the 4 regional plant introduction stations. All projects at the NCRPIS, including Maize Germplasm and GEM, prepared posters and presentations. Tours were given and there were many venues for exchanges of ideas.

2007 Project Plans

Acquisition:
We are planning to complete the inventory and image documentation of the Goodman Maize Race Collection. We will then prioritize and start the acquisition and regeneration processes.

More GEM accessions will be released for distribution by the NCRPIS in 2007.

The NCRPIS, NCGRP, CIMMYT, and Dr. Wilfredo Salhuana will work on a continuing project to develop and cross reference a consolidated list of the holdings of the various L.A. countries' maize germplasm collections, the CIMMYT collection, and U.S. collections in order to identify materials that may be at imminent risk of loss.

Regeneration:
Funding will support tropical maize regenerations of 50 accessions per year by private sector nursery providers to NCRPIS specifications. We plan on attempting a Hawaii tropical nursery and a highland maize observation planting.

Regenerations in Ames will be maintained at 300-350 accessions annually.

Quarantine regenerations on St. Croix will continue at the 30-50 accession level during 2007.

Maintenance:
Ames numbered accessions will be reviewed and PI numbers assigned; it is estimated that over 99% of the 1800 Ames-numbered accessions and the 425 available NSL-numbered accessions currently available could readily be assigned permanent PI numbers.

Dr. Buckler has agreed to quality screen a large group of increases of the Goodman-Buckler diversity set in 2007 with SSR markers.

Viability testing will increase in 2007 to maintain the maize testing schedule to provide timely data for regeneration priorities.

Evaluation:
I will attempt to augment the collection of images currently on GRIN of 4,644 accessions with images of an additional 10,000 accessions in 2007. These images have already been taken, and will be loaded with the GRIN loader software developed by the NCRPIS.

The maize curator will continue to collaborate with the NCRPIS pathologist and interested private and public pathologists to systematically obtain data on maize pathogen resistance in the collection and to acquire valuable disease reaction indicator materials. Additional evaluation information will result in more effective use of accessions in the future.

The project will continue to plant observation plots to obtain maturity data. Additionally, older data from field book sources will be gleaned for inclusion into GRIN. Maturity data is one of the most important pieces of data determining selection of accessions which meet researchers' objectives, and allows them to plan their work flow.

We will load existing molecular marker information and frequencies on collections held at the NCRPIS into the new GRIN molecular marker area. After finishing the NC State isozyme data, we will add SSR data obtained at NCRPIS. Dr. Laura Marek, the oilseeds curator, has expertise in this area and will assist in refining the current design for the molecular marker schema in GRIN.

H. Medicinal Plants (J. McCoy)

Germplasm Collections:
Perennial crop collections currently curated by the Medicinal project include *Echinacea* (prairie coneflower), *Hypericum* (St. John's wort), *Actaea racemosa* (black cohosh), *Prunella vulgaris* (heal all), and various miscellaneous species listed under the NC7-medicinals site-crop.

Acquisition:
During 2006, we received and/or collected 70 new accessions of medicinal species representing 17% of the current collection (Table 1). The collection currently consists of 402 accessions.

Collection trips:
In collaboration with the USDA-ARS station in Palmer Alaska, three populations of *Oplopanax horridus* were collected September 5, 2006. In collaboration with the Shaw Nature Reserve of Missouri Botanical Garden, a collection trip was conducted September 25-26 in Missouri. Eight accessions were collected, and arrangements were made with a researcher to secure future accessions, some of which have been received. A second short collection trip was coordinated in September in North and South Carolina in collaboration with Dr. Patrick McMillan, which resulted in five new accessions. The main emphasis of the trip was the collection of native *Hypericum* germplasm and the recollection of two *Prunella* accessions.

Availability and Backup:
Fifty-four percent of the NC7 medicinal accessions are currently available (Table 1.). Seventy-five accessions have been harvested and 104 made available in 2006. Sixty-eight accessions have been backed up in 2006, with a total of 242 accessions now backed up in Fort Collins, representing 60% of the total collection (Table 2).

Regeneration and Maintenance:
The majority of the growing season was spent maintaining 64 field cages along with 44 greenhouse cages. Seeds from 75 perennial accessions of *Echinacea, Hypericum*, *Actaea*, and *Prunella*, regenerated in field or greenhouse cages, were harvested, and are currently being processed and stored (Table 2). Regeneration efforts focused on new *Hypericum* and *Prunella* accessions for both field and greenhouse planting in 2006. Vegetative and rhizome samples of these new accessions were also made available to ISU / NIH researchers for both chemical and genetic analyses.

Distribution:
Three hundred and twenty one items were distributed in 2005; of these, 78% were domestic while 22% were foreign distributions (Table 3A). Along with seed distribution, leaf samples from *Hypericum* and *Echinacea* accessions grown under greenhouse conditions continue to be distributed for molecular-marker analyses to Dr. Jonathan Wendel's lab and to Dr. Eve Wurtele's lab for associated HPLC analysis. Both projects are associated with the ISU NIH Center for Research on Dietary Supplements grant project. *Echinacea* rhizome harvests were dried and ground by Wiley mill and made available to NIH collaborators.

Characterization and Taxonomy:
Hypericum descriptors were completed and submitted to the New Crops CGC for approval. Descriptor data for 53 morphological features were collected from 31 flowering field accessions of *Hypericum*, following the new CGC descriptor-list protocol.

All 2006 blooming accessions were photographed and will be loaded to GRIN in 2007, utilizing standardized file-naming protocols.

A collaboration has been established with Dr. Matthias Hamburger, University of Basel, Switzerland, to chemically analyze the *Actaea racemosa* collection. Dr. Jonathan Wendel's lab is preparing a publication comparing molecular marker analysis and chemical characteristics of a subset of our *Hypericum* collection. Dr. Mark Widrlechner has been collaborating with Dr. Eve Wurtele's lab on a paper analyzing alkamide profiles from *Echinacea* accessions and relating those profiles to two different taxonomic treatments for the genus.

Pathogen Observations:
Field plantings were monitored weekly during the growing season, for *Colletotrichum gloeosporioides* and aster yellows disease symptoms. Both pathogens were present in 2005 field plantings. A *C. gloeosporioides* seed screening protocol for *Hypericum* accessions continues to be utilized for all new and harvested seed accessions. Thirty-three *Hypericum* accessions have been screened for *C. gloeosporioides* (Table 3B). Positive identification was confirmed for *C. gloeosporioides* via spore identification and no contaminated seeds were found.
All germination and pathogen data collected have been entered in the GRIN database.

Joe-Ann McCoy's other research and training activities:
An IA Pesticide Applicator License was maintained and the annual PGOC meetings were attended in Ames, IA. She attended and gave presentations at the ASHS Annual conference in New Orleans, LA, the AAIC / New Crops Symposium in San Diego, CA, and the NC Natural Products Association Annual Meeting in Boone, NC. She also gave two presentations on medicinal plant curation in Palmer and Fairbanks, Alaska and presented an invited talk to the Clemson University Horticulture Department seminar series.

She completed a Medicinal Plant Database to evaluate the current status of medicinal taxa available via GRIN and posted it to the station website. The database contains 5,693 taxa collected from 27 compendia, with 26% of these taxa currently available via GRIN. The list has been correlated to current NPGS (National Plant Germplasm System) accessions for identification of gaps in collection holdings which will help identify priority species for future collection and acquisition efforts. Following taxonomic verification efforts by Dr. John Wiersema, the database will be publicly accessible via the GRIN database.

She regularly attended monthly meetings for NIH cooperators associated with the Center for Research on Botanical Dietary Supplements. In reference to the NIH project, she continued to work with graduate students to supply plant material for center projects, to identify and provide commercial *Hypericum* seed to cooperators for field testing and HPLC analysis, and to provide relevant journal articles and conference proceedings associated with the project.

Posters / Publication:
Publications:

1. Haidet, M., Byrne, M., and McCoy, J. Submitted. A Review of Germplasm Collection Efforts and Conservation Potential in the United States. HerbalGram. The Journal of the American Botanical Council.
2. McCoy, J. In press. Lavender – A Review. The Lavender Journal (Australia).
3. McCoy, J. In press. Preservation of Medicinal and Aromatic Crops. 2006. In Press. AAIC Proceedings New Crops Symposium. San Diego, CA.
4. McCoy, J., Davis, J., Camper, N., Kahn, I. and Bharathi, A. 2007. Influence of Rhizome Propagule Size on Yields and Triterpene Glycoside Concentrations of *Actaea racemosa*. HortScience.
5. Senchina, D., Wu L., Flinn, G., Konopka, D., McCoy, J., Widrlechner, M., Wurtele, E., Kohut, M. 2006. Dried *Echinacea* sp. roots retain cytokine-modulating capabilities in an *in vitro* human adult model of influenza vaccination. Planta Medica 72: 1207-1215.

Poster:
Hillwig, M., Wurtele, E., Hammer, K., Birt, D., Maury, W., Price, J., McCoy, J. 2006. Understanding Bioactivity and Metabolite Diversity in St. John's Wort and Related Species. The Second Scientific Meeting of the Metabolomics Society. Harvard Medical School. Boston, MA. June 24-28, 2006.

Online:

McCoy, J. and M. Widrlechner. NCRPIS Medicinal Plant Database. 2006. http://www.ars.usda.gov/Main/docs.htm?docid=13437

Invited Talks:

1. 1. Utilizing the USDA Germplasm Collection for Medicinal Plant Research and Production 2. Forest Plant Pathogens. North Carolina Natural Products Association. NC Arboretum, Asheville, NC. 11/17-18/2006.
2. Utilizing the NPGS via GRIN for Medicinal Plant Research. AAIC Annual Meeting. New Crops Symposium. San Diego, CA. 10/16/2006.
3. Medicinal Plant Research – Clemson University – Horticulture Department Seminar Series – 10/6/2006.
4. Development of Native Medicinal Plants as Crops. University of Alaska, Anchorage, AL. 9/8/2006.
5. Utilizing the NPGS (National Plant Germplasm System) via GRIN for Medicinal Plant Research. ASHS Annual Conference. New Orleans, LA. 7/27/2006.

Annual Meetings:
Attended annual meetings for 1.) ASHS; 2.) PGOC; 3.) The North Carolina Natural Products Association; and 4.) AAIC / New Crops.

Manuscript Review:
In 2006, seven peer reviewed manuscripts were reviewed for journals .

Plans for 2007:
A collection trip proposal, submitted in 2006 by Joe-Ann McCoy and Barbara Hellier (USDA-ARS, Pullman, WA) to the Republic of Georgia has been funded and will be implemented in 2007. Additional domestic collection trips will be planned for Fall, 2007 for various medicinal species. *Hypericum* and *Echinacea* descriptor data will continue to be collected for 2007 field accessions.

A primary 2007 goal will be to regenerate and make available a larger portion of the Medicinals collection. Also, voucher specimens will continue to be collected for all accessions and labeled and cataloged appropriately. Further acquisition of native medicinal species to increase the Medicinal collection holdings will also be a primary goal.

The curator has been invited to give three talks in 2007 on the status of medicinal plants in the NPGS, Medicinal plant germplasm curation, and *Actaea racemosa* research.

A collaboration is being established with Alaska and Clemson University to collect and analyze populations of *Oplopanax horridus*.

I. Oilseed Crops (L. Marek, curator; B. Bingaman and I. Larsen, technicians)

Acquisitions:
In 2006, we received 103 new oil seed accessions.

Helianthus:

Thirteen cultivated *Helianthus annuus* accessions previously held only at NCGRP, Ft Collins were requested in 2006. These included lines developed at the USDA-ARS Sunflower Research Unit in Fargo and one expired PVP developed at Pioneer. Two accessions, including the Pioneer line, had enough seed to allow distribution as original seed; twelve were planted and of these enough seed were harvested for eight accessions to allow distribution as soon as the harvest is stored in spring 2007. During a two week trip across Florida, Georgia, Alabama and Mississippi in September, Dr. Marek and USDA Sunflower researchers Dr. Gerald Seiler and Dr. Thomas Gulya collected 22 accessions of *Helianthus* [*H. resinosus* (11 populations), *H. smithii* (3), *H. longifolius* (2), *H. floridanus* (2), *H.* sp. (2), *H. debilis* ssp. *debilis* (1), and *H. argophyllu*s (1)]. The collection trip was funded by the NPGS PEO office and a Sclerotinia research grant. An additional accession of *H. longifolius* was collected later in the fall by a local collaborator, Robert Stack, from a site where a population identified during the principal trip had no mature seed. One accession of *H. carnosus* was collected by Dr. Cheryl Peterson, botanist, Bok Historic Sanctuary, Florida. During a visit to the NPGS Parlier location to collect observation data for *Helianthus* increases, Dr. Marek and Irv Larsen collected two accessions of wild *H. annuus*. An additional 18 wild *Helianthus* accessions collected in Ohio were received from the OPGC [*H. divaricatus* (3 populations), *H. giganteus* (3), *H. hirsutus* (3), *H. mollus* (2), *H. strumosus* (2), *H. occidentalis* (2), *H. grosseserratus* (1), *H. microcephalus* (1), and *H.* sp. (1)]. Fifteen of the new wild accessions are available as original seed

Miscellaneous asters:
Thirty-five miscellaneous aster accessions collected in Ohio were received from the OPGC. The collections included 16 *Eupatorium* accessions (5 species), 5 *Helenium* accessions (2 species), 5 *Heliopsis helianthoides* accessions, 3 *Verbesina* accessions (2 species), and 6 *Vernonia* accessions (2 species). Two of these accessions are available for distribution as original seed.

Brassicaceae:
Three Brassicaceae accessions were received in 2006. Two, one *B. rapa* and one *B. napus* came off PVP protection and were received from NCGRP. One *Camelina sativa* accession was received from its developer, Dr. David Baltensperger, then at the University of Nebraska. The *Camelina* and the *B. napus* accessions are available for distribution.

Linum:
Six *Linum usitatissimum* accessions were received from a collection trip to Tajikistan taken by Barbara Hellier and one *L. hypericifolium* was received from the Republic of Georgia. The *Linum* accessions will not be available for distribution until after increase in 2007.

Cuphea:
One accession of *Cuphea carthagenensis* was collected in North Carolina by Dr. Joe-Ann McCoy during the fall of 2005. This accession is available for distribution.

Collection Maintenance:
General statistics about availability and management of the collections are presented in Tables 1 and 2 in the appendix.

As part of my efforts to ensure that the active oil seed collection contains only viable accessions and accessions for which we can distribute seeds, 327 *Helianthus* accessions were inactivated in 2006. These accessions included five *H. annuus* cultivars or cultivated accessions, wild annual (190) [primarily wild *H. annuus* (136)] and wild perennial (132) accessions. An accession was inactivated if it had one or no seeds or if it had fewer than 10 seeds and more than one failed germination attempt. At least 97% of the inactivated accessions were collected in the 1970's or early to mid-1980's and had never been successfully increased. An estimated additional 100 *Helianthus* accessions will be inactivated over the next few years as the backlog of unavailable accessions is

eliminated. Similar analyses of collection viability are underway for the Brassicaceae, *Cuphea* and *Linum* collections.

Helianthus, Ames increases:
The cultivated *H. annuus* accessions are 91% available. When CSR-restricted accessions are removed from the calculations, cultivated *Helianthus* accessions are 94% available. We are managing our increases to maintain that level of availability and to ensure that the core collection accessions are available. In 2006 we regenerated 44 *H. annuus* cultivated accessions. Cultivated *H. annuus* accessions requiring long seasons or short days to flower are increased in the greenhouse as space allows (three to four accessions per season; four in the winter of 2005-2006; three underway for 2006-2007). Research cooperators currently have strong interest in wild *Helianthus* germplasm as potential sources of disease resistance, herbicide tolerance and other valuable traits. As a result, we have dramatically increased our efforts to make wild annual and perennial accessions available at the same level as the cultivated accessions. Wild annual *Helianthus* accessions are 90% available and wild perennial accessions are 50% available. In 2006, we caged 35 wild annual *Helianthus* accessions and harvested seed from 31 of the accessions. We caged 130 wild perennial populations, 56 of which had been previously established in the field. The 74 new accessions represented 68% of the attempted wild perennials, an increase in germination success of 10% over 2005. Seed was harvested from 82 of the caged perennial accessions.

Helianthus, Parlier alternate growout site:
We are working with NPGS Parlier, CA personnel to increase wild taxa that require longer growing seasons than are reliably obtained in Ames or which are cold sensitive. The Parlier location has 40 sunflower cages, purchased by NCRPIS, and can grow up to 40 sunflower accessions per year. Our association with the Parlier group has evolved into a very successful program. In 2005 we implemented the increase protocol of germinating seed in Ames and shipping live seedlings to Parlier. The Parlier staff transplant seedlings and manage plant growth. As in Ames, plots are caged before blooming, pollinator insects are introduced during flowering, and plants are harvested as seed heads mature. It is informative for us to observe the intact harvested seed heads; therefore, harvested material is shipped to Ames for threshing and processing. In 2006 we sent seedlings for 31 accessions, 28 of which were successfully harvested including, excellent harvests for three *H. radula* accessions, a species never before available for distribution. The 2006 harvested material arrived in Ames on January 4, 2007 and is being processed. Accession availability will be dependent on amount and quality of the seed.

The Parlier group records basic field data (date transplanted, date of first flowering, dates of harvest) but does not have the staff to record descriptor data (for example: ray and disc flower color, plant height, branching status, others) or to take images. Because some accessions represent taxa which we never see growing in Ames, it is important that these observation data be captured. In October 2006, Dr. Marek and Mr. Larsen traveled to Parlier to take images and record descriptor information; this will be an annual effort.

Brassicaceae:
Brassicaceae accessions are 80% available. We continue to work towards having 90% or more of these accessions available. We established 108 new Brassicaceae field populations in 2006. An additional 40 field populations were the result of successful over-wintering in the field and transfer back to the field of accessions that had over-wintered in the greenhouse. We harvested 111 of the 2006 field populations. Thirty-seven accessions did not flower in the field and plants from 27 of these accessions were transferred to over-winter (2006-2007) in the greenhouse. Transplanting was a priority for accessions which had no remaining seed and/or for those for which we did not have useful information with which to predict winter survival. Nineteen of the 2005 accessions transferred to the greenhouse to over-winter flowered and were harvested. We anticipate that 29 of the 2006-2007 greenhouse over-wintering accessions should flower. Greenhouse 2006-2007

flowering accessions include the 27 2006 transfers and remaining 2005 transfers. Many of the wild Brassicaceae are of Mediterranean origin and could be expected to bloom during cool, moist, short-day winter weather. For example, *Erysimum* accessions have not flowered in the field but have done very well in the winter greenhouse. The winter greenhouse increases have involved a strong cooperation with the NCRPIS entomology personnel to obtain appropriate pollinators in a timely manner.

Linum:
We had successful harvests for all four *Linum usitatissimum* accessions planted in 2006. Two of the accessions were cultivars from China, available now for the first time, and two were replacements for low germination lots from previous increases. Twenty-one flax accessions were harvested in 2006, 19 from the field and four during the 2005-2006 winter increase season. As with the Brassicaceae, if an accession did not flower in the field and we did not have additional seed or useful information with which to predict winter survival in the field, we brought plants into the greenhouse before hard freezes in the fall. Due to greenhouse space constraints, generally a portion of the population was left in the field to indicate winter survival. There may be interest in some of the wild *Linum* as ornamentals and winter survival information is an important evaluation characteristic.

Cultivated flax accessions are 99% available. Wild *Linum* accessions are currently 40% available; we are working towards having more than 90% of these accessions available.

Cuphea:
Seeds are available for 92% of the accessions of seven species (*Cuphea calophylla, C. carthagenensis, C. lanceolata, C. lutea, C. tolucana, C. viscosissima, C. wrightii)* and the *Cuphea* hybrid accessions that have been part of the PSR23 breeding efforts by members of the National *Cuphea* Research Consortium for the agronomic development of *Cuphea* as a domestic source of mid-chain fatty acids. Seeds were harvested from 21 of 30 accessions established in the field in 2006. Fifty-two percent of the *Cuphea* accessions of species of primary interest for horticultural/floricultural uses are available. Due to steady interest in *Cuphea* by horticultural groups, we are working to make a larger percentage of non-consortium targeted accessions available. In addition to the traditional priority work of increasing the percentage of distributable accessions for *Cuphea*, we increased a white, less-sticky PSR23 mutant with less shattering selected by the Consortium group at Morris, MN. We also grew and harvested a half acre of Illinois PSR23 for the Consortium. In 2006, the Illinois *Cuphea* fields were destroyed by army worm and the Minnesota and North Dakota production fields were lost to drought. As a result, seed produced in Ames is providing an important source for the 2007 Consortium plantings.

Distributions:
General statistics about distributions of the collections are presented in Table 3 in the appendix.

Helianthus:
The five year trend in *Helianthus* germplasm requests shows a relatively constant demand for cultivated germplasm. There has been an increase of about 20% in wild germplasm distribution during the last five years and the number of requestors of wild germplasm also increased about 20% during that time period. *Helianthus* accessions were distributed during 2006 for evaluation of resistance to sunflower moth, banded sunflower moth, stem weevil, red sunflower seed weevil, multiple races of rust, downy mildew, verticillium, and the Sclerotinia disease complex. Accessions were also sent to co-operators to study salt and drought tolerance, to screen for *Orobanche* resistance and to use in phytoremediation research. Other accessions were requested to study the genetics of flowering time and photoperiod regulation. Several research groups requested accessions to investigate biomass production and allocation. One project requested accessions to use for the study of the efficacy of fumigants to kill weed seeds in grain shipments to Australia.

Brassicaceae:
Demand for Brassicaceae accessions continued to be strong in 2006. The largest single distribution was to EMBRAPA, Brazil. Portions of the Brassicaceae collection were distributed for phytoremediation research, tissue culture research and biofumigant and green manure studies and well as for evaluations for salt tolerance, for fatty acid composition and for disease resistance. The profile of distributed items is strongly dependent on whether or not comprehensive trait screenings are underway.

Linum:
The largest single *Linum* distribution was to EMBRAPA, Brazil. We also distributed *Linum* accessions to several breeding programs working with oil and fiber characteristics as well as to a disease resistance project.

Cuphea:
Cuphea accessions were distributed to breeding and evaluation programs including an observation and evaluation trial for southern Minnesota and to groups participating in the National Cuphea Consortium.

Research Activities:
General statistics about observations and images recorded for the collections are presented in Table 4 in the appendix.

Helianthus:
Germination experiments: Our focus on making 90% or more of the wild *Helianthus* germplasm available for distribution has some challenges. Increases have never been attempted for most wild accessions; 65% of the original perennial seed and 85% of the original wild annual seed has been stored for 19 years or longer. We have found that an extended cold, moist treatment of seed prior to transfer to germination conditions is the most consistently useful, least labor intensive strategy to promote germination. Germination can also be improved in some accessions by clipping the non-embryo end of the seed. Pathogen contamination of old original seed is our biggest concern for many accessions. In consultation with the NCRPIS germination research group, we have incorporated a short soak in dilute hydrogen peroxide followed by rinsing in cool, running tap water prior to the pre-germination cold incubation period. Before transfer of the seeds to germination temperatures, the seeds are rinsed and placed in clean germ boxes.

Brassicaceae:
Re-identification field plot: In 2006, we established 22 plots for the purpose of observing and recording characters that would allow field identification/re-classification of a group of *B. carinata* and *B. juncea* accessions. The plots included two standard *B. juncea* check varieties, two *B. carinata* accessions re-identified in 2004 by C. Gomez-Campo, *Brassica* taxonomic world expert, and one standard *B. carinata* accession. Our data support the re-identification proposed by Gomez-Campo and the re-classification of six additional accessions.

Vernalization experiments: As part of our efforts to improve production of biennial Brassicaceae accessions, we planted 26 accessions in the greenhouse in the fall of 2006. This will provide a longer term treatment at vernalization temperatures and promote reproductive growth in accessions which have not flowered in the field after the standard vernalization treatment.

Cuphea:
Germination experiments: Based on results from our 2005 experiments, we included an eight week pre-germination moist cold treatment for the panel of five taxa (one accession each of *C. lanceolat*a, *C. viscosissima*, *C. carthagenensis*, *C. wrightii* and *C. lutea*) used in this on-going testing. We also

included an some comparisons of different germination temperatures. We observed a dramatic response of *C. viscosissima* to the cold pre-treatment when the accession was germinated in a 25/15 temperature regime: the selected *C. viscosissima* accession germinated at 97%; the *C. lanceolate* accession germinated at only 50%. When the accessions were germinated without a cold pre-treatment under a 30/20 C temperature regimen, *C. lanceolata* germinated at 98% and *C. viscosissima* germinated at only 1%. We plan to extend these observations in 2006 using a randomly selected panel of wild *C. viscosissima* accessions and to do a more complete test of the effect of germinating temperatures. We continue to try to find optimal germination conditions for our increases as well as to be able to make useful recommendations for our cooperators.

Collection trips:
I participated in one targeted collection trip for wild *Helianthus* germplasm in 2006. In September, I met Dr. Gerald Seiler, Botanist, and Dr. Thomas Gulya, Plant Pathologist, from the USDA Sunflower Research Group, Fargo in Tampa, FL. We spent 12 days collecting wild *Helianthu*s germplasm in the southeast traveling 4000 miles across Florida, Georgia, Alabama and Mississippi. In addition, during an October trip with Irv Larsen, sunflower technician, to the NPGS Parlier, CA location to record observation data and take images of the 2006 Parlier sunflower increase, we collected two wild *H. annuus* populations.

Professional Activities:
Publications and reviews:
Marek, L.F., Seiler, G.J., Gulya Jr, T.J. 2006. In Pursuit of Wild Western Sunflowers. 28th Sunflower Research Workshop, January 11-12, 2006, Fargo, ND. Available: HTTP://WWW.SUNFLOWERNSA.COM/RESEARCH/RESEARCH-WORKSHOP/DOCUMENTS/MAREK_WILD_WESTERN_SUNFLOWERS_06.PDF

Seiler, G.J., Gulya Jr, T.J., Marek, L.F., Knauf, C. 2006. Plant Exploration to Collect Wild *Helianthus niveus* subspecies for Sunflower Improvement. 28th Sunflower Research Workshop, January 11-12, 2006, Fargo, ND. Available: HTTP://WWW.SUNFLOWERNSA.COM/RESEARCH/RESEARCH-WORKSHOP/DOCUMENTS/SEILER_HELIANTHUS_06.PDF

Seiler, G.J., Gulya Jr, T.J., and Marek, L.F. 2006. Exploration for Wild *Helianthus* Species from the Desert Southwest USA for Potential Drought Tolerance. Helia: in press.

Peer reviewer for three journal articles, HortScience.

Grant applications:
Brassica oil evaluation grant written for Terry Isbell, NCAUR, Peoria; submitted through the Crucifer CGC to NPGS. Proposal developed at the request of the CGC.
FY 2007 southwest *Helianthus* collection trip proposal; submitted to the PEO office, NPGS.

J. Vegetables (K. Reitsma, L. Clark)

Collections curated by the Vegetable Project include *Cichorium* (NC7-chicory), *Cucumis sativus* (NC7-cucumis.cucs), *Cucumis melo* (NC7-cucumis.melo), *Cucumis* species (NC7-cucumis.wilds), *Cucurbita pepo* (NC7-cucurbita), *Cucumella aspera* and *Oreosyce africana* (NC7-cucurbits.misc), *Daucus* (NC7-daucus), *Ocimum* (NC7-ocimum), and *Pastinaca* (NC7-parsnips). Statistics for accession numbers and availability for each site crop are found in Table 1.

Acquisition:
Seventy-three new accessions were received and are listed by site crop in Table 1. The new accessions include 27 *Cichorium* from the NCGRP; 4 *Cucumis melo* (1 from Tajikistan, 3 abandoned PVPs) and 3 *C. sativus* accessions (old breeding lines from Dr. Todd Wehner, North Carolina State University); 3 *Cucurbita* (2 from Tajikistan, 1 abandoned PVP); and 36 *Daucus* from NCGRP.

Maintenance:
Table 2 contains 2006 data for regenerations attempted and accessions harvested.

Cichorium regenerations focused on accessions not currently available for distribution. Of the 49 planted, 27 accessions failed to germinate. Sixteen of these will be inactivated if additional seed cannot be provided by the donor. The remaining accessions that did not germinate have additional seed to attempt regeneration in 2008.

Cucurbit regenerations focused on accessions having low viability, low seed quantities, or distribution lots 20 or more years old. Most of the *Cucumis melo* regenerations were grown from seed lots received at Ames in 1987 from Griffin, GA when the collection was transferred to the NCRPIS. Some of these old seed lots have been found to be contaminated with *Acidovorax avenae* subsp. *citrulli*, the causal agent of bacterial fruit blotch (BFB), but no alternative seed source exists. Therefore, special precautions are taken with all melon seed increases to identify (and remove) contamination and prevent BFB spread to adjacent accessions. These seed lots were direct seeded into peat pots in the greenhouse, and individual flats were isolated from each other by a barrier system designed in collaboration with Larry Lockhart (Program Manager), Brian Buzzell (Farm Mechanic), and the Pathology and Vegetable Projects. The vertical barrier consists of a 2' tall by 8' long polycarbonate panel (5/16" thick) with 18" × 24" side walls attached perpendicularly every 24" to create four compartments on each side. The barrier system is attached to the top of an 8' × 3' greenhouse bench top to stabilize the unit. The compartments are open on the front and the top, and one flat of melon seedlings is placed in each compartment. To further reduce the chance of spreading the disease, a bottom-watering system was used, where each flat containing the peat pots was placed in a second flat which served as a reservoir for water. The reservoirs were carefully filled with water so as not to allow the foliage to become wet. Seedlings were observed daily for symptoms of BFB. Any seedlings positive for BFB were destroyed before the accession was transplanted into field cages. Field plantings were scouted regularly for evidence of the disease, but none was found.

Twenty-nine 5' × 15' × 40' and one 5' × 5' × 40' field cages were used to regenerate 30 accessions of *Cucurbita* in 2006. We continue to monitor the effectiveness of the large cages in reducing the incidence of and/or delaying the transmission of squash mosaic virus. Also, one hard-to-handle accession (PI 165004) was regenerated through controlled pollination by Dr. G. Whiteaker (Sakata Seed America, California) who was interested in this accession for research purposes. We had been unable to successfully regenerate the accession in Ames because it required a longer growing season. Enough seed was received from Dr. Whiteaker to allow for backup at NCGRP and permit distribution from the Ames collection. (For additional information on current NCRPIS research activities on bacterial fruit blotch and squash mosaic virus, please refer to the Plant Pathology section of this annual report.)

Daucus regeneration efforts included new accessions and older accessions with low seed quantity or viability. In addition to the regenerations in Ames, we received seed increases from R. Maxwell, Seminis Vegetable Seeds, Idaho (6 accessions), and R. Freeman, Nunhems, Oregon (22 accessions). Seven of Freeman's regenerations were of at-risk cultivars from NCGRP, which were then assigned PI numbers and incorporated into our active collection.

Ocimum regenerations included 10 accessions grown due to low quantity and declining viability. Two accessions were regenerated to ensure we would have sufficient seeds on had due to potential interest that may be generated by the research of Dr. S.R Mentreddy and his graduate student Mr. C. Sims, Alabama A&M University, Normal, AL. Dr. Mentreddy and Mr. Sims are currently evaluating chemical profiles of specific accessions from the NPGS collection that show promise for antidiabetic, antimicrobial, and anticarcinogenic properties.

As NCRPIS accessions are regenerated, seed samples are sent to NCGRP for back-up. Seven of the nine vegetable collections have 80% or more of their accessions backed up at NCGRP (Table 2).

In 2006, 386 germination tests (Table 2) were performed, including seed increases from the 2005 regenerations and 5-year viability testing of *Daucus* accessions.

Distribution:
Packet and accession distributions for the vegetable collections are summarized in Table 3A and 3B. In 2006, 5050 packets (items) were distributed for 207 domestic and 86 foreign orders. This represented 2876 vegetable accessions. Distribution history of the vegetable crops for the last five years can be found in the following table.

Crop	Calendar Year	No. of Orders	No. of Recipients	No. of Items Distributed	No. of Accessions Distributed
Cichorium	2002	8	8	261	134
	2003	8	7	195	144
	2004	5	4	45	43
	2005	9	9	257	118
	2006	10	9	44	38
Cucumis	2002	58	46	2658	1773
	2003	46	36	1901	1391
	2004	73	64	1393	1105
	2005	101	89	4768	2142
	2006	126	108	3967	2095
Cucurbita	2002	20	17	165	132
	2003	11	11	170	150
	2004	38	35	702	490
	2005	51	49	1568	829
	2006	58	52	424	300
Cucurbits–Misc.	2002	0	0	0	0
	2003	1	1	1	1
	2004	1	1	2	2
	2005	2	2	2	1
	2006	2	2	4	2
Daucus	2002	11	11	75	67
	2003	13	12	426	294
	2004	21	21	596	378
	2005	23	23	491	375
	2006	34	33	466	357
Ocimum	2002	7	7	18	16
	2003	8	8	52	42
	2004	22	22	235	84
	2005	23	21	204	85
	2006	21	21	123	69
Pastinaca	2002	2	2	9	8
	2003	1	1	1	1
	2004	3	3	5	4
	2005	1	1	1	1
	2006	3	3	22	15
Total		820	739	21242	12684

Characterization and Taxonomy:
Digital images, along with basic notes for taxonomic identification and accession characterization, were recorded during regeneration (Table 4). Data for approximately 17 descriptors, primarily fruit descriptors, were recorded at harvest for *Cucumis* and *Cucurbita* accessions. Plant habit, flowering dates, and life-cycle notes were recorded for *Daucus*. Some fruit images of *Cucumis* have been loaded to GRIN, and more fruit images of C*ucumis* and *Cucurbita* will be loaded to GRIN in 2007.

In April, an observation field of all available *Cichorium* accessions was planted to collect characterization data for GRIN. Data for 13 descriptors were loaded to GRIN, for a total of 3228 new observations. Digital images of plants and flowers, and scans of foliage were also captured for GRIN.

With the assistance of Dr. Mark Widrlechner (Horticulturist), taxonomic identities are reviewed and confirmed as each accession is regenerated. The 2006 re-identifications included: 2 *Cucumis sp.* to *C. metulifer*; 1 *C. meeusei* to *C.* species; 1 *Cucurbita pepo* to *C. maxima*; 6 *Daucus* sp. to 1 *D. broteri, 2 D. guttatus, 1 Caucalis sp*, and 2 *Torilis* sp.; 2 *Daucus guttatus* to *D. broteri* and *D. carota*; 1 *Daucus carota* to *D. pusillus*; 2 *D. involucratus* to *D. guttatus* and *D.* sp.; and 1 *D. carota* to unidentified-Apiaceae.

Dr. Widrlechner, Cindy Clark, Kathy Reitsma, Dr. Joseph Kirkbride, Jr.(USDA-ARS, Beltsville, MD), and Mr. Amanuel Ghebretinsae (doctoral student, St. Louis University, St. Louis, MO) are attempting to describe and identify six *Cucumis* sp. accessions from Zambia which may be a previously un-described species. Based on molecular data acquired and analyzed by Mr. Ghebretinsae, all of the accessions appear to belong to a single species.

Evaluation/Utilization:
Dr. Charles Block (Pathologist) continued to screen all *Cucurbita* and *Cucumis* seedlings grown for regeneration for the presence of squash mosaic virus, by using ELISA protocols before seedlings are transplanted to the field. Seedling screening has been done since 1993. He also visually inspected all cucurbit field plantings for disease during the 2006 growing season. Seed-borne diseases are of specific interest, with BFB in *Cucumis melo* being of greatest concern since phytosanitary issues have prevented the distribution of *Cucumis* germplasm to some countries. This year we again encountered angular leaf spot (*Pseudomonas syringae* pv. *lachyrmans*) in some *Cucumis* cages – a disease which we had not seen in this area for at least 15 years.

The Pollinator Program and the Vegetable Program also continue to collaborate on pollinator tests. We are investigating whether bumblebees or honey bees are more efficient pollinators in the large *Cucurbita* cages, as well as whether domicile numbers and placement within a cage influences the effectiveness of the insect pollinators. Collaboration continues on developing a year-round cage and pollinator program for regenerating *Cucumis* and *Cucurbita* in the greenhouse. For more information on this work, please refer to the Entomology section of the annual report.

Dr. Mark Widrlechner and I are collaborating with Dr. Philipp Simon (USDA-ARS, University of Wisconsin, Madison) to develop a core collection for the *Daucus* collection. We have also sent Dr. Simon subsamples of both the annual and biennial portions of several *Daucus* accessions having mixed life cycles for molecular evaluation and analysis.

Plans for 2007:
Regenerations: Fifty-two accessions of *Daucus* were started in the greenhouse in October 2006 for the summer 2007 field cages. Four of these accessions are of mixed annual/biennial life cycle; the annual plants will be regenerated then bulked with the biennial portion before inventory and storage. Regeneration of hard-to-handle and wild *Cucumis* species will continue in the greenhouse

as time, space, and labor permit. We will continue to increase *Cucumis* and *Cucurbit* accessions where distribution quantity or viability has fallen below critical values as set on GRIN. The *Cucumis melo* will be started in the greenhouse using the barrier system described above to prevent the transmission of *Acidovorax avenae* ssp. *citrulli*.

Germinations: Viability tests will be performed on the 2006 cucurbit regeneration seed lots in April 2007 and on the 2006 *Daucus* regeneration seed lots in June 2007

Characterization: A 2-year observation planting of all selected *Daucus* accessions will be direct seeded in the spring of 2007 for characterization and taxonomic verification. Resulting data will be loaded into GRIN. We will also continue to record characterization data as regenerations occur on other vegetable accessions.

Review of accession passport data will begin on the *Cichorium* collection in preparation for assigning PI numbers to the 196 Ames-numbered accessions in the collection. Once PI numbers are assigned, taxonomy and accession numbers will be updated in the images acquired during the 2006 *Cichorium* observation planting so they can then be loaded to GRIN.

Evaluation: We will continue to collaborate with the Pollinator Program on tests evaluating whether alfalfa leaf cutter bees may be a useful pollinator for vegetable crops in field and greenhouse regenerations. Collaboration continues on improving the year-round cage and pollinator program for regenerating *Cucumis* and *Cucurbita* in the greenhouse. For more information on these tests, please refer to the Entomology section of the annual report. In 2007, we will continue to investigate ways to improve insect-pollinator effectiveness in the large *Cucurbita* cages by introducing two honey bee nucleus hives (one each at the north and south ends of the cages), raising the nucleus hives above the canopy of foliage, and trying *Bombus* (bumblebees) as pollinators.

The Pathology Project will continue to assist us in monitoring the effectiveness of the cage program in reducing the incidence of and/or delaying the transmission of squash mosaic virus and other insect-vectored diseases of cucurbits.

In April 2006, we received seeds and field books for the *Cucurbita pepo* portion of the Oved Shifriss collection. Dr. Shifriss was a long time vegetable breeder at Rutgers University working primarily with squash – specifically the B gene for precocious yellow fruit pigmentation (bicolor fruit). Preliminary review of the seed indicates that viability may be low. There is a significant amount of damage to packets and seeds from mice and mold. It will take a considerable amount of time to decipher the field book data in order to determine which of Dr. Shifirss' lines should be or can be maintained and incorporated into our collection.

K. Research Leader Activities (C. Gardner)

Primary duties include the coordination of the ARS and NC7 components of the North Central Regional Plant Introduction Station, including the Plant Introduction Research and GEM CRIS Projects. In 2006, the NC-7 Project Revision was completed, thanks to assistance of the RTAC members, our Administrative Advisor Dean Wintersteen, and to Mark Widrlechner.

From 2005 - present, I serve as mentor for Sustainable Agriculture M.S. student Lindsay Werth who is characterizing the Native American Southwestern US maize accessions. PhD Student Von Mark Cruz completed his doctoral studies in August, 2006 on aspects of genetic control of flowering time in *Brassica napus* and returned to the Phillipines where he is employed at IRRI, the International Rice Research Institute.

Current research activities/interests include:

1. Development of best pollination practices guidelines to preserve genetic profile during regeneration practices.
2. Co-advises Sustainable Agriculture M.S. student Lindsay Werth's Southwestern Maize racial characterization project.
3. Research interests in the development of use of alfalfa leafcutter bees for NCRPIS crop regenerations and development of medicinal crop plants collections.
4. Improving the software tools available to public and internal users of GRIN
5. Serves on ASA's Biosecurity Committee and as President-elect of the AAIC, American Assoc. of Industrial Crops
6. Coordinating collection of site needs for the ARS's NPGS greenhouse initiative
7. Co-chair for the 9th International Plant – Pollinator Relations Symposium in Ames, IA in June, 2007.
8. Member of the National Plant Germplasm Coordinating Committee.

As part of the charge of the NPGCC, and with the assistance of D. Kovach and L. Burke, I prepared data summaries on PGR distributions from all NPGS sites and domestic distribution of PGR to the four CSREES regions. (See Tables 7 and 8.)

In 2007, the ARS Plant Introduction Research Unit's two CRIS Project Plans will be completed and submitted for OSQR review.

Peer-Reviewed 2006 Publications:

Crane, J., D. Kovach, C. Gardner, C. Walters. 2006. Triacylgylcerol phase and intermediate seed storage physiology: a study of *Cuphea carthagenensis*. Planta 223: 1081-1089.

Cruz, V.M.V., J.D. Nason, R. Luhman, L.F. Marek, R.C. Shoemaker, E.C. Brummer, C.A.C. Gardner. 2006. Analysis of bulked and redundant accessions of Brassica germplasm using assignment tests of microsatellite markers. Euphytica 152:339-349.

Cruz, V.M.V., C.L. Rife, J.D. Nason, E.C. Brummer, and C.A.C. Gardner. Measuring the effectiveness of isolation of *Brassica napus* L. accessions during caged germplasm regeneration (submitted for publication in Genetic Resources and Crop Evolution).

Volk, G.M., J. Crane, A.M. Caspersen, L.M. Hill, C. Gardner, C. Walters. 2006. Massive cellular disruption occurs during early imbibition of *Cuphea* seeds containing crystallized triacylglycerols. Planta DOI 10.1007/s00425-006-0310-4.

Year 2006 Table 1. NCRPIS Accessions (Accs), Acquired, Available

CURATOR	GENUS_CROP	Number Accs	Number Accs Acquired	Percent Acquired	Number Available	Percent Available	Percent Avail Last Year
Brenner	NC7-amaranth	3334	3	0	3159	95	94
	NC7-celosia	54	0	0	29	54	43
	NC7-echinochloa	305	2	1	247	81	78
	NC7-grasses	120	1	1	76	63	62
	NC7-legumes	229	1	0	105	46	46
	NC7-melilotus	957	5	1	702	73	72
	NC7-panicum	953	4	0	872	92	92
	NC7-perilla	23	0	0	22	96	100
	NC7-quinoa	271	37	14	206	76	81
	NC7-setaria	1005	1	0	909	90	89
	NC7-spinach	401	0	0	367	92	94
	NC7-umbels	1093	8	1	537	49	49
	Total:	8745	62	1	7231	83	82
Marek	NC7-asters	360	36	10	102	28	28
	NC7-brassica	2003	2	0	1724	86	86
	NC7-crucifers	1198	1	0	860	72	65
	NC7-crucifers.pvp	1	0	0	0	0	0
	NC7-cuphea	651	1	0	483	74	72
	NC7-euphorbia	220	1	0	47	21	21
	NC7-flax	2829	6	0	2810	99	99
	NC7-flax.wilds	161	1	1	63	39	39
	NC7-sun.cults	1698	13	1	1543	91	90
	NC7-sun.wilds	10	2	20	5	50	50
	NC7-sun.wilds.ann	1301	4	0	1170	90	84
	NC7-sun.wilds.per	739	38	5	370	50	34
	Total:	11171	105	1	9177	82	80
McCoy	NC7-medicinals	402	70	17	217	54	50
	Total:	402	70	17	217	54	50
Millard	NC7-corn.kin	34	0	0	5	15	15
	NC7-maize	19687	285	1	12378	63	66
	Total:	19721	285	1	12383	63	66
Reitsma	NC7-chicory	277	27	10	210	76	78
	NC7-cucumis.cucs	1354	3	0	1279	94	95
	NC7-cucumis.melo	3110	4	0	2348	75	77
	NC7-cucumis.wilds	331	0	0	144	44	43
	NC7-cucurbita	989	3	0	810	82	82
	NC7-cucurbits.misc	2	0	0	2	100	100
	NC7-daucus	1112	36	3	850	76	78
	NC7-ocimum	96	0	0	90	94	89
	NC7-parsnips	70	0	0	51	73	72
	Total:	7341	73	1	5784	79	79
Widrlechner	NC7-mints	139	14	10	86	62	56
	NC7-ornamentals	1990	49	2	877	44	43
	Total:	2129	63	3	963	45	44
NCRPIS Total:		**49509**	**658**	**1**	**35755**	**72**	**73**

Year 2006 Table 2. NCRPIS Accessions (Accs) Germinated, Regenerated, Made Available, Backed Up

CURATOR	GENUS_CROP	Number Accs	Number Accs Germed	Percent Accs Germed	Number Attempted Regen	Number Harvested Regen	Number Perm Perennial	Number Perennial Harvested (Vegetative)	Number Accs Made Available	Number Accs Growing	Number Accs Backed UP for YR	Total Number Accs Backed Up	Percent Accs Backed Up
Brenner	NC7-amaranth	3334	53	2	67	63	0	0	59	0	54	3165	95
	NC7-celosia	54	7	13	1	0	0	0	6	0	8	31	57
	NC7-echinochloa	305	14	5	9	4	0	0	12	0	16	257	84
	NC7-grasses	120	13	11	13	11	0	0	10	0	9	78	65
	NC7-legumes	229	0	0	0	1	0	0	1	0	1	168	73
	NC7-melilotus	957	0	0	36	23	0	0	16	0	0	773	81
	NC7-panicum	953	0	0	3	25	0	0	2	0	3	890	93
	NC7-perilla	23	0	0	0	0	0	0	0	0	0	22	96
	NC7-quinoa	271	18	7	1	0	0	0	18	0	7	207	76
	NC7-setaria	1005	18	2	56	25	0	0	19	0	10	943	94
	NC7-spinach	401	2	0	4	2	0	0	2	0	1	374	93
	NC7-umbels	1093	3	0	20	40	0	0	3	0	17	572	52
	Total:	8745	128	1	210	194	0	0	148	0	126	7480	86
Marek	NC7-asters	360	0	0	0	0	0	0	11	0	9	83	23
	NC7-brassica	2003	371	19	48	35	0	0	25	2	28	1947	97
	NC7-crucifers	1198	121	10	85	60	0	0	112	44	91	921	77
	NC7-crucifers.pvp	1	0	0	0	0	0	0	0	0	0	1	100
	NC7-cuphea	651	34	5	0	0	0	0	33	0	24	575	88
	NC7-euphorbia	220	0	0	0	0	0	0	0	0	0	53	24
	NC7-flax	2829	263	9	0	4	0	0	15	0	14	2819	100
	NC7-flax.wilds	161	3	2	11	23	0	0	1	23	1	61	38
	NC7-sun.cults	1698	47	3	0	5	0	0	56	0	20	1617	95
	NC7-sun.wilds	10	1	10	0	0	0	0	0	0	0	5	50
	NC7-sun.wilds.ann	1301	114	9	0	3	0	0	45	0	41	1188	91
	NC7-sun.wilds.per	739	94	13	0	1	0	0	167	0	144	397	54
	Total:	11171	1048	9	144	131	0	0	465	69	372	9667	87
McCoy	NC7-medicinals	402	63	13	4	75	0	0	104	4	68	242	60
	Total:	402	63	16	4	75	0	0	104	4	68	242	60
Millard	NC7-corn.kin	34	2	6	0	1	0	0	0	0	1	8	24
	NC7-maize	19687	1670	8	546	631	0	1	332	4	89	13921	71
	Total:	19721	1672	8	546	632	0	1	332	4	90	13929	71
Reitsma	NC7-chicory	277	1	0	49	22	0	0	14	0	0	226	82
	NC7-cucumis.cucs	1354	48	4	12	11	0	0	49	0	48	1272	94
	NC7-cucumis.melo	3110	48	2	47	50	0	0	41	0	33	2506	81
	NC7-cucumis.wilds	331	1	0	4	2	0	0	1	0	0	149	45
	NC7-cucurbita	989	21	2	33	25	0	0	19	0	15	790	80
	NC7-cucurbits.misc	2	0	0	0	1	0	0	0	0	0	2	100
	NC7-daucus	1112	258	23	16	40	0	0	32	0	63	919	83
	NC7-ocimum	96	8	8	10	11	0	0	7	0	7	90	94
	NC7-parsnips	70	1	1	0	0	0	0	1	0	1	47	67
	Total:	7341	386	5	171	162	0	0	164	0	167	6001	82
Widrlechner	NC7-mints	139	74	53	8	16	0	0	15	0	15	89	64
	NC7-ornamentals	1990	202	10	101	144	166	18	56	0	41	669	34
	Total:	2129	276	13	109	160	166	18	71	0	56	758	36
NCRPIS Total:		**49509**	**3573**	7	**1184**	**1354**	**166**	**19**	**1284**	77	**879**	**38077**	77

Year 2006 Table 3A. External NCRPIS Distributions

			External Domestic Distributions				Foreign Distributions				External Domestic and Foreign Distributions			
CURATOR	GENUS_CROP	Number Accs in Collection	Number Accs	Number Orders	Number Recipients	Number Items	Number Accs	Number Orders	Number Recipients	Number Items	Number Accs	Number Orders	Number Recipients	Number Items
Brenner	NC7-amaranth	3334	153	33	31	210	2572	26	22	3024	2634	59	53	3234
	NC7-celosia	54	21	6	5	27	5	3	3	5	22	9	8	32
	NC7-echinochloa	305	7	6	6	10	21	13	10	39	24	19	16	49
	NC7-grasses	120	4	4	3	5	4	3	3	4	7	7	6	9
	NC7-legumes	229	11	6	6	15	0	0	0	0	11	6	6	15
	NC7-melilotus	957	37	8	6	38	16	4	4	18	49	12	10	56
	NC7-panicum	953	15	8	8	16	36	14	13	61	42	22	21	77
	NC7-perilla	23	22	8	8	60	21	6	6	42	22	14	14	102
	NC7-quinoa	271	69	22	17	128	188	15	14	273	196	37	31	401
	NC7-setaria	1005	36	10	9	44	161	13	12	183	179	23	21	227
	NC7-spinach	401	377	21	21	861	377	5	5	758	377	26	26	1619
	NC7-umbels	1093	126	28	27	159	21	9	7	31	137	37	34	190
	Total:	8745	878	160	147	1573	3422	111	99	4438	3700	271	246	6011
Marek	NC7-asters	360	53	13	11	59	2	1	1	2	54	14	12	61
	NC7-brassica	2003	1043	52	40	1328	1059	18	16	1204	1421	70	56	2532
	NC7-crucifers	1198	163	26	24	257	90	8	8	101	208	34	32	358
	NC7-crucifers.pvp	1	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-cuphea	651	224	16	12	284	48	5	4	53	254	21	16	337
	NC7-euphorbia	220	10	2	2	11	4	2	2	4	13	4	4	15
	NC7-flax	2829	47	10	9	48	1176	9	9	1236	1199	19	18	1284
	NC7-flax.wilds	161	28	4	4	28	64	5	5	111	66	9	9	139
	NC7-sun.cults	1698	184	44	32	265	192	12	12	203	346	56	44	468
	NC7-sun.wilds	10	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-sun.wilds.ann	1301	517	30	27	797	115	5	5	124	565	35	32	921
	NC7-sun.wilds.per	739	77	15	13	120	31	3	3	31	83	18	16	151
	Total:	11171	2346	212	174	3197	2781	68	65	3069	4209	280	239	6266
McCoy	NC7-medicinals	402	151	36	28	249	62	6	5	72	162	42	33	321
	Total:	402	151	36	28	249	62	6	5	72	162	42	33	321
Millard	NC7-corn.kin	34	6	16	14	34	0	0	0	0	6	16	14	34
	NC7-maize	19687	2198	518	295	7054	625	67	61	873	2477	585	356	7927
	Total:	19721	2204	534	309	7088	625	67	61	873	2483	601	370	7961
Reitsma	NC7-chicory	277	37	9	8	43	1	1	1	1	38	10	9	44
	NC7-cucumis.cucs	1354	157	34	32	200	1286	24	22	2525	1286	58	54	2725
	NC7-cucumis.melo	3110	388	59	50	546	428	25	21	542	719	84	71	1088
	NC7-cucumis.wilds	331	36	12	11	49	73	11	11	105	90	23	22	154
	NC7-cucurbita	989	175	44	41	238	175	14	11	186	300	58	52	424
	NC7-cucurbits.misc	2	2	1	1	2	2	1	1	2	2	2	2	4
	NC7-daucus	1112	330	27	26	404	49	7	7	62	357	34	33	466
	NC7-ocimum	96	65	20	20	116	7	1	1	7	69	21	21	123
	NC7-parsnips	70	8	1	1	8	7	2	2	14	15	3	3	22
	Total:	7341	1198	207	190	1606	2028	86	77	3444	2876	293	267	5050
Widrlechner	NC7-mints	139	36	15	15	51	4	4	4	4	37	19	19	55
	NC7-ornamentals	1990	292	77	67	379	57	12	9	57	322	89	76	436
	Total:	2129	328	92	82	430	61	16	13	61	359	108	95	491
NCRPIS Total:		**49509**	**7105**	**934**	**589**	**14143**	**8979**	**249**	**208**	**11957**	**13789**	**1183**	**797**	**26100**

Year 2006 Table 3B. Internal NCRPIS Distributions

			NC7 Related (# Accs)							Seed Storage Maintenance	
CURATOR	GENUS_CROP	Number Accs	Backed Up	Germed	Obs	Regen	Path Test	Total	# Distinct Accs for NC7 Orders	# Accs Stored	# Accs Ct Rev
Brenner	NC7-amaranth	3334	54	53	21	2	0	130	77	59	1699
	NC7-celosia	54	8	7	1	1	0	17	9	6	1
	NC7-echinochloa	305	16	14	12	0	0	42	34	18	13
	NC7-grasses	120	9	13	1	12	0	35	26	13	10
	NC7-legumes	229	1	0	0	0	0	1	1	4	0
	NC7-melilotus	957	0	0	0	1	0	1	1	5	0
	NC7-panicum	953	3	0	21	0	0	24	23	4	1
	NC7-perilla	23	0	0	0	0	0	0	0	1	1
	NC7-quinoa	271	7	18	1	1	0	27	21	55	4
	NC7-setaria	1005	10	18	22	28	0	78	51	19	7
	NC7-spinach	401	1	2	2	4	0	9	8	2	81
	NC7-umbels	1093	17	2	0	16	0	35	34	25	0
	Total:	8745	126	127	81	65	0	399	285	211	1817
Marek	NC7-asters	360	9	0	0	20	0	29	29	37	8
	NC7-brassica	2003	28	776	1	71	0	876	824	39	37
	NC7-crucifers	1198	91	120	0	118	3	332	219	132	26
	NC7-crucifers.pvp	1	0	0	0	0	0	0	0	0	0
	NC7-cuphea	651	24	34	3	38	0	99	75	36	19
	NC7-euphorbia	220	0	0	0	0	0	0	0	1	0
	NC7-flax	2829	14	267	12	4	0	297	267	22	3
	NC7-flax.wilds	161	1	3	0	13	0	17	16	8	0
	NC7-sun.cults	1698	20	645	9	60	4	738	710	71	178
	NC7-sun.wilds	10	0	0	0	0	0	0	0	0	1
	NC7-sun.wilds.ann	1301	41	36	44	53	2	176	143	59	91
	NC7-sun.wilds.per	739	144	100	0	74	0	318	256	250	37
	Total:	11171	372	1981	69	451	9	2882	2539	655	400
McCoy	NC7-medicinals	402	68	71	1	0	33	146	95	131	15
	Total:	402	68	71	1	0	33	146	95	131	15
Millard	NC7-corn.kin	34	1	2	0	1	0	4	3	0	0
	NC7-maize	19687	89	1952	1116	557	403	4117	3489	1164	1577
	Total:	19721	90	1954	1116	558	403	4121	3492	1164	1577
Reitsma	NC7-chicory	277	0	0	234	49	0	283	273	27	5
	NC7-cucumis.cucs	1354	48	48	0	12	9	117	70	54	366
	NC7-cucumis.melo	3110	33	48	0	47	666	794	700	55	188
	NC7-cucumis.wilds	331	0	1	5	3	0	9	8	2	110
	NC7-cucurbita	989	15	21	0	33	0	69	51	29	205
	NC7-cucurbits.misc	2	0	0	0	0	0	0	0	0	0
	NC7-daucus	1112	63	289	1	16	0	369	312	70	119
	NC7-ocimum	96	7	8	0	10	0	25	18	7	8
	NC7-parsnips	70	1	1	3	0	0	5	3	1	1
	Total:	7341	167	416	243	170	675	1671	1435	245	1002
Widrlechner	NC7-mints	139	15	66	3	9	0	93	73	28	1
	NC7-ornamentals	1990	41	195	7	99	0	342	308	133	20
	Total:	2129	56	261	10	108	0	435	381	161	21
NCRPIS Total:		**49509**	**879**	**4810**	**1520**	**1352**	**1120**	**9654**	**8227**	**2567**	**4832**

Year 2006 Table 4. NCRPIS Accessions (Accs) Observations (Obs) in GRIN, Images in GRIN

CURATOR	GENUS_CROP	Number Accs	Number Accs Obs Trials	Number Accs Obs in Curator Notes	Number Obs in GRIN for Year	Number Acc Obs in GRIN for Year	Number Acc Obs in GRIN Last Year	Number Acc Obs in GRIN (all years)	Number Accs Imaged	Number Acc Images in GRIN for Year	Number Acc Images in GRIN (all years)
Brenner	NC7-amaranth	3334	21	95	11815	3234	297	3309	50	18	265
	NC7-celosia	54	1	0	3	2	2	7	0	2	5
	NC7-echinochloa	305	12	15	0	0	52	290	10	0	0
	NC7-grasses	120	1	15	0	0	0	1	10	0	0
	NC7-legumes	229	0	1	1	1	0	85	2	1	1
	NC7-melilotus	957	0	25	1	1	2	912	20	0	0
	NC7-panicum	953	21	45	1	1	0	944	45	0	0
	NC7-perilla	23	0	0	0	0	0	0	1	0	1
	NC7-quinoa	271	1	2	57	57	10	229	37	0	1
	NC7-setaria	1005	22	80	6	6	0	991	75	0	0
	NC7-spinach	401	2	4	0	0	1	401	3	0	0
	NC7-umbels	1093	0	25	0	0	5	7	35	0	0
	Total:	8745	81	307	11884	3302	369	7176	288	21	273
Marek	NC7-asters	360	0		0	0	0	4	36	0	0
	NC7-brassica	2003	1		570	102	117	1637	59	67	283
	NC7-crucifers	1198	0		1217	194	33	605	139	141	339
	NC7-crucifers.pvp	1	0		0	0	1	1	0	0	0
	NC7-cuphea	651	3		36	35	0	355	1	0	0
	NC7-euphorbia	220	0		0	0	0	0	1	0	0
	NC7-flax	2829	12		72	19	17	2818	6	0	0
	NC7-flax.wilds	161	0		277	23	15	81	18	2	2
	NC7-sun.cults	1698	9		2797	1603	39	1635	14	0	1
	NC7-sun.wilds	10	0		0	0	0	6	0	0	0
	NC7-sun.wilds.ann	1301	44		569	39	44	1223	17	0	1
	NC7-sun.wilds.per	739	0		1756	137	99	461	129	0	0
	Total:	11171	69		7294	2152	365	8826	420	210	626
McCoy	NC7-medicinals	402	1		0	0	133	133	105	0	0
	Total:	402	1		0	0	133	133	105	0	0
Millard	NC7-corn.kin	34	0		0	0	0	0	1	0	0
	NC7-maize	19687	1116		15476	2852	2731	15914	1558	877	4644
	Total:	19721	1116		15476	2852	2731	15914	1559	877	4644
Reitsma	NC7-chicory	277	234	46	3228	235	250	275	43	0	0
	NC7-cucumis.cucs	1354	0	196	163	150	1349	1350	12	150	150
	NC7-cucumis.melo	3110	0	700	395	301	3094	3095	43	301	381
	NC7-cucumis.wilds	331	5	112	0	0	297	297	1	0	1
	NC7-cucurbita	989	0	210	61	42	981	981	27	42	45
	NC7-cucurbits.misc	2	0	0	0	0	0	1	1	0	0
	NC7-daucus	1112	1	62	0	0	1068	1068	48	0	0
	NC7-ocimum	96	0	10	0	0	96	96	3	0	0
	NC7-parsnips	70	3	0	0	0	0	0	0	0	0
	Total:	7341	243	1336	3847	728	7135	7163	178	493	577
Widrlechner	NC7-mints	139	3		0	0	0	0	15	0	0
	NC7-ornamentals	1990	18		85	46	48	125	107	46	94
	Total:	2129	21		85	46	48	125	122	46	94
NCRPIS Total:		**49509**	**1531**	**1643**	**38586**	**9080**	**10781**	**39337**	**2672**	**1647**	**6214**

Year 2006 Table 5. Five-Year Summary of NCRPIS Accession Orders by Crop

CURATOR	GENUS_CROP	TIME_PERIOD	Number Orders	Number Recipients	Number Items Distributed	Number Accessions Distributed
Brenner	NC7-amaranth	01/01/2002 - 12/31/2002	35	31	301	160
		01/01/2003 - 12/31/2003	43	42	921	516
		01/01/2004 - 12/31/2004	39	37	472	352
		01/01/2005 - 12/31/2005	59	53	540	229
		01/01/2006 - 12/31/2006	59	53	3234	2634
	Total:		235	216	5468	3891
	NC7-celosia	01/01/2002 - 12/31/2002	6	6	8	6
		01/01/2003 - 12/31/2003	3	3	17	14
		01/01/2004 - 12/31/2004	4	4	5	4
		01/01/2005 - 12/31/2005	5	5	7	6
		01/01/2006 - 12/31/2006	9	8	32	22
	Total:		27	26	69	52
	NC7-echinochloa	01/01/2002 - 12/31/2002	4	4	5	5
		01/01/2003 - 12/31/2003	5	5	25	25
		01/01/2004 - 12/31/2004	7	7	31	27
		01/01/2005 - 12/31/2005	5	5	58	56
		01/01/2006 - 12/31/2006	19	16	49	24
	Total:		40	37	168	137
	NC7-grasses	01/01/2002 - 12/31/2002	1	1	1	1
		01/01/2003 - 12/31/2003	1	1	1	1
		01/01/2004 - 12/31/2004	0	0	0	0
		01/01/2005 - 12/31/2005	1	1	3	3
		01/01/2006 - 12/31/2006	7	6	9	7
	Total:		10	9	14	12
	NC7-legumes	01/01/2002 - 12/31/2002	7	5	69	50
		01/01/2003 - 12/31/2003	5	5	31	26
		01/01/2004 - 12/31/2004	3	3	83	75
		01/01/2005 - 12/31/2005	7	6	28	24
		01/01/2006 - 12/31/2006	6	6	15	11
	Total:		28	25	226	186
	NC7-melilotus	01/01/2002 - 12/31/2002	5	5	43	42
		01/01/2003 - 12/31/2003	11	10	210	197
		01/01/2004 - 12/31/2004	9	7	68	58
		01/01/2005 - 12/31/2005	16	14	83	73
		01/01/2006 - 12/31/2006	12	10	56	49
	Total:		53	46	460	419
	NC7-panicum	01/01/2002 - 12/31/2002	2	2	9	9
		01/01/2003 - 12/31/2003	7	6	719	661
		01/01/2004 - 12/31/2004	9	8	920	877
		01/01/2005 - 12/31/2005	11	11	80	68
		01/01/2006 - 12/31/2006	22	21	77	42
	Total:		51	48	1805	1657
	NC7-perilla	01/01/2002 - 12/31/2002	4	4	26	22
		01/01/2003 - 12/31/2003	7	7	56	22
		01/01/2004 - 12/31/2004	3	3	21	14
		01/01/2005 - 12/31/2005	11	11	74	22
		01/01/2006 - 12/31/2006	14	14	102	22
	Total:		39	39	279	102
	NC7-quinoa	01/01/2002 - 12/31/2002	23	22	333	161
		01/01/2003 - 12/31/2003	22	20	275	195
		01/01/2004 - 12/31/2004	19	18	98	58
		01/01/2005 - 12/31/2005	32	30	302	138
		01/01/2006 - 12/31/2006	37	31	401	196
	Total:		133	121	1409	748

	NC7-setaria	01/01/2002 - 12/31/2002	9	8	48	43
		01/01/2003 - 12/31/2003	7	7	55	50
		01/01/2004 - 12/31/2004	12	12	131	116
		01/01/2005 - 12/31/2005	10	9	150	126
		01/01/2006 - 12/31/2006	23	21	227	179
	Total:		61	57	611	514
	NC7-spinach	01/01/2002 - 12/31/2002	12	11	767	362
		01/01/2003 - 12/31/2003	14	12	321	260
		01/01/2004 - 12/31/2004	15	14	80	71
		01/01/2005 - 12/31/2005	12	12	399	370
		01/01/2006 - 12/31/2006	26	26	1619	377
	Total:		79	75	3186	1440
	NC7-umbels	01/01/2002 - 12/31/2002	21	17	294	208
		01/01/2003 - 12/31/2003	17	15	248	150
		01/01/2004 - 12/31/2004	33	32	353	193
		01/01/2005 - 12/31/2005	27	25	239	215
		01/01/2006 - 12/31/2006	37	34	190	137
	Total:		135	123	1324	903
	Brenner Total:		891	822	15019	10061
Marek	NC7-asters	01/01/2002 - 12/31/2002	7	5	14	11
		01/01/2003 - 12/31/2003	7	7	25	21
		01/01/2004 - 12/31/2004	4	4	7	6
		01/01/2005 - 12/31/2005	9	9	73	70
		01/01/2006 - 12/31/2006	14	12	61	54
	Total:		41	37	180	162
	NC7-brassica	01/01/2002 - 12/31/2002	51	47	527	361
		01/01/2003 - 12/31/2003	57	49	1562	795
		01/01/2004 - 12/31/2004	57	50	4347	1735
		01/01/2005 - 12/31/2005	56	54	1688	1286
		01/01/2006 - 12/31/2006	70	56	2532	1421
	Total:		291	256	10656	5598
	NC7-crucifers	01/01/2002 - 12/31/2002	24	23	241	212
		01/01/2003 - 12/31/2003	15	15	89	79
		01/01/2004 - 12/31/2004	31	27	1403	793
		01/01/2005 - 12/31/2005	52	48	1486	497
		01/01/2006 - 12/31/2006	34	32	358	208
	Total:		156	145	3577	1789
	NC7-crucifers.pvp	01/01/2002 - 12/31/2002	0	0	0	0
		01/01/2003 - 12/31/2003	0	0	0	0
		01/01/2004 - 12/31/2004	0	0	0	0
		01/01/2005 - 12/31/2005	0	0	0	0
		01/01/2006 - 12/31/2006	0	0	0	0
	Total:		0	0	0	0
	NC7-cuphea	01/01/2002 - 12/31/2002	10	8	247	216
		01/01/2003 - 12/31/2003	19	12	389	244
		01/01/2004 - 12/31/2004	14	10	229	180
		01/01/2005 - 12/31/2005	20	13	451	277
		01/01/2006 - 12/31/2006	21	16	337	254
	Total:		84	59	1653	1171
	NC7-euphorbia	01/01/2002 - 12/31/2002	4	4	8	6
		01/01/2003 - 12/31/2003	2	2	9	7
		01/01/2004 - 12/31/2004	1	1	3	2
		01/01/2005 - 12/31/2005	1	1	1	1
		01/01/2006 - 12/31/2006	4	4	15	13
	Total:		12	12	36	29
	NC7-flax	01/01/2002 - 12/31/2002	8	8	73	63
		01/01/2003 - 12/31/2003	6	6	96	95
		01/01/2004 - 12/31/2004	16	15	211	201
		01/01/2005 - 12/31/2005	14	14	1677	1441
		01/01/2006 - 12/31/2006	19	18	1284	1199
	Total:		63	61	3341	2999

	NC7-flax.wilds	01/01/2002 - 12/31/2002	2	2	18	12
		01/01/2003 - 12/31/2003	3	3	20	19
		01/01/2004 - 12/31/2004	6	6	69	32
		01/01/2005 - 12/31/2005	6	6	34	30
		01/01/2006 - 12/31/2006	9	9	139	66
	Total:		26	26	280	159
	NC7-sun.cults	01/01/2002 - 12/31/2002	44	36	562	422
		01/01/2003 - 12/31/2003	43	34	543	405
		01/01/2004 - 12/31/2004	38	31	310	210
		01/01/2005 - 12/31/2005	62	46	1635	789
		01/01/2006 - 12/31/2006	56	44	468	346
	Total:		243	191	3518	2172
	NC7-sun.wilds	01/01/2002 - 12/31/2002	32	20	887	650
		01/01/2003 - 12/31/2003	34	22	472	354
		01/01/2004 - 12/31/2004	44	35	549	386
		01/01/2005 - 12/31/2005	53	38	1056	783
		01/01/2006 - 12/31/2006	45	40	1072	648
	Total:		208	155	4036	2821
	Marek Total:		1124	942	27277	16900
McCoy	NC7-medicinals	01/01/2002 - 12/31/2002	22	17	207	96
		01/01/2003 - 12/31/2003	35	27	387	122
		01/01/2004 - 12/31/2004	31	29	221	112
		01/01/2005 - 12/31/2005	58	49	378	185
		01/01/2006 - 12/31/2006	42	33	321	162
	McCoy Total:		188	155	1514	677
Millard	NC7-corn.kin	01/01/2002 - 12/31/2002	5	5	16	7
		01/01/2003 - 12/31/2003	7	7	22	8
		01/01/2004 - 12/31/2004	8	8	11	6
		01/01/2005 - 12/31/2005	7	7	11	6
		01/01/2006 - 12/31/2006	16	14	34	6
	Total:		43	41	94	33
	NC7-maize	01/01/2002 - 12/31/2002	399	279	4714	2511
		01/01/2003 - 12/31/2003	226	178	2298	1475
		01/01/2004 - 12/31/2004	334	241	4473	2207
		01/01/2005 - 12/31/2005	381	275	4425	1828
		01/01/2006 - 12/31/2006	585	356	7927	2477
	Total:		1925	1329	23837	10498
	Millard Total:		1968	1370	23931	10531
Reitsma	NC7-chicory	01/01/2002 - 12/31/2002	8	8	261	134
		01/01/2003 - 12/31/2003	8	7	192	144
		01/01/2004 - 12/31/2004	5	4	45	43
		01/01/2005 - 12/31/2005	9	9	257	118
		01/01/2006 - 12/31/2006	10	9	44	38
	Total:		40	37	799	477
	NC7-cucumis	01/01/2002 - 12/31/2002	58	46	2658	1773
		01/01/2003 - 12/31/2003	46	36	1901	1391
		01/01/2004 - 12/31/2004	73	64	1393	1105
		01/01/2005 - 12/31/2005	100	89	4762	2140
		01/01/2006 - 12/31/2006	126	108	3967	2095
	Total:		403	343	14681	8504
	NC7-cucurbita	01/01/2002 - 12/31/2002	20	17	165	132
		01/01/2003 - 12/31/2003	11	11	170	150
		01/01/2004 - 12/31/2004	38	35	702	490
		01/01/2005 - 12/31/2005	51	49	1568	829
		01/01/2006 - 12/31/2006	58	52	424	300
	Total:		178	164	3029	1901

	NC7-cucurbits.misc	01/01/2002 - 12/31/2002	0	0	0	0
		01/01/2003 - 12/31/2003	1	1	1	1
		01/01/2004 - 12/31/2004	1	1	2	2
		01/01/2005 - 12/31/2005	2	2	2	1
		01/01/2006 - 12/31/2006	2	2	4	2
	Total:		6	6	9	6
	NC7-daucus	01/01/2002 - 12/31/2002	11	11	75	67
		01/01/2003 - 12/31/2003	13	12	426	294
		01/01/2004 - 12/31/2004	21	21	596	378
		01/01/2005 - 12/31/2005	23	23	491	375
		01/01/2006 - 12/31/2006	34	33	466	357
	Total:		102	100	2054	1471
	NC7-ocimum	01/01/2002 - 12/31/2002	7	7	18	16
		01/01/2003 - 12/31/2003	8	8	52	42
		01/01/2004 - 12/31/2004	22	22	235	84
		01/01/2005 - 12/31/2005	23	21	204	85
		01/01/2006 - 12/31/2006	21	21	123	69
	Total:		81	79	632	296
	NC7-parsnips	01/01/2002 - 12/31/2002	2	2	9	8
		01/01/2003 - 12/31/2003	1	1	1	1
		01/01/2004 - 12/31/2004	3	3	5	4
		01/01/2005 - 12/31/2005	1	1	1	1
		01/01/2006 - 12/31/2006	3	3	22	15
	Total:		10	10	38	29
	Reitsma Total:		820	739	21242	12684
Widrlechner	NC7-mints	01/01/2002 - 12/31/2002	4	4	22	19
		01/01/2003 - 12/31/2003	8	8	44	38
		01/01/2004 - 12/31/2004	17	16	45	28
		01/01/2005 - 12/31/2005	17	16	59	38
		01/01/2006 - 12/31/2006	19	19	55	37
	Total:		65	63	225	160
	NC7-ornamentals	01/01/2002 - 12/31/2002	54	48	340	256
		01/01/2003 - 12/31/2003	58	50	311	194
		01/01/2004 - 12/31/2004	67	65	290	213
		01/01/2005 - 12/31/2005	68	62	265	190
		01/01/2006 - 12/31/2006	89	76	436	322
	Total:		336	301	1642	1175
	Widrlechner Total:		401	364	1867	1335
NCRPIS Total:			**5392**	**4392**	**90850**	**52188**

Year 2006 Table 6. **NC7 CSREES Regional Order History**

TIME_PERIOD	Total Number of Orders	Number of Orders (DI)	Foreign Orders (DI)	Domestic Orders (DI)	Domestic Orders (DI) CSREES Regions			
					NC7	NE9	S9	W6
01/01/2006 to 12/31/2006	1507	1183	249	934	506	111	184	133
01/01/2005 to 12/31/2005	1226	929	173	756	348	77	198	133
01/01/2004 to 12/31/2004	1043	787	164	623	287	71	159	106
01/01/2003 to 12/31/2003	872	614	157	457	204	49	100	104
01/01/2002 to 12/31/2002	1032	780	171	609	304	71	133	101
01/01/2001 to 12/31/2001	862	651	166	485	241	51	91	102
01/01/2000 to 12/31/2000	782	555	150	405	209	47	74	75

Appendix Table 7: Germplasm Distributions, All NPGS, 2000-2006

SITE - Non-Genetic Stocks Collections	2000	2001	2002	2003	2004	2005	2006*	7 Yr Totals
Brownwood, TX	31	112	34	47	232	NA	NA	456
Corvallis, OR	1504	2286	2365	2211	2812	3853	3083	18114
Cotton - College Station, TX	989	869	487	3951	1671	1385	4160	13512
Davis, CA	1717	2199	2311	2060	3130	3110	4190	18717
Palmer, AK - Arctic Germplasm								
Nat. Germplasm Rep, Geneva, NY	2819	1817	3505	4824	6419	5269	9604	34257
Hilo, HI	389	399	434	530	659	489	307	3207
Mayaguez, PR	0	0	0	0	46	209	571	826
Miami, FL	260	333	318	323	669	264	458	2625
National Arboretum, Glendale, MD	244	442	243	42	149	22	NA	1142
NC-7 (Ames, IA)	12186	15211	13916	12491	18632	23817	26509	122762
NE-9 (Geneva, NY)	2632	1770	2435	1849	3722	2400	7449	22257
NR6 (Sturgeon Bay, WI)	7291	6606	4763	5340	6154	3928	3617	37699
Natl. Small Grains, Aberdeen, ID	39032	33092	14880	29435	23959	20029	24825	185252
NCGRP, Ft. Collins, CO	1651	2838	2238	2710	2228	2915	747	15327
OPGC, Columbus, OH	0	0	0	0	47	630	602	1279
Parlier, CA	0	0	0	1	268	411	501	1181
Plant Exchange Office, Beltsville, MD	3	0	0	0	0	0	0	3
Riverside, CA	554	788	496	353	343	417	NA	2951
S-9, Griffin, GA	49242	16568	29248	50950	24103	16919	18906	205936
Soybean, Urbana, IL	24511	16544	21946	16125	21871	26935	19349	147281
Tobacco, Raleigh, NC	271	559	586	1245	479	0	316	3456
W-6, Pullman, WA	24608	16823	15048	18652	18929	24319	22168	140547
Sub-Total	**169934**	**119256**	**115253**	**153139**	**136522**	**137321**	**147362**	**978787**
Site - Genetic Stocks Collections								
GSHO (Barley Gen Stocks), Aberdeen, ID	320	645	128	171	171	124	343	1902
GSPI (Pea Gen Stocks), Pullman, WA	210	38	446	46	39	17	31	827
GSTR (Wheat Gen Stocks) Aberdeen, IA	74	93	118	60	291	311	322	1269
GSZE (Maize Gen Stocks) Urbana, IL[T]	1699	3780	13167	11256	3595	2352	2582	38431
Tomato Gen Stocks, Davis, CA	4640	4684	5372	4800	4500	4447	4628	28443
Sub-Total Genetic Stocks	6943	9240	19231	16333	8596	7251	7906	70872
Total - All Types	**176877**	**128496**	**134484**	**169472**	**145118**	**144572**	**155268**	**1049659**

* As of November, 2006

[T] For 2002 and 2005, the majority of packets were due to single requests for the entire set from the Maize Gene Discovery Project.

Table 8: National Germplasm Distributions, Non-Genetic Stocks 2000 - 2006

Sites	Total # Order Pkts for Site[ŦŦ]	Distribution Packets/Plant Materials External to Germplasm Site System: Total Domestic	Domestic Regions: North Central	Northeast	South	West	APO	Total International	Total # Distributed	Percent of Total
NC7	210791	73363	31699	9806	15673	16185		43341	116704	23.0
NE9	23252	12921	2441	4738	2430	3305	7	8446	21367	4.1
S9	329699	175836	14938	9869	135167	15859	3	27397	203233	40.1
W6[Ŧ]	164829	91595	18751	7075	18988	46781		45993	137588	27.1
NR6	30071	22033	17374	1724	358	2577		7053	29086	5.7
PI Site Subtotal	758,642	375,748	85,203	33,212	172,616	84,707	10	132,230	507,978	64.4
All other sites	700,970	174,780	45,374	25,307	55,264	48,796		105,945	280,725	35.6
Grand Total	1,459,612	550,528	130,577	58,519	227,880	133,503	10	238,175	788,703	100.0
Percent of Total US Distributions		100	23.8	10.6	41.4	24.2	0.0			

[Ŧ]W6 Distributions include those conserved by Palmer, AK, Parlier, CA and Prosser, WA

[ŦŦ] This column includes distributions for internal site use; the Total # Distributed column excludes internal use.

National Germplasm Distributions, Genetic Stocks 2000 - 2006

Sites	Total #	Percent of Total
GSHO (Barley Gen Stocks), Aberdeen, ID	1902	2.5
GSPI (Pea Gen Stocks), Pullman, WA	827	1.1
GSTR (Wheat Gen Stocks) Aberdeen, IA	1269	1.6
GSZE (Maize Gen Stocks) Urbana, IL	44861	58.0
Tomato Gen Stocks, Davis, CA	28443	36.8
Gen Stocks Total	**77,302**	100.0