NCRPIS Annual Report - 2007
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NORTH CENTRAL REGIONAL PLANT INTRODUCTION STATION
NC-7 ANNUAL REPORT, JANUARY 1 - DECEMBER 31, 2007

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

Voting members

1. Illinois	T. Hymowitz	7. Missouri	S. Flint-Garcia
2. Indiana	J. Janick	8. Nebraska	G. Hergert
3. Iowa	K. Lamkey	9. N. Dakota	B. Johnson
4. Kansas	M. Stamm	10. Ohio	D. Francis
5. Michigan	A. Iezzoni	11. S. Dakota	K. Glover
6. Minnesota	J. Orf	12. Wisconsin	W. Tracy

Non-voting members

13. California-Davis	R. Karban	18. Michigan	J. Hancock
14. Connecticut	M. Brand	19. Missouri	P. Bueselinck
15. Delaware	J. Hawk	20. New Jersey	T. Molnar
16. Illinois	G. Kling	21. Texas	J. Da Silva
17. Iowa	R. Hall		

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

*Voting members

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

See organizational chart, Figure 1 in the Appendix.

III. PROGRESS OF WORK AND PRINCIPAL ACCOMPLISHMENTS:

Personnel changes - June, 2007– May, 2008:
Departures:
David Losure, ISU Agricultural Specialist, Maize; Dec. 2007
Joe-Ann McCoy, USDA-ARS Biologist/Medicinal Plant Curator; Dec. 2007

New Hires:
Trent Moore, ISU Agricultural Specialist, Maize; March, 2008

Promotions:
Pete Cyr, from a GS11 IT Specialist to a GS-12 Applications Software Dvlp. IT Specialist; May, 2008

Management of Federal STEP (Student Temporary Employees):
It was necessary to reduce student labor positions to 17 FTE in FY07 from 20 FTE in FY06 due to a combination of slightly declining budgets and rising salary and operational expenses. These STEP positions support curatorial activities including regeneration, seed processing, viability testing, farm and facilities operations, and IT support. Students were interviewed and selected by ISU Program Manager Larry Lockhart, ARS maize technician Matt Lively, 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 Specialists Lynnette Richey and Kim Grandon.

Construction and Facilities:
Considerable sweat equity was invested in the land previously used by the ISU Student Organic Farm in order to support its use for NCRPIS activities. Greenhouse #3 benefited from significant efforts to renovate its evaporative cooler, replace its emergency generator panel, and install landscape fabric over its gravel floor. The fabric helps control insect populations and aids in the removal of dirt and plant debris. A condensation problem in the GEM Project seed storage cooler was resolved with the application of an icynene coating to its roof. Environmental monitoring was installed in the server room which will notify three individuals (in succession) if temps rise; this enables better protection of our server infrastructure and Access Security System.

Equipment:
New farm operations equipment increased our capacity to support pumpkin regenerations, plantings for the two maize projects, maintenance of woody ornamental plantings, the entomology staff's efforts to supply pollinators to the regeneration cages, and general regeneration activities. See Farm section for more detail.

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

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

Acquisition and Documentation Highlights:
In 2007, (Table 1) 450 accessions were acquired, which is nearly 1% of the previous collection holdings. This compared with 650 new accessions in 2006, 282 in 2005 and 450 in 2004. These include new *Melilotus* from Kyrgyzstan; North American *Fraxinus*; 124 maize lines including 63 from the Australian germplasm system; *Helianthus* from Spain, Australia and the southwestern US, including a *H. ciliaris* accession from the White Sands Missile Range; *Camelina sativa* from Slovenia; medicinal plants, *Cucumis*, and *Daucus* from the Republic of Georgia; and *Cucumis* from China and *Daucus* from Tunisia, as well as many species from the U.S.

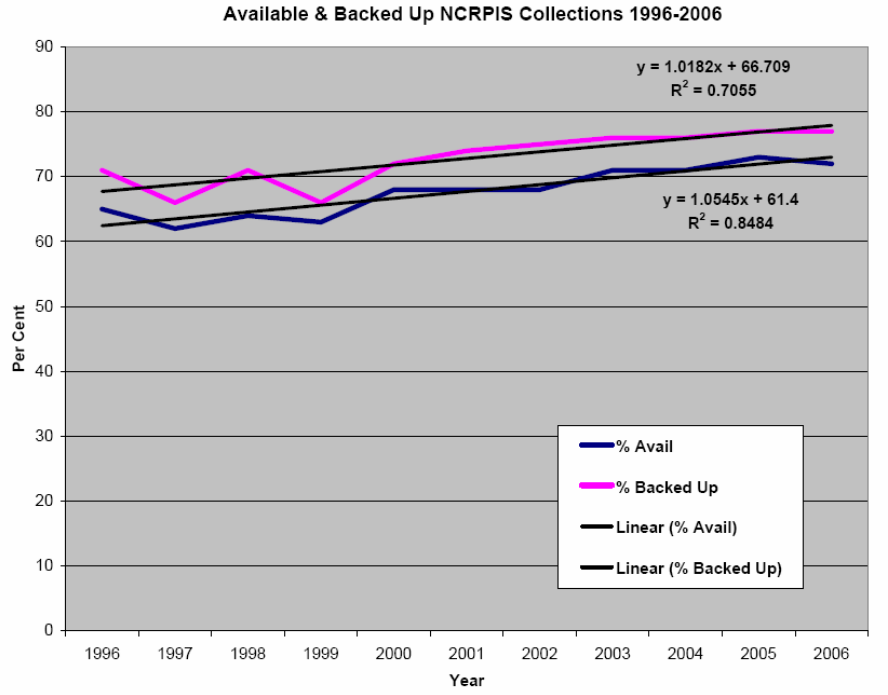
Of ongoing concern is the successful entry of germplasm collected from international explorations into the U.S. Chinese *Fraxinus* germplasm was destroyed upon entry to the U.S. by APHIS officials due to contamination with insects and disease. It is critical that clean, pest- and pathogen-free seed be shipped or carried in by collectors; sufficient time needs to be devoted to collection sample preparation and sufficient care post-collection.

The excellent quantities of seed provided by collectors for many new accessions has made a significant proportion available and distributable immediately.

Over 2,580 accessions were assigned PI numbers in 2007, the highest number of assignments in the past 12 years. This focus will continue in 2008. Taxonomic re-identification was completed for 187 accessions. Sixty seven were nominated for inactivation, 17 of these due to duplication. R. Stebbins continues to enter old passport information from logbooks for early Ames-numbered accessions, a project that is now 60% complete. Georeferencing of the wild Helianthus collection was completed by R. Beyer and L. Marek.

Original seed samples continue to be scanned by L. Pfiffner and L. Burke, in order to provide useful visual references for comparison of regeneration lots with original samples.

Regeneration and Maintenance Highlights:
In 2007, 1,204 accessions were grown for regeneration and 1,048 harvested, including those grown in previous years and harvested in 2007. An additional 122 perennials are growing in permanent plantings. Over 1,400 accessions were made available to the public. About 2,970 accessions were backed up at the NCGRP in Ft. Collins, CO; this compared with 880 in 2006; 79% of the NCRPIS collections are backed up (Table 2). Overall collection available is holding at 73%, as in 2006, despite 1% growth in collection size.



Substantial gains were made in availability of the chicory, wild flax and mint collections (Table 1). Regeneration methods for *Setaria sphacelata* were modified; literature indicates this species should be grown in isolation.

Assistance in regeneration was provided by USDA-ARS staff of Parlier, CA; Mayaguez, PR; the St. Croix quarantine nursery staff supported regeneration of 126 maize accessions. Dr. Matt Krakowsky (ARS, Tifton, GA) increased several older public Georgia lines which have been difficult to increase in Ames. A winter nursery was grown by Hawaii Seed Research on the island of Kauai.

In addition to the *Daucus* regenerations grown in Ames, seed increases were received from R. Maxwell, Seminis Vegetable Seeds, ID, and R. Freeman, Nunhems, OR. Dr. Freeman and Dr. Maxwell were sent additional PI-numbered accessions, respectively, for regeneration in 2008.

Distribution:
2007 external distributions included 22,261 items of 10,328 unique accessions to fulfill 1,138 orders from 813 individuals. This compares with the record high (2006) of 26,100 items of 13,789 accessions. Approximately 35% were distributed internationally, and 65% were to domestic researchers (Table 3A). The relative numbers of distributions generally correlate well with the proportional makeup of the collections.

Curator	Collection Size - 2007	% of Total Collections	% of 2007 Ext. Distributions
Brenner	8771	17.6	12.1
Marek	11290	22.6	24.7
McCoy	446	0.9	1.6
Millard	19928	39.9	40
Reitsma	7371	14.7	20.2
Widrlechner	2165	4.3	1.4
Totals	**49971**	**100**	**100**

Some trends of interest in our distributions include high demand for *Aronia* – its fruit has high antioxidant concentrations, and is used in juices and foods for human consumption. More maize was distributed in 2007 than in 2006 (12.2%), and in 2006 than in 2005 (80%). Research on biofuel applications and health and nutrition contribute to a portion of these increases. Maize distributions were made for several disease screens, including *Aspergillus,* Northern Corn Leaf Blight, and diplodia ear rot resistance, and also for quality trait evaluations using NIRS (near infra red spectroscopy). *Echinacea* and *Prunella* plant materials were provided for NIH-funded research on botanical dietary supplements at ISU.

The largest Helianthus distribution in 2007 was for an evaluation of wild *H. annuus* for naturally occurring herbicide tolerance. Germplasm demand for germplasm for evaluation of disease and insect tolerance continue to account for a significant portion of *Helianthus* distributions. Researchers have also requested germplasm for studies on genetic control of flowering time, photoperiod regulation, and for biomass production.

The largest single Brassicaceae distribution was sent to Australia for disease resistance and aluminum tolerance evaluation.

NPGS curators at all sites continue to receive many requests from individuals not affiliated with research institutions, generally for home gardening. Although our resources cannot support maintaining and distributing the collections to home gardeners, we have tried to inform these requestors about plant genetic resource conservation, and to encourage interested individuals to save seeds, conserve and share germplasm and associated information. Home gardeners are generally redirected to other sources of commercially available materials.

Evaluation and Characterization:
In 2007, the NCRPIS utilized 6,566 accessions for observation, evaluation and characterization for a wide array of descriptor information. About 35,140 observations were entered in the GRIN database (http://www.ars.grin.gov/npgs/). Images added to GRIN for the year number 1785 (Table 4).

The amaranth project (Brenner & Flomo) loaded over 13,150 descriptor notes, includ*ing the Coriandrum* data provided by Dr. Pedro Lopez' dissertation research, and *Amaranthus* data. The oilseed project (Marek, Larsen, Bingaman) loaded over

7900 notes. The maize project (Millard, Lively Losure) loaded over 13,000 observations. The vegetable project's (Reitsma, Clark) *Daucus* and *Cichorium* evaluation projects have generated large descriptor datasets.

Information technology and telecommunications:
The NCRPIS has been called upon to provide expertise and leadership for the development of GRIN-Global (the successor to the GRIN system); this has become the primary focus of two NCRPIS staff members. This project is undertaken as a partnership between USDA-ARS, Bioversity and the Global Crop Diversity Trust (the Trust). The Trust secured a significant Gates Foundation Grant to develop a genebank information management system which can be deployed to any genebank in the world. The basic GRIN database schema is recognized as essential to preserve; improved interfaces and views are required to support the needs of genebank curatorial personnel and external, public users of information associated with the collections. The source code for the products of development will be freely available. The system will be able to function on either networked systems or stand-alone PCs, and will be free of recurring licensing costs.

Pete Cyr, the NCRPIS' Applications Software Development IT Specialist, serves as the Project Manager. Mark Millard, the NCRPIS Maize Curator, serves as the Business Analyst. Mark has long provided leadership in the development and enhancement of GRIN functionality.

Together with the staff of the USDA-ARS Database Management Unit (DBMU), Beltsville, MD, who are responsible for the current GRIN system, representatives of seed- and clonally-propagated NPGS sites, and our international partners, they are working to accomplish project objectives within tight timelines. U.S. curators are to test a prototype system in late 2008-2009. International genebank personnel will test a release candidate in 2009. Work on the new public GRIN interface will begin in 2009, with deployment anticipated in late 2010.

Please see IT section for reports on support activities.

Germplasm's Viability and Health:
Over 2,860, or 6%, or the NCRPIS collections were tested for viability in 2007. This included 4% of the collections managed by D. Brenner, 6% of the oilseeds, 13% of the medicinal plants, 5% of the maize, and 11% of the vegetable collections (Table 2). Viability testing methods were compared for *Echinochloa*. Comparative testing of seeds from primary, secondary and tertiary umbels of *Daucus* was conducted (Kovach). The germination lab (Erickson) also provided support for a seed-longevity study focused on *Cucurbita* and *Daucus*.

Use of a thermal gradient table has enabled D. Kovach to conduct a series of experiments comparing controlled temperature, light and humidity conditions to establish appropriate seed germination testing protocols for various crops.

Pathologist C. Block, together with the entomology and vegetable project team members, surveyed the attractiveness of several squash varieties to cucumber

beetles, a vector of squash mosaic virus (SQMV). They evaluated their effectiveness as a 'trap crop' in order to reduce beetle feeding on caged Cucurbita.

C. Block evaluated maize accessions for resistance to Stewart's wilt, and continued a collaborative research project with Iowa State Univ. (ISU) Seed Science Center personnel on development of real time PCR assays for detection of *Pantoea stewartii* and *Stenocarpella diplodia* from maize seed. Block and VanRoekel monitored and tested cucurbit seedlings for *Acidovorax avenae* subsp. *citrulli* infection; they monitored all seedlings for SQMV infection using ELISA testing.

Insect management:
Entomologists S. Hanlin and S. McClurg supplied 809 accessions in 832 cages with six types of pollinator insects in 2007. Please see their section of the annual report for information on their continuing efforts to enhance the pollination program's effectiveness and efficiency.

The staff is comparing use of solid 'fondant' sugar with corn syrup for feeding the honey bees. Experiments to identify a method to encourage pollinator movement throughout the large Cucurbita cages, frequently inhibited by dense foliage, continue.

Hanlin, McClurg and the curatorial projects used the originally released version of the Pocket Pollinator software application in 2007 to initiate and manage pollinator requests for regeneration cages. An enhanced version will be used in 2008.

Enhancement:
The Germplasm Enhancement of Maize Project, or GEM, continues to work with public and private collaborators to adapt exotic maize germplasm to broaden the genetic diversity of temperate U.S. maize production and provide unique, key priority traits. The Project released 21 S3 lines in 2007; for the period 2001-2007, 173 lines have been released. Research and breeding is designed to identify traits and genes to support improvement of agronomic productivity, disease resistance, insect resistance, and value-added grain characteristics, including total extractable starch to support ethanol production, and resistant starch – of importance to human health and nutrition.

D. Brenner continues to pursue development of ornamental *Amaranthus tricolor* resistant to *Phomopsis amaranticola*. He is also evaluating outcrossing of grain amaranth cultivars with weedy amaranth species in cooperation with other researchers.

Outreach and Scholarship:
Approximately 400 visitors toured the NCRPIS during 2007. 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:
Processes involved in regeneration, characterization, and making viable germplasm available are labor intensive. Currently, resources do not allow maintenance and regeneration efforts to keep pace with demand. We will continue to try to improve conservation methods to better use the resources available to us, and to develop labor and resource saving technologies.

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 need to be enhanced; wise selection of targets for these efforts requires use of complex and varied sources of information. 2008 collection expeditions are planned to acquire *Helianthus* from the Midwest and mid-south, *Fraxinus* from Illinois, Missouri and Iowa; wild spinach relatives from the High Plains; and *Chenopodium* and *Amaranthus* from Texas.

Better characterization information is essential to enable well-target use of the collections, especially given the increasing constraints of limited research and conservation resources. Collaboration between vegetable curation staff at the NCRPIS and ARS researchers in Wisconsin will focus on *Daucus* characterization and taxonomy. Oilseeds curation staff will increase the Thlaspi and Camelina collections in order to better support biofuel researchers.

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. The project is rapidly approaching completion, as the datasets and graphic presentations are completed for Alaska. 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. Hiring a new medicinal plants curator will be a high priority in 2008.

Efforts to characterize the Southwestern U.S. maize landraces were completed; data entry to GRIN and publication of thesis findings are anticipated in 2008.

Real-time PCR analytic methods will continue to be evaluated and modified by Pathologist Charlie 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 for the next three years will center on the development of the successor to the GRIN system, GRIN-Global - its schema, internal and public interfaces. These efforts will be facilitated by contributions from germplasm stakeholders in the U.S. and abroad, as we seek examples of use cases and desired features and functionalities of the new system.

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. has resulted in synergy which facilitates 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.

Work of NC-7 participants, from the CRIS reporting system:
CA – Richard Karban reported on experimental results designed to identify plant traits associated with resistance against feeding by herbivores under field conditions. Valley oaks were used as a model system to examine the relationship between several leaf traits and herbivory. The leaf toughness trait best predicted levels of leaf damage for the 60 species evaluated. Native species to the central California valley area were more heavily damaged than introduced species. Research was conducted to determine whether volatile cues emitted by clipped sagebrush signal neighboring plants to become more resistant to herbivores, and the mechanisms involved. His lab found that volatile cues allowed branches to coordinate their defenses. Volatile cues were found to inhibit germination of competitors, but not sagebrush seeds. Sagebrush populations were found to be genetically structured such that neighbors are more likely to be related to each other than non-neighbors.

DE – Jim Hawk reported on use of tropical maize germplasm accessions for development of maize germplasm with improved agronomic performance, enhanced disease and pest resistance, and improved grain quality traits. High performing lines were identified that were derived from Cuba164 and DKXL212. A number of doubled haploid lines were generated from three GEM breeding crosses; three of these lines have shown higher yield/moisture performance in hybrids compared to lines developed through conventional breeding methods.

IA – Kendall Lamkey and other researchers at ISU are utilizing maize germplasm for trait improvement, population development, lignocellulosic research, and for research aimed at unraveling the basis of heterosis. Richard Hall continues to utilize poplar germplasm for development of populations with increased biomass production for energy use.

IN – Jules Janick reported that apple frost tolerance to apple was evaluated in 2006 and 2007, and three varieties demonstrated reasonable tolerance to frost, as determined by the quantity and quality of apple crop. Wild arugula accessions were selected for late blooming. A method was developed to induce flowering in the field for *Artemisia annua*, the source of artemisinin, a drug for malaria, by controlling daylength. Scholarly studies were completed on analysis of ancient images and texts of Solanaceae and Cucurbitaceae.

IL – Theodore Hymowitz reported that germplasm of more than 19 genera of wild perennial species of the genus *Glycine* have been collected and preserved, and characterized for potential use in improving the domestic cultivated soybean. Sources of resistance have been identified for soybean cyst nematode, white mold, sudden death syndrome, soybean rust, bean pod mottle virus, and other economically important pathogens. Development of a bibliographic database for the wild perennial *Glycine* species continues.

KS – Mike Stamm reported that accessions of winter and spring *Brassica napus* from the NCRPIS collection have been vital in expanding the germplasm base needed to develop canola-quality cultivars adapted to the southern Great Plains. These resources provide genes which can be effectively used for continual cultivar improvement. Over 500 accessions have been evaluated in the past five years, and will continue to be evaluated across a wider range of environments over the coming years, with a focus on the southern part of the region where canola production is rapidly increasing. KS7436, a 2006 release, was developed using NPGS germplasm. It has higher oil content than most commercially available, open-pollinated cultivars. The southern Great Plains has the potential to become the largest canola producing area in the U.S., given cultivars with enhanced yield potential, winter survival ability, drought and heat tolerance, and oil quality needed to support acreage expansion. Increased canola production would support the livestock feeding industry, biodiesel use, and food oil.

MI – The Michigan and U.S. sour cherry industry has historically relied on a 400 year old cultivar, Montmorency, which has multiple trait improvement needs. Amy Iezzoni and colleagues reported on efforts to breed sour cherry cultivars that have stable resistance to cherry leaf spot (CLS), a major goal for the MSU sour cherry breeding program, through combining multiple resistance genes in a single cultivar. They have identified resistance to CLS in two wild species, *Prunus canescens* and *P. maackii*, where fungal growth was abnormal and sporulation did not occur. Efforts also focus on selection of sweet cherry dwarfing rootstocks for evaluation, in order to improve production and reduce costs associated with large tree size, pruning and hand harvesting.

J. Hancock and Iezzoni reported on breeding to minimize the potential for freeze injury to tart cherry flowers by developing late-blooming cultivars with increased pistil hardiness. The collections of late-blooming cherry germplasm assembled at Michigan State University and the NPGS can support these objectives; additional germplasm is sought. Efforts to general a whole new generation of high quality blueberries and strawberry cultivars with minimum pesticide requirements also continue. New northern highbush blueberry hybrids have been distributed to

testing partners that cover a broad range of seasons and have high fruit quality. Hancock and Lewers are working to generate a linkage map using SSR markers and traits of horticultural importance for strawberry, using wild and cultivate *Fragraria* germplasm from North and South America.

MN – James Orf reported on efforts using comparative genomic tools and legume plant genetic resources to characterize of the evolution of disease resistance genes, and extending this knowledge through development of resistant germplasm. Significant diversity exists, as determined by examining the sequence variation of two resistance genes in detail on soybean chromosome 'F,' where multiple resistance specificities have been mapped, including a cloned resistance gene to bacterial blight (Rpg1), using dozens of different soybean cultivars. Comparative genomic analysis will provide insight into how legumes generate disease resistance diversity, and the mechanisms used by plants to defend themselves and recognize novel pathogens.

ND – Burton Johnson reported on 10 breeding projects at NDSU, nine in agronomic crops. ND crop production includes cereals, barley, oats, spring & durum wheats, corn, soybean, dry edible beans, sunflower, flax, crambe, potato, pulse crops and canola. Cool season oilseed crop production research in ND and the adjoining region is very important. Alternative crops research in ND would include sunflower, dry bean, borage and Cuphea (which are both semi-domesticated), spearmint, and winter annual crops such as camelina, canola (1 M acres in ND), and peas. Camelina (40,000 ac in ND in 2007) may end up being more economically productive as there were essentially no weed control costs. A useful source of biofuels information is http://www.biodiesel.org/. Dakota Skies and ADM will use canola in their biofuel production plants.

NE – Gary Hergert reported on testing of winter wheat, canola, and several alternate crops in western Nebraska, including camelina, proso millet, sunflower and forage pea. A new wheat variety, NE01643, is ready for release. Variety test information for all crops can be found on the University of Nebraska web site, http://varietytest.unl.edu/index.html. Low water use crops are needed for the High Plains; bird seed production now occupies about one-third of the Nebraska Panhandle dry land acres, with proso millet being the primary bird seed grain produced. Niger seed and canary grass also have potential high impact for the bird seed market. Oilseeds such as canola, camelina and sunflower can produce high quality food oils, serve as sources for biodiesel production, and lend themselves to the dry production conditions. Pulse crop plant introductions are being evaluated for production traits, disease tolerance, seed size and color. A graduate student is completing work with Leadplant, *Amorpha canescens*, a deep-rooted perennial of the bean family that nitrifies the soil and grows in a wide range of conditions.

OH – David Francis reported on tomato breeding efforts at The Ohio State University OARDC for cultivar development for Midwestern U.S. processing industry. The researchers demonstrated that it will be feasible to develop DNA-based molecular markers for application to domesticated germplasm conservation and management (http://www.tomatomap.net) and for the manipulation of consumer traits. A Mediterranean tomato accession was identified as a unique genetic

resource relative to North American heirloom tomatoes and modern fresh market and processing varieties.

WI – Bill Tracy devoted effort to the understanding the genetic basis of development of durable resistance to common rust in sweet corn, from early vegetative stages through the reproductive and maturation adult phases, in order to support development of durable resistance. His team, in collaboration with other researchers, is also studying the genetics and biochemistry of the smooth versus wrinkled phenotype, genetic of traits for weed competitiveness, and effects of recurrent selection of sweet corn germplasm for germination under cold conditions. Use of highland exotic germplasm has led to improvement of various parameters related to germination. News sources of disease resistance may be useful to commercial breeders in diversifying their germplasm and improving stability of disease resistance.

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 of 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 2007 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.
- Collections of microorganisms that act as symbionts or as plant pathogens need to be appropriately preserved and available for research use. The USDA, APS and CDC need to communicate and coordinate efforts to ensure these collections are developed and maintained.
- Insufficient numbers of individuals are being trained in plant breeding and genetics, plant pathology, entomology, and related disciplines to meet current and future US needs; this is of serious concern.
- Imaging methods used for herbarium specimens should be studied and implemented as appropriate by the NCRPIS and more broadly, by the NPGS.

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 19.0 FTE's. We coordinated and completed facility construction and upgrades.

Labor:
During 2007, 38 applications for hourly employment were received and reviewed. There were 24 interviews, resulting in 21 new or returning hourly employees hired. Currently there are 39 Biological Science Aides (15.5 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.
Scott McCubbin (STEP) shared with vegetable and pollination projects.

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 gates for shadehouses.
2. Lined Compost Wagon with poly.
3. Renovated GH3 evaporative cooler.
4. Replaced Emergency Generator Panel GH3.
5. Designed and Installed HQ Sign.
6. Installed landscape fabric on floor of GH3.
7. Installed windows in Seed Picking and Breakroom doors.
8. Coordinated GEM Cooler roof coating with Icynene.
9. Installed temperature alarm in server room.
10. Removed greenhouse and cleaned up former organic farm building area so planting areas for ornamental projects could be established.

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. 95 Hp Tractor (JD 6430)
2. Three vehicles
3. Pumpkin cage frames
4. Ice Machine
5. Roto-tiller
6. Lawn Tractor
7. Root lifter/digger
8. Water tank and trailer
9. Three Utility Vehicles
10. 55 Hp tractor and loader

Tours:
This past year, we organized and conducted 14 tours. There were approximately 387 visitors to the NCRPIS during 2007

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

Larry Lockhart attended the University of Arizona Controlled Environment Agriculture Course and is currently participating in ISU 12+ Supervisory Leadership Class.

B. Information Technology and Telecommunications (P. Cyr)

Pete Cyr was assisted in IT duties by one part-time student hired in May of 2007. The following list outlines the progress made by the IT team during FY 2007 at NCRPIS.

Equipment:
As of December 2007 NCRPIS has 70 workstations installed for use by permanent staff members and part-time temporary student help. There were 14 new workstations deployed in 2007 to replace aging equipment on curatorial staff desktops. 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.

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.

During 2007 all workstations and servers at NCRPIS received security updates from Microsoft on the second Tuesday of the month. PatchLink software is the standardized solution for patch management in ARS and was used for tracking and updated non-Microsoft software installed on the workstations and servers.

In 2007 NCRPIS upgraded several administrative workstations with standard USDA/ARS software packages including ARIS, CATS and PCMS.

All computer systems on campus and at the farm (servers and workstations) use Symantec Anti-Virus Corporate Edition for virus protection.

Modified and enhanced the software system used to upload accession images to GRIN so that this software could be deployed to other NPGS sites. This image loading software has greatly assisted the curators in removing backlogs of archived accession images that needed to be loaded to the GRIN system.

Enhanced and deployed a new version of the PDA based software used to collect inventory actions for accessions grown in the field. The inventory action data stored on the PDA out in the field is automatically uploaded to the GRIN system when the PDA is docked to the workstation in the office.

Enhanced and deployed new version(s) of the PDA based software used to track and manage pollinator requests in the field. The pollinator requests are automatically uploaded and stored on the GRIN NC7 table space so that they can be queried for enhanced insect inventory management and annual reporting of pollinator requests by accession/crop. Curators use this PDA based system to create requests and Entomologist use the PDA software to track request changes and manage insect inventory demands.

Developed, tested and deployed the 1)Planting Report, 2) the 1-Year Report, and 3) the 5-Year Report web-based data entry forms that are used to collect data about accessions under study as part of the NC7 Woody Ornamental Trials. These forms are the core of a publicly accessible website used to capture data from participating cooperators at specifically scheduled times.

Maintained and enhanced the local intranet website used by NCRPIS for dissemination of group information. Assisted D. Kovach in development and maintenance of web pages located on the consolidated ARS website.

Migrated all NCRPIS email users to the new Microsoft Exchange 2003 email server located in Ft. Collins CO.

Documentation:
Updated user documentation for the GRIN Image Loader and distributed it to NPGS sites that are learning to use the NC7 mass image loader for uploading images to the GRIN system.

Posted staff meeting, committee meeting minutes, farm operation, safety, and health information to the NCRPIS intranet website.

Plans for 2008:
Continue to replace NCRPIS workstations on an as needed basis (targeting a 3-5 year lifespan for daily use workstations).

Upgrade the Symantec anti-virus software used to protect the servers and workstations at NCRPIS.

Continue development of the APR website and deploy to a publicly accessible web server so that seed requestors can provide NC7 with feedback about quality and value of the accessions provided to them.

Enhance the GRIN image loader software to accommodate new tab-delimited barcodes used at the NC7 site.

Continue to develop, test and deploy applications to be installed and used on the PDAs. These applications will be designed to assist curators in collecting and analyzing field 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 end of second quarter of 2007.

Enhancement to GRIN: A recommendation from the NP301 review is to upgrade and improve the GRIN database system. The USDA-ARS NPGS was approached by the Global Crop Diversity Trust last year to form a partnership with the Trust and Bioversity International to not only enhance GRIN, but to develop a new version, dubbed "GRIN-Global," that could be implemented worldwide, even on individual personal computers in developing nations. Leadership and software development for this project is coming from NC7, with additional software development and database management coming from the DBMU in Beltsville. In 2008 a Technical Steering Group will provide stakeholders a mechanism for delivering project feedback. Also in 2008, we will develop the internal system specifications for GRIN-Global client interface, enhance the database schema, migrate the current Oracle database to the MySQL and Microsoft SQL Server database platforms, and design, develop and test the prototype client interface for the new GRIN-Global system.

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

Seed Research:
Based on meetings with curators initiated in 2006, a seed viability research plan was proposed and prioritized for the coming years. In general, investigations into promoting germination of highly dormant seed lots and those of low viability were given priority. In 2007, David Kovach investigated short-term inhibition of germination to allow for cellular repair in insecticide-damaged maize seed. Results to date have not been positive; other treatments, successful in *Zizania*, are planned. He also experimented with heat treatments in wild *Spinacia* seed. Short-term heat treatments (4 days @ 50° C) promoted slightly earlier germination for one accession, but had no effect on another; more work on this species is planned.

An experiment was conducted to determine the optimal temperature range for *Daucus* seed germination and attempts were made to induce development of immature embryos. Literature suggests that immature embryos are the cause of low viability in *Daucus* that are harvested from secondary and tertiary umbels. Preliminary tests conducted by Maria Erickson in 2007 indicated that seeds harvested in 2006 from secondary and tertiary umbels germinated at rates at least 20% lower than those from primary umbels. Experiments are planned to look at embryo development in relation to the flower position.

David learned that *Daucus* seeds germinated well across a fairly wide range of temperatures (alternating temperatures of 10/15 to 30/35° C) given a test of sufficient duration. Embryo development was not induced under typical germination moisture conditions; high-humidity conditions will be tested next. He also sequentially harvested *Daucus* seeds one month apart from the same accessions to determine maturity effects on viability; most of these seeds have been cleaned and will be tested in 2008.

Calendula seeds from three accessions were harvested by the Horticulture crew. These samples will be stored at 4 and 23° C and tested over time to track dormancy release (after-ripening). Four accessions of *Echinochloa* seeds were tested for germination over a range of temperatures (alternating temperatures of 5/10 to 25/30° C), with and without fluorescent light. Results indicated a need for light at the higher temperatures. Lower temperatures acted as a cold-stratification treatment and promoted germination when seeds were transferred to 20/25° C after 5/10° C. A follow-up study of 16 accessions indicated that light promoted germination in all but one of the accessions. This is in contrast to the 'relaxed' requirements of the Association of Official Seed Analysts (AOSA) rules, which do not require light. One accession of *Echinochloa* was highly dormant and is the subject of further investigations.

In 2007 a thermal gradient germination table (TGT) was purchased and set up in the Entomology Building, which met the space requirements for this equipment. Special leveling jacks, voltage-surge protection, and lightning protection were added to the unit for personnel and equipment safety. Temperature indicators on the unit

were tested against thermometers to ensure indicators' accuracy. Several germination experiments have been conducted on the TGT that have demonstrated the value of this equipment.

Understanding the dynamics of viability loss can help determine regeneration and viability-testing needs, allowing for the more efficient management of labor and physical resources. Expanding upon earlier work to document after-ripening and seed longevity in *Calendula*, David assisted Mark Widrlechner by calculating seed-longevity statistics with varying parameters and calculated quadratic regression equations in relation to changes in seed germination over time for major crops held at the NCRPIS. Together, during the coming year, David and Mark plan to consult with Dr. Philip Dixon, ISU Department of Statistics, to develop better descriptive and predictive models for viability loss over time that can be built from existing seed-longevity data.

Germination Testing:
During 2007, Maria Erickson and her crew continued to fill seed-germination orders, conduct germination tests on more than 2,800 accessions (see Table 2), and help curators germinate seeds for regeneration. The number of accessions tested in 2007 increased for the amaranth (+210) and vegetable (+453) projects over that of 2006. The number of accessions tested for the oilseed, medicinal, maize, and ornamental projects decreased from the previous year (-1369), resulting in a net decrease of 706 total accessions from testing in 2006.

In addition to routine germination tests, Maria carried out targeted germination tests for Ames-numbered accessions of *Amaranthus* (139), *Melilotus* (74), asters (73), crucifers (105), *Cichorium* (146), *Cucumis sativus* (13), *Cucumis melo* (119), wild *Cucumis* (16), and *Daucus* (66) to facilitate PI-number assignment. She conducted germination tests on *Echinochloa* to compare light versus dark and water versus 0.1% potassium nitrate solution, as well as comparative germination tests of seeds from the primary, secondary and tertiary umbels of *Daucus* (see Seed Research above). Maria also conducted germination tests of older samples (≈10 years) of *Cucurbita* and *Daucus* to provide additional data for a seed-longevity study coordinated by Mark Widrlechner.

Computer Application Development and Graphics Support:
In 2007, David programmed computer application forms and reports to retrieve data from the GRIN Database, and used statistical software packages to run descriptive statistics and determine regressions for the seed longevity studies described in the Seed Research section. He also developed a form to locate and remove duplicate viability records from the GRIN database in preparation for this work. David created new Oracle tables, forms, reports, and specialized coding for performing calculations when fields contained characters for standardized Tab-delimited Code 128 barcode labels and tags.

David continued to serve station needs by providing AutoCAD drawings and large-format printing for professional posters and local use. A new, large-format cutter and stand to trim posters was obtained.

Internet website related:
In 2007, David enhanced the appearance of the station's home page (http://www.ars.usda.gov/mwa/ames/ncrpis) on the USDA Consolidated Website. Spotlights on germplasm collection trips, Native American Outreach, and the Genetic Enhancement of Maize (GEM) project were the main foci of changes. The web pages providing further information on collection trips and GEM were expanded with more information and photos. The Ames Area Civil Rights website (http://www.ars.usda.gov//Main/site_main.htm?docid=8446) was regularly updated with information provided by the NCRPIS Civil Rights Committee representative. This included regular observance information, changes in personnel, and the posting of committee meeting minutes in pdf format.

Cooperative efforts:
In 2007, David provided statistics for the station and for personnel needs. This included detailing distribution information for multi-genus site crops. Other statistical information was extracted periodically from the GRIN database for the Station's research leader, Candice Gardner. One such statistical capture looked at the National Plant Germplasm System's service to its cooperators as a whole and by individual Plant Introduction Stations, as measured by distribution numbers.

David designed the layout for a new version of the station brochure (initially for 9 × 16" standard print-shop size), then modified and redesigned it for in-house printing on 8½ × 14" paper. The brochure design was reviewed by curators, staff, and the research leader. Ideas were incorporated into the new design. These brochures were used at the International Insect Pollination Symposium (held in Ames) and station tours, and included in seed orders to new cooperators.

Training:
Maria Erickson attended the Association of Official Seed Analysts - Society of Commercial Seed Technologists (AOSA-SCST) Annual Meeting from June 4-11 in Cody, Wyoming. She attended two workshops: Tetrazolium (TZ) Testing and Native Species Seed Quality, both of which provided Maria with additional knowledge applicable to the NCRPIS. She became a member of the TZ Testing Committee. She also attended the Seed Testing Rules Session. Maria attended several sessions describing the planned merger of the Certified Seed Analysts and the Registered Seed Technologists within the AOSA-SCST consolidation plan.

<u>D. Kovach and M. Erickson:</u>
USDA Computer Security Awareness Training, USDA Privacy Basics Training, Civil Rights: Recognizing and Preventing Reprisal, Civil Rights: Reasonable Accommodation, ISU Discrimination and Harassment Training, and ARS Conflict Resolution Training with Pat Frick.

<u>D. Kovach:</u>
Chemical Hygiene and Fume Hood Safety from ISU Environmental Health and Safety.

<u>M. Erickson:</u>
Online Chemical Hygiene training from ISU Environmental Health and Safety.

Plans for 2008:
Seed research projects are planned for the coming year based on consultation with Mark Widrlechner and curatorial teams. And as noted under Seed Research above, David and Mark will be collaborating with Dr. Philip Dixon and his graduate student, Allan Trapp, ISU Statistics, on more accurate ways to describe viability change over time and develop models to predict seed longevity.

David plans to attend a seed physiology conference during 2008, possibly the C04 Seed Physiology, Production and Technology section of the ASA-CSSA-SSSA Meetings in Houston, TX. Maria will attend the AOSA-SCST Annual Meeting in Saint Paul, MN.

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

Acquisition:
The North Central Regional Plant Introduction Station (NCRPIS) acquired 397 new accessions in 2007. Of these new accessions, 316 were received from within the National Plant Germplasm System (NPGS) through exploration and transfer. This included 95 accessions of wild *Helianthus* from collection trips in the southwestern United States and Australia, 67 accessions of ornamentals, 37 accessions of medicinals from collection trips conducted by NCRPIS personnel, and 32 accessions of *Daucus*.

The remaining 81 accessions, received from outside the NPGS, included 44 accessions of *Zea*.

As new accessions are recorded in the Germplasm Resources Information Network (GRIN) database, 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, 187 accessions received taxonomic re-identifications. Among these were 61 accessions of *Daucus* and 25 accessions of *Amaranthus*. Also, 67 accessions were nominated for inactivation, including 27 accessions of ornamentals and 17 accessions of *Daucus*. Seventeen of these were inactivated due to duplication. The inventory lots of these accessions were combined with the lots of their respective duplicates.

Additionally, 2,587 accessions were assigned PI numbers, the highest number of assignments in the past 12 years. Included in this group were 810 accessions of *Helianthus* and 638 accessions of *Zea*.

Rachael Beyer completed processing the Major Goodman maize racial collection in 2007, with 690 inventory lots completed. She added inventory information, secondary identifiers and accession actions to the GRIN database and placed the samples into storage in the -20˚F freezer.

Projects:
Robert worked with M. Widrlechner to prepare 115 accessions of mints and ornamentals for PI-number assignment. Any errors in GRIN were corrected, and reports were printed for a final check before requesting PI numbers.

In addition, Robert continued to enter old passport information from logbooks for early Ames-numbered accessions. This long-term project is now 60% complete. During the course of this project, duplicate accessions and missing GRIN records were encountered and corrected.

Robert reformatted the habitat records for all NCRPIS accessions which included legal descriptions (i.e. township, range, section) in the locality. 239 accessions were updated to a uniform format.

Robert revised the instructions for processing duplicate accessions, inactivation of accessions, and PI number assignment. These instructions were updated to correspond with the newest version of GRIN.

Rachael completed a georeferencing project for oilseeds curator, L. Marek. She entered latitude and longitude coordinates based on geographical descriptors, as well as county information, for 1820 wild *Helianthus* accessions. She also assisted M. Widrlechner by plotting geographic coordinates from ash seed collections on Google Earth.

In 2007, Rachael began a project updating the library database. She verified database contents along with 1016 book locations and entered publication dates.

Rachael worked on several health and safety areas. She assisted project manager L. Lockhart by updating all staff safety training records, revised the farm's Emergency Procedures booklet, updated the Health & Safety cabinet – making sure all supplies were well stocked and not expired, ensured all staff and student emergency contact information was current, and completed CPR/AED and First Aid training. Together with Lisa Pfiffner, she updated First Aid kits in all farm buildings and vehicles.

Rachael completed several short-term projects. On behalf of C. Gardner, she compiled all FY 2007 expenditures from CATS for a budget review. On behalf of D. Brenner, she translated Latin passages from a Russian seed-exchange list. She assisted Marci Bushman with the development of a PowerPoint presentation on time and attendance for new-student orientation. On behalf of M. Widrlechner, she acted as recording secretary for two Hardiness Zone Map Technical Review Team teleconferences.

Rachael served on the selection committee for the new half-time, term Computer Assistant, Jesse Perrett. She also served as NCRPIS' Combined Federal Campaign canvasser.

Conclusions:
Compared to 2006, new accessions received at NCRPIS were down by 226 in 2007. Among the maintenance areas, re-identifications were up by 76%, nominations to the inactive file were down by 88%, PI number assignments were up by 3175%, and duplications were up by 89% compared to the previous year.

All figures for acquisitions and maintenance were below the 12-year average with the exception of PI-number assignments, which were far above average. This reflects the increased time and effort given to assigning permanent PI numbers to all suitable accessions in the NCRPIS collection.

E. Order processing (R. Stebbins)

During 2007, there were 1,612 orders entered into GRIN. These orders led to the external distribution of 22,261 items (primarily seed packets, but also vegetative samples) (Table 3A). Of these, 14,494 items (65%) were distributed within the United States, and 7,767 (35%) were sent to foreign requestors. Additionally, 12,692 items (Table 3B) were distributed within the NCRPIS, for such uses as regeneration, evaluation, and germination and disease testing.

The number of orders entered into GRIN in 2007 was 3% less than that of 2006; also, the number of items distributed was down by 3,839 or 15%. The number of requests received electronically this year was 1,208, a decrease of 3% from 2006.

At C. Gardner's direction, additional depth in support of germplasm distributions was developed. 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, and methods for US Mail and FedEx shipping, internal filing, and the processing of 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. L. Pfiffner continued to serve as the federal supervisor for several of the crews led by state supervisors.

In 2007, we stored 1,969 inventory lots, including 292 original seed lots, 236 non-Ames increase lots, 1,373 Ames increase lots and 38 check lots. During storage, 204 lots were bulked with previously regenerated samples to create 155 new bulked lots. Of those, 149 became available for distribution. Of all stored lots, 1,049 lots were made available for distribution. We split 72 original lots to make them available for distribution in limited quantities. We reviewed 3,897 inventory lots for seed

quantity, and any discrepancies were corrected in the GRIN database. 1,645 samples were prepared and transferred to a -20C freezer for long-term storage. Of these, 1,476 were maize inventory lots donated by Major Goodman in 2004. Under our supervision, R. Beyer completed this project in 2007 by entering the remaining 1,476 samples into the GRIN database and placing them into the -20C freezer. The data she entered included inventory actions, on-hand amounts, freezer location and secondary identifiers.

In 2007, 187 accessions received taxonomic re-identification. We re-labeled the 416 seed samples affected and filed the pertinent documentation. In addition, seed samples of 47 inactivated accessions were removed from the active collection and placed in inactive storage. We also re-labeled 6321 seed lots associated with the assignment of 2,587 new PI numbers, and then corrected cold-storage locations to reflect the change in numbering.

We filled 1229 seed orders in 2007, including those for distribution, observation, germination, transfer and backup. There were 1245 lots 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 29,523 packets (the majority filled by seed storage personnel) to meet distribution and observation requests. Of these, 21,734 were distributed domestically and 7789 outside of the US. We transferred 37 inventory lots to other NPGS sites. To fill gaps in viability data, we initiated 8 germination orders.

2007 saw the continuation of the prepacking program. With the aid of our student worker, we prepacked 16,927 packets of 1327 inventory lots. A large portion of the prepacking program focused on the expired PVP maize accessions received at NC7. Most of these accessions are in high demand as soon as received. Prior to regeneration, the distribution lots (original seed) are prepacked at 15 seeds per prepack. Once the accession has been successfully regenerated, standard distribution amounts are prepacked from the new source. In 2007, we received 21 expired maize PVP accessions, which in turn were distributed as 583 order items in 86 orders. In 2008, PVPs will expire for 30+ accessions.

With the impending opening of the Arctic Seed Vault in February of 2008, we prepared 2,052 accessions for backup there. Each sitecrop was reviewed for newer, good-quality distribution lots, and 22 orders were created Sample amounts ranged from 200 to 800 seeds depending on the amount of seed needed for two regenerations. Packets were filled and orders were sent to NCGRP for repackaging and consolidated shipment.

Another project started in 2007 was the creation of orders for NIR analyses of maize samples by Linda Pollak's and Sue Duvick's lab. Seed samples previously sent to R. Bergquist in 2000 and then returned to NC7 were scanned and bulk loaded to create orders in GRIN. To date, 13 orders have been created involving 6,226 items, and 4,981 samples have been provided to the Pollak lab for analysis.

Seed storage personnel continued to maintain the germplasm distribution display in the farm headquarters hallway. New maps were printed at the start of 2007, and national and international distribution destinations were noted.

Scanning of original seed samples continues. In 2007, 313 scans were taken, mostly of original samples. Some of the samples were new to the station while others were of samples being pulled for regeneration when the entire sample was needed. Creating a visual reference of seed lots that have been used up for planting is important for comparison with the increase lots by curators and storage personnel.

In the summer of 2007, the station hosted four Native American interns, and assigned them to various projects. In seed storage, the students worked on two software programs used to extract plant and seed measurements from images. Students scanned images and measured samples physically and via use of newly acquired software, Winfolia, to evaluate its applicability to NC7 needs.

Training:
L. Burke:
Blood Borne Pathogen re-certification, CPR and First Aid training recertification

L. Burke and L. Pfiffner:
USDA Computer Security Awareness Training, USDA Privacy Basics, Civil Rights: Recognizing and Preventing Reprisal, Civil Rights: Reasonable Accommodation, ISU Discrimination and Harassment Training, and ARS Conflict Resolution Training with Pat Frick.

VII. CURATORIAL AND SCIENTIFIC TEAM REPORTS

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

Progress:
Caged pollination:
Bee pollinators (minus the alfalfa leafcutting bee) were supplied to 507 cages for controlled pollination of 374 accessions.

Honey bee pollination (Hanlin):
Honey bees were used to pollinate 297 accessions in the field and 12 accessions in the greenhouse. Bees pollinated 107 accessions of *Helianthus* (106 accessions in the field and one accession in the greenhouse), 14 accessions of *Cuphea*, five accessions of *Vernonia,* 65 accessions of Cucumis (56 accessions in the field and nine accessions in the greenhouse), 39 accessions of *Daucus*, three accessions of Cucurbita, nine accessions of *Echinacea*, 15 accessions of *Actaea*, four accessions of *Ligustrum*, five accessions of *Physocarpus*, eight miscellaneous ornamentals/medicinal in the field and one accession in the greenhouse, 31 accessions of *Melilotus*, and one accession of miscellaneous umbels.

The 101 parent colonies of honey bees (127 double-story nucleus colonies and 29 single story nucleus colonies) over-wintered in the indoor wintering facility with a survival rate of 73% for the parent colonies and 22% for the nucleus colonies, lower than last year's 86% and 52%. We left 16 strong, three-story parent colonies in the field, placing them into groups of four and wrapping each group with tar paper (30 pound); their survival rate was 50%. Because of heavy snow in late November 2007, it was necessary to leave 16 two-story parent colonies and 35 double story nucleus hives outside in a well protected yard. The outside hives were placed in groups of three and each group was wrapped with tar paper. All queens to be used for queen rearing will be selected in the spring of 2008 from resilient parent colonies.

To prepare for spring 2007 cage pollinations, we purchased 50 "Buckfast" queens. We made 50 nucleus hives with two frames of brood and three frames of adhering bees in each nuc. Each nuc then received a caged queen 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. Approximately 20 single story nucs were unused in the spring and were made into double story nucleus hives which were used throughout the summer to make additional nucs for cages.

Fifty "Buckfast" three pound packages were purchased and placed into full size hives in late spring 2007. We collected two local swarms; these were made into colonies and were included in our nucleus hive production throughout the summer.

Queen rearing throughout the summer 2007 produced an average of 55 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.

In early August, 37 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.

Half of all parent and double story nucleus hives were sampled in early August for mites; populations ranged from 0 to 31 mites per approximately 100 bees and an average of 17 mites per 100 bees. Because of the wide variation in and relatively low mite numbers, no hives were treated fall 2007. In the spring of 2008 all overwintered colonies and nucs will be tested and if mites are found, infested hives will be treated. Mite populations in fall 2007 were determined using only the "powder sugar roll," where 1 tablespoon of powdered sugar is placed in a jar with 100 bees randomly sampled from the hive. In the spring this method will be combined with the use of the "sticky board" method to determine mite populations. The "sticky board" method consists of placing a specially designed vegetable oil-covered plywood board on the bottom board, placing a single mite strip into the middle of the brood frames and after 24 hours, counting all mites which drop and adhere to the board. The spring treatment will use one of two types of mite strips which contain either coumaphos or thymol as the active ingredient. If sampling determines that a mite treatment is needed in the fall of 2008, the organic based Thymol mitecide Apiguard® will be used (last used in 2006).

All parent colonies and nucleus hives to be over-wintered were provided 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 summer of 2007, 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 cooler temperatures during the winter of 2007/2008, the "environmental control method" was used to our advantage; an exterior door was opened on colder days, allowing the room temperature to drop, thus killing the moth larvae.

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. Because we received a new supply of high fructose corn syrup in March, we did not have a crystallizing problem during the summer and did not use the submersible heater. During the winter, syrup was circulated daily for 15 minutes; in the spring, the heater is returned to the tank to prevent crystallization.

Bombus pollination (Hanlin):
Twenty-one "research" colonies of *Bombus impatiens* were ordered throughout the spring/summer of 2007 from a commercial supplier. *Bombus* colonies were used to pollinate twenty- eight field cages. One *Bombus* colony is used for pollinating more than one cage with a minimum lapse of 48 hours between the two locations to prevent contamination. Bees pollinated six accessions of *Caragana*; two accessions of *Staphylea*; two accessions of Diervilla*;* one accession of *Symphytum;* eight accessions of *Helianthus* and two accessions of Cucurbita.

We continued to use the 60-quart protective plastic containers to house/protect hives while in field cages. The plastic container and hive are placed on a stand consisting of a hive body and lid with two water-filled quart containers placed on either side of the hive to prevent the wind from blowing the container and hive off of the stand.

Osmia cornifrons/*O. lignaria* pollination (Hanlin):
Osmia were used to pollinate a total of 67 field cages and one greenhouse cage or 44 accessions. Bees pollinated 27 accessions of *Brassica*, seven accessions of *Linum*; three accessions of *Eruca*, three accessions of *Sinapis*; one accession of Biscutella; one accession of *Camelina*; one accession of *Melilotus* and one accession of *Monarda* (greenhouse).

Approximately 7,483 bees were used to fill 210 domiciles in 2007. The number of domiciles used in cages in 2007 was 68. We collected approximately 1,750 bees in 2007 for use in the spring of 2008, about 67 bees higher than 2006 as a result of a wetter/cooler spring and more accurate timing of domicile placement and the blooming of target plants. 5,000 bees will need to be purchased in 2008.

We continued to use a handheld GPS unit when placing "increase" domiciles in the spring; the coordinates for each domicile were recorded and in the summer the

handheld was used again to accurately locate each domicile. All domiciles were located this year, however since a different GPS setting was used in the spring than in the summer, we could not locate all domiciles immediately.

For the Des Moines Water Works Park "increase" location, a standardized aerial map was used for the second year to plot all domicile locations and in the summer to locate the domiciles when they were retrieved.

To prevent the discarding of unused bees, 30 "pollination" domiciles were placed at one of two field locations at the station in early June. Wild osmia bees or emerging bees could procreate in the domiciles and these "increases" could be used for pollination in 2008.

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 91 greenhouse and field cages containing 104 accessions of 20 genera in 2007. Flies were used to pollinate 14 accessions of 6 genera in 14 cages (4 greenhouse and 10 field) for Horticulture, including *Ampelopsis, Calendula, Euonymus, Matricaria, Parthenocissus, Tanacetum*; 33 accessions of 10 genera in 15 greenhouse cages for Brassica-Oilseeds, including *Biscutella, Brassica, Crambe, Erysimum, Hesperis, Isatis, Lepidium, Linum, Matthiola*, and *Sinapis*; 6 accessions of 2 genera in 6 field cages for Miscellaneous Umbels, including *Coriandrum* and *Setaria*; 48 accessions of 1 genus (*Daucus*) with 7 species or subspecies in 53 cages (7 greenhouse and 46 field) for Vegetables; and 3 accessions of 1 genus (*Hypericum*) in 3 greenhouse cages for Medicinals.

Fly pollinations were begun 1 Jan 2007 and carried through until 31 Dec 2007 with the exception of the month of October, when no flies were requested by curatorial staff. The first delivery to a field cage was 7 May 2007 and the field season ended for flies 29 September 2007; 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 fall seasons (June through December). The grand total of fly deliveries in 2007 was 1162 cartons. During the winter/spring there were anywhere from 5 to 25 active cages in the greenhouses. This total jumped to 52 cages in both field and greenhouse in mid-June with a peak of 61 cages in July mostly in the field. Cage numbers dropped to 35 in early September and we finished the field season at the end of September with 4 cages. Only 1 to 2 cages were active in the greenhouses in November – December 2007.

Both blue bottle flies and houseflies were delivered to greenhouse and field cages from January through 31 August 2007; the distribution of blue bottle flies continued through 29 September 2007. Blue bottle flies only were utilized in November-December 2007 due to the crops in season.

We continue to use purchased fly pupae and are very satisfied with the vendors we have established business with in the past few years. Blue bottle fly pupae are shipped either every other week (summer) or every three weeks (winter - spring) from Forked Tree Ranch in Porthill, ID. Housefly pupae are shipped weekly year round from Beneficial Insectary in Redding, CA.

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 336 greenhouse and field cages containing 331 accessions of 32 genera in all of 2007. ALC were used to pollinate: 28 accessions of 13 genera in 29 cages (5 greenhouse and 24 field) for Horticulture including *Ampelopsis, Calendula, Cornus, Dasiphora, Euonymus, Hyssopus, Malva, Monarda, Parthenocissus, Potentilla, Sanvitalia, Spiraea, Tanacetum*; 83 accessions of 11 genera in 76 cages (11 greenhouse and 65 field) for Brassica-Oilseeds including *Biscutella, Brassica, Crambe, Eruca, Erysimum, Hesperis, Isatis, Lepidium, Linum, Matthiola, Sinapis*; 7 accessions of two genera in 8 field cages for Miscellaneous Umbels including *Coriandrum* and *Melilotus*; 115 accessions of 3 genera in 122 cages (20 greenhouse and 102 field) for Vegetables including *Cucumis, Daucus, Ocimum*; 98 accessions of 3 genera in 101 field cages for Sunflower-Oilseeds including *Cuphea, Helianthus, Vernonia*.

ALC pollinations started 11 January 2007 and ended 9 November 2007 with no stop in deliveries during that time period. The first field delivery of ALC was 11 May 2007 and field deliveries continued until 12 October 2007 when it became too chilly during the daytime for ALC to move much inside of field cages; the very early and late calendar ALC deliveries were to greenhouse cages. ALC were used later in the field season in 2007 than in prior years as they were requested by the Sunflower project to supplement honey bees in the late-blooming wild-type *Helianthus* field cages. A larger number of ALC were used in Brassica cages in 2007 as well since the curator was satisfied with the results of bee activity and seed set in the 2006 field cages, where ALC were added to supplement Osmia and honey bees on a trial basis.

ALC were re-introduced to cages on an "as-needed" basis (ranging from twice weekly to once every several weeks) after surveying for activity from bees of prior releases. Cages with formal curator requests for ALC were checked for re-supply needs weekly; informally requested cages (e.g. Vegetable project requests that ALC be added to all flowering *Daucus* and *Cucumis* cages as the excess supply of ALC bees allows) or those McClurg started at her own discretion were checked on a rotating basis after the formally requested cages had been supplied with bees. The grand total number of ALC deliveries in 2007 was 1224. During the winter-spring of 2007 ca 20 cages were supplied at least weekly in the greenhouses; the peak number of active cages for 2007 summer deliveries ranged from 149 to 179 in August through September. Some of these cages received only a single delivery of bees.

We received very high quality ALC leaf cells from our primary supplier (JWM, Idaho) in January 2007. No parasitic wasps emerged from these cells this year; we were able to emerge healthy active bees from these cells through 31 December 2007. Due to this success and issues associated with orders from other suppliers for use in

winter greenhouse cages, we have decided to use ALC cells from JWM only starting in 2009. Our ability to supply ALC bees during the early part of the new year for greenhouse cages will depend on the quality of cells received for the prior year (i.e. how long bees will emerge from the old cells) and the arrival date of the new cells for the coming year (which may be shipped anywhere from January – March).

We did not make any changes in ALC handling/distribution protocols during the majority of 2007. During fall 2007, McClurg began researching containers to replace the pint glass jars used for incubation of cells; her goal was to build or find a non-breakable container that could fit inside the large emergence boxes so the cells/bees would not need handling again once placed into those containers. As of December 2007, she had begun to adapt some plastic food containers with screened inserts to serve as incubation containers.

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

Pollination Improvement:

Pollinator Request Database and Pocket Pollinator:

Beginning in January 2007, we asked curators to submit all of their pollinator requests via the web interface that had been initially introduced during the 2006 field season. These requests are now maintained in the local pollinator request database. We began checking the database at regular intervals to obtain current insect pollination requests via SQL queries embedded in an Excel workbook.

In mid-April 2007 we were presented with the initial version of Pocket Pollinator, a program developed by P. Cyr for use on handheld computers; it is designed to a) simplify the process of curators submitting pollinator requests and entomologists tracking the dates that insects were delivered to or removed from cages, and b) to support development of a rich database of pollinator records linked to the relative success of regeneration efforts and seedlot quality. The program uses the inventory database lotcode (IVP, IVNO, IVS, IVT) of currently growing accessions to identify the physical location of the accession (Farmfield, Loclow). Accession data can be entered into Pocket Pollinator either by scanning barcodes on cage labels or by typing data into the keyboard of the handheld. Other data is entered from pull-down menus in the program. In order to update work records registered in the program by entomologists or submit new requests by curators, the handheld devices are docked to a desktop computer or utilize a wireless connection in the main building; "synchronizing with GRIN" uploads the newly created or modified data to the pollinator request database.

From April through July, 2007 nine updates to the initial version of Pocket Pollinator (versions 1.0 to 2.0) were created and tested, based on user feedback to Cyr. These updates corrected or enhanced operations, safeguarded data entry, and increased program effectiveness for data collection and entry. Hanlin primarily tracks insect in and out dates for all new curator requests. McClurg relies on the program to maintain an accurate listing of all the "ongoing" active ALC bee and fly cages in addition to being alerted to new requests, and to accurately record all actual

fly and ALC bee deliveries to cages. There were some challenges to overcome based on different protocols employed by curatorial projects, primarily dealing with lot codes and cage numbering systems. Another issue during the 2007 field season was dealing with program recognition and record handling of accessions which started regeneration as Ames numbers and were then assigned PI numbers during or after the growing season.

When curatorial staff had technical problems with the web interface, their handheld devices, or the Pocket Pollinator program, we gave guidance and support as we were able and referred problems beyond our realm of expertise to P. Cyr and J. Perrett.

In late October 2007, we reviewed requested changes with P. Cyr to determined other desired programming changes which are anticipated in early 2008.

McClurg learned to write SQL queries as embedded in an Excel workbook in order to sort and analyze the pollinator request database records. She also learned the basics of Access and its' query function in order to edit the pollinator request database records. McClurg assists Hanlin with queries and data correction as needed.

This entire system works best for the entomologists when the curatorial staff applies exterior labels to their cages. This was widely practiced during the 2007 field season, however improvements in attaching the labels to cage screens and having labels actually on the screens before insects are delivered are needed in the future.

Honey bees:
For the third year, an electric fence was placed at the NADC location prior to moving bees into the bee yard. The fenced in area was approximately 50' X 25' and was set up as a deterrent for raccoons knocking off feed buckets and opening weaker nucleus hives to feed on honey frames.

A power washer was used for cleaning "dirty" queen excluders in the fall. In the past excluders were either hand scraped or dipped into 25 gallon garbage cans of hot water and cleaned with a brush. Both of these methods can cause damage to the excluders and allow the queens to be able to move through the excluder. The power washer method seemed to remove all of the wax and other bee materials with minimal labor and did not appear to damage the excluder.

As suggested by the Dutch beekeepers who visited the station in June 2007, fondant sugar or "baker's sugar" was tested as a possible alternative food source to the high fructose sugar syrup which is presently being used as bee feed. For the month of September, 15 nucleus hives caged with sunflowers were given one of three treatments, 1) mesh bagged powdered fondant sugar suspended in a protective holder above the nuc, 2) meshed bagged powdered fondant sugar placed directly in the feed hole, and 3) non-bagged solid fondant sugar placed directly in the feed hole. Observations were made tri-weekly and the amount of fondant used and the bee feeding activity was recorded. The treatment which the bees used the quickest was the solid fondant, while the bees did not use the suspended powdered fondant at all. The solid fondant would last approximately two weeks before a new piece needed to

be added, and the bagged powdered fondant placed in the hive needed to be replaced every three weeks. Based on these findings, we plan to continue this study in the spring/summer 2008 using only the solid fondant sugar while comparing costs between fondant and the sugar syrup, and the time and labor involved.

We wish to improve the insect pollination of cucurbits that are being grown in very large (20' x 40') field cages. Many of these accessions have extensive vining habits and large leaves; the resulting thick foliage inside the cages seems to discourage or inhibit insect pollinator movement throughout the cage, as poor fruit set often results. During summer of 2007, in cooperation with K. Reitsma and L. Clark of the vegetable project, we compared the pollination efficiency of honey bees to *Bombus,* and elevated vs. ground placement of insect colonies in cages of two cucurbit accessions. The honey bee treatments were as follows: 1) single nucs placed only at north end of cage per normal protocol and half of the cages having these nucs positioned on the ground while the other half of the cages had nucs raised on a hive body/lid; 2) double nuc treatment had a nuc placed at both the north and south ends of the cage, with half of the cages having raised nucs and the other half with nucs on the ground. The *Bombus* treatment was a single colony placed either at the north or the south end of the cage; all *Bombus* colonies were raised off the ground since we had limited resources available (cages, land, *Bombus* colonies). Observations were made to assess bee flight and fruit production during the summer. Entomology staff observed greater bee flight for both insect species in 2007 compared to previous years. Vegetable staff noted limited fruit production with very few fruit produced in one of the two accessions; it should be noted that the accessions being grown are considered "hard to handle" and in need of seed increase. Pollinations seem to have been more fruitful along the sides and fronts of the cages where vegetation was less dense.

Contacts/Cooperation:
The entomology staff assisted several individuals with protocols or pollinator contact information throughout 2007. Pete Gilberton, a graduate student at NDSU, requested information on the use of honey bees and bumble bees as pollinators of Cuphea. Eric Mader of Midori Horticulture Services of Madison, WI requested our protocols for handling and rearing blue bottle fly and housefly. Tim Kornder, a commercial vegetable producer from Belle Plain, MN also requested housefly rearing protocols. Craig Abel (USDA-ARS) at Stoneville, MS requested contact information for local suppliers of bumble bees and honey bees; he also exchanged 30 "drawn" comb for "foundation frames" to use in his honey bee research. Susan Stieve of the Ornamental Plant Germplasm Center in Columbus, OH requested our alfalfa leafcutting bee protocols.

In April, the entomology staff assisted Nathan Brockman (Entomologist at Reiman Gardens, Ames, IA) with the "Bee-Aware" display. The staff supplied Mr. Brockman with pollinator equipment, samples of domiciles and other bee equipment used at the station, an observation hive and a copy of the history of insect pollinator use at the NCRPIS poster. This poster was adapted from that made for the RTAC/PGOC tour at the station in June 2006.

This summer the entomology staff assisted Dr.Reid Palmer (USDA, ARS) by suppling domiciles and emerged alfalfa leafcutting bees for pollination of an experimental plot near Mead, NE. This research was a continuation of cooperative work done with R. Palmer and his graduate students based on pollination research of male sterile lines of soybeans using alfalfa leafcutting bees and honey bees.

From June 5 to July 27, the entomology staff co-mentored two Native American interns, Robert Shelltrack and Jordan Shelltrack, who were at Iowa State University under the auspices of the George Washington Carver internship program. The first three weeks in June, the interns worked with the staff to get acquainted with the pollinators used at the station and the work done to supply the pollinators to curatorial staff. The remaining time, Jordan Shelltrack observed and compared honey bee and alfalfa leafcutting bee pollination activity in pre-selected cages and accessions as a research study; he presented his findings to the other students and mentors in the Carver program via a poster and oral presentation at the end of July.

This fall the entomology staff visited with Ann Perry (writer) and Peggy Greb (photographer) for an article being written about the NCRPIS pollinators for the ARS news magazine. The article is to be published in spring 2008.

Presentations:
On May 9, S. Hanlin was invited to present to approximately 200 sixth graders at the Squirrel Hollow Nature Center "outdoor classroom" in Jefferson IA. The hands on presentation was based on general honey bee facts, the equipment used in beekeeping and a short introduction to the other pollinators used at NCRPIS.

On June 28 and 29, the entomology staff was shadowed by three Dutch beekeepers. The beekeepers had been participants at the 9th International Pollination Symposium and were interested in U.S. beekeeping techniques such as queen rearing, feeding and honey production. In addition to working with the honey bees, they were also shown and assisted with the handling of the flies and the alfalfa leafcutting bees.

Publications/Posters:
Novel Use of Alfalfa Leafcutting Bees (Megachile rotundata) for Plant Genetic Resource Conservation. Hanlin, S.J., McClurg, S.G., Gardner, C.A. Abstract and poster In: C.A.C. Gardner, M.A. Harris, R.W. Hellmich, H.T. Horner, J.D. Nason, R.G. Palmer, J.J. Tabke, R.W. Thornburg, and M.P. Widrlechner, eds. (2007) 9th International Pollination Symposium on Plant-Pollinator Relationships – Diversity in Action: Program and Abstracts. Iowa State University, Ames, IA, USA. Pp 140-141.

Insect Pollination at North Central Regional Plant Introduction Station – Past and Present. Hanlin, S.J., McClurg, S.G., Gardner, C.A. Abstract and poster In: C.A.C. Gardner, M.A. Harris, R.W. Hellmich, H.T. Horner, J.D. Nason, R.G. Palmer, J.J. Tabke, R.W. Thornburg, and M.P. Widrlechner, eds. (2007) 9th International Pollination Symposium on Plant-Pollinator Relationships – Diversity in Action: Program and Abstracts. Iowa State University, Ames, IA, USA. Pp 142-143.

This poster was also displayed at the International Plant Propagators Society in Montreal August 2007.

Regeneration of Self-Compatible Pimpinella Plants Benefits from the Addition of Fly Pollinators. Reitsma, K.R., Clark, L.C., McClurg, S.G., Hanlin, S.J., Brenner, D.M., Widrlechner, M.P. Abstract and poster In: C.A.C. Gardner, M.A. Harris, R.W. Hellmich, H.T. Horner, J.D. Nason, R.G. Palmer, J.J. Tabke, R.W. Thornburg, and M.P. Widrlechner, eds. (2007) 9th International Pollination Symposium on Plant-Pollinator Relationships – Diversity in Action: Program and Abstracts. Iowa State University, Ames, IA, USA. Pp 144-145.

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)

Plans for 2008:
In the past, any Brassica/miscellaneous oilseed cages containing Osmia bees in the spring that needed further pollination after June were supplied with honey bees. During the summer of 2007, no cages had Osmia replaced by honey bees; rather alfalfa leafcutting bees (ALC) were placed in these cages in addition to the Osmia bees and were observed by entomology staff for their efficiency in pollinating the plants. In most cases, bees of both types were observed on the flowers in these cages as was true when ALC were first placed in Brassica field cages in 2006. In 2008, all requested Brassica/miscellaneous oilseed cages will utilize Osmia in the spring and any further summer pollination will likely be completed by the alfalfa leafcutting bee. A replicated field study to compare/confirm the effectiveness of the ALC bee following Osmia as opposed to honey bees following Osmia is planned for 2008.

The Fondant sugar feeding study (September 2007) will be followed by a more in-depth study to test results of feeding solid fondant sugar vs. high fructose corn syrup, and related costs. The focus for the research this summer will be a cost comparison study rather than a fondant form comparison. The study will look at overall cost per nucleus hive, use efficiency, storage by the bees and the labor costs of each feed type.

In a continuing study to encourage pollinator activity throughout the large *Cucurbita* cages, we will try to find a method that allows easier flight of the pollinators (Bombus and honey bees) through the thick foliage and vines found in these cages. This summer's focus is to design a protective structure for the insect colonies which will both elevate them from the ground and prevent the colony from becoming obstructed by vines; the design will need to allow for free bee flight in and out of the colony as well as provide ready access for monitoring and feeding the bees. Fruit set in cages with protected colonies vs. non-protected bees will be compared.

We will provide feedback on revised versions of the "Pocket Pollinator" handheld computer program which records pollinator actions as the work is performed by entomology staff and allows for more simple submission of pollinator requests.

Summary of Pollinators supplied to regeneration cages in 2007

Number of Unique ACCESSIONS per pollinator

	Honeybee	Bombus	Osmia	Flies	ALC	TOTAL
Amaranth/Mis Umb	35	0	1	6	7	49
Brassica	0	0	42	33	83	158
Horticulture	16	11	1	14	28	70
Medicinals	24	0	0	3	0	27
Sunflower	126	8	0	0	98	232
Vegetable	108	2	0	48	115	273
OVERALL	**309**	**21**	**44**	**104**	**331**	**809**

Number of TOTAL CAGES per pollinator

	Honeybee	Bombus	Osmia	Flies	ALC	TOTAL
Amaranth/Mis Umb	63	0	2	6	8	79
Brassica	0	0	65	15	76	156
Horticulture	16	12	1	14	29	72
Medicinals	26	0	0	3	0	29
Sunflower	163	8	0	0	101	272
Vegetable	144	8	0	53	122	327
OVERALL	**412**	**28**	**68**	**91**	**336**	**935**

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

Progress:

Pest investigations and control:

Cucumber beetles can serve as vectors of plant disease when they feed on the plant parts that extend through or are pushed up next to the screens of the cucurbit increase cages. Together with the Vegetable curation team (K. Reitsma and L. Clark) and Plant Pathologist C. Block, use of a field trap crop to aid in reducing the presence of cucumber beetles on cucurbit cages was evaluated during the summer of 2007. The Vegetable team direct seeded on three planting dates ca three weeks apart and maintained the plot, Block surveyed for disease and general success of the planting, while I monitored the beetle population in the trap area vs. the Cucurbita cage area.

We selected several commercial cucurbit varieties thought to be attractive to cucumber beetles to test in the trap crop, grown in a large open plot near the Cucurbita increase cages. Included in the trap crop were several varieties of squash ("Blue Hubbard"* and "Ambercup"), a zucchini ("Elite"* which has a very dark fruit

color), a mini-pumpkin ("Baby Boo") and a wild-type cucurbit (Ames 26894* *Cucurbita pepo texana*) from the PI collection which appeared very attractive to the beetles in previous years. Of the three primary varieties (* above) grown in this plot, the "Blue Hubbard" squash lived up to its' reputation as attractive to the cucumber beetles. Per field observations by Block and McClurg, there was always a large population of beetles (both spotted and striped cucumber beetles as well as rootworm beetles) on this variety, no matter how far away the plantings were from the Cucurbita cages. The zucchini variety was fairly attractive also, but may have exhibited some disease problems and was not as vigorous as the squash. Although the wild-type cucurbit was still somewhat attractive to the beetles, its' very slow growth habit and tiny flowers made it a less effective plant to include in the trap crop. Per beetle counts by Block and McClurg, more beetles were always present in the trap crop area no matter what plant variety was being assessed, than were present on the Cucurbita cage screens monitored at the same time. It thus seems very beneficial to include a trap crop planting near the cucurbit cages to reduce the beetle population on cages.

The large open plot design seemed to work well in 2007, as did the three sequential planting dates; there were blooms present in the trap area from the time the first planting was established until the end of the field season and these blooms always held a greater number of beetles than were counted on the nearby cage screens. Future trap crop plot designs need to account for field maintenance needs while continuing to draw the beetles away from the cucurbit cages. I recommend continuing to include several varieties in the trap crop in order to ensure continuous blooming within the trap area throughout the field season; "Blue Hubbard" squash is strongly recommended as the mainstay of the trap by C. Block. Another zucchini variety (more disease resistant) and a pie-type pumpkin may also be appropriate choices according to various tests of trap crops used to protect open commercial plantings. Periodic chemical applications to the trap crop plants in order to control the beetle population may be advisable.

Contacts:
Several NCRPIS staff members requested assistance with insect pest identification during fall of 2007, including larvae feeding on amaranth roots which were sent to the Systematic Entomology Laboratory (SEL) in Beltsville, MD for David Brenner, and information on Ash Seed Weevil obtained for Jeff Carstens. In addition, I responded to a request for pest identification on amaranth from a high school student from Prescott, AZ.

Plans for 2008:
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 also continue to offer support to all NCRPIS and GEM project personnel when insect pest identification/information is needed, and to process, archive and make data publicly available from past host plant resistance evaluations as requested by curators.

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

Research Notes:

Maize (*Zea mays)*:

One hundred and thirty-two (132) inbred maize accessions were evaluated for Stewart's wilt (*Pantoea stewartii*) resistance. The five most-resistant accessions, with average scores of 1.6 or lower on a 1-9 scale, were Ames 25559 (H60, a top five repeat from 2006), Ames 26791 (H55, a top five repeat from 2006), NSL 67786 (Mo301AE), CIze 317 (CI 317B) and PI 558533 (Mo21R, a top five repeat from 2006). We conducted an initial test of 40 Stewart's wilt-resistant inbreds for resistance to northern leaf blight (races O and 1). Results were inconclusive due to low disease intensity.

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 and B. Van Roekel continued evaluations for resistance to Sclerotinia stalk rot in wild sunflowers, with co-investigators Dr. Tom Gulya at Fargo, ND and Dr. Laura Marek at Ames. Greenhouse screening protocols were improved and 61 wild accessions were evaluated across 12 sunflower species and subspecies. Promising resistance was identified in *Helianthus argophyllus*, *H. debilis*, and the perennial species *H. resinosus*.

Disease observations on seed increase crops:

Field observations for plant diseases were made in the seed increase plots of maize, cucurbits, sunflower, Brassica, and carrots. The pathology team inspected plots or cages of more than 700 accessions and conducted over 5,000 plant and seed health lab tests.

Corn (*Zea mays*):

The maize seed increase plots (472 entries) were surveyed during August for the presence of Stewart's wilt, common rust, common smut, gray leaf spot, and northern leaf blight. Stewart's wilt, which is the main disease of phytosanitary concern, was scarce and found in very few plots in 2007. Lab tests were run on 1056 maize seed lots - 680 for Stewart's wilt; 359 for Goss' wilt, and 17 for crazy top downy mildew.

Cucumber and melon (*Cucumis sativus* and *C. melo*):

The bacterial fruit blotch (BFB) management plan for cucurbit transplants was in its third year of implementation. The objective is to prevent seed transmission and spread of *Acidovorax avenae* subsp. *citrulli* in the greenhouse by the use of vertical barriers between accessions, bottom watering, and frequent plant inspections. This is especially important for regenerations made from seed lots that were transferred to the Station in 1987 from Griffin, GA. No BFB was found in the greenhouse. Accessions were monitored regularly in the field between planting and harvest and no BFB occurred. There was some angular leaf spot early in the year (June), but it

disappeared when the weather got hot. Powdery mildew was the only other disease problem in the field.

Cucurbit virus-testing:
All cucurbit transplants in the greenhouse were tested by ELISA for seed-borne squash mosaic virus to prevent infection in the field planting. No seed transmission was found in any *Cucumis sativus* or *C. melo* accession in 2007. One *Cucurbita pepo* accession had SqMV-infected seedlings (Table 1).

Species	Accessions tested	Accessions with infected plants	Plants tested	# of SqMV infected plants	% infected plants
C. sativus	39	0	1195	0	0%
C. melo	16	0	537	0	0%
C. pepo	2	1	545	19	3.5%
Total	**57**	**1**	**2277**	**19**	**0.8%**

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 observed in the field in 2007.

Brassica and related *Brassicaceae* genera:
Seventy-two seed increase plots were surveyed for all diseases in late June. 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*). None of these diseases was detected in 2007 except for black rot which was identified in three plots.

Miscellaneous:
The only unusual disease observed at the Station in 2007 was Verticillium wilt of winged sumac (*Rhus copallina*). This was our first record on this host.

Publications:
Block, C.C., Gulya, T.J. and Marek, L.F. 2007. Greenhouse evaluation of wild sunflower species for resistance to Sclerotinia wilt. Phytopathology 97:S11.

Fessehaie, A., Block, C.C., Shepherd, L.M., and Misra, M.K. 2007. Molecular characterization of Stenocarpella maydis based on nuclear ribosomal internal transcribed spacer regions between the 18S and 28S nuclear rRNA gene sequences. Phytopathology 97:S35.

Fessehaie, A., Block, C.C., Shepherd, L.M., and Misra, M.K. 2007. Quantitative TaqMan real-time PCR assay for Stenocarpella maydis, the causal agent of Diplodia ear and stalk rot of maize. Phytopathology 97:S35.

Fessehaie, A., Block, C.C., Shepherd, L.M., and Misra, M.K. 2007. Duplex TaqMan real-time PCR assay for quantitative detection of Pantoea stewartii subsp. stewartii and Stenocarpella maydis. Phytopathology 97:S35.

Fessehaie, A., Block, C.C., Shepherd, L.M., and Misra, M.K. 2007. Evaluation of LNA, MGB and non-modified DNA probes to improve the detection limit of TaqMan real-time PCR assay for Pantoea stewartii subsp. stewartii. Phytopathology 97:S35.

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

Acquisition and inactivation (Table 1):
Forty-one accessions were acquired. Of these, 16 were transferred from NCGRP, and six were collected in the wild by David Brenner. One accession was selected from an older accession which exhibited segregation. Eighteen came from outside of the NPGS.

Fifteen *Melilotus* accessions were acquired. Included are five collected in 2006 in Kyrgyzstan and donated by D. Johnson of the USDA, ARS in Logan, Utah (Ames 29036 to Ames 29040). Ten *Melilotus* accessions were transferred from the NCGRP in Ft. Collins, Colorado (NSL 448060 to NSL 448069), and were provided by the Beltsville USDA office in 1973.

Six crownvetch accessions, *Securigera varia* (NSL 448054 to NSL 448059) were transferred from the NCGRP.

Ten miscellaneous Umbelliferae were donated. Five are from the Republic of Georgia, and were provided by Edward J. Garvey of the USDA, ARS Natl. Germplasm Resources Laboratory in Beltsville, MD. Five are from Tunisia and were collected and provided by Philipp W. Simon of the USDA-ARS Vegetable Crops Research Unit, Madison, WI.

Five *Amaranthus* accessions were acquired, two of which are East African grain cultivars that were provided for taxonomic determinations (Ames 29034, and Ames 29035), two were collected in the wild (Ames 29205, and Ames 29306), and one is an unusual extreme dwarf *A. caudatus* (Ames 29204) that segregated from an older accession. The leaves of the extreme dwarf form a rosette and the entire plant is only three cm tall.

Three *Chenopodium* accessions were collected as part of a long-term effort to acquire close relatives of *C. quinoa* including all the subspecies of *C. berlandieri* as recognized in the Flora of North America. Two subspecies were added to the collection, from Maine (Ames 29206 and Ames 29207) and from Louisiana (Ames 29307). Fortunately, attendance at conferences near both collection sites made these collections relatively convenient and inexpensive.

One *Setaria* accession (Ames 29120) was collected in Iowa; the species *Setaria verticillata* was not previously represented from North America.

A newly released cultivar 'Koch' of Calamovilfa longifolia (Ames 29312) was donated by the NRCS Rose Lake Plant Materials Center in Michigan.

The *Amaranthus* collection shrank by five accessions from 3,334 to 3,329 accessions following the inactivation of ten accessions and the addition of five accessions mentioned above. Sixteen accessions were inactivated in the combined crops.

Maintenance and distribution (Tables 2, 3A, and 3B):
Three-hundred-seventy-four accessions were planted in 2007. Of these, 167 plantings were for regeneration, and 207 were for observations**.** Most of the observation plantings were grown in single plastic flats to confirm taxonomy and for other trait observations.

This was an ordinary year for germplasm distribution of my crops (Table 5). There were no unusually large orders that have caused jumps in distribution in some years.

The number of accessions tested for germination, 338, is up dramatically from 128 in 2006. The numbers fluctuate depending on station priorities, the age of the inventory lots, and normal variations in scheduling. This was a good year for viability testing in these crops.

<u>*Amaranthus* and *Chenopodium*</u>:
Most of the *Amaranthus* plantings were for observation, and most of the *Chenopodium* plantings were for regeneration.

We are directing more efforts toward characterization and taxonomic confirmation and less toward regeneration now that the *Amaranthus* collection is 96% available. Many of the observation plantings are to compare lots of a single accession, or compare similar accessions

<u>*Echinochloa*, *Panicum*, *Setaria*, miscellaneous Poaceae</u>:
This year *Setaria sphacelata* plants were pollinated in isolation for the first time. Three accessions were in cages in widely spaced areas of the farm. Seven other accessions were taken home by NCRPIS volunteers, or brought to isolated places during flowering. This change was in response to a publication (below) that describes *S. sphacelata* as an outcrossing species. Seedlots from previous regenerations of this species, not grown in isolation, will require purity evaluation.

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:
An application of Ortho Systemic Insect Killer (Aug. 8, 2007) on the field plantings of *Melilotus* was very successful in controlling an infestation of aphids.

PI 593235 'Israel' is a long-season annual *M. albus* that was developed in the 1950s for very large growth habit. It has some potential for use in biomass studies, and its increase was successfully harvested from plants grown in a field cage.

Spinacia:
In 2008 seeds will be sent to collaborators in California for a regeneration effort there.

The demand for *Spinacia* germplasm remains high since many of the requestors screen the entire collection for disease resistance.

The experiments with seed dormancy breaking in wild *Spinacia tetrandra* were continued by David Kovach and me. In the fall of 2005, original seeds of PI 647861 germinated after they were kept in sand-filled flats in a warm greenhouse through the summer. The resulting 2006 harvest had a harvest population size of 63 plants. The freshly harvested seeds tested in December 2006 had excellent viability as indicated by seed dissection, but were 100% dormant. These dormant seeds were planted in February 2007 using the same method as succeeded for the parent lot, but only 3 seedlings germinated from 100 seed units. Other methods also failed to generate useful frequencies of germination. It is possible that, after sufficient after-ripening, the 2006 seeds will germinate well and be made available for distribution. However, dormancy remains a problem.

Miscellaneous Umbelliferae:
In 2007 the umbel regeneration effort was reduced as part of a station-wide resource allocation plan. However, the backlog of harvested seeds was cleaned, and many accessions will be tested for viability and stored in 2008.

Characterization/taxonomy/evaluation (Table 4):
Assigning permanent PI numbers to worthy accessions with temporary Ames numbers was a NCRPIS priority in 2007. For the collections that I curate, 522 new PI numbers were assigned. Most of these were for the *Amaranthus* and Umbelliferae site crops. Sam Flomo made great progress by loading 255 accession images into GRIN. It was also a successful year for loading observations; 13,156 observations were loaded. These observations include notes on *Amaranthus* plants and most of the *Coriandrum* data provided by Pedro Antonio López from his doctoral research.
There were 56 taxonomic changes in 2007 for these crops. Twenty-five of these were in *Amaranthus,* 12 were in *Chenopodium*. The remaining changes were dispersed, but mostly for the millets.

Enhancement and/or utilization:

Amaranthus:

I am leading a research project in cooperation with Mike Owen of ISU and eleven cooperators in other states. The goal is to evaluate PI 538327 (D136-1) as a low outcrossing line, by comparison with higher outcrossing in PI 558499 ('Plainsman'). The cooperators grew plants from seeds we sent them, and then sent the seed harvests back for us to evaluate the frequency of outcrossing. The project is on schedule with seed harvests returned to us and waiting for cleaning. After cleaning, the seeds will be grown to determine the frequency of the off-types that result from outcrossing in the two lines. Many of the cooperators are NC7 scientists and the results should have regional implications.

Amaranthus tricolor accessions resistant to the endemic disease *Phomopsis amaranthicola* were crossed with some of the crop's market type varieties. In 2007, field-grown hybrid progenies segregated for disease resistance; these plants had ornamental, chlorophyll-deficient leaf blades. It may take several seasons until they are ready for release in order to address challenges related to seed dormancy and purity.

The Guinness World Record tallest amaranth is now 7.06 m as of October 15, 2007 the record holder is Brian Moore of Ewing, NJ. This beats the old world record of 4.61 m set in 2004 at the NCRPIS. Both records are from plants of PI 553076 *Amaranthus australis*.

Insect grubs in *Amaranthus tricolor* stems were sampled during the summer and Sharon McClurg sent them to the Systematic Entomology Laboratory, in Beltsville, MD for identification. They were identified as *Conotrachelus* sp. which is consistent with the literature. These insects are a common occurrence in *A. tricolor* field plantings.

Publications and presentations:

Brenner, D.M. 2007. *Ex situ* conservation. Invited presentation to an Iowa State University class. Conservation Biology EEOB 531. April 12, 2007.

Brenner, D.M. 2007. Curator Report. Presentation at the NC7 Technical Committee meeting. Urbana, Illinois. June 19-20, 2007

Brenner, D.M. 2007. *Amaranthus* Enhancement Breeding at the North Central Regional Plant Introduction Station. . *In* 2007 Agronomy Abstracts. ASA, Madison, WI. Poster presentation at the American Society of Agronomy meeting November 2007 New Orleans, LA

Brenner, D.M. 2007. Commercial mosquito nets as pollination cages within greenhouses. Presentation at the NPGS Curator Workshop, Denver, Colorado December 1-3, 2007

Widrlechner, M.P., K.R. Reitsma, and D.M. Brenner. 2006. Results of an exploration to expand the diversity of Dacus and Apiaceae germplasm collections. Umbelliferae Improvement Newsletter 16:3-7.

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

Plans for 2008:
Melilotus may be of use as a companion crop with switchgrass grown for biomass production, providing fertility and aiding with erosion control. In 2007 I suggested the idea in a report to the Clover Crop Germplasm Committee. Several researchers are interested. I plan to present this idea with a poster at the 2008 American Society of Agronomy meeting. If experiment results support its use, the need for synthetic fertilizer in switchgrass plantations will be reduced, thus increasing sustainability. My role in this is to encourage researchers to test these hypotheses.

The following publication is a good starting point for further research on sweetclover in switchgrass:

Gettle, R.M., J.R. George, K.M. Blanchet, D.R. Buxton, and K.J. Moore. 1996. Frost-seeding legumes into established switchgrass: establishment, density, persistence, and sward composition. Agronomy Journal 88:98-103.

Acquisition:
The new Project Plan for the NCRPIS has specific acquisition objectives. Two of these objectives will be addressed in the coming year.

Spinach related genera occur in the wild in the United States. Two species, *Monolepis nuttalliana* and *Suckleya suckleyana* are native to western Nebraska. A collection trip to Nebraska is planned for July of 2008.

The Flora of North America recognizes six subspecies of *Chenopodium berlandieri* in the United States. They are of interest because of cross compatability with the crop species *Chenopodium quinoa.* Five of the subspecies have been collected after a multi year effort. The remaining subspecies, *C. berlandieri* var. *berlandieri,* is native to southern Texas and will be targeted for collection in association with conferences scheduled in Texas in the fall of 2008.

Acknowledgments:
Adam Conzemius, Meghan Hermiston, and Ryan Herwig, worked with us as part time student help.

The University of Illinois research group let by Patrick J. Tranel is extremely prolific in publishing excellent *Amaranthus* research. Some of their publications are listed below.

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

Bhargava, A., Shukla S., and Ohri D. 2007. Evaluation of foliage and leaf quality traits in Chenopodium spp. in multiyear trials. Euphytica 153:199-213

Bhargava, A.; Shukla, S.; Rajan, S.; Ohri, D. 2007. Genetic Diversity for Morphological and Quality Traits in Quinoa(*Chenopodium quinoa* Willd.) Germplasm. Genetic Resources and Crop Evolution 54:167-173.

Christensen, S.A., D.B. Pratt, C. Pratt, P.T. Nelson, M.R. Stevens, E.N. Jellen, C.E. Coleman. D.J. Fairbanks, A. Bonifacio and P.J. Maughan. 2007. Assessment of genetic diversity in the USDA and CIP-FAO international nursery collections of quinoa (Chenopodium quinoa Willd.) using microsatellite markers. Plant Genetic Resources: Characterization and Utilization 5:82-95

Gélinas, Bruce and Philippe Seguin. 2007. Oxalate in grain amaranth. Journal of Agricultural and Food Chemistry 55:4789-4794.

Hu, J., Mou, B., Vick, B.A. 2007. Genetic diversity of 38 spinach (Spinacia oleracea L.) germplasm accessions and 10 commercial hybrids assessed by TRAP markers. Genetic Resources and Crop Evolution. 54:1667-1674.

López, P.A., Widrlechner, M.P., Simon, P.W., Rai, S., Bailey, T.B., Gardner, C.A. 2007. Screening coriander gene pool for special uses. In: Janick, J. and Whipkey, A., editors. Issues in New Crops and New Uses. 2006 AAIC Annual Meeting and Sixth New Crops Symposium, October 14-18, 2006, San Diego, California. p. 280-283.

López, P.A., M.P. Widrlechner, P.W. Simon, S. Rai, T.D. Boylston, T.A. Isbell, T.B. Bailey, C.A. Gardner, and L. Wilson. 2007. Assessing phenotypic, biochemical, and molecular diversity in coriander (*Coriandrum sativum* L.) germplasm. Genetic Resources and Crop Evolution 55:247-275.

Mou, B. 2007. Leafminer-resistant spinach germplasm 03-04-63. HortScience. Vol. 42(7):1717-1718.

Volenberg, D.S., W.L. Patzoldt, A.G. Hager, and P.J. Tranel. 2007. Responses of contemporary and historical waterhemp (*Amaranthus tuberculatus*) accessions to glyphosate. Weed Sci. 55:327-333.

Wassom, J.J. and P.J. Tranel. 2005. Amplified fragment length polymorphism-based genetic relationships among weedy *Amaranthus* species. J. Heredity 96:410-416.

Research indirectly related to our germplasm:

Butola, J.S., and H.K. Badola. 2004. Effect of pre-sowing treatment on seed germination and seedling vigour in *Angelica glauca*, a threatened medicinal herb. Current Science 87:796-799.

Del Castillo, C., T. Winkel, G. Mahy, and J. Bizoux. 2007. Genetic structure of quinoa (Chenopodium quinoa Willd.) from the Bolivian altiplano as revealed by RAPD markers. Genetic Resources and Crop Evolution 54:897-905.

Gamel. T.H., J.P. Linssen, A.S. Mesallam, L.A. Shekib. 2006. Seed treatments affect functional and antinutritional properties of amaranth flours. Journal of the Science of Food and Agriculture 86:1095-1102

Gaurab Gangopadhyay, Saubhik Das and Kalyan Mukherjee. 2002. Speciation in Chenopodium in West Bengal, India. Genet Res Crop Evol 49:503-510.

Ghorbani1 R., W. Seel, M.H. Rashed, and C. Leifert. 2006. Effect of plant age, temperature and humidity on virulence of Ascochyta caulina on common lambsquarters (Chenopodium album). Weed Science 54:526-531.

Gyulai, G. , Humphreys, M. O. , Lagler, R. , Szabo, Z. , Toth, Z. , Bittsanszky, A. , Gyulai, F. , Heszky, L. 2006. Seed remains of common millet from the 4th (Mongolia) and 15th (Hungary) centuries: AFLP, SSR, and mtDNA sequence recoveries. Seed Science Research 16: 179-191.

Hammer, K., and K. Khoshbakht. 2007. Foxtail millet (Setaria italica (L.) P. Beauv.) in Mazandaran/Northern Iran. Genetic Resources and Crop Evolution 54:907-911.

Jeschke, M.R., P.J. Tranel, and A.L. Rayburn. 2003. DNA content analysis of smooth pigweed (*Amaranthus hybridus*) and tall waterhemp (*A. tuberculatus*): implications for hybrid detection. Weed Science 51:1-3.

Kim, K.S., S.H. Park, and M. G. Choung. 2007. Nondestructive determination of oil content and fatty acid composition in perilla seeds by near-infrared spectroscopy. Journal of Agricultural and Food Chemistry 55:1679-1685.

Maertens, K.D., C.L. Sprague, P.J. Tranel, and R.A. Hines. 2004. *Amaranthus hybridus* populations resistant to triazine and acetolactate synthase-inhibiting herbicides. Weed Research 44:21-26.

Leon, R.G., D.C. Bassham, and M.D. K. Owen. 2007. Thermal and hormonal regulation of the dormancy-germination transition in Amaranthus tuberculatus seeds. Weed Research 47:335-344.

Leon, R.G., D.C. Bassham, and M.D. K. Owen. 2006. Germination and proteme analyses reveal intra-specific variation in seed dormancy regulation in common waterhemp (Amaranthus tuberculatus). Weed Science, 54:305-315.

Leon, R.G., M.D. K. Owen and D.C. Bassham. Inheritance of deep seed dormancy and stratificaiton-mediated dormancy alleviation in Amaranthus tuberculatus Seed Science Research, 16:193-202.

Martirosyan, D.M., L.A. Miroshnichenko, S.N. Kulakova, A.V. Pogojeva, and V.I. Zoloedov. 2007. Amaranth oil application for coronary heart disease and hypertension. *Lipids in Health and Disease* 6**:**1

Patzoldt, W.L., B.S. Dixon, and P.J. Tranel. 2003. Triazine resistance in *Amaranthus tuberculatus* (Moq) Sauer that is not site-of-action mediated. Pest Manage. Sci. 59:1134-1142.

Patzoldt, W.L. and P.J. Tranel. 2007. Multiple ALS mutations confer herbicide resistance in waterhemp (*Amaranthus tuberculatus*). Weed Science 55:421-428.

Patzoldt, W.L., P.J. Tranel, and A.G. Hager. 2005. A waterhemp (*Amaranthus tuberculatus*) biotype with multiple resistance across three herbicide sites of action. Weed Science 53:30-36.

Patzoldt, W.L., P.J. Tranel, and A.G. Hager. 2002. Variable herbicide responses among Illinois waterhemp (*Amaranthus rudis* and *A. tuberculatus*) populations. Crop Protection. 21:707-712.

Patzoldt, W.L., A.G. Hager, J.S. McCormick, and P.J. Tranel. 2006. A codon deletion confers resistance to herbicides inhibiting protoporphyrinogen oxidase. Proc. Natl. Acad. Sci. USA. 103:12329-12334..

Pfeiffera, W.H. and B. McClaffertyb. 2007. Breeding Crops for Better Nutrition. Crop Sci 47:S-88-S-105

Rayburn, A.L., R. McCloskey, T.C. Tatum, M.R. Jeschke, and P.J. Tranel. 2005. Genome size analysis of weedy *Amaranthus* species. Crop Science 45:2557-2562.

Scrabel, L., S. Varotto, and M. Sattin. 2007. A European biotype of *Amaranthus retroflexus* cross-resistant to ALS inhibitors and response to alternative herbicides. Weed Research 2007 Dec; 47(6): 527-533.

Tatum, T.C., R. Skirvin, P.J. Tranel, M. Norton, and A.L. Rayburn. 2005. In vitro procedure for obtaining mitotic chromosomes from weedy *Amaranthus* species. In Vitro Cell. Dev. 41:844-847.

Tranel, P.J., W. Jiang, W.L. Patzoldt, and T.R. Wright. 2004. Intraspecific variability of the acetolactate synthase gene. Weed Science 52:236-241.

Tranel, P.J**.**, J.J. Wassom, M.R. Jeschke, and A.L. Rayburn. 2002. Transmission of herbicide resistance from a monoecious to a dioecious weedy *Amaranthus* species. Theor. Appl. Genet. 105:674-679.

Trucco, F., D. Zheng, A.J. Woodyard, J.R. Walter, T.C. Tatum, A.L. Rayburn, and P. J. Tranel. 2007. Non-hybrid progeny from crosses of dioecious amaranths: implications for gene flow research. Weed Science 55:119-122.

Trucco, F., T. Tatum, K.R. Robertson, A.L. Rayburn, and P.J. Tranel. 2006. Characterization of waterhemp (*Amaranthus tuberculatus*) x smooth pigweed (*A. hybridus*) F1 hybrids. Weed Technol. 20:14-22.

Trucco, F., M.R. Jeschke, A.L. Rayburn, and P.J. Tranel. 2005. *Amaranthus hybridus* can be pollinated frequently by *A. tuberculatus* under field conditions. Heredity 94:64-70.

Trucco, F., A.G. Hager, and P.J. Tranel. 2006. Acetolactate synthase mutation conferring imidazolinone-specific herbicide resistance in *Amaranthus hybridus*. J. Plant Physiol. 163:475-479.

Trucco, F., T. Tatum, A.L. Rayburn, and P.J. Tranel. 2005. Fertility, segregation at a herbicide-resistance locus, and genome structure in BC1 hybrids from two important weedy *Amaranthus* species. Mol. Ecol. 14:2717-2728.

Trucco, F., M.R. Jeschke, A.L. Rayburn, and P.J. Tranel. 2005. Promiscuity in weedy amaranths: high frequency of female tall waterhemp (*Amaranthus tuberculatus*) x smooth pigweed (*A. hybridus*) hybridization under field conditions. Weed Science 53:46-54.

Ling-Juan Zhou, Ke-Quan Pei, Bo Zhou, and Ke-Ping Ma. 2007. A molecular approach to species identification of Chenopodiaceae pollen grains in surface soil. American Journal of Botany 94:477-481.

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

Acquisition:
During 2007, we worked with Robert Stebbins to enter information for 85 new accessions of ornamentals and mint-family plants into the GRIN database (Table 1). The largest groups of new acquisitions included 54 accessions of North American *Fraxinus* and 15 accessions from the Republic of Georgia collected by NPGS-sponsored explorations during 2006 and 2007. In addition, we were able to re-obtain samples of two 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. The first execution of these plans came about through two trips to Maine and New Hampshire, an exploration in northeastern China, and collections coordinated by Kevin Conrad of the US National Arboretum, which focused on Maryland. Mark Widrlechner and Jeff Carstens conducted an initial reconnaissance of native ash populations in Maine and New Hampshire in July, which identified target locations with good seed production for Candice Gardner and Jeff Carstens to revisit and collect in September. The September trip resulted in 15 new accessions. The Chinese exploration was coordinated by Kang Wang of the Beijing Botanic Garden and Kris Bachtell of the Morton Arboretum, with financial support from the USDA-

ARS Plant Exchange Office. Although collections of 25 Chinese *Fraxinus* accessions were made and sent to the United States, they were destroyed by USDA-APHIS because of insect and disease contamination. In late 2007, Kevin Conrad transferred 38 ash collections to the NCRPIS, which will be assessed for seed quality via x-ray imaging by David Ellis at the National Center for Genetic Resources Preservation (NCGRP) early in 2008.

Special efforts were focused on checking for duplication and verifying passport data and identities, and confirming our ability to conserve accessions as part of a process to assign PI numbers to ornamentals and mints in 2007. As a result, 114 Ames-numbered accessions received PI numbers.

Maintenance:
Field plantings of trees and shrubs continued to receive special attention for maintenance and rejuvenation in 2007, along with the establishment of a new cage field for shrubs with 42 accessions. In 2007, we obtained a new side digger for lifting bare-root nursery stock. The horticulture crew continues to work on mulching long-term field plantings in order to increase plant growth and reduce labor and time requirements associated with mowing. A research collaboration with Gayle Volk (NCGRP) that began with a focus on the development of a protocol for the cryogenic storage of dormant *Salix* cuttings has evolved into a study of techniques to storage dormant buds of *Fraxinus*.

Availability:
During 2007, approximately 45% of the ornamental collections and 70% of the mint-family plants were available for distribution (Table 1), figures slightly above those reported in 2006 (44 and 62%).

Back-up:
Approximately 37% of the ornamental collections and 71% of the mint-family plants are duplicated at NCGRP (Table 2), figures slightly above those reported in 2006 (34% and 64%).

Regeneration:
Regeneration efforts moderated below the high levels of 2006, with summer field work shifting temporarily to the collection of characterization data on the *Calendula* collection (see below). The harvests listed in Table 2 include 28 successful cage increases and 26 woody-ornamental seed increases. There were also 36 accessions of woody plants established from seeds and 18 accessions vegetatively re-propagated.

Viability Testing:
In 2007, few lots were tested for germination (Table 2), primarily ones completed early in 2007 from 2006 regenerations or those required for new, bulked seed lots. Viability tests for 2007 regeneration lots began in 2007, but they were not scheduled to be completed until 2008. Only those finished in 2007 are included in the statistics for this Annual Report.

Distribution:
As summarized below (and in Table 3), requests for accessions of ornamental germplasm declined somewhat in 2007, both in relation to the number of recipients and the number of items shipped. The 268 "order items" included all the distributions for the NC7 Trials (described in the following section), along with 9 plants, 557 cuttings, 60 scions, 27 leaf samples for DNA extraction, and 200 seed packets, distributed to fulfill external requests for ornamental plant germplasm. This group encompassed 48 genera; those most in demand were *Salix* (400 cuttings), *Solenostemon* (46 cuttings), *Cornus* (17 packets, 12 cuttings and 5 plants), *Aronia* (14 packets, 10 cuttings, and 6 leaf samples for DNA extraction), *Maclura* (30 cuttings), and *Calendula* (26 packets). *Aronia* is notable because of increasing demand for its fruits for human consumption, because of interest in the fruits' high concentration of antioxidants.

Demand for mint-family germplasm remained relatively constant in 2007, nearly meeting the peak number of packets distributed in the previous two years, but actually exceeding past figures for the total number of accessions distributed.

Historical Summary of Distribution Activity:
Note: In the summer of 2004, about 240 accessions of *Echinacea* and *Hypericum* were transferred to the Medicinal Project for curation. In addition, since 2002, more than 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. 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	03	108	91	883	320
	04[1]	87	81	361	297
	05[1]	58	53	241	187
	06[1]	89	76	436	322
	07[1]	75	71	268	196
Mint Family	03	9	9	45	39
	04[1]	17	16	45	37
	05[1]	17	16	59	38
	06[1]	19	19	55	37
	07[1]	10	10	54	47

[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, and past records were checked as part of the PI-numbering decision process. In all, 16 ornamental and 2 mint-family accessions were re-identified, the largest group resulting from a field evaluation of 76 *Calendula* accessions. During 2007, Jeff Carstens captured images of 81 ornamental and mint-family accessions for our local database (Table 4). These are named following our standard protocol. Images for 128 accessions were loaded to GRIN in 2007, by using the mass-loading system for images developed by Pete Cyr.

Evaluation:
Germplasm samples of *Aronia* were supplied to Mark Brand, Univ. of Connecticut, in support of a CGC-endorsed evaluation of this genus for landscape characteristics. In addition, a genetic characterization of our *Aronia* collections is now underway at the University of Leiden in the Netherlands.

Seeds of *Spiraea alba* and *tomentosa* were supplied to Mike Mickelbart's laboratory at Purdue University to support graduate-student research on these species' light and water requirements and adaptation. Traits that will be evaluated under varying light and water regimens include attractiveness, flower profusion, plant height, shape, width, and vigor. Traits that will be evaluated under varying water regimens include drought damage, leaf area, photosynthetic rate, and transpiration efficiency.

Draft descriptor lists were prepared for *Calendula* during 2006. In 2007, we tested many of the draft descriptors for *Calendula* by conducting a field evaluation of 76 accessions at the PI Farm during the summer. From this effort, we captured data for 26 descriptors along with floral images. These data and images will be loaded to GRIN early in 2008.

An extensive collection of evaluation data was received from NC-7 trial-site cooperators. Ten-year evaluation data from 2004-2007 will be summarized and prepared for loading to our Internet database.

Enhancement:
There was no major progress to report with enhancement activities in 2007.

Coordination of the NC-7 Regional Ornamental Trials:
Plant Distribution - In 2007, Mark Widrlechner and Jeff Carstens distributed 281 plants of six accessions to 21 sites for long-term evaluation, with an additional 88 plants of these accessions provided to 9 public gardens. Mark Widrlechner had never observed conditions at the five New England NC-7 Trial locations. In place of a plant-delivery trip, Mark and Jeff visited cooperators in Connecticut, Rhode Island, New Hampshire, Maine, and Vermont to learn more about their growing conditions and the challenges they face. It was possible to combine these visits with a reconnaissance trip to locate native *Fraxinus* populations with good seed production in Maine and New Hampshire.

We completed work on a specialized descriptor list that allows NC-7 Trial data to be added directly to the observations area in GRIN and submitted the draft list to the Woody Landscape Plant CGC for review and approval (which we received in May, 2007).

Computer-generated, web-based planting reports and one- and five-year performance report forms were developed by Pete Cyr and Jeff Carstens, then were tested and distributed to trial-site cooperators for the first time in 2007. These electronic forms will drastically reduce the amount of time spent via cooperators and the NCRPIS technician entering data. Only the ten-year reporting forms remain to be converted to the web-based format. In 2007, these were distributed as paper forms.

A brief paragraph with an overview of the NC-7 Regional Ornamental Trials Program has been added to all 344 accessions tested since 1954 that are found in Public GRIN in a new format utilizing Accession Actions. Evaluation data summaries for data submitted by the cooperators on distributions of 51 accessions made from 1984 through 1993 have been posted to GRIN in a new format also utilizing Accession Actions. Evaluation data from 1994 through 2007 will be eventually linked to GRIN as well through the descriptor list approved by the Woody Landscape Plant CGC. In addition, a weblink directing Public GRIN users to the NC7 trials webpage has been updated for 18 accessions. The remaining 326 accessions will have links added/updated in the near future.

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.

Three updates were emailed or sent to trial cooperators in 2007 to inform them about progress on electronic reporting, as well as on how to use the electronic reports and plant descriptions for that distribution year.

Germplasm activities in crops other than those curated:
Throughout 2007, 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 completed service as the Agency's representative to administer a Specific Cooperative Agreement (SCA) between ARS and The Ohio State University to fund the OPGC, and assisted in planning for the hiring of a new Director for the OPGC to fill the vacancy resulting from the resignation of Director David Tay in June.

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*. A proposal to NIH to request new funding for the Center was approved for a three-year period beginning in June, 2007. Mark Widrlechner continues his involvement with the Center by overseeing a subcontract to ARS,

which supports the curation and distribution of the Station's *Echinacea* and *Hypericum* germplasm collections so they can be evaluated for chemical composition, genetic diversity, and bioactivity. He assisted Center researchers in interpreting secondary-metabolite, passport and molecular-marker data for *Echinacea* and passport and taxonomic data for *Hypericum*. Research publications resulting from these efforts are detailed in the Medicinal Plant section of this Annual Report.

During 2007, Mark Widrlechner was involved with a number of other collaborative germplasm activities including:

1. studies with Aleš Lebeda of Palacký Univ., Olomouc, Czech Republic to assess variation in resistance to downy mildew in *Cucumis melo* germplasm;
2. projects with collaborators at the Center for Research on Botanical Dietary Supplements to document patterns of genetic variation and phylogenetic relationships in *Hypericum perforatum* and *Echinacea*, and to compare patterns of biochemical variation in *Echinacea* against two competing taxonomic treatments;
3. the writing of an article for Systematic Botany, which describes a new species of *Cucumis* from Zambia, with Kathy Reitsma, Cindy Clark, Amanuel Ghebretinsae (St. Louis Univ.) and Joseph Kirkbride (USDA-ARS, Beltsville);
4. service on the organizing committee for the 9th International Pollination Symposium, held in Ames in June, 2007, including the presentation of a plenary address, chairing a session on the use of pollinating insects for germplasm conservation, and working with the NCRPIS Vegetable and Insect Pollination teams on a preparation of a poster on a test of flies for the pollination of *Pimpinella*;
5. service on a team to develop a proposal to Bioversity International and the Global Crop Diversity Trust that would create new germplasm management software for national, regional, and international gene banks; and
6. assistance to Candice Gardner in drafting a new Project Plan for the ARS CRIS Project that supports NCRPIS operations, which will undergo external review early in 2008.

Research products:
Past collaborations with Gayle Volk at NCGRP led to the development of a protocol for the cryogenic storage of dormant cuttings of *Salix*, which are now being backed-up annually at NCGRP, with a goal of backing-up our entire, clonal collection of this genus.

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. During 2007, significant progress was made towards the completion of a spreadsheet 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 at the Chicago Botanic Garden supported through a Specific Cooperative Agreement.

In 2007, Mark Widrlechner continued his service 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 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 coordinated the review of draft maps for the 48 conterminous states and prepared a review of draft maps for Hawaii, Puerto Rico and Alaska for early in 2008.

In December, Mark Widrlechner summarized initial results from studies to use long-term viability data and historical germplasm-distribution statistics to estimate target quantities for seed regeneration and presented these results at the NPGS Curators' Workshop in Denver.

Mark Widrlechner identified resources and informed NCRPIS staff about books and websites documenting toxic-plant germplasm, including contact dermatitis and allergic reactions, and shared this information with NPGS managers. He is preparing a database to link NPGS holdings to the references, "Toxic Plants of North America" and "Handbook of Poisonous and Injurious Plants."

Other Horticultural project-training and staff-development activities:
In 2007, Mark Widrlechner and Jeff Carstens attended the Iowa Shade Tree Short Course, conducting a tour of the Plant Introduction Farm for participants as part of this program. Jeff Carstens completed an ISU graduate-level course, NREM 501 Genecology, during the fall semester.

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 and began service as a reviewer for Journal of Environmental Horticulture. He also served as a peer reviewer for manuscripts submitted to five other scientific journals, and as an internal reviewer for four 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:
Reitsma, K.R., L.C. Clark, S.G. McClurg, S.J. Hanlin, D.M. Brenner, and M.P. Widrlechner. 2007. Regeneration of self-compatible *Pimpinella* plants benefits from the addition of fly pollinators. Abstract and poster. In: C.A.C. Gardner, M.A. Harris, R.W. Hellmich, H.T. Horner, J.D. Nason, R.G. Palmer, J.J. Tabke, R.W. Thornburg, and M.P. Widrlechner, eds. (2007) 9th International Pollination Symposium on Plant-Pollinator Relationships – Diversity in Action: Program and Abstracts. Iowa State University, Ames, IA, USA. Pp 144-145.

Richards, Ken W. and Mark P. Widrlechner. 2007. Protocols to determine pollination requirements and optimal pollinators for plant genetic resource regeneration. Invited presentation (given by second author) and abstract. In: C.A.C. Gardner, M.A. Harris, R.W. Hellmich, H.T. Horner, J.D. Nason, R.G. Palmer, J.J. Tabke, R.W. Thornburg, and M.P. Widrlechner, eds. (2007) 9th International Pollination Symposium on Plant-Pollinator Relationships – Diversity in Action: Program and Abstracts. Iowa State University, Ames, IA, USA. Pp 58-59.

Widrlechner, Mark P. 2007. The North Central Regional Plant Introduction Station – Maintaining plant genetic resources for the future. Invited presentation to the Golden K Kiwanis, Ames, IA, 26 July.

Widrlechner, Mark P. 2007. A method for determining target regeneration quantities. Presentation to the NPGS Curators' Workshop, Denver, CO, 2 December.

Publications which appeared in print in 2007:
LaLone, Carlie A., Kimberly D.P. Hammer, Lankun Wu, Jaehoon Bae, Norma Leyva, Yi Liu, Avery K.S. Solco, George A. Kraus, Patricia A. Murphy, Eve S. Wurtele, Ok-Kyung Kim, Kwon Il Seo, Mark P. Widrlechner, and Diane F. Birt. 2007. *Echinacea* species and alkamides inhibit prostaglandin E2 production in RAW264.7 mouse macrophage cells. Journal of Agricultural & Food Chemistry 55: 7314-7322.

Lebeda, A., J. Štěpánková, M. Kršková, and M.P. Widrlechner. 2007. Resistance in *Cucumis melo* germplasm to *Pseudoperonospora cubensis* pathotypes. Advances in Downy Mildew Research 3: 157-167.

Lebeda, A., M.P. Widrlechner, J. Staub, H. Ezura, J. Zalapa, and E. Křístková. 2007. Cucurbits (Cucurbitaceae; *Cucumis* spp., *Cucurbita* spp., *Citrullus*_spp.). Chapter 8, pages 273-377 in: Genetic Resources, Chromosome Engineering, and Crop Improvement Series, Volume 3 - Vegetable Crops. (R.J. Singh, ed.) CRC Press, Boca Raton, FL.

López, P.A., M.P. Widrlechner, P.W. Simon, S. Rai, T.B. Bailey, and C.A. Gardner. 2007. Screening coriander gene pool for special uses. Pp. 280-283 in: Issues in New Crops and New Uses (J. Janick and A. Whipkey, eds.), ASHS Press, Alexandria, VA.

López, Pedro A., Mark P. Widrlechner, Philipp W. Simon, Satish Rai, Terri D. Boylston, Terry A. Isbell, Theodore B. Bailey, Candice A. Gardner, and Lester A. Wilson. 2007 (as doi). Assessing phenotypic, biochemical, and molecular diversity in coriander (*Coriandrum sativum* L.) germplasm. Genetic Resources and Crop Evolution. doi: 10.1007/s10722-007-9232-7.

Percifield, Ryan J., Jennifer S. Hawkins, Joe-Ann McCoy, Mark P. Widrlechner, and Jonathan F. Wendel. 2007. Genetic diversity in *Hypericum* and AFLP markers for species-specific identification of *H. perforatum* L. Planta Medica 73: 1614-1621. doi: 10.1055/s-2007-993749.

Richards, Ken W. and Mark P. Widrlechner. 2007. Protocols to determine pollination requirements and optimal pollinators for plant genetic resource regeneration. Presentation and abstract In: C.A.C. Gardner, M.A. Harris, R.W. Hellmich, H.T. Horner, J.D. Nason, R.G. Palmer, J.J. Tabke, R.W. Thornburg, and M.P. Widrlechner, eds. (2007) 9th International Pollination Symposium on Plant-Pollinator Relationships – Diversity in Action: Program and Abstracts. Iowa State University, Ames, IA, USA. Pp 58-59.

Widrlechner, Mark P. 2007. While they were asleep: Do seeds after-ripen in cold storage? Experiences with *Calendula*. Combined Proceedings of the International Plant Propagators' Society 56: 377-382.

Widrlechner, Mark P. 2007. Old and new trends influencing the introduction of new nursery crops. Pp. 237-245 in: Issues in New Crops and New Uses (J. Janick and A. Whipkey, eds.), ASHS Press, Alexandria, VA.

Widrlechner, Mark P., Kathleen R. Reitsma, and David M. Brenner. 2006 (published in 2007). Results of an exploration to expand the diversity of *Daucus* and Apiaceae germplasm collections. Umbelliferae Improvement Newsletter 16: 3-7.

Departmental Activities:
Mark Widrlechner continued as an active member of 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 continued to serve as a member of the POS Committee for a Ph.D. candidate in the Interdepartmental Plant Physiology Program and became a member of the POS Committee for a Ph.D. candidate in Natural Resources Ecology and Management.

Conclusions and Plans for 2008:
Curation:
Curation efforts in 2007 focused on completing regenerations from cage fields and long-term plantings and on conducting a field evaluation of *Calendula* to capture descriptor and image data.

Looking ahead to 2008, herbaceous regeneration in 2008 will focus on *Potentilla*, so we can make a large proportion of this collection available for a future field

evaluation. Before conducting that evaluation, we will draft a *Potentilla* descriptor list consistent with descriptors being developed as part of the Plant Structure Ontology in the Genome Database for Rosaceae.

Given the serious threat caused by the continued expansion of Emerald Ash Borer in the North Central Region, we will continue to collaborate with Kevin Conrad, Ned Garvey, Dave Ellis, Kris Bachtell (Morton Arboretum), and Bob Karrfalt (USDA Forest Service) to refine and execute plans to conserve North American ash (*Fraxinus*) germplasm (and acquire Chinese germplasm). We are planning a trip to Michigan and Indiana for the spring of 2008 to meet with key participants in ash conservation. We are also planning a collection trip to Missouri and southern Illinois and possibly another just to the east of the EAB infestation for the fall of 2008.

The loading of characterization data and images collected in 2007 to the GRIN database will be a major priority in 2008, including pdf files of historic NC-7 Regional Ornamental Trial reports.

We look forward to sharing our thoughts on enhancements to GRIN as part of the development of GRIN-Global and also to the completion of a web-based system for the capture and management of all data from the NC-7 Regional Ornamental Trials.

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. completing the validation of risk-assessment models for the invasiveness of non-native woody plants in the Midwest with data collected from the Chicago region through the support of a Specific Cooperative Agreement (SCA) with the Chicago Botanic Garden, and securing a graduate student to expand this project to develop broader, regional models through the support of an SCA with Jan Thompson at Iowa State University;
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. evaluating patterns of historical viability data in order to develop efficient testing algorithms and intervals for stored seed samples that balance the resources used to conduct these tests with the need to identify samples that are declining in viability; and
5. completing and submitting a study for publication (with Jonathan Wendel's lab) that applies variation in chloroplast and nuclear DNA-sequence data to the evolutionary history of *Echinacea*.

Staff Development:
Plans for staff development for 2008 will focus on training experiences for Jeff Carstens, which are likely to include attendance at the Iowa Shade Tree Short Course, visits to NC7 Ornamental Trial sites and local nurseries, and safety training.

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

Equipment:
A new 4-row ALMACO planter was purchased by the GEM project. It allows for flexible row spacing, and optional usage of a seed splitter allows for four rows to be planted by two riders. The current curation planter requires one rider for each of row, and has a capacity of two rows. This planter will be used by the curation project in conjunction with the current planter.

Personnel:
State maize project Agricultural Specialist, Mr. David Losure, resigned effective the end of calendar year 2007. Plans are to refill the position at the current level with minor job description changes. Student staffing was increased for the summer of 2007 allowing for additional increases to be performed.

Research Progress:
The thesis project on the races of maize in the Southwestern U.S. was completed. Dr. Candice Gardner the NCRPIS RL assisted in the project. A large amount of morphological and agronomic data was generated from Ames, IA and the NW Agricultural Experiment Station at Farmington, NM, and will be loaded into GRIN.

Acquisition:
Statistics show a 124 accession increase in 2007 as seen in Table 1. These included 17 new GEM accessions, twenty-one expired Plant Variety Protected (PVP) accessions, and 63 accessions from the Australian Germplasm System including waxy inbreds brought in through quarantine. Finally, 17 additional TZ inbred lines from the Nigerian program were brought in through quarantine increase on St. Croix.

Incorporation of the Goodman Racial collection was completed in 2007. These accessions were received in 2004 and were allocated to that year, but final bookkeeping was completed in 2007. The collection consisted of 1007 new accessions to the Ames active maize collection within the 1356 accession Goodman Maize Race Collection; 488 were new to NPGS and 519 were held by the NCGRP collection at Fort Collins but not at Ames. There were 349 accessions which appear to have already been within the Ames collection.

Regeneration:
There were 588 *Zea* accession regenerations attempted in Ames in the summer of 2007, comparing favorably with 439 accessions in 2006 and 130 accessions in 2005. These included 444 inbreds (61 inbreds were expired PVPs) and 144 populations. Several of the accessions with unknown adaptability were grown on 20% plots, small

plots with 20% of the normal plot size. We can increase seed to make these available if they are sufficiently adapted. If they are populations, we will need to grow more plants as time permits to maintain long term preservation at the 100 plant population level. Since our techs are now well trained, we ran rescue regenerations on a large number (273) of the 588 accessions grown in the summer of 2007. These are accessions that have very small original sample size or poor viability. They are surface sterilized, germinated in the growth chamber, transplanted to jiffy pots, hardened, and finally transplanted to the field. We were able to produce seeds from at least two-thirds of these accessions. The season in Ames allowed a mid-April planting for two-thirds of the direct seeded accessions, followed by an extended cool wet period. Stands were poor on some of the expired PVP inbreds, but all early planted materials had some stand establishment. The cool wet spell delayed planting slightly of the other third of the direct seeded nursery. Inbreds were irrigated during anthesis for a period of two weeks with a traveling gun irrigation system, but a third of the nursery was planted in fields that do not have irrigation access. We hauled water with a water wagon to the accessions with the least amount of seed inventory. Later in July the rains started and all plantings matured with adequate moisture. Fusarium ear rot frequency was above average, but I would classify this year's nursery as better than average. Little Stewart's wilt and Goss's wilt were observed in the plantings, in contrast to the infection levels observed in 2006.

The GEM project helped the maize curation project out by allowing us to pollinate Cuba 164 plants for which they had controlled photoperiod response by using dark screening during early vegetative growth. They used the pollen for making topcrosses needed for an experiment and then we used the males again to make sibbed seed for a needed increase. A couple hundred sibbed ears were harvested.

An increase of 53 populations from at least 18 different races and 10 inbred lines that had previous increase difficulties on Puerto Rico was done near Waimea, Kauai through the facilities of Hawaiian Seed Research. Seed quality on most accessions was good. Unexpectedly, some races like Pira Naranjo and Chococeno did not do well, probably due to heavy tillering and delayed maturity under the milder Kauai climate. When these accessions are planted at this location at this density, we will try removing tillers.

This year's St. Croix quarantine nursery consisted of 126 accessions. There were 82 Australian inbred lines, 24 Nigerian inbreds, and the rest were populations mostly from Africa.

Greenhouse increases included eight maize accessions consisting of Gaspe types, difficult-to-regenerate Goodman-Buckler inbreds, and four *Zea diploperennis* accessions.

Dr. Matthew Krakowsky, USDA-ARS at Tifton, Georgia, increased seven old Georgia inbreds. Seed quality was the best I've seen on these old lines. This work is greatly appreciated as regeneration of many of these old Southeastern U.S. lines is difficult. He has left Georgia and is now at Raleigh, North Carolina. We welcome

him to the North Carolina GEM project and hope to collaborate with Matt there, as well as with his future successor at Tifton, Georgia.

Maintenance:
Table 1 indicates that accession availability increased from 63% to 64% at the end of 2007. This was true even though additional unavailable accessions were incorporated from the Goodman racial collection; their inclusion into the collection statistics was completed in 2007. A total of 576 maize accessions were made available in 2007 for a net gain in availability of 321 accessions.

In 2007, 965 accessions or 5% of the collection were tested for viability compared with 1670 accessions or 8% of the collection in 2006.

In 2007, 634 accessions were given permanent PI numbers. This compares with 10 accessions in 2006 and 27 in 2005.

Due largely to the increased permanent number assignment, there were 1,027 accessions backed up in 2007 compared to 89 in 2006. The percent backup went from 71% in 2006 to 74% in 2007.

Distribution:
Table 5 shows that maize packet distributions, orders, and the number of 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	2003	7	7	22	8
	2004	8	8	11	6
	2005	7	7	11	6
	2006	16	14	34	6
	2007	14	14	28	6
Average		**10**	**10**	**21**	**6**
Maize	2003	226	178	2298	1475
	2004	334	241	4473	2207
	2005	381	275	4425	1828
	2006	585	356	7927	2477
	2007	553	376	8870	2175
Average		**415**	**285**	**5598**	**2032**

Characterization:
There were 9,425 data points relating to 14 ear descriptors on 554 accessions loaded into GRIN in 2007 compared to 9,330 data points relating to 14 ear descriptors on 476 accessions in 2006. These ear descriptions were a large portion of the 13,001 data points loaded into GRIN on 2,436 accessions in 2007 and are similar to the 15,476 loaded to GRIN on 2,852 accessions in 2006.

We imaged 829 accessions in 2007 compared to 1,559 in 2006 and 3,556 in 2005. The reduction is due to most imaging being confined to regenerations rather than to accessions already in cold storage that have never been imaged. Almost all accessions in the collection have an image captured.

We continued to refine PDA programs and Micro computer programs to capture maize plant measurements in the field for direct loading into GRIN.

Evaluation:
There were three disease screening nurseries sent out in 2007. Dr. Steve Moore at Louisiana State University received 300 accessions for top crosses that will be screened for Aspergillus resistance screening. Dr. Bill Dolezal with Pioneer Hi-Bred screened 250 accessions for northern leaf blight resistance and diplodia ear rot screening. Dr. Charles Block, USDA-ARS at the NCRPIS, screened 230 accessions for Stewart's wilt resistance. Conditions were good for disease screening in Louisiana and at Johnston. Stewart's Wilt development was uneven.

We sent 5,079 packets for NIR evaluation in the lab of Dr. Linda Pollak and Ms. Sue Duvick in 2007. We have received a substantial amount of compositional data on %starch, %oil, %protein, and density. This data should be loaded to GRIN in 2008.

Communication:
Again in 2007, several tours were given and there were many venues for exchanges of ideas. The GEM project field day continues to generate visits from many maize scientists who are also interested in the maize germplasm collection. There was a half day long interview from a crew with "Modern Marvels" cable television program relating to the maize collection. The emphasis of the program was on biofuel and industrial processing of maize, therefore there was little room for images of the maize diversity, and the interview tape was excluded from the final show.

Plans for 2008:
Top Priority Computer Project: Four NCRPIS staff members, including the maize curator, serve on a committee to enhance GRIN. The maize curator will be serving on a part time bases as a curator-user analyst on a project to develop the new version of GRIN, known as GRIN-Global. This is one of the highest priorities for the NPGS.

Acquisition:
The University of Illinois retired pathologist Dr. Don White has a large collection of inbred lines. We plan to review those holding for important missing accessions. We are also planning to contact Dr. Zeno Wicks, retired maize geneticist from South Dakota to ensure there are no additional inbred lines or population cycles that are important to add to the maize collection.

After a short six month hiatus in expired PVPs due to an open PVP examiner position 18 years ago, there will be a approximately 30 maize PVP lines added to the collection in 2008.

More GEM accessions will be released for distribution by the NCRPIS in 2008.

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 1,200 Ames-numbered accessions and 400 currently available NSL-numbered accessions could be assigned permanent PI numbers. This process has become the highest priority for 2008.

There is the Goodman-Buckler diversity set of inbreds of some 300 lines. (Of this set, a subset of 25 inbreds was crossed with B73 to form the populations from which the NAM inbreds resulted. The NAM inbreds are available through the Maize Genetic Stocks Center in Urbana, IL.) All of the inbreds that were intercrossed (to form the NAM inbreds) have been increased at the NCRPIS. We are very near completion of regeneration of the Goodman-Buckler diversity set of inbreds. Only a handful of the 300 lines, or accessions, remain. These have not been without issues. C49 for instance, is an old, old line that was almost lost; it has gone through a greenhouse and field transplantation. Enough seed has now been generated for a large field planting. A split planting to manage risk may be needed. The current version of Wisconsin line WD has a genetic defect that prevents increase much beyond what seed is planted. WD was dropped from the 300 lines - it is not part of the NAM inbreds, and we have dropped this inbred from the set. Quality assurance with SSR markers also needs to be done on about half of the increases (Buckler effort). About a dozen inbreds have been identified as being different than earlier NPGS versions. They have been added to the collection as a new accession with an identifier that recognizes that difference (i.e. P39 Goodman-Buckler).

Viability tests will be increased 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 5,000 accessions with images of additional accessions in 2008. These images have already been captured, and will be loaded with the new GRIN loader software developed by NCRPIS staff.

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

H. Medicinal Plants (J. McCoy, M. Widrlechner)

The curation of medicinal-plant germplasm progressed well through the 2007 field season. However, in December, Dr. Joe-Ann McCoy left the NCRPIS to become Director of a new medicinal-plant germplasm repository at The North Carolina Arboretum in Asheville. At that time, Mark Widrlechner temporarily assumed responsibility for the curation of these collections.

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 managed under the NC7-medicinals site-crop.

Acquisition:
During 2007, we received and/or collected 41 new accessions of medicinal species representing 9% of the current collection (Table 1). The collection currently consists of 446 accessions. Special efforts were focused on checking for duplication, verifying passport data and identities, and confirming our ability to conserve accessions, as part of a process to assign PI numbers to medicinal plants in 2007. As a result, 66 Ames-numbered accessions received PI numbers.

The main focus of germplasm acquisition in 2007 was on the medicinal plants of the Republic of Georgia. Specifically, Georgia's diverse habitats support numerous medicinal taxa, which can expand the genetic diversity of our current collection, especially for *Hypericum* and *Prunella.*

Joe-Ann McCoy and Barbara Hellier, the USDA-ARS Horticultural Crops Curator at Pullman, WA, collaborated with two Georgian counterparts, Marina Mosulishvili and Ana Gulbani, to conduct an 18-day plant exploration trip to collect medicinal genera. The group convened in Tbilisi, Georgia on August 27, 2007, and 115 accessions were collected between August 28 and September 13, representing about 50 species. As a result, 33 accessions were added to the NCRPIS Medicinal Plant site-crop. The trip covered a variety of habitats ranging from 40 to 2,336 meters in elevation and extending from the Black Sea coast to the Caucasus Mountains.

Availability and Backup:
Sixty percent of the NC7 medicinal accessions are currently available (Table 1). In 2007, 62 seed lots of these accessions were made available and 85 accessions were backed up, with a total of 276 accessions now backed up in Fort Collins, representing 62% of the total collection (Table 2).

Regeneration and Maintenance:
The majority of the growing season was spent maintaining 36 field cages along with 2 greenhouse cages. Regeneration efforts focused on the completion of caged plantings established in previous years. Seeds from 31 perennial accessions of *Echinacea, Hypericum*, *Actaea*, and *Prunella* regenerated in field and greenhouse cages were harvested, and are currently being processed and stored (Table 2).

Distribution:
358 items were distributed in 2007; of these, 74% were domestic and 26% were foreign distributions (Table 3A). Along with seed distribution, *Prunella* plants were provided to Dr. Basil Nikolau's lab for metabolomic analyses, and excess *Echinacea* plants and roots were shared with a number of research projects. In the fall, *Echinacea* roots and *Prunella* plants were harvested, dried and ground by Wiley mill and made available to projects associated with the ISU NIH Center for Research on Botanical Dietary Supplements grant project.

Characterization and Taxonomy:
All the medicinal plants in the cage field were checked to verify identifications and past records were checked as part of the PI-numbering process. In all, 14 accessions of medicinal plants were re-identified in 2007.

Descriptor data were collected from nine *Echinacea* accessions, and digital images of plants were taken for three accessions, along with 26 digital images of seeds taken by Lisa Pfiffner. The data and images will be loaded to GRIN early in the coming year.

Three interesting papers reporting on the characterization and biosystematics of *Hypericum* and *Echinacea* were published or submitted for publication in 2007.

A research team in Dr. Jonathan Wendel's lab at Iowa State Univ., led by Ryan Percifield, used AFLP markers in a phenetic study that linked AFLP variation to morphological variation within *Hypericum perforatum* and related species. The group also identified a small number of unique AFLP markers that can be used to distinguish *H. perforatum* from other species. These results were published in Planta Medica (citation included in publication list, below).

A research team in Dr. Eve Wurtele's lab at Iowa State Univ., led by Lankun Wu, used multivariate analyses of metabolic profiles based on ~40 lipophilic components of *Echinacea* (mostly alkamides and related compounds) to test two competing taxonomic treatments of this genus. Wu's results lend stronger support for a treatment developed by Ronald McGregor in the 1960s than for a more recent approach authored by Shannon Binns et al. This paper was submitted to Planta Medica in 2007, and a revised draft is currently under review.

Dr. Diane Birt, Iowa State Univ., presented an overview of ongoing research from the NIH Center for Research on Botanical Dietary Supplements (which she directs), focusing on our *Echinacea* germplasm collection and their bioactive constituents at a workshop held at the 2007 Experimental Biology Annual Meeting. Topics included a description of the germplasm collection and results of anti-viral, anti-inflammatory, and anti-pain bioassays. The paper resulting from this talk will be published in the American Journal of Clinical Nutrition in February, 2008.

Pathogen Observations:
Field plantings were monitored weekly during the growing season, for *Colletotrichum gloeosporioides* and aster yellows disease symptoms. Both pathogens

had been 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. Twenty-two *Hypericum* accessions were 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:
Joe-Ann attended and gave presentations at the Plants and Plant Systems for Small Farm Product Diversification Conference in Beaver, WV, a Workshop on Extending Small-farm Profitability in Dalton, GA, and the Annual Meeting of the Society for Economic Botany in Glencoe, IL. She also presented an invited talk at Clemson University's Coastal Research and Education Center in Charleston, SC.

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 seed samples to cooperators for field testing and HPLC analysis, and to identify and share relevant journal articles and conference proceedings with researchers associated with the project.

She also attended annual tractor-safety training.

Publications by Joe-Ann McCoy:
Haidet, M., Byrne, M., and McCoy, J. 2007. Safeguarding the seeds of native plants. HerbalGram 75: 30-37.

McCoy, J. 2007. Utilizing the National Plant Germplasm System for medicinal plant research. Pp. 258-260 in: Janick, J. and Whipkey, A., editors. Issues in New Crops and New Uses. ASHS Press, Alexandria, VA.

McCoy, J.H. 2007. Medicinal plant curation and new crop development research. Pp. 65-68 in: Morales, M.R. and Foster, J.G., editors. Appalachian Opportunities: Plants and Plant Systems for Small Farm Product Diversification. Fifth Appalachian Opportunities Symposium, March 10, 2007, Mountain State University, Beckley, WV.

McCoy, J.H. 2007. Propagation research results for *Actaea racemosa* L. (black cohosh) and analysis of associated triterpene glycosides. Pp. 87-89 in: Morales, M.R. and Foster, J.G., editors. Appalachian Opportunities: Plants and Plant Systems for Small Farm Product Diversification. Fifth Appalachian Opportunities Symposium, March 10, 2007, Mountain State University, Beckley, WV.

McCoy, J., Davis, J.M., Camper, N.D., Kahn, I., and Bharathi, A. 2007. Influence of rhizome propagules size on yields and triterpene glycoside concentrations of black cohosh [*Actaea racemosa* L. syn *Cimicifuga racemosa* (L.) Nutt.]. HortScience 42: 61-64.

Percifield, R.J., Hawkins, J.S., McCoy, J., Widrlechner, M.P., and Wendel, J.F. 2007. Genetic diversity in *Hypericum* and AFLP markers for species-specific identification of *H. perforatum* L. Planta Medica 73: 1614-1621. doi: 10.1055/s-2007-993749.

Invited Talks by Joe-Ann McCoy:
"Black Cohosh." Plants and Plant Systems for Small Farm Product Diversification Conference, Appalachian Farming Systems Research Center, Beaver, WV, March 10, 2007.

"Seed Savers – Medicinal Plant Germplasm." Plants and Plant Systems for Small Farm Product Diversification Conference, Appalachian Farming Systems Research Center, Beaver, WV, March 10, 2007.

"Medicinal Plant Research." Workshop on Extending Small-farm Profitability, Sleepy Hollow Farm, Dalton, GA, May 12, 2007.
"Medicinal Plant Curation and New Crop Development Research." Clemson University, Coastal Research and Education Center, Charleston, SC, May 16, 2007.

"Utilizing the NPGS for Medicinal Plant Research." Society for Economic Botany Annual Meeting, Glencoe, IL, June 3-7, 2007.

Manuscript Review:
In 2007, Joe-Ann reviewed eight manuscripts for journals and a book.

Plans for 2008:
The main goal for this project in 2008 is to hire a skilled person to serve as the curator for these collections and to oversee the production of well-documented, known-source raw materials of *Hypericum, Echinacea* and *Prunella* for the NIH-funded Botanical Center. In the absence of a full-time curator, only a limited number of accessions of each of these three genera will be started for seed-regeneration and to meet raw-material requests from Botanical Center researchers.

Efforts will also be made to load medicinal-plant images, evaluation data, and voucher records to GRIN.

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

Acquisitions:
We received 112 new oil seed accessions in 2007.

Helianthus:
Seven cultivated *Helianthus annuus* accessions were received from NCGRP, Ft Collins. Four accessions were transferred because intellectual property rights protection had expired (two PVP and two CSR). Three accessions from Spain under active CSR protection were released by the inventors for the purpose of seed distribution. During February and March 2007, USDA Sunflower researchers Dr. Gerald Seiler and Dr. Thomas Gulya travelled to Australia to collect naturalized sunflower populations. They collected 37 *H. annuus* accessions and two *H. debilis*

ssp cucumerifolius accessions. An additional 23 accessions [*H. annuus* (19 populations), *H. argophyllus* (3),and *H. debilis ssp cucumerifolius* (1) previously collected were donated by Australian cooperators Dr. Gary Kong, Dr. Sue Thompson and Dr. Jeff Mitchell. During a 15 day trip to Texas, Oklahoma, New Mexico, and Arizona in September and October, Dr. Marek and Dr. Gerald Seiler collected 35 accessions of *Helianthus* [*H.ciliaris* (21 populations), *H. laciniatus* (8), *H. arizonensis* (3), and *H. annuus* (2)]. An additional accession of *H.ciliaris* was collected from a restricted area of the White Sands Missile Range in late October and donated by local collaborator, Dr. David Anderson. Both 2007 sunflower explorations were funded by the NPGS Plant Exchange Office. Seventy-five percent of the new wild accessions are available as original seed. Three of the new cultivated accessions are being distributed as original seed; three were increased in 2007 and one will be increased during the 2008 season.

Brassicaceae:
Three new Brassicaceae accessions were received in 2007. Two *Camelina sativa* land race populations were donated by Robert Hrastar, Slovenian Institute of Hop Research and Brewing, Slovenia and one *Thlaspi arvensi* accession was received from Dr. Terry Isbell, NCAUR, Illinois. All three accessions are available for distribution.

Linum:
In 2007, four *Linum usitatissimum* accessions were requested from NCGRP, all of which had IPR protection that expired in1993 but which had never been transferred to NCRPIS. These accessions are available as original seed. One *Linum* sp. accession was received from a collection trip to Georgia taken by Joe-Ann McCoy and Barbara Hellier in September 2007. The accession will be increased and identified to species in 2008. Based on habitat information, it is expected to be *L. usitatissimum*.

Collection Maintenance:
As part of our strategy to ensure that the active oil seed collection contains only viable accessions, 12 *Helianthus* accessions were inactivated during 2007. 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. As part of a station wide effort to convert Ames numbered accessions to PI numbers, 1249 available Ames numbered oil seed accessions were submitted to DBMU and given PI numbers in 2007. Of the 1245 remaining Ames numbered oil seed accessions, 15-20% should be converted to PI numbers during 2008 as a result of successful 2007 increase attempts. As many as 20% of existing Ames numbered oil seed accessions will be inactivated after viability analyses are completed for all groups.

General statistics about availability and management of the collections are presented in Tables 1 and 2 in the appendix. Fewer regenerations than average were started for the field in 2007 for all oil seed groups due to budget uncertainties. Selected details for oil seed accessions increased during 2007 are noted below.

Helianthus, Ames increases:
Cultivated *H. annuus* accessions are 94% available. Availability increases to 96% when CSR restricted accessions are removed from the calculations. We are managing our increases to maintain that level of availability and to ensure that the core collection accessions are available. In 2007, 34 *H. annuus* cultivated accessions were regenerated and two accessions were increased for the USDA Sunflower Research Group in Fargo, ND to provide check material for winter greenhouse disease evaluations. Cultivated *H. annuus* accessions requiring long seasons or short days to flower are increased in the NCRPIS greenhouse as space allows (two to four accessions per season; three during the winter of 2006-2007; two underway for 2007-2008). Wild annual *Helianthus* accessions are 87% available and wild perennial accessions are 59% available. In 2007, we caged 14 wild annual *Helianthus* accessions and harvested seed from 12 of the accessions. We caged 92 wild perennial populations, 81 of which had been previously established in the field. Seed was harvested from 78 of the caged perennial accessions.

Helianthus, Parlier alternate grow-out site:
We are working with NPGS Parlier personnel to increase wild taxa that require longer growing seasons than are reliably obtained in Ames. The Parlier environment also provides a valuable alternative for growing mountain and desert species such as *H. exilis* and *H. deserticola* that have not done well in the Midwestern summer humidity and heavy soils. The Parlier location has 40 sunflower cages, purchased by NCRPIS, and can grow up to 40 sunflower accessions per year. 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 flowering, pollinator insects are introduced during flowering, and plants are harvested as seed heads mature. Harvested material is shipped to Ames for threshing and processing. In 2007 we sent seedlings for 29 accessions, all of which were successfully harvested including two *H. agrestis* accessions, a species not available for distribution for more than ten years. In addition, two accessions established in 2006 were re-caged and harvested in 2007. The 2007 harvested material arrived in Ames in December and is being processed.

The Parlier group records basic field data (date transplanted, dates of harvest) but does not have the staff to record descriptor data such as ray and disc flower color, plant height, branching characteristics nor 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 2007, Dr. Marek and Mr. Larsen traveled to Parlier to take images and record descriptor information.

Brassicaceae:
Brassicaceae accessions are 83% available. We continue to work towards having 90% or more of these accessions available. In spring 2007, field populations for 35 Brassicaceae accessions, 25 Brassica and 10 miscellaneous crucifers were established by direct seeding. An additional 24 Brassicaceae accessions, 16 *Brassica* and eight miscellaneous crucifers, were established in the field from seedlings started in December 2006 and over-wintered in the NCRPIS cool temperature

greenhouse as part of an effort to improve our vernalization protocol. Seed was harvested from 45 of the field accessions. Six of the eight 2006 fall started crucifer accessions did not flower in the field and were transferred to the greenhouse in fall 2007. Transplanting is a priority for accessions which have no remaining seed and/or for those for which we did not have useful information with which to predict winter survival. In fall 2006, 27 accessions that had not flowered in the field were transferred to the greenhouse. Nineteen of these accessions flowered, set seed and were harvested in winter 2007. Eight accessions did not flower during the winter and have been maintained in the greenhouse. Three accessions did not survive transfer. Winter greenhouse increases involve strong cooperation with the NCRPIS entomology personnel to obtain appropriate pollinators in a timely manner. Flies have been very successful pollinators in the winter greenhouse. 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 well in the winter greenhouse.

<u>*Linum*</u>:
We successfully harvested all six *Linum usitatissimum* accessions planted for regeneration in 2007. The accessions were received from a 2006 collection trip to Tajikistan. Seven wild flax accessions were harvested in 2007, one from a 2007 established field population and six from overwintered 2005 and 2006 established field populations. Several of the overwintered wild flax accessions have been identified by the NCRPIS horticultural group to be of possible interest as ornamentals and plants for those accessions have been transferred to one of their perennial nurseries.

Cultivated flax accessions are 99% available. Wild *Linum* accessions are currently 40% available; we are working towards increasing the availability of these species.

<u>*Cuphea*</u>:
Seeds are available for 92% of the accessions of seven species (*Cuphea. calophylla, C. carthegenensis, 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* Consortium for the agronomic development of *Cuphea* as a domestic source of mid-chain fatty acids. Seeds were harvested from 11 of 14 accessions established in the field in 2007. One accession died in the field before flowering. Plants for the other two non-flowering accessions were transferred to the greenhouse before fall frosts. Fifty-seven percent of the *Cuphea* accessions of species of primary interest for horticultural or 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 again increased a white, less-sticky PSR23 mutant with less shattering for the Consortium group at Morris, MN. We also grew and harvested a three-quarter acre plot of Illinois PSR23 for the Consortium.

Miscellaneous asters, *Vernonia:*
As a result of interest expressed by the USDA New Crops Group in Maricopa, AZ, we are working toward making as broad a representation of the *Vernonia galamensis* germplasm available as possible. *Vernonia* had not been increased at the station for several years and six accessions were attempted in 2007. Seed was harvested from all six accessions.

Distributions:
General statistics about oil seed collection distributions are presented in Table 3 in the appendix.

Helianthus:
The largest *Helianthus* distribution in 2007 (976 accessions) was requested for an evaluation of wild *H. annuus* for naturally occurring herbicide tolerance. Accessions were also distributed for evaluation of disease and insect resistance. Accessions were also sent to co-operators to study genetic control of flowering time and photoperiod regulation, to screen for orobanche resistance and for use in phyto-remediation research. Several research groups requested accessions to investigate biomass production and allocation.

Brassicaceae:
Demand for Brassicaceae accessions continued to be strong in 2007. The largest single distribution was sent to Australia (602 accessions) for disease resistance and aluminum tolerance evaluations. Portions of the Brassicaceae collection were distributed for phytoremediation research, and biofumigant and green manure studies and well as for additional for disease resistance evaluations, oil composition and biofuels/oil crop evaluation.

Linum:
Linum accessions were distributed to several breeding programs working with oil and fiber characteristics as well as to an archaeobotanical research group and to a program investigating possible gene flow between flax and its wild relatives.

Cuphea:
Cuphea accessions were distributed to ornamental breeding programs and to groups participating in the National Cuphea Consortium. The largest single distribution (471 accessions) was sent to a breeding program in the Netherlands.

Research Activities:
General statistics about observations and images recorded for the collections are presented in Table 4 in the appendix. The oil seeds project worked towards standardization of its image loading protocol and began to load sunflower increase associated images to GRIN. Image loading for Brassicaceae accessions continued. Images are loaded of the inflorescence, whole plant, and harvested seed for all increase accessions. Other specialized images are included depending on the crop. For example, harvested siliques are imaged and presented on GRIN for Brassicaceae accessions.

Helianthus:

Germination protocols: Our focus on making 90% or more of the wild Helianthus germplasm available for distribution has some challenges. Increases had 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. Pathogen contamination of old original seed is our biggest concern for many accessions. In consultation with Dr. Gerald Seiler at the USDA, ARS Sunflower Research Group in Fargo, ND we incorporated a seven day rinse in cool, running tap water prior to the pre-germination cold incubation period for Parlier regeneration germinations started in December. Preliminary observations indicate a significant reduction in contamination in compared with previous increase years. Before transfer of the seeds to germination temperatures, any accessions showing contamination are rinsed and placed in clean germ boxes.

Photoperiod control experiments: To complement the versatility that the NPGS Parlier alternate grow-out location provides for sunflower regenerations, we tested protocols to promote early flowering in Ames for late flowering taxa that survive the mid-western summer humidity. One technique we tested was to induce a photoperiod modification by moving potted sunflower plants from a natural light exposure to a dark room for 16 hours each day for one month. Three groups of each of two species, *H. argophyllus*, naturally late flowering, and *H. exilis*, naturally early flowering, were treated. One group for each species was comprised of control plants that were never exposed to photoperiod modification. Treated plants were exposed to the short day/long night photoperiod modification for either the month of April (Group 1), May (Group 2) or June (Group 3). Plants were transplanted to the field during the first week of July. Plants in all groups of *H. exilis* flowered, including the control group, by early June. Only Group 3 treated plants of *H. argophyllus* flowered during the growing season.

A second protocol tested was to control the photoperiod in the field for one accession of *H. argophyllus* by covering a standard pollinator-control screened cage with black landscape cloth for 16 hours each day, mid-July until mid-August, extending the dark period by approximately seven hours. Treated plants were flowering when the treatment was terminated; control plants did not flower until the last week in September. Only treated plants produced significant seed. We expect to make use of this second protocol to test as many as ten accessions of several taxa during 2008.

Disease resistance evaluations: Sclerotinia is the most important disease in sunflower in production fields in northern North America. At the request of the pathology group at the USDA Sunflower Research Unit, Fargo, I analysed the NPGS cultivated collection early in 2007 and determined that roughly half of the cultivated sunflower accessions had never been evaluated for their response to this important disease. The Fargo pathology group has begun to screen un-tested cultivated germplasm which we are sending in groups of 150 accessions. Because wild material is often the source of disease resistance, not only in sunflower but in many crops, the Ames pathology group is involved in a joint effort with the Fargo group to develop a greenhouse screen that successfully predicts field response. *H. resinosus* was the

primary target of a 2006 wild sunflower collection trip and this material has provided several accessions that showed close to 100% resistance in both greenhouse and field testing during 2007.

Brassicaceae:
Re-identification field plot: In 2007, we established 22 plots for the purpose of confirming 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 started 24 accessions, 16 *Brassica* and 8 miscellaneous crucifers in December 2006. These accessions were over-wintered in the NCRPIS cool temperature winter greenhouse (10C set point maximum temperature; no cooling capacity to keep the temperature at 10C when external ambient temperature exceeds set point). This treatment provided a significantly longer cool temperature regime under natural light conditions for the seedlings than the previously the used protocol (~ 20 weeks vs. 4-8 weeks). One *Brassica* accession bolted, flowered and was harvested in the greenhouse. Of the *Brassica* accessions transferred to the field, all flowered uniformly and all plants within each accessions flowered. Two of the miscellaneous crucifer genera flowered, although only one *Lepidium* accession produced viable seed. Viable non-flowering accessions, including one *Erysimum* accession were transferred to the greenhouse before fall frosts. Expanding on these results, 42 *Brassica* and 4 miscellaneous crucifer accessions were started in December 2007.

Camelina: In the past few years, *Camelina sativa* has generated intense interest as an oil seed crop due to its uncommon cold and drought tolerance. It is being developed for biofuel production and, because of high omega-3 fatty acid content in the oil, for human consumption. In 2007, all 54 camelina accessions in the NPGS collection were direct seeded in observation plots for imaging and to record descriptors. We identified 20 accessions that are probable winter types (eight *C. sativa* accessions). Eight accessions, including one *C. sativa*, did not survive the mid-summer heat in Iowa. Seed from the plots was not harvested and was primarily consumed by birds. Seedlings which developed from seed that fell to the ground and germinated were left to overwinter.

Camelina and Thlaspi increase plots: As part of a cooperative effort with Dr. Lance Gibson, New Crops faculty at Iowa State University, we established eight *Camelina* and 13 *Thlaspi* increase plots in August to overwinter for early spring seed production. Most accessions bolted and flowered during October, suggesting that August is too early to start these species to overwinter in Iowa. All plots were left in the field to observe overwintering. The 21 accessions were started in the greenhouse in later November to allow transplanting to the field if plots do not overwinter.

Cuphea:
DARPA project: Ames was one of four locations in a project developed by Dr. Russ Gesch, USDA, Morris, MN, measuring a range of phenological and physiological characteristics of six cuphea germplasm accessions from three species. Our team planted seeds and transplanted seedlings in a replicated plot design. We maintained the plots and recorded emergence counts, flowering dates, plant heights and observations on plant stand over time. Information was collected weekly from a hobo soil probe and transferred to Dr. Gesch. A member of the Morris research team traveled to each of the four locations on a regular basis to record additional information.

Collection trips:
I participated in one targeted collection trip, funded by the NPGS Plant Exchange Office, for wild *Helianthus* germplasm in 2007. In September, I met Dr. Gerald Seiler, Botanist, from the USDA Sunflower Research Group, Fargo in Amarillo, TX. We spent 15 days collecting wild *Helianthu*s germplasm in the southwest traveling almost 5000 miles across. One targeted species, *H. laciniatus*, was not previously represented in the active collection; a second species, *H. arizonensis* had no distributable germplasm, and the third targeted species, *H. ciliaris* had only one distributable accession in the collection at the time of the collection trip.

Training:
ISU 12+ Supervisory Leadership Training Course sponsored by Human Resource Services, September 2007 - May 2008.

Meetings and Presentations:
Helianthus:
In January 2007, I presented the annual *Helianthus* Germplasm Status Report for the Sunflower CGC meeting preceding the annual NSA Research Forum in Fargo, ND.

Brassicaceae:
In July 2007, I presented the annual Brassicaceae Germplasm Status Report for the Crucifer CGC committee during the ASHS Meeting in Phoenix, AZ.

New Crops:
In February, I presented an overview of the *Cuphea* collection and discussed ongoing germination experiments at the *Cuphea* Winter Technical Meeting in Phoenix, AZ.

NPGS Curator Workshop:
I served as one of three who organized the December 2007, 2nd Biennial NPGS Curator Workshop in Denver, CO, where I co-presented two sessions with Mark Millard, NCRPIS, about the use of SQL to facilitate queries in the internal curator's version of GRIN. I also made a presentation about collecting wild sunflower germplasm, focused on the 2007 collection trip to the southwestern US.

Publications and reviews:
Seiler, G.J., Gulya Jr, T.J., Marek, L.F. 2007. Re-collection of *Helianthus argophyllus*, Source of the PLarg Gene for Downy Mildew Resistance, Surviving for 25 Years in Daytona Beach, Florida 27th Sunflower Research Workshop, January 10-11, 2007, Fargo, ND. Available: http://www.sunflowernsa.com/research/research-workshop/documents/Seiler_etal_Daytona_07.pdf

Gulya, T.J., Seiler, G.J., Kong, G., Marek, L.F. 2007. Exploration and collection of rare Helianthus species from southeastern United States. Helia. 30(46): 13-24**.**

Cruz, V.M.V., Luhman, R., Marek, L.F., Rife, C.L., Shoemaker, R.C., Brummer, E.C., Gardner, C.A. 2007. Characterization of flowering time and SSR marker analysis of spring and winter type *Brassica napus* L. germplasm. Euphytica 15:43-57.

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 was funded.

FY 2008 Southeastern US *Helianthus* collection trip proposal; submitted to the PEO office, NPGS.

Service Activities:
NCRPIS:
I serve on the NCRPIS' Safety and Computer Committees. The Computer Committee was reformed in 2006.

Agronomy Departmental activities:
I continue to coordinate the monthly Agronomy Department Professional and Scientific staff meetings. Following an agenda pattern established in 2004-2005, the group continues to have informal monthly presentations by P&S staff from the different research/teaching/service groups within the department describing their area activities after the main agenda discussion usually led by the department chair. NCRPIS P&S staff presented in fall of 2004.

PGOC:
I participated in the PGOC annual meeting in Beltsville, MD in May 2007. I serve as a member of the *In situ* Conservation Subcommittee, and the GIS and Georeferencing Subcommittee, which met informally at the December 2007 Curator Workshop in Denver.

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), *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: NCRPIS Accessions (Accs), Acquired, Available of the appendices.

Acquisition:
Forty-seven new accessions were received and are listed by site crop in Table 1. The new accessions include 1 *Cucumis melo* (from Georgia, collected by Garvey, et.al.) and 9 *C. sativus* accessions (2 disease differentials from Dr. T. Wehner, North Carolina State University; 4 from China, transferred from NE9; 3 from Georgia); 3 *Cucurbita* (from Georgia); 32 *Daucus* (31 from Tunisia, collected by Dr. P. Simon, University of Wisconsin, Madison, WI; 1 from Georgia); and 2 *Ocimum* (1 from Georgia, 1 expired PVP from NCGRP).

Maintenance:
Table 2: NCRPIS Accessions (accs) Germinated, Regenerated, Made Available, Backed Up of the appendices contains data for regeneration attempted and number of accessions harvested in 2007.

Fifty-six *Cucumis* field cage regenerations focused on accessions with low viability, low seed quantities, or distribution lots 20 or more years old. Ten of the 21 *Cucumis melo* regenerations were grown from seed lots transferred to the NCRPIS in 1987 from Griffin, GA. 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. Regeneration protocols developed to identify (and remove) contamination and prevent BFB spread to adjacent accessions are described in the 2006 annual report and the NCRPIS Operations Manual. Greenhouse regenerations of hard-to-handle *Cucumis* also continue as space is available. We were able to construct two additional regeneration cages for both the Entomology greenhouse and for Farm GH3 giving us a total of sixteen cages for the 2007 winter *Cucumis* regenerations.

The two accessions of *Cucurbita pepo* regenerated in 2007 were each planted in 12 cages as part of an insect pollinator study to determine whether honey bees or bumble bees are a more suitable pollinator, and whether domicile placement within a cage affects pollinator effectiveness. Results of the study will be analyzed after seed viability tests are completed in April.

Daucus regeneration efforts included new accessions and old 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 (6 accessions). Dr. Freeman and Dr. Maxwell were sent another 12 and 6 PI-numbered accessions, respectively, for regeneration in 2008.

One expired PVP accession of *Ocimum basilicum* ('Purple Ruffles') was regenerated in anticipation of possible increased demand for the accession.

As NCRPIS accessions are regenerated, seed samples are sent to NCGRP for back-up. Overall, 82% of the vegetable collections are backed up which is above the station's average of 79%. Six of the eight vegetable site-crops have 81% or more of their accessions backed up at NCGRP (Table 2).

One *Cucumis melo* and 17 *Daucus* accessions were inactivated due to non-viability of the seed, and 2 *Cichorium* were also inactivated because the plants did not match the cultivar descriptions.

In 2007, 839 germination tests (Table 2) were performed, including seed increases from the 2006 regenerations and 5-year viability testing of *Cichorium*, *Cucumis melo*, *Cucurbita*, and *Daucus* accessions.

Distribution:
Packet and accession distributions for the vegetable collections are summarized in Table 3A: External NCRPIS Distributions and Table 3B: Internal NCRPIS Distributions in the appendices. In 2007, 4504 seed packets (items) were distributed for 164 domestic and 62 foreign orders. This represented 2695 vegetable accessions. Distribution history of the vegetable crops for the last five years can be found in Table 5: Five-Year Summary of NCRPIS Accession Orders by Crop of the appendices.

Characterization and Taxonomy:
Digital images, along with basic notes for taxonomic identification and accession characterization, were recorded during regeneration (Table 4: NCRPIS Accessions (Accs) Observations (Obs) in GRIN, Images in GRIN). 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*. Fruit images of *Cucumis* and Cucurbita have been loaded to GRIN.

In April, plants of 73 selected *Daucus* accessions were transplanted into an observation field to verify taxonomy, collect characterization data, and capture digital images of plants, flowers, and foliage for GRIN. Herbarium specimens were also taken of these accessions. Another two-year observation planting is planned for 2008.

With the assistance of Dr. Mark Widrlechner (NCRPIS Horticulturist), taxonomic identities are reviewed and confirmed as each accession is regenerated or grown in observation plots. The 2007 re-identifications included: five *Cucumis* accessions to other species within *Cucumis*, one *Cucurbita pepo* to *C. moschata*; two *Daucus* sp. to unidentified-Apiaceae species (non-*Daucus*) and sixty-one to other *Daucus* species, subspecies, or varieties.

A general review of passport data for Ames-numbered accessions was completed for *Cichorium*, *Daucus*, *Ocimum*, and *Pastinaca* and a request for PI-number assignment was submitted in December 2007. On 4 January 2008, PI numbers were assigned for 166 *Cichorium*, 298 *Daucus*, 20 *Ocimum*, and 46 *Pastinaca*.

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. Publication of this new species description is pending.

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 2007 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.

In the summer of 2007, the Vegetable Project collaborated with Sharon McClurg (Entomology) and Charlie Block (Plant Pathology) in a preliminary evaluation of the feasibility of using a trap crop to effectively control cucumber beetle feeding on the NCRPIS cucurbit regeneration cages. Please see the report from Entomology for more information.

Publications/Posters:
Regeneration of Self-Compatible Pimpinella Plants Benefits from the Addition of Fly Pollinators. Reitsma, K.R., Clark, L.C., McClurg, S.G., Hanlin, S.J., Brenner, D.M., Widrlechner, M.P. poster presented at International Pollination Symposium, Ames, IA June 2007.

Plans for 2008:
Regenerations: Forty accessions of *Daucus* were started in the greenhouse in October 2007 for the 2008 field cages. Regeneration of hard-to-handle *Cucumis* 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. The *Cucumis melo* will be started in the greenhouse using the barrier system described in the 2006

NCRPIS Annual Report and NCRPIS Operations Manual to prevent the transmission of *Acidovorax avenae* ssp. *citrulli*.

Germinations: Viability tests will be performed on the 2007 cucurbit regeneration seed lots in April 2008 and on the 2007 *Daucus* regeneration seed lots in June 2008

Characterization: A 2-year observation planting of selected *Daucus* accessions will be direct seeded in the spring of 2008 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 cucurbit collections in preparation for assigning PI numbers to many of the Ames-numbered accessions in the collections (414 *Cucumis*, 91 *Cucurbita*). Once PI numbers are assigned, labeling embedded in digital images acquired on these accessions will be updated with the new PI numbers and loaded to GRIN.

Evaluation: Collaboration continues on improving the year-round cage and insect pollinator program for regenerating vegetable crops. For more information on this subject, please refer to the Entomology section of the annual report. In 2008, we will continue to investigate ways to improve insect-pollinator effectiveness in the large *Cucurbita* cages by introducing protective structures around honey bee and Bombus (bumblebee) hives to prevent cucurbit vines from obstructing bee movement in and out of their domiciles.

The Pathology Project will continue to collaborate 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.

K. Research Leader Activities (C. Gardner)

Administration and Leadership Activities:
With the assistance of many of the curatorial and scientific staff of the NCRPIS, I developed new five year project plans for the Plant Introduction Research Unit's two CRIS Projects, Plant Introduction Research and the Germplasm Enhancement of Maize (GEM) Project.

About 25% of my time in 2007 was devoted to assisting in the development of the GRIN—Global proposal and ensuring the project got off to a successful start. Funded in part by the Global Crop Diversity Trust via a grant from the Gates Foundation, and in part by the USDA-ARS through dedication of key personnel, the project's objective is to develop a rational genebank information management system which will be free of recurring license fees, database neutral, and can be used on either stand-alone or networked computers by any genebank in the world. Source code developed as a result of the project will be made freely available. The GRIN-Global system will be designed to replace the GRIN system in the U.S.

The goals and timelines of the project are ambitious. By the end of 2008, a working prototype will be in the hands of selected genebank personnel for beta testing. By the end of 2009, a new public interface prototype will be available for testing. Bioversity will provide the expertise for translation of the interface into several languages, development of training and documentation materials, and training of international genebank personnel.

Pete Cyr, our Software Applications and Network Systems Information Specialist, serves as the project leader. Together with Mark Millard, our maize curator who serves as systems analyst for the project; Brock Weaver, a contract software developer employed by Bioversity; the ARS GRIN Database Management Unit (DBMU) personnel; National Program Leader Peter Bretting; and our Global Crop Diversity Trust and Bioversity partners, our development efforts will be primarily devoted to this critically important project for the next three years.

Research Activities:
In the fall of 2007, MS student Lindsay Werth completed her studies evaluating the Southwestern Native American maize collection for phenotypic, agronomic and phenological traits. As a result of her analyses, the Pima and Papago tribal accessions were more fully differentiated.

Together with horticultural technician Jeff Carstens, I participated in a September, 2007 germplasm collection trip in Maine and New Hampshire to collect *Fraxinus* species. Currently threatened by the devastating Emerald Ash Borer, the trip was a result of planning and proposals described in M. Widrlechner's section of this report.

Professional Interactions:
Together with Dr. Reid Palmer, USDA, ARS, I co-chaired a committee devoted to the organization and execution of the 9th International Symposium on Plant Pollinator Relationships in Ames, IA in May, 2007.

I served as Vice-Chair of the PGOC in 2006-2007, and will serve as Chair in 2008-2009. Key objectives of the PGOC during this time include the development and adoption of georeferencing standards for GRIN, and developing mechanisms to facilitate transfer of learning between sites and to increase the level of their interactions.

I served as President of the American Association of Industrial Crops (AAIC) in 2007-2008, and am responsible for the organization of its annual meeting, September 7-10, 2008, in College Station, TX.

Publications:
Peer-reviewed:
Cruz, V.M., Rife, C.L., Nason, J.D., Brummer, E.C. and Gardner, C.A. Measuring the effectiveness of isolation of Brassica Napus L. accessions during caged germplasm regeneration. (15-Apr-07). Accepted for publication in Plant Genetic Resources Newsletter.

Cruz, V.M., Luhman, R., Rife, C.L., Shoemaker, R.C., Marek, L.F., Brummer, E., Gardner, C.A. 2007. Characterization of flowering time and SSR marker analysis of spring and winter type Brassica napus L. germplasm. Euphytica. 153:43-57.

Volk, G.M., Crane, J., Caspersen, A.M., Kovach, D.A., Gardner, C.A., Walters, C.T. 2007. Hydration of Cuphea seeds containing crystallized triacylglycerols. Functional Plant Biology 34:360-367.

Presentations and Proceedings:

Novel Use of Alfalfa Leafcutting Bees (Megachile rotundata) for Plant Genetic Resource Conservation. Hanlin, S.J., McClurg, S.G., Gardner, C.A. Abstract and poster In: C.A.C. Gardner, M.A. Harris, R.W. Hellmich, H.T. Horner, J.D. Nason, R.G. Palmer, J.J. Tabke, R.W. Thornburg, and M.P. Widrlechner, eds. (2007) 9th International Pollination Symposium on Plant-Pollinator Relationships – Diversity in Action: Program and Abstracts. Iowa State University, Ames, IA, USA. Pp 140-141.

Insect Pollination at North Central Regional Plant Introduction Station – Past and Present. Hanlin, S.J., McClurg, S.G., Gardner, C.A. Abstract and poster In: C.A.C. Gardner, M.A. Harris, R.W. Hellmich, H.T. Horner, J.D. Nason, R.G. Palmer, J.J. Tabke, R.W. Thornburg, and M.P. Widrlechner, eds. (2007) 9th International Pollination Symposium on Plant-Pollinator Relationships – Diversity in Action: Program and Abstracts. Iowa State University, Ames, IA, USA. Pp 142-143.
This poster was also displayed at the International Plant Propagators Society in Montreal August 2007.

Lopez, P.A., Widrlechner, M.P., Simon, P.W., Rai, S., Bailey, T.B., Gardner, C.A. 2007. Screening coriander gene pool for special uses. In: Janick, J. and Whipkey, A., editors. Issues in New Crops and New Uses. 2006 AAIC Annual Meeting and Sixth New Crops Symposium, October 14-18, 2006, San Diego, California. p. 280-283.

Abstracts:

Gardner, C.A., Blanco, M.H., Engstrom, F., Smelser, A.D. 2007. Reducing photoperiod response of tropical maize germplasm for use in Midwestern maize introgression [abstract]. American Society of Agronomy Abstracts. American Society of Agronomy Annual Meeting. Nov. 4-8, 2007, New Orleans, LA. 279-7. CD-ROM.

Millard, M.J., Gardner, C.A. 2007. The Other NPGS Maize Collection: A Rich Source of Maize Genetic Diversity [abstract]. Maize Genetics Conference Abstracts.

Year 2007 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	3329	5	0	3207	96	95
	NC7-celosia	54	0	0	28	52	54
	NC7-echinochloa	304	0	0	247	81	81
	NC7-grasses	121	1	1	76	63	63
	NC7-legumes	235	6	3	107	46	46
	NC7-melilotus	972	15	2	731	75	73
	NC7-panicum	947	0	0	905	96	92
	NC7-perilla	23	0	0	22	96	96
	NC7-quinoa	274	3	1	205	75	76
	NC7-setaria	1010	1	0	914	90	90
	NC7-spinach	401	0	0	353	88	92
	NC7-umbels	1101	10	1	545	50	49
	Total:	8771	41	0	7340	84	82
Marek	NC7-asters	360	0	0	103	29	28
	NC7-brassica	2002	0	0	1757	88	86
	NC7-crucifers	1202	4	0	908	76	72
	NC7-crucifers.pvp	1	0	0	0	0	0
	NC7-cuphea	651	0	0	505	78	74
	NC7-euphorbia	220	0	0	47	21	21
	NC7-flax	2834	5	0	2817	99	99
	NC7-flax.wilds	161	0	0	76	47	39
	NC7-sun.cults	1707	7	0	1595	93	91
	NC7-sun.wilds.ann	1369	64	5	1192	87	90
	NC7-sun.wilds.per	773	32	4	413	53	50
	NC7-sun.wilds.sp	10	0	0	5	50	0
	Total:	11290	112	1	9418	83	80
McCoy	NC7-medicinals	446	41	9	266	60	54
	Total:	446	41	9	266	60	54
Millard	NC7-corn.kin	34	0	0	6	18	15
	NC7-maize	19894	124	1	12699	64	63
	Total:	19928	124	1	12705	64	66
Reitsma	NC7-chicory	276	0	0	231	84	76
	NC7-cucumis.cucs	1365	9	1	1275	93	94
	NC7-cucumis.melo	3111	1	0	2311	74	75
	NC7-cucumis.wilds	331	0	0	143	43	44
	NC7-cucurbita	991	3	0	811	82	82
	NC7-daucus	1129	32	3	893	79	76
	NC7-ocimum	98	2	2	91	93	94
	NC7-parsnips	70	0	0	51	73	73
	Total:	7371	47	1	5806	79	79
Widrlechner	NC7-mints	141	3	2	98	70	62
	NC7-ornamentals	2024	82	4	916	45	44
	Total:	2165	85	4	1014	47	44
NCRPIS Total:		**49971**	**450**	**1**	**36549**	**73**	**73**

Year 2007 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	3329	202	6	42	31	0	0	71	0	153	3206	96
	NC7-celosia	54	1	2	2	1	0	0	1	0	8	31	57
	NC7-echinochloa	304	16	5	0	0	0	0	1	0	0	261	86
	NC7-grasses	121	0	0	1	2	0	0	0	0	9	78	64
	NC7-legumes	235	0	0	1	1	0	0	2	0	2	174	74
	NC7-melilotus	972	106	11	12	32	0	0	32	0	48	801	82
	NC7-panicum	947	0	0	1	1	0	0	39	0	33	916	97
	NC7-perilla	23	0	0	1	0	0	0	0	0	0	22	96
	NC7-quinoa	274	2	1	63	26	0	0	0	0	0	208	76
	NC7-setaria	1010	0	0	13	15	0	0	8	0	17	951	94
	NC7-spinach	401	0	0	6	6	0	0	2	1	0	374	93
	NC7-umbels	1101	11	1	25	7	0	0	13	0	42	583	53
	Total:	8771	338	4	167	122	0	0	169	1	312	7605	87
Marek	NC7-asters	360	1	0	0	0	0	0	2	0	0	83	23
	NC7-brassica	2002	74	4	25	35	0	0	41	2	171	1952	98
	NC7-crucifers	1202	139	12	40	23	0	6	36	26	180	944	79
	NC7-crucifers.pvp	1	0	0	0	0	0	0	0	0	0	1	100
	NC7-cuphea	651	18	3	0	0	0	0	22	0	44	581	89
	NC7-euphorbia	220	0	0	0	0	0	0	0	0	0	53	24
	NC7-flax	2834	0	0	0	0	0	0	3	0	50	2824	100
	NC7-flax.wilds	161	14	9	0	9	1	0	15	0	23	72	45
	NC7-sun.cults	1707	334	20	0	3	0	0	65	0	246	1633	96
	NC7-sun.wilds.ann	1369	28	2	0	16	0	0	26	0	131	1209	88
	NC7-sun.wilds.per	773	50	6	0	4	0	0	59	0	157	425	55
	NC7-sun.wilds.sp	10	0	0	0	0	0	0	0	0	0	5	50
	Total:	11290	658	6	65	90	1	6	269	28	1002	9782	87
McCoy	NC7-medicinals	446	57	13	8	31	0	0	62	0	85	276	62
	Total:	446	57	13	8	31	0	0	62	0	85	276	62
Millard	NC7-corn.kin	34	1	3	0	0	0	0	1	0	0	8	24
	NC7-maize	19894	964	5	788	621	0	0	576	6	1027	14698	74
	Total:	19928	965	5	788	621	0	0	577	6	1027	14706	74
Reitsma	NC7-chicory	276	160	58	0	0	0	0	22	0	20	242	88
	NC7-cucumis.cucs	1365	14	1	48	38	0	0	16	0	98	1273	93
	NC7-cucumis.melo	3111	164	5	24	16	0	0	44	0	26	2515	81
	NC7-cucumis.wilds	331	4	1	14	9	0	0	3	0	2	151	46
	NC7-cucurbita	991	345	35	2	2	0	0	20	0	33	801	81
	NC7-daucus	1129	141	12	41	60	0	0	95	0	159	945	84
	NC7-ocimum	98	11	11	1	1	0	0	11	0	11	91	93
	NC7-parsnips	70	0	0	0	0	0	0	0	0	0	47	67
	Total:	7371	839	11	130	126	0	0	211	0	349	6065	82
Widrlechner	NC7-mints	141	0	0	1	6	0	0	14	0	22	100	71
	NC7-ornamentals	2024	10	0	45	52	121	20	115	0	174	739	37
	Total:	2165	10	0	46	58	121	20	129	0	196	839	39
NCRPIS Total:		**49971**	**2867**	**6**	**1204**	**1048**	**122**	**26**	**1417**	**35**	**2971**	**39273**	**79**

Year 2007 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	3329	129	42	37	216	230	14	13	316	310	56	50	532
	NC7-celosia	54	23	6	6	36	2	2	2	2	23	8	8	38
	NC7-echinochloa	304	14	5	5	15	0	0	0	0	14	5	5	15
	NC7-grasses	121	5	2	2	6	0	0	0	0	5	2	2	6
	NC7-legumes	235	9	2	2	9	0	0	0	0	9	2	2	9
	NC7-melilotus	972	23	9	8	34	7	3	3	7	27	12	11	41
	NC7-panicum	947	10	8	7	11	10	3	3	10	20	11	10	21
	NC7-perilla	23	10	5	5	14	7	1	1	7	14	6	6	21
	NC7-quinoa	274	78	28	27	145	93	12	10	162	128	40	37	307
	NC7-setaria	1010	22	10	10	26	206	6	6	291	225	16	16	317
	NC7-spinach	401	365	14	13	755	366	5	5	441	374	19	18	1196
	NC7-umbels	1101	100	24	23	118	80	6	6	81	164	30	29	199
	Total:	8771	788	155	145	1385	1001	52	49	1317	1313	207	194	2702
Marek	NC7-asters	360	13	5	4	13	3	2	2	3	16	7	6	16
	NC7-brassica	2002	508	52	39	665	721	12	10	1090	1048	64	49	1755
	NC7-crucifers	1202	358	32	28	445	178	16	15	395	413	48	43	840
	NC7-crucifers.pvp	1	0	0	0	0	0	0	0	0	0	0	0	0
	NC7-cuphea	651	151	15	7	181	478	4	3	539	507	19	10	720
	NC7-euphorbia	220	8	4	3	10	0	0	0	0	8	4	3	10
	NC7-flax	2834	14	5	5	14	45	3	3	46	56	8	8	60
	NC7-flax.wilds	161	4	2	2	4	15	2	1	15	19	4	3	19
	NC7-sun.cults	1707	306	49	33	447	286	15	14	308	542	64	47	755
	NC7-sun.wilds.ann	1369	986	24	22	1065	84	9	9	87	1017	33	31	1152
	NC7-sun.wilds.per	773	59	15	14	111	38	3	3	39	89	18	17	150
	NC7-sun.wilds.sp	10	0	0	0	0	0	0	0	0	0	0	0	0
	Total:	11290	2407	203	157	2955	1848	66	60	2522	3715	269	217	5477
McCoy	NC7-medicinals	446	155	52	42	265	80	6	6	93	181	58	48	358
	Total:	446	155	52	42	265	80	6	6	93	181	58	48	358
Millard	NC7-corn.kin	34	5	10	10	19	5	4	4	9	6	14	14	28
	NC7-maize	19894	1952	477	308	7130	898	76	68	1740	2175	553	376	8870
	Total:	19928	1957	487	318	7149	903	80	72	1749	2181	567	390	8898
Reitsma	NC7-chicory	276	25	3	3	25	151	2	2	178	162	5	5	203
	NC7-cucumis.cucs	1365	357	28	26	447	660	21	20	952	789	49	46	1399
	NC7-cucumis.melo	3111	839	56	45	1279	212	12	12	253	933	68	57	1532
	NC7-cucumis.wilds	331	71	10	8	119	145	15	13	320	145	25	21	439
	NC7-cucurbita	991	187	35	31	289	210	6	5	236	323	41	36	525
	NC7-daucus	1129	252	20	17	281	46	4	4	49	284	24	21	330
	NC7-ocimum	98	27	9	8	33	35	2	2	35	51	11	10	68
	NC7-parsnips	70	8	3	3	8	0	0	0	0	8	3	3	8
	Total:	7371	1766	164	141	2481	1459	62	58	2023	2695	226	199	4504
Widrlechner	NC7-mints	141	30	7	7	35	19	3	3	19	47	10	10	54
	NC7-ornamentals	2024	161	63	60	224	44	12	11	44	196	75	71	268
	Total:	2165	191	70	67	259	63	15	14	63	243	85	81	322
NCRPIS Total:		**49971**	**7264**	**898**	**604**	**14494**	**5354**	**240**	**209**	**7767**	**10328**	**1138**	**813**	**22261**

Year 2007 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	3329	153	202	227	131	0	713	562	71	20
	NC7-celosia	54	8	0	4	2	0	14	14	0	1
	NC7-echinochloa	304	0	19	14	9	0	42	33	0	92
	NC7-grasses	121	9	0	0	2	0	11	11	1	1
	NC7-legumes	235	2	0	0	1	0	3	3	11	75
	NC7-melilotus	972	48	106	2	48	0	204	158	51	6
	NC7-panicum	947	33	43	1	3	0	80	47	43	14
	NC7-perilla	23	0	0	3	1	0	4	4	0	0
	NC7-quinoa	274	0	2	11	63	0	76	76	3	3
	NC7-setaria	1010	17	0	45	43	7	112	95	7	284
	NC7-spinach	401	0	4	3	4	0	11	9	4	3
	NC7-umbels	1101	42	11	5	52	0	110	98	20	90
	Total:	8771	312	387	315	359	7	1380	1110	211	589
Marek	NC7-asters	360	0	0	0	5	0	5	5	4	76
	NC7-brassica	2002	171	31	271	32	0	505	449	38	115
	NC7-crucifers	1202	180	140	60	36	0	416	325	53	17
	NC7-crucifers.pvp	1	0	0	0	0	0	0	0	0	1
	NC7-cuphea	651	44	18	33	11	0	106	88	20	32
	NC7-euphorbia	220	0	0	0	0	0	0	0	0	33
	NC7-flax	2834	50	0	0	6	0	56	56	9	2
	NC7-flax.wilds	161	23	13	0	1	0	37	25	22	19
	NC7-sun.cults	1707	246	45	5	39	5	340	306	58	15
	NC7-sun.wilds.ann	1369	131	28	28	44	0	231	204	47	723
	NC7-sun.wilds.per	773	157	50	55	23	0	285	245	111	73
	NC7-sun.wilds.sp	10	0	0	0	0	0	0	0	2	0
	Total:	11290	1002	325	452	197	5	1981	1703	364	1106
McCoy	NC7-medicinals	446	85	87	3	32	22	229	176	117	0
	Total:	446	85	87	3	32	22	229	176	117	0
Millard	NC7-corn.kin	34	0	1	0	1	2	4	4	1	1
	NC7-maize	19894	1027	881	5617	668	425	8618	7487	1458	1358
	Total:	19928	1027	882	5617	669	427	8622	7491	1459	1359
Reitsma	NC7-chicory	276	20	160	5	0	0	185	163	21	13
	NC7-cucumis.cucs	1365	98	14	0	49	0	161	149	23	243
	NC7-cucumis.melo	3111	26	164	0	21	665	876	834	48	109
	NC7-cucumis.wilds	331	2	4	0	7	0	13	12	4	99
	NC7-cucurbita	991	33	330	1	2	0	366	346	28	26
	NC7-daucus	1129	159	146	84	107	0	496	437	128	123
	NC7-ocimum	98	11	11	3	1	0	26	14	11	10
	NC7-parsnips	70	0	0	0	0	0	0	0	0	31
	Total:	7371	349	829	93	187	665	2123	1955	263	654
Widrlechner	NC7-mints	141	22	15	0	1	0	38	24	18	42
	NC7-ornamentals	2024	156	75	79	16	0	326	233	134	77
	Total:	2165	178	90	79	17	0	364	257	152	119
NCRPIS Total:		**49971**	**2953**	**2600**	**6559**	**1461**	**1126**	**14699**	**12692**	**2566**	**3827**

Year 2007 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	3329	227	75	11460	3323	366	3324	63	134	378
	NC7-celosia	54	4	4	0	0	2	7	0	0	5
	NC7-echinochloa	304	14	8	44	23	0	294	6	23	23
	NC7-grasses	121	0	0	10	10	0	10	0	10	10
	NC7-legumes	235	0	0	4	3	1	88	7	3	4
	NC7-melilotus	972	2	17	25	17	1	913	25	17	17
	NC7-panicum	947	1	3	39	20	1	939	1	19	19
	NC7-perilla	23	3	0	0	0	0	0	0	0	1
	NC7-quinoa	274	11	39	27	25	57	244	25	25	26
	NC7-setaria	1010	45	50	72	38	6	996	23	24	24
	NC7-spinach	401	3	7	0	0	0	401	0	0	0
	NC7-umbels	1101	5	16	1475	218	0	225	4	0	0
	Total:	8771	315	219	13156	3677	434	7441	154	255	507
Marek	NC7-asters	360	0		0	0	0	4	0	0	0
	NC7-brassica	2002	271		2153	1655	102	1899	57	57	332
	NC7-crucifers	1202	60		887	675	194	830	2	0	337
	NC7-crucifers.pvp	1	0		0	0	0	1	0	0	0
	NC7-cuphea	651	33		49	29	35	367	8	8	8
	NC7-euphorbia	220	0		0	0	0	0	0	0	0
	NC7-flax	2834	0		0	0	19	2818	0	0	0
	NC7-flax.wilds	161	0		36	24	23	84	0	0	2
	NC7-sun.cults	1707	5		1740	100	1605	1637	53	25	25
	NC7-sun.wilds.ann	1369	28		897	73	39	1235	43	21	22
	NC7-sun.wilds.per	773	55		2156	170	137	478	114	72	72
	NC7-sun.wilds.sp	10	0		0	0	0	6	2	0	0
	Total:	11290	452		7918	2726	2154	9359	279	183	798
McCoy	NC7-medicinals	446	3		0	0	0	133	23	0	0
	Total:	446	3		0	0	0	133	23	0	0
Millard	NC7-corn.kin	34	0		0	0	0	0	0	0	0
	NC7-maize	19894	5617		13001	2436	2852	16709	829	364	4965
	Total:	19928	5617		13001	2436	2852	16709	829	364	4965
Reitsma	NC7-chicory	276	5	0	0	0	234	274	0	0	0
	NC7-cucumis.cucs	1365	0	629	838	814	150	1353	42	814	832
	NC7-cucumis.melo	3111	0	272	53	41	300	3095	16	41	413
	NC7-cucumis.wilds	331	0	34	0	0	0	296	7	0	1
	NC7-cucurbita	991	1	34	0	0	42	980	0	0	45
	NC7-daucus	1129	84	1014	0	0	0	1051	69	0	0
	NC7-ocimum	98	3	0	0	0	0	96	1	0	0
	NC7-parsnips	70	0	0	0	0	0	0	0	0	0
	Total:	7371	93	1983	891	855	726	7145	135	855	1291
Widrlechner	NC7-mints	141	0		28	24	0	24	3	24	24
	NC7-ornamentals	2024	86		146	106	46	222	78	104	190
	Total:	2165	86		174	130	46	246	81	128	214
NCRPIS Total:		**49971**	**6566**	**2202**	**35140**	**9824**	**6212**	**41033**	**1501**	**1785**	**7775**

Year 2007 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	01/01/2003 - 12/31/2003	43	42	915	511
		01/01/2004 - 12/31/2004	39	37	470	350
		01/01/2005 - 12/31/2005	59	53	539	228
		01/01/2006 - 12/31/2006	59	53	3230	2630
		01/01/2007 - 12/31/2007	56	50	532	310
	Total:		256	235	5686	4029
	NC7-celosia	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
		01/01/2007 - 12/31/2007	8	8	38	23
	Total:		29	28	99	69
	NC7-echinochloa	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
		01/01/2007 - 12/31/2007	5	5	15	14
	Total:		41	38	178	146
	NC7-grasses	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
		01/01/2007 - 12/31/2007	2	2	6	5
	Total:		11	10	19	16
	NC7-legumes	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
		01/01/2007 - 12/31/2007	2	2	9	9
	Total:		23	22	166	145
	NC7-melilotus	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
		01/01/2007 - 12/31/2007	12	11	41	27
	Total:		60	52	458	404
	NC7-panicum	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
		01/01/2007 - 12/31/2007	11	10	21	20
	Total:		60	56	1817	1668
	NC7-perilla	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
		01/01/2007 - 12/31/2007	6	6	21	14
	Total:		41	41	274	94
	NC7-quinoa	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
		01/01/2007 - 12/31/2007	40	37	307	128
	Total:		150	136	1383	715

	NC7-setaria	01/01/2003 - 12/31/2003	7	7	55	49
		01/01/2004 - 12/31/2004	12	12	131	116
		01/01/2005 - 12/31/2005	10	9	150	125
		01/01/2006 - 12/31/2006	23	21	227	177
		01/01/2007 - 12/31/2007	16	16	317	225
	Total:		68	65	880	692
	NC7-spinach	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
		01/01/2007 - 12/31/2007	19	18	1196	374
	Total:		86	82	3615	1452
	NC7-umbels	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	36	33	189	136
		01/01/2007 - 12/31/2007	30	29	199	164
	Total:		143	134	1228	858
	Brenner Total:		968	899	15803	10288
Marek	NC7-asters	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
		01/01/2007 - 12/31/2007	7	6	16	16
	Total:		41	38	182	167
	NC7-brassica	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
		01/01/2007 - 12/31/2007	64	49	1755	1048
	Total:		304	258	11884	6285
	NC7-crucifers	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
		01/01/2007 - 12/31/2007	48	43	840	413
	Total:		180	165	4176	1990
	NC7-crucifers.pvp	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
		01/01/2007 - 12/31/2007	0	0	0	0
	Total:		0	0	0	0
	NC7-euphea	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
		01/01/2007 - 12/31/2007	19	10	720	507
	Total:		93	61	2126	1462
	NC7-euphorbia	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
		01/01/2007 - 12/31/2007	4	3	10	8
	Total:		12	11	38	31
	NC7-flax	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
		01/01/2007 - 12/31/2007	8	8	60	56
	Total:		63	61	3328	2992

	NC7-flax.wilds	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
		01/01/2007 - 12/31/2007	4	3	19	19
	Total:		28	27	281	166
	NC7-sun.cults	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
		01/01/2007 - 12/31/2007	64	47	755	542
	Total:		263	202	3711	2292
	NC7-sun.wilds	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
		01/01/2007 - 12/31/2007	42	38	1302	1106
	Total:		218	173	4451	3277
	Marek Total:		1202	996	30177	18662
McCoy	NC7-medicinals	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	44	35	323	163
		01/01/2007 - 12/31/2007	58	48	358	181
	McCoy Total:		226	188	1667	763
Millard	NC7-corn.kin	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
		01/01/2007 - 12/31/2007	14	14	28	6
	Total:		52	50	106	32
	NC7-maize	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
		01/01/2007 - 12/31/2007	553	376	8870	2175
	Total:		2079	1426	27993	10162
	Millard Total:		2131	1476	28099	10194
Reitsma	NC7-chicory	01/01/2003 - 12/31/2003	8	7	191	143
		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
		01/01/2007 - 12/31/2007	5	5	203	162
	Total:		37	34	740	504
	NC7-cucumis	01/01/2003 - 12/31/2003	46	36	1902	1392
		01/01/2004 - 12/31/2004	73	64	1395	1107
		01/01/2005 - 12/31/2005	102	91	4764	2141
		01/01/2006 - 12/31/2006	126	108	3971	2097
		01/01/2007 - 12/31/2007	115	94	3370	1867
	Total:		462	393	15402	8604
	NC7-cucurbita	01/01/2003 - 12/31/2003	11	11	169	149
		01/01/2004 - 12/31/2004	38	35	702	490
		01/01/2005 - 12/31/2005	51	49	1567	828
		01/01/2006 - 12/31/2006	58	52	424	300
		01/01/2007 - 12/31/2007	41	36	525	323
	Total:		199	183	3387	2090

	NC7-daucus	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	33	32	460	356
		01/01/2007 - 12/31/2007	24	21	330	284
	Total:		114	109	2303	1687
	NC7-ocimum	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
		01/01/2007 - 12/31/2007	11	10	68	51
	Total:		85	82	682	331
	NC7-parsnips	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
		01/01/2007 - 12/31/2007	3	3	8	8
	Total:		11	11	37	29
	Reitsma Total:		908	812	22551	13245
Widrlechner	NC7-mints	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
		01/01/2007 - 12/31/2007	10	10	54	47
	Total:		71	69	257	188
	NC7-ornamentals	01/01/2003 - 12/31/2003	57	49	299	189
		01/01/2004 - 12/31/2004	66	64	289	212
		01/01/2005 - 12/31/2005	67	61	262	187
		01/01/2006 - 12/31/2006	89	76	432	319
		01/01/2007 - 12/31/2007	75	71	268	196
	Total:		354	321	1550	1103
	Widrlechner Total:		425	390	1807	1291
NCRPIS Total:			**5860**	**4761**	**100104**	**54443**

Year 2007 Table 6. **NC7 CSREES Region 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
01/01/2007 to 12/31/2007	1483	1138	240	898	455	113	181	149
01/01/2006 to 12/31/2006	1509	1184	249	935	507	111	184	133
01/01/2005 to 12/31/2005	1224	928	173	755	348	77	198	132
01/01/2004 to 12/31/2004	1045	787	164	623	287	71	159	106
01/01/2003 to 12/31/2003	871	613	157	456	204	49	100	103
01/01/2002 to 12/31/2002	1031	779	170	609	304	71	133	101
01/01/2001 to 12/31/2001	862	650	166	484	241	50	91	102

Year 2007 Figure 1.