NCRPIS Annual Report - 2000
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NORTH CENTRAL REGIONAL PLANT INTRODUCTION STATION
NC-7 ANNUAL REPORT, JANUARY 1 - DECEMBER 31, 2000

I. PROJECT TITLE: NC-7 "Plant Germplasm and Information Management and Utilization."

II. COOPERATING AGENCIES AND PRINCIPAL LEADERS:

A. Administrative Advisor — R.F. Ross, Iowa

B. Regional Coordinator — *C.A.C. Gardner, Iowa

C. State Experiment Stations Representatives

1.	Illinois	*T. Hymowitz	7.	Missouri	*P. Arelli
2.	Indiana	*J. Janick, Chmn.	8.	Nebraska	*D. Baltensperger
3.	Iowa	*C. Brummer	9.	N. Dakota	*B. Johnson
4.	Kansas	*C. Rife	10.	Ohio	*R. Miller
5.	Michigan	*A. Iezzoni	11.	S. Dakota	*A. Boe
6.	Minnesota	*H. Pellett	12.	Wisconsin	*W. Tracy

*Voting members

D. U. S. Department of Agriculture

1.	ARS National Program Staff, Plant Germplasm	*P. Bretting
2.	ARS Plant Exchange Office	*E. Garvey
3.	ARS Area Director, Midwest Area	A. Hewings
4.	Cooperative State Research, Education and Extension Service	M. Fitzner
5.	Natural Resources Conservation Service	*J. Rissler
6.	National Center for Agric. Util. Research	*T. Abbott
7.	National Seed Storage Laboratory	*H. Shands

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

1.	USDA-ARS Staff	
a.	Research Leader/Coordinator	C.A.C. Gardner
	Supervisory Program Support Assistant	L. Wilson-Voss
	Office Automation Clerk	S. Winter
	Office Automation Clerk	Vacant
	Biological Science Lab Technician	L. Pfiffner
b.	Horticulturist	M. Widrlechner
	Agricultural Research Technician	P. Ovrom
	Agricultural Research Technician	D. Kovach
	Biological Science Lab Technician	S. Wike
	Biological Science Lab Technician	L. Burke
	Biological Science Lab Technician	M. Arnold
	Germplasm Program Assistant	R. Stebbins
c.	Research Entomologist	R. Wilson
	Agricultural Research Technician	S. McClurg
	Entomologist	S. Hanlin
d.	Plant Pathologist	C. Block
	Agricultural Research Technician	J. Van Roekel
e.	Geneticist	M. Brothers
	Biological Science Technician	I. Larsen

2. Iowa State University Staff

a.	Research Station Superintendent II	L. Lockhart
	Farm Equipment Operator III	L. Crim
	Field-Lab Technician II	J. Scheuermann
	Clerk III	L. Minor
b.	Curator II (Maize)	M. Millard
	Field-Lab Technician II	Vacant
	Field-Lab Technician II	G. Crim
d.	Curator II (Brassica, Grasses)	R. Luhman
	Field-Lab Technician II (½ time)	S. Bruner
e.	Curator II (Vegetables)	K. Reitsma
	Field Lab Technician II	C. Clark
f.	Curator II (Amaranth)	D. Brenner
	Field-Lab Technician II (½ time)	S. Bruner

III. PROGRESS OF WORK (C.A.C. Gardner)

The NCR Plant Introduction Station completed its 52nd year of operation in 2000. Efforts this past year were greatly enabled by an additional $225,000 in permanent funding, largely due to the ASTA's initiative to secure additional Congressional funding. Germplasm management, conservation, evaluation, characterization and enhancement activities require much labor, which is supplied chiefly by part-time ISU students. Year 2000 saw an increase in the amount of hourly FTE's, reversing a steady decline since 1989 due to flat budgets and rising costs. As a result, station staff were able to make available 68% of our collections, representing an increase in availability of 1.5% accessions over 1999. They were also able to collect and provide key information which enhances the viability of the accessions.

Key collaborations were developed by our curators and scientific staff to strengthen research and enhancement programs involving crops held in our collections, both nationally and internationally.

The decision has been made to transfer the Germplasm Enhancement of Maize (GEM) project from the USDA-ARS's Corn Insects and Crop Genetics Unit at ISU to the Plant Introduction Station Unit. This administrative change will occur in 2001. As a result, substantive renovation efforts are planned at the PI Farm to accommodate GEM personnel and PI needs.

Personnel changes:

Stephanie Bruner was hired as an ISU Field Lab Tech II. She works half-time on the Brassica project and half-time on the Amaranth project, March.

Barb Henry, Office Automation Clerk, accepted another ARS position at the National Animal Disease Center, March.

Lisa Pfiffner was hired as a temporary GS-4 Biological Science Technician, working with the maize curation project, May.

The position of ISU Field Lab Tech II that supported the maize curation effort, held by Taiby Ladjahasan, was vacated in June.

Stacey Winter was hired as a full-time Office Automation Clerk in August.

Scott Wike was hired as a temporary GS-4 Biological Science Technician in August, to help coordinate germination and viability testing.

Rose Schroder, Office Automation Clerk (student position) graduated and vacated her position in August.

Dr. Richard Wilson, CAT I Entomologist, retired effective December 31, after over 29 years of USDA service.

We wish our former employees well, and much success in their future endeavors, and welcome our new employees to the NCRPIS family.

Construction:

Completed addition to Farm Manager's residence in May.

Initiated installation of new fire suppression system in the headquarters building, cold-storage rooms and the walk-in freezer (to be completed April, 2001).

Installed a central air conditioning unit to better control temperature of the computer room in the headquarters building.

Replaced old garage doors in headhouse.

Added a moisture condensing system to the headquarters compressed air system to remove moisture from the air lines used with seed cleaning and packaging.

Equipment:

In addition to providing resources for more FTE labor, we were able to acquire or develop the following critical items:

Three new crew cab trucks for vegetable, Brassica and bee crews.
A new 45 Hp tractor for planting and general farm use.
A "gator" utility vehicle for general farm use.
A plasma cutter and a glass bead blaster for shop use.
Developed and constructed a new, heavy-duty furrowing machine.
Two IBM laptop computers.
A line to upgrade communications between NCRPIS and the GRIN database computer in Beltsville, MD.

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

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

Acquisition:

Approximately 330 new accessions were acquired by NCRPIS in 2000.

Acquisitions include 9 accessions received as a result of a plant exploration in Turkmenistan by Turkmenistani collaborators, funded by the USDA.

Approximately 70 ornamental accessions were acquired, including 12 as a result of the 1999 Ukrainian exploration, 8 from the Russian Far East via the Minnesota Landscape Arboretum and the oaks and maples native to NC Iowa.

Approximately 112 maize accessions were acquired, originating largely from new CSR accessions or these originally held only at NSSL.

Two *Helianthus anomalous* and one *Helianthus deserticola* accessions were collected during a plant exploration to the U.S. desert southwest.

Maintenance:

Over 46,000 accessions representing over 300 genera and 1,800 species are maintained at NCRPIS. Of these, approximately 68% are available to the research community.

Nearly 1,100 accessions were backed up at NSSL, resulting in 72% back-up of our collection.

13,331 seed lots were re-inventoried in 2000 to verify seed amounts; this included those completing the maize collection.

Over 4,000 seed lots were stored, including 3,030 original lots prepared for long-term freezer storage and regeneration lots from Ames or other remote sites.

A more efficient method for storing maize balanced samples was developed.

Approximately 300 inactivated accessions were moved to inactive storage.

The miscellaneous Umbelliferae collection was transferred to curator David Brenner from curator Kathy Reitsma in order to more equitably distribute crop assignments.

Regeneration:

The 2000 season was characterized by early, warmer than normal temperatures which hastened plant development. When compared to prior seasons, 2000 was one of the most successful regeneration seasons on record, over all crops.

Over 1,600 accessions were cultivated for regeneration in Ames, IA, Fargo, ND, St. Croix, Parlier, CA and Mayaguez, PR during 2000, and were successfully harvested to date.

Seventy-eight flax accessions were grown in Ames and 56 in Fargo in 2000. Based on two years experience, Ames appears to be an appropriate site for flax regeneration.

Sakata Seed Company of Salinas, CA, continued to provide *Spinacia* regeneration resources; 66 accessions were grown in 2000. Eighty-six percent of the *Spinacia* collection is now available due in no small way to this collaboration.

Two major seed companies continued to provide regeneration resources in tropical nurseries to assist with regeneration of some of the tropical maize populations.

Efforts were initiated to utilize blue bottle flies as pollinator insects for some of the miscellaneous Umbelliferae.

Distribution:

Over 28,300 seed packets or plants were distributed in 2000. Of these, approximately 22% 343 distributed to international requestors and the remaining 78% to domestic requestors.

Characterization:

Digital image acquisition greatly accelerated in 2000. As equipment improves and the staff’s experience grows, use of images to provide valuable descriptive information will continue to expand. Over 7,600 digital images were recorded in 2000; over 700 images have already been transferred to and are publically accessible in the GRIN database. The other images are in final processing stages; an initiative started in 2000 to establish naming and parameter standards for images (across curation projects) will enable us to better manage image transfer and storage in 2001. A search engine, developed by computer intern Nick Golder, greatly facilitates this process.

Oracle forms developed by David Kovach and Mark Millard have facilitated entry of germination, silique sample, and evaluation and harvest descriptor data for many crops. Altogether, 100,319 observations were loaded to GRIN this year as compared to 20,093 observations loaded in 1999 (Table 4).

Isozyme assessment of the genetic diversity of the 112 members of the domesticated sunflower core subset and a randomly selected array of 112

accessions was completed. Rare alleles were identified in the randomly chosen group; the core subset may be modified to include these alleles.

The ornamental curatorial staff tested the draft descriptor list for *Echinacea*. This data was used to help verify taxonomic identification. The New Crops CGC will review a refined descriptor list, and, upon their approval, an extensive dataset will be loaded into GRIN in 2001.

All of the historical observation data from the old NC7-CUCUMIS and NC7-CUCURBITA crop groups from GRIN2 were converted and loaded into GRIN3, resulting in the addition of 14,891 observations to GRIN.

An attempt will be made to develop a standardized list of descriptors for all NPGS Cucurbita species to be presented for approval at the next Cucurbit Crop CGC meeting.

A backlog of Amaranthus observation data was entered into GRIN. Data made accessible include observations on male sterility in some of the accessions.

Evaluation:

A collaboration between William Graves of ISU and Mark Widrlechner, NCRPIS Horticulturist, to evaluate *Betula* and *Alnus* species for abiotic stress was completed and will be published in 2001.

All available maize accessions were analyzed for NIR-OIL content by Richard Bergquist's Pioneer/Dupont lab. Data was provided to NCRPIS and will be loaded into GRIN.

Entomological evaluations of resistance of maize to ECB1 and ECB2, sunflower to sunflower moth, and *Brassica* to green peach aphid, were conducted; results were provided to curators and other researchers.

Cucumis sativus and *Cucumis melo* accessions were evaluated for resistance to powdery mildew and anthracnose.

The first year of a three year program to screen the NCRPIS maize collection for disease resistance by public and private collaborators was completed. Funds to support public collaboration were provided by the Midwest Area USDA-ARS administrators.

Information management and computers:

As a result of an in-house data acquisition and management review held in March, 2000, information management issues were identified, prioritized, and assigned to appropriate individuals for development and/or resolution. Progress made in this area represents a significant accomplishment.

Oracle forms related to entry of descriptor, evaluation and harvest information, order creation, order processing, and pathogen testing data into GRIN were developed by Dave Kovach. He also developed special use forms and reports to facilitate labeling, inventory, and administrative processes.

As a result of resolution of *Cucumis*, *Cucurbita* and *Helianthus* descriptor issues, over 16,000 observations were loaded to the GRIN database and thus made available to the research community, thereby facilitating future use of the collections.

Y2K turnover created no issues; it was almost a non-event at NCRPIS, thanks to all the work done by key staff assigned to the Y2K project.

In February a 128 Kbps frame relay circuit was installed to connect NCRPIS operations with the GRIN system in Beltsville, MD. This has enhanced productivity as well as communication speed by providing stability of connections and reducing "down-time."

Over 107 accessions received taxonomic re-identification.

PI numbers were assigned to 745 accessions previously designated with Ames numbers.

Testing germplasm's germination, viability, and health:

Germination or viability assays were conducted on nearly 4,700 accessions, or 10% of our collections.

Our pathologist conducted phytosanitary inspections on the seed-increase plots for amaranth, *Brassica*, carrots, cucurbits, sunflower and maize.

Disease problems noted in 2000 plantings included:

- Stewart’s wilt and common rust of maize
- Cercospora leaf spot, anthracnose and watermelon leaf blotch of *Cucumis*
- Septoria leaf blight of wild *Helianthus*
- Alternaria leaf blight of cultivated *Helianthus*
- Aster yellows disease of *Echinacea*
- Tomato ringspot virus of *Diervilla*
- Pythium damping-off of *Amaranthus* in greenhouse planting
- Powdery mildew of *Brassica*

Techniques were developed to utilize quantitative ELISA to estimate bacterial populations in kernels infected at low frequencies with *Erwinia stewartii*. The result of this project is development of a better sampling procedure for Stewarts’ wilt.

The plant pathologist wrote 23 additional declarations certifying freedom from pest problems based on field inspections or laboratory testing.

Insect management:

Overwintering survival rate of honeybees increased to 97% over 1999's 85% survival rate.

Experimental development of *Bombus* colonies was initiated to provide *Bombus* pollinators in the future.

Procedures to rear house flies were refined to improve production. Protocols are currently being conducted on rearing blue bottle flies, which are thought to be a better pollinator insect than house flies for some of the Umbelliferae.

A study to compare four methods of feeding honeybee nucleus hives was conducted in the Cucurbita cages last summer. One style of quart containers was found to be superior because it reduced syrup waste and eliminated the problem of buckets blowing off the hives, also eliminating another poential source of pollen contamination.

Outreach:

About 350 visitors toured the NCRPIS in 2000.

Staff members continue to participate in teaching students, civic and other organizations about germplasm conservation and management, and the work done at NCRPIS.

Several staff members serve on advisory boards for various germplasm-related projects or organizations. The amaranth curator served as President of the Amaranth Institute.

NCRPIS staff traveled extensively to present lectures, attend and facilitate workshops, serve on advisory committees and review panels or establish contacts with foreign germplasm researchers.

NCRPIS's *Brassica* curator hosted the three-month training visit of Dr. Vijay Pal Singh, visiting FAO scholar from India.

Scholarship:

Our staff authored or co-authored 13 journal articles, made presentations at five scientific society meetings, and chaired two sessions of the C-8 Germplasm Symposia at the Agronomy Society Meetings in 2000. Publication covered the diverse areas of interest of our researchers, ranging from taxonomy of native and invasive plants, climatic adaptation of plants, molecular and biochemical characterization, host plant resistance, and plant pathology epidemiology and germplasm management issues.

V. SUPPORT TEAM REPORTS

a. Farm (L. Lockhart, L. Crim, J. Scheuermann)

General:

We supervised and coordinated daily operations at the NCRPIS farm. This includes management of all facilities, fields, and greenhouse space. We supervised or conducted 67 pesticide applications in the field and/or greenhouses. We responded to 97 maintenance requests from staff members at the farm and the campus location. We coordinated and scheduled the student labor force of 17.0 FTE's. We coordinated facility construction and upgrades.

Labor:

During 2000, 103 applications for hourly employment were received and reviewed. There were 65 interviews, resulting in 43 hourly employees hired. This is nearly a three-fold increase in the number of interviews conducted during 1999. We attribute this to the increase in full-time equivalents budgeted for FY2001 and the need to replace students lost to graduation. We had some difficulty attracting qualified candidates for fall harvest. We initiated a base pay raise to $7.50 per hour and were able to hire the number of employees needed. Our system of rewarding employees based on longevity and for working more hours seems to be reducing the rate of student employee turn-over. Currently there are 42 (16.3 FTE) part-time hourly employees working at the NCRPIS.

NCRPIS Farm Crew:

Lloyd Crim (Equipment Operator III) has been on staff since March 1998 and is primarily responsible for facility and field maintenance.

Jerry Scheuermann (Field Lab/Tech) has been on staff since Dec 1991 is primarily responsible for general farm equipment and vehicle maintenance.

Larry Lockhart(Station Superintendent II) has been on staff since 1985.

Jamie Voss, Matt McKenna, and Wes Haugebak (student employees) assisted the farm staff throughout the year.

Maintenance projects:

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

The Manager's Residence addition was completed in May. This addition included a bedroom and family room which has provided much needed additional space for the Superintendent's family.

Six old garage doors were removed from the head house and replaced with modern overhead doors, greatly improving accessibility and appearance of the building.

A moisture condensing system was added to the headquarters compressed air system. This system removes moisture from the air lines that often interferes with seed cleaning and packaging machines. The system works very well and has eliminated the time consuming chore of emptying moisture traps used with the old system.

The 1985 IH884 tractor used for planting and mowing received a complete engine overhaul.

A new heavy duty furrowing machine for cutting furrows around cages to facilitate screen installation was designed and constructed. This machine will replace a lighter weight version, previously designed and constructed by our staff. That machine proved to be a great labor saving device but also suffered a number of breakdowns during planting season due to insufficient structural strength.

A $250,000 fire suppression system is being installed in the headquarters building, cold storage rooms and the walk-in freezer. Project completion is anticipated in April 2001.

A central air conditioning unit was installed to control the increased temperature of the computer room in the headquarters building.

A tank room was constructed, insulated, and paneled to provide a place to install the Inergen tanks for the fire suppression system.

Purchasing:

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

1) new crew cab trucks for the vegetable, Brassica and bee crews
2) a 45Hp tractor for planting and opening furrows
3) A ‘gator’ utility vehicle was purchased for general farm use
4) a plasma cutter
5) a glass bead blaster for use in the shop.

Tours:

This past year, we organized and conducted 39 tours. There were 352 visitors to the NCRPIS during 2000.

Staff Training:

We conducted three Tractor Safety Training sessions and several worker protection standard training sessions.

Future Plans:

The next year promises to be a busy year with several maintenance and construction projects already in progress.

Completion of a $250,000 fire suppression system.

Construction of a 4800 sq ft addition to the machinery storage building.

Movement of dryers from existing lab/office building to new machinery storage addition and addition of 50% more dryer capacity.

Construction of a 20 x 50' cold seed storage unit addition adjacent to the

existing north cold seed storage room to accommodate the addition of the GEM project.

Replacement of the Kool-Cel cooling system in greenhouse number three.

Possible upgrade to irrigation systems, additional tiling of field and grading of waterways if fiscally possible.

Construction of a new parking area to replace parking area lost to new seed storage area.

b. Controlled insect pollination program (S. Hanlin)

Progress:

Cage pollination: A total of 757 cages were supplied with pollinators for controlled pollination of 845 plant germplasm accessions. Honey bees were used to control pollinate 638 accessions in the field. *Osmia* spp. were used to control pollinate 119 Brassicaceae cages and 36 horticulture cages in combination with honey bees. House flies were used in 21 cages of *Daucus* and 42 cages of *Coriandrum* in combination with honey bees. House flies were also placed into 16 greenhouse cages of *Daucus* and two cages of *Foeniculum*. Blue bottle flies were later used in the *Foeniculum* cages to replace the house flies. An estimated 75-90% of the caged accession regenerations utilizing pollinator insects successfully set seed.

Beekeeping: Honey bees were successfully over-wintered in the indoor wintering facility with a survival rate of 97% for the parent colonies and 54% for the nucleus colonies. These percentages are higher than last year's 85% survival rate for the parent colonies and 52% survival rate for the nucleus colonies. This winter, we placed 148 parent colonies and 206 double-story nucleus colonies in the facility. Forty-nine queens were purchased in July to increase our nucleus hive numbers and to add diversity to the bee stock. All queens to be used for queen rearing will be selected next spring from surviving colonies.

A random sample of 24 hives was treated with Apistan during the spring to detect Varroa mite levels in the hives. Mite population levels were found to be below economically significant levels in the spring, so complete treatment was not used on all hives. To prevent a possible mite outbreak during the winter, all colonies were treated with Apistan strips in the fall prior to placing them into the overwintering facility. Next year, "checkmite" or coumaphos will be used as a Varroa mite treatment rather than Apistan strips. A yearly rotation of several mite treatments will be started next year in order to prevent development of resistant mite populations in our bee stock.

All parent colonies were treated for tracheal mite in the spring using menthol crystals as a preventative procedure. No testing for tracheal mites was done this year due to use of resistant bee stock and detection of less than 1% tracheal mite infestation for the last several years.

Bombus: *Bombus* spp. was obtained on three separate occasions, a total of 27 queens were caught by the crew or by station staff during the spring. By early summer only 22% (6 queens) were productive. No colonies were used for controlled pollination this year and all surviving queens were released in the summer.

Megachile rotundata: No alfalfa leaf-cutting bees (ALC) were used this year to regenerate plant germplasm accessions. However, thirty domiciles of ALC were used for a cooperative research project with Dr. Reid Palmer.

Osmia cornifrons/Osmia lignaria: *Osmia* spp. were used to pollinate all Brassicaceae seed increase plots. *Osmia* spp. also were used to assist in the

pollination of several horticultural accessions during times of honey bee shortages.

Last year's purchased stock was of a lower quality because of disease problems occurring on the west coast. However, increases were comparable to last year. The number of straws filled or partially filled was 638. Because of the lower quality of bees purchased this year and a higher cost per bee, a new supplier will be used next year.

A new bee pasture location was used this year, a small private orchard owned by Dean Biechler. Eight domiciles were placed at this site. Populations in every domicile increased in most of the straws, so the site will be used again next year

Musca domestica: House fly rearing continues in the entomology growth chamber. An additional 200 pupae were obtained from the University of Wyoming, because of loss of the original colonies due to a malfunction which caused fluctuation in the heat and humidity in the rearing room. Additional fly pupae were obtained from the entomology department at ISU to increase colonies of flies. Three cages of house flies are presently maintained as production colonies to supply flies for pollination.

Cochliomyia macellaria
In December, 2000 pupae of blue bottle flies were purchased from a supplier in Idaho. The flies are thought to be a better pollinator than house flies which are presently being used. The flies were used in greenhouse cages of *Foeniculum*, and also will be used with accessions of *Daucus* in the greenhouse. Presently, a medium for egg laying and larval development is being researched.

Research:

A study comparing the media and procedures used at the University of Wyoming to the medium and process which has been used in the past at the NCRPIS for house fly ova-depositing was done. Results showed that the original medium used at NCRPIS was preferred by the flies and that the NCRPIS process made collection and distribution of pupae to cages easier.

For the second year, a comparison study between three different sized wood domiciles and PVC pipe domiciles was carried out at the Des Moines "Water Works Park". The results showed that *Osmia* showed little difference in preference between the PVC pipe and the larger wood domiciles, however, there was less increases in the two smaller sized domiciles. For next year, I will use only the larger wood domiciles and the PVC pipe for this study.

A comparison study was initiated using honeybees and two species of sunflower leaf cutter bee (*Megachile pugnata* and *M. apiculis*) The three pollinator species were randomly placed into small cages containing each a cultivated species of sunflower or one of two types of wild species. In addition, several *Oenothera* plants were placed in the cages containing *M. pugnata* to assist in the formation of the egg cases. In the first year, there appeared to be a slight advantage for the honeybees based on seed weight. *Megachile apiculis* showed the least amount of seed production, however this was possibly due to some seedling emergence problems. The cultivated species which was used showed seed production in all trials, which possibly was a result of self-pollination.

In the month of August, a comparison feeding study was done using four types or methods of feeding nucleus hives. The study occurred in the *Cucurbita* cages, with containers checked and refilled on a weekly basis. The container types or methods used consisted of 16 pint containers; 16 quart containers and 16 one-gallon buckets, which were placed on top of the cage. These new methods were compared to the original one-gallon method placed on the nucleus hive. The purpose of this study was to determine if less syrup could be used for feeding,

and also result in elimination of the problem of buckets falling or blowing off the nucleus, thus allowing bees to escape, resulting in potential pollination contamination. It was found that the quart containers provided the best solution for both problems. Quarts will be phased in as feed containers over the next two years, starting next spring.

As a possible assistance for keeping personnel cooler while wearing bee suits, a special designed "cool vest" was tried by all individuals on the bee crew. Each person placed the vest on at the beginning of the working day and removed it when it thawed. The vest was thought not to be of benefit by the crew, in that the vest's ice packs lasted only about two hours. Once thawed, the packs added an additional layer of clothing and weight, which is undesirable. One of the individuals commented that the vest was very uncomfortable to wear because frozen ice packs jabbed him in the ribs. Because of these findings, it was decided that there were other, more beneficial methods than the cool vest.

Cooperation:

A cooperative study was carried out in the months of July and August with Dr. Reid Palmer. The purpose of the study was to observe the attractiveness of soybean flowers to both ALC bees and honeybees. Thirty ALC domiciles were placed into a soybean test plot at the Curtis farm and eight double nucleus hives were set out in a separate test plot. This study was conducted to determine if either of these insects would be of use for a project using male sterile soybeans slated for 2001. Dr. Palmer made all observations and collected data from the plots. The NCRPIS entomologist supplied all insects needed in the project and the expertise for determining needed colony/domicile numbers. I also accompanied Dr. Palmer and Dr. Hunt Wiley of Dairyland Seed to Stein Seed Co., where variables associated with types of pollinators used with "male sterile" lines of soybeans were discussed.

In July, four double nucleus hives were positioned in a small experimental plot of *Cucurbita* managed by Dave Stevenson, an ISU food science graduate student. He was supplied with our extra hives or nuclei for pollination. These hives are used for nuc production throughout the summer; they accumulate pollen and nectar.

Presentations:

On January 9, I presented a talk on honey general bee biology and beekeeping techniques for honey production and pollination to the Gilbert 4-H (Franklin Happy Go Luckies).

Jim Robbins brought Lee May Shrow, a visiting scientist from China, on July 19. Ms. Shrow was interested in learning about which types of insects were used at the station for pollination in order to help her identify a pollinator insect for use with male sterile soybean lines used in her research. Ms. Shrow was shown the shop displays of domiciles and insects which are used, and also the fields where she could observe the insects in cages in several plots.

For most of the tours given at the station, a general overview is presented of the insects which are used for pollination and the domiciles which are used in conjunction with an informative display.

2001 Research plans:

To continue research on domicile preference of *Osmia* sp. at the Des Moines Water Works Park: This final year, only the PVC pipe domiciles and the larger wood domiciles will be used. Possible problems with interpretation could result if synchrony of the timing of the blooming of apple trees and the timing of bee hatching does not occur, with the potential result that neither of the domiciles would show an increase in population. Determination of the "degree days" required for both the blooming of the apple trees and the development and

emergence of the *Osmia* is needed.

To continue to research on the development of bumble bee colonies: This spring, *Bombus impatiens* queens will be caught rather than *B. bimaculatus*. A sight identification key will be used for separating and selecting the queens immediately after capture. The rearing and overwintering procedure which will be tested is presently being used at the University of Minnesota. Potential problems include possible failure of the colonies to buildup even though the same rearing methods are being used, or that *B. impatiens* will not be captured in this area. To prevent a possible lack of bees needed for pollination at the station, I have identified a bumble bee supplier and am prepared to purchase needed *Bombus impatiens* colonies.

To continue the sunflower pollination comparison study using *Megachile pugnata*, *Megachile apiculis*, and honey bees: A problem was found last year in that *M. apiculis* was thought to be an invasive species on the west coast. The individual which supplied *M. apiculis* indicated there was little concern in the use of the bees in Iowa, especially in a caged situation. However, USDA-ARS bee researchers at the "bee lab" in Logan Utah were concerned with continued use of these bees in the Midwest. I have decided to continue this study as last year, only with a different set of cultivated sunflower accession being used, because I believe our use does not pose undue risk. These bees are endemic to the United States.

To continue the cooperation with Dr. Reid Palmer to determine the attraction of *Megachile rotundata* and honeybees to male sterile lines of soybeans: We also hope to determine if there are possible wild solitary bees which pollinate soybeans, by making field observations and possibly capturing specimens for rearing. Lack of available time to make field observations and to collect wild bees increases the difficulty. The collection of the bees and rearing studies will probably be done by NCRPIS beekeeping personnel, however, observations could be made by Dr. Palmer's personnel.

A study will be conducted to investigate the use of other possible pollinators on crops grown at the NCRPIS. It will consist of setting up field plots of various species of accessions and making daily observations and recording the types of insect pollinators visiting different plant types, and current atmospheric conditions. If an insect appears to be a possible pollinator, specimens will be caught and rearing methods determined. The USDA-ARS "bee biology and systematics lab" in Logan UT will be contacted for assistance in the identification and rearing process. The lab will also be contacted for a list of documented pollinators which have been observed pollinating a specific species of plant. Little time is available to make field observations and collect insects, however, station staff have offered to assist the entomology crew as needed.

Research will be conducted to determine if different media combinations other than decaying materials can be used for ova-depositing by blue bottle flies. A successful medium must support not only egg production and collection, but resulting larvae must be able to develop and pupate. If it is found that the flies will only lay eggs and develop on decomposing organic materials, studies will be designed to determine if the blue bottle flies are actually better pollinators than house flies, and, if so, whether it is more economical to purchase the flies rather than try and rear them.

c. Computers and Telecommunications: (R. Luhman, M. Millard, R. Stebbins, R. Wilson)

Progress:

There were no problems related to Y2K turnover. This positive result was due to extensive efforts of several NCRPIS staff to ensure Y2K compliance of all systems before January 1, 2000.

Installation of a 128 Kbps frame relay circuit to connect NCRPIS operations with the GRIN system in Beltsville, MD was completed in February, 2000. The new equipment has not only greatly increased communication speeds, but has also resulted in greater stability of connectivity. Previously, we experienced frequent communication failures due to line problems; this posed serious challenges to productivity.

A new Gateway server was added to our inventory. This server has dual 800 MHz processors. The server has been very reliable.

A Quantum SnapServer was purchased for storage of data files.

A Mammoth 2 tape Drive and Backup Exec software has greatly increased our backup efficiency.

A 10/100 Ethernet switch running between our servers has increased the speed in which backups run.

Digital imaging of NCRPIS accessions has greatly increased in 2000. The purchase of four new digital cameras has aided in this endeavor.

A large flat bed scanner was purchased to increase the efficiency of corn imaging.

Four flat bed scanners with document feeders were added to inventory.

Fifteen desktop PC's were added to inventory. The cascade sequence involved the movement of 46 desktop PC's to optimize fit of capacity of hardware with users' needs.

Two laptop PC's were added to inventory.

Scripts have been written for searching our Intranet for image files.

Plans: We are continuing to investigate upgrading our server to Windows 2000. We are also considering upgrading our internal network to 100 MHz transmission.

d. Seed Research, Seed De-treatment, and Computer Application Development (D. Kovach)

Seed Research:

Research continued this year on *Angelica*. The main objective was to grow the plants through the summer, vernalize the plants in the fall, and then place the plants inside a greenhouse for flower development and seed increase. At this writing, the plants are in the greenhouse and some plants have initiated flowering. The Vegetable crew has taken responsibility for the greenhouse portion of this project.

Viability and literature review work was conducted on *Betula* seed. NSSL had reported some seed sent there for backup as 'non-filled' or 'non-viable.' Their findings were verified here and a literature search was conducted to determine the best method of evaluating seed quality for this genus. Results of the experiments and literature search were forwarded to Mark Widrlechner and Paul Ovrom.

Computer Application Development:

I developed many forms and reports as a result of a station 'In-House Process Review' conducted in February 2000. The main objective of the forms was to facilitate data entry for the curators and staff. Several of the forms are still in their early stages and will be refined as I receive user feedback. Other forms were received well and very little refinement was needed. The last group of forms received heavy use, much user feedback, and consequently has been refined and fined tuned to the users' needs. This feedback on the forms is of tremendous help in developing forms that meet the needs they were intended for.

The types of forms and reports developed were related to:

Brassica silique data.
Cucumis and *Cucurbita*.
Evaluation/Methods entry.
Germination order creation and data entry.
Observation descriptors entry form.
Order processing.
Pathogen test data.
Pathogen tests/Order processing related.
Several new and modified labeling abilities.
Special use forms for inventory count review work.
Special use forms for 'volume' filling for orders.
Sunflower observation and harvest data.

I also began the process of writing of some portions of a User's Manual for Oracle forms and reports. The process is still in its early stages. The manual is currently in hard copy form, but in the future the manual will also be added to our Intranet.

GRIN Database related:

At the request of Kathy Reitsma, the vegetable curator, I added NC7-cucumis and NC7-cucurbita descriptors to the GRIN database. We both agreed that a couple more descriptors are needed to adequately describe the *Cucumis* and *Cucurbita* crops. This will require some thought and probably more input from the Cucurbit CGC before adding more descriptors.

In preparation for using the new Sunflower observation forms, several sunflower observation descriptors were consolidated. This was approved by Mary Brothers, sunflower curator, and the Sunflower CGC. Irv Larsen tested a new form that uses the new descriptors and encountered no problems with this new format.

Equipment and facilities related:

A new labeler was purchased which allows for mechanized application of labels to packets and brochures.

AutoCAD plans were drawn up to facilitate room renovation and shop expansion plans. These plans allowed for discussion of ideas among the site personnel and for the transmittal of ideas to the area architect/engineer.

Supervision:

I assumed new general supervisory duties with the hiring of Scott Wike, as temporary Biological Technician position in August. The new person has been of great help to the curators in conducting seed germination tests, literature searches related to seed germination testing, and data entry.

EEO/HRM/CR:

In October, I completed a three-year commitment to the Ames Area ARS Civil Rights Committee.

Seminars, Trips, and Other Training:

Oracle Development Tools User Group 2000 Conference, Ft. Lauderdale, Florida, June 11-15, 2000. This was a national conference of computer application developers who use the Oracle Corporation's development tools. Of special benefit was learning short cuts and tools that helped speed the development of forms with our current software. Another benefit from the conference was learning what was coming down the 'pipe line' for new Oracle development tools. Lastly, I was able to meet with Erick Abadie, Gorm Emberland, and Quinn Sinnott, Oracle developers from the USDA Database Management Unit, who were also in attendance at the meeting. Their insight and advice was very helpful in how to proceed in the future.

Plans for 2001:

I hope to conduct research on breaking seed dormancy and optimal seed storage from harvested *Angelica* seed.

More forms and reports are in the plans for 2001. I hope to attend a training conference on several aspects of Oracle development tools and learn database management skills (April 29 - May 3, 2001).

I would also like to 'revisit' the forms already in use to improve them.

Lastly, I would like to learn the newer versions of the Oracle forms (especially the one to be released this year) and transfer our current forms to the new version.

e. Information Management: Germplasm Program Assistant (R. Stebbins)

Germplasm Collections

Acquisition:

The North Central Regional Plant Introduction Station (NCRPIS) acquired a total of 337 new accessions in 2000. Of these new accessions, 143 were received from within the National Plant Germplasm System (NPGS). The majority of these came from the National Seed Storage Laboratory (NSSL) in Fort Collins, Colorado. Included in this NPGS group were 79 accessions of *Zea mays* subsp. *mays* and 27 accessions of *Brassica*.

The remaining 194 accessions, received from outside the NPGS, included 60 accessions of ornamentals, 33 accessions of *Zea mays* subsp. *mays*, and 22 accessions of umbels. As new accessions are recorded on the Germplasm Resources Information Network (GRIN), an effort is made to include as much passport information as possible. Typical passport information would include a source history, cooperator records, collection site description, pedigree, secondary identifiers, and any other pertinent information provided by the donor.

Maintenance:

Assistance with curatorial management was provided by processing requests for taxonomic re-identifications and nominations of accessions to the inactive file. In total, 107 accessions received taxonomic re-identifications. Among these were 25 accessions of ornamentals, 21 accessions of umbels, and 20 accessions of *Amaranthus*. Also, 177 accessions were nominated for inactivation. The inactivations included 85 accessions of *Cucurbita* and 55 accessions of ornamentals.

Additionally, 745 accessions were assigned PI numbers. Included in this group were 447 accessions of *Cucumis melo*, 97 accessions of *Cucurbita pepo*, and 89 accessions of *Helianthus*.

Finally, 118 accessions were inactivated due to duplication. The inventory lots of these accessions were combined with the lots of their respective duplicates. This group included 56 accessions of *Brassica* and 53 accessions of *Amaranthus*.

Projects:

One of the first steps in obtaining a PI number for an accession is to proof the passport information for accuracy and completeness. Proofing passport information is an ongoing project that is secondary to logging in new material. This project involves locating paper files of accession information, corresponding with collectors and donors, Internet searches, and researching maps and GIS databases.

One of my projects involved working with Mark Widrlechner to prepare 27 accessions of ornamentals for PI number assignment. This required printing accession reports for the curator to proof. Any errors in GRIN were corrected and new reports were printed for a final check before requesting PI numbers. I also worked with Kathy Reitsma to update the passport data for 447 accessions of *Cucumis melo* from India in preparation for PI number assignment.

Working together with Rick Luhman, we completed the bulking of 125 *Brassica* accessions which were determined to be similar and therefore combined to form 19 new accessions.

Latitudes and longitudes were added for approximately 300 accessions of wild *Helianthus annuus* in cooperation with Mary Brothers and the Plant Exchange Office. Dr. Robert Webster, National Germplasm Resources Laboratory, is using these data to conduct an ecogeographic assessment of wild *Helianthus* germplasm diversity.

I spent four days in Texas during June as part of a team from NCRPIS to collect data from a corn research plot set up to test resistance to European corn borer.

I worked with the Archive Committee to reorganize old field books by genus.

I surveyed past NCRPIS annual reports for information regarding alfalfa. This information was used in a presentation by Stephanie Greene (USDA, ARS, Prosser, WA).

I coordinated communications with 12 foreign and domestic seed banks to request seed. The requests covered many different crops at NCRPIS.

I served as secretary of the Computer Committee. The committee is responsible for maintaining a modern and efficient computer system which includes budgeting, planning, repairing, and purchasing.

I served on the selection committee for the Germination and Corn Tech positions.

On a few occasions, I processed outgoing seed orders. I received training to accomplish this task when Linda Minor is out of the office.

Conclusions:

Compared to 1999, new accessions received at NCRPIS were down by 688 in 2000, a decrease of 67% from 1999. In maintenance areas, re-identifications were down by

54%, nominations to the inactive file were down by 87%, PI number assignments were up by 67%, and duplications were down by 6% compared to their 1999 levels.

All figures for acquisitions and maintenance were below the five-year average, with the exception of PI number assignments, which was 50% above average. This was due to the large group of Indian *Cucumis melo*.

f. Order processing (L. Minor)

During 2000, there were 887 orders entered into GRIN. A total of 28,395 packets was distributed to requestors and evaluators throughout the world. Of the total packets distributed, 22% of these were sent to foreign requestors.

The number of orders entered into GRIN this year was 2% greater than that of 1999. Packet distribution was up by 8,147 or ca. 98%. The number of requests received electronically this year was 347 compared to 299 in 1999.

We distributed 349 Initial Accession Performance Report forms in 2000. By the end of the year, 239 (68%) had been returned. The Summary Accession Performance Reports and Final Reports that were mailed out in 2000 totaled 182. Of these, 123 (68%) have been returned. The return rate on the Initial Performance Report forms remained nearly the same as that of 1999.

The Accession Performance Report Committee met and has begun modifying the report forms to capture more information. Development has begun on forms that will allow for electronic transfer of information.

Committees:

Accession Performance Report
Archives
Courtesy
Richard Wilson Retirement
Selection Committee for Office Automation Clerk

Training:

Microsoft Office - A One-Day Seminar, December 20, 2000

g. Seed Storage (L. Burke)

In 2000, 4041 lots were stored, including both newly received lots and those either regenerated at Ames or at remote sites. Inventories of 13331 lots were reviewed to insure correct seed amounts, and 3030 original lots were prepared for long-term freezer storage.

Seed orders prepared in 2000 included distribution, observation, germination, transfer and backup orders. There were 1111 lots (1091 accessions) sent to the National Seed Storage Laboratory (NSSL) for backup. Backup lots were either new accessions for NSSL or supplemental lots for previously supplied accessions. We distributed 28,395 packets to meet distribution and observation requests. Of these, 22,083 were distributed domestically and 6312 outside the U.S. Our largest seed order was a maize observation order that was sent for oil analysis with over 10,000 packets. We transferred 6 accessions (8 lots) to other NPGS sites.

Major projects for 2000 included: completion of the maize collection re-inventory; development of an efficient method for storing maize balanced samples; storage of 1600+ maize accessions donated by Pioneer; completion of the movement of the *Cucumis melo* original packets into the freezer for long term storage; and Lisa Burke's trip to NSSL to learn more about their operations and procedures and improve communications.

In 2000, 107 accessions received taxonomic re-identification. All these seed

samples were re-labeled by seed storage personnel. In addition, seed samples of 295 inactivated accessions were removed from the active collection and placed in inactive storage. PI numbers were assigned to 745 accessions with Ames numbers. New labels were made and cold storage locations and GRIN records were adjusted to reflect these changes. For 118 lots identified as duplicates appropriate changes were made to those packets and their locations and to GRIN.

Inventory actions	Lot activity	Order activity	Packets
NSSL backup	1111	Distribution + Observation	28395
Stored	4041	Domestic	22083
Count reviewed	13331	Foreign	6312
Lots prepared for freezer	3030		
Inactivation	295		
Taxonomic re-identification	107		
Duplications resolved	118		
PI number assignment	745		
Transferred accessions	6		

One full-time permanent federal employee, one full-time temporary federal employee and one part-time (20 hours per week for nine months) state employee staffed the seed storage department in 2000.

VII. Curatorial and Scientific Team Reports

a. Entomology (R. Wilson, S. McClurg)

Progress:

Field

Maize - European corn borer evaluations in Ames: Four hundred eighty-three maize accessions were evaluated for leaf-feeding resistance to first-generation European corn borer. Thirteen accessions were rated as resistant; most of these accessions are highly inbred lines developed in the United States.

A replicated test to measure the relative accuracy of single-plant versus single-row ratings for reporting first-generation European corn borer damage was conducted on three accessions. It appears that single plant ratings may be more indicative of the range of variation in resistance response for an accession.

One hundred maize accessions were reevaluated in a replicated test for second-generation European corn borer resistance. Stalk and shank tunneling was calculated and an ANOVA-2 performed in MSTATC. There were highly significant differences between entries for both shank and stalk tunneling distance. In comparison to B52 resistant check means, 47 accessions had shank tunneling length means less than the check and 5 accessions had mean stalk tunneling length less

than B52. The five accessions demonstrating significantly less stalk tunneling were mostly tropical in origin.

Cooperative research:

In cooperation with personnel from our local Corn Insects/Crop Genetics Unit, and Frank Krupla of South Texas Ag Research, a second-generation European corn borer evaluation of seven accessions from Peru and Ecuador, five derived lines developed by Craig Abel (ARS, Stoneville, MS), and two checks were conducted in Raymondville, TX.

We tested fifteen accessions of maize for Craig Abel in our Ames location in a

replicated trial for both first and second-generation European corn borer resistance.

Sunflower - A replicated retest of forty-three accessions of cultivated sunflowers previously reported as resistant to sunflower moth was conducted in the field in Ames. Data collection is in progress.

Cooperative research:

In cooperation with S. Hanlin, M. Brothers, and I. Larsen, three accessions of sunflower were evaluated for effectiveness of pollination by three bee species, including two species of sunflower leafcutter bee, in a replicated field test in Ames. Data collection is in progress.

Brassica - Thirty-nine accessions were planted in a field plot in Rosemont, MN (space courtesy of David Ragsdale, University of Minnesota) for evaluation of green peach aphid feeding. Natural populations of aphids were not as high as expected; damage was not heavy on most accessions.

Cooperative Research:

Thirty-eight accessions of *Brassica* were planted in Fargo, ND by cooperator Denise Olsen (North Dakota State University). Three accessions were noted as resistant to flea beetle feeding damage. Two of the accessions were *B. napus*, the third was *B. fruticulosa* subsp. *fruticulosa*. One of the *B. napus* accessions was from South Korea, the other two accessions originated in Germany.

Five hundred and eighty-one *Brassica* accessions were planted in the field at Hermiston, OR with the cooperation of Gary Reed (Oregon State University). R. Wilson evaluated the plants for damage by natural populations of cabbage aphid. Resistance was noted in thirty-one accessions. Of these, twenty-five accessions are *B. rapa* or *B. rapa* subspecies; twelve of these *B. rapa* accessions originated in India.

Laboratory

Sunflower - Using field cages to evaluate wild sunflowers for sunflower moth resistance is not time and space efficient; a laboratory evaluation may be a desirable alternative. One hundred and two laboratory diets containing lyophilized sunflower heads from 1999 Ames field plots were prepared. Measurements of sunflower moth larval and pupal weight and development time data were analyzed. Plans for additional diet trials were developed.

Cooperative research:

Maize - Seven accessions from Peru and five checks were grown in Isabela, Puerto Rico in a continuing attempt to determine the chemical resistance factors detrimental to European corn borer. Several stages of plant material were collected by cooperators and sent to Ames for lyophilization. The dried material will undergo chemical extractions by Mark Berhow, (ARS, Peoria, IL) and artificial diets will be prepared by Corn Insects/Crop Genetics personnel in Ames.

Rearing - A colony of sunflower moths is being maintained at NCRPIS in order to provide sufficient numbers of insects for the field and laboratory evaluations.

A colony of green peach aphids is being maintained in the growth chamber in order to provide sufficient numbers of insects for greenhouse evaluation of *Brassica*.

A small colony of Madagascan cockroaches was maintained for use in educational presentations.

S. McClurg attended an insect rearing workshop in Starkville, MS in September, 2000. Participants from around the United States, Mexico, Canada, Switzerland and the Netherlands learned principles of mass-rearing quality insects. Valuable contacts were established and much technical information was gained. Ongoing correspondence has been maintained with several of the workshop attendees to improve insect rearing at NCRPIS and other facilities.

Greenhouse

Brassica - Fifteen accessions of *Brassica* that showed field resistance to cabbage aphid in Oregon in 1999 were grown in a replicated retest to evaluate for green peach aphid resistance. Of these, only one accession was rated as resistant. Ames 23087, *B. fruticulosa* subsp. *fruticulosa* from Germany, is one of the accessions that also showed resistance to flea beetle in the field in North Dakota.

Activities:

Presentations:

We participated in NCRPIS station tours by demonstrating the host plant resistance evaluation and enhancement programs to various visitors throughout the year.

Publications:

Wilson, R.L., C.A. Abel, and M.E. Brothers. 2000. Comparing species of bees for controlled pollination of *Helianthis petiolaris* in field cages. J. Iowa Acad. Sci. 107:1-2.

Abel, C.A., R.L. Wilson, B.R. Wiseman, W.H. White, and F.M. Davis. 2000. Conventional resistance of experimental maize lines to corn earworm (Lepidoptera: Noctuidae), fall armyworm (Lepidoptera: Noctuidae), southwestern corn borer (Lepidoptera: Crambidae), and sugarcane borer (Lepidoptera: Crambidae). J. Econ. Entomol. 93:982-988.

Wilson, R.L. and S.G. McClurg. 2000. Preliminary work on making laboratory diets for determining resistance to sunflower moth using lyophilized sunflower heads. Proc. 11th Great Plains Sun. Ins. Wrkshp.: 59-63.

Abel, C.A., M.A. Berhow, R.L. Wilson, B.F. Binder, and B.E. Hibbard. 2000. Evaluation of conventional resistance to European corn borer (Lepidoptera: Crambidae) and western corn rootworm (Coleoptera: Chrysomelidae) in experimental maize lines developed from a backcross breeding program. J. Econ. Entomol. 93:1814-1821.

Manuscript review:

During 2000, R. Wilson peer-reviewed several manuscripts for colleagues and reviewed manuscripts for the editors of the Journal of Economic Entomology, and the Journal of the Kansas Entomological Society.

Department activities:

R. Wilson regularly attended faculty meetings and seminars held in both the Entomology and Agronomy departments at Iowa State University, Ames. He also served on several Agronomy Department committees, including: Agronomy Department Building Committee, Plant Breeding Panel, Greenhouse and Growth Chamber Committee, and the P&S and Merit Staff Awards Committee.

R. Wilson continues his service on a graduate committee for one Ph.D. candidate (Ted Wilson) in Entomology at Iowa State University.

Other:

R. Wilson serves as the primary resource person for entomological problems on amaranth in the United States. Growers and professionals often request information from him regarding insect problems they encounter on amaranth.

Plans for 2001:

The retirement of Research Entomologist, R. Wilson, in December, 2000 has created a great challenge for our project, as we are presently unable to replace him with another scientist of similar expertise. The coming year will be an appropriate time to reevaluate the services that our project has provided to NCRPIS curators and other cooperators and determine the most appropriate direction for the future. Research Technician, S. McClurg will continue host-plant resistance evaluations in the field, laboratory, and greenhouse with the collaboration of NCRPIS curators and cooperating scientists from other ARS units as deemed appropriate by the Research Leader, C. Gardner. These evaluations include: reaction to first and second-generation European corn borer and corn earworm in maize, sunflower moth in cultivated sunflower, *Lygus* bug in amaranth, and green peach aphid in *Brassica*. R. Wilson has agreed to act as a consultant in the field evaluation of *Brassica* in Oregon. S. McClurg will use time saved via a reduction of field work effort to process, archive and make data publicly available from past evaluations. We hope to develop an effective method of evaluating cucumber beetle resistance in the NCRPIS cucurbit collection; evaluation of cucurbitacin levels will be completed before continuing work on field evaluation methods. S. McClurg will also become more involved in support activities for the NCRPIS insect pollinator program, assisting in the rearing and placement of bees and flies, as well as providing cooperation in new pollinator studies proposed by S. Hanlin and NCRPIS curators.

b. <u>Horticulture (M.P. Widrlechner, P. Ovrom)</u>

Germplasm Collections

Acquisition:

During 2000, we received 70 new accessions of ornamentals (Table 1). The largest groups were all of woody landscape plants, resulting from additional collections made by Ukrainian collaborators as a follow-up to our 1999 exploration (12 accessions), donations for possible inclusion in the NC7 Regional Ornamental Trials presented by the Dawes Arboretum (11 accessions), and wild collections from the Russian Far East donated by the Minnesota Landscape Arboretum (8 accessions). We also took advantage of heavy seed crops in 2000 by collecting native oaks and maples growing on calcareous soils in north central Iowa.

Maintenance:

<u>Availability</u>:

During 2000, approximately 41% of the ornamental collections and 50% of the mint family plants were available for distribution (Table 1). These figures are nearly the same as those reported in 1999.

<u>Back-up:</u>

Approximately 29% of the ornamental collections and 48% of the mint family plants

are duplicated at NSSL (Table 2), nearly the same as reported in 1999.

Regeneration:

Regeneration efforts expanded greatly in 2000, beginning in 1999 with the establishment of a 100-cage, three-year field planted with 185 accessions. The harvests listed in Table 2 include 136 successful cage increases (17 annuals and 119 perennials), 42 woody ornamental seed increases, and 1 herbaceous seed increase in isolation. There were also 38 accessions of woody plants established from seeds. The number of ornamental accessions regenerated in 2000 greatly exceeded any previous year.

Viability Testing:

In 2000, 106 ornamental accessions were tested for germination (Table 2), bringing the total number of active, ornamental accessions tested in-house to 537 (22% of the collection). As part of the inactivation process, we also initiated germination tests on *Alnus* and *Betula* accessions that were thought to be inviable based on test results reported by NSSL and/or by Dr. William Graves at Iowa State University. Our test results contributed to the inactivation of eight accessions of *Alnus* and *Betula* in 2000.

Distribution:

As summarized in Table 3, during 2000, 596 “order items” included all the distributions for the NC7 Trials (described in the following section), along with 54 plants, 560 cuttings and 314 packets of seed, which were distributed to fulfill other requests for ornamental plant germplasm. In addition, 37 seed packets were distributed of mint family germplasm. The 314 packets of ornamental seeds distributed encompassed 51 genera; those most in demand were *Betula* (49 packets), *Alnus* (31 packets), *Echinacea* (28 packets), *Spiraea* (23 packets), *Gypsophila* (20 packets), *Antirrhinum* (18 packets), and *Aronia* (17 packets). The number of packets distributed for *Echinacea* greatly underestimates the demand for this genus, which is a very popular subject for both ornamental and medicinal plant research.

Historical Summary of Distribution Activity:

Crop	Years	No. of Orders	No. of Recipients	No. of Items Distributed	No. of Accessions Distributed
Ornamentals	96	57	52	282	117
	97	85	69	520	269
	98	92	84	531	234
	99	92	83	658	272
	00	84	79	596	282
Mint Family	96	1	1	11	11
	97	3	3	33	18
	98	10	10	85	47
	99	3	3	8	8
	00	3	3	37	35

Characterization/taxonomy:

During 2000, the draft descriptor list for *Echinacea* was tested and a datalogger used in the cage field to collect ca. 3600 evaluation and characterization data points on 94 accessions (Table 4). These data were used to help verify taxonomic identifications. The initial data set has been proofed; and we are now in the process of refining the descriptor list for approval by the New Crops Crop Germplasm Committee. Approval of the descriptor list will enable loading of an extensive data set into GRIN in 2001, which will allow the research community to gain a better understanding of our collections and increase the efficiency of their use in research.

All other herbaceous ornamentals in the cage-increase field, and many of the tree and shrub accessions being regenerated, were checked to verify identifications. In all, 25 accessions were re-identified. During 2000, with the assistance of Robert Stebbins, 32 images of ornamentals were added to our local database (see Table 4), bringing the total number of ornamental images to 309. These will be loaded to GRIN in the coming year.

Evaluation:

In collaboration with William Graves, at Iowa State University, Horticulturist, Mark Widrlechner, to participate as co-Primary Investigator on grants received from the Horticultural Research Institute in 1999 and from the ARS National Program Staff in January 2000 to conduct research evaluating *Betula* and *Alnus* species for drought and flooding tolerance.

During June and July 2000, five *Betula* and four *Alnus* species were subjected to repeated drought and flooding events in the greenhouse. Two *Betula* species died rapidly after their rooting zones were flooded. Flooding reduced leaf area and visual health ratings for certain other taxa. Drought treatments did not kill any accessions, but did reduce leaf area for two *Alnus* species. Results are being prepared for loading into the GRIN database and for publication.

The following evaluation data (see Table 4) were received from NC-7 Trial Site

Cooperators and loaded to our Internet database (described further in the section “Coordination of the NC-7 Regional Ornamental Trials”).

Reports of planting (12 accessions distributed in 2000):
ca. 800 data points

One-year reports (11 accessions distributed in 1999):
ca. 2180 data points

Ten-year reports (13 accessions distributed in 1990):
ca. 1260 data points

Enhancement:

There was no major progress to report with enhancement activities in 2000.

Coordination of the NC-7 Regional Ornamental Trials:

Plant Distribution - In 2000, 601 plants of twelve accessions were distributed to 26 sites for long-term evaluation, with an additional 244 plants provided to arboreta and botanic gardens.

Computer-generated, "One- and Ten-year Performance Report" forms were distributed to trial-site cooperators this spring. Five updates were emailed or sent to trial cooperators in 2000 to inform them about recent developments in the testing program. One of the major developments that links us more closely to trial sites is the existence of our NCRPIS home page. Paul Ovrom has made considerable progress in expanding our web site by posting trial results, images of trial plants and other information about the trials on the Internet. Evaluation results for plants distributed in 1984-89 and descriptions of all plants distributed for testing between 1990-2001 are now available through this site. Our web site was featured in an article published in the September 2000 issue of Agricultural Research magazine and in the December 2000 issue of HortIdeas. The NC-7 Trials were also publicized through oral and poster presentations in 2000, as described below.

Many of the tree and shrub seed collections made in September 1999 in Ukraine are being germinated and cultivated for long-term testing in the NC-7 Trials, with two overall goals: finding well-adapted, new landscape plants for the North Central Region and testing scientific hypotheses about the relationships between soils, climates, vegetation patterns and woody plant adaptation. The first of these accessions will be distributed to Trial Sites in 2001.

In May 2000, Paul Ovrom delivered plants and met with cooperators at three trial sites in Ohio, two in Illinois and one in Iowa. In all, 101 plants of 12 accessions were delivered.

Germplasm activities in crops other than those curated:

Nine requests for accessions with special horticultural or agronomic characteristics were handled by Mark Widrlechner, resulting in the distribution of 164 packets of seed and 5 Cuphea accessions as cuttings.

With the help of Robert Stebbins, Germplasm Program Assistant, the Station’s acquisition of new germplasm from Indices Seminum and from the USDA-NRCS Plant Materials Centers was coordinated.

Mark Widrlechner continued work on a statistical analysis of germplasm demand

patterns for the period 1988-1999 for ten major NCRPIS crops in conjunction with efforts by Lisa Burke and the curatorial team. Data have been assembled, graphed, and interpreted, and results will be summarized for publication in a peer-reviewed journal in 2001. A better understanding of patterns of germplasm distribution can be used to refine managerial strategies for germplasm regeneration and maintenance.

In his role as Co-major Professor, Mark Widrlechner has continued to guide Amalio Santacruz-Varela in a research project to elucidate patterns of genetic and morphologic variation among New World popcorn germplasm. Amalio completed his survey of isozyme variation and made excellent progress on the collection of SSR marker data in 2000, and hopes to finish his dissertation in 2001.

Throughout the year, Mark Widrlechner actively participated in a university-industry-ARS collaboration to establish the Ornamental Plant Germplasm Center (OPGC), a new National Plant Germplasm System site in Columbus, Ohio, which will focus on the conservation of herbaceous ornamental genera. He serves as the Agency's representative to administer a Specific Cooperative Agreement between ARS and The Ohio State University to fund the OPGC. He also served on a committee to select a permanent Director and Curator for the OPGC. These new hires will be on staff in Columbus early in 2001.

In 2000, Mark Widrlechner chaired our internal Seed Infestation Prevention Committee (SIPCO) and compiled a brief report reviewing the use of below-freezing temperatures to control insects in stored seeds. Recommendations from SIPCO led to changes in the way that our Station handles incoming seed samples in order to better control insects.

Mark Widrlechner's other research and training activities:

Collaborations continue with Welby Smith of the Minnesota Department of Natural Resources in preparing a treatment of *Rubus* for a new book on the woody plants of Minnesota and with the staffs of herbaria at the University of Wisconsin, National Arboretum, and Ohio State University to identify and document their *Rubus* collections.

After being contacted by Dr. James Dinsmore, at Iowa State University, Mark Widrlechner prepared a climatic and geographic analysis of the native distributions of exotic woody plants known to be established in Iowa. Parts of the world with climatic conditions similar to Iowa also are home to trees and shrubs that have become invasive in Iowa. This work was presented in October to the Symposium on Invasive Plants and Animals in Iowa, sponsored by the Iowa Academy of Science, and has been submitted for publication.

Working with colleagues at Iowa State University, he continues to assist with the documentation of the flora of Ames and its dynamics by verifying the identification of woody plants and by making field collections, often in the vicinity of the Plant Introduction Farm, a potential introduction source for exotic plants. He coauthored a paper describing the flora of Ames, which has just been accepted for publication by the JIAS and three presentations on this project, two given at the 2000 annual meeting of the Iowa Academy of Science and another at the Symposium on Invasive Plants and Animals in Iowa, on historical changes in the occurrence of native and exotic species in the Ames flora.

Other Horticultural project training activities:

Other important aspects of training for the Horticulture project include course work for keeping pesticide applicator's licenses current and improving database skills. Paul Ovrom and Mark Widrlechner attended pesticide continuing education at the Iowa Shade Tree Short Course in March and a training sessions in December. In November, Paul attended a course on use of Access software, which he was able to apply to the management of the NC-7 Trial website.

Communications Activities:

Manuscript and Proposal Review:

Mark Widrlechner served as a peer reviewer for manuscripts submitted to Seed Technology, Genetica, and the Proceedings of the North American Prairie Conference, as a USDA peer-reviewer for papers from other ARS scientists, and as an informal reviewer for a manuscript from a scientist in the Czech Republic. He also assisted Candice Gardner in reviewing a manuscript for Plant Breeding Reviews and plant exploration proposals for the Plant Exchange Office in Beltsville, and reviewed a Small Business Initiative Research proposal for USDA-CSREES.

Posters, Presentations and seminars:

Norris, William, Deborah Lewis, Richard Pope, Mark Widrlechner, and Jimmy Thompson. 2000. Patterns of invasion and extirpation in the Ames, Iowa flora (1850-1999). Invited talk presented to the Symposium on Invasive Plants and Animals in Iowa, Ames, IA, 6 October.

Ovrom, Paul and Mark Widrlechner. 2000. USDA-ARS NC-7 Regional Woody Ornamental Trials. Poster presented at the 50th Annual Meeting of the Eastern Region International Plant Propagators' Society, Oakbrook, IL, 1 October.

Widrlechner, Mark P. 2000. Choosing appropriate plants - can the Internet help? Invited talk presented to the 44th Annual Shade Tree Short Course, Ames, IA, 15 March.

Widrlechner, Mark P. 2000. Finding and evaluating new landscape plants for the north central states. Invited talk presented to the 2000 Northern Plant Symposium, East Lansing, MI, 15 September.

Widrlechner, Mark P. 2000. The role of environmental analogs in identifying potentially invasive woody plants in Iowa. Invited talk presented to the Symposium on Invasive Plants and Animals in Iowa, Ames, IA, 7 October.

Publications which appeared in print in 2000:

Dosmann, Michael S., Jeffery K. Iles, and Mark P. Widrlechner. 2000. Stratification and light improve germination of katsura tree seed. HortTechnology 10: 571-573.

Fuentes-Granados, Roger G., Mark P. Widrlechner, and Lester A. Wilson. 2000. Inheritance studies of aromatic compounds in *Agastache foeniculum* (Pursh) Kuntze. J. Essential Oil Res. 12: 581-594.

Lewis, D.Q., W.R. Norris, M.P. Widrlechner, J.D. Thompson, and R.O. Pope. 2000. The dynamic flora of a midwestern city 2: History of collecting the vascular flora of Ames, Iowa since 1858. Program Abstracts 112th Session Iowa Academy of Science, Des Moines, 21-22 April, p. 13.

Norris, W.R., D.Q. Lewis, M.P. Widrlechner, J.D. Thompson, and R.O. Pope. 2000. The dynamic flora of a midwestern city 3: An analysis of floristic change and plant collection patterns in Ames, Iowa since 1858. Program Abstracts 112th Session Iowa Academy of Science, Des Moines, 21-22 April, p. 13.

Widrlechner, Mark P. and David A. Kovach. 2000. Dormancy-breaking protocols for Cuphea seed. Seed Science & Technology 28: 11-27.

Departmental Activities:

Mark Widrlechner continued as an active member of the Crop Seeds Committee and the Plant Breeding and Genetics Advisory Panel of the Agronomy Department at Iowa State University and as a member of a Horticulture Department Committee on the management of the Reiman Gardens. He collaborated on the development and revision of a multi-disciplinary proposal, involving Iowa State University, the University of Iowa, and the PI Station, to request $5.5 million (direct costs) from the NIH to create a Center for Research on Botanical Dietary Supplements. He also served on an interdepartmental committee to develop and conduct a World Bank training session on sustainable agriculture at Iowa State University in 2000.

Mark Widrlechner continued to serve as Co-major Professor for one Ph.D. candidate in Plant Breeding, Amalio Santacruz-Varela, and completed service as a committee member for an M.S. student in Botany, James Watkins, who graduated in June 2000.

Conclusions and Plans for 2001:

Curation

Our expansion of ornamental regeneration efforts, which began in 1999, is producing significant results. The number of successful ornamental regenerations was higher in 2000 than any time in the past twenty years. Much of that effort focused on seed multiplication of *Echinacea*, and the products of those efforts include all known taxa, which will be made available to the research community in March 2001. We have also made considerable progress in testing a draft descriptor list for *Echinacea*; the results of which should be posted on GRIN in 2001.

In 2001, we plan to establish a new three-year cage field for recently acquired *Echinacea* collections along with other herbaceous ornamentals and aromatic, mint-family plants.

With the establishment of the Ornamental Plant Germplasm Center (OPGC) in Ohio and the hiring of permanent staff, we expect that many of our herbaceous ornamental collections will be transferred to the OPGC during the coming year. We will ensure that the inventory and passport data for transferred collections are in the best possible condition. These transfers should allow us to focus more closely on a smaller set of herbaceous ornamental genera, especially on those genera that also have medicinal, aromatic or industrial uses, and on woody landscape plants. This topic will be discussed further in our upcoming external review and at the Herbaceous Ornamental and Woody Landscape Plant CGC meetings in 2001. We will host the Woody Landscape Plant CGC's meeting in June 2001.

Research

Considerable progress was made on the following four research projects during the past year: analysis of geographic range and invasiveness of non-native woody plants in Iowa in relation to climatic analogs, description of the flora of Ames, statistical analysis of patterns of germplasm demand, and evaluation of alders and birches for tolerance to drought and flooding stress. By the end of 2000, two publications were in press: a paper describing our understanding of the flora of Ames, Iowa since the 1850s and one on the occurrence of an Old World species of *Rubus* discovered recently in Iowa and Michigan. Two other papers were at journals undergoing review: a paper describing the 1999 Ukrainian plant exploration and one analyzing the native ranges of invasive, non-native woody plants in Iowa in relation to climatic analogs.

Research efforts during 2001 will focus on expanded studies of the interaction between climate and adaptation of woody landscape plants, and completion of work on the evaluation of stress tolerance in alders and birches and investigations of patterns of germplasm demand. Mark Widrlechner will also participate in ongoing studies on the genetic diversity of our germplasm collections, including research on popcorn by Amalio Santacruz-Varela and sunflowers by Mary Brothers. Studies will also continue on the biosystematics of *Rubus* and the dynamics of the local flora, with special attention paid to the role of exotic species.

Staff Development

During the summer of 2000, Paul Ovrom was promoted to GS9 and given additional responsibilities for the coordination of the NC-7 ornamental trials. As part of his professional development during the coming year, Paul plans to attend the Shade Tree Short Course, the Eastern Region IPPS meeting, specialized computer training and possibly an ISU course on Molecular Biology Techniques, Genetics 542.

In 2001, Mark Widrlechner plans to visit the Western Regional Plant Introduction Station in Pullman, Washington to observe their operation, looking for “take-home” lessons that can be applied to our efforts.

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

Research Progress:

Field and Greenhouse

Amaranthus evaluation for Phomopsis leaf and stem blight:

Evaluation of 86 amaranth accessions, from 24 species, was done in replicated field trials to compare greenhouse reaction to field reaction for *Phomopsis* leaf and stem blight. Disease reactions in the field were nearly identical to those in the greenhouse. All *A. tricolor* accessions tested to date have been very susceptible. Plants typically die from stem canker within 2-3 weeks of infection. Some *A. tricolor* accessions contain a small percentage of plants that resist or at least delay the stem girdling - Ames 15325, Ames 15326, Ames 5135, Ames 23273, and PI 349553.

Species identity of the amaranth Phomopsis:

Phomopsis identification is difficult, particularly for isolates from little-studied hosts. Therefore, two isolates were sent to Dr. Amy Rossman at the Systematic Botany and Mycology Laboratory at Beltsville, MD for inclusion in a taxonomic study. We have not obtained species determination beyond the initial indication that the fungus is a *Phomopsis*. This isolate is different from *Phomopsis* isolates used in biological control studies of weedy amaranth in

Florida.

Search for weed or crop hosts of Phomopsis spp.:

Heavy *Phomopsis* infections on *A. tricolor* are routinely observed in late July/early August at Ames, but the inoculum source is unknown. Leilani Robertson, a summer intern from the ISU Plant Health and Protection curriculum, conducted a search for alternate crop or weed hosts. Numerous weeds and crop plants were tested. Soybeans were studied in particular because of their association with *Phomopsis* diseases. Reciprocal inoculations of soybean isolates onto amaranth and amaranth isolates onto soybean showed no cross-compatibility. The only alternate host identified for our *Phomopsis* isolate was *A. retroflexus* (redroot pigweed).

Maize germplasm evaluation:

A 3-year project was initiated, supported by funding from the USDA-ARS area office at Peoria, to evaluate subsets of accessions from the NCRPIS maize germplasm collection for reaction to a variety of foliar diseases and ear mold pathogens. Pathologists at three universities, five private seed corn companies, and one USDA-ARS location cooperated in the screening project. Public cooperators were compensated at $3.00/row. The private company pathologists generously contributed their work. A total of 2274 maize accessions were evaluated for one or more of the following diseases: northern corn leaf blight, eyespot, common rust, gray leaf spot, Stewart's wilt, maize dwarf mosaic virus, *Fusarium* ear rot and *Gibberella* ear rot. Data will be made publicly available via GRIN <www.ars-grin.gov/npgs>.

Four hundred accessions were planted at the PI station, in two replications, to screen for Stewart's wilt resistance. All were popcorn accessions except 44 PVP inbreds. High levels of common rust (*Puccinia sorghi*) and an extended period of hot, dry weather interfered with disease ratings on some accessions. Eight plants per row were rated for Stewart's wilt and the results were averaged. None of the PIs' resistance ratings were as high as those of the resistant hybrid checks, but several were very close. All accessions with an average score of 3 or less (on a 1-9 scale) will be retested in 2001.

Sunflower genetic enhancement:

An additional cycle of evaluation and selection for resistance to *Alternaria helianthi*, *Septoria helianthi*, and powdery mildew was completed in two populations of wild *Helianthus annuus*. *Septoria* disease pressure was exceptionally high, providing an excellent opportunity to identify and cull the more susceptible plants. Resistant plants were allowed to randomly intermate via open pollination. Seed was harvested from ~105 plants from population ASPM1 (***A****lternaria*, ***S****eptoria*, **p**owdery **m**ildew resistant) and from ~55 plants from population ASPM2. No further selection is planned and the two populations will be released as public breeding populations.

Sunflower germplasm evaluation for disease resistance:

One hundred and twenty-eight wild *H. annuus* accessions were evaluated for resistance to *Alternaria helianthi* and *Septoria helianthi* resistance in Ames this year. In earlier trials, Dr. Tom Gulya (USDA-ARS, Fargo) had identified downy mildew and rust resistant accessions from this group. The *Septoria* screening environment was excellent. *Alternaria* did not establish well enough to rate for resistance, possibly because *Septoria* incidence was so high. All accessions from WA, ID, CA, ND, AZ, and NM were highly susceptible, with many plants killed by late July. Most of the promising accessions came from TX, with a few from IL and KS.

Cucumber disease resistance evaluation:

One hundred and forty-eight *C. sativus* accessions from India (1992 Indo-US

collection trip) were evaluated in the field for anthracnose resistance (*Colletotrichum orbiculare*) and in the winter greenhouse for powdery mildew resistance (*Sphaerotheca fuliginea*). Three PIs - 606003, 606029, and 606037 - had a moderate level of anthracnose resistance, <5.0 on a 1-9 scale, but all of the others were highly susceptible. No powdery mildew resistance was found.

Laboratory research

Erwinia stewartii populations in infected maize seeds:

We are using quantitative ELISA to estimate bacterial populations in *E. stewartii*-infected maize kernels. About 2400 individual kernels have been tested and 182 infected kernels have been identified. Some kernels had ELISA signals that were too weak to be detected at dilutions commonly used in testing labs. The signal was lost when the samples were diluted from 2 ml of buffer to 100 ml. By determining the frequency of these low-dose kernels, we will be able to compensate for them by developing better sampling procedures for Stewart's wilt seed health testing.

Curator support - disease notes and phytosanitary activities:

Plant disease inspections were conducted in the seed-increase plots for amaranth, *Brassica*, cucurbits, sunflower, and maize. All accessions were inspected and the notes are used to confirm the presence/absence of diseases of phytosanitary importance.

Amaranthus notes:

All of the amaranth seed increases were conducted in the greenhouse. No disease problems were observed other than *Pythium* damping-off. Increased *Pythium* damping-off and wilting problems seem to be associated with a switch to a commercial soil-less greenhouse planting mix.

Brassica and related genera notes:

All plants in the regeneration plot cages were inspected during early July 2000. Some black rot infection (*Xanthomonas campestris* pv. *campestris*) was noted in 3 *Brassica rapa* accessions and in 3 *Brassica juncea* accessions. Powdery mildew (*Erysiphe cruciferarum*) severity was very high overall, to a level where it may have caused premature plant death in some accessions. There was also a heavy aphid infestation in the plots.

Cucumis sativus and C. melo notes:

The seed increase cages (49 cucumber, 87 melon, 31 wild *Cucumis*) were inspected on July 18, Aug 10 and Aug 29. The only noticeable disease on July 18 was *Cercospora* leaf spot, caused by *Cercospora citrullina*. The level of leaf infection was high enough that a chlorothalonil (Bravo) spray was applied, essentially stopping disease development.

Anthracnose developed fairly late in the season (after Aug 10), but damage was confined to a few accessions. A second fungicide spray during mid-August may have been warranted. A fairly high number of melon accessions had symptoms of bacterial leaf infection, caused by the watermelon fruit blotch pathogen. All affected accessions were tagged, and the seed was treated during processing with a 15 minute 1% hydrochloric acid (HCl) seed wash. Powdery mildew was not observed until late August and little leaf damage resulted. No other diseases were observed.

Cucurbita pepo notes:

All pumpkin and squash seedlings were tested for squash mosaic virus (SqMV) by

ELISA before transplanting to the field. Forty-eight accessions (1307 plants) were tested and four infected seedlings were detected.

In addition, all seedlings from 40 accessions of *C. melo* (original seed) and 38 accessions of *C. sativus* (original seed) were tested for SqMV. No infected plants were found. Testing of plants grown from original seed was done to prevent the potential introduction of new virus strains.

Sunflower notes:

The main disease of phytosanitary concern in sunflower is downy mildew, caused by *Plasmopara halstedii*. All seeds were treated before planting with Allegiance fungicide (metalaxyl). No downy mildew has been observed since we began using a seed treatment in 1998. No downy mildew was found during two field plot inspections. We removed two plants that were infected by *Sclerotinia*.

Septoria leaf blight caused significant defoliation in many wild accessions by mid-August, but did not affect the cultivated accessions. We have often observed a pattern where wild accessions exhibit resistance to *Alternaria* leaf blight and susceptibility to *Septoria* leaf blight. The reverse is common for cultivated accessions. Possible reasons for this difference are unknown.

Maize notes:

Stewart’s wilt symptoms were found early in the season. The disease caused significant damage to about 35 of 211 accessions. Beginning in early August, we inspected every plant in each row (two inspections) of the inbred and population fields and marked infected plants with orange spray paint. The curator excluded plants with symptoms of systemic infection from the seed increase harvest. Sixty-eight of the 211 accessions had no Stewart’s wilt symptoms on any plants.

Common rust was the other noticeable disease in the plots. Because of the time it took to conduct the Stewart’s wilt survey, no additional disease notes were taken except common smut incidence.

Ornamental notes:

Charles Block and Mark Widrlechner inspected the *Echinacea* field cages in May for aster yellows. All suspected positive plants were removed from the cages. Aster yellows disease is transmitted by leafhoppers, but is not known to be seed transmitted.

Several *Diervilla* plants (woody ornamentals) in the shade house tested positive for tomato ringspot virus. We suspect that these plants were infected upon receipt from the supplier.

Laboratory seed health testing:

Seed lots often require testing before they can be shipped internationally, per phytosanitary requirements of the importing countries. The number of accessions requiring lab testing was lower in 2000 than in 1999. The plant pathologist wrote 23 additional declarations (ADs) certifying freedom from pest problems based on field inspection or lab testing. The ADs are attached to phytosanitary certificates issued by USDA-APHIS.

Communication Activities:

Meetings attended:

Charles Block attended presentations on corn and soybean insects and disease problems at 22nd Annual Seed Technology Conference held at Ames, Feb. 2000.

Charles Block attended the annual meeting of the American Phytopathological Society in New Orleans, August, 2000. He was appointed to serve on the APS Seed Pathology Committee.

Charles Block attended the American Seed Trade Association Corn and Soybean Research Conference, Chicago, Dec. 6-8, 2000. The NCR-25 Corn and Sorghum Pathology committee meeting was held in conjunction with ASTA. He gave reports to the NCR-25 and maize CGC on corn research at NCRPIS and on the maize germplasm evaluation project.

2001 Project Plans:

In cooperation with the maize curator, we are contacting cooperators and planning a second year of evaluation for a variety of corn diseases. Evaluations will be conducted by cooperators at public universities and at private seed companies. Our role will be to (1) assemble test arrays of germplasm; (2) distribute accessions; (3) receive and process evaluation data for entry into GRIN; (4) distribute data in other forms to cooperators and the maize breeding community; and (5) provide seed of promising accessions for further testing and development.

We plan to conduct Stewart's wilt evaluations in field plots. We are well equipped to conduct this research. The only planned change is to inoculate at an earlier growth stage to make plant ratings easier.

The two disease-resistant sunflower populations will be prepared for release as public breeding populations.

We will work with Tom Gulya and Robert Webster to identify potential correlations between ecogeographic variables and one or more disease resistance traits in wild *Helianthus annuus*. It may yield insight toward testing additional PIs in the collection or if necessary, to collect at sites that are thought to harbor populations with good disease resistance.

We continue to work with Kathy Reitsma, the vegetable curator, on a project to assess the feasibility of a non-destructive seed assay for *Acidovorax avenae* subsp. *citrulli*, i.e. seed washing and agar plating on selective media. Little is known about the longevity of the pathogen in stored seed and possibilities for seed treatment or eradication.

We will do anthracnose screening of additional cucumber and melon accessions in the field this summer, focusing mainly on material collected recently in China.

We will process 50-100 additional infected kernels (1200-2500 total kernels) in the study on *E. stewartii* bacterial populations in corn kernels. We estimate that these kernels will add enough data points to complete the study.

We will investigate selective agar media for *E. stewartii*. ELISA works well for detection, but does not indicate whether bacteria are alive. There is need for a selective medium that limits interference from *Erwinia herbicola*.

At the end of 2000, we began implementing an Oracle data form (written by NCRPIS' Dave Kovach) that allows the pathology staff to enter laboratory seed testing data and field observations directly into GRIN. We are working with Dave Kovach to customize the form to better fit our needs. Creating new definitions (pathogen codes) is one area that needs further work. Determining whether to base the code

on the common disease name or on the pathogen name, which may change, is a major issue. Use of these forms will get data into GRIN more quickly and give Linda Minor up-to-date information, allowing order processing to proceed more efficiently.

d. Zea Curation (M. Millard, G. Crim, L. Pfiffner)

Construction:

The two maize technicians, G. Crim (ISU field tech II) and L. Pfiffner (federal temporary tech) consolidated their working area into the maize processing room, freeing up a room at the farm for technical staff for other projects.

Equipment:

A new flatbed Epson flatbed scanner was purchased in fiscal 2000 with a bed size of 12.2 X 17.2 inches. The bed of the scanners currently being used is 8.5 x 14 inches and required from 5 to 9 images to scan the 25 ears of accessions with larger ear sizes. This new scanner is twice as fast and allows all 25 ears to be captured in 3 images. This frees a significant amount of manual labor for other tasks.

A 900 MHz Pentium III computer was purchased for the imaging room to replace the station's first Pentium, purchased in 1993 that ran at 90 MHz. Although the imaging room is primarily used by the maize staff for imaging ears and kernels, other NCRPIS projects are encouraged to do their imaging work there also and they often do.

M. Millard (ISU maize curator II) received a new 900 MHz Pentium III. L. Pfiffner (federal temporary tech) received the curator's 600 MHz Pentium III. G. Crim (ISU field tech II) received a new 600 MHz Pentium III computer last year. These new computers are also equipped with CD writers, which are used for data archive.

Personnel:

A temporary federal maize technician, Lisa Pfiffner, joined the maize project in May 2000. Ms. Pfiffner's appointment is for a maximum of two years, and was created to alleviate workload constraints in the absence of a second, permanent ISU Field Technician. T. Ladjahasan's (ISU field tech II) employment was terminated by ISU in July 2000. We hope to be able to fill the second full-time ISU technician position during 2001.

Research Progress:

The first GEM accession (GEMS-0001) was released by ARS in June 2000 for distribution by the NCRPIS. It has demonstrated resistance to first generation European corn borer. The resistance mechanism is not related to DIMBOA concentration. It was extracted from PI 503806 (Piura 144) from Peru. During fiscal 2000 GEMS-0001 was distributed to 15 cooperators.

In February 2000, the NCRPIS spent a week reviewing data acquisition procedures on all crops held at the NCRPIS including maize and the entomology and pathology programs. The purpose of this review was to describe all NCRPIS data collection, capture, management and communication methodologies. Each curator or scientist presented a summary of their project's activities, data collection, analysis and management procedures. Each person identified progress benchmarks and also additional resource needs, software, hardware, personnel needs, and infrastructure bottlenecks and methods to improve data capture efficiency were identified. Other staff members with common interests learned about data capture as well as capture methods and technology. Input was sought as to the value of

this data and the methodology used. Unit wide priorities were set so that resources could be designated for prioritized data acquisition projects. The maize description process involves a high deal of complexity and detail, which consumes a large amount of resources. It is the belief of the RL that this process is not sustainable in the long term, and that new alternatives must be explored.

Acquisition:

During 2000, Table 1 shows 112 accessions received, down from the 278 accessions received last year. Most of the accessions fall into two groups, those originally held only at NSSL and new CSR (Crop Science Registered) accessions.

Regeneration:

There were 200 accession regenerations attempted in 2000 in Ames; this compares with 274 in 1999 and 174 in 1998. Regenerations included 124 populations and 76 inbred lines. The season started out warmer and drier than average. Conditions supported Stewart's wilt infestation in a number of Southwestern U.S. landraces that are evidently highly susceptible to Stewart's wilt. Otherwise, dry conditions at optimal temperatures punctuated with timely rains most of the season resulted in an above average nursery. Drier conditions at the end of the season abruptly ended maize development, but later accessions benefitted from the earlier, warmer conditions. Seed quality and pollination success for the entire nursery was above average, and the harvest was completed earlier than at any other time in the curator's memory.

Over 5000 seeds were harvested from each of two *Zea perennis* accessions alternately grown in pots in the greenhouse in isolation in the winter and outside in summer in 2000. This taxon produces fewer seeds per plant, so this was a very successful increase. PI 217407 (Ladyfinger Pop) was grown in the greenhouse from original seed to determine whether some sweet kernels that were observed in more recent increases were contaminants. No sweetcorn was observed on selfed plants and a successful increase of 8000 kernels was obtained. Plants from this increase will be sib-pollinated in future increases. Ladyfinger is one of the NCRPIS's most important accessions since it was the original source of the Ht gene and has a very unique plant and ear type.

Two hundred fifty six accessions were received from the St. Croix quarantine nursery in fiscal 2000. One hundred thirty seven were planted in fiscal 2000. Planting of maize on St. Croix in 2000 was slowed to allow other species to be planted on St. Croix and to allow the NCRPIS to catch up on a processing backlog from earlier regenerations. Miguel Serrano, a research entomologist at the station, has been acting as coordinator for the quarantine nurseries since Ms. Ester Peregrine left in April 1999 to join the soybean germplasm group at Urbana, Illinois.

Pioneer and Novartis each increased 10 accessions at their facilities on the island of Kauai, Hawaii. Regenerations of accessions adapted to mid and lower elevations were quite successful, while those originating from very high elevations were not. The NCRPIS is very grateful for this assistance and thankful that it will continue in 2001.

As in 1999, no accessions were received by the NCRPIS in 2000 from NPGS funded nurseries on Puerto Rico. Dr. Linda Pollak's staff increased two accessions on Puerto Rico for the NCRPIS. The NCRPIS funded and planted 20 accessions in 2000 for harvest in 2001 at the Illinois Crop Improvement Association nursery facilities near Ponce, Puerto Rico.

Maintenance:

Table 1 indicates that maize availability is up 2% from last year. This

represents a turnaround of the situation that occurred last year where the number of accessions available actually decreased for the first time in the curator's memory. This is largely attributable to increased processing efforts, which eliminated a large portion of the backlog awaiting processing.

There was no significant activity in backing up accessions at NSSL in 2000. Only a small shipment of 42 *Zea* accessions was made to NSSL in 2000. We plan to review approximately 1000 accessions of *Zea* for PI-number assignment in 2000. These will then be shipped to NSSL. PI assignment before shipment to NSSL increases the efficiency of the entire backup process.

Viability testing in 2000 11% (1,847) was down 52% in maize (Table 3) from the 21% (3,557) tested in 1999. Supervision of viability testing was transferred to a new technician responsible for supervision of all testing at the NCRPIS. This position was filled later in the year and the transition took some time before viability testing could resume at 1999 levels. During this time, the labor that was previously designated for testing was used to accelerate regeneration processing. We expect to resume viability testing of 20% of accessions annually in 2001.

Distribution:

We distributed a whopping 17,022 packets (Table 3) in 2000 compared to 4,545 packets on 2,809 accessions in 1999. Seed packet distribution in 2000 reflects the large number of packets distributed for oil analysis and pathology observations. Without these large projects, we distributed 3,404 packets compared to the previous 5-year average of 4,457 packets. This still represents a significant amount as the accessions were distributed to 182 cooperators compared to the previous 5-year average of 154.

CROP	Year	No. of Orders	No. of Recipients	No. of Items Distributed	No. of Accessions Distributed
Maize	1996	251	179	4415	2776
	1997	202	160	5034	3281
	1998	178	137	3297	2184
	1999	231	167	4545	2808
	2000	257	192	18103	10982

The NCRPIS sent over 10,000 accessions to the Pioneer/Dupont lab of Dr. Richard Bergquist, located at Savoy, Illinois, where NIR oil analysis was performed on this seed. The seed samples were returned to the NCRPIS at Pioneer/Dupont's expense for further analysis. The NCRPIS seed shipping staff is commended for this work. It was necessary to get the seed to Pioneer/Dupont before their fieldwork started after only a single month's notice so that the analysis did not interfere with their pollinations.

The NCRPIS sent over 4,000 packets of almost 2,300 accessions to nine pathologists for disease screening. Again, this job was beyond the normal level of maize shipping activities.

Characterization

Imaging work continues at a high speed in 2000. Mr. N. Golder, computer intern, created a search engine for the local image database. The first images were placed on GRIN and further preparatory work was performed on the raw images for

loading into GRIN in 2001. Over 26,000 images have been obtained on each of 7,223 accessions since digital imaging began in 1996.

There were 7,513 images obtained on 2,190 accessions in 2000, a 3.4

image/accession ratio, compared with 6,502 images on 3,256 accessions in 1999, a 2.0 image/accession ratio. This reflects the fact that more images are obtained per accession during processing, and in 2000 more accessions were processed than in 1999. This number of images would have been even larger had we not converted to a scanner with a larger surface area. More accessions were scanned in 1999 because we did a single kernel scan on accessions that had previously not been imaged. This process was done in combination with the preparation of seed samples for germination. In 2000, fewer germination tests were done, therefore fewer accessions were imaged.

Maize images were loaded onto the GRIN database for the first time in 2000, making them available to the Internet public. Seven hundred twenty five accessions have a scanned kernel image on GRIN.

Evaluation:

An NIR analysis for oil was performed on almost 10,000 accessions by Pioneer-Dupont in the lab of Dr. Richard Bergquist located at Savoy, Illinois. The data were provided to the NCRPIS and will be loaded into GRIN. Many thanks to Pioneer/Dupont for this effort. Below is a table of the distribution of oil values. These values are confounded with seed types and seed colors. At this time, the NCRPIS is working with the GEM quality traits lab of Dr. L. Pollak to determine the meaning of these values. We are currently running NIR analysis on approximately 200 accessions at both the high and low ends of the oil value distribution. So far, it appears that a different calibration may be needed for accessions with a high amount of red or blue kernels. It also appears that values from normal white or yellow kernels are very reproducible across the two labs. NSL 117227 (Alexho S K Synthetic C20) had an oil value of 13.2% and 12.8% in the Pioneer-Dupont and GEM lab respectively.

Oil Values	Number
< 1.0%	9
1.0 <= X < 2.0%	22
2.0 <= X < 3.0%	216
3.0 <= X < 4.0%	1656
4.0 <= X < 5.0%	3839
5.0 <= X < 6.0%	2810
6.0 <= X < 7.0%	697
7.0 <= X < 8.0%	299
8.0 <= X < 9.0%	97
9.0 <= X < 10.0%	15
X > 10%	7

A comprehensive program for screening for disease resistance among the accessions held in the NCRPIS maize collection was initiated in fiscal 2000. There were 2,274 accessions distributed among nine public and private institution pathologists in 4,000 packets. Dr. C. Block, NCRPIS pathologist, and the maize curator traveled in September 2000 to the Pioneer research facility at Winterville, North Carolina, where they conduct anthracnose stalk rot and *Fusarium* ear rot screenings. We then visited the gray leaf spot screening nursery of Dr. E. Stromberg at Blacksburg, Virginia. Both locations grew evaluation trails for the NCRPIS maize program.

There were 500 accessions evaluated for first generation European corn borer in 2000.

There were 100 accessions evaluated for second generation European corn borer in 2000. This was a replicated retest of accessions previously thought to be somewhat resistant the second generation European corn borer.

Two replications of a large preliminary observation planting of 456 accessions from the United States were planted in Ames in 2000. The purpose of the planting was to observe the variability among U.S. maize races, to determine useful accessions for an evaluation of the U.S. races of maize, and the resources needed to complete such a study. Maturity, plant height, and ear height data were recorded. Dr. W. Salhuana and maize scientists and graduate students from Iowa State University and the University of Missouri were invited to observe the planting.

Communication:

As a result of the data acquisition and management review, the GRIN (Germplasm Resources Information Network) database management unit (DBMU) was invited to the NCRPIS in June 2000 to observe current data handling procedures and to discuss enhancements to GRIN that the NCRPIS thought necessary to make GRIN more useful to NCRPIS staff and NCRPIS customers. The maize curator, who is also the GRIN liaison for the NCRPIS, helped manage this visit for optimum effect, especially for the maize program.

The maize curator (in his role as the GRIN liaison) demonstrated Oracle forms used in maize program data acquisition to both the Plant Germplasm Operations Committee (PGOC) in July 2000 at Beltsville, Maryland and at the GRIN users meeting in October 2000 at Beltsville, Maryland. The intent was to share methodology with other NPGS (National Plant Germplasm System) sites so that other sites can be enlisted in making GRIN more useful to NPGS sites and their customers. The maize curator also took part in the GRIN users' meeting in activities designed to improve the data entry capabilities of GRIN. The objective is the inclusion of more data in GRIN and improved accessibility to NPGS customers. It was announced at this meeting that extensive changes to the public GRIN interface could not be completed until these data entry capabilities were improved.

2001 Project Plans

Acquisition:

More GEM accessions are expected to be released for distribution by the NCRPIS in fiscal 2001.

The NCRPIS will begin procuring the core accessions designated by CIMMYT and published in CD format from the LAMP project that have not already been incorporated into the NCRPIS collection. Also, the NCRPIS will try to fill gaps in races not held currently. Additionally, more of the Caribbean accessions will be acquired from CIMMYT.

The NCRPIS will finish acquiring from NSSL some 700 accessions of U.S. populations and inbred lines that are not held in Ames. NSSL has reviewed their holdings of U.S. accessions not held in the active collection at Ames. When this is complete, NSSL will not hold any significant number of accessions that are not also being distributed either by the NCRPIS or CIMMYT.

The NCRPIS will continue its program of acquiring public materials and previously Crop Science registered accessions from public institutions. The curator needs to acquire accessions from Indiana, Missouri, Nebraska, and Kansas programs in 2001.
Regeneration:

Regenerations in Ames will be maintained at 200-250 accessions annually. Resources need to be increased to allow for 300-400 accessions to be increased annually in the future or re-directed within the maize project to facilitate accomplishment of this goal.

The private sector will again be asked to help increase tropical accessions during their off season. Two companies contributed winter nursery resources in fiscal 2000 and one company has offered to increase 10 accessions at 3 sites in fiscal 2001. The NCRPIS is approaching other companies to increase between 10 and 100 accessions per year. The NCRPIS is restarting its tropical maize increases during fiscal 2001 with 20 accessions planted on Puerto Rico.

NCRPIS will work with CIMMYT and Peruvian collaborators to achieve regeneration of highland tropical accessions that cannot be regenerated in environments currently available to us.

Quarantine regenerations on St. Croix will be resumed during the second half of fiscal 2001.

Maintenance:

Viability tests will be maintained at 3,000 per year, allowing the collection to be completely tested on a five-year rotating basis.

There are some 600 regenerated accessions that will be processed in the first semester of 2001 from previous St. Croix increases. This backlog will be processed before the regeneration program is increased above current levels. This will complete the processing of backlogged regenerations.

We will again attempt to back up the last of the Goodman tropical increases from Mexico in fiscal 2001 at NSSL and distribute 500 kernel samples to CIMMYT. Additionally, we are going to send several hundred accessions from other LAMP countries which the NCRPIS received, but which CIMMYT has not yet received.

We will try to send several hundred accessions of maize to CIMMYT representing landraces from the U.S. This will assist CIMMYT’s ability to serve as an international center for maize germplasm. It will also indicate to the world the U.S. position in freely sharing farmer varieties. We have plenty of seed on hand of most of these landraces since increasing them at the 100-ear population size generates plenty of seed.

The NCRPIS, NSSL, CIMMYT, and Dr. Wilfredo Salhuana will work on a continuing project to develop a consolidated list of the holdings of the various countries’ collections, the CIMMYT collection, and U.S. collections in order to identify materials that may be at imminent risk of loss.

Evaluation:

The maize curator will continue to work with the NCRPIS pathologist and interested private and public pathologists in systematically obtaining data on maize pathogen resistance in the collection. NCRPIS and private in-kind support should allow for preliminary observations to be obtained on 4-5,000 more accessions in 2001. Additional evaluation information will result in more effective use of accessions in the future.

e. 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 can be found in Table 1. In 2000, 545 vegetable accessions were assigned PI numbers including 448 *Cucumis* collected in India in 1992 by Staub and McCreight and 97 *Cucurbita pepo* from various donors and origins. Inactivations included 12 inviable *Cucumis sativus* accessions received as remnant seed from a deceased breeder's collection, and 85 *Cucurbita pepo* accessions primarily from two collection trips (Mexico and Spain) for which we received small original seed samples or poor quality seeds. Attempts to re-acquire accessions from donors were unsuccessful.

Acquisition:

Thirty new accessions were received and are listed by site-crop in Table 1. Twenty-three of these accessions were received as a result of a 1999 collection trip by P. Simon and T. Kotlinska to Poland, and included *Cucumis*, *Cucurbita*, *Daucus*, and *Pastinaca*. Dr. Simon's collection trip to France, Spain, and Portugal has been approved for funding in 2001, and while *Daucus* germplasm collection is the primary goal, other genera will also be collected.

Maintenance:

Actual numbers for regenerations attempted and accessions harvested are found in Table 2. The majority of the 2000 *Cucumis sativus*, *Cucumis melo*, and *Cucurbita pepo* regenerations focused on accessions with low seed quantities for distribution. With the arrival of 281 new accessions from Simon and Kotlinska's collection trip to Greece, Poland, Syria, and Turkey in 1999, Daucus regeneration efforts have primarily been directed towards making newly acquired accessions available.

A cage field of various wild species of *Cucumis* was planted in 2000 in an attempt to see if some of the wild species could be successfully and safely regenerated in the field using honey bees in contrast to regenerating the accessions in a greenhouse using more expensive and labor intensive hand pollination. Of the 50 cages, we were able to harvest fruit from 24 cages. The field will be monitored in 2001 to see whether any of the species may pose weed problems.

As accessions are regenerated, seed samples are sent to NSSL for back-up. Half of the vegetable collections have better than 70% of their accessions backed up at NSSL, two collections have nearly 60%, and two have under 35% duplicated at NSSL (Table 1). We received substantial original seed quantities on many of the new *Daucus* accessions, and these may be sent to NSSL for back-up after viability testing.

In 2000, we performed a total of 351 germination tests (Table 2). Most of the tests were conducted on seed increases from the 1999 regenerations. Several new original seed lots having large seed quantities were also tested for potential use as back up samples for NSSL.

Distribution:

Packet and accession distributions for *Cichorium*, *Cucumis*, *Cucurbita*, *Daucus*, *Ocimum*, and *Pastinaca* are summarized in Table 3. In 2000, 2520 packets (items) were distributed for these vegetable crops. This is below the five-year average of 3470 packets, but the requests have been more targeted for specific accessions or for accessions having specific characteristics or disease resistance. Distribution history for the last five years can be found in the following table.

Crop	Calendar Year	No. of Orders	No. of Recipients	No. of Items Distributed	No. of Accessions Distributed
Cichorium	1996	3	3	76	72
	1997	4	3	22	20
	1998	4	4	76	39
	1999	6	5	123	115
	2000	5	5	52	52
Cucumis	1996	19	15	3697	1799
	1997	21	19	2910	1866
	1998	18	17	1585	996
	1999	21	21	3066	2085
	2000	23	22	1555	1235
Cucurbita	1996	4	4	15	11
	1997	15	15	275	249
	1998	15	15	114	98
	1999	16	15	170	137
	2000	19	18	457	363
Daucus	1996	14	11	377	254
	1997	13	11	271	204
	1998	19	16	922	525
	1999	20	16	487	337
	2000	11	11	211	209
Ocimum	1996	2	2	108	67
	1997	3	3	91	46
	1998	7	7	211	72
	1999	7	7	206	88
	2000	7	7	245	75
Pastinaca	1996	0	0	0	0
	1997	2	2	16	13
	1998	0	0	0	0
	1999	2	2	8	8
	2000	0	0	0	0

Characterization and Taxonomy

Digital images, along with basic notes for taxonomic identification and accession characterization, are recorded during regeneration (Table 4). Data for approximately 17 descriptors, primarily fruit descriptors, are recorded at harvest for *Cucumis* and *Cucurbita* accessions. Data will be loaded to GRIN for the cucurbit crops once their descriptor lists have been revised and approved by the Cucurbit Crop Germplasm Committee. All four RPIS's currently have

responsibility for various *Cucurbita* species, and each station uses a different set of descriptors. A standardized list of characterization descriptors will be presented for approval at the next CGC meeting. Images will be made available on GRIN once the NCRPIS Imaging Committee establishes guidelines for naming and loading images to the database.

In April 2000, all of the historical observation data from the old NC7-CUCUMIS and NC7-CUCURBITA crop groups from GRIN2 were converted and loaded into GRIN3, resulting in the addition of 14,891 observations to GRIN (Table 4). Approximately 1,100 observations are not included in Table 4 since accessions linked to those historical observations are no longer assigned to NCRPIS. An additional 1,311 observations recorded for downy mildew and gummy stem blight evaluations on *Cucumis melo* were also loaded into GRIN. Also, data loaded previously for gummy stem blight were updated to include sample size and means.

With the assistance of the Dr. Mark Widrlechner (Horticulturist), taxonomic identities are reviewed and confirmed as each accession is regenerated. The 2000 re-identifications included: 14 *Cucumis* to 1 *Lagenaria* and 13 other *Cucumis* species; 20 *Daucus* to 1 *Daucus carota*, 13 *Caucalis*, 4 *Orlaya*, and 2 unidentified Apiaceae; 4 *Cucurbita pepo* to *C. moschata*. The *Lagenaria* and *C. moschata* accessions were transferred to the SRPIS in Griffin, Georgia.

Evaluation/Utilization:

Dr. Charles Block (Pathologist) continued to screen all *Cucurbita* seedlings grown for regeneration for the presence of virus infection with an ELISA protocol before seedlings can be transplanted to the field. He also visually inspected all cucurbit field plantings for disease during the 2000 growing season. Seed-borne diseases are of specific interest, with bacterial fruit blotch in *Cucumis melo* being of greatest concern since phytosanitary issues have prevented the distribution of *Cucumis* germplasm to some countries. Dr. Block also evaluated 148 *Cucumis sativus* and 386 *Cucumis melo* accessions for resistance to powdery mildew and anthracnose.

We are awaiting oil analysis and DNA fingerprinting data for the NPGS Ocimum collection from Dr. Katerina Svoboda and her student Senga Kyle, at The Scottish Agricultural College Auchincruive, Ayr, Scotland, UK.

Future Plans:

Regenerations: A large planting of 74 *Cichorium* accessions is planned for the summer of 2001. The taxonomy of these accessions will be reviewed and plant images will be taken for inclusion in GRIN. Thirty new accessions of biennial *Daucus* were started in the greenhouse in October 2000 for summer 2001 field cages, and an additional 50 new accessions of annual Daucus will be direct seeded into a summer regeneration field for increase and taxonomic verification. The number of field regenerations for *Cucumis* and *Cucurbita* will remain fairly constant as we continue to increase accessions where distribution quantities and percent germination have fallen below critical values.

Germinations: In April 2001, viability testing will be performed on seed lots resulting from the 2000 cucurbit regenerations. Viability testing will continue during the summer months on the 2000 *Daucus* and *Ocimum* regeneration lots, and on 5-year germination testing to monitor the viability of the distribution lots in the vegetable collections.

Characterization: Revised descriptor lists will be developed for *Cucumis* and *Cucurbita* by working with members of the Cucurbit Crop Germplasm Committee and other NPGS cucurbit curators. Once the descriptor lists have been approved, Oracle forms can be developed to assist in loading newly acquired characterization data and existing characterization data into GRIN.

Evaluation: The Pollinator Program and the Vegetable Program will collaborate on some small pollinator tests. One test involves evaluating whether blue-bottle flies will pollinate umbels more efficiently than do houseflies in greenhouse isolation cages. A second evaluation is tentatively planned on the wild species of *Cucumis* in greenhouse isolation tents.

f. Crucifers and Grasses (R. Luhman and S. Bruner)

The collection:

Thirty-three new *Brassica* accessions were added to the active collection during calendar 2000 (Table 1). Nineteen of the new *Brassica* accessions are bulks we created from second year grow outs of 263 accessions received from the National Center for Agricultural Utilization Research in 1988. These bulks were based upon two years of field morphological comparisons, oil analyses and other seed characterization data. The remainder of the new *Brassica* accessions included four *B. juncea* collected in Poland, five *B. carinata* donated from Spain, three *B. napus* accessions (one collected in Poland and two CSR accessions from the United States), one *B. rapa* accession collected in Poland, and one *B. tournefortii* accession collected in Spain. Sixty Brassica accessions were inactivated in 2000 and 18 accessions were reactivated.

New crucifer accessions included one *Thlaspi* accession collected in France, two *Alyssum* accessions (one collected in Portugal and one collected in the United States), one *Hesperis* collected from Finland, one *Camelina* collected in France, and one *Sinapis* collected in Spain. Six crucifer accessions were inactivated in 2000.

New *Setaria* accessions included three accessions donated from China, and five accessions donated from the United States. Fourteen *Setaria* accessions were inactivated.

One *Panicum* accession was inactivated during calendar 2000.

Percent of material available has changed very little in calendar 2000 (Table 1).

Regeneration and Maintenance:

The 2000 regeneration included species from the Brassicaceae and from the wild *Linum* collection (Table 2). There were no regeneration attempts for the millet collection. Thirty-four *Brassica* accessions and 52 miscellaneous crucifers were actually started in the greenhouse in the year 2000. Two additional *Brassica*, four additional crucifer, and eight additional wild *Linum* accessions were started in 1999 with the goal of producing seeds in 2000. Thirty-three *Brassica*, 54 miscellaneous crucifer and seven *Linum* accessions were harvested in 2000. Twenty-seven of the miscellaneous crucifer harvests were from 1999-2000 over-wintered accessions. Eight accessions started for the 2000 growing season have been overwintered for possible harvests in 2001.

Germination testing of the entire *Brassica* collection was initiated in 2000 (Table 2). It had been seven years since the last germination. The results of the 2000 germination tests have shown that several *Brassica* accessions are showing signs of deterioration. Status of accessions in which the percent viable seeds have fallen below 70 has been changed to not available; these are high priorities for 2001 regeneration. We also have completed five year germination tests of *Crambe*, *Lepidium*, and *Eruca* accessions.

The percentage of the *Brassica* collection backed up at the National Seed Storage Lab changed little from 1999. Material sent to NSSL either replaced lots currently held by NSSL with better quality seed or provided new material.

Distribution:

During 2000, we distributed 1128 packets domestically and 1208 packets internationally of the crops that I curate (Table 2). This represents 891 accessions domestically and 1143 accession internationally. Most of the orders (62%) were for *Brassica*. The table below indicates that there has been an increasing number of *Brassica* orders over the last five years. However, the number of *Brassica* accessions distributed has remained relatively constant, suggesting that orders for *Brassica* are becoming more focused. The focus has been primarily related to the increased orders for phytoremediation work. There are four *Brassica* accessions that I generally supply for phytoremediation requests. These four accessions come out of a paper published by Kumar et. al. in 1985 titled Phytoextraction: The Use of Plants to Remove Heavy Metals from Soils.

Crop	Year	No. Of Orders	No. of Recipients	No. of Items Distributed	No. of Accessions Distributed
Brassica	1996	31	29	944	801
	1997	39	36	2267	973
	1998	36	32	1560	1201
	1999	53	46	2181	1123
	2000	69	56	1245	862
Crucifers	1996	17	14	461	308
	1997	17	13	334	297
	1998	18	17	403	303
	1999	15	13	299	227
	2000	16	15	72	66
Echinochloa	1996	2	2	16	16
	1997	0	0	0	0
	1998	8	7	52	46
	1999	2	2	9	8
	2000	5	4	166	149
Flax.wilds	1996	3	3	24	11
	1997	0	0	0	0
	1998	2	2	19	19
	1999	3	3	26	16
	2000	0	0	0	0
Grasses	1996	1	1	1	1
	1997	2	2	4	4
	1998	3	3	11	9
	1999	1	1	1	1
	2000	0	0	0	0
Panicum	1996	2	2	12	12
	1997	4	4	52	47
	1998	7	7	34	34
	1999	2	2	7	7
	2000	9	8	58	49
Setaria	1996	6	6	187	164
	1997	6	6	251	235
	1998	7	7	57	51
	1999	7	6	27	26
	2000	13	12	795	757

Observations:

We continued to perfect digital imaging methods for crucifers during maintenance (Table 4). Photographs are generally taken at full flower in JPEG format, downloaded to our server, and manipulated with Adobe PhotoShop. We are also continuing to record images of silique samples. Silique images are scanned in TIFF format. The NCRPIS Imaging Committee is developing standards for loading

images to GRIN. Once these standards are in place, plant images from the last two years and silique images from the last three years will be loaded to GRIN.

Observations were recorded during regeneration, and plant samples were taken for later observation data (Table 4). Silique sample data became much easier to enter into the GRIN database with the development of an Oracle form designed for this purpose by David Kovach. Observation data entered to GRIN during 2000 contained data from the 1999 and the 2000 growing seasons. One-thousand ninety one observations representing 98 accessions were collected in 2000. Entry of this data into GRIN was started in 1999 but has only recently been completed.

One hundred two remaining non-bulked accessions of the 1988 Brassica shipment from the National Center of Agricultural Utilization Research (NCAUR) were grown during the 2000 growing season for morphological comparisons. The morphological data was recently analyzed and decisions made as to which accessions should be bulked together. These bulked accessions will be grown in the 2001 regeneration field.

Visitors and Meetings:

The NCRPIS hosted an Indian Visitor (Dr. Vijay Singh) from April 10, 2000 through July 7, 2000. Dr. Singh's primary interest was oilseed *Brassica*. He was helpful to the NCRPIS *Brassica* project when looking at the NCAUR (material originally from India) observation data.

The Crucifer CGC met at the American Society for Horticultural Science (ASHS) meetings in July 2000. The primary emphasis during this meeting was vegetable *Brassica*. I did not attend this meeting but did submit a report, and did meet with two CGC members during the 3rd International Brassica Symposium at the Horticulture Research International Conference in Wellesbourne, England in September 2000. The next two meetings of the Crucifer CGC will be during the 2001 ASHS meetings and during the 2001 American Society of Agronomy meetings.

Two items of interest developed during the Wellesbourne meetings. The first was that Horticulture Research International has adopted a modified *Brassica* scanning method initially observed by Dr. David Astley when he visited the NCRPIS in 1998. The second item was that Dr. Suzanne Warwick from Canada is interested in obtaining information from us concerning all of our Brassicaceae pollination work.

Future Plans:

The 2001 growing season is currently underway. Biennial crucifers were started in the greenhouse in November, December and early January. Annual *Brassica* accessions will be started in the greenhouse during February and March and will be transplanted to the field in early April. We are anticipating ca. 150 accessions for regeneration in 2001. We also may have a 2001 millet regeneration field.

g. Amaranthus, Celosia, Chenopodium, Coronilla, Dalea, Galega, Marina, Melilotus, Perilla and Spinacia (D. Brenner and S.Bruner)

Acquisition and inactivation (Table 1)

Nine wild *Spinacia turkestanica* accessions were acquired through collaboration with collectors in Turkmenistan. This acquisition is the result of a grant proposal I prepared with scientists in Turkmenistan, which was funded by the NPGS Plant Exploration office for 2000. These new accessions will be of interest to scientists seeking improved disease resistance in spinach.

People in countries where wild *Spinacia* is native should be recruited for collecting germplasm to improve our holdings. I am communicating with potential collectors in Pakistan and in the country of Georgia.

Eight of the 12 new *Amaranthus* and *Chenopodium* accessions were collected in the wild. Five new accessions were derived from older accessions with mixed species. Re-organization due to duplication within the collection reduced the amaranth collection size by 53 accessions.

Our first two accessions of *Achyranthes* were acquired from the J. L. Hudson seed company and a French botanical garden's Index Seminum. These *Achyranthes* accessions are part of an effort to obtain diverse genera within Amaranthaceae for use in biosystematic studies. They are included in the NC7-Celosia site crop.

The 25 new Umbelliferae accessions include 13 genera. Thirteen accessions were collected in Turkey or Poland by Dr. Philipp W. Simon. Seven were received through Indices Seminum of European Botanical Gardens. Our first *Zizia*, a native prairie species, was collected in Iowa.

Acquisition of rare *Perilla* chemotypes for production of aromatic oils is needed. In the past several promising sources have been unable to provide this germplasm.

Maintenance and distribution (Tables 2 and 3)

Amaranthus and Chenopodium:

The NC7-amaranth accessions regenerated were mostly *Amaranthus caudatus*. The NC7-quinoa accessions regenerated were mostly wild *Chenopodium* species. In both these genera the accessions with new original seeds have been regenerated. Therefore in 2001 the accessions selected for regeneration will be mostly those with problems such as replacing open pollinated seed lots, or small seed lots.

Spinacia:

Sixty *Spinacia* accessions were sent to Mr. Matt Linder of the Sakata Seed Company in Salinas, California for regeneration using facilities and labor donated by the Sakata Seed Company and by Dr. Ed Ryder of the USDA-ARS. Cooperation with the seed regeneration group in Salinas should be continued, although at a reduced scale, because most (86%)of the accessions are now available.

The Centre for Genetic Resources in the Netherlands(CGN)genebank is now distributing seeds free of charge which is a welcome change from their fee-for-service policy. This will make *Spinacia* germplasm more available to the research community, and potentially could reduce our *Spinacia* distributions.

Miscellaneous Umbelliferae:

The Miscellaneous Umbelliferae collection was transferred to me on February 3, 2000. It was transferred from Kathy Reitsma to more equitably distribute crop assignments. Ms. Reitsma has provided guidance on learning about the germplasm and regeneration methods. This crop group is difficult to work with because it is diverse, with 31 genera and at least four life duration types (annual, biennial, perennial polycarpic, and perennial monocarpic). Seeds can deteriorate quickly in storage making regeneration of some accessions necessary after only ten years. Furthermore, viability tests can be ambiguous since non-viable and dormant seeds are difficult to distinguish.

One-hundred-forty-eight annual accessions were direct-seeded into the field on March 23, 2000. They were mostly *Coriandrum* and *Anethum*, but *Ammi*, *Bifora*, *Cuminum* and *Foeniculum* were also included. Emergence was delayed by dry weather, but the increase was successful. Some of the field-grown *Coriandrum* and

Foeniculum seeds were damaged by *Systole* sp., a seed Chalcid insect. We need to learn more about the basic biology of these insects; for example, we do not know what the alternate hosts are, how far the insects travel after emergence from the seeds, or if peak oviposition can be avoided by shifting the planting date.

A small greenhouse planting of 18 Umbelliferae accessions yielded mixed results. Most of the *Foeniculum* accessions failed to germinate, presumably due to poor viability of original seeds. The one *Foeniculum* that germinated flowered and set seed well. The *Petroselinum* grew well in the fall greenhouse, but died upon removal from the vernalization treatment due to earlier freezing injury. A *Carum* accession was vernalized in a refrigerator and emerged healthy from vernalizing.

Dr. Phil Simon, one of the most active scientists working with the Umbelliferae, suggested that we pollinate umbels with blue bottle flies from <http://www.forkedtreeranch.com/index.html>. Mr. Steve Hailin, our pollination entomologist, is experimenting with the use and propagation of these flies.

Characterization/taxonomy/evaluation (Table 4)

This has been a very successful year for entering old *Amaranthus* observation data from field books into GRIN. Debra Stansberry, an hourly employee on my crew, and I, were able to enter 1,042 of these backlogged observations. Her data entry was possible because of her skill, and because the speed and reliability of our GRIN connection has improved with the new frame relay connection. Data on traits, such as male sterility, are much more accessible than before.

The first *Amaranthus caudatus* accessions with non-shattering utricles were identified during routine regeneration activities (Ames 15042). The non-shattering trait was at high frequency in populations. Some rare *A. caudatus* male-sterile accessions were also identified; with the trait at low frequency in populations. This information could prove useful to breeders in South America where *A. caudatus* is important for grain production.

An accession of *Coriandrum* (PI 170317) was observed to flower very late; this trait would be of special value in a slow-to-bolt cilantro (leafy vegetable) variety.

A *Melilotus* regeneration cycle starting in the fall of 2001 will include accessions with controversial taxonomy and members of the core collection. I am revising the crop descriptors for GRIN and collaborating in preparation of a status report that includes all of the genera of interest to the *Trifolium* and Special Purpose Legume CGC.

Fifty-five Chenopodium accessions were assigned new PI numbers.

Herbarium specimens were prepared of 43 accessions to serve as taxonomic vouchers. These are in addition to the 1,930 accessions that have herbarium specimens at all herbaria, already recorded in GRIN, for my crops.

Accession distributions 1996-2000

Crop	Year	No. of Orders	No. of Recipients	No. of Items Distributed	No. of Accessions Distributed
Amaranth	1996	42	33	544	239
	1997	53	40	444	186
	1998	63	57	2746	1786
	1999	62	50	3682	2487
	2000	44	37	860	451
Celosia	1996	2	2	6	6
	1997	3	3	3	2
	1998	2	2	6	5
	1999	3	3	24	17
	2000	6	6	11	8
Legumes	1996	2	2	9	9
	1997	9	7	25	20
	1998	6	5	34	16
	1999	4	4	32	32
	2000	7	7	16	13
Melilotus	1996	4	4	704	654
	1997	5	5	38	19
	1998	11	9	213	154
	1999	9	9	287	254
	2000	16	12	712	554
Perilla	1996	4	4	26	10
	1997	4	4	25	18
	1998	1	1	3	3
	1999	4	4	61	20
	2000	6	6	41	21
Quinoa	1996	16	13	304	130
	1997	8	7	18	16
	1998	13	12	121	92
	1999	10	10	294	163
	2000	21	19	342	149
Spinach	1996	6	6	1009	218
	1997	10	8	1196	253
	1998	13	11	1395	309
	1999	11	10	1061	332
	2000	7	7	670	348
Umbels	1996	7	7	128	87
	1997	8	8	325	183
	1998	9	9	127	116
	1999	14	13	150	87
	2000	11	1	101	82

The five-year order record for *Amaranthus* indicates a decrease from 1998 and 1999 levels; we distributed one very large order in each of those years. In 1998, 1,541 accessions were sent to Peru for crop improvement; in 1999, 2,429 accessions were sent to Japan for starch characterization. This starch type information is of value in identifying lines for clear noodle production, which is a potential premium market in Asia.

The *Melilotus* requests have increased again this year due to activities of several small evaluation and breeding projects. Since *Melilotus* is a superior nitrogen-fixing plant, projected increases in the cost of fertilizer, could favor *Melilotus* cultivation.

Perhaps the spinach requests have moderated because most of our clients have already screened the collection for resistance response genes to the recently identified blue mold disease races.

Enhancement and/or utilization:

AMARANTHUS:

The enhancement project for reduction of the loss due to shattering in grain amaranths continues. One-hundred-forty-eight non-shattering breeding lines were grown in the field in Ames, Iowa, and Scottsbluff, Nebraska. The plants performed very differently in the two environments. In Nebraska they were much taller, later, and weaker stemmed than modern cultivar check varieties. In Iowa some of the lines were shorter and earlier than the modern cultivars. On the basis of the 2000 field year I am putting greater emphasis on backcrossing non-shattering into the cultivar Plainsman.

A collaboration was initiated with Charlie Block to enhance cultivated *A. tricolor* for disease resistance to *Phomopsis*.

'Kerala Red' an amaranth accession from the NCRPIS is now available commercially in Europe <http://www.vidaverde.co.uk/leafgreens.html>. This unusually mild flavored and intensely red colored accessions was originally collected in Ames, Iowa. It is described in the following reference:

Brenner, D. and D.J. Makus. 1997. 'Kerala Red' ornamental amaranth. HortScience. 32:749-750.

The results of screening 229 accessions of mostly NCRPIS germplasm for grain yield in China have been published (Wu et al. 2000). Four high-yielding lines were identified. These high-yielding lines will now be distributed frequently when grain types are requested.

CORONILLA, DALEA, GALEGA, MARINA, and SECURIGERA:

An unusual accession, PI 612573, is grouped with these genera although its genus not been identified. It was distributed to 3 scientists who will assist with taxonomic identification. Three additional scientists have worked on this problem in other years. This dilemma is due to its unusual fruit type that does not fit standard identification keys used with these genera.

SPINACIA:

The following new paper validates the use of wild *Spinacia* germplasm as a source of disease resistance, based on a study of germplasm from the CGN genebank.

Handke, S., H. Seehaus, and M. Rades. 2000. Detection of a linkage of the four dominant mildew resistance genes ?$M_1M_2M_3M_4$? in spinach from wildtype Spinacia turkestanica. (In German, with English summary.) Gartenbauwissenschaft 65:73-78.

Spinach breeding and germplasm utilization could be further facilitated by a organized system for classifying accessions by disease race resistance. Data generated in this way could be included in GRIN. The present system of secret in-house testing by breeding companies is proprietary and wasteful of germplasm and effort. This idea was discussed at the Leafy Vegetable CGC meeting in Seaside, California, but is not yet implemented.

Publications and presentations:

Brenner, D.M., D.D. Baltensperger, P.A. Kulakow, J.W. Lehmann, R.L. Myers, M.M. Slabbert, B.B. Sleugh. 2000. Genetic resources and breeding of *Amaranthus*. Plant Breeding Reviews 19:227-285.

Wu, Huaixiang, Mei Sun, Shaoxian Yue, Hongliang Sun, Yizhong Cai, Ronghua Huang, David Brenner, and Harold Corke. 2000. Field evaluation of an *Amaranthus* genetic resource collection in China. Genetic Resources and Crop Evolution 47:43-53.

Brenner, D.M. Spinach germplasm from the North Central Regional Plant Introduction Station in Ames, Iowa. Summary and presentation, p. 12. In Sept. 25-28, 2000. Summaries and Program, International Lettuce and Leafy Vegetable Conference, Seaside, CA.

Brenner, D.M. Amaranth germplasm for utilization from the North Central Regional Plant Introduction Station. Abstract and poster presentation, American Society of Agronomy Annual Meeting, Nov. 5-9, 2000. Minneapolis, MN. P. 191 In Agronomy abstracts . ASA, Madison, WI.

Brenner, D.M. Amaranth research and possibilities for organic producers, presentation for the ICN (televised) course, "Organic Crop Production", AGRON/HORT 494X, February 14, 2000. Iowa State University, Ames, IA.

I prepared written Progress Reports for three Crop Germplasm Committees: Clover and Special Purpose Legumes, Leafy Vegetables, and New Crops.

Acknowledgments:

Stephanie Bruner is our newest full-time, technician. She supports my project half-time September-March, and the *Brassica* project March-September. Student crew members included Matt Lively, Debra Stansberry, Reggie Graeve, and John Gruber. Mary Arnold, from the seed storage crew, assisted with harvesting in late summer when the student crew departed.

h. <u>Sunflower and Miscellaneous Asters (M. Brothers, I. Larsen)</u>

The status of the *Helianthus*, flax, and miscellaneous aster germplasm collections is summarized in Table 1. In 2000, 89 Ames-numbered *Helianthus* accessions were assigned permanent PI numbers.

Acquisition:

Most notable of the accessions acquired in 2000 (Table 1) were three accessions (two *H. anomalous* and one *H. deserticola*) collected by Dr. Gerald Seiler and M. Brothers in Utah. The *Helianthus* collection contains few accessions of these species, which are desirable for their drought tolerance characteristics. An adequate number of seed was collected so these accessions can be distributed to requestors.

Maintenance:

In comparison to 1999, there was relatively little change in the percentage of available accessions in 2000 (Table1). In 1999, a storm with straight line winds exceeding 70 mph severely damaged our field regenerations. As a result, few accessions were successfully regenerated and made available for distribution. Regenerations conducted in 2000 (Table 2) have been harvested and are currently being processed for storage in 2001.

As accessions are regenerated, we continue to send samples to NSSL for back-up

purposes. Nearly the entire flax collection is duplicated at NSSL, as are 90 % of the cultivated *Helianthus* collection, 54% of the wild *Helianthus* collection, and 20% of the miscellaneous asters (Table 2).

In 2000, 186 germination tests were conducted, including scheduled, five-year tests and initial germination tests on new inventory lots (Table 2). A study comparing the effectiveness of four germination protocols in promoting germination across a range of wild *Helianthus* species was conducted (Brothers et al., 2000), and the protocol for the most effective treatment is being distributed to germplasm requestors.

A pollinator study conducted in cooperation with the Entomology team was initiated in 2000 to test the effectiveness of various *Helianthus* pollinators. The study will be repeated in 2001 to obtain a second year of data.

Distribution:

The packet and accession distribution summaries for the miscellaneous asters, flax and *Helianthus* germplasm collections are provided in Table 3. As in previous years, the *Helianthus* germplasm collection is highly requested by the world-wide research community. In fact, in 2000 almost 80% of *Helianthus* germplasm packets were sent to requestors outside of the United States.

The distribution of miscellaneous asters, flax and wild *Helianthus* germplasm remained about average in 2000. However, the distribution of cultivated *Helianthus* germplasm decreased in 2000 due to the lack of a large external evaluation project, which did occur in previous years. The distribution history for the last five years is provided in the table that follows.

Crop	Calendar Year	No. of Orders	No. of Recipients	No. of Items Distributed	No. of Accessions Distributed
Misc. Asters	1996	5	4	14	13
	1997	6	6	29	21
	1998	8	7	132	67
	1999	8	8	15	14
	2000	8	8	87	40
	5-year Average	7	7	55	31
Flax	1998	8	7	66	62
	1999	14	13	297	259
	2000	8	8	120	118
	3-year Average	10	9	161	146
Cult. *Helianthus*	1996	42	31	2690	1054
	1997	57	40	2882	1025
	1998	43	31	1855	916
	1999	55	39	2114	1095
	2000	28	27	884	740
	5-year Average	45	34	2086	966
Wild *Helianthus*	1996	35	29	833	483
	1997	28	25	492	355
	1998	28	22	547	426
	1999	35	29	704	448
	2000	21	15	820	588
	5-year Average	29	24	679	460

The flax collection was transferred to the NCRPIS January 1998.

Characterization/taxonomy:

Plant and achene data were recorded for *Helianthus* increases and plant data were recorded for flax increases (Table 4). Also added to GRIN were the fatty acid composition of *Helianthus* accessions and the original cluster assignment for accessions in the cultivated *Helianthus* collection which was used to generate the *Helianthus* core subset. Characterization of *Helianthus* achenes is now recorded on GRIN using an Oracle based form developed by D. Kovach. The form allows for direct entry into GRIN, and various recordkeeping procedures related to inventory maintenance are streamlined.

In earlier GRIN versions, a series of *Helianthus* descriptors were used to capture multiple values for a specific trait. These descriptors were merged into a single descriptor and the primary, secondary, and tertiary values are now indicated in the frequency field. These changes make querying the database more user-friendly, especially for the public database users.

The flax data set we received with the transfer of the collection in 1998 was reviewed and compared to the data on GRIN. The missing data were identified and loaded into GRIN. Included in this data is percentage oil, which previously was not available for the public to query. Other data added to GRIN, which are not reflected in Table 4, are 2792 historical flax germination records.

The isozyme assessment of the genetic diversity of the 112-accession domesticated *Helianthus* core subset and a randomly selected array of 112 accessions was completed. A few rare alleles have been identified in the randomly selected group; the *Helianthus* core subset may be modified to include these alleles. The isozyme data will be used to further test the validity of the core subset and to elucidate further inter- and intra- cluster relationships.

Fourteen wild *Helianthus* accessions were re-identified to another species based on a review of passport data.

Evaluation/Utilization:

For a second year, eight *H. debilis* ssp. *debilis* accessions were evaluated by M. Brothers and M. Widrlechner for their potential as a bedding plant. Selected accessions will be evaluated in 2001.

In 2000, *Helianthus* seed was distributed for evaluation of host-plant resistance to *Alternaria helianthi*, *Septoria helianthi*, and sunflower moth (41 accessions identified as resistant in previous studies were retested).

Enhancement:

An enhancement program to develop wild *H. annuus* populations resistant to *Alternaria helianthi*, *Septoria helianthi*, and powdery mildew continued. This project is described further in the Plant Pathology section of this report.

Future Plans:

A project to capture digital images of *Helianthus* achenes will be initiated in 2001. We will also continue our efforts to record digital images of *Helianthus* floral traits to use as references for characterization data.

The isozyme data generated from the assessment of genetic diversity within the *Helianthus* core subset and an additional 112 accessions needs to be verified and analyzed. A publication will then be prepared.

Many of the crops at the NCRPIS require insect pollinators. We would like to conduct a study to determine the effect of a concentrated presence of these pollinating insects on the occurrence of outcrossing in flax, a predominately

self-pollinating crop. Current flax regeneration practices do not exclude possible pollinating insects.

Publications:

Brothers, M.E., I. Larsen, and D. Kovach. 2000. Germinating wild sunflower species. Proc. of the 22nd Sunflower Res. Workshop 22:146-149.

Gulya, T., and M.E. Brothers. 2000. Rust resistance in wild *Helianthus* annuus and variation by geographic origin. Proc. of the 22nd Sunflower Res. Workshop 22:38-41.

Wilson, R.L., C.A. Abel, and M.E. Brothers. 2000. Comparing species of bees for controlled pollination of *Helianthus petiolaris* in field cages. Jour. Iowa Acad. Sci. 107:1-2.

i. Cuphea and Euphorbia (J. W. Van Roekel)

Cuphea

Acquisition:

Three *Cuphea* accessions were added to the collection in 2000 (Table 1). These cuttings are being grown in the greenhouse for identification and future seed regeneration.

Maintenance:

Due to changes in my responsibilities, maintenance of the collection has been limited for the most part to maintaining greenhouse plants that are sterile, or that have not been successfully regenerated. No *Cuphea* accessions were regenerated this year, and germination testing has been curtailed dramatically.

Dr. Mark Widrlechner is reviewing the collection for accessions that should be inactivated.

Distribution:

Distributions for *Cuphea* are included in Table 3. The distribution history for the last five years is provided in the table that follows.

Crop	Calendar Year	No. of Orders	No. of Recipients	No. of Items Distributed	No. of Accessions
Cuphea	1996	10	8	120	102
	1997	18	14	680	371
	1998	6	5	25	18
	1999	12	11	110	98
	2000	10	8	122	89

Characterization/taxonomy:

None.

Evaluation/Enhancement:

Meetings with several individuals who are actively working on evaluation and enhancement have been held. Although no active evaluation or enhancement of *Cuphea* is being done at NCRPIS, information, training, and germplasm are being shared with researchers who are actively pursuing commercialization of the crop.

Future Plans:

Dr. Steven Knapp (Oregon State University), has been increasing efforts to bring *Cuphea* into commercial production. This has resulted in a consortium of interested parties to participate in field trials and further research to achieve that goal. NCRPIS is participating in this group.
A collaborator who may have access to original seed for a number of accessions that have not been successfully regenerated has been contacted in an effort to obtain seed for regeneration. If this effort is not successful, these accessions will be inactivated.

Regeneration efforts for this growing season will be considered based on viability, seed availability, and resources available for the coming season.

Euphorbia

Acquisition:

No new accessions of *Euphorbia* were added to the collection in 2000. (Table 1)

Maintenance:

Regeneration has been limited in 2000 to harvesting existing plants in the greenhouse. This is being done as the plants set seed.

Distribution:

Distributions for *Euphorbia* are included in Table 3. The distribution history for the last five years is provided in the table that follows.

Crop	Calendar Year	No. of Orders	No. of Recipients	No. of Items Distributed	No. of Accessions Distributed
Euphorbia	1996	1	1	1	1
	1997	4	4	18	11
	1998	0	0	0	0
	1999	2	2	2	2
	2000	3	3	37	37

Characterization/taxonomy:

None.

Evaluation/Enhancement:

None.

Future Plans:

At this time, regeneration efforts will be limited to using vernalization to induce flowering of greenhouse plants. These will be harvested as appropriate.

j. Molecular Marker: (M. Brothers)

Mary Brothers continued the isozyme evaluation of the 112-accession sunflower core subset and an additional 112 randomly select sunflower accessions as discussed in the sunflower curation section.

Amalio Santacruz-Varela, PhD candidate, continued his research to characterize the genetic variation of popcorn accessions originating from Latin America and the United States. He evaluated seven popcorn populations from North America using 21 isozyme loci; 56 popcorn populations were evaluated for genetic variation of 31 simple sequence repeats (or microsatellite loci).

During 2000, the NCRPIS's molecular marker laboratories and equipment have been used by Dr. Laura Merrick, Associate Scientist, Iowa State University, to conduct a molecular study of wild and cultivated squash (*Cucurbita* spp.) germplasm. Her research objectives were 1) to characterize the extent of gene flow or hybridization occurring among wild and cultivated squash in cropping systems of central Mexico and 2) to characterize the levels of genetic diversity in Mexican landrace populations of four species of squash. Dr. Merrick also used the facilities to train Isaac Meneses-Márques, a visiting scientist from Mexico, in molecular techniques. I. Meneses' molecular study entailed an analysis of genetic variance components and response to selection of squash landrace varieties of *C. pepo* from areas of central Mexico.

Table 1: Accessions Acquired - Calendar Year 2000

Table 1: Accessions Acquired -	Sitecrop	No. of Accessions	No. Acquired	Percent Acquired	No. Available	Percent Available	Percent Available last year
Brenner	NC7-amaranth	3283	8	0	2866	87	81
	NC7-celosia	52	2	4	17	33	34
	NC7-legumes	227	1	0	98	43	44
	NC7-melilotus	920	0	0	678	74	74
	NC7-perilla	21	0	0	21	100	100
	NC7-quinoa	236	4	2	166	70	72
	NC7-spinach	391	9	2	338	86	84
	NC7-umbels	941	25	3	152	16	17
Brothers	NC7-asters	311	8	3	84	27	27
	NC7-flax	2807	1	0	2796	100	99
	NC7-sun.cults	1634	7	0	1331	81	81
	NC7-sun.wilds	2152	4	0	1006	47	45
Luhman	NC7-brassica	1972	33	2	1570	80	79
	NC7-crucifers	1097	6	1	632	58	56
	NC7-echinochloa	227	0	0	149	66	63
	NC7-flax.wilds	155	0	0	16	10	10
	NC7-grasses	116	0	0	13	11	11
	NC7-panicum	982	0	0	857	87	87
	NC7-setaria	995	8	1	892	90	86
Millard	NC7-corn.kin	33	0	0	6	18	6
	NC7-maize	17022	112	1	10840	64	62
Reitsma	NC7-chicory	249	1	0	174	70	65
	NC7-cucumis.cucs	1352	15	1	1219	90	88
	NC7-cucumis.melo	3017	2	0	2150	71	70
	NC7-	345	0	0	112	32	30
	NC7-cucurbita	942	9	1	774	82	74
	NC7-daucus	1053	1	0	613	58	53
	NC7-ocimum	96	0	0	72	75	75
	NC7-parsnips	80	1	1	21	26	20
VanRoekel	NC7-cuphea	820	3	0	483	59	59
	NC7-euphorbia	216	0	0	43	20	19
Widrlechner	NC7-mints	120	0	0	60	50	50
	NC7-ornamentals	2433	70	3	1008	41	41
	TOTALS:	46297	330	< 1	31257	68	66

Table 2: Accessions regenerated, Germinated and/or Backed-UP - Calendar Year 2000

Curator	Sitecrop	# Accessions	# Accs Germ	% Germ	# Att Regen	# Harv Regen	# Perm Peren	# Peren Harv	#Accs Backed Up	# Accs Backed TOTAL	% Accs Backed Up
Brenner	NC7-amaranth	3283	200	6	110	165	0	0	114	2967	90
	NC7-celosia	52	2	4	8	3	0	0	1	15	29
	NC7-legumes	227	3	1	0	0	0	0	2	110	48
	NC7-melilotus	920	0	0	0	0	0	0	6	738	80
	NC7-perilla	21	0	0	0	0	0	0	0	20	95
	NC7-quinoa	236	9	4	2	10	0	0	17	183	78
	NC7-spinach	391	77	20	60	77	0	0	54	344	88
	NC7-umbels	941	246	26	166	115	0	0	5	200	21
Brothers	NC7-asters	311	2	1	11	4	5	0	2	62	20
	NC7-flax	2807	96	3	134	78	0	0	72	2801	100
	NC7-sun.cults	1634	33	2	101	96	0	0	46	1476	90
	NC7-sun.wilds	2152	55	3	150	128	9	3	57	1155	54
Luhman	NC7-brassica	1972	1357	69	34	33	0	0	80	1825	93
	NC7-crucifers	1097	303	28	52	54	0	0	56	712	65
	NC7-echinochloa	227	3	1	0	0	0	0	8	171	75
	NC7-flax.wilds	155	0	0	0	7	0	0	0	3	2
	NC7-grasses	116	0	0	0	0	0	0	0	37	32
	NC7-panicum	982	0	0	0	0	0	0	11	874	89
	NC7-setaria	995	25	3	0	0	0	0	31	922	93
Millard	NC7-corn.kin	33	0	0	1	1	1	1	0	8	24
	NC7-maize	17022	1847	11	223	478	8	8	42	12111	71
Reitsma	NC7-chicory	249	85	34	0	0	0	0	0	146	59
	NC7-cucumis.cucs	1352	44	3	59	47	0	0	45	1210	89
	NC7-cucumis.melo	3017	91	3	94	81	0	0	338	2277	75
	NC7-	345	7	2	51	24	0	0	8	117	34
	NC7-cucurbita	942	26	3	50	43	0	0	20	727	77
	NC7-daucus	1053	52	5	86	67	0	0	44	623	59
	NC7-ocimum	96	35	36	32	22	0	0	0	70	73
	NC7-parsnips	80	11	14	0	0	0	0	0	6	8
VanRoekel	NC7-cuphea	820	0	0	0	0	0	0	2	558	68
	NC7-euphorbia	216	0	0	0	0	0	0	1	52	24
Widrlechner	NC7-mints	120	0	0	0	0	0	0	0	57	48
	NC7-ornamentals	2433	106	4	149	17	38	162	31	717	29
	TOTALS:	46297	4715	10	1573	1550	61	174	1093	33294	72

Table 3: Accession Distributions - Calendar Year 2000

Sitecrop	No. of Accessions	No. of Items Distributed	No. of Items Distributed Inter-nationally	No. of Accessions Distributed Domestically	No. of Accessions Distributed Inter-nationally	Total No. of Accessions Distributed	No. of Accessions Distributed	No. of Orders	No. of Recipients
NC7-amaranth	3283	234	626	153	410	451	14	44	37
NC7-celosia	52	10	1	7	1	8	15	6	6
NC7-legumes	227	12	4	10	3	13	6	7	7
NC7-melilotus	920	144	568	131	541	554	60	16	12
NC7-perilla	21	25	16	21	15	21	100	6	6
NC7-quinoa	236	33	309	25	144	149	63	21	19
NC7-spinach	391	344	326	339	322	348	89	7	7
NC7-umbels	941	75	26	61	26	82	9	11	11
NC7-asters	311	3	84	3	37	40	13	8	8
NC7-flax	2807	86	34	86	32	118	4	8	8
NC7-sun.cults	1634	135	752	124	678	740	45	28	27
NC7-sun.wilds	2152	215	605	196	513	588	27	21	15
NC7-brassica	1972	1021	224	792	189	862	44	69	56
NC7-crucifers	1097	24	48	23	47	66	6	16	15
NC7-echinochloa	227	0	166	0	149	149	66	5	4
NC7-flax.wilds	155	0	0	0	0	0	0	0	0
NC7-grasses	116	0	0	0	0	0	0	0	0
NC7-panicum	982	45	13	41	13	49	5	9	8
NC7-setaria	995	38	757	35	745	757	76	13	12
NC7-corn.kin	33	19	1	7	1	7	21	9	9
NC7-maize	17022	17949	154	10972	109	10982	65	257	192
NC7-chicory	249	6	46	6	46	52	21	5	5
NC7-cucumis.cucs	1352	290	427	287	407	608	45	23	22
NC7-cucumis.melo	3028	626	186	479	163	603	20	42	33
NC7-cucumis.wilds	345	8	18	8	17	24	7	8	7
NC7-cucurbita	942	85	372	84	322	363	39	19	18
NC7-daucus	1053	53	158	51	158	209	20	11	11
NC7-ocimum	96	123	122	75	72	75	78	7	7
NC7-parsnips	80	0	0	0	0	0	0	0	0
NC7-cuphea	820	42	80	41	76	89	11	10	8
NC7-euphorbia	216	37	0	37	0	37	17	3	3
NC7-mints	120	20	17	20	17	35	29	3	3
NC7-ornamentals	2433	384	212	140	183	282	12	84	79
TOTALS:	46308	22086	6352	14254	5436	18361	40	658	507

Table 4: Accession Observations - Calendar Year 2000

Curator	Sitecrop	# Accs	# Obs Trials	# Acc Obs taken	# Obs in GRIN YR	# Acc Obs GRIN YR	# Acc Obs in GRIN Last YR	# Accs Obs in GRIN TOTAL	# Acc Image	# Acc Image in GRIN YR	# Acc Image in GRIN TOTAL
Brenner	NC7-amaranth	3283	14	0	9306	1137	95	3202	0	0	221
	NC7-celosia	52	3	0	0	0	0	2	0	0	3
	NC7-legumes	227	0	0	0	0	0	84	0	0	0
	NC7-melilotus	920	0	0	84	45	0	543	0	0	0
	NC7-perilla	21	0	0	0	0	0	0	0	0	1
	NC7-quinoa	236	2	0	0	0	2	5	0	0	1
	NC7-spinach	391	1	0	0	0	0	0	0	0	0
	NC7-umbels	941	0	0	0	0	0	1	0	0	0
Brothers	NC7-asters	311	0		0	0	0	3	0	0	0
	NC7-flax	2807	0	1300	17549	2790	0	2800	0	0	0
	NC7-sun.cults	1634	61	1700	17921	1390	1209	1573	21	0	0
	NC7-sun.wilds	2152	138	2000	6661	699	193	1698	0	0	0
Luhman	NC7-brassica	1972	39	87	687	87	20	1538	85	1	1
	NC7-crucifers	1097	0	119	612	102	68	386	86	0	0
	NC7-echinochloa	227	0	0	0	0	0	10	0	0	0
	NC7-flax.wilds	155	0	0	10	2	0	5	3	0	0
	NC7-grasses	116	0	0	0	0	0	1	0	0	0
	NC7-panicum	982	0	0	0	0	0	0	0	0	0
	NC7-setaria	995	0	0	0	0	0	74	0	0	0
Millard	NC7-corn.kin	33	0	0	0	0	0	0	0	0	0
	NC7-maize	17022	10877	0	32365	11671	1491	13807	7223	725	725
Reitsma	NC7-chicory	249	0	0	0	0	0	0	0	0	0
	NC7-cucumis.cucs	1352	148	752	6659	631	0	845	46	0	0
	NC7-cucumis.melo	3017	386	1944	1331	1091	0	2409	83	0	0
	NC7-cucumis.wilds	345	0	600	0	0	0	97	12	0	0
	NC7-cucurbita	942	0	731	7132	446	0	447	44	0	0
	NC7-daucus	1053	0	0	0	0	0	456	25	0	0
	NC7-ocimum	96	0	0	0	0	0	0	0	0	0
	NC7-parsnips	80	0	0	0	0	0	0	0	0	0
VanRoekel	NC7-cuphea	820	8	0	0	0	0	329	0	0	0
	NC7-euphorbia	216	0	0	0	0	0	0	0	0	0
Widrlechner	NC7-mints	120	0	0	0	0	0	0	0	0	0
	NC7-ornamentals	2433	18	7840	2	2	0	7	32	0	0
	TOTALS:	46297	11695	17073	100319	20093	3078	30322	7660	726	1179